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Disclaimer: Everything within the poster and document are for reference and informational purposes only.
The following articles and references have been compiled and organized by members of the Fragrance Free Coalition.

Symptoms and Conditions Document

(Symptoms & Conditions are organized by symptom, condition or body system associated with exposure to fragrance chemicals in fragranced products.)

Download the poster to share or get the Products Doc at: https://www.fragrancefreecoalitionusa.com/

Go Fragrance Free: Healthier Air Has Never Been Easier.

Many hospitals, businesses, and employees are not aware that fragranced products can create access barriers to their facilities and can adversely affect the health of those working there. Fragranced products include: fragranced cleaning and laundry products, lotions/sanitizers, deodorant, air fresheners or other scented items.

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Who are We?

We are a small group of people who started meeting weekly in 2022 and see the need for fragrance free healthcare and fragrance free public spaces.

We are speaking out for the children, elderly and anyone else who reacts to fragrance chemicals (allergens / petrochemicals / skin sensitizing chemicals). There are growing numbers of people who need unscented indoor and outdoor air (not polluted by fragrance chemicals) in order to feel well on a daily, minute by minute basis.

The easiest way to create healthier air is to not pollute it with petrochemicals/fragrances to begin with. Purchasing fragrance free cleaning and laundry products, fragrance free deodorants, soaps, hand sanitizers and lotions, as well as eliminating air 'fresheners' are easy changes with major impact.

This is why members of the Fragrance Free Coalition created an interactive poster and reference documents supporting the decision to "Go Fragrance Free."

"Do Fragrances Compromise Your Health?" became a theme question when we realized that many people do not yet realize how the chemicals in their fragranced and scented products can be impacting their health. We started this project in 2022 after recognizing the need for Fragrance Free Healthcare, schools and businesses. We are lived experience experts that care deeply about the health of our loved ones, our pets, the planet and ourselves.

Our Mission

Fragrances have become ubiquitous in society.
By the word 'fragrance' we mean: Fragrance, Perfume, Parfum, Aroma or Scent by any and all means synthetic or natural.
In a world where fragrance (from laundry products to perfume in a bottle) is a 'trade secret' and self-regulated, it is important to learn what is 'truly' within these formulations and what the possible, probable and known health implications are.

The purpose of this poster is to show clear evidence supporting the need for fragrance free healthcare facilities, schools, workplaces and homes. As more people recognize that eliminating fragrance chemicals will create healthier indoor air, more fragrance free policies will be created and enforced in public spaces.

Within this document we included research articles and other publications pertaining to fragrance in consumer products. You will also find articles pertaining to some of the (over 3,500) chemicals that are in many fragrance formulations, along with the health implications related to those chemicals.

Our Call To Action

With the goal of protecting the health and safety of our children, elderly, pets, water systems, and air, we ask people to read labels on laundry, body care, and cleaning products and choose the ones labeled "Fragrance Free".
We urge you to share this poster with medical personnel, school boards, teachers, businesses, government offices, nursing homes and non-profit organizations to raise awareness about a new way of achieving healthier air both indoors and outdoors.

Go Fragrance Free: Healthier Air Has Never Been Easier.

How did we find our information?

The research in this document was compiled using PubMed, ScienceDirect and various internet searches. The parameters for PubMed were “fragrance*” or “scent*” or “odor*” or “parfum*” or “Perfume*” and “products or items of interest”. More articles were found in the reference section of various articles. Articles were selected by their inclusion of fragrance and/or fragrance chemicals and consumer products, along with the adverse effects of such products. To request full articles not available online, please see your local public library, university library or medical center library. Copyright and permissions can be found for each article at its corresponding link. Plus, a thank you is in order to the researchers who helped us to better understand our findings.

Disclaimer/Disclosure:

This document is in support of an informational graphic poster. That poster may or may not accompany these pages. This was not intended to be a research project or a literature review. It is not all extensive, nor all inclusive, but could be used as a starting point for further assessment and review. This is intended for informational purposes only, and not to diagnose, treat or cure any conditions. Please seek professional medical or legal advice as needed.

The poster was created by members of the Fragrance Free Coalition with Canva©.

How to use this Document

- Each category has a varied number of research articles or published articles under it. Many are PubMed articles, some are from other sources.
- Each article shows the title, citation, link and quote(s) from that article.
- We have quoted portions of each article to give an overview and to highlight connections to “possible reactions” and “known reactions” to fragrance chemicals. This extensive document does not list every research article available regarding fragrance and fragrance chemicals. It is important to know that you may notice there are repeats of articles in different sections, we chose to repeat some if we found that they pertained to that topic.
  (For a downloadable poster (to print and share) please see our website under ‘resources’.)
- If a ‘free text’ version of the article was available, we add that as a PDF when possible.
- We have arranged articles in each section based on the order we find most impactful.
- Chemicals in **bold**, are known chemicals found in fragrance formulations, secondary pollutants of fragrance chemicals or emissions from fragranced products.
  You can research the chemicals that are commonly used in fragrances via:
  -The IFRA list (which is only a portion of fragrance chemicals used in Europe)
  -Chemical companies who sell fragrance ingredients or
  -Fragrance ingredient disclosures from varying companies (please recognize that very few companies disclose their ingredients and even if they do, they usually do not disclose if those ingredients are petroleum based/petro-chemicals/synthetic, extracted with chemicals, nor do they disclose how they are processed/created)
- At the end of some sections you may see a **[Note:]** from us with a list of chemicals related to fragrance, keywords or a comment to clarify how a publication relates to fragrance chemicals.
- Feel free to use the “Find” (Ctrl/Command+F) feature to search this document.
- There are blue hyperlinks within the document that may take you to another section of this document, or to varying sites and publications of interest. If a link no longer works, please research the article title with various browsers.

Where to do more research

Below are some of the main databases and resources we searched, you can easily use them too.

FRAGRANCE CHEMICAL RESEARCH RESOURCES:

CSCP - California Safe Cosmetics Program product database
(click on “Browse Ingredients Reported” to see reported fragrance ingredients) This may be the best glimpse into some of the fragrance chemicals within a single product because it is like reading a ‘fragrance label’:
-see the Cosmetics section of the poster to learn why this Database is IN THE NEWS right now.

FCCP | A repository of Fragrance Chemicals in Children’s Products
Searching this database is eye opening even though it is small. They reference “153 fragrance chemicals from published literature… the current regulatory status and possible health risks associated with the fragrance chemicals upon exposure to children.”

IFRA - The International Fragrance Association transparency list
Use your “find” function (and/or your chemicals synonyms) to search this list created by surveying participating fragrance companies in Europe. **This is not an all inclusive fragrance list**, but it is the largest list of disclosed chemicals used in fragrance. In 2022, they listed 3,619 chemicals used for odor, malodor coverage or function/durability in a fragrance compound (In 2016 the list contained 350 more chemicals). IFRA doesn’t make any laws, but they do make suggestions to perfumers to limit or not use certain chemicals.)

PubMed, Science Direct, Springer, Google Scholar and CDC are good places to find more research.

CHEMICAL RESEARCH RESOURCES:

PubChem
(search Pubchem to see chemical info, chemical safety, synonyms, and more...)

ECHA - European Chemical Database

NOAA - National Oceanic and Atmospheric Administration

EPA - CompTox Chemicals Dashboard

You can also search:

-Chemical companies who sell fragrance ingredients/fragrance companies.
-Fragrance ingredient disclosures on products themselves: please recognize that when companies disclose all of their fragrance ingredients (by law they do not have to, not even with California's new law) and even when they do, they often do not disclose if they use the synthetic/petro-chemical version of that chemical, if they extracted their ‘natural’ version with petro-chemicals or if they added a synthetic masking agent, or malodor control to cover up the odors of the chemicals used to create a product or to make it ‘unscented’. The use of masking agents in unscented products is why purchasing Fragrance Free is a better option, still, it’s up to the company's discretion if they choose to create a ‘truly’ fragrance free product or if they decide to legally not include some ingredients on their label.

Thank You - Fragrance Free Coalition (you can find us on Facebook or online)

DISCLAIMER:
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AIRBORNE CONTACT DERMATITIS

Facial Swelling, Skin Sensitization,
Eczema, Airborne Contact Urticaria, All Acute or Chronic Dermatoses
Also see: Allergies

Allergies to fragrance chemicals are comparable to allergies to peanuts, in that if someone wearing a fragrance is in close proximity to you, similar to being around someone eating peanuts, you can experience an allergic reaction. You can also experience skin sensitization reactions from fragrance chemicals in the air.

1. *Airborne-contact dermatitis of non-plant origin: an overview*

Ghosh S. Airborne-contact dermatitis of non-plant origin: an overview. Indian J Dermatol. 2011 Nov;56(6):711-4. doi: 10.4103/0019-5154.91834. PMID: 22345776; PMCID: PMC3276902.
Article Link: https://pubmed.ncbi.nlm.nih.gov/22345776/ - Full Text

"Airborne-contact dermatitis (ABCD) denotes an unique type of contact dermatitis originating from dust, sprays, pollens or **volatile chemicals by airborne fumes** or particles without directly handling this allergen. This form of dermatitis commonly involves face, neck, v-area of chest and eyelids. Exposed as well as nonexposed skin can be affected. Axillae and waist lines can also be the target of this disease. This form of dermatitis can sometimes also be generalized.

Airborne dermatoses often cause diagnostic problems and create a puzzle not only to the patient but also to the doctor. **The incidence of airborne dermatoses has increased considerably in recent years.**"

"Pattern of allergens contributory to ABCD detected in the study were as follows: potassium dichromate 39.7% (n=25), **fragrance mix 28.1%** (n=18), epoxy resin 26.6% (n=17), colophony 17.8% (n=12), **formaldehyde** 13.2% (n=7) and parthenium 9.4% (n=6). Cement, **perfumes or deodorants**, volatile paints and synthetic glues have become commonest allergens contributing to ABCD in urban and semiurban areas."

"Fragrance allergy leading to ABCD has been reported by many authors."

2. *Airborne contact dermatitis - current perspectives in etiopathogenesis and management*

Handa S, De D, Mahajan R. Airborne contact dermatitis - current perspectives in etiopathogenesis and management. Indian J Dermatol. 2011 Nov;56(6):700-6. doi: 10.4103/0019-5154.91832. PMID: 22345774; PMCID: PMC3276900.
Article Link: https://pubmed.ncbi.nlm.nih.gov/22345774/ - Full Text

"Airborne contact dermatitis (ABCD) is a morphological diagnosis that encompasses **all acute or chronic dermatoses** predominantly of exposed parts of body, which are caused by substances which when released into the air, settle on the exposed skin."

"In airborne allergic dermatitis, initially there is a refractory phase where there is a periodic or continuous contact with allergen but no response. This is followed by an induction phase where the hapten penetrates skin, conjugates with epidermal protein, comes in contact with antigen presenting cells, migrates to draining

lymph nodes followed by stimulation of naive T cells. This leads to proliferation of activated T cells to produce effector and memory cells which then enter the circulation. Re-exposure to the specific hapten leads to the release of mediators producing **skin inflammation**. A **persistent inflammation** is produced due to continued presence of effector cells."

"The common allergens … include various acids and alkalis, metals and powders of metallic salts, cement, industrial solvents, glass fibers, sewage sludge, ammonia, vegetable and wood allergens, plastics, rubbers and glues, insecticides, pesticides, animal feed additives and many others. The airborne contactants can also be classified on the basis of their physical state as **volatile airborne contactants** like acids, alkalis, ammonia and pesticides; droplets like insecticides, **perfumes** and **hair sprays**; powders which include aluminum, anhydrous calcium silicate, and metallic oxides; and particles like tree sawing particles, wool and plastics."

"Dooms-Goossens classified airborne dermatitis into five different types, namely, **airborne irritant contact dermatitis**, **airborne allergic contact dermatitis**, **airborne phototoxic reactions**, **airborne photoallergic reactions** and **airborne contact urticaria**.[33]"

"Rare presentations include **acne like**, **lichenoid eruptions**, fixed drug eruptions, **exfoliative dermatitis**, **telengiectases**, **paresthesias**, **purpura**, **erythema multiforme like eruption**, pellagra like dermatitis and **lymphomatoid CD**. Some agents cause more than one type of reaction. P. hysterophorus can produce allergic CD, photocontact dermatitis and a lichenoid eruption. Similarly, **formaldehyde** and phosphorus sesquisulfide can lead to an **airborne irritant** or **allergic CD** and **contact urticaria**."

"In the classical airborne allergic contact dermatitis, there is involvement of exposed areas of face, "V" of neck, hands and forearms, **"Wilkinson's triangle,"** both eyelids, nasolabial folds and under the chin. The involvement of both light-exposed and protected areas helps to differentiate ABCD from a photo-related dermatitis. Another close differential is **atopic eczema** as both ABCD and atopic eczema have predominant flexural and skin crease involvement. Initially, there is an acute flare of the dermatitis during the plant growing season but, with repeated exposure, the flare becomes prolonged and produces a chronic lichenified eczema associated with secondary infection, **fissuring** and **hypo or hyperpigmentation**…. Some patients present with **facial swelling** before manifesting classical **eczematous lesions**."

3. *Airborne contact dermatitis: common causes in the USA*

Schloemer JA, Zirwas MJ, Burkhart CG. Airborne contact dermatitis: common causes in the USA. Int J Dermatol. 2015 Mar;54(3):271-4. doi: 10.1111/ijd.12692. Epub 2014 Jul 1. PMID: 24981079.
Article Link: https://pubmed.ncbi.nlm.nih.gov/24981079/ PDF

"**Airborne contact dermatitis (ABCD)** is an **inflammatory reaction** caused by exposure to particles suspended in air…. Airborne contact dermatitis can be classified as either allergic or irritant contact dermatitis, depending on its etiology and the mechanism of inflammation…. Many **allergens** and **chemicals** have been documented as causative agents of ABCD."

"Many other agents responsible for causing ABCD have been reported in the literature.… Others include ammonia, anhydrous calcium sulfate, cleaning products, and **formaldehyde**."

"Of note, the incidence of ABCD caused by chemicals of the isothiazolinone family, including **methylisothiazolinone** and **methylchloroisothiazolinone**, is on the rise as these chemicals are used

increasingly as preservatives in many household products. Additionally, **dermatitis** resulting from methylisothiazolinone and related compounds may be allergic in nature, as evidenced by positive patch testing.

“Occupational hazards such as exposure to irritating chemicals and repetitive friction or abrasions to the surface of the skin can also pose a potential gateway for ABCD.”

[Note: Limonene is a common skin sensitizer and known allergen in fragrance and fragranced products. Limonene (natural or synthetic) is a terpene. Terpenes can create formaldehyde and particulate matter in air as secondary pollutants. Limonene is on the IFRA list as a fragrance ingredient.**]**
[Note: Methylchloroisothiazolinone and Methylisothiazolinone (MCI-MI) are preservatives and known allergens used in air fresheners and personal care products.**]**

4. *A link between skin and airways regarding sensitivity to fragrance products?*

Elberling J, Linneberg A, Mosbech H, Dirksen A, Frølund L, Madsen F, Nielsen NH, Johansen JD. A link between skin and airways regarding sensitivity to fragrance products? Br J Dermatol. 2004 Dec;151(6):1197-203. doi: 10.1111/j.1365-2133.2004.06251.x. PMID: 15606515.
Article Link: https://pubmed.ncbi.nlm.nih.gov/15606515/

“**Contact sensitization to fragrances is one of the commonest causes of contact allergy in the general population**… as well as among patients with eczema. Exposure to volatile fragrances is commonplace and may be related to various **eye and airway symptoms**. Skin exposure to fragrances is known to cause **perfume contact allergy** and **eczema….”**

“Positive, independent and **significant associations were found between eye and airway symptoms** elicited by fragrance products and perfume contact allergy and hand eczema…. Individuals with perfume contact allergy and/or hand eczema, as opposed to those without, have more frequent and **more severe eye or airway symptoms after exposure to volatile fragrance product**s.”

“We show consistent and significant associations between perfume contact allergy diagnosed by patch testing and symptoms elicited by fragrance products from the eyes and airways. The symptoms were mostly reported as elicited **within seconds and minutes after airborne exposure to fragrance products**.”

5. *Airborne contact dermatitis to drugs*

Minciullo PL, Imbesi S, Tigano V, Gangemi S. Airborne contact dermatitis to drugs. Allergol Immunopathol (Madr). 2013 Mar-Apr;41(2):121-6. doi: 10.1016/j.aller.2012.01.004. Epub 2012 Mar 24. PMID: 22445186.
Article Link: https://pubmed.ncbi.nlm.nih.gov/22445186/ - PDF

“Airborne agents consist of volatile substances, droplets of the causative agent, and solid particles originated from powdery dust of various materials.”

“Airborne reactions involve exposed areas, such as the face, the neck, the hands, wrists, underarms; however, reactions on non-exposed areas (by particles trapped under clothing) have been also reported. Generalised reactions may occur due to inhalation or transcutaneous absorption.”

“Airborne causes are still greatly underestimated because reports in the literature often omit this term when dust or volatile substances are responsible for skin reactions.“

[Note: Airborne Contact Dermatitis happens with fragrance chemicals as well. ie: air fresheners, fragranced laundry products, deodorant, dish soap, floor cleaners and scented hand sanitizers. Anyone with contact allergies cannot avoid the air, please go Fragrance Free with all products especially in healthcare, dental, schools, or any public space.**]**

6. *Qualitative Analysis of Air Freshener Spray*

Ibrahim ALshaer F, Fuad ALBaharna D, Ahmed HO, Ghiyath Anas M, Mohammed ALJassmi J. Qualitative Analysis of Air Freshener Spray. J Environ Public Health. 2019 Nov 5;2019:9316707. doi: 10.1155/2019/9316707. PMID: 31781257; PMCID: PMC6874985.
Article Link: https://pubmed.ncbi.nlm.nih.gov/31781257/ - PDF

“Information lacks concerning the gaseous emissions of fragrance products in spite of the extensive indoor exposure and widespread use of fragrances to them. In addition, **95 percent of the chemicals are synthetic compounds in fragrances that are derived from petroleum**.”

“Some chemicals after analysis turned out to be noted as **skin allergens** or **irritants** and even chemicals that may interfere with **bodily functions**.“

“The present study has identified the presence of different compounds in spray air fresheners that were not disclosed on the product’s label. The results depicted common compounds in both low- and high-cost air fresheners. **Chemicals found in this study were not revealed on the product label as manufacturers are not required to list all ingredients**. These chemicals usually tend to be listed on the product label as “parfum” or “fragrance”. There should be a law that strictly indicates whether the products contain any synthetic chemicals for people to be aware of what they are exposed to, although, manufacturers are not required to reveal all hidden ingredients on the label as stated by the Consumer Product Safety Commission (CPSC).”

[Note: Fragrance is considered the new ‘second hand smoke’, **“**The parallels between second-hand smoke and synthetic fragrance use are many. At its core, both are battles over indoor air quality **“** - quote and link from De Vader, Christy L. & Barker, Paxson.
Chemicals that cigarettes/cigarette smoke and fragranced products can have in common are: Acetone, Formaldehyde, Benzene, acetaldehyde, terpenoids and phenols.**]**

7. *Deodorants are the leading cause of allergic contact dermatitis to fragrance ingredients*

Heisterberg MV, Menné T, Andersen KE, Avnstorp C, Kristensen B, Kristensen O, Kaaber K, Laurberg G, Henrik Nielsen N, Sommerlund M, Thormann J, Veien NK, Vissing S, Johansen JD. Deodorants are the leading cause of allergic contact dermatitis to fragrance ingredients. Contact Dermatitis. 2011 May;64(5):258-64. doi: 10.1111/j.1600-0536.2011.01889.x. PMID: 21480912.
Article Link: https://pubmed.ncbi.nlm.nih.gov/21480912/

“Fragrances frequently cause contact allergy, and **cosmetic products are the main causes of fragrance contact allergy.”**

“Correlation was observed between **deodorants** listed as the cause of allergy and allergy detected with fragrance mix II (FM II) and hydroxyisohexyl 3-cyclohexene carboxaldehyde.”

“Deodorants were the leading causes of fragrance allergy, especially among men. Seemingly, deodorants have an 'unhealthy' composition of the fragrance chemicals present in FM II.”

8. *Multicomponent analytical methodology to control phthalates, synthetic musks, fragrance allergens and preservatives in perfumes*

Sanchez-Prado L, Llompart M, Lamas JP, Garcia-Jares C, Lores M. Multicomponent analytical methodology to control phthalates, synthetic musks, fragrance allergens and preservatives in perfumes. Talanta. 2011 Jul 15;85(1):370-9. doi: 10.1016/j.talanta.2011.03.079. Epub 2011 Apr 5. PMID: 21645712.
Article Link: https://pubmed.ncbi.nlm.nih.gov/21645712/

“The average number of **fragrance allergens** is twelve per sample; their presence must be indicated in the list of ingredients when its concentration exceeds the 0.001%, but values higher than 1% have been found in some samples. Preservatives data show that **parabens**, although ubiquitous in other cosmetic products, are not widely used in perfumery. In contrast, the presence of **BHT (butylated hydroxytoluene)** is indeed widespread.”

“The degree of compliance with the European Regulation on the labelling has been evaluated in a subset of samples, and **only about the 38% of the perfumes were properly labelled for the allergens tested.”**

9. *Health risks of chemicals in consumer products: A review*

Li D, Suh S. Health risks of chemicals in consumer products: A review. Environ Int. 2019 Feb;123:580-587. doi: 10.1016/j.envint.2018.12.033. Epub 2019 Jan 7. PMID: 30622082.
Article Link: https://pubmed.ncbi.nlm.nih.gov/30622082/ - Full Text

“It should also be noted that some chemicals have multiple functional uses, while we chose the most dominant functional use for each chemical. An example is the grouping of **phthalates**. Despite categorized as plasticizer together in this review, several phthalates such as **diethyl phthalate and dimethyl phthalate are used as solvents in personal care products and cosmetics as carriers of fragrance** (Schettler, 2006).”

“…we found that the volume of the peer-reviewed literature that addresses human health risks of the chemicals in consumer products did grow over the last two decades, while its growth could by no means match the speed of increasing volume and diversity of the chemicals produced and used in consumer products by the society. This **growing gap between increasing reliance on chemicals in consumer products and our knowledge on their human health risks raises a potential public health concern**, given the pervasive nature of today's mass production and consumption practice.”

10. *Environmental Distribution of Personal Care Products and Their Effects on Human Health*

Khalid M, Abdollahi M. Environmental Distribution of Personal Care Products and Their Effects on Human Health. Iran J Pharm Res. 2021 Winter;20(1):216-253. doi: 10.22037/ijpr.2021.114891.15088. PMID: 34400954; PMCID: PMC8170769.
Article Link: https://pubmed.ncbi.nlm.nih.gov/34400954/ - PDF

"**Chemicals in PCPs (personal care products) have a high health risk to human and aquatic life** (14). Little information is available about exposures from PCPs and some ingredients of PCPs known as EDCs and involved in abnormal developmental and reproductive ability."

"**There are 50-300 different chemicals used as fragrances for PCPs**. Such chemicals may be **acetals, alcohols, aldehydes, amides, amines, carboxylic acids, coumarins, dioxanes, epoxides, esters, ethers, heterocyclics, hydrocarbons, ketones, lactones, musks, nitriles, phenols, pyrans, pyrazines, quinolines, or Schiff's bases**. Several PCPs such as **detergents, soaps, cleaners, and fabric softeners** contain various fragrances…"

"Fragrances are a mixture of VOCs that tend to break and mix with the dust or pollutants to form harmful secondary products or toxic air pollutants that are potentially more irritating or allergenic than the original substance. For example, **terpenes from PCPs may react with indoor ozone to form secondary pollutants such as formaldehyde."**

"Fragrances exacerbate symptoms of **asthmatic** patients and may induce **atopic asthma**. Fragrances with significant absorption in the UV range of 290-400 nm can cause **phototoxicity** and **photoallergy** resulting in dermal irritation and contact dermatitis. Dermatological patients often complain about **hand eczema and allergy**, mostly due to the ubiquitous usage of fragrances. Fragrance chemicals are also responsible for **airborne contact** and **facial dermatitis**. The incidence of **allergic contact dermatitis**, **hypersensitivity**, and **skin sensitization** found to be higher among women than men due to their frequency of use of PCPs and ubiquitous presence of fragrance chemicals."

[Note: Endocrine Disrupting Chemicals (EDC's) are commonly used in perfumes and fragranced products as preservatives or fragrance. What are EDC's and how can they affect us?**]**

11. *Exposing covert fragrance chemicals*

Scheinman PL. Exposing covert fragrance chemicals. Am J Contact Dermat. 2001 Dec;12(4):225-8. doi: 10.1053/ajcd.2001.28697. PMID: 11753900.
Article Link: https://pubmed.ncbi.nlm.nih.gov/11753900/

"**Fragrance is the most common cosmetic allergen found when dermatitis patients are patch tested** in the United States and in many places worldwide. Fragrances are ubiquitous in our daily lives and are present in items ranging from toiletries to toilet tissue. Although fragrances enhance the smell or mask unpleasant odors of various cosmetics and household items, it becomes very difficult for fragrance-allergic patients to find products they can use. Many items labeled unscented and fragrance-free contain esoteric fragrance chemicals that most consumers would not recognize. This article details some covert fragrance agents to help physicians better educate their fragrance-sensitive patients.

12. ALSO SEE SECTIONS: Allergies, Respiratory/Pulmonary (Nose & Lungs), Dermatological

Back to top of Airborne Contact Dermatitis **Back to Table of Contents**

Website: https://www.fragrancefreecoalitionusa.com/

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Poster and Document are for reference and educational purposes only.

ALLERGIES

Contact Dermatitis (Allergic Hives), Contact Urticaria (Allergic Hives)
Anaphylactic Reaction, Airborne Contact Dermatitis, Atopic Dermatitis
Also see: Airborne Contact Dermatitis

1. *An atlas of fragrance chemicals in children's products*

Ravichandran J, Karthikeyan BS, Jost J, Samal A. An atlas of fragrance chemicals in children's products. Sci Total Environ. 2022 Apr 20;818:151682. doi: 10.1016/j.scitotenv.2021.151682. Epub 2021 Nov 15. PMID: 34793786.
Article Link: https://pubmed.ncbi.nlm.nih.gov/34793786/

"We find that several **fragrance chemicals in children's products are potential carcinogens, endocrine disruptors, neurotoxicants, phytotoxins and skin sensitizers.**"
Fragrance chemicals have been linked to the onset and exacerbation of **several allergic** and **non-allergic disease conditions** in humans."

"Exposure of children to hazardous chemicals via any route is a significant concern due to the potential **impact on the growth and development** during early childhood."
****FCCP Chemical Database:** FCCP A repository of Fragrance Chemicals in Children's Products
****FCCP Chemical Classification Data Compilation:** Graphical Abstract

2. *A link between skin and airways regarding sensitivity to fragrance products?*

Elberling J, Linneberg A, Mosbech H, Dirksen A, Frølund L, Madsen F, Nielsen NH, Johansen JD. A link between skin and airways regarding sensitivity to fragrance products? Br J Dermatol. 2004 Dec;151(6):1197-203. doi: 10.1111/j.1365-2133.2004.06251.x. PMID: 15606515.
Article Link: https://pubmed.ncbi.nlm.nih.gov/15606515/

"**Contact sensitization to fragrances is one of the commonest causes of contact allergy in the general population**… as well as among patients with eczema. Exposure to volatile fragrances is commonplace and may be related to various **eye and airway symptoms**. Skin exposure to fragrances is known to cause **perfume contact allergy** and **eczema…."**

"Positive, independent and **significant associations were found between eye and airway symptoms** elicited by fragrance products and perfume contact allergy and hand eczema…. Individuals with perfume contact allergy and/or hand eczema, as opposed to those without, have more frequent and **more severe eye or airway symptoms after exposure to volatile fragrance product**s."

"We show consistent and significant associations between perfume contact allergy diagnosed by patch testing and symptoms elicited by fragrance products from the eyes and airways. The symptoms were mostly reported as elicited **within seconds and minutes after airborne exposure to fragrance products**."

3. *Cosmetic Habits and Cosmetic Contact Dermatitis in Children*

Goossens, A. Cosmetic Habits and Cosmetic Contact Dermatitis in Children. *Curr Treat Options Allergy* 2, 228–234 (2015). https://doi.org/10.1007/s40521-015-0057-x
Article Link: https://link.springer.com/article/10.1007/s40521-015-0057-x - PDF

"Almost all cosmetic ingredients may be responsible for allergic **contact dermatitis**. Emulsifiers and other vehicle compounds, such as wool alcohols (lanolin), are possible allergenic culprits in cosmetics; however, **fragrance components** (fragrance mix, myroxylon pereirae, and colophonium), hair dye chemicals, and preservative agents are certainly the most important allergens"
"Although guidelines for the maximum concentration of fragrances (and preservatives) in cosmetics have been provided, it has been previously demonstrated that, for example, **cosmetic "toys" may contain much higher concentrations of fragrances**."

"**Allergic contact dermatitis from cosmetics in children and adolescents has recently become more frequently observed and recognized**. Fragrances, hair dyes, sunscreen agents, and preservative agents, particularly methylisothiazolinone, are the most important **allergens**."
"It remains an important task for the cosmetic industry to avoid the main allergens known from the literature and to formulate cosmetics intended to be used in this age group as safely as possible."

4. *Airborne contact dermatitis: common causes in the USA*

Schloemer JA, Zirwas MJ, Burkhart CG. Airborne contact dermatitis: common causes in the USA. Int J Dermatol. 2015 Mar;54(3):271-4. doi: 10.1111/ijd.12692. Epub 2014 Jul 1. PMID: 24981079.
Article Link: https://pubmed.ncbi.nlm.nih.gov/24981079/ PDF

"Airborne contact dermatitis (ABCD) is an inflammatory reaction caused by exposure to particles suspended in air…. Airborne contact dermatitis can be classified as either allergic or irritant contact dermatitis, depending on its etiology and the mechanism of inflammation…. Many **allergens** and **chemicals** have been documented as causative agents of ABCD."

"Many other agents responsible for causing ABCD have been reported in the literature.… Others include ammonia, anhydrous calcium sulfate, cleaning products, and **formaldehyde**."

"Of note, the incidence of ABCD caused by chemicals of the isothiazolinone family, including methylisothiazolinone and methylchloroisothiazolinone, is on the rise as these chemicals are used increasingly as preservatives in many household products. Additionally, dermatitis resulting from methylisothiazolinone and related compounds may be allergic in nature, as evidenced by positive patch testing.

"Occupational hazards such as exposure to irritating chemicals and repetitive friction or abrasions to the surface of the skin can also pose a potential gateway for ABCD."

[Note: Limonene is a common skin sensitizer and known allergen in fragrance and fragranced products. Limonene (natural or synthetic) is a terpene. Terpenes can create formaldehyde and particulate matter in air as secondary pollutants. Limonene is on the IFRA list as a fragrance ingredient.**]**
[Note: Methylchloroisothiazolinone and Methylisothiazolinone (MCI-MI) are preservatives and known allergens used in air fresheners and personal care products.**]**

[Note: Fragrance is considered the new 'second hand smoke', **"**The parallels between second-hand smoke and synthetic fragrance use are many. At its core, both are battles over indoor air quality **"** - quote and link from De Vader, Christy L. & Barker, Paxson.
Chemicals that cigarettes/cigarette smoke and fragranced products can have in common are: Acetone, Formaldehyde, Benzene, acetaldehyde, terpenoids and phenols.**]**

5. *Fragrances: Contact Allergy and Other Adverse Effects*

de Groot AC. Fragrances: Contact Allergy and Other Adverse Effects. Dermatitis. 2020 Jan/Feb;31(1):13-35. doi: 10.1097/DER.0000000000000463. PMID: 31433384.
Article Link: https://pubmed.ncbi.nlm.nih.gov/31433384/

"In the general adult population, up to 4.5% may be allergic to fragrance materials, and in consecutive patients patch tested for suspected contact dermatitis, the frequency may reach 20% to 25%...

"Fragrances are an important and frequent cause of contact allergy and allergic contact dermatitis, notably from their presence in fragranced products such as deodorants, **fine fragrances** and aftershaves, other cosmetics (**both leave-on and rinse-off products**), household products, topical pharmaceuticals, essential oils, foods, and, to a lesser degree, industrial products."

"Other adverse effects reported from fragrances include immediate type reactions (mostly nonimmune immediate contact reactions, contact urticaria), **photosensitivity**, **respiratory disorders**, and miscellaneous adverse effects including irritant **contact dermatitis**, **depigmentation**, and **systemic adverse effects**."

"Fragrances are volatile, and therefore, in addition to skin exposure, a perfume also exposes the **eyes and nasorespiratory tract**. Already 35 years ago, it was suspected and later confirmed that fragrances can induce or worsen respiratory problems including **asthmatic attacks**."

"People may experience symptoms not only from wearing perfume themselves but also around cosmetic counters, candle shops, and from perfumes worn by other people. Currently, it is estimated that 2% to 4% of the adult population is affected by respiratory or eye symptoms from such exposures. Frequently reported **symptoms include dry, itching, or watery eyes; nasal irritation; congestion; and sneezing; as well as mouth and throat irritation, shortness of breath, and cough.**"

6. *Indoor Exposure to Selected Air Pollutants in the Home Environment:* A Systematic Review

Vardoulakis S, Giagloglou E, Steinle S, Davis A, Sleeuwenhoek A, Galea KS, Dixon K, Crawford JO. Indoor Exposure to Selected Air Pollutants in the Home Environment: A Systematic Review. Int J Environ Res Public Health. 2020 Dec 2;17(23):8972. doi: 10.3390/ijerph17238972. PMID: 33276576; PMCID: PMC7729884.
Article Link: https://pubmed.ncbi.nlm.nih.gov/33276576/ - PDF

"There is increasing awareness that the quality of the **indoor environment** affects our health and well-being…. Identified indoor **$PM_{2.5}$** sources include smoking, cooking, heating, use of **incense, candles,** and **insecticides**, while **cleaning**, housework, presence of pets and movement of people were the main sources of coarse particles….Household characteristics and occupant activities play a large role in indoor exposure,

particularly cigarette smoking for PM2.5, gas appliances for NO2, and **household products** for **VOCs** and PAHs."

"Typical **VOCs** found in the indoor environment include **benzene**, **toluene**, **ethylbenzene** and **xylenes (BTEX)** from fuel combustion and evaporation, and house renovations; benzene and **styrene** from cigarette smoking; alkanes from natural gas; 1,4-dichlorobenzene from moth repellents; **a-pinene** from wood-based building materials; and **limonene** from **fragranced** household **cleaning and laundry products**… Reported **VOC concentrations were generally higher indoors than outdoors**, including for **benzene**, particularly in colder seasons due to reduced ventilation and the use of oil and gas heaters."

"Indoor sources were dominant for most **VOCs** and particularly for **limonene, a-pinene, hexanal**, pentanal, **o-xylene**, and **n-dodecane**. Use of **artificial air freshener was significantly associated with total VOC (TVOC), benzene**, **toluene** and **ethylbenzene**."

"Indoor air quality (IAQ) in particular has an impact on multiple health outcomes, including **respiratory** and **cardiovascular illness, allergic symptoms, cancers,** and **premature mortality."**

7. *Skin exposure to scented products used in daily life and fragrance contact allergy in the European general population - The EDEN Fragrance Study*

van Amerongen CCA, Ofenloch RF, Cazzaniga S, Elsner P, Gonçalo M, Naldi L, Svensson Å, Bruze M, Schuttelaar MLA. Skin exposure to scented products used in daily life and fragrance contact allergy in the European general population - The EDEN Fragrance Study. Contact Dermatitis. 2021 Jun;84(6):385-394. doi: 10.1111/cod.13807. Epub 2021 Mar 2. PMID: 33576005; PMCID: PMC8247875.

Article Link: https://pubmed.ncbi.nlm.nih.gov/33576005/ - PDF

"**Sensitive skin** was associated with exposure to scented products and with **fragrance allergy**. In univariable regression analysis, exposure to leave-on products and to specific scented product subgroups was significantly associated with fragrance allergy."

"These products can be intended to be left on the skin such as **creams** and perfumes, intended to be rinsed off the skin such as **shampoos** or shaving products, or intended to be used as household items."
"The current study shows that females are indeed more exposed to scented products and consequently may be more frequently **sensitized** to fragrance **allergens** than males."

"In the current analysis, sensitive skin was associated with exposure to perfumes, sunscreens, **skin creams** and eye make-up. In addition, reporting a **sensitive skin** was associated with **fragrance contact allergy** in univariable regression analysis."
"We found significant associations between overall exposure to scented products and fragrance contact allergy."

8. *Symptom-trigger factors other than allergens in asthma and allergy*

Claeson AS, Palmquist E, Lind N, Nordin S. Symptom-trigger factors other than allergens in asthma and allergy. Int J Environ Health Res. 2016 Aug;26(4):448-57. doi: 10.1080/09603123.2015.1135314. Epub 2016 Jan 20. PubMed PMID: 26788835.

Article Link: https://pubmed.ncbi.nlm.nih.gov/26788835/

“Data from a population-based study, the Västerbotten Environmental Health Study, were used to compare persons with **asthma**, **allergic rhinitis**, **allergic dermatitis**, multiple diagnoses of asthma/allergy and no asthma or allergy. Persons with asthma and multiple diagnoses reported odorous/pungent and building-related environmental factors to trigger symptoms to a larger extent than did the reference group, mainly due to **perfume** and odors from flowers. They also **reported behavioral disruptions and affective reactions to odorous/pungent environments**. These findings increase the understanding of the role of odorants in symptom development and thereby the prevention of health problems in asthma and allergy in indoor air.”

“Environmental exposures of particular interest for indoor air quality, such as exposure to odorants, have also been referred to as triggers of asthma and allergy, although the exposure in some cases may result in allergic symptoms without clinical signs (e.g. **bronchoconstriction**). For example, a condition with **asthma-like overreaction** in the lower airways, called **sensory hyperreactivity**, has been identified in which patients display normal pulmonary function and negative allergy tests, and is **typically not treated by their ordinated asthma medication** (Millqvist et al. 1998). **The symptoms in these patients are often induced by non-specific trigger factors, such as perfumes**.”

9. *Pediatric allergic contact dermatitis. Part I: Clinical features and common contact allergens in children*

Neale H, Garza-Mayers AC, Tam I, Yu J. Pediatric allergic contact dermatitis. Part I: Clinical features and common contact allergens in children. J Am Acad Dermatol. 2021 Feb;84(2):235-244. doi: 10.1016/j.jaad.2020.11.002. Epub 2020 Nov 17. PMID: 33217510.
Article Link: https://pubmed.ncbi.nlm.nih.gov/33217510/ - PDF

“Children can develop ACD (Allergic Contact Dermatitis) at any age…. Therefore, all children should be asked about the use of personal care products such as **shampoos, soaps, lotions, detergents, and topical medications.**…systemic contact dermatitis can occur through oral ingestion of contact allergens in food, such as carmine in red velvet cupcakes, nickel in oatmeal and cocoa, and **balsam of Peru (BoP)** in ketchup….Nickel, **fragrance mix (FM) I**, BoP, propylene glycol, CAPB, bacitracin, neomycin, cobalt, **formaldehyde (and its releasers)**, methylisothiazolinone (MI), and **lanolin** are top relevant allergens in the United States.”

“Fragrances are ubiquitous environmental allergens, and although **there are potentially thousands of allergenic fragrance chemicals,** fragrance markers such as BoP, FM I, and FM II are most frequently used in patch testing…. Fragrances are often used in household products like candles and cleaning supplies. **Children may also be exposed to fragrances used by their care takers, such as perfumes, leading to cases of connubial ACD**.”

“**Formaldehyde** is found in cosmetic and personal care products (**including baby products**), cleaning supplies, adhesives, sporting equipment, and paints. **One study showed that more than 25% of those with PPTs to formaldehyde were also sensitized to its releasers** such as quaternium-15, dimethyloldimethyl hydantoin, bronopol, diazolidinyl urea, and imidazolidinyl urea.

“Often, products such as **baby wipes may contain formaldehyde releasers** even though they may not be listed among the ingredients. **Formaldehyde (and releasers) contact allergy is more frequent in the United States compared to Europe, likely reflecting stricter regulation of product concentration and labeling in Europe.”**

[Note: Balsam of Peru is used in fragrance and is a known allergen. Like with all fragrance allergies, avoidance is suggested.**]**
[Note: Formaldehyde is a secondary pollutant from fragrance and fragranced products.
Also, a 2012 study, 21 out of 30 perfume samples were shown to release formaldehyde when tested but formaldehyde was not listed on any of the labels. Formaldehyde is a sensitizer and known allergen.**]**

10. *Contact Allergens in Top-Selling Textile-care Products*

Bai H, Tam I, Yu J. Contact Allergens in Top-Selling Textile-care Products. Dermatitis. 2020 Jan/Feb;31(1):53-58. doi: 10.1097/DER.0000000000000566. PMID: 31905182.
Article Link: https://pubmed.ncbi.nlm.nih.gov/31905182/

"Ten common allergens were identified: benzisothiazolinone, benzyl benzoate, cocamidopropyl betaine, decyl glucoside, **"fragrances,"** lauryl glucoside, methylisothiazolinone, methylchloroisothiazolinone, phenoxyethanol, and propylene glycol. **Fragrances and essential oils are the top allergens in laundry detergents** (66.7%), **fabric softeners** (90%), **dryer sheets** (75%), and **stain removers** (58.8%). …found that 139 to 2820 parts per million of **detergent residue remain** after one wash and **required 20 to 22 washes to become undetectable. Formaldehyde** is a preservative that may be emitted by laundry products during the washing and drying process but not listed by manufacturers.

11. *Fragrance allergens in household detergents*

Wieck S, Olsson O, Kümmerer K, Klaschka U. Fragrance allergens in household detergents. Regul Toxicol Pharmacol. 2018 Aug;97:163-169. doi: 10.1016/j.yrtph.2018.06.015. Epub 2018 Jun 22. PMID: 29940212.
Article Link: https://pubmed.ncbi.nlm.nih.gov/29940212/

"For the first time, fragrance allergens were evaluated in a complete set of detergents in households. In 131 households, we investigated the prevalence of detergents and searched their lists of ingredients for 26 fragrance allergens liable to be indicated on products according to the European Detergents Regulations. On the ingredient lists of 1447 products, these 26 fragrance substances were named almost 2000 times, most often limonene, linalool and hexyl cinnamal. Benzyl salicylate was used frequently in all-purpose cleaners. Linalool and limonene, hexyl cinnamal and butylphenyl methylpropional and citronellol and linalool co-occurred most often together in products. **Fragrance allergens** co-occurring together most frequently within households were eugenol, coumarin and cinnamyl alcohol. The study shows that **detergents could play a relevant role for the exposure of consumers towards fragrance allergens** and that they should not be underestimated as an exposure source during the exposure assessment."
Further factors such as **chemical transformation (e.g. by oxidation) into stronger allergens or new molecules** of often unknown properties and individual use practices can increase the risk of allergy further (Bråred Christensson et al., 2016; Niu et al., 2017; Rossignol et al., 2013)."
"Our results demonstrate that detergents could contribute to the aggregated exposure to fragrance allergens… The results indicate that detergents, next to cosmetics, should be included in exposure scenarios calculating the aggregate exposure. Furthermore, detergents can also contribute to the co-exposure of consumers, possibly leading to enhanced sensitization."

12. *Baby-Wipe Dermatitis: Preservative-Induced Hand Eczema in Parents and Persons Using Moist Towelettes*

Guin JD, Kincannon J, Church FL. Baby-wipe dermatitis: preservative-induced hand eczema in parents and persons using moist towelettes. Am J Contact Dermat. 2001 Dec;12(4):189-92. doi: 10.1053/ajcd.2001.28052. PMID: 11753890.
Article Link: https://pubmed.ncbi.nlm.nih.gov/11753890/

"Results: A total of 6 women and 3 men with **hand eczema** were found to be allergic to (preservatives found in) different brands of moist towelettes used in diaper hygiene. Many were **allergic to fragrance materials** as well."

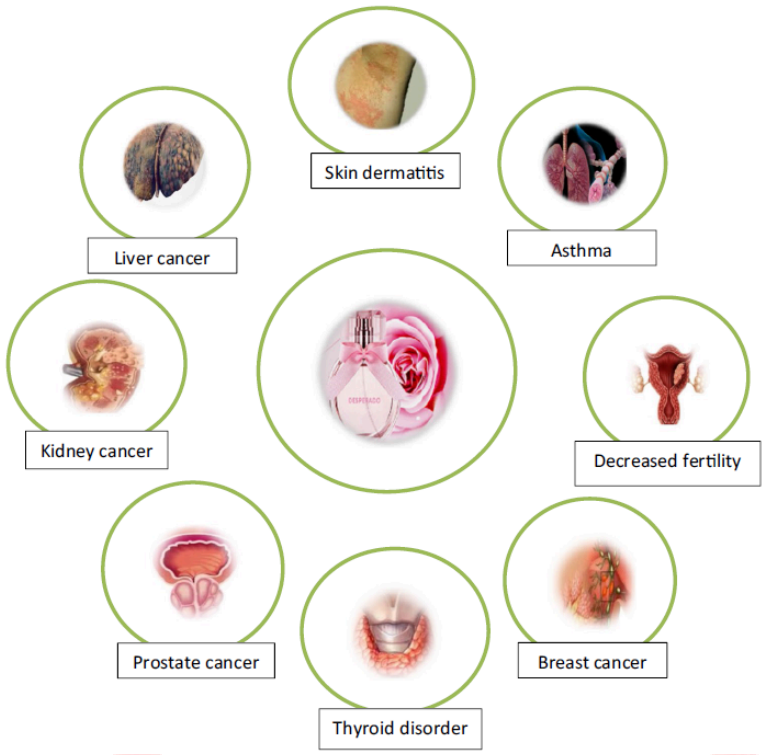
"Hand eczema in a grip-like pattern is good reason to inquire about baby wipes as a possible source, as most patients do not recognize that source even after undergoing patch tests."

13. *Evaluation of pollutants in perfumes, colognes and health effects on the consumer: a systematic review*

Kazemi Z, Aboutaleb E, Shahsavani A, Kermani M, Kazemi Z. Evaluation of pollutants in perfumes, colognes and health effects on the consumer: a systematic review. J Environ Health Sci Eng. 2022 Feb 3;20(1):589-598. doi: 10.1007/s40201-021-00783-x. PMID: 35669814; PMCID: PMC9163252.
Article Link: https://pubmed.ncbi.nlm.nih.gov/35669814/ - PDF

(Note: Graphic is from preceding article**)** **(**Creative Commons Attribution 4.0 International license**).**

Fig. 2 Effects of exposure to perfumes and colognes



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"Diethyl phthalate is a chemical used to **make perfumes last longer.** The U.S. Clean Water Act lists it as a **toxic** and priority pollutant."

“Complications of using perfume include **neuropathy (depression, autism), neoplasms (breast cancer, prostate cancer), effects on the liver, migraine headaches, asthma attacks, mucosal symptoms (watery or red eyes, sneezing), neurological problems (dizziness, convulsions, headache, fainting, imbalance), respiratory (cough, shortness of breath), skin (skin rash, urticaria, redness of the skin, skin tingling, dermatitis), immune system (swollen lymph nodes, fever, fatigue), gastrointestinal tract (nausea, bloating, diarrhea)** and c**ardiovascular (rapid** or **irregular heartbeat, tremors, chest discomfort**)”

“**Contaminants in perfumes and colognes** and their health effects on the consumer were systematically reviewed. It was found that the most attention of researchers was to identify the compounds in perfumes and colognes and their concentrations. Among the most common pollutants **phthalates** and their derivatives can be mentioned. Other pollutants included **parabens, triclosan, salicylates, terpenes, aldehydes, benzene, toluene, styrene, and aluminum-based salts**. These pollutants have also been shown to have adverse effects on consumer health such as **asthma and allergies, cardiovascular disease, central nervous system damage, breast cancer, endocrine cancer, respiratory disorders, reproduction, thyroid, adrenal gland function and immune system.”**

[Note: Graphic lists “effects of exposure to perfumes and colognes”: Kidney Cancer, Liver Cancer, Prostate Cancer, Thyroid Disorder, Breast Cancer, Decreased Fertility, Asthma and Skin Dermatitis.**]**

13. *Review on perfume and present status of its associated allergens*

Kumar M, Devi A, Sharma M, Kaur P, Mandal UK. Review on perfume and present status of its associated allergens. J Cosmet Dermatol. 2021 Feb;20(2):391-399. doi: 10.1111/jocd.13507. Epub 2020 Jun 16. PMID: 32445606.
Article Link: https://pubmed.ncbi.nlm.nih.gov/32445606/

“It is concluded that most **fragrance** ingredients act as **allergens** and thus increases the risk of **sensitization** on activation.”

“**European Union Cosmetic Regulation 12/23/2009 listed 26 allergens but no other regulatory agencies specify perfumes as allergens**, they just describe perfumes as cosmetic products. If any individual suffering from allergy, or contact dermatitis on its application, he/she should be aware regarding it and should reduce or **avoid** the use of those ingredients to overcome such problems of **hyper-sensitivity**.”

15. *Fragrance contact allergens in 5588 cosmetic products identified through a novel smartphone application*

Bennike NH, Oturai NB, Müller S, Kirkeby CS, Jørgensen C, Christensen AB, Zachariae C, Johansen JD. Fragrance contact allergens in 5,588 cosmetic products identified through a novel smartphone application. J Eur Acad Dermatol Venereol. 2018 Jan;32(1):79-85. doi: 10.1111/jdv.14513. Epub 2017 Sep 11. PMID: 28796916.
Article Link: https://pubmed.ncbi.nlm.nih.gov/28796916/

“**More than 25% of the adult European population suffers from contact allergy, with fragrance substances** recognized as one of the main causes. Since 2005, 26 fragrance contact allergens have been mandatory to label in cosmetic products within the EU if present at 10 ppm or above in leave -on and 100 ppm or above in wash -off cosmetics.”

“The largest product categories investigated were “**cream, lotion and oil**” (n=1192), “shampoo and conditioner” (n=968) and “deodorants” (n=632). Among cosmetic products labelled to contain at least one of the 26 fragrances, 85.5% and 73.9% contained at least two and at least three of the 26 fragrances, respectively. **Linalool** (49.5%) and **limonene** (48.5%) were labelled most often among all investigated products…. “

“Six of the 26 fragrance substances were labelled on less than one percent of all products, including the natural extracts **Evernia furfuracea (tree moss)** and **Evernia prunastri (oak moss)**. 329 (5.9%) products had one or more of the 26 fragrance substances labelled , but did not have “parfum/fragrance/aroma” listed on the label.”

“Consumers are widely exposed to, often multiple, well-established fragrance contact allergens through various cosmetic products intended for daily use. **Several fragrance substances that are common causes of contact allergy were rarely labelled in this large sample of cosmetic products.**”
[Note: The U.S. has no regulations to list allergens or any ingredient used in fragrance formulations. There are currently 26 known contact allergens in fragrance, but that does not mean there are only 26 allergens possible in fragrance formulas, many chemicals in fragrance still remain untested as possible allergens.**]**

16. *Sensitizing fragrances in absorbent hygiene products*

Desmedt B, Marcelis Q, Zhilivoda D, Deconinck E. Sensitizing fragrances in absorbent hygiene products. Contact Dermatitis. 2020 May;82(5):279-282. doi: 10.1111/cod.13472. Epub 2020 Feb 5. PMID: 31951286.
Article Link: https://pubmed.ncbi.nlm.nih.gov/31951286/

“Allergenic fragrances are present in a wide range of products but they are not regulated in all industries to the same extent. In Europe, absorbent hygiene products (AHPs) are only covered by the general product safety directive and therefore **fragrances can be used freely…”**
“...the consumer is unaware that these products can contain allergens. Indeed some of these products **do not even disclose the presence of perfume**. They only vaguely indicate the presence of fragrances by using attributes such as “fresh”. **The results show that allergenic fragrances can be present at concentrations that would require individual labeling if the cosmetic legislation would be applied.**”

17. *Rapid and green determination of 58 fragrance allergens in plush toys*

Wang Z, Zhang Q, Li H, Lv Q, Wang W, Bai H. Rapid and green determination of 58 fragrance allergens in plush toys. J Sep Sci. 2018 Feb;41(3):657-668. doi: 10.1002/jssc.201700556. Epub 2017 Dec 14. PMID: 29150895.
Article Link: https://pubmed.ncbi.nlm.nih.gov/29150895/

“**Toys are scented** to cover unpleasant odors or to enhance their attractiveness to consumers. However, **some fragrances are important sources of allergens**, which can **trigger respiratory illnesses (asthma and rhinitis), migraine headaches, neurotoxicity, endocrine-disrupting activities,** and other negative effects.”

18. *Risk in cleaning: chemical and physical exposure*

Wolkoff P, Schneider T, Kildesø J, Degerth R, Jaroszewski M, Schunk H. Risk in cleaning: chemical and physical exposure. Sci Total Environ. 1998 Apr 23;215(1-2):135-56. doi: 10.1016/s0048-9697(98)00110-7. PMID: 9599458.

Article Link: https://pubmed.ncbi.nlm.nih.gov/9599458/

"...both field studies and **emission testing** indicate that the use **of cleaning agents** results in a temporal **increase in the overall VOC level**. This increase may occur during the cleaning process and thus it can enhance the probability of increased short-term exposure of the cleaners. However, the increased levels can also be present after the cleaning and result in an overall **increased VOC level** that can possibly **affect the indoor air quality (IAQ)** perceived by occupants."

"Perfumes or fragrances are used either to give the products a pleasant odour or to mask an unpleasant smell… They **are not essential for the technical function of the product.** Some of the used perfumes or fragrances are reported allergens. **Therefore, the risk of the exposure of cleaners to these substances is often unnecessary**."

19. *Qualitative Analysis of Air Freshener Spray*

Ibrahim ALshaer F, Fuad ALBaharna D, Ahmed HO, Ghiyath Anas M, Mohammed ALJassmi J. Qualitative Analysis of Air Freshener Spray. J Environ Public Health. 2019 Nov 5;2019:9316707. doi: 10.1155/2019/9316707. PMID: 31781257; PMCID: PMC6874985.
Article Link: https://pubmed.ncbi.nlm.nih.gov/31781257/ - PDF

"Information lacks concerning the gaseous emissions of fragrance products in spite of the extensive indoor exposure and widespread use of fragrances to them. In addition, **95 percent of the chemicals are synthetic compounds in fragrances that are derived from petroleum**."

"Some chemicals after analysis turned out to be noted as **skin allergens** or **irritants** and even chemicals that may interfere with **bodily functions**."

"The present study has identified the presence of different compounds in spray air fresheners that were not disclosed on the product's label. The results depicted common compounds in both low- and high-cost air fresheners. **Chemicals found in this study were not revealed on the product label as manufacturers are not required to list all ingredients**. These chemicals usually tend to be listed on the product label as "parfum" or "fragrance". There should be a law that strictly indicates whether the products contain any synthetic chemicals for people to be aware of what they are exposed to, although, manufacturers are not required to reveal all hidden ingredients on the label as stated by the Consumer Product Safety Commission (CPSC)."

20. *Potential Allergens in Disposable Diaper Wipes, Topical Diaper Preparations, and Disposable Diapers: Under-recognized Etiology of Pediatric Perineal Dermatitis*

Yu J, Treat J, Chaney K, Brod B. Potential Allergens in Disposable Diaper Wipes, Topical Diaper Preparations, and Disposable Diapers: Under-recognized Etiology of Pediatric Perineal Dermatitis. Dermatitis. 2016 May-Jun;27(3):110-8. doi: 10.1097/DER.0000000000000177. PMID: 27172304.
Article Link: https://pubmed.ncbi.nlm.nih.gov/27172304/

"**We found fragrances in 33.3% of diaper wipes and 43.6% of topical diaper preparations.**"
"Other potential **allergens** identified with high frequency include >-tocopherol, **fragrances**, propylene glycol, parabens, iodopropynyl butylcarbamate, and lanolin."

[Note: In the EU, 26 known fragrance allergens have been a labeling requirement since 2009, but as of 2022 the EU is planning to add 56 more fragrance allergens.**]**

[Note: IN THE U.S. NEWS - On Dec. 29, 2022, the MOCRA - (Modernization of Cosmetic Regulation Act) was signed into law. In a few years, the U.S. should start listing fragrance allergens in cosmetics, but this Act may tie the hands of states' ability to make a law pertaining to disclosing the over 3,000 other potentially concerning fragrance ingredients (like California did).
To learn more, see what **Women's Voices for the Earth (WVE)** have figured out.
To read the Act, go to congress.gov link/PDF (page 1396).
What to know:
Which products qualify as 'cosmetics' and Who regulates what??
Items such as fragranced laundry products, air fresheners, carpet fragrance, fragrance in cleaning products or car / car wash fragrances are not considered cosmetics, therefore, it is safe to say that companies who sell these products will not be obligated to list the known fragrance allergens in their products.**]**

21. *Occupational acute anaphylactic reaction to assault by perfume spray in the face*

Lessenger JE. Occupational acute anaphylactic reaction to assault by perfume spray in the face. J Am Board Fam Pract. 2001 Mar-Apr;14(2):137-40. PMID: 11314921.
Article Link: https://pubmed.ncbi.nlm.nih.gov/11314921/ - PDF

"Fragrances have been found to cause exacerbations of symptoms and **airway obstruction** in asthmatic patients, including **chest tightening** and **wheezing**, and are a common cause of **cosmetic allergic contact dermatitis.** In many work settings the use of fragrances is limited. Workers should be prepared to take immediate steps should an employee go into **anaphylactic shock**."

22. *Relationship between indoor air pollutant levels and residential environment in children with atopic dermatitis*

Lee JH, Lee HS, Park MR, Lee SW, Kim EH, Cho JB, Kim J, Han Y, Jung K, Cheong HK, Lee SI, Ahn K. Relationship between indoor air pollutant levels and residential environment in children withatopic dermatitis. Allergy Asthma Immunol Res. 2014 Nov;6(6):517-24. doi: 10.4168/aair.2014.6.6.517. Epub 2014 Sep 11. PMID: 25374751; PMCID: PMC4214972.
Article Link: https://pubmed.ncbi.nlm.nih.gov/25374751/ - PDF

"The prevalence of AD (Atopic Dermatitis) is currently increasing and the incidence in children is reported to range from 15-30% worldwide…."
"**Exposure to volatile organic compounds (VOCs) can damage the epidermal barrier** and enhance adverse effects of house dust mites on sensitized subjects with AD. Exposure to formaldehyde and nitrogen dioxide (NO2) at domestic concentration can cause **skin barrier function impairment** in patients with AD."

"Indoor air pollutant concentrations were measured including particulate matter with diameter less than 10 μm (PM10), **formaldehyde**, carbon dioxide (CO2), carbon monoxide (CO), nitrogen dioxide (NO2), **total volatile organic compound (TVOC)**, **benzene**, **toluene**, ethyl-benzene, **xylene**, **styrene**, bacterial aerosols and airborne fungi."

"In conclusion,…To alleviate AD symptoms, identifying aggravating factors including indoor air quality is important. In this regard, simple questioning about aspects of residential environment such as visible fungus on

the walls and **the use of artificial air freshener** are helpful to assess the possibility of increased indoor air pollutant levels when direct measurement is not feasible."

[Note: Benzene is a reported fragrance ingredient in the CSCP Product Database.**]**
[Note: Toluene (often a nail polish thinner) is used as a solvent or fragrance in perfume and bath products on the CSPC Product Database. Toluene is on the IFRA list and on the EPA's Priority Pollutant List.**]**
[Note: Xylene "occurs naturally in petroleum and coal tar, and is major component of gasoline and fuel oil". Xylene is used as a musk fragrance. Xylene is on IFRA.**]**
[Note: Styrene is "primarily a synthetic chemical**"** used in fragrance. It is on the CSPC list as 'parfum/fragrance' and also on the IFRA list.**]**

23. *Fragrance chemicals in domestic and occupational products*

Rastogi SC, Heydorn S, Johansen JD, Basketter DA. Fragrance chemicals in domestic and occupational products. Contact Dermatitis. 2001 Oct;45(4):221-5. doi: 10.1034/j.1600-0536.2001.450406.x. PMID: 11683833.
Article Link: https://pubmed.ncbi.nlm.nih.gov/11683833/

"Epidemiological studies have described an increasing prevalence of **fragrance allergy** and indicated an association with **hand eczema."**
"**Fragrances are one of the most common causes of allergic contact dermatitis**…approximately 2500 substances are used in fragrances, which may contain from 10 to more than 300 different chemical compounds."

24. *Environmental factors in the development of autism spectrum disorders*

Sealey LA, Hughes BW, Sriskanda AN, Guest JR, Gibson AD, Johnson-Williams L, Pace DG, Bagasra O. Environmental factors in the development of autism spectrum disorders. Environ Int. 2016 Mar;88:288-298. doi: 10.1016/j.envint.2015.12.021. Epub 2016 Jan 28. PMID: 26826339.
Article Link: https://pubmed.ncbi.nlm.nih.gov/26826339/ - PDF

"Many modern companies do not disclose the industrial secrets in many of their fragrances that are, in reality, a complex concoction of synthetic chemicals and natural essences, which often have been found to be petrochemicals."

"Among those are chemicals, such as **musk ketone** and **diethyl phthalate**, which are responsible for **allergic reactions** and **hormone disruption**…. Although these **chemicals have been found to accumulate in human tissues,** they have not yet been adequately analyzed for safety in products used by unsuspecting humans. **As a result of a giant loophole in the Federal Fair Packaging and Labeling Act of 1973**, which explicitly exempts fragrance producers from having to disclose cosmetic ingredients on product labels, fragrance concealment is not illegal and is often used by the industry to hide from the public the full list of ingredients, even substances that can cause grave health problems (Environmental Working Group (EWG), 2005). It is a common practice for businesses to list the chemicals as simply "fragrance," which may mean that **the majority of the ingredients are never revealed to buyers**."

"Even worse, people who use cologne, fragrances, body spray, and other scented cosmetics are blindly exposed to dangerous chemicals since the Food and Drug Administration lacks authority to control mandates to manufacturers that require testing of all fragrances for safety, before being released to the public."

"Also, during pregnancy, the use of fragrances and other cosmetics may actually expose the developing fetus to **diethyl phthalate (DEP)**, a common fragrance solvent that can cause **abnormal development of reproductive organs in infant males**, **Attention Deficit Disorder** in children, and **sperm damage in adults**."

"The role of environmental factors like **fragrances**, glyphosate **and other synthetic chemicals derived from petrochemicals containing carcinogenic, mutagenic, hormones disturbing and neuromodifying capabilities** in the molecular and cellular pathogeneses of ASD has not been evaluated. This is partly due to the 1973 FDA decision to exempt fragrances and cosmetics from appropriate testing, which is generally required for any consumer item that enters the human body and is metabolized by human metabolic pathways."

25. *Pressurized liquid extraction-gas chromatography-mass spectrometry analysis of fragrance allergens, musks, phthalates and preservatives in baby wipes*

Celeiro M, Lamas JP, Garcia-Jares C, Llompart M. Pressurized liquid extraction-gas chromatography-mass spectrometry analysis of fragrance allergens, musks, phthalates and preservatives in baby wipes. J Chromatogr A. 2015 Mar 6;1384:9-21. doi: 10.1016/j.chroma.2015.01.049. Epub 2015 Jan 22. PMID: 25662066.
Article Link: https://pubmed.ncbi.nlm.nih.gov/25662066/

"These products may contain complex **mixtures of harmful chemicals**….Thirty-six of the target analytes were detected, highlighting the presence of **phenoxyethanol in all analyzed samples at high concentrations."**

"All the samples contained fragrance allergens in many cases at high levels (up to 2400 μg g−1) and three musks were detected in the samples."

"A pressurized liquid extraction followed by gas chromatography–mass spectrometry method has been developed for the determination of **fragrance allergens**, preservatives, **phthalates**, and **musks** in baby wipes and wet toilet paper intended for children. Twenty-five of the 65 target analytes are banned or subjected to restrictions according to European Legislation (EC No 1223/2009)."

[Note: Phthalates are synthetic odorless plasticizers used as solvents, binders or fixatives in many fragrances. Why are phthalates in the news? Phthalates are considered Endocrine Disrupting Chemicals.
On the California Safe Cosmetics Program Product Database: DEP, DIDP, and DBP are reported as fragrance while DEHP and DBP are perfume solvents. IFRA lists DEP and DMP, as "reported fragrance ingredients".**]**
[Note: Most **Musk** in fragrances are created synthetically.**]**

26. *Development and application of a novel method to assess exposure levels of sensitizing and irritating substances leaching from menstrual hygiene products*

Marcelis Q., Gatzios A, Deconinck E, Rogiers V, Vanhaecke T, Desmedt B. Development and application of a novel method to assess exposure levels of sensitizing and irritating substances leaching from menstrual hygiene products,
Emerging Contaminants,Volume 7, 2021, Pages 116-123, ISSN 2405-6650, https://doi.org/10.1016/j.emcon.2021.02.004.
Article Link: https://www.sciencedirect.com/science/article/pii/S2405665021000068?via%3Dihub - PDF

"All **fragrance chemicals** selected for the method development are classified as **skin sensitizers** category 1B…Six products were found to leach at least one of the following five sensitizing and irritating compounds:

α-isomethyl ionone, benzyl salicylate, hexyl cinnamaldehyde, linalool and piperonal. Piperonal was the **most abundant compound leaching** from the MHPs, with leaching concentration levels measured to **28.22 µg/g.** In addition, the **leaching level of benzyl salicylate was** found to be **11.03 µg/g. The latter fragrance concentration is above 10 µg/g and would trigger mandatory labelling if the Cosmetic Regulation would apply for MHPs. However, none of the identified and quantified skin sensitizers were mentioned on the package."**

27. *Fragrance allergens in 'specific' cosmetic products*

Nardelli A, Drieghe J, Claes L, Boey L, Goossens A. Fragrance allergens in 'specific' cosmetic products. Contact Dermatitis. 2011 Apr;64(4):212-9. doi: 10.1111/j.1600-0536.2011.01877.x. PMID: 21392029.
Article Link: https://pubmed.ncbi.nlm.nih.gov/21392029/

"This study not only underlines the usefulness of **fragrance-ingredient labelling** in order to identify the **causal allergen(s)** present in specific **cosmetic** products, but may also provide information on trends in the actual use of **sensitizing fragrance ingredients** in them."

28. *Environmental Distribution of Personal Care Products and Their Effects on Human Health*

Khalid M, Abdollahi M. Environmental Distribution of Personal Care Products and Their Effects on Human Health. Iran J Pharm Res. 2021 Winter;20(1):216-253. doi: 10.22037/ijpr.2021.114891.15088. PMID: 34400954; PMCID: PMC8170769.
Article Link: https://pubmed.ncbi.nlm.nih.gov/34400954/ - PDF

"**Chemicals in PCPs (personal care products) have a high health risk to human and aquatic life** (14). Little information is available about exposures from PCPs and some ingredients of PCPs known as EDCs and involved in abnormal developmental and reproductive ability."

"**There are 50-300 different chemicals used as fragrances for PCPs**. Such chemicals may be **acetals, alcohols, aldehydes, amides, amines, carboxylic acids, coumarins, dioxanes, epoxides, esters, ethers, heterocyclics, hydrocarbons, ketones, lactones, musks, nitriles, phenols, pyrans, pyrazines, quinolines, or Schiff's bases**. Several PCPs such as **detergents, soaps, cleaners, and fabric softeners** contain various fragrances…"

"Fragrances are a mixture of VOCs that tend to break and mix with the dust or pollutants to form harmful secondary products or toxic air pollutants that are potentially more irritating or allergenic than the original substance. For example, **terpenes from PCPs may react with indoor ozone to form secondary pollutants such as formaldehyde."**

"Fragrances exacerbate symptoms of **asthmatic** patients and may induce **atopic asthma**. Fragrances with significant absorption in the UV range of 290-400 nm can cause **phototoxicity** and **photoallergy** resulting in dermal irritation and contact dermatitis. Dermatological patients often complain about **hand eczema and allergy**, mostly due to the ubiquitous usage of fragrances. Fragrance chemicals are also responsible for **airborne contact** and **facial dermatitis**. The incidence of **allergic contact dermatitis**, **hypersensitivity**, and **skin sensitization** found to be higher among women than men due to their frequency of use of PCPs and ubiquitous presence of fragrance chemicals."

[Note: Endocrine Disrupting Chemicals (EDC's) are commonly used in perfumes and fragranced products as preservatives or fragrance. What are EDC's and how can they affect us?**]**

29. *Chemicals of concern in plastic toys*

Aurisano N, Huang L, Milà I Canals L, Jolliet O, Fantke P. Chemicals of concern in plastic toys. Environ Int. 2021 Jan;146:106194. doi: 10.1016/j.envint.2020.106194. Epub 2020 Oct 22. PMID: 33115697.
Article Link: https://pubmed.ncbi.nlm.nih.gov/33115697/ - PDF

"Out of 126 CoCs (chemicals of concern), we found 31 plasticizers, 18 flame retardants and **8 fragrances**."
"The 27 substances identified in category I, correspond well to chemicals present in other prioritization lists. For example, widely regulated **phthalates** are also identified as CoCs in the present study. These phthalates include **DEHP, DINP, DBP, DiDP, di-(n-octyl)-phthalate** (DNOP, CAS: 117-84-0), and **benzyl butyl phthalate** (BBP, CAS: 85-68-7)."

"Finally, we found 37 substances that appear in our category IV, which contains substances that appear in other priority lists, but for which we were not able to quantify any risk. This includes the **allergenic fragrance d-Limonene** (CAS: 5989-27-5), which was detected in toys…"

[Note: 8 listed Fragrance chemicals of concern from Table 1: **Hexadecanoic Acid, Linalool, Acetophenone, Biphenyl, Diethyl Propanedioate, Propylbenzene, Methylparaben, Propylparaben]**

[Note: Styrene is "primarily a synthetic chemical**"** used in fragrance. It is on the CSPC list as 'parfum/fragrance' and also on the IFRA list.**]**

[Note: Phenol used in fragrance is mostly synthetic derived from benzene/petro. It is an EDC and declared as fragrance on the CSCP list and on the IFRA fragrance transparency list. Phenol is on the Washington State List of Chemicals of High Concern to Children and Priority Pollutant List.**]**

[Note: Phthalates are synthetic odorless plasticizers used as solvents, binders or fixatives in many fragrances. Why are phthalates in the news? Phthalates are considered Endocrine Disrupting Chemicals.
On the California Safe Cosmetics Program Product Database: DEP, DIDP, and DBP are reported as fragrance while DEHP and DBP are perfume solvents. IFRA lists DEP and DMP, as "reported fragrance ingredients".**]**

30. *Smell of autism: Synthetic fragrances and cause for allergies, asthma, cancer and autism*

Bagasra O, Pace DG. Smell of autism: Synthetic fragrances and cause for allergies, asthma, cancer and autism. OA Autism 2013 Jun 19;1(2):15.
Article Link:
https://www.researchgate.net/publication/269626082_Smell_of_autism_Synthetic_fragrances_and_cause_for_allergies_asthma_cancer_and_autism)

"The aim of this review was to discuss synthetic fragrances and cause for **allergies**, **asthma**, **cancer** and **autism**…"
"This review summarizes some of the subjective concerns and attempts to date that have brought greater objective scrutiny to the debate over the safety of components used in the imprecise objects called

fragrances."
"The link between autism spectrum disorder (ASD) and exposure to toxic ingredients in perfumes, even at minute (femtomolar) levels, has been suggested by recent scholarship. Scents are known to have the capacity to reach the brain, including the brain of a foetus whose mother uses **perfume that derives from synthetic scents made from mutagenic chemicals**."

"**Fragrance is a seemingly innocuous term added to health and beauty products. Ultimately, this mysterious term may actually undermine both health and beauty.** Fragrance is a common euphemism for an undisclosed blend of chemical ingredients drawn from an arsenal comprised of about 3,100 total ingredients. 'Musky' may increase sales, 'exotic' may attract customers and '6loral' may sound beautifully natural, but these terms may also conceal the existence of petrochemicals and other synthetic chemicals that, when blended with natural ingredients, can form **dangerous cocktails of fragrance**"

31. Fragrance compounds: The wolves in sheep's clothings

Patel S. Fragrance compounds: The wolves in sheep's clothings. Med Hypotheses. 2017 May;102:106-111. doi: 10.1016/j.mehy.2017.03.025. Epub 2017 Mar 22. PMID: 28478814.
Article Title: https://pubmed.ncbi.nlm.nih.gov/28478814/

"It is deplorable and alarming that awareness of the threats of perfume allergy is very low. Tricked by aggressive advertisement and to improve aesthetic appeal, people are exposing themselves to multiple chemical fragrance compounds. Further, it is a matter of concern that an alert individual cannot escape the perils of fragrances by mere lifestyle revision, and avoidance of the chemicals. Like the harms of passive smoking, passive exposure to the perfumes occurs in a number of public places. In realization of the dangers of peanut allergy to vulnerable individuals, peanut was pulled off from the food platter in passenger planes. Similar awareness and action is needed for perfumes as well.… An aware individual does not deserve to get the brunt of someone else's reckless lifestyle choices. Also, the cleaning staff in public places must be trained so as to ensure prevention of perfume abuse i.e. excess usage."

"A study found traces of **musk fragrances** such as **galaxolide**, **tonalide**, **cashmeran,** and UV-filters in marine species (mussel, clam, flounder, herring and mullet) and macroalgae, which constitute seafood. These **bioaccumulated xenobiotics** will ultimately reach to the human body via the food chain"

"Perfume manufacturers do not disclose the ingredients and quantity of the fragrance compounds in the name of 'trade secret'. Though they ought to abide by ethics, for profit and the goals of high market share, they forgo those. With the help of unscrupulous advertisements and sponsored research reports, they keep luring naive and unaware consumers.… It is appalling that even if people know the threats, they continue using these toxins, resonating the ''death wish" concept discussed in the popular TV series ''Mad men".... The fragrance compounds so ubiquitous in modern times initiate vicious cycles of 'exposure – pathologies – drugs', which must be understood, information disseminated and terminated. Based on the review work and hypotheses, it can be stated that perfumes and other fragrance compounds in day-to-day consumer products are 'slow killers with fatal punch'.

"Growing recognition of the widespread use of fragrances in modern society is alarming. These pleasant-seeming deleterious compounds are the causal factors of a wide array of **immuneneural**- **hormonal health issues**. **Allergy**, **irritation**, **migraine**, **asthma**, **depression**, **high blood pressure**, **diabetes** and other

symptoms should not be trivialized. Unheeded, and continued, the fragrance compounds can lead to **gynaecomastia**, **cancers**, **gender manipulation**, **teratogenicity**."

"**Creating public awareness is essential to avoid grave health consequences**. Toxicology research on perfumes must be prioritized, just like other urgent topics like 'antibiotics-drug resistance' and 'pesticide-food safety'. This review 'though barely scratches the surface' of the enormous health threats of 'synthetic fragrances' is expected to evoke alertness."
[Note: Gynaecomastia is enlarged male breast tissue**]**

32. *Multicomponent analytical methodology to control phthalates, synthetic musks, fragrance allergens and preservatives in perfumes*

Sanchez-Prado L, Llompart M, Lamas JP, Garcia-Jares C, Lores M. Multicomponent analytical methodology to control phthalates, synthetic musks, fragrance allergens and preservatives in perfumes. Talanta. 2011 Jul 15;85(1):370-9. doi: 10.1016/j.talanta.2011.03.079. Epub 2011 Apr 5. PMID: 21645712.
Article Link: https://pubmed.ncbi.nlm.nih.gov/21645712/

"The average number of **fragrance allergens** is twelve per sample; their presence must be indicated in the list of ingredients when its concentration exceeds the 0.001%, but values higher than 1% have been found in some samples. Preservatives data show that **parabens**, although ubiquitous in other cosmetic products, are not widely used in perfumery. In contrast, the presence of **BHT (butylated hydroxytoluene)** is indeed widespread."

"The degree of compliance with the European Regulation on the labelling has been evaluated in a subset of samples, and **only about the 38% of the perfumes were properly labelled for the allergens tested."**

33. *Health risks of chemicals in consumer products: A review*

Li D, Suh S. Health risks of chemicals in consumer products: A review. Environ Int. 2019 Feb;123:580-587. doi: 10.1016/j.envint.2018.12.033. Epub 2019 Jan 7. PMID: 30622082.
Article Link: https://pubmed.ncbi.nlm.nih.gov/30622082/ - Full Text

"It should also be noted that some chemicals have multiple functional uses, while we chose the most dominant functional use for each chemical. An example is the grouping of **phthalates**. Despite categorized as plasticizer together in this review, several phthalates such as **diethyl phthalate and dimethyl phthalate are used as solvents in personal care products and cosmetics as carriers of fragrance** (Schettler, 2006)."

"…we found that the volume of the peer-reviewed literature that addresses human health risks of the chemicals in consumer products did grow over the last two decades, while its growth could by no means match the speed of increasing volume and diversity of the chemicals produced and used in consumer products by the society. This **growing gap between increasing reliance on chemicals in consumer products and our knowledge on their human health risks raises a potential public health concern**, given the pervasive nature of today's mass production and consumption practice."

34. *Laundry detergents and detergent residue after rinsing directly disrupt tight junction barrier integrity in human bronchial epithelial cells*

Wang M, Tan G, Eljaszewicz A, Meng Y, Wawrzyniak P, Acharya S, Altunbulakli C, Westermann P, Dreher A, Yan L, Wang C, Akdis M, Zhang L, Nadeau KC, Akdis CA. Laundry detergents and detergent residue after rinsing directly disrupt tight junction barrier integrity in human bronchial epithelial cells. J Allergy Clin Immunol. 2019 May;143(5):1892-1903. doi: 10.1016/j.jaci.2018.11.016. Epub 2018 Nov 27. PMID: 30500342.

Article Link: https://pubmed.ncbi.nlm.nih.gov/30500342/ - PDF

"It is well documented that increased exposure to multiple environmental factors, such as air pollutants, tobacco smoke, **allergens in the air, fragrances**, and preservatives, contribute to the development and exacerbation of asthma and other allergies.… The popularizing of synthetic laundry detergents coincided with the uprising of allergic diseases over the past few decades."

"Laundry detergents contain numerous ingredients that might be irritants (surfactants and bleaches) or sensitizers (**fragrances** and enzymes) and can cause asthma and other allergic diseases."

"Airway epithelial cells form a surface barrier against inhaled environmental insults. Increasing evidence indicates that defective epithelial barrier function is associated with asthma….

"Our data demonstrated that **both laundry detergents and detergent residue after rinsing showed high cytotoxicity and directly impaired barrier integrity of bronchial epithelial cells."**

"Fragrance can also cause exacerbations of symptoms and airway obstruction in asthmatic patients."
"Considering the high concentration and large amount of detergent residue in clothing and the close contact with human organs, the irritative and sensitized ingredients of **laundry detergents** can be easily **inhaled** into the airways and reach the lung from newly washed clothing."

"It must be noted that contents of **household detergents, carpet cleaners, dishwashers, and laundry detergents** are quite similar, indicating extensive exposure to detergents. Therefore the problem of long-term high exposure to detergent in daily life should receive attention for public health. "

"Epigenetic mechanisms are thought to play a role in different complex diseases of the lungs, such as **asthma** and **COPD**, which are strongly influenced by environmental factors, such as cigarette smoke. Although we showed a negligible effect of laundry detergents on chromatin accessibility and DNA methylation in HBECs, these data helped us reach the conclusion that **laundry detergents directly attack barrier integrity**, without affecting the epigenome in short-term exposure. However, we cannot rule out the possibility that a longer time period and more chronic daily exposure to detergent could influence **DNA methylation**. In line with this concept, one recent study demonstrated that exposure of HBECs to diesel exhaust had minimal effects on DNA methylation at 48 hours; however, when the same lung was exposed to diesel exhaust but separated by 4 weeks, significant changes in DNA methylation were observed."

35. *The associations between personal care products use and urinary concentrations of phthalates, parabens, and triclosan in various age groups: The Korean National Environmental Health Survey Cycle 3 2015-2017*

Lim S. The associations between personal care products use and urinary concentrations of phthalates, parabens, and triclosan in various age groups: The Korean National Environmental Health Survey Cycle 3 2015-2017. Sci Total Environ. 2020 Nov 10;742:140640. doi: 10.1016/j.scitotenv.2020.140640. Epub 2020 Jul 2. PMID: 32721747.

Article Link: https://pubmed.ncbi.nlm.nih.gov/32721747/ - PDF

"**Phthalates** and parabens are ubiquitous chemicals of public concern… Furthermore, the use of **fragrance products**, makeup, and **air fresheners** significantly increased the exposure risk to EtP in **preschoolers**."

"Furthermore, the exposure levels of many **phthalates**, parabens, and TCS are higher in children than adults(NIER, 2018; Wang et al., 2019) and **children are a susceptible population to these chemicals**. In the case of parabens, the estimated **dermal absorption** amount of parabens related with PCPs use in **infants** and **toddlers** was several times higher than that in adult women(Guo and Kennan, 2013)."

"Exposure to phthalates and parabens is an important public concern, especially with respect to the **potential endocrine disrupting effects of phthalates** (DEHP, DBP, and BBP) (European Commission, 2000) and the anti-androgenic effect of parabens (Orton et al., 2014). Additionally, **exposure to phthalates in the prenatal period was associated with asthma** (Berger et al., 2020) and **psychomotor development** (Qian et al., 2019)in children and was related to **allergic symptoms**, **sensitization (**Hoppin et al., 2013), **preterm birth**(Ferguson et al., 2019) and **type 2 diabetes** in adults (Sun et al., 2014)."

"This study showed the associations between PCPs use and urinary concentrations of phthalates, parabens, and TCS in various age groups in a nationally representative population in Korea. The exposure risks to these chemicals were different according to the patterns of PCPs use by age groups and gender. Female participants used all categories of PCPs more frequently than male participants in adolescents and adults, with statistical significance."

[Note: Endocrine Disrupting Chemicals (EDC's) are commonly used in perfumes and fragranced products as preservatives or fragrance. What are EDC's and how can they affect us?**]**
[Note: Phthalates are synthetic odorless plasticizers used as solvents, binders or fixatives in many fragrances. Why are phthalates in the news? Phthalates are considered Endocrine Disrupting Chemicals.
On the California Safe Cosmetics Program Product Database: DEP, DIDP, and DBP are reported as fragrance while DEHP and DBP are perfume solvents. IFRA lists DEP and DMP, as "reported fragrance ingredients".**]**

36. *[Occupational asthma caused by scented gravel in cat litter boxes]*

Jensen OC, Petersen I. Erhvervsasthma fremkaldt af duftstoffer i kattegrus [Occupational asthma caused by scented gravel in cat litter boxes]. Ugeskr Laeger. 1991 Mar 25;153(13):939-40. Danish. PMID: 2024303.
Article Link: https://pubmed.ncbi.nlm.nih.gov/2024303/

"Perfumes are now added to articles in everyday use to an increasing extent. One example of this is addition of **perfume** to gravel (kitty litter) in cat toilets. **It is recognized that perfumes may cause toxic and allergic skin reactions while perfume as the cause of asthma is not so well recognized.** In the case described here, exposure to industrial perfume resulted in asthma on account of irritation. "

37. *Airborne contact dermatitis to drugs*

Minciullo PL, Imbesi S, Tigano V, Gangemi S. Airborne contact dermatitis to drugs. Allergol Immunopathol (Madr). 2013 Mar-Apr;41(2):121-6. doi: 10.1016/j.aller.2012.01.004. Epub 2012 Mar 24. PMID: 22445186.
Article Link: https://pubmed.ncbi.nlm.nih.gov/22445186/ - PDF

"Airborne agents consist of volatile substances, droplets of the causative agent, and solid particles originated from powdery dust of various materials."

“Airborne reactions involve exposed areas, such as the face, the neck, the hands, wrists, underarms; however, reactions on non-exposed areas (by particles trapped under clothing) have been also reported. Generalised reactions may occur due to inhalation or transcutaneous absorption.”

“Airborne causes are still greatly underestimated because reports in the literature often omit this term when dust or volatile substances are responsible for skin reactions.“

[Note: Airborne Contact Dermatitis happens with fragrance chemicals as well. ie: air fresheners, fragranced laundry products, deodorant, dish soap, floor cleaners and scented hand sanitizers. Anyone with contact allergies cannot avoid the air, please go Fragrance Free with all products especially in healthcare, dental, schools, or any public space.**]**

38. *Contact Dermatitis to Medications and Skin Products*

Nguyen HL, Yiannias JA. Contact Dermatitis to Medications and Skin Products. Clin Rev Allergy Immunol. 2019 Feb;56(1):41-59. doi: 10.1007/s12016-018-8705-0. PMID: 30145645.
Article Link: https://pubmed.ncbi.nlm.nih.gov/30145645/

“Today, consumer products, such as soaps, moisturizing creams, cosmetics, household cleaners, fragrances, **topical medication**, and others, contain a myriad of ingredients that can **cause skin allergy.** When these products contact the skin, they can produce **eczematous pruritic reactions** known as contact dermatitis…”
“…the prevalence of contact dermatitis has been increasing worldwide for the past few decades.”

“**Fragrance mix I**, **fragrance mix II**, and **Myroxylon pereirae resin (Balsam of Peru)** are in the **top 11 allergens** of the NACDG 2013–2014…”

“**Fragrance mix I** contains eight allergens:
cinnamic alcohol, cinnamic aldehyde, α-amylcinnamal aldehyde, eugenol, isoeugenol, hydroxycitronellal, geraniol, and oakmoss absolute…”

“…**fragrance mix II** was introduced with six more compounds:
hydroxyisohexyl-3-Cyclohexene- carboxaldehyde (HICC), citral, farnesol, coumarin, citronellol, and α-hexylcinnamal …”

[Note: also see, **Airborne Contact Dermatitis**, these reactions are happening to people when fragrance chemicals float around and are simply present in the air. For example, someone can react if their caregiver or person next to them uses fragranced laundry products.**]**

39. *Toxic Chemicals Emitted from Air fresheners & Disinfectants*

Geetha Balasubramani, Paul Pradeep, J Nisitha S. Toxic Chemicals Emitted from Air fresheners & Disinfectants. IJRASET. Volume 10 Issue X Oct 2022, Pgs 1338-1345. ISSN : 2321-9653 *IJRASET47180*
Article Link:
https://www.ijraset.com/research-paper/toxic-chemicals-emitted-from-air-fresheners-and-disinfectants - PDF

(Note: This graphic is from preceding article**)**

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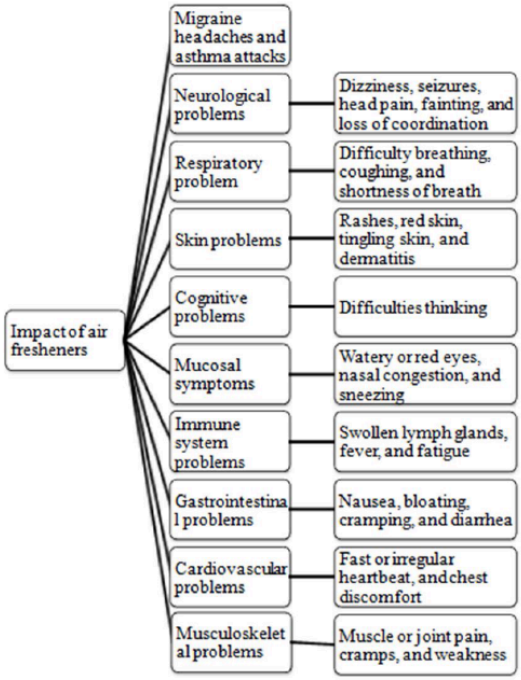


Figure 2: The diagram above illustrates the classification of illnesses brought on by exposure to air fresheners.

40. *Airborne contact dermatitis - current perspectives in etiopathogenesis and management*

Handa S, De D, Mahajan R. Airborne contact dermatitis - current perspectives in etiopathogenesis and management. Indian J Dermatol. 2011 Nov;56(6):700-6. doi: 10.4103/0019-5154.91832. PMID: 22345774; PMCID: PMC3276900.

Article Link: https://pubmed.ncbi.nlm.nih.gov/22345774/ - Full Text

“Airborne contact dermatitis (ABCD) is a morphological diagnosis that encompasses all acute or chronic dermatoses predominantly of exposed parts of body, which are caused by substances which when released into the air, settle on the exposed skin.”

“In airborne allergic dermatitis, initially there is a refractory phase where there is a periodic or continuous contact with allergen but no response. This is followed by an induction phase where the hapten penetrates skin, conjugates with epidermal protein, comes in contact with antigen presenting cells, migrates to draining lymph nodes followed by stimulation of naive T cells. This leads to proliferation of activated T cells to produce effector and memory cells which then enter the circulation. Re-exposure to the specific hapten leads to the release of mediators producing skin inflammation. A persistent inflammation is produced due to continued presence of effector cells.”

“The common allergens … include various acids and alkalis, metals and powders of metallic salts, cement, industrial solvents, glass fibers, sewage sludge, ammonia, vegetable and wood allergens, plastics, rubbers and glues, insecticides, **pesticides**, animal feed additives and many others. The airborne contactants can also be classified on the basis of their physical state as **volatile airborne contactants** like acids, alkalis, ammonia and pesticides; droplets like insecticides, **perfumes** and **hair sprays**; powders which include aluminum, anhydrous calcium silicate, and metallic oxides; and particles like tree sawing particles, wool and plastics.”

“Dooms-Goossens classified airborne dermatitis into five different types, namely, airborne irritant contact dermatitis, airborne allergic contact dermatitis, airborne phototoxic reactions, airborne photoallergic reactions and airborne contact urticaria.[33] Rare presentations include **acne like**, **lichenoid eruptions**, fixed drug eruptions, **exfoliative dermatitis**, **telengiectases**, **paresthesias**, **purpura**, e**rythema multiforme** like eruption, pellagra like dermatitis and **lymphomatoid CD**. Some agents cause more than one type of reaction. P. hysterophorus can produce allergic CD, photocontact dermatitis and a lichenoid eruption. Similarly, **formaldehyde** and phosphorus sesquisulfide can lead to an **airborne irritant** or **allergic CD** and **contact urticaria**.”

“In the classical airborne allergic contact dermatitis, there is involvement of exposed areas of face, “V” of neck, hands and forearms, “Wilkinson's triangle,” both eyelids, nasolabial folds and under the chin. The involvement of both light-exposed and protected areas helps to differentiate ABCD from a photo-related dermatitis. Another close differential is atopic eczema as both ABCD and atopic eczema have predominant flexural and skin crease involvement. Initially, there is an acute flare of the dermatitis during the plant growing season but, with repeated exposure, the flare becomes prolonged and produces a chronic lichenified eczema associated with secondary infection, fissuring and **hypo or hyperpigmentation**…. Some patients present with **facial swelling** before manifesting classical eczematous lesions.“

41. *Fragrance allergic contact dermatitis*

Cheng J, Zug KA. Fragrance allergic contact dermatitis. Dermatitis. 2014 Sep-Oct;25(5):232-45. Doi: 10.1097/DER.0000000000000067. PMID: 25207685.
Article Link: https://pubmed.ncbi.nlm.nih.gov/25207685/

“Growing recognition of the widespread use of fragrances in modern society has fueled attempts to prevent sensitization through improved allergen identification, labeling, and consumer education. This review provides an overview and update on **fragrance allergy.** Fragrance materials are used as flavoring agents in oral hygiene products, foods, and drinks. In industrial products, they are found in paints, rubber, plastics, insecticides, and herbicides; in the household, in paper products, fabric and clothes, sunscreens, as well as topical medicaments.”

“Within its more commonly known realm of use in cosmetics and toiletries, fragrances are present in lip balms, lipsticks, deodorants, lotions, creams, wet wipes, and a variety of baby products. **Nearly everyone is exposed to fragrances and mostly on a daily basis.** Not surprisingly fragrances are the most common cause of **allergic contact dermatitis** (ACD) from cosmetic products and are the second most common cause of positive patch test results after nickel.”

42. *Fragranced consumer products: effects on autistic adults in the United States, Australia, and United Kingdom*

Steinemann A. Fragranced consumer products: effects on autistic adults in the United States, Australia, and United Kingdom. Air Qual Atmos Health. 2018;11(10):1137-1142. doi: 10.1007/s11869-018-0625-x. Epub 2018 Sep 25. PMID: 30546500; PMCID: PMC6244938
Article Link: https://pubmed.ncbi.nlm.nih.gov/30546500/ - PDF

“Fragranced consumer products are ubiquitous in society and emit numerous volatile organic compounds including hazardous air pollutants.”

“Health effects were categorized as follows:
(a) migraine headaches;
(b) asthma attacks;
(c) neurological problems (e.g., dizziness, seizures, head pain, fainting, loss of coordination);
(d) respiratory problems (e.g., difficulty breathing, coughing, shortness of breath);
(e) skin problems (e.g., rashes, hives, red skin, tingling skin, dermatitis);
(f) cognitive problems (e.g., difficulties thinking, concentrating, or remembering);
(g) mucosal symptoms (e.g., watery or red eyes, nasal congestion, sneezing);
(h) immune system problems (e.g., swollen lymph glands, fever, fatigue);
(i) gastrointestinal problems (e.g., nausea, bloating, cramping, diarrhea);
(j) cardiovascular problems (e.g., fast or irregular heartbeat, jitteriness, chest discomfort);
(k) musculoskeletal problems (e.g., muscle or joint pain, cramps, weakness); and
(l) other.”

“Specific problematic exposures, associated with adverse health effects for autistic adults, include but are not limited to the following: …air fresheners and deodorizers (62.9%), the scent of laundry products coming from a dryer vent (57.5%), being in a room recently cleaned with scented products (65.9%), **being near someone wearing a fragranced product** (60.5%), and other types of fragranced consumer products (64.3%)… Among autistic adults reporting health effects, 74.1% across the three countries (85.4% US, 82.4% AU, 54.5% UK) report that the severity of these health effects from fragranced products was potentially disabling. Among non-autistic adults, the prevalence of potentially disabling effects was 25.4%.”

“...62.1% of autistic adults are unable or reluctant to use the restrooms in a public place if it has an air freshener, deodorizer, or scented product; 59.8% are unable or reluctant to wash their hands with soap in a public place if the soap is fragranced; 58.7% enter a business and then want to leave as quickly as possible if they smell air fresheners or a fragranced product; and **66.7% have been prevented from going someplace because they would be exposed to a fragranced product that would make them sick…”**

“Involuntary exposure is a concern. Autistic individuals are prevented from accessing public restrooms, societal venues, businesses, and workplaces due to adverse health effects from fragranced products. Further, 59.4% of autistic adults have lost workdays, in the past year, due to fragranced product exposure in the workplace. **A strong majority of autistic as well as non-autistic adults would prefer that workplaces, health care facilities, and health care professionals were fragrance-free than fragranced.**”

43. Ten questions concerning air fresheners and indoor built environments

Anne Steinemann, Ten questions concerning air fresheners and indoor built environments, Building and Environment, Volume 111, 2017, Pages 279-284, ISSN 0360-1323, https://doi.org/10.1016/j.buildenv.2016.11.009.
Article Link: https://www.sciencedirect.com/science/article/pii/S0360132316304334?via%3Dihub - PDF

“This article investigates the seeming paradox that **products designed to improve the indoor environment can pose unintended and unknown risks.** It examines the science, health, and policy perspectives, and provides recommendations and research directions.”

“Air fresheners can contribute to indoor hazardous air pollutants, both through direct emissions and secondary reaction products… Within buildings and other indoor environments, the use of air fresheners has a strong

association with high indoor levels of **terpenes, benzene, toluene**, ethyl-benzene, m,p-xylene, and **total volatile organic compounds**…"

"Air fresheners can contribute to human exposure to primary and secondary air pollutants… Air freshener exposures, **even at low levels**, have been associated with a range of adverse health effects, which include **migraine headaches, asthma attacks, breathing difficulties, respiratory difficulties, mucosal symptoms, dermatitis, infant diarrhea and earache, neurological problems, and ventricular fibrillation**..."
"In addition to population based studies, specific air freshener chemicals (VOCs such as acetaldehyde, SVOCs such as phthalates, and ultrafine particles) emitted from air fresheners have been associated with adverse effects to the **neurological, cardiovascular, respiratory, reproductive, immune, and endocrine systems, and with cancer**. For instance, acetaldehyde, which can be both a primary and secondary emission from air fresheners, is associated with both **acute and chronic hazards to the respiratory system**, and classified as a carcinogenic hazardous air pollutant in the US…"

44. *Allergic contact dermatitis from fragrance components in specific topical pharmaceutical products in Belgium*

Nardelli A, D'Hooghe E, Drieghe J, Dooms M, Goossens A. Allergic contact dermatitis from fragrance components in specific topical pharmaceutical products in Belgium. Contact Dermatitis. 2009 Jun;60(6):303-13. doi: 10.1111/j.1600-0536.2009.01542.x. PMID: 19489964.
Article Link: https://pubmed.ncbi.nlm.nih.gov/19489964/

"Three hundred and seventy (10%) of 3280 of the topical pharmaceutical products were found to contain a total of 66 fragrance substances. Among 3378 patients suffering from iatrogenic allergic contact dermatitis, 127 were found to react to 48 specific products, for which 38 different fragrance substances gave relevant positive reactions. Women were more affected than men, and legs, hands, and face were the most commonly affected body sites."

"**Fragrances**, the presence of which is in most cases **unnecessary**, do contribute to iatrogenic allergic contact dermatitis. Moreover, **sensitized patients have difficulties in avoiding their specific allergens because standardized labelling of the ingredients in pharmaceutical products is lacking**."

[Note: In the EU, 26 known fragrance allergens have been a labeling requirement since 2009, but as of 2022 the EU is planning to add 56 more fragrance allergens.**]**

[Note: IN THE U.S. NEWS - On Dec. 29, 2022, the MOCRA - (Modernization of Cosmetic Regulation Act) was signed into law. In a few years, the U.S. should start listing fragrance allergens in cosmetics, but this Act may tie the hands of states' ability to make a law pertaining to disclosing the over 3,000 other potentially concerning fragrance ingredients (like California did).
To learn more, see what **Women's Voices for the Earth (WVE)** have figured out.
To read the Act, go to congress.gov link/PDF (page 1396).
What to know:
Which products qualify as 'cosmetics' and Who regulates what??
Items such as fragranced laundry products, air fresheners, carpet fragrance, fragrance in cleaning products or car / car wash fragrances are not considered cosmetics, therefore, it is safe to say that companies who sell these products will not be obligated to list the known fragrance allergens in their products.**]**

45. *Baby-Wipe Dermatitis: Preservative-Induced Hand Eczema in Parents and Persons Using Moist Towelettes*

Guin JD, Kincannon J, Church FL. Baby-wipe dermatitis: preservative-induced hand eczema in parents and persons using moist towelettes. Am J Contact Dermat. 2001 Dec;12(4):189-92. doi: 10.1053/ajcd.2001.28052. PMID: 11753890.
Article Link: https://pubmed.ncbi.nlm.nih.gov/11753890/

"Results: A total of 6 women and 3 men with **hand eczema** were found to be allergic to (preservatives found in) different brands of moist towelettes used in diaper hygiene. Many were **allergic to fragrance materials** as well."

"Hand eczema in a grip-like pattern is good reason to inquire about baby wipes as a possible source, as most patients do not recognize that source even after undergoing patch tests."

46. *Skin safety and health prevention: an overview of chemicals in cosmetic products*

Panico A, Serio F, Bagordo F, Grassi T, Idolo A, DE Giorgi M, Guido M, Congedo M, DE Donno A. Skin safety and health prevention: an overview of chemicals in cosmetic products. J Prev Med Hyg. 2019 Mar 29;60(1):E50-E57. doi: 10.15167/2421-4248/jpmh2019.60.1.1080. PMID: 31041411; PMCID: PMC6477564.
Article Link:https://pubmed.ncbi.nlm.nih.gov/31041411/

"Cosmetic products contain a wide range of chemicals to which we are exposed everyday."
"Fragrances were present in 52.3% of the examined products, mostly **limonene** (76.9%) and **linalool** (64.6%) but also **citronellol** (34.1%), **geraniol** (31.5%), **coumarin** (30%) and **hexyl cinnamal** (29.2%)."
"…**substances may induce several acute adverse side-effects, i.e. contact dermatitis and allergic reactions.** For these reasons, an enhancement of the criteria used for cosmetics formulation is required since many chemicals used singularly or combined are potentially unsafe."

47. *Environmental factors and allergic diseases*

Jenerowicz D, Silny W, Dańczak-Pazdrowska A, Polańska A, Osmola-Mańkowska A, Olek-Hrab K. Environmental factors and allergic diseases. Ann Agric Environ Med. 2012;19(3):475-81. PMID: 23020042.
Article Link: https://pubmed.ncbi.nlm.nih.gov/23020042/ - PDF

"It has been estimated, that over 85 000 chemicals are recognized in the human environment and they may act as contact allergens or irritants, causing allergic or non-allergic contact dermatitis. Among them metals, **fragrances**, preservatives, botanicals and paraphenylenediamine are considered as the most significant."
"According to data from North America and Western Europe, 12.5%-40.6% of the population are diagnosed as allergic to at least one chemical."

"Cosmetics, fragrances, and botanicals are also important causes of both **irritant** and **allergic contact dermatitis**… Fragrances are important sources of **allergic contact dermatitis**. Fragrances are found in various types of cosmetics – most traditionally in perfume or cologne form. Fragrances, including fragrance mix, balsam of Peru, and cinnamic aldehyde, are the most commonly identified **allergens** in **cosmetic-induced contact hypersensitivity reactions**."

48. *Exposing covert fragrance chemicals*

Scheinman PL. Exposing covert fragrance chemicals. Am J Contact Dermat. 2001 Dec;12(4):225-8. doi: 10.1053/ajcd.2001.28697. PMID: 11753900.

Article Link: https://pubmed.ncbi.nlm.nih.gov/11753900/

"**Fragrance is the most common cosmetic allergen found when dermatitis patients are patch tested** in the United States and in many places worldwide. Fragrances are ubiquitous in our daily lives and are present in items ranging from toiletries to toilet tissue. Although fragrances enhance the smell or mask unpleasant odors of various cosmetics and household items, it becomes very difficult for fragrance-allergic patients to find products they can use. Many items labeled unscented and fragrance-free contain esoteric fragrance chemicals that most consumers would not recognize. This article details some covert fragrance agents to help physicians better educate their fragrance-sensitive patients."

49. ALSO SEE SECTIONS: Airborne Contact Dermatitis, Asthma, Inflammation, Respiratory/Pulmonary

Back to top of Allergies **Back to Table of Contents**

Website: https://www.fragrancefreecoalitionusa.com/

DISCLAIMER:
Poster and Document are for reference and educational purposes only.

ASTHMA

Bronchoconstriction, Asthma-like Symptoms, Wheezing, Shortness of Breath
Also see: Airborne Contact Dermatitis

The following websites show proactive ways to reduce Asthma triggers in your home, school or work.
EPA: ***Care for Your Air: A Guide to Indoor Air Quality***
State of Rhode Island, Dept of Health: ***Reducing Asthma Triggers at Home*****.**

1. *Effects of indoor environment and lifestyle on respiratory health of children in Chongqing, China*

Li W, Liu Q, Chen Y, Yang B, Huang X, Li Y, Zhang JJ. Effects of indoor environment and lifestyle on respiratory health of children in Chongqing, China. J Thorac Dis. 2020 Oct;12(10):6327-6341. doi: 10.21037/jtd.2020.03.102. PMID: 33209472; PMCID: PMC7656398.
Article Link: https://pubmed.ncbi.nlm.nih.gov/33209472/ - PDF

"Frequent use of **air fresheners** is associated with **reduced lung function** in children."

"According to an WHO report, 100 thousand people die of **asthma** every year due to indoor air pollution around the world, of which 35% are children."

"A study conducted in American adults found that 1,4-dichlorobenzene (1,4-DCB) was associated with reduced pulmonary function… 1,4-DCB was commonly found in air fresheners, toilet bowl deodorants, and mothballs."

"Air fresheners have also been found to increase lung irritation and toxic effects on mice in acute toxicity experiments on mice. There are numerous types of air fresheners, which traditionally consist of **diethyl ether** and **aromatic flavor ingredients**. Besides, propane, butane, dimethyl ether and other ingredients are added to high-pressure canned products and these ingredients could **impair children's lung function**. **The use of air fresheners does not improve indoor air quality. Instead, it could exacerbate indoor pollution."**

[Note: The chemicals used in fragrance in products, including air fresheners, qualify as 'trade secrets'.**]**

2. *Characterization of air freshener emission: the potential health effect*

Kim S, Hong SH, Bong CK, Cho MH. Characterization of air freshener emission: the potential health effects. J Toxicol Sci. 2015;40(5):535-50. doi: 10.2131/jts.40.535. PMID: 26354370.
Article Link: https://pubmed.ncbi.nlm.nih.gov/26354370/ - PDF

"The use of these products (air fresheners) may be associated with an increase in the measured level of **terpene**, such as **xylene** and other volatile air freshener components, including **aldehydes**, and **esters**. Air freshener is usually used indoors, and thus some compounds emitted from air freshener may have potentially harmful health impacts, including **sensory irritation**, **respiratory symptoms**, and **dysfunction of the lungs**."

"**The constituents of air fresheners can react with ozone to produce secondary pollutants such as formaldehyde, secondary organic aerosol (SOA), oxidative product, and ultrafine particles.** These pollutants then adversely affect human health, in many ways such as **damage to the central nervous**

system, alteration of hormone levels, etc. In particular, the ultrafine particles may induce **severe adverse effects on diverse organs**, including the **pulmonary and cardiovascular systems."**

"This review suggests that exposure to air freshener compounds, such as **VOCs that react with ozone to form secondary pollutants**, cause diverse health issues. In addition, **several key compounds such as benzene, terpenes, and phthalate etc. of air pollutants are related to air freshener use**. **We suggest that the use of air fresheners should be avoided**, and there is a need to reduce chemical components which are potentially reactive with ozone in air fresheners."

[Note: Fragrance is considered the new 'second hand smoke', **"**The parallels between second-hand smoke and synthetic fragrance use are many. At its core, both are battles over indoor air quality **"** - quote and link from De Vader, Christy L. & Barker, Paxson.
Chemicals that cigarettes/cigarette smoke and fragranced products can have in common are: Acetone, Formaldehyde, Benzene, acetaldehyde, terpenoids and phenols.**]**

3. *Measurement of endocrine disrupting and asthma-associated chemicals in hair products used by Black women*

Helm JS, Nishioka M, Brody JG, Rudel RA, Dodson RE. Measurement of endocrine disrupting and asthma-associated chemicals in hair products used by Black women. Environ Res. 2018 Aug;165:448-458. doi: 10.1016/j.envres.2018.03.030. Epub 2018 Apr 25. PMID: 29705122.
Article Link: https://pubmed.ncbi.nlm.nih.gov/29705122/

"The **hair products tested contained 45 endocrine disrupting or asthma-associated chemicals,** including every targeted chemical class. We found cyclosiloxanes, parabens, and the fragrance marker **diethyl phthalate (DEP)** at the highest levels, and **DEP** most frequently. Root stimulators, hair lotions, and relaxers frequently contained nonylphenols, parabens, and **fragrances**; anti-frizz products contained cyclosiloxanes. **Hair relaxers for children contained five chemicals regulated by California's Proposition 65 or prohibited by EU cosmetics regulation. Targeted chemicals were generally not listed on the product label."**

"The **fragrance** chemicals **linalool, limonene, and 1,3,4,6,7,8-hexahydro-4, 6,6,7,8, 8-hexamethylcyclopenta[g]-2-benzopyran (HHCB, or Galaxolide)** were also found at higher detection frequencies and concentrations compared to other target chemicals. Root stimulators, hair lotions, and relaxers frequently contained nonylphenols, parabens, and **fragrance chemicals** whereas anti-frizz products contained cyclosiloxanes. **We did not find strong agreement between detected and labeled chemicals,** although chemicals detected at higher concentrations were labeled more often."

"**All products contained at least one of the 19 targeted fragrance chemicals, and most had multiple fragrances**, with several root stimulators containing over half of the fragrances targeted. **Linalool**, **limonene**, and **HHCB (or Galaxolide)** were the most common (found in about **40% of products**). We found **limonene at the highest concentration among fragrance chemicals (1900 µg/g, or 0.19% by weight)**, and **limonene**, **linalool**, **phenethyl alcohol**, and **terpineol** were frequently detected at **> 100 µg/g in multiple products**."

4. *Inhalation challenge effects of perfume scent strips in patients with asthma*

Kumar P, Caradonna-Graham VM, Gupta S, Cai X, Rao PN, Thompson J. Inhalation challenge effects of perfume scent strips in patients with asthma. Ann Allergy Asthma Immunol. 1995 Nov;75(5):429-33. PMID: 7583865.
Article Link: https://pubmed.ncbi.nlm.nih.gov/7583865/

"This study was undertaken to determine whether perfume inhalation from magazine scent strips could exacerbate **asthma**."

"**Perfume-scented strips in magazines can cause exacerbations of symptoms and airway obstruction in asthmatic patients**. **Severe and atopic asthma increases risk of adverse respiratory reactions to perfumes**."

5. *Symptom-trigger factors other than allergens in asthma and allergy*

Claeson AS, Palmquist E, Lind N, Nordin S. Symptom-trigger factors other than allergens in asthma and allergy. Int J Environ Health Res. 2016 Aug;26(4):448-57. doi: 10.1080/09603123.2015.1135314. Epub 2016 Jan 20. PubMed PMID: 26788835.
Article Link: https://pubmed.ncbi.nlm.nih.gov/26788835/

"Data from a population-based study, the Västerbotten Environmental Health Study, were used to compare persons with **asthma**, **allergic rhinitis**, **allergic dermatitis**, multiple diagnoses of asthma/allergy and no asthma or allergy. Persons with asthma and multiple diagnoses reported odorous/pungent and building-related environmental factors to trigger symptoms to a larger extent than did the reference group, mainly due to **perfume** and odors from flowers. They also **reported behavioral disruptions and affective reactions to odorous/pungent environments**. These findings increase the understanding of the role of odorants in symptom development and thereby the prevention of health problems in asthma and allergy in indoor air."

"Environmental exposures of particular interest for indoor air quality, such as exposure to odorants, have also been referred to as triggers of asthma and allergy, although the exposure in some cases may result in allergic symptoms without clinical signs (e.g. **bronchoconstriction**). For example, a condition with **asthma-like overreaction** in the lower airways, called **sensory hyperreactivity**, has been identified in which patients display normal pulmonary function and negative allergy tests, and is **typically not treated by their ordinated asthma medication** (Millqvist et al. 1998). **The symptoms in these patients are often induced by non-specific trigger factors, such as perfumes**."

6. *Cleaning Agents and Asthma*

Quirce S, Barranco P. Cleaning agents and asthma. J Investig Allergol Clin Immunol. 2010;20(7):542-50; quiz 2p following 550. PMID: 21313993.
Article Link: https://pubmed.ncbi.nlm.nih.gov/21313993/ - PDF

"Perfumes and scents are components common of many cleaning products. **Pine scent** containing **terpenes can** act as a **sensitizer**, as can **limonene**, **eugenol**, and **other fragrances**. The main sensitizers contained in cleaning products are **disinfectants**, quaternary ammonium compounds (such as benzalkonium chloride), amine compounds, and fragrances…. Exposure to the ingredients of cleaning products may give rise to both **new-onset asthma**, with or without a latency period, and **work exacerbated asthma**. High-level exposure to irritants may induce reactive airways dysfunction syndrome."

"Terpenes can cause secondary emissions due to reactions of the primary exposures with oxidizers present in indoor air. These reactions can **release secondary ultrafine particles** that may be responsible for **respiratory irritation** symptoms."

"Exposure to different cleaning compounds, including **fragrances**, has been reported to **cause asthma-like symptoms** with no significant changes in lung function. High-level **respiratory irritant exposures** can **induce new onset of asthma** with no latency period, namely, **reactive airways dysfunction syndrome.**"

"Most of the cleaning agents associated with asthma like symptoms have harmful irritative and/or sensitizing properties and may be involved in the development of chronic respiratory symptoms.
Sensitizers
• Amine compounds (eg, monoethanolamine)
• Disinfectants (eg, **aldehydes**)
• Quaternary ammonium compounds (eg, benzalkonium chloride)
• Scents containing terpenes (eg, pinene, d-limonene), eugenol
• Isothiazolinones, **formaldehyde** (preservatives)
• Others: natural rubber latex "
"The main chemical classes of disinfectants are alcohols (eg, ethanol, isopropanol), **aldehydes** (glutaraldehyde, orthophthalaldehyde), oxidizers (eg, sodium hypochlorite, H2O2), phenolics (phenol, thymol, o-phenylphenol), and quaternary ammonium compounds. **Disinfectants have been identified as the most hazardous group of cleaning agents."**
[Note: Fragrance does not clean or disinfect, yet many many products are fragranced.**]**

7. *Fragranced consumer products: effects on asthmatic Australians*

Steinemann A, Wheeler AJ, Larcombe A. Fragranced consumer products: effects on asthmatic Australians. Air Qual Atmos Health. 2018;11(4):365-371. doi: 10.1007/s11869-018-0560-x. Epub 2018 Mar 17. PMID: 29780436; PMCID: PMC5954056.
Article Link: https://pubmed.ncbi.nlm.nih.gov/29780436/ - PDF

"Exposure to fragranced consumer products is associated with adverse health effects such as **asthma attacks, breathing difficulties, and migraine headaches….** Nationally, 55.6% of asthmatics, and 23.9% of non-asthmatics, report adverse health effects after exposure to fragranced products."

"Overall, the majority of asthmatics and non-asthmatics were unaware of **potentially hazardous chemicals emitted from fragranced products**, even ones called green or organic, and would not continue to use a fragranced product if they knew it emitted these pollutants…. Most asthmatics (67.1%) and non-asthmatics (69.2%) were not aware that **fragrance chemicals do not need to be fully disclosed** on the product label or material safety data sheet."

"A majority of asthmatics (62.6%) and non-asthmatics (55.8%) **would prefer an airplane without scented air pumped through the passenger cabin…** Nearly half of both asthmatics (50.2%) and non-asthmatics (40.4%) **would prefer that healthcare facilities and healthcare professionals were fragrance-free."**
"More than half of asthmatics (50.5%) and nearly half of non-asthmatics (39.7%) **would support a fragrance-free policy in the workplace**…**prefer a hotel without scented air"**

"…55.6% of "asthmatics" in our study who report adverse health effects due to fragranced product exposure would represent over 2.2 million adult Australians (ABS 2016). Combining this with the **23.9% of**

“non-asthmatics” (71.5%) who also report adverse health effects would represent over 4.5 million adult Australians affected adversely **by fragranced consumer products.”**

“Results from this study show that **voluntary and involuntary exposure to fragranced products** is widespread in Australian society, that **exposure is associated with a range of potentially serious and adverse health effects,**…In addition to the adverse health consequences, exposure to fragranced products imposes significant **adverse impacts** on workplace productivity and quality of life, **including the ability to access public places such as restrooms.”**

“**A straightforward approach to reduce undesirable effects would be to reduce or avoid use of fragranced products**, **especially in public places that would impose involuntary risks**, and to **implement fragrance-free policies in workplaces, healthcare facilities, and other environments.”**

8. *Laundry detergents and detergent residue after rinsing directly disrupt tight junction barrier integrity in human bronchial epithelial cells*

Wang M, Tan G, Eljaszewicz A, Meng Y, Wawrzyniak P, Acharya S, Altunbulakli C, Westermann P, Dreher A, Yan L, Wang C, Akdis M, Zhang L, Nadeau KC, Akdis CA. Laundry detergents and detergent residue after rinsing directly disrupt tight junction barrier integrity in human bronchial epithelial cells. J Allergy Clin Immunol. 2019 May;143(5):1892-1903. doi: 10.1016/j.jaci.2018.11.016. Epub 2018 Nov 27. PMID: 30500342.

Article Link: https://pubmed.ncbi.nlm.nih.gov/30500342/ - PDF

“It is well documented that increased exposure to multiple environmental factors, such as air pollutants, tobacco smoke, **allergens in the air, fragrances**, and preservatives, contribute to the development and exacerbation of asthma and other allergies.… The popularizing of synthetic laundry detergents coincided with the uprising of allergic diseases over the past few decades.”

“Laundry detergents contain numerous ingredients that might be irritants (surfactants and bleaches) or sensitizers (**fragrances** and enzymes) and can cause asthma and other allergic diseases.”

“Airway epithelial cells form a surface barrier against inhaled environmental insults. Increasing evidence indicates that defective epithelial barrier function is associated with asthma….”

“Our data demonstrated that **both laundry detergents and detergent residue after rinsing showed high cytotoxicity and directly impaired barrier integrity of bronchial epithelial cells.”**

“Fragrance can also cause exacerbations of symptoms and airway obstruction in asthmatic patients.”
“Considering the high concentration and large amount of detergent residue in clothing and the close contact with human organs, the irritative and sensitized ingredients of **laundry detergents** can be easily **inhaled** into the airways and reach the lung from newly washed clothing.”

“It must be noted that contents of **household detergents, carpet cleaners, dishwashers, and laundry detergents** are quite similar, indicating extensive exposure to detergents. Therefore the problem of long-term high exposure to detergent in daily life should receive attention for public health. “

“Epigenetic mechanisms are thought to play a role in different complex diseases of the lungs, such as **asthma** and **COPD**, which are strongly influenced by environmental factors, such as cigarette smoke. Although

we showed a negligible effect of laundry detergents on chromatin accessibility and DNA methylation in HBECs, these data helped us reach the conclusion that **laundry detergents directly attack barrier integrity**, without affecting the epigenome in short-term exposure. However, we cannot rule out the possibility that a longer time period and more chronic daily exposure to detergent could influence **DNA methylation**. In line with this concept, one recent study demonstrated that exposure of HBECs to diesel exhaust had minimal effects on DNA methylation at 48 hours; however, when the same lung was exposed to diesel exhaust but separated by 4 weeks, significant changes in DNA methylation were observed."

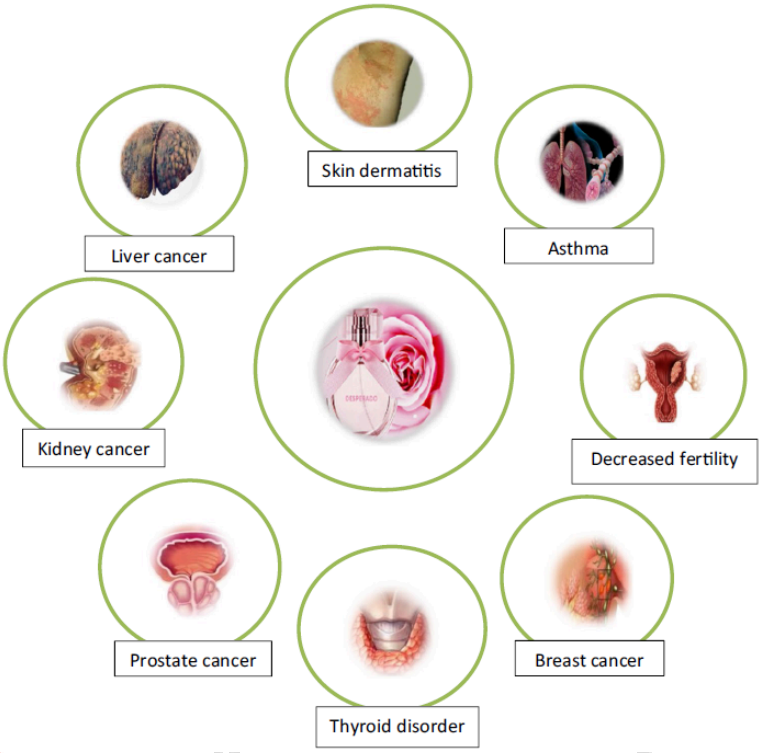
9. *Evaluation of pollutants in perfumes, colognes and health effects on the consumer: a systematic review*

Kazemi Z, Aboutaleb E, Shahsavani A, Kermani M, Kazemi Z. Evaluation of pollutants in perfumes, colognes and health effects on the consumer: a systematic review. J Environ Health Sci Eng. 2022 Feb 3;20(1):589-598. doi: 10.1007/s40201-021-00783-x. PMID: 35669814; PMCID: PMC9163252.

Article Link: https://pubmed.ncbi.nlm.nih.gov/35669814/ - PDF

(Note: Graphic is from preceding article**) (**Creative Commons Attribution 4.0 International license**).**

Fig. 2 Effects of exposure to perfumes and colognes



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"Diethyl phthalate is a chemical used to **make perfumes last longer.** The U.S. Clean Water Act lists it as a **toxic** and priority pollutant."

“Complications of using perfume include **neuropathy (depression, autism), neoplasms (breast cancer, prostate cancer), effects on the liver, migraine headaches, asthma attacks, mucosal symptoms (watery or red eyes, sneezing), neurological problems (dizziness, convulsions, headache, fainting, imbalance), respiratory (cough, shortness of breath), skin (skin rash, urticaria, redness of the skin, skin tingling, dermatitis), immune system (swollen lymph nodes, fever, fatigue), gastrointestinal tract (nausea, bloating, diarrhea)** and c**ardiovascular (rapid** or **irregular heartbeat, tremors, chest discomfort**)”

“**Contaminants in perfumes and colognes** and their health effects on the consumer were systematically reviewed. It was found that the most attention of researchers was to identify the compounds in perfumes and colognes and their concentrations. Among the most common pollutants **phthalates** and their derivatives can be mentioned. Other pollutants included **parabens, triclosan, salicylates, terpenes, aldehydes, benzene, toluene, styrene, and aluminum-based salts**. These pollutants have also been shown to have adverse effects on consumer health such as **asthma and allergies, cardiovascular disease, central nervous system damage, breast cancer, endocrine cancer, respiratory disorders, reproduction, thyroid, adrenal gland function and immune system.”**

[Note: Graphic lists “effects of exposure to perfumes and colognes”: Kidney Cancer, Liver Cancer, Prostate Cancer, Thyroid Disorder, Breast Cancer, Decreased Fertility, Asthma and Skin Dermatitis.**]**

10 *Endocrine Disruptors and Asthma-Associated Chemicals in Consumer Products*

Dodson RE, Nishioka M, Standley LJ, Perovich LJ, Brody JG, Rudel RA. Endocrine disruptors and asthma-associated chemicals in consumer products. Environ Health Perspect. 2012 Jul;120(7):935-43. doi: 10.1289/ehp.1104052. Epub 2012 Mar 8. PMID: 22398195; PMCID: PMC3404651..

Article Link: https://pubmed.ncbi.nlm.nih.gov/22398195/ - PDF

“Laboratory and human studies raise concerns about endocrine disruption and asthma resulting from exposure to chemicals in consumer products… Analytes included parabens, **phthalates**, bisphenol A (BPA), triclosan, ethanolamines, alkylphenols, **fragrances**, glycol ethers, cyclosiloxanes, and ultraviolet (UV) filters.”
“In other products, the highest concentrations and numbers of detects were in fragranced products (e.g., perfume, air fresheners, and **dryer sheets**) and sunscreen.”

“**Some products that did not contain the well-known endocrine-disrupting phthalates contained other less-studied phthalates** (dicyclohexyl phthalate, diisononyl phthalate, and di-n-propyl phthalate; also endocrine-disrupting compounds), suggesting a substitution. Many detected chemicals were not listed on product labels.”

“**Endocrine Disrupting compounds (EDCs) are chemicals that can alter hormonal signaling and have potential effects on developing reproductive and nervous systems, metabolism, and cancer** (Colborn et al. 1993). Some phthalates inhibit testosterone synthesis (Howdeshell et al. 2008)...”

“**Fragrances have been shown to exacerbate asthma**. …The phthalate bis(2-ethylhexyl) phthalate (DEHP) in dust was associated with **asthma and wheezing in children**…”

“Our results also indicate that use of multiple products can lead to **exposure to an even larger mixture of compounds,** even if a consumer selected products considered alternative according to our criteria. For example, a consumer who used the alternative surface cleaner, tub and tile cleaner, **laundry detergent**, bar

soap, shampoo and conditioner, facial cleanser and lotion, and toothpaste (a plausible array of product types for an individual) would potentially be exposed to at least 19 compounds: two parabens, three **phthalates**, MEA, DEA, five alkylphenols, and seven **fragrances**."

[Note: Fragrance chemicals listed in Figure 1 are: Benzylacetate, Eugenol, Hexyl cinnemal, Limonene, Linalool, Methyl eugenol, Methyl salicylate, Pinene, Terpineol, AHTN, Bucina,l Diphenyl ether, DPMI, HHCB, Isobornyl acetate, Methyl ionone, Musk ketone, Musk xylene, Phenethyl alcohol**]**
[Note: Endocrine Disrupting Chemicals (EDC's) are commonly used in perfumes and fragranced products as preservatives or fragrance. What are EDC's and how can they affect us?**]**

[Note: Phthalates are synthetic odorless plasticizers used as solvents, binders or fixatives in many fragrances. Why are phthalates in the news? Phthalates are considered Endocrine Disrupting Chemicals.
On the California Safe Cosmetics Program Product Database: DEP, DIDP, and DBP are reported as fragrance while DEHP and DBP are perfume solvents. IFRA lists DEP and DMP, as "reported fragrance ingredients".**]**

11. *Occupational asthma caused by scented gravel in cat litter boxes*

Jensen OC, Petersen I. Erhvervsasthma fremkaldt af duftstoffer i kattegrus [Occupational asthma caused by scented gravel in cat litter boxes]. Ugeskr Laeger. 1991 Mar 25;153(13):939-40. Danish. PMID: 2024303.
Article Link: https://pubmed.ncbi.nlm.nih.gov/2024303/

"Perfumes are now added to articles in everyday use to an increasing extent. One example of this is addition of **perfume** to gravel (kitty litter) in cat toilets. **It is recognized that perfumes may cause toxic and allergic skin reactions while perfume as the cause of asthma is not so well recognized.** In the case described here, exposure to industrial perfume resulted in asthma on account of irritation. "

12. *Toxic effects of air freshener emissions*

Anderson RC, Anderson JH. Toxic effects of air freshener emissions. Arch Environ Health. 1997 Nov-Dec;52(6):433-41. doi: 10.1080/00039899709602222. PMID: 9541364.
Article Link: https://pubmed.ncbi.nlm.nih.gov/9541364/

"The emissions of this **solid Air Freshener produced acute respiratory and neurotoxicity in mice**, and they did not lower the toxic impact of the other pollutants tested. Collectively, toxicity data, chemical data, and MSDS information predict that some humans exposed to emissions of the AF we studied might experience some combination of **eye, nose, and/or throat irritation**; **respiratory difficulty**; **bronchoconstriction** or an **asthma-like reaction**; and **CNS reactions** (e.g., **dizziness**, **incoordination**, **confusion**, **fatigue**)."

13. *Toxic Chemicals Emitted from Air fresheners & Disinfectants*

Geetha Balasubramani, Paul Pradeep, J Nisitha S. Toxic Chemicals Emitted from Air fresheners & Disinfectants. IJRASET. Volume 10 Issue X Oct 2022, Pgs 1338-1345. ISSN : 2321-9653 IJRASET47180
Article Link:
https://www.ijraset.com/research-paper/toxic-chemicals-emitted-from-air-fresheners-and-disinfectants - PDF

(Note: This graphic is from preceding article**)**

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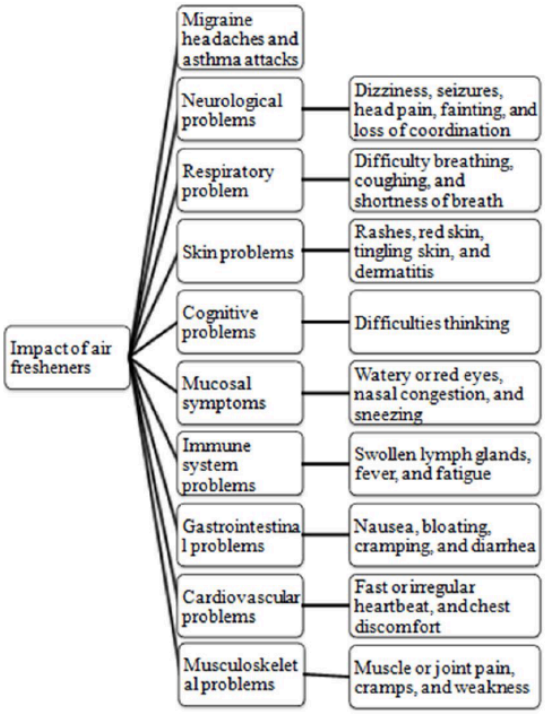

Figure 2: The diagram above illustrates the classification of illnesses brought on by exposure to air fresheners.

14. Acetaldehyde at a low concentration synergistically exacerbates allergic airway inflammation as an endocrine-disrupting chemical and as a volatile organic compound

Kawano T, Matsuse H, Fukahori S, Tsuchida T, Nishino T, Fukushima C, Kohno S. Acetaldehyde at a low concentration synergistically exacerbates allergic airway inflammation as an endocrine-disrupting chemical and as a volatile organic compound. Respiration. 2012;84(2):135-41. doi: 10.1159/000337112. Epub 2012 Apr 25. PMID: 22538484.

Article Link: https://pubmed.ncbi.nlm.nih.gov/22538484/

"Acetaldehyde is an endocrine-disrupting chemical (EDC) and a volatile organic compound (VOC). It is also a **carcinogen** and **teratogen** that causes **bronchoconstriction** in a subset of **asthmatics**. However, the mechanism through which acetaldehyde acts as an EDC/VOC causing **allergic airway inflammation** remains unknown."

"Conclusions: **Exposure to acetaldehyde can enhance allergic airway inflammation in asthma**."

[Note: Acetaldehyde is on the **IFRA** list. It is on the Carcinogens and Reproductive Toxicants List. *"Acetaldehyde at a low concentration synergistically exacerbates allergic airway inflammation as an endocrine-disrupting chemical and as a volatile organic compound"* **]**

[Note: Endocrine Disrupting Chemicals (EDC's) are commonly used in perfumes and fragranced products as preservatives or fragrance. What are EDC's and how can they affect us?**]**

15. *Fragranced consumer products: effects on asthmatics*

Steinemann A. Fragranced consumer products: effects on asthmatics. Air Qual Atmos Health. 2018;11(1):3-9. doi: 10.1007/s11869-017-0536-2. Epub 2017 Dec 11. PMID: 29391919; PMCID: PMC5773620

Article Link: https://pubmed.ncbi.nlm.nih.gov/29391919/ **-** PDF

"Fragranced consumer products, such as **cleaning supplies**, air fresheners, and personal care products, can emit a range of air pollutants and trigger adverse health effects…"

"...41.0% of asthmatics report **health problems** from air fresheners or deodorizers, 28.9% from scented laundry products coming from a dryer vent, **42.3% from being in a room cleaned with scented products,** and 46.2% from being near someone wearing a fragranced product."

"**Fragranced consumer products pervade society and emit numerous volatile organic compounds, such as limonene, alpha-pinene, beta-pinene, acetaldehyde, and formaldehyde…"**

"Fragranced products have been associated with a range of adverse health effects including work-related asthma (Weinberg et al. 2017), asthmatic exacerbations (Kumar et al. 1995; Millqvist and Löwhagen 1996), **respiratory difficulties** (Caress 2009), **mucosal symptoms** (Elberling et al. 2005)**, migraine headaches** (Kelman 2004), and **contact dermatitis** (Rastogi et al. 2007; Johansen 2003), as well as **neurological, cardiovascular, cognitive, musculoskeletal, and immune system problems** (Steinemann 2016)."

"Results indicate that 64.3% of asthmatics report one or more types of adverse health effects from fragranced products, including **respiratory problems** (43.3%), **migraine headaches** (28.2%), and **asthma attacks** (27.9%)..."

16. *A pilot study of total personal exposure to volatile organic compounds among Hispanic female domestic cleaners*

Oyer-Peterson K, Gimeno Ruiz de Porras D, Han I, Delclos GL, Brooks EG, Afshar M, Whitworth KW. A pilot study of total personal exposure to volatile organic compounds among Hispanic female domestic cleaners. J Occup Environ Hyg. 2022 Jan;19(1):1-11. doi: 10.1080/15459624.2021.2000615. Epub 2022 Jan 28. PMID: 34731075; PMCID: PMC8813894.

Article Link: https://pubmed.ncbi.nlm.nih.gov/34731075/ - PDF

"Cleaners have an elevated risk for the development or exacerbation of **asthma** and other **respiratory** conditions, possibly due to exposure to cleaning products containing **volatile organic compounds (VOCs)** leading to **inflammation** and **oxidative stress**. …29% and 20% reported suffering from **skin irritation** and **trouble breathing**…"

"...the highest exposures experienced by the women were from **d-limonene** (mean = 22.5 ppb; median = 4.3 ppb), followed by **toluene** (mean = 1.5 ppb; median = 1.1 ppb), **α-pinene** (mean = 0.8 ppb; median = 0.7 ppb) and **β-pinene** (mean = 0.7 ppb; median = 0.6 ppb)..."

"Additionally, while they are exposed to myriad **VOCs**, these women were particularly exposed to **terpene compounds**, which are often **found in scented cleaning products.**"

17. *Ten questions concerning air fresheners and indoor built environments*

Anne Steinemann, Ten questions concerning air fresheners and indoor built environments, Building and Environment, Volume 111, 2017, Pages 279-284, ISSN 0360-1323, https://doi.org/10.1016/j.buildenv.2016.11.009.
Article Link: https://www.sciencedirect.com/science/article/pii/S0360132316304334?via%3Dihub - PDF

"This article investigates the seeming paradox that **products designed to improve the indoor environment can pose unintended and unknown risks.** It examines the science, health, and policy perspectives, and provides recommendations and research directions."

"Air fresheners can contribute to indoor hazardous air pollutants, both through direct emissions and secondary reaction products… Within buildings and other indoor environments, the use of air fresheners has a strong association with high indoor levels of **terpenes, benzene, toluene**, ethyl-benzene, m,p-xylene, and **total volatile organic compounds**…"

"Air fresheners can contribute to human exposure to primary and secondary air pollutants… Air freshener exposures, **even at low levels**, have been associated with a range of adverse health effects, which include **migraine headaches, asthma attacks, breathing difficulties, respiratory difficulties, mucosal symptoms, dermatitis, infant diarrhea and earache, neurological problems, and ventricular fibrillation**..."
"In addition to population based studies, specific air freshener chemicals (VOCs such as acetaldehyde, SVOCs such as phthalates, and ultrafine particles) emitted from air fresheners have been associated with adverse effects to the **neurological, cardiovascular, respiratory, reproductive, immune, and endocrine systems, and with cancer**. For instance, acetaldehyde, which can be both a primary and secondary emission from air fresheners, is associated with both **acute and chronic hazards to the respiratory system**, and classified as a carcinogenic hazardous air pollutant in the US…"

18. *Update on asthma and cleaning agents*

Folletti I, Siracusa A, Paolocci G. Update on asthma and cleaning agents. Curr Opin Allergy Clin Immunol. 2017 Apr;17(2):90-95. doi: 10.1097/ACI.0000000000000349. PMID: 28141626.
Article Link: https://pubmed.ncbi.nlm.nih.gov/28141626/

"Asthma due to cleaning products has been known for 20 years… There is some evidence that an **irritant mechanism is more common, although several case reports showed an immunologic mechanism** (e.g. disinfectants, **amine compounds**, **aldehydes** and **fragrances**)."

"Moreover, two interesting reviews published in 2010 suggested that **occupational asthma in cleaning workers** may be due to **specific sensitization to disinfectants** such as quaternary ammonium compounds (e.g. benzalkonium chloride and lauryl dimethyl benzyl ammonium chloride), chloramine T, glutaraldehyde, **fragrances** and ethanolamines.… **Many cases of cleaning-related asthma occur in healthcare workers**."

19. *Prevalence and predictors of occupational asthma among workers in detergent and cleaning products industry and its impact on quality of life in El Asher Men Ramadan, Egypt*

Ahmed AS, Ibrahim DA, Hassan TH, Abd-El-Azem WG. Prevalence and predictors of occupational asthma among workers in detergent and cleaning products industry and its impact on quality of life in El Asher Men Ramadan, Egypt. Environ Sci Pollut Res Int. 2022 May;29(23):33901-33908. doi: 10.1007/s11356-022-18558-8. Epub 2022 Jan 15. PMID: 35034305; PMCID: PMC8761047.

Article Link: https://pubmed.ncbi.nlm.nih.gov/35034305/ - PDF

"Cleaning products are mixtures of many chemical ingredients that are known to contain sensitizers, disinfectants, and **fragrances**, as well as **strong airway irritants** which associated with **lower respiratory tract** and **asthma symptoms**."

"Workers in detergent and cleaning products industry are vulnerable group for developing occupational asthma and other **respiratory problems** as they are exposed to a wide range of irritants and sensitizers in the chemical substances used, besides common indoor allergens and pollutants (Quirce & Barranco, 2010)."

"**When the airway epithelium is damaged as a result of repeated irritating exposure, the inflammatory Th2 response is triggered** (Tarlo & Lemiere, 2014)."

20. *Fragranced consumer products: effects on autistic adults in the United States, Australia, and United Kingdom*

Steinemann A. Fragranced consumer products: effects on autistic adults in the United States, Australia, and United Kingdom. Air Qual Atmos Health. 2018;11(10):1137-1142. doi: 10.1007/s11869-018-0625-x. Epub 2018 Sep 25. PMID: 30546500; PMCID: PMC6244938
Article Link: https://pubmed.ncbi.nlm.nih.gov/30546500/ - PDF

"Fragranced consumer products are ubiquitous in society and emit numerous volatile organic compounds including hazardous air pollutants."

"Health effects were categorized as follows:
(a) migraine headaches;
(b) asthma attacks;
(c) neurological problems (e.g., dizziness, seizures, head pain, fainting, loss of coordination);
(d) respiratory problems (e.g., difficulty breathing, coughing, shortness of breath);
(e) skin problems (e.g., rashes, hives, red skin, tingling skin, dermatitis);
(f) cognitive problems (e.g., difficulties thinking, concentrating, or remembering);
(g) mucosal symptoms (e.g., watery or red eyes, nasal congestion, sneezing);
(h) immune system problems (e.g., swollen lymph glands, fever, fatigue);
(i) gastrointestinal problems (e.g., nausea, bloating, cramping, diarrhea);
(j) cardiovascular problems (e.g., fast or irregular heartbeat, jitteriness, chest discomfort);
(k) musculoskeletal problems (e.g., muscle or joint pain, cramps, weakness); and
(l) other."

"Specific problematic exposures, associated with adverse health effects for autistic adults, include but are not limited to the following: …air fresheners and deodorizers (62.9%), the scent of laundry products coming from a dryer vent (57.5%), being in a room recently cleaned with scented products (65.9%), **being near someone wearing a fragranced product** (60.5%), and other types of fragranced consumer products (64.3%)… Among autistic adults reporting health effects, 74.1% across the three countries (85.4% US, 82.4% AU, 54.5% UK) report that the severity of these health effects from fragranced products was potentially disabling. Among non-autistic adults, the prevalence of potentially disabling effects was 25.4%."

"...62.1% of autistic adults are unable or reluctant to use the restrooms in a public place if it has an air freshener, deodorizer, or scented product; 59.8% are unable or reluctant to wash their hands with soap in a

public place if the soap is fragranced; 58.7% enter a business and then want to leave as quickly as possible if they smell air fresheners or a fragranced product; and **66.7% have been prevented from going someplace because they would be exposed to a fragranced product that would make them sick…"**

"Involuntary exposure is a concern. Autistic individuals are prevented from accessing public restrooms, societal venues, businesses, and workplaces due to adverse health effects from fragranced products. Further, 59.4% of autistic adults have lost workdays, in the past year, due to fragranced product exposure in the workplace. **A strong majority of autistic as well as non-autistic adults would prefer that workplaces, health care facilities, and health care professionals were fragrance-free than fragranced.""**

21. *History of the Obesogen Field: Looking Back to Look Forward*

Heindel JJ. History of the Obesogen Field: Looking Back to Look Forward. Front Endocrinol (Lausanne). 2019 Jan 29;10:14. doi: 10.3389/fendo.2019.00014. PMID: 30761083; PMCID: PMC6362096.
Article Link: https://pubmed.ncbi.nlm.nih.gov/30761083/

"Exposure to EDCs during early development (DOHaD) has been shown to **increase susceptibility to a variety of diseases including infertility, asthma, breast and prostate cancer, early puberty, susceptibility to infections, heart disease, autoimmune disease, and attention deficit hyperactivity disorder/learning disability**. The chemicals that she noted as having the ability to cause weight gain include organochlorine pesticides, carbamates, polychlorinated biphenols, plastics such as **phthalates** and bisphenol A (BPA), heavy metals and solvents.**"**

"EDCs are found in a wide variety of products including pesticides/herbicides/fungicides, flame retardants, surfactants, plastics, **sunscreens, cosmetics,** and **personal care products,** etc. [reviewed in (5)]."

"Originally, **EDCs** were shown to interfere with **estrogen, androgen and thyroid hormone signaling (7, 8) resulting in diseases and dysfunctions in reproduction, learning, memory, and behavior."**

[Note: Endocrine Disrupting Chemicals (EDC's) are commonly used in perfumes and fragranced products as preservatives or fragrance. What are EDC's and how can they affect us?**]**

22. *Fragranced laundry products and emissions from dryer vents: implications for air quality and health*

Goodman N, Nematollahi N and Steinemann A (2021) Fragranced laundry products and emissions from dryer vents: implications for air quality and health. Air Quality, Atmosphere and Health, 14. pp. 245-249.
Article Link: https://researchonline.jcu.edu.au/64706/ - PDF

"The study pursues three main objectives: (a) to determine the frequency and types of health problems associated with exposure to fragranced laundry products from dryer vents, (b) to assess and compare the VOCs from fragranced and fragrance-free laundry products, and (c) to calculate potential reductions in **limonene** emissions from dryer vents by switching from fragranced to fragrance-free laundry products. Results can provide a scientific foundation and practical approach to reduce pollutants and potential health risks associated with the use of laundry products and their emissions through dryer vents."

“Among the general population in the US and AU, 12.5% and 6.1% of adults report health problems when exposed to **scented laundry products** from dryer vents. Adverse health effects include **respiratory problems (the most frequently reported, collectively), mucosal symptoms, skin problems, asthma attacks, migraine headaches, neurological problems**, among others.”

“Dryer vent emissions from seven households were analyzed for their limonene concentrations…”
“In households that switched from fragranced products to fragrance-free products, emissions of limonene were reduced within two weeks by up to 99.7% (average 79.1%).”

“At a regional level, during use of fragranced laundry products, limonene emissions from dryer vents across metropolitan Melbourne is estimated at 1.99 tons/year.”
“In this same analytical approach, applied to the state of California, limonene emissions from dryer vents across the state was estimated at 10.95 tons/year”

“This study indicates that fragranced laundry products emitted from dryer vents can be sources of indoor and outdoor air pollutants and health risks. The study also indicates that switching from fragranced to fragrance-free laundry products can generate potential improvements for air quality and health.”

23. Emissions from dryer vents during use of fragranced and fragrance-free laundry products

Goodman, N.B., Wheeler, A.J., Paevere, P.J. et al. Emissions from dryer vents during use of fragranced and fragrance-free laundry products. Air Qual Atmos Health 12, 289–295 (2019). https://doi.org/10.1007/s11869-018-0643-8
Article Link: https://link.springer.com/article/10.1007/s11869-018-0643-8 - PDF

“The study focused on D-limonene because it is (a) a prevalent and dominant VOC in fragranced laundry products as well as other fragranced consumer products, (b) a suitable marker as it is generally found in fragranced laundry products but not in fragrance-free laundry products, (c) associated with a range of adverse human health and environmental effects, and classified as a potentially hazardous compound (SWA 2018), and (d) a terpene that readily reacts with ozone to generate a range of hazardous secondary air pollutants.”

(note: Graphic is from preceding article**)**
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Table 3 GC/MS headspace analysis of VOCs emitted from the fragranced laundry detergent and the fragrance-free laundry detergent used in this study, listed according to retention time

Compound	CAS #	Fragranced detergent	Fragrance-free detergent
Acetaldehyde*	75-07-0	✓	✓
Ethanol*	64-17-5	✓	
Acetone*	67-64-1	✓	✓
2-methyl-Pentane*	107-83-5	✓	
2-methyl-2-Propanol	75-65-0		✓
2-Propen-1-ol*	107-18-6	✓	
2-methyl-Hexane*	591-76-4	✓	
2,3-dimethyl-Pentane*	565-59-3	✓	
3-methyl-Hexane*	589-34-4	✓	
1,3-dimethyl-Cyclopentane	2453-00-1	✓	
Ethylbenzene*	100-41-4		✓
Heptane*	142-82-5	✓	
methyl-Cyclohexane*	108-87-2	✓	
2,3,4-trimethyl-Hexane	921-47-1	✓	
(E)-3-Hexen-1-ol	928-97-2	✓	
1-Hexanol*	111-27-3	✓	
α-Pinene	80-56-8	✓	
2-methyl-ethyl ester Pentanoic acid	39255-32-8	✓	
Sabinene	3387-41-5	✓	
3-Carene	13466-78-9	✓	
β-Myrcene	123-35-3	✓	
β-Ocimene	3779-61-1	✓	
4-Hexen-1-ol, acetate	72237-36-6	✓	
Acetic acid, hexyl ester	142-92-7	✓	
Octanal	124-13-0	✓	
D-Limonene*	5989-27-5	✓	
β-Phellandrene	555-10-2	✓	
2,6-dimethy-l-5-Heptenal	106-72-9	✓	
2,6-dimethyl-7-Octen-2-ol	18479-58-8	✓	
1,3,4-Trimethyl-3-cyclohexenyl-1-carboxaldehyde	40702-26-9	✓	
Linalool*	78-70-6	✓	
3-methyl-5-propyl-Nonane	31081-18-2		✓
(E)- 7-Tetradecene	41446-63-3		✓
Cyclododecane	294-62-2		✓
Benzyl acetone	2550-26-7	✓	
4-tert-Butylcyclohexyl acetate	104-05-2	✓	
α-Terpinyl acetate	98-55-5	✓	
2-Carene	554-61-0	✓	
Lilial*	80-54-6	✓	

* Classified as hazardous under Safe Work Australia, Hazardous Chemical Information System (SWA 2018)

"This study demonstrated the **improvements to air quality after switching from fragranced to fragrance-free products.** It found that, by a change to fragrance-free laundry products, concentrations of D-limonene can be almost completely eliminated from the dryer vent emissions. This strategy may also reduce the formation and concentrations of secondary pollutants such as **formaldehyde**, **acetaldehyde**, and ultrafine particles. Findings from this study can provide an important foundation for future research, and for demonstrating cost-effective strategies to reduce VOC emissions and personal exposures."

24. *Environmental Distribution of Personal Care Products and Their Effects on Human Health*

Khalid M, Abdollahi M. Environmental Distribution of Personal Care Products and Their Effects on Human Health. Iran J Pharm Res. 2021 Winter;20(1):216-253. doi: 10.22037/ijpr.2021.114891.15088. PMID: 34400954; PMCID: PMC8170769.
Article Link: https://pubmed.ncbi.nlm.nih.gov/34400954/ - PDF

"**Chemicals in PCPs (personal care products) have a high health risk to human and aquatic life** (14). Little information is available about exposures from PCPs and some ingredients of PCPs known as EDCs and involved in abnormal developmental and reproductive ability."

"**There are 50-300 different chemicals used as fragrances for PCPs**. Such chemicals may be **acetals, alcohols, aldehydes, amides, amines, carboxylic acids, coumarins, dioxanes, epoxides, esters, ethers, heterocyclics, hydrocarbons, ketones, lactones, musks, nitriles, phenols, pyrans, pyrazines, quinolines, or Schiff's bases**. Several PCPs such as **detergents, soaps, cleaners, and fabric softeners** contain various fragrances…"

"Fragrances are a mixture of VOCs that tend to break and mix with the dust or pollutants to form harmful secondary products or toxic air pollutants that are potentially more irritating or allergenic than the original substance. For example, **terpenes from PCPs may react with indoor ozone to form secondary pollutants such as formaldehyde."**

"Fragrances exacerbate symptoms of **asthmatic** patients and may induce **atopic asthma**. Fragrances with significant absorption in the UV range of 290-400 nm can cause **phototoxicity** and **photoallergy** resulting in dermal irritation and contact dermatitis. Dermatological patients often complain about **hand eczema and allergy**, mostly due to the ubiquitous usage of fragrances. Fragrance chemicals are also responsible for **airborne contact** and **facial dermatitis**. The incidence of **allergic contact dermatitis**, **hypersensitivity**, and **skin sensitization** found to be higher among women than men due to their frequency of use of PCPs and ubiquitous presence of fragrance chemicals."

[Note: Endocrine Disrupting Chemicals (EDC's) are commonly used in perfumes and fragranced products as preservatives or fragrance. What are EDC's and how can they affect us?**]**

25. *Rapid and green determination of 58 fragrance allergens in plush toys*

Wang Z, Zhang Q, Li H, Lv Q, Wang W, Bai H. Rapid and green determination of 58 fragrance allergens in plush toys. J Sep Sci. 2018 Feb;41(3):657-668. doi: 10.1002/jssc.201700556. Epub 2017 Dec 14. PMID: 29150895.
Article Link: https://pubmed.ncbi.nlm.nih.gov/29150895/

"**Toys are scented** to cover unpleasant odors or to enhance their attractiveness to consumers. However, **some fragrances are important sources of allergens**, which can **trigger respiratory illnesses (asthma and rhinitis), migraine headaches, neurotoxicity, endocrine-disrupting activities,** and other negative effects."

26. *Smell of autism: Synthetic fragrances and cause for allergies, asthma, cancer and autism*

Bagasra O, Pace DG. Smell of autism: Synthetic fragrances and cause for allergies, asthma, cancer and autism. OA Autism 2013 Jun

19;1(2):15.
Article Link:
https://www.researchgate.net/publication/269626082_Smell_of_autism_Synthetic_fragrances_and_cause_for_allergies_asthma_cancer_and_autism)

“The aim of this review was to discuss synthetic fragrances and cause for **allergies**, **asthma**, **cancer** and **autism**…”
“This review summarizes some of the subjective concerns and attempts to date that have brought greater objective scrutiny to the debate over the safety of components used in the imprecise objects called fragrances.”
“The link between autism spectrum disorder (ASD) and exposure to toxic ingredients in perfumes, even at minute (femtomolar) levels, has been suggested by recent scholarship. Scents are known to have the capacity to reach the brain, including the brain of a foetus whose mother uses **perfume that derives from synthetic scents made from mutagenic chemicals**.”

“**Fragrance is a seemingly innocuous term added to health and beauty products. Ultimately, this mysterious term may actually undermine both health and beauty.** Fragrance is a common euphemism for an undisclosed blend of chemical ingredients drawn from an arsenal comprised of about 3,100 total ingredients. ‘Musky’ may increase sales, ‘exotic’ may attract customers and ‘floral’ may sound beautifully natural, but these terms may also conceal the existence of petrochemicals and other synthetic chemicals that, when blended with natural ingredients, can form **dangerous cocktails of fragrance**”

27. Fragrance compounds: The wolves in sheep's clothings

Patel S. Fragrance compounds: The wolves in sheep's clothings. Med Hypotheses. 2017 May;102:106-111. doi: 10.1016/j.mehy.2017.03.025. Epub 2017 Mar 22. PMID: 28478814.
Article Title: https://pubmed.ncbi.nlm.nih.gov/28478814/

“It is deplorable and alarming that awareness of the threats of perfume allergy is very low. Tricked by aggressive advertisement and to improve aesthetic appeal, people are exposing themselves to multiple chemical fragrance compounds. Further, it is a matter of concern that an alert individual cannot escape the perils of fragrances by mere lifestyle revision, and avoidance of the chemicals. Like the harms of passive smoking, passive exposure to the perfumes occurs in a number of public places. In realization of the dangers of peanut allergy to vulnerable individuals, peanut was pulled off from the food platter in passenger planes. Similar awareness and action is needed for perfumes as well.… An aware individual does not deserve to get the brunt of someone else’s reckless lifestyle choices. Also, the cleaning staff in public places must be trained so as to ensure prevention of perfume abuse i.e. excess usage.”

“A study found traces of **musk fragrances** such as **galaxolide**, **tonalide**, **cashmeran,** and UV-filters in marine species (mussel, clam, flounder, herring and mullet) and macroalgae, which constitute seafood. These **bioaccumulated xenobiotics** will ultimately reach to the human body via the food chain”

“Perfume manufacturers do not disclose the ingredients and quantity of the fragrance compounds in the name of ‘trade secret’. Though they ought to abide by ethics, for profit and the goals of high market share, they forgo those. With the help of unscrupulous advertisements and sponsored research reports, they keep luring naive and unaware consumers.… It is appalling that even if people know the threats, they continue using these toxins, resonating the ‘‘death wish” concept discussed in the popular TV series ‘‘Mad men”.... The fragrance compounds so ubiquitous in modern times initiate vicious cycles of ‘exposure – pathologies – drugs’, which

must be understood, information disseminated and terminated. Based on the review work and hypotheses, it can be stated that perfumes and other fragrance compounds in day-to-day consumer products are 'slow killers with fatal punch'.

"Growing recognition of the widespread use of fragrances in modern society is alarming. These pleasant-seeming deleterious compounds are the causal factors of a wide array of **immuneneural**- **hormonal health issues**. **Allergy**, **irritation**, **migraine**, **asthma**, **depression**, **high blood pressure**, **diabetes** and other symptoms should not be trivialized. Unheeded, and continued, the fragrance compounds can lead to **gynaecomastia**, **cancers**, **gender manipulation**, **teratogenicity**."

"**Creating public awareness is essential to avoid grave health consequences**. Toxicology research on perfumes must be prioritized, just like other urgent topics like 'antibiotics-drug resistance' and 'pesticide-food safety'. This review 'though barely scratches the surface' of the enormous health threats of 'synthetic fragrances' is expected to evoke alertness."
[Note: Gynaecomastia is enlarged male breast tissue**]**

28. *Sanitary pads and diapers contain higher phthalate contents than those in common commercial plastic products*

Park CJ, Barakat R, Ulanov A, Li Z, Lin PC, Chiu K, Zhou S, Perez P, Lee J, Flaws J, Ko CJ. Sanitary pads and diapers contain higher phthalate contents than those in common commercial plastic products. Reprod Toxicol. 2019 Mar;84:114-121. doi: 10.1016/j.reprotox.2019.01.005. Epub 2019 Jan 16. PMID: 30659930; PMCID: PMC6504186.
Article Link: https://pubmed.ncbi.nlm.nih.gov/30659930/

"VOCs increase the risk for neurocognitive impairment, asthma, congenital disability, and cancer. Notably, exposure to methylene chloride, **toluene**, and **xylene** are known to **negatively affect the development and function of reproductive system**."

"…sanitary pads in direct contact with the skin around the external genitalia were likely causing **menstrual irregularities.** The skin of this area tends to be thinner and more absorbent than those…such as the hands."
"Exposure to phthalates is known to **affect the development and functions of the cardiovascular, reproductive and endocrine systems**."

"...daily absorption of **toluene** from sanitary pad reached to the maximum of 38.4% RfD. **Given the fact that women are exposed to various chemicals through various routes, consideration should be given to the risks of chemicals that are additionally absorbed from the sanitary pad."**

[Note: Phthalates are synthetic odorless plasticizers used as solvents, binders or fixatives in many fragrances. Why are phthalates in the news? Phthalates are considered Endocrine Disrupting Chemicals.
On the California Safe Cosmetics Program Product Database: DEP, DIDP, and DBP are reported as fragrance while DEHP and DBP are perfume solvents. IFRA lists DEP and DMP, as "reported fragrance ingredients".**]**

[Note: Toluene (often a nail polish thinner) is used as a solvent or fragrance in perfume and bath products on the CSPC Product Database. Toluene is on the IFRA list and on the EPA's Priority Pollutant List.**]**

29. *The associations between personal care products use and urinary concentrations of phthalates, parabens, and triclosan in various age groups: The Korean National Environmental Health Survey Cycle 3 2015-2017*

Lim S. The associations between personal care products use and urinary concentrations of phthalates, parabens, and triclosan in various age groups: The Korean National Environmental Health Survey Cycle 3 2015-2017. Sci Total Environ. 2020 Nov 10;742:140640. doi: 10.1016/j.scitotenv.2020.140640. Epub 2020 Jul 2. PMID: 32721747.

Article Link: https://pubmed.ncbi.nlm.nih.gov/32721747/ - PDF

"**Phthalates** and parabens are ubiquitous chemicals of public concern… Furthermore, the use of **fragrance products**, makeup, and **air fresheners** significantly increased the exposure risk to EtP in **preschoolers**."

"Furthermore, the exposure levels of many **phthalates**, parabens, and TCS are higher in children than adults(NIER, 2018; Wang et al., 2019) and **children are a susceptible population to these chemicals**. In the case of parabens, the estimated **dermal absorption** amount of parabens related with PCPs use in **infants** and **toddlers** was several times higher than that in adult women(Guo and Kennan, 2013)."

"Exposure to phthalates and parabens is an important public concern, especially with respect to the **potential endocrine disrupting effects of phthalates** (DEHP, DBP, and BBP) (European Commission, 2000) and the anti-androgenic effect of parabens (Orton et al., 2014). Additionally, **exposure to phthalates in the prenatal period was associated with asthma** (Berger et al., 2020) and **psychomotor development** (Qian et al., 2019)in children and was related to **allergic symptoms**, **sensitization (**Hoppin et al., 2013), **preterm birth**(Ferguson et al., 2019) and **type 2 diabetes** in adults (Sun et al., 2014).**"**

"This study showed the associations between PCPs use and urinary concentrations of phthalates, parabens, and TCS in various age groups in a nationally representative population in Korea. The exposure risks to these chemicals were different according to the patterns of PCPs use by age groups and gender. Female participants used all categories of PCPs more frequently than male participants in adolescents and adults, with statistical significance."

[Note: Endocrine Disrupting Chemicals (EDC's) are commonly used in perfumes and fragranced products as preservatives or fragrance. What are EDC's and how can they affect us?**]**
[Note: Phthalates are synthetic odorless plasticizers used as solvents, binders or fixatives in many fragrances. Why are phthalates in the news? Phthalates are considered Endocrine Disrupting Chemicals.
On the California Safe Cosmetics Program Product Database: DEP, DIDP, and DBP are reported as fragrance while DEHP and DBP are perfume solvents. IFRA lists DEP and DMP, as "reported fragrance ingredients".**]**

30. ALSO SEE SECTIONS: Airborne Contact Dermatitis, Respiratory/Pulmonary, Prenatal

Back to top of Asthma **Back to Table of Contents**

Website: https://www.fragrancefreecoalitionusa.com/

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CANCER

Breast, Prostate, Kidney, Liver, Endocrine, Bladder, Lung, Thyroid, Hepatocellular, Skin

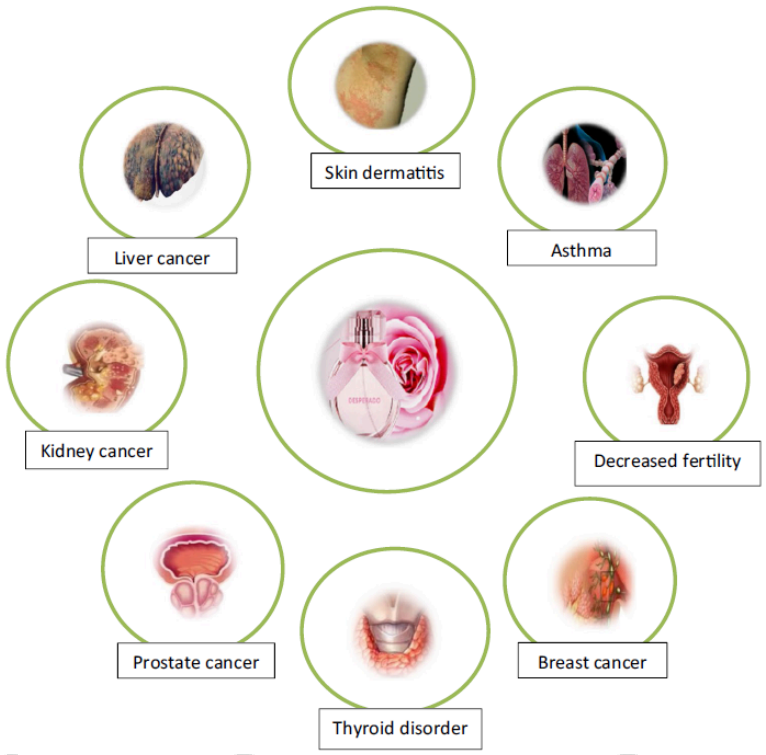
1. *Evaluation of pollutants in perfumes, colognes and health effects on the consumer: a systematic review*

Kazemi Z, Aboutaleb E, Shahsavani A, Kermani M, Kazemi Z. Evaluation of pollutants in perfumes, colognes and health effects on the consumer: a systematic review. J Environ Health Sci Eng. 2022 Feb 3;20(1):589-598. doi: 10.1007/s40201-021-00783-x. PMID: 35669814; PMCID: PMC9163252.

Article Link: https://pubmed.ncbi.nlm.nih.gov/35669814/ - PDF

(Note: Graphic is from preceding article) (Creative Commons Attribution 4.0 International license).

Fig. 2 Effects of exposure to perfumes and colognes



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"Diethyl phthalate is a chemical used to **make perfumes last longer.** The U.S. Clean Water Act lists it as a **toxic** and priority pollutant."

"Complications of using perfume include **neuropathy (depression, autism), neoplasms (breast cancer, prostate cancer), effects on the liver, migraine headaches, asthma attacks, mucosal symptoms (watery or red eyes, sneezing), neurological problems (dizziness, convulsions, headache, fainting, imbalance), respiratory (cough, shortness of breath), skin (skin rash, urticaria, redness of the skin, skin tingling,**

dermatitis), immune system (swollen lymph nodes, fever, fatigue), gastrointestinal tract (nausea, bloating, diarrhea) and c**ardiovascular (rapid** or **irregular heartbeat, tremors, chest discomfort**)"

"**Contaminants in perfumes and colognes** and their health effects on the consumer were systematically reviewed. It was found that the most attention of researchers was to identify the compounds in perfumes and colognes and their concentrations. Among the most common pollutants **phthalates** and their derivatives can be mentioned. Other pollutants included **parabens, triclosan, salicylates, terpenes, aldehydes, benzene, toluene, styrene, and aluminum-based salts**. These pollutants have also been shown to have adverse effects on consumer health such as **asthma and allergies, cardiovascular disease, central nervous system damage, breast cancer, endocrine cancer, respiratory disorders, reproduction, thyroid, adrenal gland function and immune system."**

[Note: Graphic lists "effects of exposure to perfumes and colognes": Kidney Cancer, Liver Cancer, Prostate Cancer, Thyroid Disorder, Breast Cancer, Decreased Fertility, Asthma and Skin Dermatitis.**]**

[Note: Fragrance is considered the new 'second hand smoke', **"**The parallels between second-hand smoke and synthetic fragrance use are many. At its core, both are battles over indoor air quality **"** - quote and link from De Vader, Christy L. & Barker, Paxson.
Chemicals that cigarettes/cigarette smoke and fragranced products can have in common are: Acetone, Formaldehyde, Benzene, acetaldehyde, terpenoids and phenols.**]**

2. *Identification of combinations of endocrine disrupting chemicals in household chemical products that require mixture toxicity testing*

Lee I, Ji K. Identification of combinations of endocrine disrupting chemicals in household chemical products that require mixture toxicity testing. Ecotoxicol Environ Saf. 2022 Jul 15;240:113677. doi: 10.1016/j.ecoenv.2022.113677. Epub 2022 May 26. PMID: 35642859.
Article Link: https://pubmed.ncbi.nlm.nih.gov/35642859/ - PDF

"The present study listed the ingredients contained in 11064 household chemical products from a publicly available database, and identified **EDCs** related to **estrogenicity**, **androgenicity**, **thyroid hormone disruption**, and **changes in steroidogenesis**."

"A total of 293 chemicals were related to **endocrine disruption**, and **nearly two-thirds of the products contained more than one of these chemicals**. Cleaning products, synthetic detergents, fabric softeners, air fresheners, and deodorants have several hotspots for **fragrances**, isothiazolinones, glycol ethers, and parabens. The **three most prevalent EDCs** in household chemical products were **added to act** as **fragrances** and preservatives."

"The most frequently observed EDCs in the five product groups are hexyl cinnamaldehyde, geraniol, citronellol, 2-(4-tert-butylbenzyl)propionaldehyde (CAS no. 80-54-6)**, and benzyl benzoate** (CAS no. 120-51-4). **These EDCs** are commonly **used to add fragrance."**

"The most frequently identified combinations were benzisothiazolinone and **butylated hydroxytoluene** (CAS no. 128-37-0) in cleaners, benzisothiazolinone and **hexyl cinnamaldehyde** in synthetic detergents, **2-(4-tert-butylbenzyl)propionaldehyde** and **citronellol** in fabric softeners, **benzyl benzoate** and **hexyl cinnamaldehyde** in air fresheners, and **geraniol** and **citral** (CAS no. 5392-40-5) in deodorants. The EDCs in these products were mostly included to act as **fragrances** and preservatives."

“Consistent with the results of this study, Wieck et al. (2018) reported that 26 fragrances were named approximately 2000 times on the ingredient list of 1447 household detergents, and **fragrances** such as **limonene, linalool, hexyl cinnamaldehyde, 2-(4-tert-butylbenzyl)propionaldehyde,** and **citronellol** were frequently mentioned (Wieck et al., 2018, Yazar et al., 2011)....**Geraniol** appeared to have the potential to **interact with estrogen receptors** in estrogen-inducible yeast expressing the human estrogen receptor (Howes et al., 2002).... **Benzyl benzoate** and **2-(4-tert-butylbenzyl)propionaldehyde** added to **synthetic detergents, fabric softeners, and air fresheners** were **reported to induce estrogenic responses in MCF-7 human breast cancer cell line** (Charles and Darbre, 2009).

“This study confirmed that DEHP, DINP, and DBP were used in cleaners, synthetic detergents, coating agents, adhesives, **air fresheners**, and paints. **Exposure to DEHP or DBP at levels seen in human populations** has been **linked to male reproductive defects**, such as **poor semen quality** and **abnormal genital development** (Radke et al., 2018).”

3. *Environmental exposure to xenoestrogens and oestrogen related cancers: reproductive system, breast, lung, kidney, pancreas, and brain*

Fucic A, Gamulin M, Ferencic Z, Katic J, Krayer von Krauss M, Bartonova A, Merlo DF. Environmental exposure to xenoestrogens and oestrogen related cancers: reproductive system, breast, lung, kidney, pancreas, and brain. Environ Health. 2012 Jun 28;11 Suppl 1(Suppl 1):S8. doi: 10.1186/1476-069X-11-S1-S8. PMID: 22759508; PMCID: PMC3388472.

Article Link: https://pubmed.ncbi.nlm.nih.gov/22759508/ - PDF

“The general population is exposed to a number of hormonally active compounds on a daily basis. . . . **Chemicals like** polycyclic aromatic hydrocarbons (PAH), pesticides, polychlorinated biphenyl (PCB), dichlorodiphenyl-trichlorethane (DDT), some drugs (e.g., antiepileptic drugs), fungicides, cotinine, phytoestrogens, mycotoxins, bisphenol A (a plastics additive), **phthalates**, alkylphenols, and metalloestrogens **mimic oestrogen action, affect oestrogen levels, or bind to oestrogen receptors**.”

“**Xenoestrogens** are present in a number of substrates such as cigarette smoke, automobile exhaust, **chemical industry pollutants**, grilled meat, volcano dust, forest fire smoke, milk, water, and **cosmetic products**. This means that all human population may be exposed to them.”

“Currently there are some 160 xenoestrogens that may be involved in **breast cancer** development. Women are the largest consumers of cosmetic products which may be a significant source of xenoestrogens. Some, such as metalloestrogens (e.g., aluminium salts), **parabens**, cyclosiloxanes, triclosan, UV screeners, **phthalates**,… Humans are exposed to these chemicals transcutaneously and measurable levels have been detected in human breast tissue.”

(Note: This graphic is from the preceding article)

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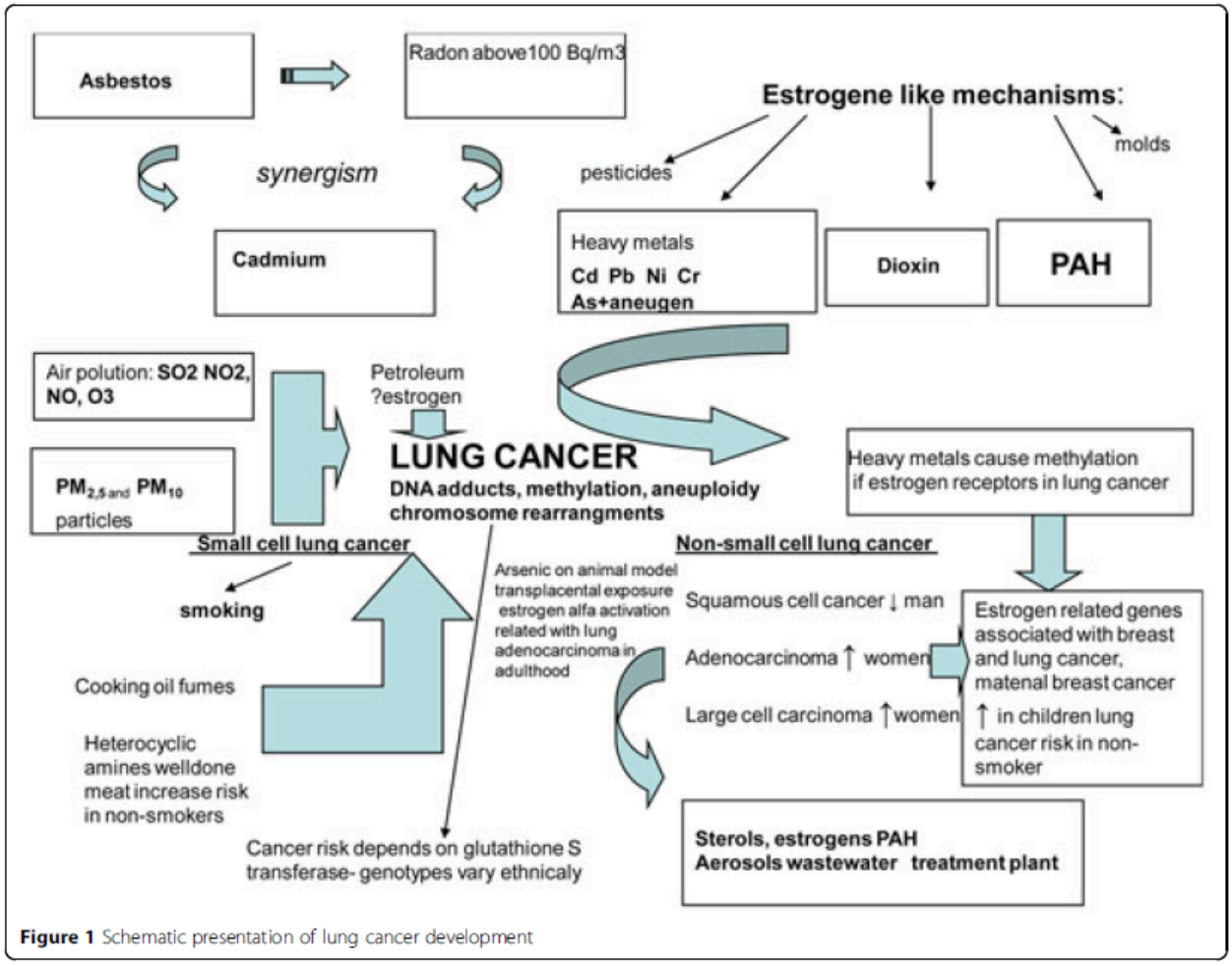

Figure 1 Schematic presentation of lung cancer development

"Although gene polymorphisms can change cancer incidence, **it is clear that environment has predominance over genes in cancer risk.** "

[Note: Phthalates are synthetic odorless plasticizers used as solvents, binders or fixatives in many fragrances. Why are phthalates in the news? Phthalates are considered Endocrine Disrupting Chemicals.

On the California Safe Cosmetics Program Product Database: DEP, DIDP, and DBP are reported as fragrance while DEHP and DBP are perfume solvents. IFRA lists DEP and DMP, as "reported fragrance ingredients".**]**

4. *Scented Candles as an Unrecognized Factor that Increases the Risk of Bladder Cancer; Is There Enough Evidence to Raise a Red Flag?*

Adamowicz J, Juszczak K, Poletajew S, Van Breda SV, Pokrywczynska M, Drewa T. Scented Candles as an Unrecognized Factor that Increases the Risk of Bladder Cancer; Is There Enough Evidence to Raise a Red Flag? Cancer Prev Res (Phila). 2019 Oct;12(10):645-652. doi: 10.1158/1940-6207.CAPR-19-0093. Epub 2019 Aug 9. PMID: 31399420.

Article: https://pubmed.ncbi.nlm.nih.gov/31399420/ - PDF

"Manufacturers of scented products, including candles or plug-in air freshener are not required to disclose all ingredients in the United States and European Union."

"**Scented** candles are a heterogenic group of products which are the source of indoor pollution. In this situation, public awareness of the potential relationship between substances emitted by scented candles and **bladder cancer** is an essential step for better prevention."
(Note: When scents/fragrances inside of a house aren't solely coming from candles, how much is 'too much'?)

5. *Oestrogenic activity of benzyl salicylate, benzyl benzoate and butylphenylmethylpropional (Lilial) in MCF7 human breast cancer cells in vitro.*

Charles AK, Darbre PD. Oestrogenic activity of benzyl salicylate, benzyl benzoate and butylphenylmethylpropional (Lilial) in MCF7 human breast cancer cells in vitro. J Appl Toxicol. 2009 Jul;29(5):422-34. doi: 10.1002/jat.1429. PMID: 19338011.
Article Link: https://pubmed.ncbi.nlm.nih.gov/19338011/

"These results demonstrate that **benzyl salicylate**, **benzyl benzoate** and **butylphenylmethylpropional (Lilial) possess oestrogenic activity in MCF7 human breast cancer cells in vitro**. All three compounds were able to displace [3H]oestradiol from both human recombinant ERα and ERβ and from ER of MCF7 cell cytosol. They were all able to increase expression of oestrogen-responsive genes, including a transfected reporter gene and the endogenous pS2 gene, in MCF7 cells"

[Note: Lilial is a synthetic fragrance and known allergen, regulated in the UK, but still used in the US. A synonym for lilial is Butylphenyl Methylpropional**]**

6. *Airborne mammary carcinogens and breast cancer risk in the Sister Study.*

Niehoff NM, Gammon MD, Keil AP, Nichols HB, Engel LS, Sandler DP, White AJ. Airborne mammary carcinogens and breast cancer risk in the Sister Study. Environ Int. 2019 Sep;130:104897. doi: 10.1016/j.envint.2019.06.007. Epub 2019 Jun 18. PMID: 31226564; PMCID: PMC6679994.
Article Link: https://pubmed.ncbi.nlm.nih.gov/31226564/ **- PDF**

"In a large, US-wide population, methylene chloride, along with several other hazardous air pollutants (including polycyclic organic matter, propylene dichloride, and **styrene**), showed some evidence of association with an increased risk of overall and ER+ breast cancer. **We also found that the air toxic-breast cancer associations were stronger among overweight/obese women.**"

[Note: Styrene is "primarily a synthetic chemical**"** used in fragrance. It is on the CSPC list as 'parfum/fragrance' and also on the IFRA list.**]**

7. *Need of the hour: to raise awareness on vicious fragrances and synthetic musks*

Patel, S., Homaei, A. & Sharifian, S. Need of the hour: to raise awareness on vicious fragrances and synthetic musks. Environ Dev Sustain 23, 4764–4781 (2021). https://doi.org/10.1007/s10668-020-00829-4
Article Link: https://link.springer.com/article/10.1007/s10668-020-00829-4

"The exposure to the **synthetic fragrances and musks**, which are produced in quantities of thousands of tons per year, has been shown to **elicit several pathologies**."

“The **fragrance compounds** are regarded as **toxins by the human immune system**, and to eliminate them, cytochrome enzymes, especially aromatases, are overexpressed. These enzymes also **convert androgens into estrogens,** but **excess estrogen production affects the endocrine system** in both males and females.”

“It is increasingly being evident that all diseases have common roots, i.e., **inflammation**.”

“**The unprecedented prevalence of diabetes, obesity, cancer, and depression, among others pathologies, is tied to the limitless usage of fragrance compounds.”**

8. *Ten questions concerning air fresheners and indoor built environments*

Anne Steinemann, Ten questions concerning air fresheners and indoor built environments, Building and Environment, Volume 111, 2017, Pages 279-284, ISSN 0360-1323, https://doi.org/10.1016/j.buildenv.2016.11.009.
Article Link: https://www.sciencedirect.com/science/article/pii/S0360132316304334?via%3Dihub - PDF

“This article investigates the seeming paradox that **products designed to improve the indoor environment can pose unintended and unknown risks.** It examines the science, health, and policy perspectives, and provides recommendations and research directions.”

“Air fresheners can contribute to indoor hazardous air pollutants, both through direct emissions and secondary reaction products… Within buildings and other indoor environments, the use of air fresheners has a strong association with high indoor levels of **terpenes, benzene, toluene**, ethyl-benzene, m,p-xylene, and **total volatile organic compounds**…”

“Air fresheners can contribute to human exposure to primary and secondary air pollutants… Air freshener exposures, **even at low levels**, have been associated with a range of adverse health effects, which include **migraine headaches, asthma attacks, breathing difficulties, respiratory difficulties, mucosal symptoms, dermatitis, infant diarrhea and earache, neurological problems, and ventricular fibrillation**...”
“In addition to population based studies, specific air freshener chemicals (VOCs such as acetaldehyde, SVOCs such as phthalates, and ultrafine particles) emitted from air fresheners have been associated with adverse effects to the **neurological, cardiovascular, respiratory, reproductive, immune, and endocrine systems, and with cancer**. For instance, acetaldehyde, which can be both a primary and secondary emission from air fresheners, is associated with both **acute and chronic hazards to the respiratory system**, and classified as a carcinogenic hazardous air pollutant in the US…”

9. *Smell of autism: Synthetic fragrances and cause for allergies, asthma, cancer and autism*

Bagasra O, Pace DG. Smell of autism: Synthetic fragrances and cause for allergies, asthma, cancer and autism. OA Autism 2013 Jun 19;1(2):15.
Article Link:
https://www.researchgate.net/publication/269626082_Smell_of_autism_Synthetic_fragrances_and_cause_for_allergies_asthma_cancer_and_autism)

“The aim of this review was to discuss synthetic fragrances and cause for **allergies**, **asthma**, **cancer** and **autism**…”
“This review summarizes some of the subjective concerns and attempts to date that have brought greater

objective scrutiny to the debate over the safety of components used in the imprecise objects called fragrances."
"The link between autism spectrum disorder (ASD) and exposure to toxic ingredients in perfumes, even at minute (femtomolar) levels, has been suggested by recent scholarship. Scents are known to have the capacity to reach the brain, including the brain of a foetus whose mother uses **perfume that derives from synthetic scents made from mutagenic chemicals**."

"**Fragrance is a seemingly innocuous term added to health and beauty products. Ultimately, this mysterious term may actually undermine both health and beauty.** Fragrance is a common euphemism for an undisclosed blend of chemical ingredients drawn from an arsenal comprised of about 3,100 total ingredients. 'Musky' may increase sales, 'exotic' may attract customers and 'floral' may sound beautifully natural, but these terms may also conceal the existence of petrochemicals and other synthetic chemicals that, when blended with natural ingredients, can form **dangerous cocktails of fragrance**"

10. Fragrance compounds: The wolves in sheep's clothings

Patel S. Fragrance compounds: The wolves in sheep's clothings. Med Hypotheses. 2017 May;102:106-111. doi: 10.1016/j.mehy.2017.03.025. Epub 2017 Mar 22. PMID: 28478814.
Article Title: https://pubmed.ncbi.nlm.nih.gov/28478814/

"It is deplorable and alarming that awareness of the threats of perfume allergy is very low. Tricked by aggressive advertisement and to improve aesthetic appeal, people are exposing themselves to multiple chemical fragrance compounds. Further, it is a matter of concern that an alert individual cannot escape the perils of fragrances by mere lifestyle revision, and avoidance of the chemicals. Like the harms of passive smoking, passive exposure to the perfumes occurs in a number of public places. In realization of the dangers of peanut allergy to vulnerable individuals, peanut was pulled off from the food platter in passenger planes. Similar awareness and action is needed for perfumes as well.… An aware individual does not deserve to get the brunt of someone else's reckless lifestyle choices. Also, the cleaning staff in public places must be trained so as to ensure prevention of perfume abuse i.e. excess usage."

"A study found traces of **musk fragrances** such as **galaxolide**, **tonalide**, **cashmeran,** and UV-filters in marine species (mussel, clam, flounder, herring and mullet) and macroalgae, which constitute seafood. These **bioaccumulated xenobiotics** will ultimately reach to the human body via the food chain"

"Perfume manufacturers do not disclose the ingredients and quantity of the fragrance compounds in the name of 'trade secret'. Though they ought to abide by ethics, for profit and the goals of high market share, they forgo those. With the help of unscrupulous advertisements and sponsored research reports, they keep luring naive and unaware consumers.… It is appalling that even if people know the threats, they continue using these toxins, resonating the "death wish" concept discussed in the popular TV series "Mad men".... The fragrance compounds so ubiquitous in modern times initiate vicious cycles of 'exposure – pathologies – drugs', which must be understood, information disseminated and terminated. Based on the review work and hypotheses, it can be stated that perfumes and other fragrance compounds in day-to-day consumer products are 'slow killers with fatal punch'.

"Growing recognition of the widespread use of fragrances in modern society is alarming. These pleasant-seeming deleterious compounds are the causal factors of a wide array of **immuneneural**- **hormonal health issues**. **Allergy**, **irritation**, **migraine**, **asthma**, **depression**, **high blood pressure**, **diabetes** and other

symptoms should not be trivialized. Unheeded, and continued, the fragrance compounds can lead to **gynaecomastia**, **cancers**, **gender manipulation**, **teratogenicity**."

"**Creating public awareness is essential to avoid grave health consequences**. Toxicology research on perfumes must be prioritized, just like other urgent topics like 'antibiotics-drug resistance' and 'pesticide-food safety'. This review 'though barely scratches the surface' of the enormous health threats of 'synthetic fragrances' is expected to evoke alertness."
[Note: Gynaecomastia is enlarged male breast tissue**]**

11. *Volatile organic compounds in feminine hygiene products sold in the US market: A survey of products and health risks*

Lin N, Ding N, Meza-Wilson E, Manuradha Devasurendra A, Godwin C, Kyun Park S, Batterman S. Volatile organic compounds in feminine hygiene products sold in the US market: A survey of products and health risks. Environ Int. 2020 Nov;144:105740. doi: 10.1016/j.envint.2020.105740. Epub 2020 Aug 28. PMID: 32866732; PMCID: PMC7958867.
Article Link: https://pubmed.ncbi.nlm.nih.gov/32866732/ - PDF

"**VOCs** are components of FHPs (feminine hygiene products) that **are added as fragrances**, adsorbents, moisture barriers, adhesives, and binders…Most of the larger non-target peaks were identified as **fragrances, such as linalool, eucalyptol and benzyl acetate**. Feminine hygiene products (FHPs) are used on highly permeable and sensitive vaginal and vulvar tissues by many women. These products contain a variety of chemicals, and few regulations require disclosure of their ingredients…."

"Products labeled as "organic," "natural," or "for sensitive skin" did not necessarily have lower VOC concentrations.**…menstrual pads had hazard ratios** of up to 11, **sprays and powders** had hazard ratios of up to 2.2 and excess cancer risks of up to 2.1 × 10−6, and **washes** had **excess cancer risks** of up to 3.3 × 10−6. Our data suggest that **all tested FHPs contained some toxic VOCs**..."

"Exposure to high concentrations or long-term exposure of VOCs has been associated with many known or suspected effects including **irritation to eyes, skin and nose**; **damage to the respiratory system, liver and kidney; reproductive effect**s; and **carcinogenicity**"

"Examples of notable VOCs include **benzene**, a known carcinogen (US EPA, 1998), 1,4-dioxane, a likely carcinogen (US EPA, 2013), and naphthalene, a possible carcinogen due to possible genetic toxicity (Schreiner, 2003; US EPA, 1999). Health risks (carcinogenic or non-carcinogenic) related to the use of FHPs over the lifecourse remain unanswered."

12. *Indoor Exposure to Selected Air Pollutants in the Home Environment:* A Systematic Review

Vardoulakis S, Giagloglou E, Steinle S, Davis A, Sleeuwenhoek A, Galea KS, Dixon K, Crawford JO. Indoor Exposure to Selected Air Pollutants in the Home Environment: A Systematic Review. Int J Environ Res Public Health. 2020 Dec 2;17(23):8972. doi: 10.3390/ijerph17238972. PMID: 33276576; PMCID: PMC7729884.
Article Link: https://pubmed.ncbi.nlm.nih.gov/33276576/ - PDF

"There is increasing awareness that the quality of the **indoor environment** affects our health and well-being….

Identified indoor **$PM_{2.5}$** sources include smoking, cooking, heating, use of **incense, candles,** and **insecticides**, while **cleaning**, housework, presence of pets and movement of people were the main sources of coarse particles….Household characteristics and occupant activities play a large role in indoor exposure, particularly cigarette smoking for PM2.5, gas appliances for NO2, and **household products** for **VOCs** and PAHs."

"Typical **VOCs** found in the indoor environment include **benzene**, **toluene**, **ethylbenzene** and **xylenes (BTEX)** from fuel combustion and evaporation, and house renovations; benzene and **styrene** from cigarette smoking; alkanes from natural gas; 1,4-dichlorobenzene from moth repellents; **a-pinene** from wood-based building materials; and **limonene** from **fragranced** household **cleaning and laundry products**… Reported **VOC concentrations were generally higher indoors than outdoors**, including for **benzene**, particularly in colder seasons due to reduced ventilation and the use of oil and gas heaters."

"Indoor sources were dominant for most **VOCs** and particularly for **limonene, a-pinene, hexanal**, pentanal, **o-xylene**, and **n-dodecane**. Use of **artificial air freshener was significantly associated with total VOC (TVOC), benzene**, **toluene** and **ethylbenzene**."

"Indoor air quality (IAQ) in particular has an impact on multiple health outcomes, including **respiratory** and **cardiovascular illness, allergic symptoms, cancers,** and **premature mortality."**

13. *Emission characteristics of VOCs emitted from consumer and commercial products and their ozone formation potential*

Dinh TV, Kim SY, Son YS, Choi IY, Park SR, Sunwoo Y, Kim JC. Emission characteristics of VOCs emitted from consumer and commercial products and their ozone formation potential. Environ Sci Pollut Res Int. 2015 Jun;22(12):9345-55. doi: 10.1007/s11356-015-4092-8. Epub 2015 Jan 21. PMID: 25601614.

Article Link: https://pubmed.ncbi.nlm.nih.gov/25601614/

"The characteristics of volatile organic compounds (VOCs) emitted from several consumer and commercial products (body wash, dishwashing detergent, **air freshener**, windshield washer fluid, lubricant, hair spray, and insecticide) were studied and compared."

"In the spray products, 21.6–96.4 % of the VOCs were propane, iso-butane, and n-butane, which are the components of liquefied petroleum gas. **Monoterpene** (C10H16) was the dominant component of the VOCs in the non-spray products (e.g., body wash, 53–88 %)."

"Besides comprising **hazardous VOCs**, VOCs from consumer products were also **ozone precursors**."
"The TVOCs from spray products (insecticide, **hair spray**, and lubricant) were higher than those from the liquid products such as the windshield washer fluid, dishwashing detergent, **body wash**, and **air freshener**."

"Limonene and 1-propanol were the components of one dishwashing detergent. In contrast, another dishwashing detergent comprised **1,3-dioxane**, **ethanol**, **ethyl acetate**, **limonene**, **β-myrcene**, 3-pentanol, and **α-pinene** (Kwon et al. 2007, 2008)."

"**Benzene, n-hexane**, and **ethylbenzene** were observed in the body washes and the **air fresheners.** Benzene was classified as Group A of the US EPA lists of **known human carcinogen** (WHO 2010). The unit cancer risk of 1 μg/m3 of benzene is 2.2–7.8 in a million (WHO 2010). The unit risk of **leukemia** per 1 μg/m3 air

concentration is 6 in a million. Therefore, **long-term exposure to a considerable amount of benzene in those products might cause health risk,** which should be investigated in future researchers."

"A **longterm exposure of n-hexane may damage the nervous system**. Exposure to 650 ppm **n-hexane** for 2–4 months causes numbness of the arms and legs (Pohanish 2012). **Ethylbenzene** irritates the eyes, skin, and respiratory tract. A **long-term exposure of ethylbenzene may cause kidney and liver disease**…."

"**Toluene and styrene were detected in body washes, dishwashing detergents**, and windshield washer fluids. It was reported that inhalation of 200–500 ppm **toluene may cause headache, nausea, and loss of appetite** (Pohanish 2012).

Styrene is considered as a possible carcinogenic to humans. Inhalation of above 100 ppm **styrene may cause headache, inflammation of the lung, kidney and liver damage, and death** (Pohanish 2012). Since body washes are used popularly and frequently, longterm exposure to the above compounds may cause health damage."

[Note: Limonene is a common skin sensitizer and known allergen in fragrance and fragranced products. Limonene (natural or synthetic) is a terpene. Terpenes can create formaldehyde and particulate matter in air as secondary pollutants. Limonene is on the IFRA list as a fragrance ingredient.**]**
[Note: Benzene is a reported fragrance ingredient in the CSCP Product Database.**]**
[Note: N-Hexane is used to extract fragrances and was on the IFRA list until 2015.**]**
[Note: Toluene (often a nail polish thinner) is used as a solvent or fragrance in perfume and bath products on the CSPC Product Database. Toluene is on the IFRA list and on the EPA's Priority Pollutant List.**]**
[Note: Styrene is "primarily a synthetic chemical**"** used in fragrance. It is on the CSPC list as 'parfum/fragrance' and also on the IFRA list.**]**
[Note: Ethyl benzene is listed for purchase as a perfuming agent.**]**

14. *Volatile organic compounds in feminine hygiene products sold in the US market: A survey of products and health risks*

Lin N, Ding N, Meza-Wilson E, Manuradha Devasurendra A, Godwin C, Kyun Park S, Batterman S. Volatile organic compounds in feminine hygiene products sold in the US market: A survey of products and health risks. Environ Int. 2020 Nov;144:105740. doi: 10.1016/j.envint.2020.105740. Epub 2020 Aug 28. PMID: 32866732; PMCID: PMC7958867.
Article Link: https://pubmed.ncbi.nlm.nih.gov/32866732/ - PDF

"**VOCs** are components of FHPs (feminine hygiene products) that **are added as fragrances**, adsorbents, moisture barriers, adhesives, and binders…Most of the larger non-target peaks were identified as **fragrances, such as linalool, eucalyptol and benzyl acetate**. Feminine hygiene products (FHPs) are used on highly permeable and sensitive vaginal and vulvar tissues by many women. These products contain a variety of chemicals, and few regulations require disclosure of their ingredients…."

"Products labeled as "organic," "natural," or "for sensitive skin" did not necessarily have lower VOC concentrations**….menstrual pads had hazard ratios** of up to 11, **sprays and powders** had hazard ratios of up to 2.2 and excess cancer risks of up to 2.1 × 10−6, and **washes** had **excess cancer risks** of up to 3.3 × 10−6. Our data suggest that **all tested FHPs contained some toxic VOCs**..."

“Exposure to high concentrations or long-term exposure of VOCs has been associated with many known or suspected effects including **irritation to eyes, skin and nose**; **damage to the respiratory system, liver and kidney; reproductive effect**s; and **carcinogenicity**”

“Examples of notable VOCs include **benzene**, a known carcinogen (US EPA, 1998), 1,4-dioxane, a likely carcinogen (US EPA, 2013), and naphthalene, a possible carcinogen due to possible genetic toxicity (Schreiner, 2003; US EPA, 1999). Health risks (carcinogenic or non-carcinogenic) related to the use of FHPs over the lifecourse remain unanswered.”

15. *Phthalates*, bisphenols, parabens*, and triclocarban in feminine hygiene products from the United States and their implications for human exposure*

Gao CJ, Kannan K. Phthalates, bisphenols, parabens, and triclocarban in feminine hygiene products from the United States and their implications for human exposure. Environ Int. 2020 Mar;136:105465. doi: 10.1016/j.envint.2020.105465. Epub 2020 Jan 13. PMID: 31945693

Article Link: https://pubmed.ncbi.nlm.nih.gov/31945693/ - PDF

“The estimated exposure doses of phthalates, parabens, and bisphenols through the dermal absorption pathway from the use of pads, panty liners, and tampons were significant.”
“Elevated exposure to phthalates has been associated with **precocious puberty, endometriosis, female genital tumors,** and **ovulation disorders. Parabens** are **estrogen agonists**, and their exposure was linked to **breast cancer**.”
“One study showed that baby wipes and diaper creams contained remarkable concentrations of antimicrobials, such as parabens. Similarly, **high concentrations phthalates have been measured in sanitary pads.**”
“In addition, pads, panty liners, and tampons are made from polypropylene (PP) and polyethylene (PE) materials, which can contain plasticizers such as phthalates, to increase the products’ flexibility. Dimethyl phthalate* (DMP), **diethyl phthalate* (DEP), dibutyl phthalate* (DBP)**, **di-iso-butyl phthalate (DIBP),** di(2-ethylhexyl) **phthalate* (DEHP),** methyl paraben (MeP), and ethyl paraben (EtP) were found in all pad, panty liner, and tampon samples.”

[Note: Phthalates are synthetic odorless plasticizers used as solvents, binders or fixatives in many fragrances. Why are phthalates in the news? Phthalates are considered Endocrine Disrupting Chemicals.
On the California Safe Cosmetics Program Product Database: DEP, DIDP, and DBP are reported as fragrance while DEHP and DBP are perfume solvents. IFRA lists DEP and DMP, as “reported fragrance ingredients”.**]**

16. *History of the Obesogen Field: Looking Back to Look Forward*

Heindel JJ. History of the Obesogen Field: Looking Back to Look Forward. Front Endocrinol (Lausanne). 2019 Jan 29;10:14. doi: 10.3389/fendo.2019.00014. PMID: 30761083; PMCID: PMC6362096.

Article Link: https://pubmed.ncbi.nlm.nih.gov/30761083/

“Exposure to EDCs during early development (DOHaD) has been shown to **increase susceptibility to a variety of diseases including infertility, asthma, breast and prostate cancer, early puberty, susceptibility to infections, heart disease, autoimmune disease, and attention deficit hyperactivity disorder/learning disability**. The chemicals that she noted as having the ability to cause weight gain include organochlorine pesticides, carbamates, polychlorinated biphenols, plastics such as **phthalates** and bisphenol A (BPA), heavy metals and solvents.**”**

“EDCs are found in a wide variety of products including pesticides/herbicides/fungicides, flame retardants, surfactants, plastics, **sunscreens, cosmetics,** and **personal care products,** etc. [reviewed in (5)].”

“Originally, **EDCs** were shown to interfere with **estrogen, androgen and thyroid hormone signaling (7, 8) resulting in diseases and dysfunctions in reproduction, learning, memory, and behavior.”**

[Note: Endocrine Disrupting Chemicals (EDC’s) are commonly used in perfumes and fragranced products as preservatives or fragrance. What are EDC’s and how can they affect us?**]**

17. *Health risks of chemicals in consumer products: A review*

Li D, Suh S. Health risks of chemicals in consumer products: A review. Environ Int. 2019 Feb;123:580-587. doi: 10.1016/j.envint.2018.12.033. Epub 2019 Jan 7. PMID: 30622082.
Article Link: https://pubmed.ncbi.nlm.nih.gov/30622082/ - Full Text

“It should also be noted that some chemicals have multiple functional uses, while we chose the most dominant functional use for each chemical. An example is the grouping of **phthalates**. Despite categorized as plasticizer together in this review, several phthalates such as **diethyl phthalate and dimethyl phthalate are used as solvents in personal care products and cosmetics as carriers of fragrance** (Schettler, 2006).”

“…we found that the volume of the peer-reviewed literature that addresses human health risks of the chemicals in consumer products did grow over the last two decades, while its growth could by no means match the speed of increasing volume and diversity of the chemicals produced and used in consumer products by the society. This **growing gap between increasing reliance on chemicals in consumer products and our knowledge on their human health risks raises a potential public health concern**, given the pervasive nature of today's mass production and consumption practice.”

18. *Long-Term Outcomes after Phthalate Exposure: Food Intake, Weight Gain, Fat Storage, and Fertility in Mice*

Holtcamp W. Long-term outcomes after phthalate exposure: food intake, weight gain, fat storage, and fertility in mice. Environ Health Perspect. 2012 Aug;120(8):a320. doi: 10.1289/ehp.120-a320a. PMID: 22854284; PMCID: PMC3440097.
Article Link: https://pubmed.ncbi.nlm.nih.gov/22854284/ - PDF

“Exposure to **endocrine-disrupting chemicals (EDCs)**, particularly **in utero**, is suspected to contribute to **obesity**, **diabetes**, **hypertension**, and **reproductive abnormalities**. Di(2-ethylhexyl) phthalate **(DEHP)**, a plasticizer found in **cosmetics**, **fragrances,** food packaging, and polyvinyl chloride, is one such EDC. Human studies have found associations between urinary metabolites of DEHP and other phthalates and **increased body mass** in humans, and maternal exposure to DEHP has been associated with **impaired gonadal development and fertility** in baby boys.”

[Note: Endocrine Disrupting Chemicals (EDC’s) are commonly used in perfumes and fragranced products as preservatives or fragrance. What are EDC’s and how can they affect us?**]**

19. *Endocrine Disruptors and Asthma-Associated Chemicals in Consumer Products*

Dodson RE, Nishioka M, Standley LJ, Perovich LJ, Brody JG, Rudel RA. Endocrine disruptors and asthma-associated chemicals in consumer products. Environ Health Perspect. 2012 Jul;120(7):935-43. doi: 10.1289/ehp.1104052. Epub 2012 Mar 8. PMID: 22398195; PMCID: PMC3404651..

Article Link: https://pubmed.ncbi.nlm.nih.gov/22398195/ - PDF

"Laboratory and human studies raise concerns about endocrine disruption and asthma resulting from exposure to chemicals in consumer products… Analytes included parabens, **phthalates**, bisphenol A (BPA), triclosan, ethanolamines, alkylphenols, **fragrances**, glycol ethers, cyclosiloxanes, and ultraviolet (UV) filters."
"In other products, the highest concentrations and numbers of detects were in fragranced products (e.g., perfume, air fresheners, and **dryer sheets**) and sunscreen."

"**Some products that did not contain the well-known endocrine-disrupting phthalates contained other less-studied phthalates** (dicyclohexyl phthalate, diisononyl phthalate, and di-n-propyl phthalate; also endocrine-disrupting compounds), suggesting a substitution. Many detected chemicals were not listed on product labels."

"**Endocrine Disrupting compounds (EDCs) are chemicals that can alter hormonal signaling and have potential effects on developing reproductive and nervous systems, metabolism, and cancer** (Colborn et al. 1993). Some phthalates inhibit testosterone synthesis (Howdeshell et al. 2008)..."

"**Fragrances have been shown to exacerbate asthma**. …The phthalate bis(2-ethylhexyl) **phthalate (DEHP)** in dust was associated with **asthma and wheezing in children**…"

"Our results also indicate that use of multiple products can lead to **exposure to an even larger mixture of compounds,** even if a consumer selected products considered alternative according to our criteria. For example, a consumer who used the alternative surface cleaner, tub and tile cleaner, **laundry detergent**, bar soap, shampoo and conditioner, facial cleanser and lotion, and toothpaste (a plausible array of product types for an individual) would potentially be exposed to at least 19 compounds: two parabens, three **phthalates**, MEA, DEA, five alkylphenols, and seven **fragrances**."

[Note: Fragrance chemicals listed in Figure 1 are: Benzylacetate, Eugenol, Hexyl cinnemal, Limonene, Linalool, Methyl eugenol, Methyl salicylate, Pinene, Terpineol, AHTN, Bucina,l Diphenyl ether, DPMI, HHCB, Isobornyl acetate, Methyl ionone, Musk ketone, Musk xylene, Phenethyl alcohol**]**
[Note: Endocrine Disrupting Chemicals (EDC's) are commonly used in perfumes and fragranced products as preservatives or fragrance. What are EDC's and how can they affect us?**]**

[Note: Phthalates are synthetic odorless plasticizers used as solvents, binders or fixatives in many fragrances. Why are phthalates in the news? Phthalates are considered Endocrine Disrupting Chemicals.
On the California Safe Cosmetics Program Product Database: DEP, DIDP, and DBP are reported as fragrance while DEHP and DBP are perfume solvents. IFRA lists DEP and DMP, as "reported fragrance ingredients".**]**

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"**VOCs** are components of FHPs (feminine hygiene products) that **are added as fragrances**, adsorbents, moisture barriers, adhesives, and binders…Most of the larger non-target peaks were identified as **fragrances, such as linalool, eucalyptol and benzyl acetate**. Feminine hygiene products (FHPs) are used on highly permeable and sensitive vaginal and vulvar tissues by many women. These products contain a variety of chemicals, and few regulations require disclosure of their ingredients…."

"Products labeled as "organic," "natural," or "for sensitive skin" did not necessarily have lower VOC concentrations**….menstrual pads had hazard ratios** of up to 11, **sprays and powders** had hazard ratios of up to 2.2 and excess cancer risks of up to 2.1 × 10−6, and **washes** had **excess cancer risks** of up to 3.3 × 10−6. Our data suggest that **all tested FHPs contained some toxic VOCs**..."

"…a recent study…reported a statistically significant and positive relationship between the frequency of **vaginal douching** (presumably using feminine washes) and whole blood concentrations of **1,4-dichlorobenzene** among women aged 20–49 years, a concern given the **toxicity of this VOC**."

"Exposure to high concentrations or long-term exposure of VOCs has been associated with many known or suspected effects including **irritation to eyes, skin and nose**; **damage to the respiratory system, liver and kidney; reproductive effects**; and **carcinogenicity**"

"Examples of notable VOCs include **benzene**, a known carcinogen (US EPA, 1998), 1,4-dioxane, a likely carcinogen (US EPA, 2013), and naphthalene, a possible carcinogen due to possible genetic toxicity (Schreiner, 2003; US EPA, 1999). Health risks (carcinogenic or non-carcinogenic) related to the use of FHPs over the lifecourse remain unanswered."

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"The estimated exposure doses of **phthalates**, parabens, and bisphenols through the dermal absorption pathway from the use of pads, panty liners, and tampons were significant."

"Elevated exposure to phthalates has been associated with **precocious puberty, endometriosis, female genital tumors,** and **ovulation disorders.** …**high concentrations phthalates have been measured in sanitary pads.**"

"In addition, pads, panty liners, and tampons are made from polypropylene (PP) and polyethylene (PE) materials, which can contain plasticizers such as phthalates, to increase the products' flexibility. Dimethyl phthalate* (DMP), **diethyl phthalate* (DEP), dibutyl phthalate* (DBP)**, **di-iso-butyl phthalate (DIBP),**

di(2-ethylhexyl) **phthalate* (DEHP),** methyl paraben (MeP), and ethyl paraben (EtP) were found in all pad, panty liner, and tampon samples."

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22. *Sanitary pads and diapers contain higher phthalate contents than those in common commercial plastic products*

Park CJ, Barakat R, Ulanov A, Li Z, Lin PC, Chiu K, Zhou S, Perez P, Lee J, Flaws J, Ko CJ. Sanitary pads and diapers contain higher phthalate contents than those in common commercial plastic products. Reprod Toxicol. 2019 Mar;84:114-121. doi: 10.1016/j.reprotox.2019.01.005. Epub 2019 Jan 16. PMID: 30659930; PMCID: PMC6504186.
Article Link: https://pubmed.ncbi.nlm.nih.gov/30659930/

"VOCs increase the risk for neurocognitive impairment, asthma, congenital disability, and cancer. Notably, exposure to methylene chloride, **toluene**, and **xylene** are known to **negatively affect the development and function of reproductive system**."

"…sanitary pads in direct contact with the skin around the external genitalia were likely causing **menstrual irregularities.** The skin of this area tends to be thinner and more absorbent than those…such as the hands."
"Exposure to phthalates is known to **affect the development and functions of the cardiovascular, reproductive and endocrine systems**."

"...daily absorption of **toluene** from sanitary pad reached to the maximum of 38.4% RfD. **Given the fact that women are exposed to various chemicals through various routes, consideration should be given to the risks of chemicals that are additionally absorbed from the sanitary pad."**

[Note: Phthalates are synthetic odorless plasticizers used as solvents, binders or fixatives in many fragrances. Why are phthalates in the news? Phthalates are considered Endocrine Disrupting Chemicals.
On the California Safe Cosmetics Program Product Database: DEP, DIDP, and DBP are reported as fragrance while DEHP and DBP are perfume solvents. IFRA lists DEP and DMP, as "reported fragrance ingredients".**]**

[Note: Toluene (often a nail polish thinner) is used as a solvent or fragrance in perfume and bath products on the CSPC Product Database. Toluene is on the IFRA list and on the EPA's Priority Pollutant List.**]**

23. *Emission characteristics of VOCs emitted from consumer and commercial products and their ozone formation potential*

Dinh TV, Kim SY, Son YS, Choi IY, Park SR, Sunwoo Y, Kim JC. Emission characteristics of VOCs emitted from consumer and commercial products and their ozone formation potential. Environ Sci Pollut Res Int. 2015 Jun;22(12):9345-55. doi: 10.1007/s11356-015-4092-8. Epub 2015 Jan 21. PMID: 25601614.
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"The characteristics of volatile organic compounds (VOCs) emitted from several consumer and commercial products (**body wash**, dishwashing detergent, air freshener, windshield washer fluid, lubricant, hair spray, and

insecticide) were studied and compared."

"In the spray products, 21.6–96.4 % of the VOCs were propane, iso-butane, and n-butane, which are the components of liquefied petroleum gas. **Monoterpene** (C10H16) was the dominant component of the VOCs in the non-spray products (e.g., body wash, 53–88 %)."

"Besides comprising **hazardous VOCs**, VOCs from consumer products were also **ozone precursors**."
"The TVOCs from spray products (insecticide, **hair spray**, and lubricant) were higher than those from the liquid products such as the windshield washer fluid, dishwashing detergent, **body wash**, and air freshener."

"Limonene and 1-propanol were the components of one dishwashing detergent. In contrast, another dishwashing detergent comprised **1,3-dioxane**, **ethanol**, **ethyl acetate**, **limonene**, **β-myrcene**, 3-pentanol, and **α-pinene** (Kwon et al. 2007, 2008)."

"**Benzene, n-hexane,** and **ethylbenzene** were observed in the **body washes** and the **air fresheners.** Benzene was classified as Group A of the US EPA lists of **known human carcinogen** (WHO 2010). The unit cancer risk of 1 μg/m3 of benzene is 2.2–7.8 in a million (WHO 2010). The unit risk of **leukemia** per 1 μg/m3 air concentration is 6 in a million. Therefore, **long-term exposure to a considerable amount of benzene in those products might cause health risk,** which should be investigated in future researchers."

"A **longterm exposure of n-hexane may damage the nervous system**. Exposure to 650 ppm **n-hexane** for 2–4 months causes numbness of the arms and legs (Pohanish 2012). **Ethylbenzene** irritates the eyes, skin, and respiratory tract. A **long-term exposure of ethylbenzene may cause kidney and liver disease**…."

"**Toluene and styrene were detected in body washes,** dishwashing detergents, and windshield washer fluids. It was reported that inhalation of 200–500 ppm **toluene may cause headache, nausea, and loss of appetite** (Pohanish 2012)."

"Styrene is considered as a possible carcinogenic to humans. Inhalation of above 100 ppm **styrene may cause headache, inflammation of the lung, kidney and liver damage, and death** (Pohanish 2012). Since **body washes** are used popularly and frequently, **longterm exposure to the above compounds may cause health damage.**"

[Note: Limonene is a common skin sensitizer and known allergen in fragrance and fragranced products. Limonene (natural or synthetic) is a terpene. Terpenes can create formaldehyde and particulate matter in air as secondary pollutants. Limonene is on the IFRA list as a fragrance ingredient.**]**
[Note: Benzene is a reported fragrance ingredient in the CSCP Product Database.**]**

[Note: N-Hexane is used to extract fragrances and was on the IFRA list until 2015.**]**
[Note: Toluene (often a nail polish thinner) is used as a solvent or fragrance in perfume and bath products on the CSPC Product Database. Toluene is on the IFRA list and on the EPA's Priority Pollutant List.**]**

[Note: Styrene is "primarily a synthetic chemical**"** used in fragrance. It is on the CSPC list as 'parfum/fragrance' and also on the IFRA list.**]**
[Note: Ethyl benzene is listed for purchase as a perfuming agent.**]**

24. *Developmental Exposure to Endocrine Disrupting Chemicals and Its Impact on Cardio-Metabolic-Renal Health*

Singh RD, Koshta K, Tiwari R, Khan H, Sharma V, Srivastava V. Developmental Exposure to Endocrine Disrupting Chemicals and Its Impact on Cardio-Metabolic-Renal Health. Front Toxicol. 2021 Jul 5;3:663372. doi: 10.3389/ftox.2021.663372. PMID: 35295127; PMCID: PMC8915840.

Article Link: https://pubmed.ncbi.nlm.nih.gov/35295127/ - Free Full Text

"**Endocrine disrupting chemicals** (EDCs) include **phenols**, **phthalates**, parabens, flame retardants, heavy metals, pesticides, perfluorinated chemicals, UV filter components, triclosan, and organochlorines."

"**Cumulative exposure to mixtures of EDCs can lead to adverse effects on the health of the exposed individuals** (Crews et al., 2003). Multiple studies, including the studies of the National Health and Nutrition Examination Survey (NHANES), have shown that **about 75–97% of US and Asian adults have detectable levels of phthalates and phenols [bisphenol A (BPA) and polyfluoroalkyl chemicals] in their urine** (Silva et al., 2004; Calafat et al., 2007, 2008; Vandenberg et al., 2010; Zhang et al., 2011; Husøy et al., 2019)."

"Epidemiological and experimental studies have also linked **adult exposure to EDCs** with **abnormal male and female reproductive health**, **diabetes**, **obesity**, **cardiovascular** and **metabolic disorders**, **thyroid function**, and **hormone sensitive cancers** (Howard and Lee, 2012; Bodin et al., 2015; Heindel et al., 2015, 2017)."

"Children are also vulnerable to EDCs (Calafat et al., 2017; Hendryx and Luo, 2018), **making EDC exposure a major health concern for all age groups**."

"**Chronic kidney disease** is a growing health problem among children and adults. The incidence and the prevalence of chronic kidney disease (CKD) **among children have been steadily increasing since the 1980s**…. A number of traditional risk factors associated with CKD in children include hypertension, obesity, diabetes, and aberrant divalent mineral metabolism…. There is growing evidence that **links exposure to EDCs with early progression to end-stage renal disease** (ESRD) (Kataria et al., 2015)...."

"Early-life exposure to EDCs was associated with elevated levels of kidney toxicity markers such as albumin-to-creatinine ratio (ACR), estimated glomerular filtration rate (eGFR), and urinary protein-to-creatinine ratio (UPCR) in some human population studies (Li et al., 2012; Trasande et al., 2013a, 2014; Malits et al., 2018)."

[Note: Phthalates are synthetic odorless plasticizers used as solvents, binders or fixatives in many fragrances. Why are phthalates in the news? Phthalates are considered Endocrine Disrupting Chemicals.
On the California Safe Cosmetics Program Product Database: DEP, DIDP, and DBP are reported as fragrance while DEHP and DBP are perfume solvents. IFRA lists DEP and DMP, as "reported fragrance ingredients".**]**

[Note: Endocrine Disrupting Chemicals (EDC's) are commonly used in perfumes and fragranced products as preservatives or fragrance. What are EDC's and how can they affect us?**]**

25. ALSO SEE SECTIONS: Airborne Contact Dermatitis, Respiratory/Pulmonary (Nose & Lungs), Liver Disease, Cardiovascular, Inflammation

Back to top of Cancer **Back to Table of Contents**

Website: https://www.fragrancefreecoalitionusa.com/

Endocrine Disruptors and Prostate Cancer

Corti M, Lorenzetti S, Ubaldi A, Zilli R, Marcoccia D. Endocrine Disruptors and Prostate Cancer. Int J Mol Sci. 2022 Jan 21;23(3):1216. doi: 10.3390/ijms23031216. PMID: 35163140; PMCID: PMC8835300.
Article Link: https://pubmed.ncbi.nlm.nih.gov/35163140/

"The established risk factors for PCa are mainly the age and the race of the individuals. For example, African Americans are twice as likely as European individuals to develop or die from PCa [19]. Other factors, such as genetics (family history), diet, and **environmental factors** can also have an impact on PCa risk [20]. These also include **endocrine disruptors (EDs),** defined as exogenous substances or a mixture that "alters function(s) of the endocrine system, causing adverse health effects in an intact organism, or its progeny, or in a (sub)populations" [21]."

"The main exposure to these contaminants occurs through the intake of contaminated water and food, but can also be taken through other sources, such as direct dermal contact or **inhalation of polluted air** [22, 23]"

Endocrine disrupting chemicals and breast cancer cells.

Darbre PD. Endocrine disrupting chemicals and breast cancer cells. Adv Pharmacol. 2021;92:485-520. doi: 10.1016/bs.apha.2021.04.006. Epub 2021 Jul 28. PMID: 34452695.
Article Link: https://pubmed.ncbi.nlm.nih.gov/34452695/

"Many hundreds of endocrine disrupting chemicals (EDCs) have been measured as entering human breast tissue from a range of environmental sources, and this review focuses on discussion of mechanisms by which such EDCs may be contributing to the globally rising incidence of breast cancer."

"Despite the complexity, EDCs do need to now be acknowledged as a risk factor for breast cancer in order for preventative strategies to include reduction in EDC exposure."

Reduction of daily-use parabens and phthalates reverses accumulation of cancer-associated phenotypes within disease-free breast tissue of study subjects.

Study where women had stopped using products with parabens and phthalates for just 28 days and what happened is their breast cancer cells actually reversed cancer-associated gene expressions. So by simply removing these toxic chemicals from daily routines they were able to switch off genes linked to breast cancer.

Dairkee SH, Moore DH, Luciani MG, Anderle N, Gerona R, Ky K, Torres SM, Marshall PV, Goodson Iii WH. Reduction of daily-use parabens and phthalates reverses accumulation of cancer-associated phenotypes within disease-free breast tissue of study subjects. Chemosphere. 2023 May;322:138014. doi: 10.1016/j.chemosphere.2023.138014. Epub 2023 Feb 4. PMID: 36746253.
Article Link: https://pubmed.ncbi.nlm.nih.gov/36746253/

The mutagenic forces shaping the genomic landscape of lung cancer in never smokers.

NIH study links particulate air pollution to increased mutations in lung cancers among nonsmokers

Whole-genome sequencing study found air pollution to cause more cancer-related changes than secondhand smoke.

Díaz-Gay M, Zhang T, Hoang PH, Khandekar A, Zhao W, Steele CD, Otlu B, Nandi SP, Vangara R, Bergstrom EN, Kazachkova M, Pich O, Swanton C, Hsiung CA, Chang IS, Wong MP, Leung KC, Sang J, McElderry J, Yang L, Nowak MA, Shi J, Rothman N, Wedge DC, Homer R, Yang SR, Lan Q, Zhu B, Chanock SJ, Alexandrov LB, Landi MT. The mutagenic forces shaping the genomic landscape of lung cancer in never smokers. medRxiv [Preprint]. 2024 May 17:2024.05.15.24307318. doi: 10.1101/2024.05.15.24307318. PMID: 38798417; PMCID: PMC11118654.
Article Link: https://pubmed.ncbi.nlm.nih.gov/38798417/

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CARDIOVASCULAR

Fainting, Tremors, Jitteriness, High Blood Pressure / Hypertension
Fast or Irregular Heartbeat, Chest Discomfort, Chest Tightness, Ventricular Fibrillation

1. *Phthalate Exposure Changes the Metabolic Profile of Cardiac Muscle Cells*

Posnack NG, Swift LM, Kay MW, Lee NH, Sarvazyan N. Phthalate exposure changes the metabolic profile of cardiac muscle cells. Environ Health Perspect. 2012 Sep;120(9):1243-51. doi: 10.1289/ehp.1205056. Epub 2012 Jun 6. PMID: 22672789; PMCID: PMC3440133.
Article Link: https://pubmed.ncbi.nlm.nih.gov/22672789/ - PDF

"Data suggest that **DEHP** exposure results in metabolic remodeling of cardiomyocytes, whereby cardiac cells increase their dependence on fatty acids for energy production. This fuel switch may be regulated at both the gene expression and post transcription levels. Our findings have important clinical implications because chronic dependence on fatty acids is associated with an accumulation in lipid intermediates, lactate, protons, and reactive oxygen species. This dependence can sensitize the **heart** to **ischemic injury** and **ventricular dysfunction**."

[Note: Phthalates are synthetic odorless plasticizers used as solvents, binders or fixatives in many fragrances. Why are phthalates in the news? Phthalates are considered Endocrine Disrupting Chemicals.
On the California Safe Cosmetics Program Product Database: DEP, DIDP, and DBP are reported as fragrance while DEHP and DBP are perfume solvents. IFRA lists DEP and DMP, as "reported fragrance ingredients".**]**

2. *Physical and psychological stress along with candle fumes induced - cardiopulmonary injury mimicking restaurant kitchen workers*

Chandrasekaran VRM, Periasamy S, Chien SP, Tseng CH, Tsai PJ, Liu MY. Physical and psychological stress along with candle fumes induced-cardiopulmonary injury mimicking restaurant kitchen workers. Curr Res Toxicol. 2021 Jul 12;2:246-253. doi: 10.1016/j.crtox.2021.07.001. PMID: 34345867; PMCID: PMC8320639.
Article Link: https://pubmed.ncbi.nlm.nih.gov/34345867/ - PDF

"Social disruption stress (SDR) mice were exposed to scented candle fumes (4.5 h/d, 5 d/wk) in an exposure chamber for 8 weeks. Exposure to **burning scented candles failed to reduce serum corticosterone level and increased proinflammatory cytokines levels and NF-κB activity in the lung**. In the present study, we evaluated the role of SDR in combination with exposure to scented candles as generally accepted to reduce stress. However, the **combined SDR and scented candle exposure were found to escalate the stress level.** This stress escalation might be due to the **cardiopulmonary inflammatory response** of the stress and candle fumes, which could be directly related to restaurant workers."

3. *Characterization of air freshener emission: the potential health effect*

Kim S, Hong SH, Bong CK, Cho MH. Characterization of air freshener emission: the potential health effects. J Toxicol Sci. 2015;40(5):535-50. doi: 10.2131/jts.40.535. PMID: 26354370.
Article Link: https://pubmed.ncbi.nlm.nih.gov/26354370/ - PDF

“The use of these products (air fresheners) may be associated with an increase in the measured level of **terpene**, such as **xylene** and other volatile air freshener components, including **aldehydes**, and **esters**. Air freshener is usually used indoors, and thus some compounds emitted from air freshener may have potentially harmful health impacts, including **sensory irritation**, **respiratory symptoms**, and **dysfunction of the lungs**.”

“**The constituents of air fresheners can react with ozone to produce secondary pollutants such as formaldehyde, secondary organic aerosol (SOA), oxidative product, and ultrafine particles.** These pollutants then adversely affect human health, in many ways such as **damage to the central nervous system, alteration of hormone levels,** etc. In particular, the ultrafine particles may induce **severe adverse effects on diverse organs**, including the **pulmonary and cardiovascular systems.”**

“This review suggests that exposure to air freshener compounds, such as **VOCs that react with ozone to form secondary pollutants**, cause diverse health issues. In addition, **several key compounds such as benzene, terpenes, and phthalate etc. of air pollutants are related to air freshener use**. **We suggest that the use of air fresheners should be avoided**, and there is a need to reduce chemical components which are potentially reactive with ozone in air fresheners.”

[Note: Fragrance is considered the new ‘second hand smoke’, **“**The parallels between second-hand smoke and synthetic fragrance use are many. At its core, both are battles over indoor air quality **“** - quote and link from De Vader, Christy L. & Barker, Paxson.
Chemicals that cigarettes/cigarette smoke and fragranced products can have in common are: Acetone, Formaldehyde, Benzene, acetaldehyde, terpenoids and phenols.**]**

4. *Obesogenic endocrine disrupting chemicals: identifying knowledge gaps*

Veiga-Lopez A, Pu Y, Gingrich J, Padmanabhan V. Obesogenic Endocrine Disrupting Chemicals: Identifying Knowledge Gaps. Trends Endocrinol Metab. 2018 Sep;29(9):607-625. doi: 10.1016/j.tem.2018.06.003. Epub 2018 Jul 13. PMID: 30017741; PMCID: PMC6098722.
Article Link: https://pubmed.ncbi.nlm.nih.gov/30017741/ - PDF

“**EDCs are chemicals that interfere with the endocrine system**, including **adipose tissue.** Historically considered as an organ whose main function is energy storage, the adipose tissue secretes numerous hormones and other factors such as leptin, adiponectin, resistin, adipsin, angiotensin, and free fatty acids. These are involved in a broad range of physiological actions including **glucose and lipid metabolism**, **appetite control**, **vascular tone control**, **angiogenesis**, and **immunity** [11]. EDCs that not only increase adipose mass / adipogenesis but also result in other **metabolic dysfunctions** are also referred to as **metabolic disrupting chemicals** (MDCs) [12].”

“Diesters of 1,2-benzenedicarboxylic acid, or **phthalates**, are used as industrial plasticizers of polyvinyl chloride to be used in floorings, vinyl upholstery, **car interiors**, and **toys** [72], plastic food packaging [73], as well as in **cosmetic products** such as **lotions and perfumes** [74]....”

The CHAMACOS cohort study reported a positive association between early life exposure (at 14 and 26 weeks of gestation) to **diethyl phthalate (DEP)**, **dibutyl phthalate (DBP)** and **di-(2-ethylhexyl)-phthalate (DEHP)** and **increase in childhood body weight, BMI, waist circumference,** and **percent body fat in 5–12 year old children,** supportive of **phthalates being developmental obesogens** [78].”

“Another study also found a positive association between mono-3-carboxypropyl phthalate at 27 to 34 weeks of gestation and **overweight/obese status in 4–7 year-old children** [79].”

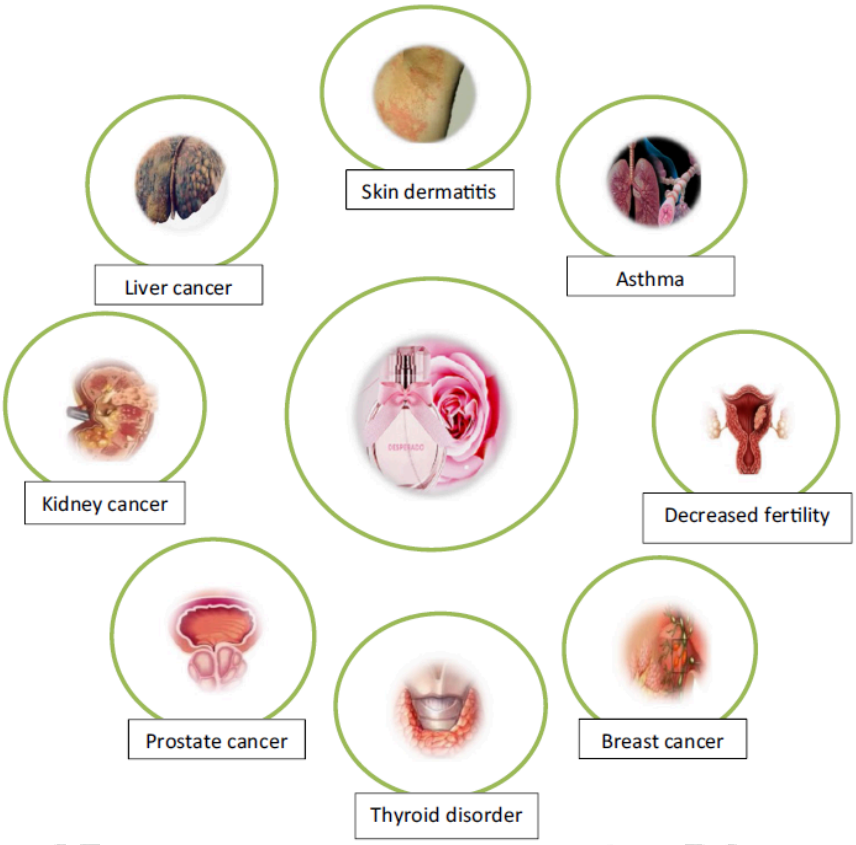
5. *Evaluation of pollutants in perfumes, colognes and health effects on the consumer: a systematic review*

Kazemi Z, Aboutaleb E, Shahsavani A, Kermani M, Kazemi Z. Evaluation of pollutants in perfumes, colognes and health effects on the consumer: a systematic review. J Environ Health Sci Eng. 2022 Feb 3;20(1):589-598. doi: 10.1007/s40201-021-00783-x. PMID: 35669814; PMCID: PMC9163252.

Article Link: https://pubmed.ncbi.nlm.nih.gov/35669814/ - PDF

(Note: Graphic is from preceding article**) (**Creative Commons Attribution 4.0 International license**).**

Fig. 2 Effects of exposure to perfumes and colognes



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“Diethyl phthalate is a chemical used to **make perfumes last longer.** The U.S. Clean Water Act lists it as a **toxic** and priority pollutant.”

“Complications of using perfume include **neuropathy (depression, autism), neoplasms (breast cancer, prostate cancer), effects on the liver, migraine headaches, asthma attacks, mucosal symptoms (watery**

or red eyes, sneezing), neurological problems (dizziness, convulsions, headache, fainting, imbalance), respiratory (cough, shortness of breath), skin (skin rash, urticaria, redness of the skin, skin tingling, dermatitis), immune system (swollen lymph nodes, fever, fatigue), gastrointestinal tract (nausea, bloating, diarrhea) and c**ardiovascular (rapid** or **irregular heartbeat, tremors, chest discomfort**)"

"**Contaminants in perfumes and colognes** and their health effects on the consumer were systematically reviewed. It was found that the most attention of researchers was to identify the compounds in perfumes and colognes and their concentrations. Among the most common pollutants **phthalates** and their derivatives can be mentioned. Other pollutants included **parabens, triclosan, salicylates, terpenes, aldehydes, benzene, toluene, styrene, and aluminum-based salts**. These pollutants have also been shown to have adverse effects on consumer health such as **asthma and allergies, cardiovascular disease, central nervous system damage, breast cancer, endocrine cancer, respiratory disorders, reproduction, thyroid, adrenal gland function and immune system."**

[Note: Graphic lists "effects of exposure to perfumes and colognes": Kidney Cancer, Liver Cancer, Prostate Cancer, Thyroid Disorder, Breast Cancer, Decreased Fertility, Asthma and Skin Dermatitis.**]**

6. *Indoor Exposure to Selected Air Pollutants in the Home Environment:* A Systematic Review

Vardoulakis S, Giagloglou E, Steinle S, Davis A, Sleeuwenhoek A, Galea KS, Dixon K, Crawford JO. Indoor Exposure to Selected Air Pollutants in the Home Environment: A Systematic Review. Int J Environ Res Public Health. 2020 Dec 2;17(23):8972. doi: 10.3390/ijerph17238972. PMID: 33276576; PMCID: PMC7729884.

Article Link: https://pubmed.ncbi.nlm.nih.gov/33276576/ - PDF

"There is increasing awareness that the quality of the **indoor environment** affects our health and well-being…. Identified indoor **$PM_{2.5}$** sources include smoking, cooking, heating, use of **incense, candles,** and **insecticides**, while **cleaning**, housework, presence of pets and movement of people were the main sources of coarse particles….Household characteristics and occupant activities play a large role in indoor exposure, particularly cigarette smoking for PM2.5, gas appliances for NO2, and **household products** for **VOCs** and PAHs."

"Typical **VOCs** found in the indoor environment include **benzene**, **toluene**, **ethylbenzene** and **xylenes (BTEX)** from fuel combustion and evaporation, and house renovations; benzene and **styrene** from cigarette smoking; alkanes from natural gas; 1,4-dichlorobenzene from moth repellents; **a-pinene** from wood-based building materials; and **limonene** from **fragranced** household **cleaning and laundry products**… Reported **VOC concentrations were generally higher indoors than outdoors**, including for **benzene**, particularly in colder seasons due to reduced ventilation and the use of oil and gas heaters."

"Indoor sources were dominant for most **VOCs** and particularly for **limonene, a-pinene, hexanal**, pentanal, **o-xylene**, and **n-dodecane**. Use of **artificial air freshener was significantly associated with total VOC (TVOC), benzene**, **toluene** and **ethylbenzene**."

"Indoor air quality (IAQ) in particular has an impact on multiple health outcomes, including **respiratory** and **cardiovascular illness, allergic symptoms, cancers,** and **premature mortality."**

7. *Spermatotoxicity in Animal Models Exposed to Fragrance Components*

Akunna GG, Saalu LG, Ogunlade B. Enye LA., (2014). Spermatotoxicity in Animal Models Exposed to Fragrance Components. Journal of Medical Sciences, 14: 46-50.

Article Link: https://scialert.net/fulltext/?doi=jms.2014.46.50 - PDF

"Various commonly-used products have been reported to contain chemicals that could **disrupt estrogen and testosterone hormone**. …The results obtained from this study showed a significant ($p<0.005$) decrease in body weight and absolute testicular weight of the rat models exposed to fragrance when compared to the control groups. It was also observed that the concentration, mobility, livability and morphology of spermatozoa from groups C, D, E and F were significantly lower ($p>0.005$) when compared to values of the control group A and B. Based on the spermiographic evaluation from this study, fragrance materials could have an adverse effect on spermatozoa of the intact male wistar rats."

"**It has been reported that through inhalation, ingestion and absorption, fragrance infiltrates the body and moves directly to the blood stream.** … Symptoms ranging from **severe mucosal discharge, sinus problems, tremor, asthmatic attack, sneezing, migraine headache, convulsions, hyperactivity, nausea, sore throat, cough, chest tightness to shortness of breath** after fragrance exposure have been vastly documented (Guin and Berry, 1980; De Groot, 1987; Schleuter et al., 1978)."

"Unswerving connection between memory and smell has been established (Rachel and Engen, 1996). This knowledge has resulted in **placement of fragrance in the category of psychoactive drugs and highlighted the ability of fragrance to cross the brain barrier thereby resulting in potential damage to brain tissue** (Andrea, 1997). **Linalool**, the most abundant fragrance substance has been indicated to cause **lethargy**, **depression** and **severe respiratory difficulties after exposure**."

8. *Obesogens: How They Are Identified and Molecular Mechanisms Underlying Their Action*

Mohajer N, Du CY, Checkcinco C, Blumberg B. Obesogens: How They Are Identified and Molecular Mechanisms Underlying Their Action. Front Endocrinol (Lausanne). 2021 Nov 25;12:780888. doi: 10.3389/fendo.2021.780888. PMID: 34899613; PMCID: PMC8655100.

Article Link: https://pubmed.ncbi.nlm.nih.gov/34899613/ - PDF

"Increasing evidence has linked chemical exposure, ingestion, and inhalation of industrial compounds to obesity and other metabolic and endocrine related diseases."

" A subset of **EDCs act as obesogens** – chemicals that lead to increased fat storage, in vivo after exposure [reviewed in (22–24)]. The environmental obesogen model proposes that obesogens cause greater susceptibility to weight gain, lipid storage, and energy imbalances that lead to obesity (25). In 2015, the Parma consensus broadened the definition of obesogens to include EDCs that affect other obesity related metabolic conditions that drive **metabolic syndrome**, such as **insulin resistance**, **hypertension**, **dyslipidemia**, and **hyperglycemia** (26).… Many chemical obesogens have been identified and numerous reviews have been written about them in recent years (22–24, 28). "

"Obesity Is More Than Calories In/Out"

"**Dibutyl phthalate (DBP)** is a plasticizer found in plastic products such as toothbrushes, food wrappers, and in common household items as a **fragrance-enhancing additive**. DBP is a known EDC and obesogen that can affect fat accumulation and metabolic processes. DBP activates multiple receptors including the estrogen receptor, constitutive androstane receptor (CAR), the pregnane X receptor (PXR), and peroxisome proliferator-activated receptor subtypes (PPARα, -β, and -γ), which regulate the expression of genes encoding metabolic enzymes."

"The study of EDCs offers insights into how normal metabolic processes can be disrupted, and why the population is becoming unhealthier, particularly with respect to **metabolic disease**."

"Avoidance of exposure through ingestion, inhalation, and direct contact is a definitive way to prevent metabolic disruption caused by EDCs before disease develops. In vivo transgenerational studies, which were only briefly discussed in this review, revealed **epigenomic reprogramming** effects and **phenotypical metabolic effects**…. The existence of such "generational toxicity" demands further education about exposure prevention and transparency to keep the public and future generations safe from the effects of exposure to harmful chemicals."

[Note: Table 1 from this article mentions Tonalide, "a musk compound used as a synthetic perfume".**]**
[Note: Endocrine Disrupting Chemicals (EDC's) are commonly used in perfumes and fragranced products as preservatives or fragrance. What are EDC's and how can they affect us?**]**

[Note: Phthalates are synthetic odorless plasticizers used as solvents, binders or fixatives in many fragrances. Why are phthalates in the news? Phthalates are considered Endocrine Disrupting Chemicals.
On the California Safe Cosmetics Program Product Database: DEP, DIDP, and DBP are reported as fragrance while DEHP and DBP are perfume solvents. IFRA lists DEP and DMP, as "reported fragrance ingredients".**]**

9. Fragrance compounds: The wolves in sheep's clothings

Patel S. Fragrance compounds: The wolves in sheep's clothings. Med Hypotheses. 2017 May;102:106-111. doi: 10.1016/j.mehy.2017.03.025. Epub 2017 Mar 22. PMID: 28478814.
Article Title: https://pubmed.ncbi.nlm.nih.gov/28478814/

"It is deplorable and alarming that awareness of the threats of perfume allergy is very low. Tricked by aggressive advertisement and to improve aesthetic appeal, people are exposing themselves to multiple chemical fragrance compounds. Further, it is a matter of concern that an alert individual cannot escape the perils of fragrances by mere lifestyle revision, and avoidance of the chemicals. Like the harms of passive smoking, passive exposure to the perfumes occurs in a number of public places. In realization of the dangers of peanut allergy to vulnerable individuals, peanut was pulled off from the food platter in passenger planes. Similar awareness and action is needed for perfumes as well…. An aware individual does not deserve to get the brunt of someone else's reckless lifestyle choices. Also, the cleaning staff in public places must be trained so as to ensure prevention of perfume abuse i.e. excess usage."

"A study found traces of **musk fragrances** such as **galaxolide**, **tonalide**, **cashmeran,** and UV-filters in marine species (mussel, clam, flounder, herring and mullet) and macroalgae, which constitute seafood. These **bioaccumulated xenobiotics** will ultimately reach to the human body via the food chain"

“Perfume manufacturers do not disclose the ingredients and quantity of the fragrance compounds in the name of ‘trade secret’. Though they ought to abide by ethics, for profit and the goals of high market share, they forgo those. With the help of unscrupulous advertisements and sponsored research reports, they keep luring naive and unaware consumers…. It is appalling that even if people know the threats, they continue using these toxins, resonating the ‘‘death wish” concept discussed in the popular TV series ‘‘Mad men”.... The fragrance compounds so ubiquitous in modern times initiate vicious cycles of ‘exposure – pathologies – drugs’, which must be understood, information disseminated and terminated. Based on the review work and hypotheses, it can be stated that perfumes and other fragrance compounds in day-to-day consumer products are ‘slow killers with fatal punch’.

“Growing recognition of the widespread use of fragrances in modern society is alarming. These pleasant-seeming deleterious compounds are the causal factors of a wide array of **immuneneural**- **hormonal health issues**. **Allergy**, **irritation**, **migraine**, **asthma**, **depression**, **high blood pressure**, **diabetes** and other symptoms should not be trivialized. Unheeded, and continued, the fragrance compounds can lead to **gynaecomastia**, **cancers**, **gender manipulation**, **teratogenicity**.”

“**Creating public awareness is essential to avoid grave health consequences**. Toxicology research on perfumes must be prioritized, just like other urgent topics like ‘antibiotics-drug resistance’ and ‘pesticide-food safety’. This review ‘though barely scratches the surface’ of the enormous health threats of ‘synthetic fragrances’ is expected to evoke alertness.”
[Note: Gynaecomastia is enlarged male breast tissue**]**

10. *Immune System: An Emerging Player in Mediating Effects of Endocrine Disruptors on Metabolic Health*

Bansal A, Henao-Mejia J, Simmons RA. Immune System: An Emerging Player in Mediating Effects of Endocrine Disruptors on Metabolic Health. Endocrinology. 2018 Jan 1;159(1):32-45. doi: 10.1210/en.2017-00882. PMID: 29145569; PMCID: PMC5761609.
Article Link: https://pubmed.ncbi.nlm.nih.gov/29145569/ - Full Article

“The incidence of metabolic disorders like type 2 diabetes and obesity continues to increase. In addition to the well-known contributors to these disorders, such as food intake and sedentary lifestyle, recent research in the exposure science discipline provides evidence that exposure to endocrine-disrupting chemicals like bisphenol A and **phthalates** via multiple routes (e.g., food, drink, **skin contact**) also contribute to the increased risk of metabolic disorders. Endocrine-disrupting chemicals (EDCs) can disrupt any aspect of hormone action. It is becoming increasingly clear that **EDCs** not only affect **endocrine function** but also **adversely affect immune system function.”**

“Similarly, EDCs have been shown to increase endoplasmic reticulum stress in in vitro and in vivo studies involving kidney (104), pancreas (105, 106), and liver (107). Mitochondrial dysfunction and endoplasmic reticulum stress are associated with increased oxidative stress (108) and metabolic dysfunction (109). Increased oxidative stress can activate various inflammatory pathways and increases the risk of metabolic abnormalities such as **insulin resistance**, **diabetes**, and **obesity** (Fig. 3).”

“Possible routes of EDC action on the immune system contributing to metabolic disorders. **By interacting with various receptors, altering the gut microbiome, inducing oxidative stress via mitochondrial dysfunction and/or endoplasmic reticulum stress, or via circadian disruption, EDCs trigger immune**

dysfunction in various tissues. Together, this may contribute toward a perturbed metabolic health. See Fig. 3 legend for expansion of abbreviation

[Note: Endocrine Disrupting Chemicals (EDC's) are commonly used in perfumes and fragranced products as preservatives or fragrance. What are EDC's and how can they affect us?**]**

11. *Toxic Chemicals Emitted from Air fresheners & Disinfectants*

Geetha Balasubramani, Paul Pradeep, J Nisitha S. Toxic Chemicals Emitted from Air fresheners & Disinfectants. IJRASET. Volume 10 Issue X Oct 2022, Pgs 1338-1345. ISSN : 2321-9653 IJRASET47180

Article Link:

https://www.ijraset.com/research-paper/toxic-chemicals-emitted-from-air-fresheners-and-disinfectants - PDF

(Note: This graphic is from preceding article**)**

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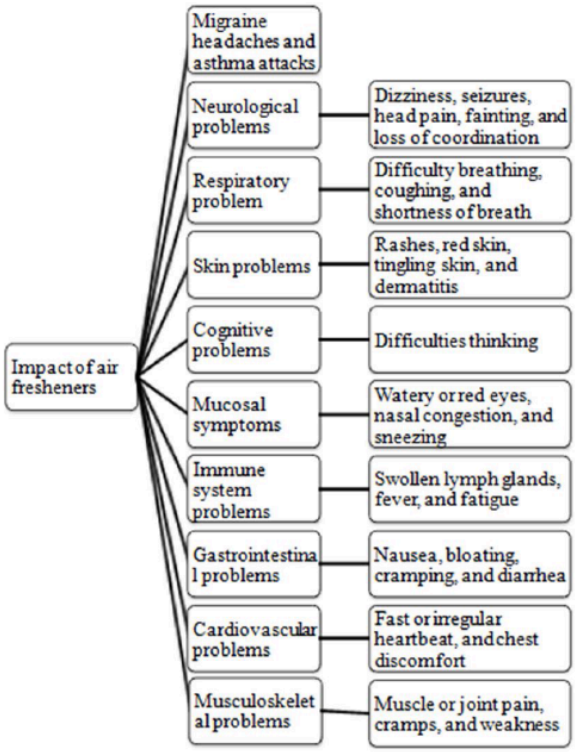

Figure 2: The diagram above illustrates the classification of illnesses brought on by exposure to air fresheners.

12. *Adverse Impact of Environmental Chemicals on Developmental Origins of Kidney Disease and Hypertension*

Hsu CN, Tain YL. Adverse Impact of Environmental Chemicals on Developmental Origins of Kidney Disease and Hypertension. Front Endocrinol (Lausanne). 2021 Oct 14;12:745716. doi: 10.3389/fendo.2021.745716. PMID: 34721300; PMCID: PMC8551449.

Article Link: https://pubmed.ncbi.nlm.nih.gov/34721300/ - PDF

“Here, we focus on environmental chemicals that pregnant mothers are likely to be exposed, including dioxins, bisphenol A (BPA), **phthalates**, per- and polyfluoroalkyl substances (PFAS), polycyclic aromatic hydrocarbons (PAH), heavy metals, and **air pollution**.”

(note: Graphic is from preceding article**)**

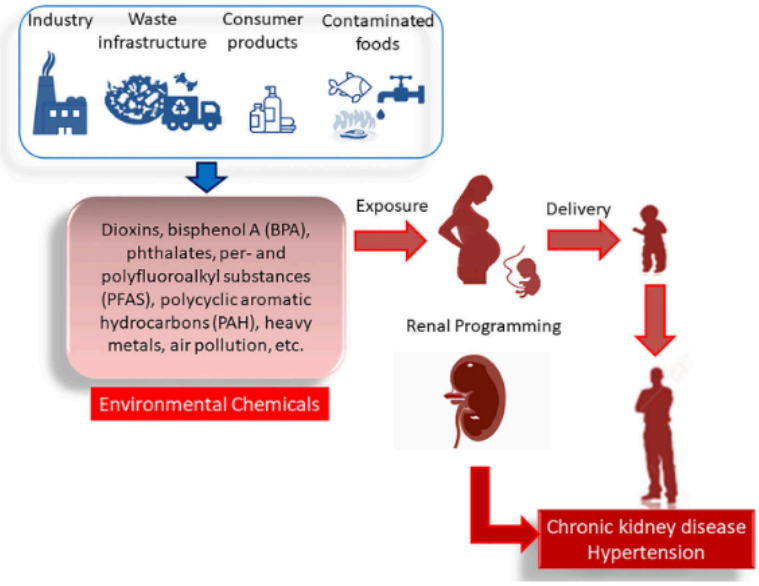

FIGURE 1 | Adverse impact of maternal environmental chemical exposure on developmental origins of kidney disease and hypertension. In pregnancy, exposure to various environmental chemicals occurs through daily consumer activity. There are many sources of contamination like industry, waste infrastructure, consumer products, contaminated foods, etc. These environmental chemicals cause renal programming, resulting in chronic kidney disease and hypertension in adulthood.

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“In pregnancy, exposure to various environmental chemicals occurs through daily consumer activity. There are many sources of contamination like industry, waste infrastructure, **consumer products**, contaminated foods, etc. These **environmental chemicals cause renal programming**, resulting in **chronic kidney disease and hypertension** in adulthood.”

“Phthalates can be delivered to the human body through diet, **inhalation, and skin contact**. Di-2-ethylhexylphthalate (**DEHP**) and di-n-butyl phthalate (DBP) are the primary phthalate ester pollutants in the environment. The metabolites of phthalates can **cross the placenta and be transferred to the fetus**. Epidemiological studies demonstrated that high urinary DEHP levels are **associated with high BP, low eGFR and albuminuria.** As phthalates have estrogenic or antiandrogenic properties, emerging evidence suggests the associations between prenatal phthalate exposure and adverse offspring outcomes. Following these findings, steps should be taken to explore the effect of phthalate exposure during pregnancy on offspring kidneys.”

[Note: Phthalates are synthetic odorless plasticizers used as solvents, binders or fixatives in many fragrances. Why are phthalates in the news? Phthalates are considered Endocrine Disrupting Chemicals.

On the California Safe Cosmetics Program Product Database: DEP, DIDP, and DBP are reported as fragrance while DEHP and DBP are perfume solvents. IFRA lists DEP and DMP, as "reported fragrance ingredients".**]**

13. *The new kids on the block: emerging obesogens*

Chamorro-Garcia R, Veiga-Lopez A. The new kids on the block: Emerging obesogens. Adv Pharmacol. 2021;92:457-484. doi: 10.1016/bs.apha.2021.05.003. Epub 2021 Jul 8. PMID: 34452694; PMCID: PMC8941623.
Article Link: https://pubmed.ncbi.nlm.nih.gov/34452694/

"Human urine levels of **alkylphenols** have been estimated in ~12 ng/ml (You et al. 2011) **Alkylphenols** are considered **xenoestrogens** (Soto et al. 1991) and their **effects on the nervous and immune systems have been widely studied** (Acir and Guenther 2018). Because **alkylphenols accumulate in human adipose tissue** (Lopez-Espinosa et al. 2009; Muller et al. 1998) non-ethoxylated alkylphenols, such as 4-nonyphenol and octylphenol have been studied in the context of **adipogenesis**."

"Using the 3T3-L1 cell model, Kassotis et al., 2018 (Kassotis et al. 2018b) tested a mixture of 23 commonly used unconventional oil and gas chemicals (UOG), including acrylamide**, alkylphenols, benzenes**, bronopol, **diethanolamine**, **ethanols**, ethylene glycol, **propylene glycol**, **styrene**, **toluene**, and **xylens**. This **mixture resulted in an increase in tryglyceride accumulation and preadipocyte proliferation at 10 µM and 1 µM,** respectively (Kassotis et al. 2018b)."

"These findings further demonstrate that chemicals that can independently promote adipogenesis, such as acrylamide and **alkylphenols** (Kassotis et al. 2018a; Lee and Pyo 2019) **can act as obesogens in environmentally collected samples containing a complex chemical mixture**. **However, developmental exposure to a similar UOG mixture altered body weight and energy expenditure, but not body composition in C57BL/6 mice (Balise et al. 2019a; Balise et al. 2019b), which highlights the need to validate in vitro findings using animal models**."

"**Alteration of adipose tissue size and homeostasis play an important role not only in obesity, but also in the development of other metabolic co-morbidities such as type 2 diabetes and cardiovascular diseases** (Bluher 2020). To note, obesity also induces wide-reaching systemic effects on other systems, such as the **reproductive and the immune system** (Francisco et al. 2018; Leisegang et al. 2021; Snider and Wood 2019)."

[Note: Alkylphenols are synthetic and used as building blocks for fragrance. Two alkylphenols on IFRA's list are propylphenol and butylphenol. With synthetic chemicals, Aquatic environment health is a concern.**]**
[Note: Benzene is a reported fragrance ingredient in the CSCP Product Database.**]**
[Note: Styrene is "primarily a synthetic chemical**"** used in fragrance. It is on the CSPC list as 'parfum/fragrance' and also on the IFRA list.**]**

[Note: Toluene (often a nail polish thinner) is used as a solvent or fragrance in perfume and bath products on the CSPC Product Database. Toluene is on the IFRA list and on the EPA's Priority Pollutant List.**]**
[Note: Xylene "occurs naturally in petroleum and coal tar, and is major component of gasoline and fuel oil". Xylene is used as a musk fragrance. Xylene is on IFRA.**]**

[Note: Fragrance is considered the new 'second hand smoke', **"**The parallels between second-hand smoke and synthetic fragrance use are many. At its core, both are battles over indoor air quality **"** - quote and link from De Vader, Christy L. & Barker, Paxson.
Chemicals that cigarettes/cigarette smoke and fragranced products can have in common are: Acetone, Formaldehyde, Benzene, acetaldehyde, terpenoids and phenols.**]**

14. *History of the Obesogen Field: Looking Back to Look Forward*

Heindel JJ. History of the Obesogen Field: Looking Back to Look Forward. Front Endocrinol (Lausanne). 2019 Jan 29;10:14. doi: 10.3389/fendo.2019.00014. PMID: 30761083; PMCID: PMC6362096.
Article Link: https://pubmed.ncbi.nlm.nih.gov/30761083/

"Exposure to EDCs during early development (DOHaD) has been shown to **increase susceptibility to a variety of diseases including infertility, asthma, breast and prostate cancer, early puberty, susceptibility to infections, heart disease, autoimmune disease, and attention deficit hyperactivity disorder/learning disability**. The chemicals that she noted as having the ability to cause weight gain include organochlorine pesticides, carbamates, polychlorinated biphenols, plastics such as **phthalates** and bisphenol A (BPA), heavy metals and solvents.**"**

"EDCs are found in a wide variety of products including pesticides/herbicides/fungicides, flame retardants, surfactants, plastics, **sunscreens, cosmetics,** and **personal care products,** etc. [reviewed in (5)]."

"Originally, **EDCs** were shown to interfere with **estrogen, androgen and thyroid hormone signaling (7, 8) resulting in diseases and dysfunctions in reproduction, learning, memory, and behavior."**

[Note: Endocrine Disrupting Chemicals (EDC's) are commonly used in perfumes and fragranced products as preservatives or fragrance. What are EDC's and how can they affect us?**]**

15. *Disparities in Environmental Exposures to Endocrine-Disrupting Chemicals and Diabetes Risk in Vulnerable Populations*

Ruiz D, Becerra M, Jagai JS, Ard K, Sargis RM. Disparities in Environmental Exposures to Endocrine-Disrupting Chemicals and Diabetes Risk in Vulnerable Populations. Diabetes Care. 2018 Jan;41(1):193-205. doi: 10.2337/dc16-2765. Epub 2017 Nov 15. PMID: 29142003; PMCID: PMC5741159.
Article Link: https://pubmed.ncbi.nlm.nih.gov/29142003/ - PDF

"Scientific evidence linking **EDCs** with the **development of diabetes** and other **metabolic disorders** continues to grow. Of note, exposures to several toxicants have been prospectively linked to diabetes risk, including PCBs, organochlorine (OC) pesticides, **various chemical constituents of air pollution,** bisphenol A (BPA), and **phthalates** (Table 1);...
moreover, exposure to these EDCs is higher among African Americans, Latinos, and low-income individuals (Supplementary Table 1). These unequal exposures raise the possibility that EDCs are underappreciated contributors to diabetes disparities."

"In this analysis, **metabolites of butyl phthalates and diethylhexyl phthalate (DEHP) were associated with diabetes** (OR 3.16 [95% CI 1.68–5.95] and 1.91 [95% CI 1.04–3.49], respectively)."

(the following quote is from Table 3 in the full document)
"Phthalates:... (are found in) Personal care products, such as **perfumes**, hair sprays, deodorants, nail polishes, insect repellants, and **most consumer products containing fragrances**, including shampoos, air fresheners, and laundry detergents"

[Note: Phthalates are synthetic odorless plasticizers used as solvents, binders or fixatives in many fragrances. Why are phthalates in the news? Phthalates are considered Endocrine Disrupting Chemicals.
On the California Safe Cosmetics Program Product Database: DEP, DIDP, and DBP are reported as fragrance while DEHP and DBP are perfume solvents. IFRA lists DEP and DMP, as "reported fragrance ingredients".**]**

[Note: Endocrine Disrupting Chemicals (EDC's) are commonly used in perfumes and fragranced products as preservatives or fragrance. What are EDC's and how can they affect us?**]**

16. *Fragranced consumer products: effects on asthmatics*

Steinemann A. Fragranced consumer products: effects on asthmatics. Air Qual Atmos Health. 2018;11(1):3-9. doi: 10.1007/s11869-017-0536-2. Epub 2017 Dec 11. PMID: 29391919; PMCID: PMC5773620
Article Link: https://pubmed.ncbi.nlm.nih.gov/29391919/ **-** PDF

"Fragranced consumer products, such as **cleaning supplies**, air fresheners, and personal care products, can emit a range of air pollutants and trigger adverse health effects…"

"...41.0% of asthmatics report **health problems** from air fresheners or deodorizers, 28.9% from scented laundry products coming from a dryer vent, **42.3% from being in a room cleaned with scented products,** and 46.2% from being near someone wearing a fragranced product."

"**Fragranced consumer products pervade society and emit numerous volatile organic compounds, such as limonene, alpha-pinene, beta-pinene, acetaldehyde, and formaldehyde…"**

"Fragranced products have been associated with a range of adverse health effects including work-related asthma (Weinberg et al. 2017), asthmatic exacerbations (Kumar et al. 1995; Millqvist and Löwhagen 1996), **respiratory difficulties** (Caress 2009), **mucosal symptoms** (Elberling et al. 2005)**, migraine headaches** (Kelman 2004), and **contact dermatitis** (Rastogi et al. 2007; Johansen 2003), as well as **neurological, cardiovascular, cognitive, musculoskeletal, and immune system problems** (Steinemann 2016)."

"Results indicate that 64.3% of asthmatics report one or more types of adverse health effects from fragranced products, including **respiratory problems** (43.3%), **migraine headaches** (28.2%), and **asthma attacks** (27.9%)..."

17. *Ten questions concerning air fresheners and indoor built environments*

Anne Steinemann, Ten questions concerning air fresheners and indoor built environments, Building and Environment, Volume 111, 2017, Pages 279-284, ISSN 0360-1323, https://doi.org/10.1016/j.buildenv.2016.11.009.
Article Link: https://www.sciencedirect.com/science/article/pii/S0360132316304334?via%3Dihub - PDF

"This article investigates the seeming paradox that **products designed to improve the indoor environment can pose unintended and unknown risks.** It examines the science, health, and policy perspectives, and provides recommendations and research directions."

"Air fresheners can contribute to indoor hazardous air pollutants, both through direct emissions and secondary reaction products… Within buildings and other indoor environments, the use of air fresheners has a strong association with high indoor levels of **terpenes, benzene, toluene**, ethyl-benzene, m,p-xylene, and **total volatile organic compounds**…"

"Air fresheners can contribute to human exposure to primary and secondary air pollutants… Air freshener exposures, **even at low levels**, have been associated with a range of adverse health effects, which include **migraine headaches, asthma attacks, breathing difficulties, respiratory difficulties, mucosal symptoms, dermatitis, infant diarrhea and earache, neurological problems, and ventricular fibrillation**..."

"In addition to population based studies, specific air freshener chemicals (VOCs such as acetaldehyde, SVOCs such as phthalates, and ultrafine particles) emitted from air fresheners have been associated with adverse effects to the **neurological, cardiovascular, respiratory, reproductive, immune, and endocrine systems, and with cancer**. For instance, acetaldehyde, which can be both a primary and secondary emission from air fresheners, is associated with both **acute and chronic hazards to the respiratory system**, and classified as a carcinogenic hazardous air pollutant in the US…"

18. *Sanitary pads and diapers contain higher phthalate contents than those in common commercial plastic products*

Park CJ, Barakat R, Ulanov A, Li Z, Lin PC, Chiu K, Zhou S, Perez P, Lee J, Flaws J, Ko CJ. Sanitary pads and diapers contain higher phthalate contents than those in common commercial plastic products. Reprod Toxicol. 2019 Mar;84:114-121. doi: 10.1016/j.reprotox.2019.01.005. Epub 2019 Jan 16. PMID: 30659930; PMCID: PMC6504186.
Article Link: https://pubmed.ncbi.nlm.nih.gov/30659930/

"Exposure to phthalates is known to affect the development and functions of the cardiovascular, reproductive and endocrine systems."
"This study found that most of sanitary pads or diapers surveyed contained both **VOCs** and **phthalates**."

[Note: Phthalates are synthetic odorless plasticizers used as solvents, binders or fixatives in many fragrances. Why are phthalates in the news? Phthalates are considered Endocrine Disrupting Chemicals.
On the California Safe Cosmetics Program Product Database: DEP, DIDP, and DBP are reported as fragrance while DEHP and DBP are perfume solvents. IFRA lists DEP and DMP, as "reported fragrance ingredients".**]**

[Note: Toluene (often a nail polish thinner) is used as a solvent or fragrance in perfume and bath products on the CSPC Product Database. Toluene is on the IFRA list and on the EPA's Priority Pollutant List.**]**

19. *Fragranced consumer products: effects on autistic adults in the United States, Australia, and United Kingdom*

Steinemann A. Fragranced consumer products: effects on autistic adults in the United States, Australia, and United Kingdom. Air Qual Atmos Health. 2018;11(10):1137-1142. doi: 10.1007/s11869-018-0625-x. Epub 2018 Sep 25. PMID: 30546500; PMCID: PMC6244938
Article Link: https://pubmed.ncbi.nlm.nih.gov/30546500/ - PDF

“Fragranced consumer products are ubiquitous in society and emit numerous volatile organic compounds including hazardous air pollutants.”

“Health effects were categorized as follows:
(a) migraine headaches;
(b) asthma attacks;
(c) neurological problems (e.g., dizziness, seizures, head pain, fainting, loss of coordination);
(d) respiratory problems (e.g., difficulty breathing, coughing, shortness of breath);
(e) skin problems (e.g., rashes, hives, red skin, tingling skin, dermatitis);
(f) cognitive problems (e.g., difficulties thinking, concentrating, or remembering);
(g) mucosal symptoms (e.g., watery or red eyes, nasal congestion, sneezing);
(h) immune system problems (e.g., swollen lymph glands, fever, fatigue);
(i) gastrointestinal problems (e.g., nausea, bloating, cramping, diarrhea);
(j) cardiovascular problems (e.g., fast or irregular heartbeat, jitteriness, chest discomfort);
(k) musculoskeletal problems (e.g., muscle or joint pain, cramps, weakness); and
(l) other.”

“Specific problematic exposures, associated with adverse health effects for autistic adults, include but are not limited to the following: …air fresheners and deodorizers (62.9%), the scent of laundry products coming from a dryer vent (57.5%), being in a room recently cleaned with scented products (65.9%), **being near someone wearing a fragranced product** (60.5%), and other types of fragranced consumer products (64.3%)… Among autistic adults reporting health effects, 74.1% across the three countries (85.4% US, 82.4% AU, 54.5% UK) report that the severity of these health effects from fragranced products was potentially disabling. Among non-autistic adults, the prevalence of potentially disabling effects was 25.4%.”

“...62.1% of autistic adults are unable or reluctant to use the restrooms in a public place if it has an air freshener, deodorizer, or scented product; 59.8% are unable or reluctant to wash their hands with soap in a public place if the soap is fragranced; 58.7% enter a business and then want to leave as quickly as possible if they smell air fresheners or a fragranced product; and **66.7% have been prevented from going someplace because they would be exposed to a fragranced product that would make them sick…”**

“Involuntary exposure is a concern. Autistic individuals are prevented from accessing public restrooms, societal venues, businesses, and workplaces due to adverse health effects from fragranced products. Further, 59.4% of autistic adults have lost workdays, in the past year, due to fragranced product exposure in the workplace. **A strong majority of autistic as well as non-autistic adults would prefer that workplaces, health care facilities, and health care professionals were fragrance-free than fragranced.**”

20. *Health risks of chemicals in consumer products: A review*

Li D, Suh S. Health risks of chemicals in consumer products: A review. Environ Int. 2019 Feb;123:580-587. doi: 10.1016/j.envint.2018.12.033. Epub 2019 Jan 7. PMID: 30622082.
Article Link: https://pubmed.ncbi.nlm.nih.gov/30622082/ - Full Text

“It should also be noted that some chemicals have multiple functional uses, while we chose the most dominant functional use for each chemical. An example is the grouping of **phthalates**. Despite categorized as plasticizer

together in this review, several phthalates such as **diethyl phthalate and dimethyl phthalate are used as solvents in personal care products and cosmetics as carriers of fragrance** (Schettler, 2006)."

"…we found that the volume of the peer-reviewed literature that addresses human health risks of the chemicals in consumer products did grow over the last two decades, while its growth could by no means match the speed of increasing volume and diversity of the chemicals produced and used in consumer products by the society. This **growing gap between increasing reliance on chemicals in consumer products and our knowledge on their human health risks raises a potential public health concern**, given the pervasive nature of today's mass production and consumption practice."

21. *Long-Term Outcomes after Phthalate Exposure: Food Intake, Weight Gain, Fat Storage, and Fertility in Mice*

Holtcamp W. Long-term outcomes after phthalate exposure: food intake, weight gain, fat storage, and fertility in mice. Environ Health Perspect. 2012 Aug;120(8):a320. doi: 10.1289/ehp.120-a320a. PMID: 22854284; PMCID: PMC3440097.
Article Link: https://pubmed.ncbi.nlm.nih.gov/22854284/ - PDF

"Exposure to **endocrine-disrupting chemicals (EDCs)**, particularly **in utero**, is suspected to contribute to **obesity**, **diabetes**, **hypertension**, and **reproductive abnormalities**. Di(2-ethylhexyl) phthalate **(DEHP)**, a plasticizer found in **cosmetics**, **fragrances,** food packaging, and polyvinyl chloride, is one such EDC. Human studies have found associations between urinary metabolites of DEHP and other phthalates and **increased body mass** in humans, and maternal exposure to DEHP has been associated with **impaired gonadal development and fertility** in baby boys."

[Note: Endocrine Disrupting Chemicals (EDC's) are commonly used in perfumes and fragranced products as preservatives or fragrance. What are EDC's and how can they affect us?**]**

22. *Sanitary pads and diapers contain higher phthalate contents than those in common commercial plastic products*

Park CJ, Barakat R, Ulanov A, Li Z, Lin PC, Chiu K, Zhou S, Perez P, Lee J, Flaws J, Ko CJ. Sanitary pads and diapers contain higher phthalate contents than those in common commercial plastic products. Reprod Toxicol. 2019 Mar;84:114-121. doi: 10.1016/j.reprotox.2019.01.005. Epub 2019 Jan 16. PMID: 30659930; PMCID: PMC6504186.
Article Link: https://pubmed.ncbi.nlm.nih.gov/30659930/

"VOCs increase the risk for neurocognitive impairment, asthma, congenital disability, and cancer. Notably, exposure to methylene chloride, **toluene**, and **xylene** are known to **negatively affect the development and function of reproductive system**."

"…sanitary pads in direct contact with the skin around the external genitalia were likely causing **menstrual irregularities.** The skin of this area tends to be thinner and more absorbent than those…such as the hands." "Exposure to phthalates is known to **affect the development and functions of the cardiovascular, reproductive and endocrine systems**."

"...daily absorption of **toluene** from sanitary pad reached to the maximum of 38.4% RfD. **Given the fact that women are exposed to various chemicals through various routes, consideration should be given to the risks of chemicals that are additionally absorbed from the sanitary pad."**

[Note: Phthalates are synthetic odorless plasticizers used as solvents, binders or fixatives in many fragrances. Why are phthalates in the news? Phthalates are considered Endocrine Disrupting Chemicals.
On the California Safe Cosmetics Program Product Database: DEP, DIDP, and DBP are reported as fragrance while DEHP and DBP are perfume solvents. IFRA lists DEP and DMP, as "reported fragrance ingredients".**]**

[Note: Toluene (often a nail polish thinner) is used as a solvent or fragrance in perfume and bath products on the CSPC Product Database. Toluene is on the IFRA list and on the EPA's Priority Pollutant List.**]**

23. Overview of air pollution and endocrine disorders

Darbre PD. Overview of air pollution and endocrine disorders. Int J Gen Med. 2018 May 23;11:191-207. doi: 10.2147/IJGM.S102230. PMID: 29872334; PMCID: PMC5973437.
Article Link: https://pubmed.ncbi.nlm.nih.gov/29872334/ - PDF

"Abstract: Over recent years, **many environmental pollutant chemicals have been shown to possess the ability to interfere in the functioning of the endocrine system and have been termed endocrine disrupting chemicals (EDCs).** These compounds exist in air as volatile or semi-volatile compounds in the gas phase or attached to particulate matter. They include components of plastics (**phthalates**, bisphenol A), components of consumer goods (parabens, triclosan, **alkylphenols, fragrance compounds**,… This review summarizes current knowledge concerning the sources of EDCs in air, measurements of levels of EDCs in air, and the potential for adverse effects of EDCs in air on human endocrine health."

"Whilst much has been written over the past two decades of the actions of EDCs from oral and dermal exposure, research is increasingly documenting their presence in air which opens a debate on the potential for adverse consequences from inhalation of EDCs."

"Since estrogens and androgens regulate reproductive functions, many of the reported effects of the exposure to EDCs have been on adverse consequences for **reproductive health**. However, physiological consequences have been demonstrated as resulting from disruption to **thyroid function** and alterations to **thyroid hormone levels**. More widely, adverse effects have also been reported as resulting from alterations to adrenocortical function, impairment of the immune system, and the loss of control on energy metabolism including development of **obesity, diabetes,** and **cardiovascular disease.**"

"**Prior** to and **just after birth** are especially **vulnerable times for exposure to EDCs** because disruption of hormonal activity in the developing embryo/fetus or young baby can have **consequences for health in adult life** most notably on **reproductive abilities, brain function, immunity, and metabolic programming**."

"**Man-made EDCs** are contained within many agricultural, industrial, and **consumer products,** which due to their widespread use, have become ubiquitous environmental pollutants. This includes components of pesticides and herbicides used both in an agricultural setting and in urban environments…. EDCs are also widely used in **personal care products** (PCPs) for purposes of preservation, deodorant, antiperspirant, conditioning, and **fragrance**."

"**EDCs** are contained in domestic pesticide sprays, **air fresheners**, **laundry detergents**, **household cleaners**, paints, adhesives, and plastics, all of which may be used routinely indoors…. As a result, **many EDCs are now measurable in indoor air and in indoor dust, often at higher levels than in outdoor air**…"

24. *Phthalate Exposure Changes the Metabolic Profile of Cardiac Muscle Cells*

Posnack NG, Swift LM, Kay MW, Lee NH, Sarvazyan N. Phthalate exposure changes the metabolic profile of cardiac muscle cells. Environ Health Perspect. 2012 Sep;120(9):1243-51. doi: 10.1289/ehp.1205056. Epub 2012 Jun 6. PMID: 22672789; PMCID: PMC3440133.

Article Link: https://pubmed.ncbi.nlm.nih.gov/22672789/ - PDF

"Data suggest that **DEHP** exposure results in metabolic remodeling of cardiomyocytes, whereby cardiac cells increase their dependence on fatty acids for energy production. This fuel switch may be regulated at both the gene expression and post transcription levels. Our findings have important clinical implications because chronic dependence on fatty acids is associated with an accumulation in lipid intermediates, lactate, protons, and reactive oxygen species. This dependence can sensitize the **heart** to ischemic injury and **ventricular dysfunction**."

[Note: Phthalates are synthetic odorless plasticizers used as solvents, binders or fixatives in many fragrances. Why are phthalates in the news? Phthalates are considered Endocrine Disrupting Chemicals.
On the California Safe Cosmetics Program Product Database: DEP, DIDP, and DBP are reported as fragrance while DEHP and DBP are perfume solvents. IFRA lists DEP and DMP, as "reported fragrance ingredients".**]**

25. *Developmental Exposure to Endocrine Disrupting Chemicals and Its Impact on Cardio-Metabolic-Renal Health*

Singh RD, Koshta K, Tiwari R, Khan H, Sharma V, Srivastava V. Developmental Exposure to Endocrine Disrupting Chemicals and Its Impact on Cardio-Metabolic-Renal Health. Front Toxicol. 2021 Jul 5;3:663372. doi: 10.3389/ftox.2021.663372. PMID: 35295127; PMCID: PMC8915840.

Article Link: https://pubmed.ncbi.nlm.nih.gov/35295127/ - Free Full Text

"**Endocrine disrupting chemicals** (EDCs) include **phenols**, **phthalates**, parabens, flame retardants, heavy metals, pesticides, perfluorinated chemicals, UV filter components, triclosan, and organochlorines."

"**Cumulative exposure to mixtures of EDCs can lead to adverse effects on the health of the exposed individuals** (Crews et al., 2003). Multiple studies, including the studies of the National Health and Nutrition Examination Survey (NHANES), have shown that **about 75–97% of US and Asian adults have detectable levels of phthalates and phenols [bisphenol A (BPA) and polyfluoroalkyl chemicals] in their urine** (Silva et al., 2004; Calafat et al., 2007, 2008; Vandenberg et al., 2010; Zhang et al., 2011; Husøy et al., 2019)."

"Epidemiological and experimental studies have also linked **adult exposure to EDCs** with **abnormal male and female reproductive health**, **diabetes**, **obesity**, **cardiovascular** and **metabolic disorders**, **thyroid function**, and **hormone sensitive cancers** (Howard and Lee, 2012; Bodin et al., 2015; Heindel et al., 2015, 2017)."

"Children are also vulnerable to EDCs (Calafat et al., 2017; Hendryx and Luo, 2018), **making EDC exposure a major health concern for all age groups**."

"**Chronic kidney disease** is a growing health problem among children and adults. The incidence and the prevalence of chronic kidney disease (CKD) **among children have been steadily increasing since the 1980s**…. A number of traditional risk factors associated with CKD in children include hypertension, obesity,

diabetes, and aberrant divalent mineral metabolism…. There is growing evidence that **links exposure to EDCs with early progression to end-stage renal disease** (ESRD) (Kataria et al., 2015)....”

“Early-life exposure to EDCs was associated with elevated levels of kidney toxicity markers such as albumin-to-creatinine ratio (ACR), estimated glomerular filtration rate (eGFR), and urinary protein-to-creatinine ratio (UPCR) in some human population studies (Li et al., 2012; Trasande et al., 2013a, 2014; Malits et al., 2018).”

[Note: Phthalates are synthetic odorless plasticizers used as solvents, binders or fixatives in many fragrances. Why are phthalates in the news? Phthalates are considered Endocrine Disrupting Chemicals.
On the California Safe Cosmetics Program Product Database: DEP, DIDP, and DBP are reported as fragrance while DEHP and DBP are perfume solvents. IFRA lists DEP and DMP, as “reported fragrance ingredients”.**]**

[Note: Endocrine Disrupting Chemicals (EDC’s) are commonly used in perfumes and fragranced products as preservatives or fragrance. What are EDC’s and how can they affect us?**]**

Volatile organic compounds and mortality from ischemic heart disease: A case-cohort study.

Nalini M, Poustchi H, Bhandari D, Chang CM, Blount BC, Wang L, Feng J, Gross A, Khoshnia M, Pourshams A, Sotoudeh M, Gail MH, Graubard BI, Dawsey SM, Kamangar F, Boffetta P, Brennan P, Abnet CC, Malekzadeh R, Freedman ND, Etemadi A. Volatile organic compounds and mortality from ischemic heart disease: A case-cohort study. Am J Prev Cardiol. 2024 Jun 23;19:100700. doi: 10.1016/j.ajpc.2024.100700. PMID: 39100747; PMCID: PMC11296009.

“Volatile organic compounds (VOCs) are major components of air pollution and tobacco smoke, two known risk factors for cardiovascular diseases. VOCs are ubiquitous in the environment and originate from a wide range of sources, including the burning of biomass, fossil fuels, and consumer products. Direct evidence for associations between specific VOCs and ischemic heart disease (IHD) mortality in the general population is scarce.”

"Although the carcinogenicity of several VOCs has received considerable attention by health organizations, their cardiovascular effects are relatively under-studied. Cancer and cardiovascular diseases share several common risk factors (e.g., tobacco smoking and air pollution) and pathophysiological processes for disease development and progression (i.e., inflammation and oxidative stress) [41]. Our findings provide strong evidence for the association between exposure to several VOCs at baseline and IHD mortality many years later in the general population."

[Note: Styrene, Xylene, Benzyl Alcohol, & Benzene are on the IFRA list.**]**

26. ALSO SEE SECTIONS: Liver Disease, Respiratory/Pulmonary (Nose & Lungs), Kidney Disease

Back to top of Cardiovascular **Back to Table of Contents**

Website: https://www.fragrancefreecoalitionusa.com/

DISCLAIMER:
Poster and Document are for reference and educational purposes only.

COGNITIVE / NEUROLOGICAL

Confusion, Cognitive Problems/Fatigue, Difficulties Thinking/Concentrating/Remembering
Aggressive Behavior Problems, Hyperactivity, Judgmental Skills,
Dizziness, Fainting, Loss of Coordination, Neuropathy, Numbness,
Tremors, Seizures, Convulsions, Sensory Irritation, Head Pain
Attention Deficit Disorder (ADD), ADHD, Depression/Maternal Depression, Autism

also see: Migraine(s) / Headache(s), Airborne Contact Dermatitis

1. *Ubiquity, Hazardous Effects, and Risk Assessment of Fragrances in Consumer Products*

Pastor-Nieto MA, Gatica-Ortega ME. Ubiquity, Hazardous Effects, and Risk Assessment of Fragrances in Consumer Products. Curr Treat Options Allergy. 2021;8(1):21-41. doi: 10.1007/s40521-020-00275-7. Epub 2021 Jan 23. PMID: 33520600; PMCID: PMC7825391.
Article Link: https://pubmed.ncbi.nlm.nih.gov/33520600/ - PDF

"Some fragrances are carcinogens, mutagens, and **toxic to reproduction** (CMR substances), thus classified with H341, H351, or H360. **Respiratory**, **neuroendocrine**, and **psychological effects** have also been discussed…. Fragrances have **neurotoxic** and **neurostimulatory effects**."

"Certain perfumes may be **cytotoxic to human fetal brain development** based on in vitro research with neuroblastoma cell lines…. Ingredients in perfumes with presumed **hormonal activities** are octinoxate and butylated hydroxytoluene (**thyroid and androgen-like activities**) and octinoxalate, oxybenzone, benzophenone-1, diethyl phthalate, galaxolide, tonalide, musk ketone, benzyl salicylate, and butylphenyl methylproprional (**estrogen or androgen activity**). Diethyl phthalate, a fragrance solvent, can cause **abnormal development of reproductive organs** in infant males**, attention deficit disorder** in children, and **sperm damage** in adults**….** According to one study, most perfumes exhibited some degree of **mutagenic potential** compared with 4-nitro-1,2-diaminobenzene, a highly mutagenic positive control**.**"

2. *An atlas of fragrance chemicals in children's products*

Ravichandran J, Karthikeyan BS, Jost J, Samal A. An atlas of fragrance chemicals in children's products. Sci Total Environ. 2022 Apr 20;818:151682. doi: 10.1016/j.scitotenv.2021.151682. Epub 2021 Nov 15. PMID: 34793786.
Article Link: https://pubmed.ncbi.nlm.nih.gov/34793786/

"We find that several **fragrance chemicals in children's products are potential carcinogens, endocrine disruptors, neurotoxicants, phytotoxins and skin sensitizers.**"
Fragrance chemicals have been linked to the onset and exacerbation of **several allergic** and **non-allergic disease conditions** in humans."
"Exposure of children to hazardous chemicals via any route is a significant concern due to the potential **impact on the growth and development** during early childhood."
****FCCP Chemical Database:** FCCP A repository of Fragrance Chemicals in Children's Products
****FCCP Chemical Classification Data Compilation:** Graphical Abstract

3. *History of the Obesogen Field: Looking Back to Look Forward*

Heindel JJ. History of the Obesogen Field: Looking Back to Look Forward. Front Endocrinol (Lausanne). 2019 Jan 29;10:14. doi: 10.3389/fendo.2019.00014. PMID: 30761083; PMCID: PMC6362096.
Article Link: https://pubmed.ncbi.nlm.nih.gov/30761083/

"Exposure to EDCs during early development (DOHaD) has been shown to **increase susceptibility to a variety of diseases including infertility, asthma, breast and prostate cancer, early puberty, susceptibility to infections, heart disease, autoimmune disease, and attention deficit hyperactivity disorder/learning disability**. The chemicals that she noted as having the ability to cause weight gain include organochlorine pesticides, carbamates, polychlorinated biphenols, plastics such as **phthalates** and bisphenol A (BPA), heavy metals and solvents.**"**

"EDCs are found in a wide variety of products including pesticides/herbicides/fungicides, flame retardants, surfactants, plastics, **sunscreens, cosmetics,** and **personal care products,** etc. [reviewed in (5)]."

"Originally, **EDCs** were shown to interfere with **estrogen, androgen and thyroid hormone signaling (7, 8) resulting in diseases and dysfunctions in reproduction, learning, memory, and behavior."**

[Note: Endocrine Disrupting Chemicals (EDC's) are commonly used in perfumes and fragranced products as preservatives or fragrance. What are EDC's and how can they affect us?**]**

4. *Toxic effects of air freshener emissions*

Anderson RC, Anderson JH. Toxic effects of air freshener emissions. Arch Environ Health. 1997 Nov-Dec;52(6):433-41. doi: 10.1080/00039899709602222. PMID: 9541364.
Article Link: https://pubmed.ncbi.nlm.nih.gov/9541364/

"The emissions of this **solid Air Freshener produced acute respiratory and neurotoxicity in mice**, and they did not lower the toxic impact of the other pollutants tested. Collectively, toxicity data, chemical data, and MSDS information predict that some humans exposed to emissions of the AF we studied might experience some combination of **eye, nose, and/or throat irritation**; **respiratory difficulty**; **bronchoconstriction** or an **asthma-like reaction**; and **CNS reactions** (e.g., **dizziness**, **incoordination**, **confusion**, **fatigue**)."

5. *Association of Prenatal Phthalate Exposure With Language Development in Early Childhood*

Bornehag CG, Lindh C, Reichenberg A, Wikström S, Unenge Hallerback M, Evans SF, Sathyanarayana S, Barrett ES, Nguyen RHN, Bush NR, Swan SH. Association of Prenatal Phthalate Exposure With Language Development in Early Childhood. JAMA Pediatr. 2018 Dec 1;172(12):1169-1176. doi: 10.1001/jamapediatrics.2018.3115. Erratum in: JAMA Pediatr. 2018 Dec 1;172(12):1205. PMID: 30383084; PMCID: PMC6583016.
Article Link: https://pubmed.ncbi.nlm.nih.gov/30383084/ - PDF

"Prenatal exposure to phthalates has been associated with **neurodevelopmental outcomes**… First-trimester phthalate exposure (particularly to DBP and possibly to BBzP) appears to be associated with **poorer language development in children** aged 2.5 to 3 years. In findings from this study, prenatal exposure to

dibutyl phthalate and butyl benzyl phthalate was statistically significantly associated with **language delay** in children in both the SELMA study and TIDES."

[Note: Phthalates are synthetic odorless plasticizers used as solvents, binders or fixatives in many fragrances. Why are phthalates in the news? Phthalates are considered Endocrine Disrupting Chemicals.
On the California Safe Cosmetics Program Product Database: DEP, DIDP, and DBP are reported as fragrance while DEHP and DBP are perfume solvents. IFRA lists DEP and DMP, as "reported fragrance ingredients".**]**

6. *Household air pollution and its effects on health*

Apte K, Salvi S. Household air pollution and its effects on health. F1000Res. 2016 Oct 28;5:F1000 Faculty Rev-2593. doi: 10.12688/f1000research.7552.1. PMID: 27853506; PMCID: PMC508913
Article Link: https://pubmed.ncbi.nlm.nih.gov/27853506/ - PDF

"Cigarette smoke contains 7,357 different chemical compounds such as **benzene**, CO, PAHs, heterocyclic amines, cyanide, **formaldehyde**, **terpenoids**, **phenols**, nicotine, and heavy metals."

"Various studies have reported that toxic levels of air pollutants are emitted when these **fragrances** are burnt. … Among the Chinese, 76.9% currently burn incense at home every day and over 90% of the population has been using these for over 20 years. **Burning of these fragrances emits high levels of** PAHs**, benzene,** nitrous oxide, and CO**.** … Household air pollution begins to affect a human even during **fetal** life. **Increased household air pollution increases oxidative stress,** which has been implicated in **decreased fertility** or, in some cases, even **infertility**. Increased oxidative stress leads to **decreased sperm motility** and **poor zygote quality**. It also plays an important role in **increasing insulin resistance**, which is associated with **polycystic ovarian disease**, a major cause of infertility."

"...a study of 10 **newborn infants** in New York by the Environmental Work Group revealed that these infants, born to mothers exposed to pollutants, had as many as **232 pollutants circulating in the cord blood collected at birth**….Similarly, another study reported that increased exposure to polycyclic aromatic hydrocarbons and heavy metals (especially lead and mercury) in the second trimester of pregnancy resulted in decreased length of the baby at birth…. They also have lower heights, which do not recover later in life…. The effect of perinatal exposure to PAHs has also been studied, revealing compromised lung function in otherwise-healthy children… Household air pollutants are also implicated in **cognitive** and **judgmental skills** …."

7. *Development and Validation of the Prevention of Toxic Chemicals in the Environment for Children Tool: A Questionnaire for Examining the Community's Knowledge of and Preferences Toward Toxic Chemicals and Children's Brain Development*

Green R, Lanphear B, Phipps E, Goodman C, Joy J, Rihani S, Flora D and Till C (2022) Development and Validation of the Prevention of Toxic Chemicals in the Environment for Children Tool: A Questionnaire for Examining the Community's Knowledge of and Preferences Toward Toxic Chemicals and Children's Brain Development. Front. Public Health 10:863071. doi: 10.3389/fpubh.2022.863071
Article Link: https://www.frontiersin.org/articles/10.3389/fpubh.2022.863071/full - free full text

"Toxic chemicals are an insidious threat to children. **Toxic chemicals elevate the risk for neurodevelopmental disorders, including learning disabilities, attention deficit hyperactivity disorder**

(ADHD), and autism spectrum disorder (ASD). The developing brain is particularly vulnerable to **toxic chemicals, even at low doses** that might not have an adverse effect on adults. Therefore, early identification and recognition by the public of potential sources of exposure to toxic chemicals are crucial to protect children."

"One recent American study found that greater parental concern about toxic chemicals was associated with lower urinary concentrations of **phthalates** and **phenols** in children's urine."

[Note: Fragrance is considered the new 'second hand smoke', **"**The parallels between second-hand smoke and synthetic fragrance use are many. At its core, both are battles over indoor air quality **"** - quote and link from De Vader, Christy L. & Barker, Paxson.
Chemicals that cigarettes/cigarette smoke and fragranced products can have in common are: Acetone, Formaldehyde, Benzene, acetaldehyde, terpenoids and phenols.**]**

[Note: Phenol used in fragrance is mostly synthetic derived from benzene/petro. It is an EDC and declared as fragrance on the CSCP list and on the IFRA fragrance transparency list. Phenol is on the Washington State List of Chemicals of High Concern to Children and Priority Pollutant List.**]**

[Note: Phthalates are synthetic odorless plasticizers used as solvents, binders or fixatives in many fragrances. Why are phthalates in the news? Phthalates are considered Endocrine Disrupting Chemicals.
On the California Safe Cosmetics Program Product Database: DEP, DIDP, and DBP are reported as fragrance while DEHP and DBP are perfume solvents. IFRA lists DEP and DMP, as "reported fragrance ingredients".**]**

8. *Neurotoxicity of fragrance compounds*

Pinkas A, Gonçalves CL, Aschner M. Neurotoxicity of fragrance compounds: A review. Environ Res. 2017 Oct;158:342-349. doi: 10.1016/j.envres.2017.06.035. Epub 2017 Jul 3. PMID: 28683407
Article Link: https://pubmed.ncbi.nlm.nih.gov/28683407/

"Most fragrance compounds belong to one of three families: **phthalates**, **synthetic musks** and "**sensitizers**" – a group where some phthalates and synthetic musks might also be found (Bridges, 2002; Llompart et al., 2013; Siti Zulaikha et al., 2015). These compounds **accumulate in the environment and wildlife**, thus serving as a source for secondary exposure in humans (in addition to direct exposure following application)."

"Several health concerns are associated with exposure to fragrance compounds: **skin**, **respiratory**, **neurological** and systemic pathology are a few examples (Bridges, 2002). Fragrance compounds are consistently presented as either the first or second most common contributors to **allergic contact dermatitis** (ACD) and **fragrance products,** when compared to over 200 other commercial products, **contain the highest number and concentration of endocrine disruptors and asthma-related compounds**…"
"Here, we argue in favor of additional studies for elucidating the **neurotoxicity** of fragrance compounds and its underlying mechanisms."

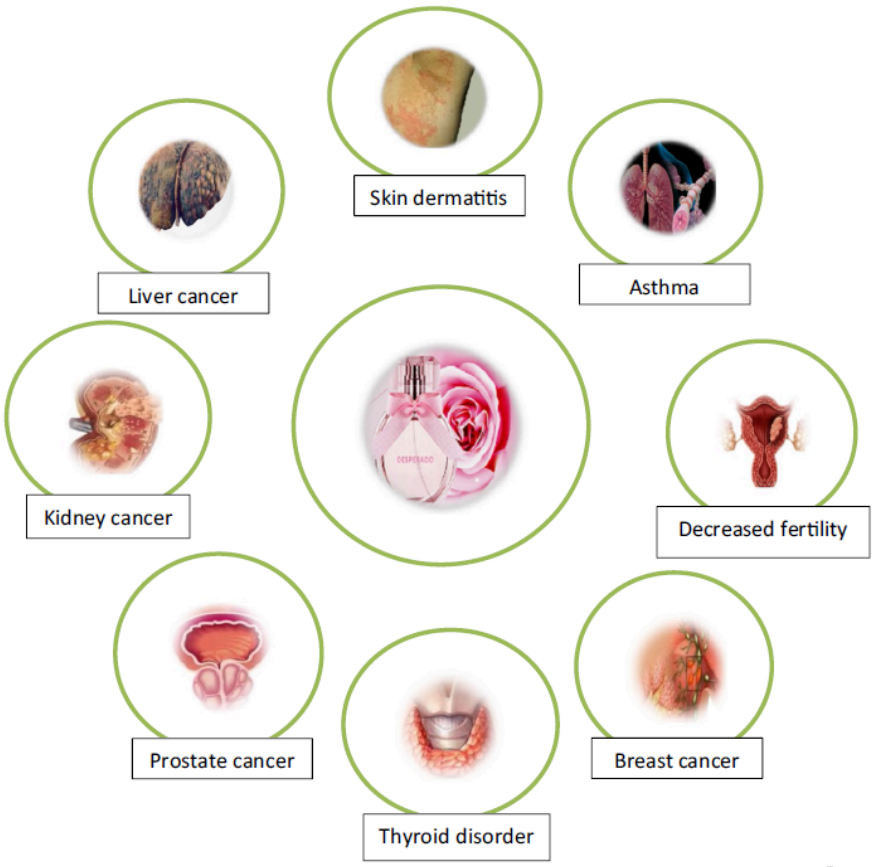
9. *Evaluation of pollutants in perfumes, colognes and health effects on the consumer: a systematic review*

Kazemi Z, Aboutaleb E, Shahsavani A, Kermani M, Kazemi Z. Evaluation of pollutants in perfumes, colognes and health effects on the consumer: a systematic review. J Environ Health Sci Eng. 2022 Feb 3;20(1):589-598. doi: 10.1007/s40201-021-00783-x. PMID: 35669814; PMCID: PMC9163252.

Article Link: https://pubmed.ncbi.nlm.nih.gov/35669814/ - PDF

(Note: Graphic is from preceding article**) (**Creative Commons Attribution 4.0 International license**).**

Fig. 2 Effects of exposure to perfumes and colognes



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"Diethyl phthalate is a chemical used to **make perfumes last longer.** The U.S. Clean Water Act lists it as a **toxic** and priority pollutant."

"Complications of using perfume include **neuropathy (depression, autism), neoplasms (breast cancer, prostate cancer), effects on the liver, migraine headaches, asthma attacks, mucosal symptoms (watery or red eyes, sneezing), neurological problems (dizziness, convulsions, headache, fainting, imbalance), respiratory (cough, shortness of breath), skin (skin rash, urticaria, redness of the skin, skin tingling, dermatitis), immune system (swollen lymph nodes, fever, fatigue), gastrointestinal tract (nausea, bloating, diarrhea)** and c**ardiovascular (rapid** or **irregular heartbeat, tremors, chest discomfort**)"

"**Contaminants in perfumes and colognes** and their health effects on the consumer were systematically reviewed. It was found that the most attention of researchers was to identify the compounds in perfumes and colognes and their concentrations. Among the most common pollutants **phthalates** and their derivatives can

be mentioned. Other pollutants included **parabens, triclosan, salicylates, terpenes, aldehydes, benzene, toluene, styrene, and aluminum-based salts**. These pollutants have also been shown to have adverse effects on consumer health such as **asthma and allergies, cardiovascular disease, central nervous system damage, breast cancer, endocrine cancer, respiratory disorders, reproduction, thyroid, adrenal gland function and immune system."**

[Note: Graphic lists "effects of exposure to perfumes and colognes": Kidney Cancer, Liver Cancer, Prostate Cancer, Thyroid Disorder, Breast Cancer, Decreased Fertility, Asthma and Skin Dermatitis.**]**

10. *Acute toxic effects of fragrance products*

Anderson RC, Anderson JH. Acute toxic effects of fragrance products. Arch Environ Health. 1998 Mar-Apr;53(2):138-46. doi: 10.1080/00039896.1998.10545975. PMID: 9577937.
Article Link: https://pubmed.ncbi.nlm.nih.gov/9577937/

"The emissions of these fragrance products caused various combinations of **sensory irritation**, **pulmonary irritation, decreases in expiratory airflow** velocity, as well as alterations of the functional observational battery indicative of neurotoxicity. **Neurotoxicity** was more severe after mice were repeatedly exposed to the fragrance products… Collectively, the experimental data and chemistry predict that some humans exposed to these FPs might experience some combination of **eye, nose, and/or throat irritation; respiratory difficulty; possibly bronchoconstriction or asthma-like reaction; and central nervous systems reactions (e.g., dizziness, incoordination, confusion, fatigue**)."

"The results of our study might help explain why some individuals report an intolerance to FPs and why some **FPs can exacerbate airflow limitation in some asthmatics**."

11. *Symptoms of mothers and infants related to total volatile organic compounds in household products*

Farrow A, Taylor H, Northstone K, Golding J. Symptoms of mothers and infants related to total volatile organic compounds in household products. Arch Environ Health. 2003 Oct;58(10):633-41. doi: 10.3200/AEOH.58.10.633-641. PMID: 15562635.
Article Link: https://pubmed.ncbi.nlm.nih.gov/15562635/

"Higher TVOC levels were associated with air freshener and aerosol use. **Infant diarrhea** and **earache** were statistically significantly associated with air freshener use, and **diarrhea** and **vomiting** were significantly associated with aerosol use. **Headache** experienced by mothers 8 mo after birth was significantly associated with the use of **air fresheners** and aerosols; **maternal depression** was significantly associated with the use of air fresheners. The results of the study suggest a **link between the use of products that raise indoor levels of TVOCs and an increased risk of certain symptoms among infants and their mothers**."
[Note: Fragranced products emit VOC's that can contribute to higher particulate matter (PM) indoors and out.**]**

12. *Toxic Chemicals Emitted from Air fresheners & Disinfectants*

Geetha Balasubramani, Paul Pradeep, J Nisitha S. Toxic Chemicals Emitted from Air fresheners & Disinfectants. IJRASET. Volume 10 Issue X Oct 2022, Pgs 1338-1345. ISSN : 2321-9653 IJRASET47180
Article Link:
https://www.ijraset.com/research-paper/toxic-chemicals-emitted-from-air-fresheners-and-disinfectants - PDF

(Note: This graphic is from preceding article)

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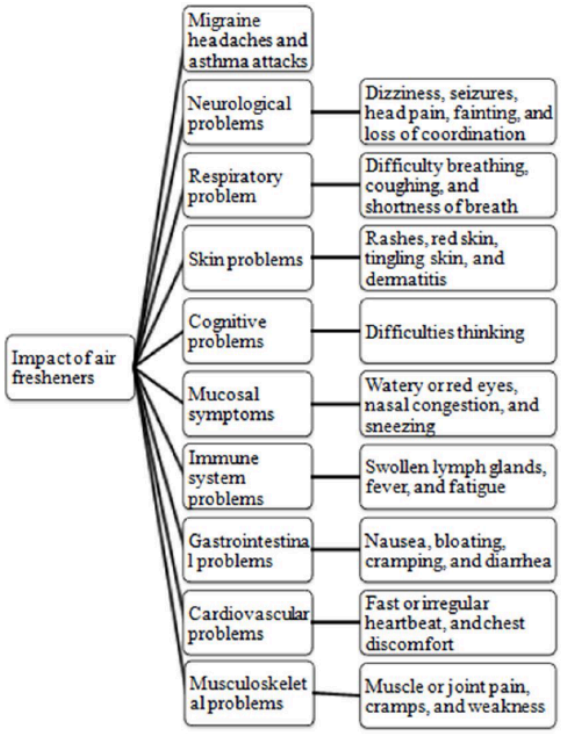

Figure 2: The diagram above illustrates the classification of illnesses brought on by exposure to air fresheners.

13. *Fragranced consumer products: effects on autistic adults in the United States, Australia, and United Kingdom*

Steinemann A. Fragranced consumer products: effects on autistic adults in the United States, Australia, and United Kingdom. Air Qual Atmos Health. 2018;11(10):1137-1142. doi: 10.1007/s11869-018-0625-x. Epub 2018 Sep 25. PMID: 30546500; PMCID: PMC6244938

Article Link: https://pubmed.ncbi.nlm.nih.gov/30546500/ - PDF

"Fragranced consumer products are ubiquitous in society and emit numerous volatile organic compounds including hazardous air pollutants."

"Health effects were categorized as follows:
(a) migraine headaches;
(b) asthma attacks;
(c) neurological problems (e.g., dizziness, seizures, head pain, fainting, loss of coordination);
(d) respiratory problems (e.g., difficulty breathing, coughing, shortness of breath);
(e) skin problems (e.g., rashes, hives, red skin, tingling skin, dermatitis);
(f) cognitive problems (e.g., difficulties thinking, concentrating, or remembering);
(g) mucosal symptoms (e.g., watery or red eyes, nasal congestion, sneezing);
(h) immune system problems (e.g., swollen lymph glands, fever, fatigue);
(i) gastrointestinal problems (e.g., nausea, bloating, cramping, diarrhea);
(j) cardiovascular problems (e.g., fast or irregular heartbeat, jitteriness, chest discomfort);

(k) musculoskeletal problems (e.g., muscle or joint pain, cramps, weakness); and
(l) other."

"Specific problematic exposures, associated with adverse health effects for autistic adults, include but are not limited to the following: …air fresheners and deodorizers (62.9%), the scent of laundry products coming from a dryer vent (57.5%), being in a room recently cleaned with scented products (65.9%), **being near someone wearing a fragranced product** (60.5%), and other types of fragranced consumer products (64.3%)… Among autistic adults reporting health effects, 74.1% across the three countries (85.4% US, 82.4% AU, 54.5% UK) report that the severity of these health effects from fragranced products was potentially disabling. Among non-autistic adults, the prevalence of potentially disabling effects was 25.4%."

"...62.1% of autistic adults are unable or reluctant to use the restrooms in a public place if it has an air freshener, deodorizer, or scented product; 59.8% are unable or reluctant to wash their hands with soap in a public place if the soap is fragranced; 58.7% enter a business and then want to leave as quickly as possible if they smell air fresheners or a fragranced product; and **66.7% have been prevented from going someplace because they would be exposed to a fragranced product that would make them sick…"**

"Involuntary exposure is a concern. Autistic individuals are prevented from accessing public restrooms, societal venues, businesses, and workplaces due to adverse health effects from fragranced products. Further, 59.4% of autistic adults have lost workdays, in the past year, due to fragranced product exposure in the workplace. **A strong majority of autistic as well as non-autistic adults would prefer that workplaces, health care facilities, and health care professionals were fragrance-free than fragranced.**"

14. *Environmental factors in the development of autism spectrum disorders*

Sealey LA, Hughes BW, Sriskanda AN, Guest JR, Gibson AD, Johnson-Williams L, Pace DG, Bagasra O. Environmental factors in the development of autism spectrum disorders. Environ Int. 2016 Mar;88:288-298. doi: 10.1016/j.envint.2015.12.021. Epub 2016 Jan 28. PMID: 26826339.
Article Link: https://pubmed.ncbi.nlm.nih.gov/26826339/ - PDF

"Many modern companies do not disclose the industrial secrets in many of their fragrances that are, in reality, a complex concoction of synthetic chemicals and natural essences, which often have been found to be petrochemicals."

"Among those are chemicals, such as **musk ketone** and **diethyl phthalate**, which are responsible for **allergic reactions and hormone disruption**…. Although these **chemicals have been found to accumulate in human tissues,** they have not yet been adequately analyzed for safety in products used by unsuspecting humans. **As a result of a giant loophole in the Federal Fair Packaging and Labeling Act of 1973**, which explicitly exempts fragrance producers from having to disclose cosmetic ingredients on product labels, fragrance concealment is not illegal and is often used by the industry to hide from the public the full list of ingredients, even substances that can cause grave health problems (Environmental Working Group (EWG), 2005). It is a common practice for businesses to list the chemicals as simply "fragrance," which may mean that **the majority of the ingredients are never revealed to buyers**."

"Even worse, people who use cologne, fragrances, body spray, and other scented cosmetics are blindly exposed to dangerous chemicals since the Food and Drug Administration lacks authority to control mandates to manufacturers that require testing of all fragrances for safety, before being released to the public."

"Also, during pregnancy, the use of fragrances and other cosmetics may actually expose the developing fetus to **diethyl phthalate (DEP)**, a common fragrance solvent that can cause **abnormal development of reproductive organs in infant males**, **Attention Deficit Disorder** in children, and **sperm damage in adults**."

"The role of environmental factors like **fragrances**, glyphosate **and other synthetic chemicals derived from petrochemicals containing carcinogenic, mutagenic, hormones disturbing and neuromodifying capabilities** in the molecular and cellular pathogeneses of ASD has not been evaluated. This is partly due to the 1973 FDA decision to exempt fragrances and cosmetics from appropriate testing, which is generally required for any consumer item that enters the human body and is metabolized by human metabolic pathways."

15. *Fragranced consumer products: effects on asthmatics*

Steinemann A. Fragranced consumer products: effects on asthmatics. Air Qual Atmos Health. 2018;11(1):3-9. doi: 10.1007/s11869-017-0536-2. Epub 2017 Dec 11. PMID: 29391919; PMCID: PMC5773620

Article Link: https://pubmed.ncbi.nlm.nih.gov/29391919/ - PDF

"Fragranced consumer products, such as **cleaning supplies**, air fresheners, and personal care products, can emit a range of air pollutants and trigger adverse health effects…"

"...41.0% of asthmatics report **health problems** from air fresheners or deodorizers, 28.9% from scented laundry products coming from a dryer vent, **42.3% from being in a room cleaned with scented products,** and 46.2% from being near someone wearing a fragranced product."

"**Fragranced consumer products pervade society and emit numerous volatile organic compounds, such as limonene, alpha-pinene, beta-pinene, acetaldehyde, and formaldehyde…"**

"Fragranced products have been associated with a range of adverse health effects including work-related asthma (Weinberg et al. 2017), asthmatic exacerbations (Kumar et al. 1995; Millqvist and Löwhagen 1996), **respiratory difficulties** (Caress 2009), **mucosal symptoms** (Elberling et al. 2005)**, migraine headaches** (Kelman 2004), and **contact dermatitis** (Rastogi et al. 2007; Johansen 2003), as well as **neurological, cardiovascular, cognitive, musculoskeletal, and immune system problems** (Steinemann 2016)."

"Results indicate that 64.3% of asthmatics report one or more types of adverse health effects from fragranced products, including **respiratory problems** (43.3%), **migraine headaches** (28.2%), and **asthma attacks** (27.9%)..."

16. *Characterization of emissions composition for selected household products available in Korea*

Kwon KD, Jo WK, Lim HJ, Jeong WS. Characterization of emissions composition for selected household products available in Korea. J Hazard Mater. 2007 Sep 5;148(1-2):192-8. doi: 10.1016/j.jhazmat.2007.02.025. Epub 2007 Feb 15. PMID: 17376591.

Article Link: https://pubmed.ncbi.nlm.nih.gov/17376591/

"Several studies have implicated these consumer products as sources of indoor air pollutants…. **These compounds have been shown to cause symptoms similar to those characterized as Sick Building**

Syndrome; this is a group of symptoms that includes **sleepiness, irritation, inability to concentrate**, and other health hazards… A major cause of health-related problems for building occupants is the inhalation of consumer-product constituents."

"Furthermore, **secondary toxic pollutants** are formed by the reaction of unsaturated organic constituents with oxidants such as ozone, hydroxyl radicals, and nitrogen oxides…. For example, **terpene**, a major constituent of household products such as cleaning products and air fresheners…, **reacts with ozone thus leading to the formation of formaldehyde**…"

"Of the 59 household products analyzed, 58 emitted one or more of the 72 compounds at chromatographic peak areas above 10(4). There were 11 analytes which occurred with a frequency of more than 10%: **limonene** (44.2%), **ethanol** (30.5%), **acetone** (18.6%), **alpha-pinene** (18.6%), **o,m,p-xylenes** (18.6%), **decane** (17.0%), **toluene** (17.0%), **beta-myrcene** (11.9%), ammonia (10.2%), **ethylbenzene** (10.2%), and hexane (10.2%)."

[Note: Bolded chemicals are chemicals found in fragrance/air fresheners/perfume/fragranced products**]**

[Note: Formaldehyde is a secondary pollutant from fragrance and fragranced products.
Also, a 2012 study, 21 out of 30 perfume samples were shown to release formaldehyde when tested but formaldehyde was not listed on any of the labels. Formaldehyde is a sensitizer and known allergen.**]**

[Note: Limonene is a common skin sensitizer and known allergen in fragrance and fragranced products. Limonene (natural or synthetic) is a terpene. Terpenes can create formaldehyde and particulate matter in air as secondary pollutants. Limonene is on the IFRA list as a fragrance ingredient.**]**

[Note: Toluene (often a nail polish thinner) is used as a solvent or fragrance in perfume and bath products on the CSPC Product Database. Toluene is on the IFRA list and on the EPA's Priority Pollutant List.**]**

17. *Exposure to widespread environmental toxicants and children's cognitive development and behavioral problems*

Jurewicz, Joanna et al. "Exposure to widespread environmental toxicants and children's cognitive development and behavioral problems." International Journal of Occupational Medicine and Environmental Health, vol. 26, no. 2, 2013, pp. 185-204. doi:10.2478/s13382-013-0099-x.
Article link: https://pubmed.ncbi.nlm.nih.gov/23715930/ - PDF

"The results from the presented studies suggest that there are strong and rather consistent indications that the developing nervous system is particularly vulnerable to insult from low levels of exposure to widespread environmental contaminants such as: **phthalates**, bisphenol A, brominated flame retardants, polycyclic aromatic hydrocarbons, gas cooking."

[Note: Phthalates are synthetic odorless plasticizers used as solvents, binders or fixatives in many fragrances.
Why are phthalates in the news? Phthalates are considered Endocrine Disrupting Chemicals.
On the California Safe Cosmetics Program Product Database: DEP, DIDP, and DBP are reported as fragrance while DEHP and DBP are perfume solvents. IFRA lists DEP and DMP, as "reported fragrance ingredients".**]**

18. *Health risks of chemicals in consumer products: A review*

Li D, Suh S. Health risks of chemicals in consumer products: A review. Environ Int. 2019 Feb;123:580-587. doi: 10.1016/j.envint.2018.12.033. Epub 2019 Jan 7. PMID: 30622082.

Article Link: https://pubmed.ncbi.nlm.nih.gov/30622082/ - Full Text

"It should also be noted that some chemicals have multiple functional uses, while we chose the most dominant functional use for each chemical. An example is the grouping of **phthalates**. Despite categorized as plasticizer together in this review, several phthalates such as **diethyl phthalate and dimethyl phthalate are used as solvents in personal care products and cosmetics as carriers of fragrance** (Schettler, 2006)."

"…we found that the volume of the peer-reviewed literature that addresses human health risks of the chemicals in consumer products did grow over the last two decades, while its growth could by no means match the speed of increasing volume and diversity of the chemicals produced and used in consumer products by the society. This **growing gap between increasing reliance on chemicals in consumer products and our knowledge on their human health risks raises a potential public health concern**, given the pervasive nature of today's mass production and consumption practice."

19. *Endocrine Disruptors and Asthma-Associated Chemicals in Consumer Products*

Dodson RE, Nishioka M, Standley LJ, Perovich LJ, Brody JG, Rudel RA. Endocrine disruptors and asthma-associated chemicals in consumer products. Environ Health Perspect. 2012 Jul;120(7):935-43. doi: 10.1289/ehp.1104052. Epub 2012 Mar 8. PMID: 22398195; PMCID: PMC3404651..

Article Link: https://pubmed.ncbi.nlm.nih.gov/22398195/ - PDF

"Laboratory and human studies raise concerns about endocrine disruption and asthma resulting from exposure to chemicals in consumer products… Analytes included parabens, **phthalates**, bisphenol A (BPA), triclosan, ethanolamines, alkylphenols, **fragrances**, glycol ethers, cyclosiloxanes, and ultraviolet (UV) filters."
"In other products, the highest concentrations and numbers of detects were in fragranced products (e.g., perfume, air fresheners, and **dryer sheets**) and sunscreen."

"**Some products that did not contain the well-known endocrine-disrupting phthalates contained other less-studied phthalates** (dicyclohexyl phthalate, diisononyl phthalate, and di-n-propyl phthalate; also endocrine-disrupting compounds), suggesting a substitution. Many detected chemicals were not listed on product labels."

"**Endocrine Disrupting compounds (EDCs) are chemicals that can alter hormonal signaling and have potential effects on developing reproductive and nervous systems, metabolism, and cancer** (Colborn et al. 1993). Some phthalates inhibit testosterone synthesis (Howdeshell et al. 2008)..."

"**Fragrances have been shown to exacerbate asthma**. …The phthalate bis(2-ethylhexyl) phthalate (DEHP) in dust was associated with **asthma and wheezing in children**…"

"Our results also indicate that use of multiple products can lead to **exposure to an even larger mixture of compounds,** even if a consumer selected products considered alternative according to our criteria. For example, a consumer who used the alternative surface cleaner, tub and tile cleaner, **laundry detergent**, bar soap, shampoo and conditioner, facial cleanser and lotion, and toothpaste (a plausible array of product types for an individual) would potentially be exposed to at least 19 compounds: two parabens, three **phthalates**, MEA, DEA, five alkylphenols, and seven **fragrances**."

[Note: Fragrance chemicals listed in Figure 1 are: Benzylacetate, Eugenol, Hexyl cinnemal, Limonene, Linalool, Methyl eugenol, Methyl salicylate, Pinene, Terpineol, AHTN, Bucina,l Diphenyl ether, DPMI, HHCB, Isobornyl acetate, Methyl ionone, Musk ketone, Musk xylene, Phenethyl alcohol**]**

[Note: Endocrine Disrupting Chemicals (EDC's) are commonly used in perfumes and fragranced products as preservatives or fragrance. What are EDC's and how can they affect us?**]**

[Note: Phthalates are synthetic odorless plasticizers used as solvents, binders or fixatives in many fragrances. Why are phthalates in the news? Phthalates are considered Endocrine Disrupting Chemicals.
On the California Safe Cosmetics Program Product Database: DEP, DIDP, and DBP are reported as fragrance while DEHP and DBP are perfume solvents. IFRA lists DEP and DMP, as "reported fragrance ingredients".**]**

20. Overview of air pollution and endocrine disorders

Darbre PD. Overview of air pollution and endocrine disorders. Int J Gen Med. 2018 May 23;11:191-207. doi: 10.2147/IJGM.S102230. PMID: 29872334; PMCID: PMC5973437.
Article Link: https://pubmed.ncbi.nlm.nih.gov/29872334/ - PDF

"Abstract: Over recent years, **many environmental pollutant chemicals have been shown to possess the ability to interfere in the functioning of the endocrine system and have been termed endocrine disrupting chemicals (EDCs).** These compounds exist in air as volatile or semi-volatile compounds in the gas phase or attached to particulate matter. They include components of plastics (**phthalates**, bisphenol A), components of consumer goods (parabens, triclosan, **alkylphenols, fragrance compounds**,… This review summarizes current knowledge concerning the sources of EDCs in air, measurements of levels of EDCs in air, and the potential for adverse effects of EDCs in air on human endocrine health."

"Whilst much has been written over the past two decades of the actions of EDCs from oral and dermal exposure, research is increasingly documenting their presence in air which opens a debate on the potential for adverse consequences from inhalation of EDCs."

"Since estrogens and androgens regulate reproductive functions, many of the reported effects of the exposure to EDCs have been on adverse consequences for **reproductive health**. However, physiological consequences have been demonstrated as resulting from disruption to **thyroid function** and alterations to **thyroid hormone levels**. More widely, adverse effects have also been reported as resulting from alterations to adrenocortical function, impairment of the immune system, and the loss of control on energy metabolism including development of **obesity, diabetes,** and **cardiovascular disease.**"

"**Prior** to and **just after birth** are especially **vulnerable times for exposure to EDCs** because disruption of hormonal activity in the developing embryo/fetus or young baby can have **consequences for health in adult life** most notably on **reproductive abilities, brain function, immunity, and metabolic programming**."

"**Man-made EDCs** are contained within many agricultural, industrial, and **consumer products,** which due to their widespread use, have become ubiquitous environmental pollutants. This includes components of pesticides and herbicides used both in an agricultural setting and in urban environments…. EDCs are also widely used in **personal care products** (PCPs) for purposes of preservation, deodorant, antiperspirant, conditioning, and **fragrance**."

"**EDCs** are contained in domestic pesticide sprays, **air fresheners**, **laundry detergents**, **household cleaners**, paints, adhesives, and plastics, all of which may be used routinely indoors…. As a result, **many EDCs are now measurable in indoor air and in indoor dust, often at higher levels than in outdoor air**…"

21. Endocrine-Disrupting Chemicals & Reproductive Health

Zlatnik MG. Endocrine-Disrupting Chemicals and Reproductive Health. J Midwifery Womens Health. 2016 Jul;61(4):442-55. doi: 10.1111/jmwh.12500. Epub 2016 Jul 8. PMID: 27391253; PMCID: PMC6701840.

Article Link: https://pubmed.ncbi.nlm.nih.gov/27391253/ - PDF

"**Phthalates** are another class of chemicals that have been implicated as **endocrine disrupters**. **Phthalates** are used in multiple consumer applications, including **personal care products** such as **lotion** or **shampoo**, often as **"fragrance"**, and as plasticizers to change the physical characteristics of base plastics, including products made with polyvinyl chloride, such as flooring, shower curtains, packaging, and some medical equipment."

"Human cohort and experimental animal studies have demonstrated possible **adverse effects on reproduction**, including associations with **poor semen quality** and **miscarriage.**"

"Prenatal phthalate exposure, as measured by phthalate metabolite levels in maternal urine, has been associated with **abnormal male genital development in the fetus**. In animal models, anogenital distance is a sensitive index of demasculinization of the male reproductive tract. Multiple epidemiologic studies, including prospective cohort studies, have shown a **shortened anogenital distance** (suggesting anti-androgenic influence) **in boys whose mothers had higher urinary phthalate levels during pregnancy**. Some cohort studies have shown an association with **smaller penile size** as well. These findings are reproducible in experimental studies with rodents."

"Prenatal phthalate exposure has also been associated with reduced "masculine play" in boys, as indicated in a follow-up study of a cohort of couples who had given blood and urine samples during pregnancy. At age 5, the boys' (n=74) play activities were assessed with a validated inventory of play styles (Pre-School Activities Inventory). **An association was seen between prenatal exposure to anti-androgenic phthalates and less male-typical play behavior in boys."**

"A recent systematic review of 11 human **studies suggests that higher levels of prenatal exposure to phthalate metabolites**, measured as urinary concentrations, are associated with **poorer cognitive and behavioral outcomes in children, especially boys**."

[Note: This article suggests you purchase fragrance free personal care products and avoid air fresheners and scented candles.**]**

22. Occurrence and Distribution of Phthalates in Sanitary Napkins from Six Countries: Implications for Women's Health

Tang Z, Chai M, Cheng J, Wang Y, Huang Q. Occurrence and Distribution of Phthalates in Sanitary Napkins from Six Countries: Implications for Women's Health. Environ Sci Technol. 2019 Dec 3;53(23):13919-13928. doi: 10.1021/acs.est.9b03838. Epub 2019 Nov 18. PMID: 31694371.
Article Link: https://pubmed.ncbi.nlm.nih.gov/31694371/

"Chemicals in feminine hygiene products **can exert adverse health effects as a result of strong absorptive capacity of the vagina and vulva**. We measured the concentrations of 15 phthalates in sanitary napkins collected from six countries and found total concentrations in the range of 1733-11942 ng/g. Di(isobutyl)phthalate **(DiBP)**, bis(2-ethylhexyl)phthalate **(DEHP)**, and di-*n*-butyl phthalate (DnBP) were the dominant congeners…"

"Most phthalates are used as additives that are not chemically bound to the product matrix and therefore can easily migrate and enter the human body. Exposure to phthalates can exert serious adverse effects on human health, including **estrogenic effects that impair the endocrine system**…. In addition, some phthalates can cause various **reproductive and developmental conditions**…."

"Hauser et al. found that urinary concentrations of **bis(2-ethylhexyl)- phthalate (DEHP)** metabolites in women undergoing in vitro fertilization were **inversely associated with oocyte yield and clinical pregnancy**. Some epidemiologic studies have reported associations between **prenatal exposure to phthalates** and adverse outcomes at birth, such as **congenital diseases** and **developmental delays**…."

"Lien et al. reported that **prenatal exposure to some phthalates can increase aggressive behavior problems** in 8-year-old children."

"**Phthalates readily accumulate in biological tissues** owing to their higher lipophilicity… Increasing evidence shows that **dermal contact from the use of cosmetics and personal care products is another relevant route of exposure to phthalates.** Sanitary napkins are used to absorb menstrual blood, and their constituents may be contaminated with phthalates. … Sanitary napkins come into direct contact with the vulva, and the **mucous membranes in the vagina and vulva can rapidly absorb chemicals without metabolizing them**…. Serum estradiol levels following the vaginal application of estradiol have been shown to be 10-fold higher than levels following oral dosing,... indicating possible health risks from this exposure route"

[Note: Phthalates are synthetic odorless plasticizers used as solvents, binders or fixatives in many fragrances. Why are phthalates in the news? Phthalates are considered Endocrine Disrupting Chemicals.
On the California Safe Cosmetics Program Product Database: DEP, DIDP, and DBP are reported as fragrance while DEHP and DBP are perfume solvents. IFRA lists DEP and DMP, as "reported fragrance ingredients".**]**

23. *Need of the hour: to raise awareness on vicious fragrances and synthetic musks*

Patel, S., Homaei, A. & Sharifian, S. Need of the hour: to raise awareness on vicious fragrances and synthetic musks. Environ Dev Sustain 23, 4764–4781 (2021). https://doi.org/10.1007/s10668-020-00829-4
Article Link: https://link.springer.com/article/10.1007/s10668-020-00829-4

"The exposure to the **synthetic fragrances and musks**, which are produced in quantities of thousands of tons per year, has been shown to **elicit several pathologies**."

"The **fragrance compounds** are regarded as **toxins by the human immune system**, and to eliminate them, cytochrome enzymes, especially aromatases, are overexpressed. These enzymes also **convert androgens into estrogens,** but **excess estrogen production affects the endocrine system** in both males and females."

"It is increasingly being evident that all diseases have common roots, i.e., **inflammation**."

"**The unprecedented prevalence of diabetes, obesity, cancer, and depression, among others pathologies, is tied to the limitless usage of fragrance compounds."**

24. *Sanitary pads and diapers contain higher phthalate contents than those in common commercial plastic products*

Park CJ, Barakat R, Ulanov A, Li Z, Lin PC, Chiu K, Zhou S, Perez P, Lee J, Flaws J, Ko CJ. Sanitary pads and diapers contain higher phthalate contents than those in common commercial plastic products. Reprod Toxicol. 2019 Mar;84:114-121. doi: 10.1016/j.reprotox.2019.01.005. Epub 2019 Jan 16. PMID: 30659930; PMCID: PMC6504186.
Article Link: https://pubmed.ncbi.nlm.nih.gov/30659930/

"VOCs increase the risk for neurocognitive impairment, asthma, congenital disability, and cancer. Notably, exposure to methylene chloride, **toluene**, and **xylene** are known to **negatively affect the development and function of reproductive system**."

"…sanitary pads in direct contact with the skin around the external genitalia were likely causing **menstrual irregularities.** The skin of this area tends to be thinner and more absorbent than those…such as the hands."
"Exposure to phthalates is known to **affect the development and functions of the cardiovascular, reproductive and endocrine systems**."

"...daily absorption of **toluene** from sanitary pad reached to the maximum of 38.4% RfD. **Given the fact that women are exposed to various chemicals through various routes, consideration should be given to the risks of chemicals that are additionally absorbed from the sanitary pad."**

[Note: Phthalates are synthetic odorless plasticizers used as solvents, binders or fixatives in many fragrances. Why are phthalates in the news? Phthalates are considered Endocrine Disrupting Chemicals.
On the California Safe Cosmetics Program Product Database: DEP, DIDP, and DBP are reported as fragrance while DEHP and DBP are perfume solvents. IFRA lists DEP and DMP, as "reported fragrance ingredients".**]**

[Note: Toluene (often a nail polish thinner) is used as a solvent or fragrance in perfume and bath products on the CSPC Product Database. Toluene is on the IFRA list and on the EPA's Priority Pollutant List.**]**

25. *Feminine Hygiene Products-A Neglected Source of Phthalate Exposure in Women*

Gao CJ, Wang F, Shen HM, Kannan K, Guo Y. Feminine Hygiene Products-A Neglected Source of Phthalate Exposure in Women. Environ Sci Technol. 2020 Jan 21;54(2):930-937. doi: 10.1021/acs.est.9b03927. Epub 2020 Jan 9. PMID: 31859481.
Article Link: https://pubmed.ncbi.nlm.nih.gov/31859481/

"**Phthalates have been associated with reproductive toxicity and precocious puberty in females,** but the occurrence of these toxicants in feminine hygiene products is rarely reported. In this study, eight phthalates were determined in 120 feminine hygiene products (56 feminine care products and 64 sanitary napkins)

collected from China. **Phthalates** were **found** in **86% and 98% of feminine care products and sanitary napkins,** respectively, with the total concentrations varying between not detectable and 813 µg/g (median: 0.26 µg/g) and 0.25 and 8.76 µg/g (1.43 µg/g), respectively. **Diethyl phthalate**, dibutyl phthalate, and bis(2-ethylhexyl)phthalate were the major compounds, accounting for >60% of the total concentrations."

[Note: Phthalates are synthetic odorless plasticizers used as solvents, binders or fixatives in many fragrances. Why are phthalates in the news? Phthalates are considered Endocrine Disrupting Chemicals.
On the California Safe Cosmetics Program Product Database: DEP, DIDP, and DBP are reported as fragrance while DEHP and DBP are perfume solvents. IFRA lists DEP and DMP, as "reported fragrance ingredients".**]**

26. *Phthalates*, bisphenols, parabens*, and triclocarban in feminine hygiene products from the United States and their implications for human exposure*

Gao CJ, Kannan K. Phthalates, bisphenols, parabens, and triclocarban in feminine hygiene products from the United States and their implications for human exposure. Environ Int. 2020 Mar;136:105465. doi: 10.1016/j.envint.2020.105465. Epub 2020 Jan 13. PMID: 31945693
Article Link: https://pubmed.ncbi.nlm.nih.gov/31945693/ - PDF

"The estimated exposure doses of **phthalates**, parabens, and bisphenols through the dermal absorption pathway from the use of pads, panty liners, and tampons were significant."

"Elevated exposure to phthalates has been associated with **precocious puberty, endometriosis, female genital tumors,** and **ovulation disorders.** …**high concentrations phthalates have been measured in sanitary pads.**"

"In addition, pads, panty liners, and tampons are made from polypropylene (PP) and polyethylene (PE) materials, which can contain plasticizers such as phthalates, to increase the products' flexibility. Dimethyl phthalate* (DMP), **diethyl phthalate* (DEP), dibutyl phthalate* (DBP)**, **di-iso-butyl phthalate (DIBP),** di(2-ethylhexyl) **phthalate* (DEHP),** methyl paraben (MeP), and ethyl paraben (EtP) were found in all pad, panty liner, and tampon samples."

[Note: Phthalates are synthetic odorless plasticizers used as solvents, binders or fixatives in many fragrances. Why are phthalates in the news? Phthalates are considered Endocrine Disrupting Chemicals.
On the California Safe Cosmetics Program Product Database: DEP, DIDP, and DBP are reported as fragrance while DEHP and DBP are perfume solvents. IFRA lists DEP and DMP, as "reported fragrance ingredients".**]**

27. *Characterization of air freshener emission: the potential health effect*

Kim S, Hong SH, Bong CK, Cho MH. Characterization of air freshener emission: the potential health effects. J Toxicol Sci. 2015;40(5):535-50. doi: 10.2131/jts.40.535. PMID: 26354370.
Article Link: https://pubmed.ncbi.nlm.nih.gov/26354370/ - PDF

"The use of these products (air fresheners) may be associated with an increase in the measured level of **terpene**, such as **xylene** and other volatile air freshener components, including **aldehydes**, and **esters**. Air freshener is usually used indoors, and thus some compounds emitted from air freshener may have potentially harmful health impacts, including **sensory irritation**, **respiratory symptoms**, and **dysfunction of the lungs**."

"**The constituents of air fresheners can react with ozone to produce secondary pollutants such as formaldehyde, secondary organic aerosol (SOA), oxidative product, and ultrafine particles.** These pollutants then adversely affect human health, in many ways such as **damage to the central nervous system, alteration of hormone levels,** etc. In particular, the ultrafine particles may induce **severe adverse effects on diverse organs**, including the **pulmonary and cardiovascular systems."**

"This review suggests that exposure to air freshener compounds, such as **VOCs that react with ozone to form secondary pollutants**, cause diverse health issues. In addition, **several key compounds such as benzene, terpenes, and phthalate etc. of air pollutants are related to air freshener use**. **We suggest that the use of air fresheners should be avoided**, and there is a need to reduce chemical components which are potentially reactive with ozone in air fresheners."

28. *Emission characteristics of VOCs emitted from consumer and commercial products and their ozone formation potential*

Dinh TV, Kim SY, Son YS, Choi IY, Park SR, Sunwoo Y, Kim JC. Emission characteristics of VOCs emitted from consumer and commercial products and their ozone formation potential. Environ Sci Pollut Res Int. 2015 Jun;22(12):9345-55. doi: 10.1007/s11356-015-4092-8. Epub 2015 Jan 21. PMID: 25601614.

Article Link: https://pubmed.ncbi.nlm.nih.gov/25601614/

"The characteristics of volatile organic compounds (VOCs) emitted from several consumer and commercial products (body wash, dishwashing detergent, **air freshener**, windshield washer fluid, lubricant, hair spray, and insecticide) were studied and compared."

"In the spray products, 21.6–96.4 % of the VOCs were propane, iso-butane, and n-butane, which are the components of liquefied petroleum gas. **Monoterpene** (C10H16) was the dominant component of the VOCs in the non-spray products (e.g., body wash, 53–88 %)."

"Besides comprising **hazardous VOCs**, VOCs from consumer products were also **ozone precursors**."
"The TVOCs from spray products (insecticide, **hair spray**, and lubricant) were higher than those from the liquid products such as the windshield washer fluid, dishwashing detergent, **body wash**, and **air freshener**."

"Limonene and 1-propanol were the components of one dishwashing detergent. In contrast, another dishwashing detergent comprised **1,3-dioxane**, **ethanol**, **ethyl acetate**, **limonene**, **β-myrcene**, 3-pentanol, and **α-pinene** (Kwon et al. 2007, 2008)."

"**Benzene, n-hexane**, and **ethylbenzene** were observed in the body washes and the **air fresheners.** Benzene was classified as Group A of the US EPA lists of **known human carcinogen** (WHO 2010). The unit cancer risk of 1 μg/m3 of benzene is 2.2–7.8 in a million (WHO 2010). The unit risk of **leukemia** per 1 μg/m3 air concentration is 6 in a million. Therefore, **long-term exposure to a considerable amount of benzene in those products might cause health risk,** which should be investigated in future researchers."

"A **longterm exposure of n-hexane may damage the nervous system**. Exposure to 650 ppm **n-hexane** for 2–4 months causes numbness of the arms and legs (Pohanish 2012). **Ethylbenzene** irritates the eyes, skin, and respiratory tract. A **long-term exposure of ethylbenzene may cause kidney and liver disease**…."

"**Toluene and styrene were detected in body washes, dishwashing detergents**, and windshield washer

fluids. It was reported that inhalation of 200–500 ppm **toluene may cause headache, nausea, and loss of appetite** (Pohanish 2012).

Styrene is considered as a possible carcinogenic to humans. Inhalation of above 100 ppm **styrene may cause headache, inflammation of the lung, kidney and liver damage, and death** (Pohanish 2012). Since body washes are used popularly and frequently, longterm exposure to the above compounds may cause health damage."

[Note: Limonene is a common skin sensitizer and known allergen in fragrance and fragranced products. Limonene (natural or synthetic) is a terpene. Terpenes can create formaldehyde and particulate matter in air as secondary pollutants. Limonene is on the IFRA list as a fragrance ingredient.**]**
[Note: Benzene is a reported fragrance ingredient in the CSCP Product Database.**]**
[Note: N-Hexane is used to extract fragrances and was on the IFRA list until 2015.**]**
[Note: Toluene (often a nail polish thinner) is used as a solvent or fragrance in perfume and bath products on the CSPC Product Database. Toluene is on the IFRA list and on the EPA's Priority Pollutant List.**]**
[Note: Styrene is "primarily a synthetic chemical**"** used in fragrance. It is on the CSPC list as 'parfum/fragrance' and also on the IFRA list.**]**
[Note: Ethyl benzene is listed for purchase as a perfuming agent.**]**

29. *Head-space, small-chamber and in-vehicle tests for volatile organic compounds (VOCs) emitted from air fresheners for the Korean market*

Jo WK, Lee JH, Kim MK. Head-space, small-chamber and in-vehicle tests for volatile organic compounds (VOCs) emitted from air fresheners for the Korean market. Chemosphere. 2008 Feb;70(10):1827-34. doi: 10.1016/j.chemosphere.2007.08.021. Epub 2007 Sep 21. PMID: 17889253.
Article Link: https://pubmed.ncbi.nlm.nih.gov/17889253/

"Five toxic or hazardous analytes were found in the headspace phase of AFs (**toluene**, **benzene**, **ethyl benzene**, and **m,p-xylene**) at a frequency of more than 50%. **Limonene** and **linalool**, which are known to be unsaturated ozone-reactive VOCs, were detected at a frequency of 58 and 35%, respectively."
"Previous studies have implicated several consumer products as being sources of indoor air pollution (Habib et al., 2006; Singer et al., 2006; Su et al., 2007)...."

"AFs work by using a nerve-deadening chemical that interferes with the human sense of smell, coating the nasal passage with an oily film, masking an offending odor with a different odor, or by deactivating the odor (EHANS, 2004). Certain VOCs emitted from AFs such as **ethanol, benzaldehyde, α-terpineol,** and **benzyl acetate** showed toxic effects at dose levels between 9 and 14 mg/kg (Cooper et al., 1995), however, **AFs emit significant amounts of VOCs when applied indoors** (Salthammer, 1999; Zhu et al., 2001; Singer et al., 2006)."

"Synthetic, chemical-based AFs contain a number of chemicals including **carcinogens** and **sensitizers**, possible **reproductive toxins**, and **neurotoxins** (EHANS, 2004). Moreover, unsaturated organic constituents emitted from AFs produce **secondary toxic pollutants** via reactions with oxidants such as ozone, hydroxyl radicals, and nitrogen oxides (Weschler and Shields, 1999; Atkinson and Arey, 2003)."

[Note: Toluene (often a nail polish thinner) is used as a solvent or fragrance in perfume and bath products on the CSPC Product Database. Toluene is on the IFRA list and on the EPA's Priority Pollutant List.**]**

[Note: Benzene is a reported fragrance ingredient in the CSCP Product Database.**]**
[Note: Xylene "occurs naturally in petroleum and coal tar, and is major component of gasoline and fuel oil". Xylene is used as a musk fragrance. Xylene is on IFRA.**]**

[Note: Limonene is a common skin sensitizer and known allergen in fragrance and fragranced products. Limonene (natural or synthetic) is a terpene. Terpenes can create formaldehyde and particulate matter in air as secondary pollutants. Limonene is on the IFRA list as a fragrance ingredient.**]**

[Note: Linalool is a common ingredient in fragranced products. Linalool is a sensitizer after it is exposed to air and can cause contact allergies.**]**
[Note: Ethyl benzene is listed for purchase as a perfuming agent.**]**

30. *Rapid and green determination of 58 fragrance allergens in plush toys*

Wang Z, Zhang Q, Li H, Lv Q, Wang W, Bai H. Rapid and green determination of 58 fragrance allergens in plush toys. J Sep Sci. 2018 Feb;41(3):657-668. doi: 10.1002/jssc.201700556. Epub 2017 Dec 14. PMID: 29150895.
Article Link: https://pubmed.ncbi.nlm.nih.gov/29150895/

"**Toys are scented** to cover unpleasant odors or to enhance their attractiveness to consumers. However, **some fragrances are important sources of allergens**, which can **trigger respiratory illnesses (asthma and rhinitis), migraine headaches, neurotoxicity, endocrine-disrupting activities,** and other negative effects."

31. *Fragranced laundry products and emissions from dryer vents: implications for air quality and health*

Goodman N, Nematollahi N and Steinemann A (2021) Fragranced laundry products and emissions from dryer vents: implications for air quality and health. Air Quality, Atmosphere and Health, 14. pp. 245-249.
Article Link: https://researchonline.jcu.edu.au/64706/ - PDF

"The study pursues three main objectives: (a) to determine the frequency and types of health problems associated with exposure to fragranced laundry products from dryer vents, (b) to assess and compare the VOCs from fragranced and fragrance-free laundry products, and (c) to calculate potential reductions in **limonene** emissions from dryer vents by switching from fragranced to fragrance-free laundry products. Results can provide a scientific foundation and practical approach to reduce pollutants and potential health risks associated with the use of laundry products and their emissions through dryer vents."

"Among the general population in the US and AU, 12.5% and 6.1% of adults report health problems when exposed to **scented laundry products** from dryer vents. Adverse health effects include **respiratory problems (the most frequently reported, collectively), mucosal symptoms, skin problems, asthma attacks, migraine headaches, neurological problems**, among others."

"Dryer vent emissions from seven households were analyzed for their limonene concentrations…"
"In households that switched from fragranced products to fragrance-free products, emissions of limonene were reduced within two weeks by up to 99.7% (average 79.1%)."

“At a regional level, during use of fragranced laundry products, limonene emissions from dryer vents across metropolitan Melbourne is estimated at 1.99 tons/year.”
“In this same analytical approach, applied to the state of California, limonene emissions from dryer vents across the state was estimated at 10.95 tons/year”

“This study indicates that fragranced laundry products emitted from dryer vents can be sources of indoor and outdoor air pollutants and health risks. The study also indicates that switching from fragranced to fragrance-free laundry products can generate potential improvements for air quality and health.”

32. *Role of perfumes in pathogenesis of autism*

Bagasra O, Golkar Z, Garcia M, Rice LN, Pace DG. Role of perfumes in pathogenesis of autism. Med Hypotheses. 2013 Jun;80(6):795-803. doi: 10.1016/j.mehy.2013.03.014. Epub 2013 Apr 8. PMID: 23578362.
Article Link: https://pubmed.ncbi.nlm.nih.gov/23578362/

“**There are 3100 ingredients that contribute to “fragrance,”** and consumers routinely have no idea about how much the pleasant smells included in perfumes may be damaging their health, and the health of their fetus…. “

“During pregnancy, the use of fragrances and other cosmetics may actually expose the **growing fetus** to **diethyl phthalate (DEP),** a common fragrance solvent that can cause **abnormal development of reproductive organs in infant males, Attention Deficit Disorder (ADD) in children, and sperm damage in adults**….”

“Two chemicals, octinoxate and **butylated hydroxytoluene (BHT)**, have **thyroid** and **androgen**-like hormonal activities… In addition, octinoxalate, oxybenzone, benzophenone-1 diethy phthalate, galaxolide, tonalid, **musk ketone**, **benzyl salicylate**, butylphenyl methylproprionate, and **even the many yet-to-be-exposed chemicals that still hide incognito within perfumes, are known to act like estrogen or androgens**….”

“We analyzed 91 perfumes by the Ames test… As shown in Fig. 3, numerous perfumes exhibit serious mutagenic potential, as compared with the positive control (4-NOPD), which is highly mutagenic. Distilled water was used as the negative control. Our analyses showed that **each of the 91 perfumes tested imparted some degree of mutagenic potential**; several exceeded the mutagenic potential of 4-NOPD by 2.5-fold. Fig. 3 only shows the few perfumes with mutagenic ability, but during our studies **we did not find a single perfume that did not have some degree of mutagenic capacity at 1:15,000 dilutions…**”

“The role of perfumes in the molecular and cellular pathogeneses of ASD has not been evaluated adequately. This is **due mainly to the 1973 FDA decision to exempt perfumes from appropriate testing**, which is generally required for any consumer item that enters the human body and is metabolized by human metabolic pathways. We **provide evidence** that many perfumes are highly mutagenic and carcinogenic, even at extremely low concentrations. We also provide evidence that even at fentomole levels, certain perfumes are **cytotoxic to human fetal brain development** (neuroblastoma cell lines) in vitro. In addition, we show that even at 1:108 dilutions, certain perfumes are **neurostimulatory** and **may cause abnormal brain development.**”

33. *Smell of autism: Synthetic fragrances and cause for allergies, asthma, cancer and*

autism

Bagasra O, Pace DG. Smell of autism: Synthetic fragrances and cause for allergies, asthma, cancer and autism. OA Autism 2013 Jun 19;1(2):15.

Article Link:

https://www.researchgate.net/publication/269626082_Smell_of_autism_Synthetic_fragrances_and_cause_for_allergies_asthma_cancer_and_autism)

"The aim of this review was to discuss synthetic fragrances and cause for **allergies**, **asthma**, **cancer** and **autism**…"

"This review summarizes some of the subjective concerns and attempts to date that have brought greater objective scrutiny to the debate over the safety of components used in the imprecise objects called fragrances."

"The link between autism spectrum disorder (ASD) and exposure to toxic ingredients in perfumes, even at minute (femtomolar) levels, has been suggested by recent scholarship. Scents are known to have the capacity to reach the brain, including the brain of a foetus whose mother uses **perfume that derives from synthetic scents made from mutagenic chemicals**."

"**Fragrance is a seemingly innocuous term added to health and beauty products. Ultimately, this mysterious term may actually undermine both health and beauty.** Fragrance is a common euphemism for an undisclosed blend of chemical ingredients drawn from an arsenal comprised of about 3,100 total ingredients. 'Musky' may increase sales, 'exotic' may attract customers and 'floral' may sound beautifully natural, but these terms may also conceal the existence of petrochemicals and other synthetic chemicals that, when blended with natural ingredients, can form **dangerous cocktails of fragrance**"

34. *Spermatotoxicity in Animal Models Exposed to Fragrance Components*

Akunna GG, Saalu LG, Ogunlade B. Enye LA., (2014). Spermatotoxicity in Animal Models Exposed to Fragrance Components. Journal of Medical Sciences, 14: 46-50.

Article Link: https://scialert.net/fulltext/?doi=jms.2014.46.50 - PDF

"Various commonly-used products have been reported to contain chemicals that could **disrupt estrogen and testosterone hormone**. …The results obtained from this study showed a significant ($p<0.005$) decrease in body weight and absolute testicular weight of the rat models exposed to fragrance when compared to the control groups. It was also observed that the concentration, mobility, livability and morphology of spermatozoa from groups C, D, E and F were significantly lower ($p>0.005$) when compared to values of the control group A and B. Based on the spermiographic evaluation from this study, fragrance materials could have an adverse effect on spermatozoa of the intact male wistar rats."

"**It has been reported that through inhalation, ingestion and absorption, fragrance infiltrates the body and moves directly to the blood stream.** … Symptoms ranging from **severe mucosal discharge, sinus problems, tremor, asthmatic attack, sneezing, migraine headache, convulsions, hyperactivity, nausea, sore throat, cough, chest tightness to shortness of breath** after fragrance exposure have been vastly documented (Guin and Berry, 1980; De Groot, 1987; Schleuter et al., 1978)."

"Unswerving connection between memory and smell has been established (Rachel and Engen, 1996). This knowledge has resulted in **placement of fragrance in the category of psychoactive drugs and highlighted the ability of fragrance to cross the brain barrier thereby resulting in potential damage to brain tissue**

(Andrea, 1997). **Linalool**, the most abundant fragrance substance has been indicated to cause **lethargy**, **depression** and **severe respiratory difficulties after exposure**."

"Synthetic musk fragrance ingredients which are widely highly distributed in many consumer products have been examined in human blood, milk and fatty tissue. They represent a new group of human contaminants which are **comparable with that of certain pesticides.** Despite several reports on the toxic effect of **fragrance,** there is a dearth of literature ascertaining its **effects on male fertility and testicular development** (Thompson and Wansker, 1981)."

35. Fragrance compounds: The wolves in sheep's clothings

Patel S. Fragrance compounds: The wolves in sheep's clothings. Med Hypotheses. 2017 May;102:106-111. doi: 10.1016/j.mehy.2017.03.025. Epub 2017 Mar 22. PMID: 28478814.

Article Title: https://pubmed.ncbi.nlm.nih.gov/28478814/

"It is deplorable and alarming that awareness of the threats of perfume allergy is very low. Tricked by aggressive advertisement and to improve aesthetic appeal, people are exposing themselves to multiple chemical fragrance compounds. Further, it is a matter of concern that an alert individual cannot escape the perils of fragrances by mere lifestyle revision, and avoidance of the chemicals. Like the harms of passive smoking, passive exposure to the perfumes occurs in a number of public places. In realization of the dangers of peanut allergy to vulnerable individuals, peanut was pulled off from the food platter in passenger planes. Similar awareness and action is needed for perfumes as well.… An aware individual does not deserve to get the brunt of someone else's reckless lifestyle choices. Also, the cleaning staff in public places must be trained so as to ensure prevention of perfume abuse i.e. excess usage."

"A study found traces of **musk fragrances** such as **galaxolide**, **tonalide**, **cashmeran,** and UV-filters in marine species (mussel, clam, flounder, herring and mullet) and macroalgae, which constitute seafood. These **bioaccumulated xenobiotics** will ultimately reach to the human body via the food chain"

"Perfume manufacturers do not disclose the ingredients and quantity of the fragrance compounds in the name of 'trade secret'. Though they ought to abide by ethics, for profit and the goals of high market share, they forgo those. With the help of unscrupulous advertisements and sponsored research reports, they keep luring naive and unaware consumers.… It is appalling that even if people know the threats, they continue using these toxins, resonating the "death wish" concept discussed in the popular TV series "Mad men".... The fragrance compounds so ubiquitous in modern times initiate vicious cycles of 'exposure – pathologies – drugs', which must be understood, information disseminated and terminated. Based on the review work and hypotheses, it can be stated that perfumes and other fragrance compounds in day-to-day consumer products are 'slow killers with fatal punch'.

"Growing recognition of the widespread use of fragrances in modern society is alarming. These pleasant-seeming deleterious compounds are the causal factors of a wide array of **immuneneural**- **hormonal health issues**. **Allergy**, **irritation**, **migraine**, **asthma**, **depression**, **high blood pressure**, **diabetes** and other symptoms should not be trivialized. Unheeded, and continued, the fragrance compounds can lead to **gynaecomastia**, **cancers**, **gender manipulation**, **teratogenicity**."

"**Creating public awareness is essential to avoid grave health consequences**. Toxicology research on perfumes must be prioritized, just like other urgent topics like 'antibiotics-drug resistance' and 'pesticide-food

safety'. This review 'though barely scratches the surface' of the enormous health threats of 'synthetic fragrances' is expected to evoke alertness."
[Note: Gynaecomastia is enlarged male breast tissue**]**

36. Emissions from dryer vents during use of fragranced and fragrance-free laundry products

Goodman, N.B., Wheeler, A.J., Paevere, P.J. et al. Emissions from dryer vents during use of fragranced and fragrance-free laundry products. Air Qual Atmos Health 12, 289–295 (2019). https://doi.org/10.1007/s11869-018-0643-8
Article Link: https://link.springer.com/article/10.1007/s11869-018-0643-8 - PDF

"The study focused on D-limonene because it is (a) a prevalent and dominant VOC in fragranced laundry products as well as other fragranced consumer products, (b) a suitable marker as it is generally found in fragranced laundry products but not in fragrance-free laundry products, (c) associated with a range of adverse human health and environmental effects, and classified as a potentially hazardous compound (SWA 2018), and (d) a terpene that readily reacts with ozone to generate a range of hazardous secondary air pollutants."
(note: Graphic is from preceding article**)**

Table 3 GC/MS headspace analysis of VOCs emitted from the fragranced laundry detergent and the fragrance-free laundry detergent used in this study, listed according to retention time

Compound	CAS #	Fragranced detergent	Fragrance-free detergent
Acetaldehyde*	75-07-0	✓	✓
Ethanol*	64-17-5	✓	
Acetone*	67-64-1	✓	✓
2-methyl-Pentane*	107-83-5	✓	
2-methyl-2-Propanol	75-65-0		✓
2-Propen-1-ol*	107-18-6	✓	
2-methyl-Hexane*	591-76-4	✓	
2,3-dimethyl-Pentane*	565-59-3	✓	
3-methyl-Hexane*	589-34-4	✓	
1,3-dimethyl-Cyclopentane	2453-00-1	✓	
Ethylbenzene*	100-41-4		✓
Heptane*	142-82-5	✓	
methyl-Cyclohexane*	108-87-2	✓	
2,3,4-trimethyl-Hexane	921-47-1	✓	
(E)-3-Hexen-1-ol	928-97-2	✓	
1-Hexanol*	111-27-3	✓	
α-Pinene	80-56-8	✓	
2-methyl-ethyl ester Pentanoic acid	39255-32-8	✓	
Sabinene	3387-41-5	✓	
3-Carene	13466-78-9	✓	
β-Myrcene	123-35-3	✓	
β-Ocimene	3779-61-1	✓	
4-Hexen-1-ol, acetate	72237-36-6	✓	
Acetic acid, hexyl ester	142-92-7	✓	
Octanal	124-13-0	✓	
D-Limonene*	5989-27-5	✓	
β-Phellandrene	555-10-2	✓	
2,6-dimethy-l-5-Heptenal	106-72-9	✓	
2,6-dimethyl-7-Octen-2-ol	18479-58-8	✓	
1,3,4-Trimethyl-3-cyclohexenyl-1-carboxaldehyde	40702-26-9	✓	
Linalool*	78-70-6	✓	
3-methyl-5-propyl-Nonane	31081-18-2		✓
(E)- 7-Tetradecene	41446-63-3		✓
Cyclododecane	294-62-2		✓
Benzyl acetone	2550-26-7	✓	
4-tert-Butylcyclohexyl acetate	104-05-2	✓	
α-Terpinyl acetate	98-55-5	✓	
2-Carene	554-61-0	✓	
Lilial*	80-54-6	✓	

* Classified as hazardous under Safe Work Australia, Hazardous Chemical Information System (SWA 2018)

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you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons license, and indicate if changes were made.**)**

"This study demonstrated the **improvements to air quality after switching from fragranced to fragrance-free products.** It found that, by a change to fragrance-free laundry products, concentrations of D-limonene can be almost completely eliminated from the dryer vent emissions. This strategy may also reduce the formation and concentrations of secondary pollutants such as **formaldehyde**, **acetaldehyde**, and ultrafine particles. Findings from this study can provide an important foundation for future research, and for demonstrating cost-effective strategies to reduce VOC emissions and personal exposures."

37. ALSO SEE SECTIONS: Gastrointestinal Tract, Diabetes, Fatigue / Muscle or Joint Pain

Back to top of Cognitive / Neurological **Back to Table of Contents**

Website: https://www.fragrancefreecoalitionusa.com/

Neurotoxicity of Ortho-Phthalates: Recommendations for Critical Policy Reforms to Protect Brain Development in Children.

Engel SM, Patisaul HB, Brody C, Hauser R, Zota AR, Bennet DH, Swanson M, Whyatt RM. Neurotoxicity of Ortho-Phthalates: Recommendations for Critical Policy Reforms to Protect Brain Development in Children. Am J Public Health. 2021 Apr;111(4):687-695. doi: 10.2105/AJPH.2020.306014. Epub 2021 Feb 18. PMID: 33600256; PMCID: PMC7958063.
Article Link: https://pubmed.ncbi.nlm.nih.gov/33600256/ PDF

"Phthalates including DEP and DBPs are commonly used in cosmetics and other personal care products, and are sometimes used as excipients in medications and supplements (see the box on page 689). 2 For example, DEP and DBPs are used in a wide range of **personal care products** including nail polish, **lotions**, **fragrances**, and **hairstyling** products. 41 Numerous studies have found correlations between personal care product use and the concentrations of phthalate metabolites in urine. 41 Overall, women have higher exposure to phthalates found in personal care products than men, and Black and Latina women have higher exposure to certain phthalates compared with White women, independent of socioeconomic status.42 Phthalates are readily transferred from mother to fetus during pregnancy. 2"

"More recently, an increasing number of prospective epidemiological studies have found associations between prenatal exposure to phthalates and adverse **neurodevelopment** in offspring.43"

Bounajem, M.T., Brandel, M.G., Nadel, J.L. *et al.* Effects of airborne particulate exposure on aneurysmal subarachnoid hemorrhage risk: brief communication. *npj Clean Air* **1**, 18 (2025). https://doi.org/10.1038/s44407-025-00018-5

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Poster and Document are for reference and educational purposes only.

DERMATOLOGICAL / SKIN

Eczema, Hives, Facial Swelling, Red Skin, Itching, Skin Tingling, Skin Sensitization, Rashes, Skin Inflammation, Depigmentation, Acne-like Eruptions

1. *A link between skin and airways regarding sensitivity to fragrance products?*

Elberling J, Linneberg A, Mosbech H, Dirksen A, Frølund L, Madsen F, Nielsen NH, Johansen JD. A link between skin and airways regarding sensitivity to fragrance products? Br J Dermatol. 2004 Dec;151(6):1197-203. doi: 10.1111/j.1365-2133.2004.06251.x. PMID: 15606515.
Article Link: https://pubmed.ncbi.nlm.nih.gov/15606515/

"**Contact sensitization to fragrances is one of the commonest causes of contact allergy in the general population**… as well as among patients with eczema. Exposure to volatile fragrances is commonplace and may be related to various **eye and airway symptoms**. Skin exposure to fragrances is known to cause **perfume contact allergy** and **eczema…."**

"Positive, independent and **significant associations were found between eye and airway symptoms** elicited by fragrance products and perfume contact allergy and hand eczema…. Individuals with perfume contact allergy and/or hand eczema, as opposed to those without, have more frequent and **more severe eye or airway symptoms after exposure to volatile fragrance product**s."

"We show consistent and significant associations between perfume contact allergy diagnosed by patch testing and symptoms elicited by fragrance products from the eyes and airways. The symptoms were mostly reported as elicited **within seconds and minutes after airborne exposure to fragrance products**."

2. *Symptom-trigger factors other than allergens in asthma and allergy*

Claeson AS, Palmquist E, Lind N, Nordin S. Symptom-trigger factors other than allergens in asthma and allergy. Int J Environ Health Res. 2016 Aug;26(4):448-57. doi: 10.1080/09603123.2015.1135314. Epub 2016 Jan 20. PubMed PMID: 26788835.
Article Link: https://pubmed.ncbi.nlm.nih.gov/26788835/

"Data from a population-based study, the Västerbotten Environmental Health Study, were used to compare persons with **asthma**, **allergic rhinitis**, **allergic dermatitis**, multiple diagnoses of asthma/allergy and no asthma or allergy. Persons with asthma and multiple diagnoses reported odorous/pungent and building-related environmental factors to trigger symptoms to a larger extent than did the reference group, mainly due to **perfume** and odors from flowers. They also **reported behavioral disruptions and affective reactions to odorous/pungent environments**. These findings increase the understanding of the role of odorants in symptom development and thereby the prevention of health problems in asthma and allergy in indoor air."

"Environmental exposures of particular interest for indoor air quality, such as exposure to odorants, have also been referred to as triggers of asthma and allergy, although the exposure in some cases may result in allergic symptoms without clinical signs (e.g. **bronchoconstriction**). For example, a condition with **asthma-like overreaction** in the lower airways, called **sensory hyperreactivity**, has been identified in which patients display normal pulmonary function and negative allergy tests, and is **typically not treated by their ordinated**

asthma medication (Millqvist et al. 1998). **The symptoms in these patients are often induced by non-specific trigger factors, such as perfumes**."

3. *Scented lotions may cause scaring and premature fading of tattoos* (case report)

Pona A, Gonzalez CD, Walkosz BJ, Dellavalle RP. Scented lotions may cause scaring and premature fading of tattoos. Dermatol Online J. 2020 Oct 15;26(10):13030/qt5d2676s2. PMID: 33147671.
Article Link: https://pubmed.ncbi.nlm.nih.gov/33147671/ - PDF

"The purpose of this case presentation is to provide evidence that **scented lotions** could potentially **harm healing** tattoos and should be mentioned in aftercare instructions."
"On day 1 after application of the scented lotion, the healing tattooed skin became **erythematous** and **pruritic** minutes after applying the scented lotion. On day 2, the tattooed skin became **swollen** and developed light pink **plaques** with multiple 1-2mm **erosions**, **scabbing**, and silver **scales**."

"Avoidance of scented lotions and use of inert vehicles on a tattoo should be included in the tattoo aftercare instructions. New tattoos should be treated like a wound. **Failure to avoid scented vehicles could precipitate an allergic or irritant contact dermatitis**, which may lead to significant tattoo fading, delayed wound healing, and scar formation."

4. *Fragranced laundry products and emissions from dryer vents: implications for air quality and health*

Goodman N, Nematollahi N and Steinemann A (2021) Fragranced laundry products and emissions from dryer vents: implications for air quality and health. Air Quality, Atmosphere and Health, 14. pp. 245-249.
Article Link: https://researchonline.jcu.edu.au/64706/ - PDF

"The study pursues three main objectives: (a) to determine the frequency and types of health problems associated with exposure to fragranced laundry products from dryer vents, (b) to assess and compare the VOCs from fragranced and fragrance-free laundry products, and (c) to calculate potential reductions in **limonene** emissions from dryer vents by switching from fragranced to fragrance-free laundry products. Results can provide a scientific foundation and practical approach to reduce pollutants and potential health risks associated with the use of laundry products and their emissions through dryer vents."

"Among the general population in the US and AU, 12.5% and 6.1% of adults report health problems when exposed to **scented laundry products** from dryer vents. Adverse health effects include **respiratory problems (the most frequently reported, collectively), mucosal symptoms, skin problems, asthma attacks, migraine headaches, neurological problems**, among others."

"Dryer vent emissions from seven households were analyzed for their limonene concentrations…"
"In households that switched from fragranced products to fragrance-free products, emissions of limonene were reduced within two weeks by up to 99.7% (average 79.1%)."

"At a regional level, during use of fragranced laundry products, limonene emissions from dryer vents across metropolitan Melbourne is estimated at 1.99 tons/year."
"In this same analytical approach, applied to the state of California, limonene emissions from dryer vents across the state was estimated at 10.95 tons/year"

"This study indicates that fragranced laundry products emitted from dryer vents can be sources of indoor and outdoor air pollutants and health risks. The study also indicates that switching from fragranced to fragrance-free laundry products can generate potential improvements for air quality and health."

5. *Development and application of a novel method to assess exposure levels of sensitizing and irritating substances leaching from menstrual hygiene products*

Marcelis Q., Gatzios A, Deconinck E, Rogiers V, Vanhaecke T, Desmedt B. Development and application of a novel method to assess exposure levels of sensitizing and irritating substances leaching from menstrual hygiene products,
Emerging Contaminants,Volume 7, 2021, Pages 116-123, ISSN 2405-6650, https://doi.org/10.1016/j.emcon.2021.02.004.
Article Link: https://www.sciencedirect.com/science/article/pii/S2405665021000068?via%3Dihub - PDF

"All **fragrance chemicals** selected for the method development are classified as **skin sensitizers** category 1B…Six products were found to leach at least one of the following five sensitizing and irritating compounds: α-isomethyl ionone, benzyl salicylate, hexyl cinnamaldehyde, linalool and piperonal. Piperonal was the **most abundant compound leaching** from the MHPs, with leaching concentration levels measured to **28.22 µg/g.** In addition, the **leaching level of benzyl salicylate was** found to be **11.03 µg/g. The latter fragrance concentration is above 10 µg/g and would trigger mandatory labelling if the Cosmetic Regulation would apply for MHPs. However, none of the identified and quantified skin sensitizers were mentioned on the package."**

6. *Potential Allergens in Disposable Diaper Wipes, Topical Diaper Preparations, and Disposable Diapers: Under-recognized Etiology of Pediatric Perineal Dermatitis*

Yu J, Treat J, Chaney K, Brod B. Potential Allergens in Disposable Diaper Wipes, Topical Diaper Preparations, and Disposable Diapers: Under-recognized Etiology of Pediatric Perineal Dermatitis. Dermatitis. 2016 May-Jun;27(3):110-8. doi: 10.1097/DER.0000000000000177. PMID: 27172304.
Article Link: https://pubmed.ncbi.nlm.nih.gov/27172304/

"**We found fragrances in 33.3% of diaper wipes and 43.6% of topical diaper preparations.**"
"Other potential **allergens** identified with high frequency include >-tocopherol, **fragrances**, propylene glycol, parabens, iodopropynyl butylcarbamate, and lanolin."
[Note: Many fragrance chemicals are known sensitizers and allergens**]**

7. *Fragrance chemicals in domestic and occupational products*

Rastogi SC, Heydorn S, Johansen JD, Basketter DA. Fragrance chemicals in domestic and occupational products. Contact Dermatitis. 2001 Oct;45(4):221-5. doi: 10.1034/j.1600-0536.2001.450406.x. PMID: 11683833.
Article Link: https://pubmed.ncbi.nlm.nih.gov/11683833/

"Epidemiological studies have described an increasing prevalence of **fragrance allergy** and indicated an association with **hand eczema."**
"**Fragrances are one of the most common causes of allergic contact dermatitis**…approximately 2500 substances are used in fragrances, which may contain from 10 to more than 300 different chemical compounds."

8. *Baby-Wipe Dermatitis: Preservative-Induced Hand Eczema in Parents and Persons Using Moist Towelettes*

Guin JD, Kincannon J, Church FL. Baby-wipe dermatitis: preservative-induced hand eczema in parents and persons using moist towelettes. Am J Contact Dermat. 2001 Dec;12(4):189-92. doi: 10.1053/ajcd.2001.28052. PMID: 11753890.
Article Link: https://pubmed.ncbi.nlm.nih.gov/11753890/

"Results: A total of 6 women and 3 men with **hand eczema** were found to be allergic to (preservatives found in) different brands of moist towelettes used in diaper hygiene. Many were **allergic to fragrance materials** as well."

"Hand eczema in a grip-like pattern is good reason to inquire about baby wipes as a possible source, as most patients do not recognize that source even after undergoing patch tests."

9. *Activation of non-sensitizing or low-sensitizing fragrance substances into potent sensitizers - prehaptens and prohaptens*

Karlberg AT, Börje A, Duus Johansen J, Lidén C, Rastogi S, Roberts D, Uter W, White IR. Activation of non-sensitizing or low-sensitizing fragrance substances into potent sensitizers - prehaptens and prohaptens. Contact Dermatitis. 2013 Dec;69(6):323-34. doi: 10.1111/cod.12127. Epub 2013 Sep 20. PMID: 24107147
Article Link: https://pubmed.ncbi.nlm.nih.gov/24107147/ - PDF

"The present review shows that several fragrance substances, including the most commonly used, easily autoxidize on contact with air, forming potent sensitizers that can be an important source of **contact allergy** to fragrances and fragranced products…. So far, all fragrance substances that have been investigated with regard to the influence of autoxidation on the allergenic potential have oxidizable allylic positions that are able to **form hydroperoxides as primary oxidation products upon air exposure**. Identification of the oxidation products in the oxidation mixture shows that hydroperoxides further oxidize, forming secondary oxidation products, finally leading to polymeric compounds. **Once the hydroperoxides have been formed, they can form specific antigens and act as skin sensitizers**…."

"Secondary oxidation products, such as **aldehydes and epoxides, can also be allergenic,** thus further increasing the sensitizing potency of the autoxidation mixture …. Conjugated **aldehydes** and allylic epoxides are especially important sensitizers, as is seen in the activation of **geraniol**, **cinnamyl alcohol**, and **α-terpinene**. Further experimental and clinical research in the area of abiotic and/or biotic activation of fragrance substances is clearly needed to increase the safety for the consumer. Overall, there is a need for more experimental research to further establish the impact of the behaviour of fragrance substances when applied on the skin."

10. *Fragrance allergens in household detergents*

Wieck S, Olsson O, Kümmerer K, Klaschka U. Fragrance allergens in household detergents. Regul Toxicol Pharmacol. 2018 Aug;97:163-169. doi: 10.1016/j.yrtph.2018.06.015. Epub 2018 Jun 22. PMID: 29940212.
Article Link: https://pubmed.ncbi.nlm.nih.gov/29940212/

"For the first time, fragrance allergens were evaluated in a complete set of detergents in households. In 131 households, we investigated the prevalence of detergents and searched their lists of ingredients for 26

fragrance allergens liable to be indicated on products according to the European Detergents Regulations. On the ingredient lists of 1447 products, these 26 fragrance substances were named almost 2000 times, most often limonene, linalool and hexyl cinnamal. Benzyl salicylate was used frequently in all-purpose cleaners. Linalool and limonene, hexyl cinnamal and butylphenyl methylpropional and citronellol and linalool co-occurred most often together in products. **Fragrance allergens** co-occurring together most frequently within households were eugenol, coumarin and cinnamyl alcohol. The study shows that **detergents could play a relevant role for the exposure of consumers towards fragrance allergens** and that they should not be underestimated as an exposure source during the exposure assessment."

"Further factors such as **chemical transformation (e.g. by oxidation) into stronger allergens or new molecules** of often unknown properties and individual use practices can increase the risk of allergy further (Bråred Christensson et al., 2016; Niu et al., 2017; Rossignol et al., 2013)."
"Our results demonstrate that detergents could contribute to the aggregated exposure to fragrance allergens…The results indicate that detergents, next to cosmetics, should be included in exposure scenarios calculating the aggregate exposure. Furthermore, detergents can also contribute to the co-exposure of consumers, possibly leading to enhanced sensitization."

[Note: In the EU, 26 known fragrance allergens have been a labeling requirement since 2009, but as of 2022 the EU is planning to add 56 more fragrance allergens.**]**

[Note: IN THE U.S. NEWS - On Dec. 29, 2022, the MOCRA - (Modernization of Cosmetic Regulation Act) was signed into law. In a few years, the U.S. should start listing fragrance allergens in cosmetics, but this Act may tie the hands of states' ability to make a law pertaining to disclosing the over 3,000 other potentially concerning fragrance ingredients (like California did).
To learn more, see what **Women's Voices for the Earth (WVE)** have figured out.
To read the Act, go to congress.gov link/PDF (page 1396).
What to know:
Which products qualify as 'cosmetics' and Who regulates what??
Items such as fragranced laundry products, air fresheners, carpet fragrance, fragrance in cleaning products or car / car wash fragrances are not considered cosmetics, therefore, it is safe to say that companies who sell these products will not be obligated to list the known fragrance allergens in their products.**]**

11. *Emissions from dryer vents during use of fragranced and fragrance-free laundry products*

Goodman, N.B., Wheeler, A.J., Paevere, P.J. et al. Emissions from dryer vents during use of fragranced and fragrance-free laundry products. Air Qual Atmos Health 12, 289–295 (2019). https://doi.org/10.1007/s11869-018-0643-8
Article Link: https://link.springer.com/article/10.1007/s11869-018-0643-8 - PDF

"The study focused on D-limonene because it is (a) a prevalent and dominant VOC in fragranced laundry products as well as other fragranced consumer products, (b) a suitable marker as it is generally found in fragranced laundry products but not in fragrance-free laundry products, (c) associated with a range of adverse human health and environmental effects, and classified as a potentially hazardous compound (SWA 2018), and (d) a terpene that readily reacts with ozone to generate a range of hazardous secondary air pollutants."

(note: Graphic is from preceding article**)**
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you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons license, and indicate if changes were made.**)**

Table 3 GC/MS headspace analysis of VOCs emitted from the fragranced laundry detergent and the fragrance-free laundry detergent used in this study, listed according to retention time

Compound	CAS #	Fragranced detergent	Fragrance-free detergent
Acetaldehyde*	75-07-0	✓	✓
Ethanol*	64-17-5	✓	
Acetone*	67-64-1	✓	✓
2-methyl-Pentane*	107-83-5	✓	
2-methyl-2-Propanol	75-65-0		✓
2-Propen-1-ol*	107-18-6	✓	
2-methyl-Hexane*	591-76-4	✓	
2,3-dimethyl-Pentane*	565-59-3	✓	
3-methyl-Hexane*	589-34-4	✓	
1,3-dimethyl-Cyclopentane	2453-00-1	✓	
Ethylbenzene*	100-41-4		✓
Heptane*	142-82-5	✓	
methyl-Cyclohexane*	108-87-2	✓	
2,3,4-trimethyl-Hexane	921-47-1	✓	
(E)-3-Hexen-1-ol	928-97-2	✓	
1-Hexanol*	111-27-3	✓	
α-Pinene	80-56-8	✓	
2-methyl-ethyl ester Pentanoic acid	39255-32-8	✓	
Sabinene	3387-41-5	✓	
3-Carene	13466-78-9	✓	
β-Myrcene	123-35-3	✓	
β-Ocimene	3779-61-1	✓	
4-Hexen-1-ol, acetate	72237-36-6	✓	
Acetic acid, hexyl ester	142-92-7	✓	
Octanal	124-13-0	✓	
D-Limonene*	5989-27-5	✓	
β-Phellandrene	555-10-2	✓	
2,6-dimethy-l-5-Heptenal	106-72-9	✓	
2,6-dimethyl-7-Octen-2-ol	18479-58-8	✓	
1,3,4-Trimethyl-3-cyclohexenyl-1-carboxaldehyde	40702-26-9	✓	
Linalool*	78-70-6	✓	
3-methyl-5-propyl-Nonane	31081-18-2		✓
(E)- 7-Tetradecene	41446-63-3		✓
Cyclododecane	294-62-2		✓
Benzyl acetone	2550-26-7	✓	
4-tert-Butylcyclohexyl acetate	104-05-2	✓	
α-Terpinyl acetate	98-55-5	✓	
2-Carene	554-61-0	✓	
Lilial*	80-54-6	✓	

* Classified as hazardous under Safe Work Australia, Hazardous Chemical Information System (SWA 2018)

"This study demonstrated the **improvements to air quality after switching from fragranced to fragrance-free products.** It found that, by a change to fragrance-free laundry products, concentrations of D-limonene can be almost completely eliminated from the dryer vent emissions. This strategy may also reduce the formation and concentrations of secondary pollutants such as **formaldehyde**, **acetaldehyde**, and ultrafine particles. Findings from this study can provide an important foundation for future research, and for demonstrating cost-effective strategies to reduce VOC emissions and personal exposures."

[Note: Fragrance is considered the new 'second hand smoke', **"**The parallels between second-hand smoke and synthetic fragrance use are many. At its core, both are battles over indoor air quality **"** - quote and link from De Vader, Christy L. & Barker, Paxson.

Chemicals that cigarettes/cigarette smoke and fragranced products can have in common are: Acetone, Formaldehyde, Benzene, acetaldehyde, terpenoids and phenols.**]**

12. *Skin safety and health prevention: an overview of chemicals in cosmetic products*

Panico A, Serio F, Bagordo F, Grassi T, Idolo A, DE Giorgi M, Guido M, Congedo M, DE Donno A. Skin safety and health prevention: an overview of chemicals in cosmetic products. J Prev Med Hyg. 2019 Mar 29;60(1):E50-E57. doi: 10.15167/2421-4248/jpmh2019.60.1.1080. PMID: 31041411; PMCID: PMC6477564.
Article Link: https://pub

"Cosmetic products contain a wide range of chemicals to which we are exposed everyday."
"Fragrances were present in 52.3% of the examined products, mostly **limonene** (76.9%) and **linalool** (64.6%) but also **citronellol** (34.1%), **geraniol** (31.5%), **coumarin** (30%) and **hexyl cinnamal** (29.2%)."
"…**substances may induce several acute adverse side-effects, i.e. contact dermatitis and allergic reactions.** For these reasons, an enhancement of the criteria used for cosmetics formulation is required since many chemicals used singularly or combined are potentially unsafe."

13. *Volatile organic compounds in feminine hygiene products sold in the US market: A survey of products and health risks*

Lin N, Ding N, Meza-Wilson E, Manuradha Devasurendra A, Godwin C, Kyun Park S, Batterman S. Volatile organic compounds in feminine hygiene products sold in the US market: A survey of products and health risks. Environ Int. 2020 Nov;144:105740. doi: 10.1016/j.envint.2020.105740. Epub 2020 Aug 28. PMID: 32866732; PMCID: PMC7958867.
Article Link: https://pubmed.ncbi.nlm.nih.gov/32866732/ - PDF

"**VOCs** are components of FHPs (feminine hygiene products) that **are added as fragrances**, adsorbents, moisture barriers, adhesives, and binders…Most of the larger non-target peaks were identified as **fragrances, such as linalool, eucalyptol and benzyl acetate**. Feminine hygiene products (FHPs) are used on highly permeable and sensitive vaginal and vulvar tissues by many women. These products contain a variety of chemicals, and few regulations require disclosure of their ingredients…."

"Products labeled as "organic," "natural," or "for sensitive skin" did not necessarily have lower VOC concentrations**….menstrual pads had hazard ratios** of up to 11, **sprays and powders** had hazard ratios of up to 2.2 and excess cancer risks of up to 2.1 × 10−6, and **washes** had **excess cancer risks** of up to 3.3 × 10−6. Our data suggest that **all tested FHPs contained some toxic VOCs**..."

"Exposure to high concentrations or long-term exposure of VOCs has been associated with many known or suspected effects including **irritation to eyes, skin and nose**; **damage to the respiratory system, liver and kidney; reproductive effect**s; and **carcinogenicity**"

"Examples of notable VOCs include **benzene**, a known carcinogen (US EPA, 1998), 1,4-dioxane, a likely carcinogen (US EPA, 2013), and naphthalene, a possible carcinogen due to possible genetic toxicity (Schreiner, 2003; US EPA, 1999). Health risks (carcinogenic or non-carcinogenic) related to the use of FHPs over the lifecourse remain unanswered."

14. *Fragrance allergens in household detergents*

Wieck S, Olsson O, Kümmerer K, Klaschka U. Fragrance allergens in household detergents. Regul Toxicol Pharmacol. 2018 Aug;97:163-169. doi: 10.1016/j.yrtph.2018.06.015. Epub 2018 Jun 22. PMID: 29940212.
Article Link: https://pubmed.ncbi.nlm.nih.gov/29940212/

"For the first time, fragrance allergens were evaluated in a complete set of detergents in households. In 131 households, we investigated the prevalence of detergents and searched their lists of ingredients for 26 fragrance allergens liable to be indicated on products according to the European Detergents Regulations."

"On the ingredient lists of 1447 products, these 26 fragrance substances were named almost 2000 times, most often **limonene**, **linalool** and **hexyl cinnamal**. **Benzyl salicylate** was used frequently in all-purpose cleaners. Linalool and limonene, hexyl cinnamal and **butylphenyl methylpropional** and **citronellol** and linalool co-occurred most often together in products. **Fragrance allergens** co-occurring together most frequently within households were **eugenol**, **coumarin** and **cinnamyl alcohol**. The study shows that **detergents could play a relevant role for the exposure of consumers towards fragrance allergens** and that they should not be underestimated as an exposure source during the exposure assessment."

"Further factors such as **chemical transformation (e.g. by oxidation) into stronger allergens or new molecules** of often unknown properties and individual use practices can increase the risk of allergy further (Bråred Christensson et al., 2016; Niu et al., 2017; Rossignol et al., 2013)."

"Our results demonstrate that detergents could contribute to the aggregated exposure to fragrance allergens…The results indicate that detergents, next to cosmetics, should be included in exposure scenarios calculating the aggregate exposure."

[Note: In the EU, 26 known fragrance allergens have been a labeling requirement since 2009, but as of 2022 the EU is planning to add 56 more fragrance allergens.**]**

[Note: IN THE U.S. NEWS - On Dec. 29, 2022, the MOCRA - (Modernization of Cosmetic Regulation Act) was signed into law. In a few years, the U.S. should start listing fragrance allergens in cosmetics, but this Act may tie the hands of states' ability to make a law pertaining to disclosing the over 3,000 other potentially concerning fragrance ingredients (like California did).
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15. *Pediatric allergic contact dermatitis. Part I: Clinical features and common contact allergens in children*

Neale H, Garza-Mayers AC, Tam I, Yu J. Pediatric allergic contact dermatitis. Part I: Clinical features and common contact allergens in children. J Am Acad Dermatol. 2021 Feb;84(2):235-244. doi: 10.1016/j.jaad.2020.11.002. Epub 2020 Nov 17. PMID: 33217510.
Article Link: https://pubmed.ncbi.nlm.nih.gov/33217510/ - PDF

“Children can develop ACD (Allergic Contact Dermatitis) at any age…. Therefore, all children should be asked about the use of personal care products such as **shampoos, soaps, lotions, detergents, and topical medications.**…systemic contact dermatitis can occur through oral ingestion of contact allergens in food, such as carmine in red velvet cupcakes, nickel in oatmeal and cocoa, and **balsam of Peru (BoP)** in ketchup….Nickel, **fragrance mix (FM) I**, BoP, propylene glycol, CAPB, bacitracin, neomycin, cobalt, **formaldehyde (and its releasers)**, methylisothiazolinone (MI), and **lanolin** are top relevant allergens in the United States.”

“Fragrances are ubiquitous environmental allergens, and although **there are potentially thousands of allergenic fragrance chemicals,** fragrance markers such as BoP, FM I, and FM II are most frequently used in patch testing…. Fragrances are often used in household products like candles and cleaning supplies. **Children may also be exposed to fragrances used by their care takers, such as perfumes, leading to cases of connubial ACD**.”

“**Formaldehyde** is found in cosmetic and personal care products (**including baby products**), cleaning supplies, adhesives, sporting equipment, and paints. **One study showed that more than 25% of those with PPTs to formaldehyde were also sensitized to its releasers** such as quaternium-15, dimethyloldimethyl hydantoin, bronopol, diazolidinyl urea, and imidazolidinyl urea.

“Often, products such as **baby wipes may contain formaldehyde releasers** even though they may not be listed among the ingredients. **Formaldehyde (and releasers) contact allergy is more frequent in the United States compared to Europe, likely reflecting stricter regulation of product concentration and labeling in Europe.”**

[Note: Balsam of Peru is used in fragrance and is a known allergen. Like with all fragrance allergies, avoidance is suggested.**]**
[Note: Formaldehyde is a secondary pollutant from fragrance and fragranced products.
Also, a 2012 study, 21 out of 30 perfume samples were shown to release formaldehyde when tested but formaldehyde was not listed on any of the labels. Formaldehyde is a sensitizer and known allergen.**]**

16. *Fragrances: Contact Allergy and Other Adverse Effects*

de Groot AC. Fragrances: Contact Allergy and Other Adverse Effects. Dermatitis. 2020 Jan/Feb;31(1):13-35. doi: 10.1097/DER.0000000000000463. PMID: 31433384.
Article Link: https://pubmed.ncbi.nlm.nih.gov/31433384/

“In the general adult population, up to 4.5% may be allergic to fragrance materials, and in consecutive patients patch tested for suspected contact dermatitis, the frequency may reach 20% to 25%...

“Fragrances are an important and frequent cause of contact allergy and allergic contact dermatitis, notably from their presence in fragranced products such as deodorants, **fine fragrances** and aftershaves, other cosmetics (**both leave-on and rinse-off products**), household products, topical pharmaceuticals, essential oils, foods, and, to a lesser degree, industrial products.”

“Other adverse effects reported from fragrances include immediate type reactions (mostly nonimmune immediate contact reactions, contact urticaria), **photosensitivity**, **respiratory disorders**, and miscellaneous adverse effects including irritant **contact dermatitis**, **depigmentation**, and **systemic adverse effects**.”

“Fragrances are volatile, and therefore, in addition to skin exposure, a perfume also exposes the **eyes and nasorespiratory tract**. Already 35 years ago, it was suspected and later confirmed that fragrances can induce or worsen respiratory problems including **asthmatic attacks**.”

“People may experience symptoms not only from wearing perfume themselves but also around cosmetic counters, candle shops, and from perfumes worn by other people. Currently, it is estimated that 2% to 4% of the adult population is affected by respiratory or eye symptoms from such exposures. Frequently reported **symptoms include dry, itching, or watery eyes; nasal irritation; congestion; and sneezing; as well as mouth and throat irritation, shortness of breath, and cough.**”

17. *Contact Dermatitis to Medications and Skin Products*

Nguyen HL, Yiannias JA. Contact Dermatitis to Medications and Skin Products. Clin Rev Allergy Immunol. 2019 Feb;56(1):41-59. doi: 10.1007/s12016-018-8705-0. PMID: 30145645.
Article Link: https://pubmed.ncbi.nlm.nih.gov/30145645/

“Today, consumer products, such as soaps, moisturizing creams, cosmetics, household cleaners, fragrances, **topical medication**, and others, contain a myriad of ingredients that can **cause skin allergy.** When these products contact the skin, they can produce **eczematous pruritic reactions** known as contact dermatitis…”
“…the prevalence of contact dermatitis has been increasing worldwide for the past few decades.”

“**Fragrance mix I**, **fragrance mix II**, and **Myroxylon pereirae resin (Balsam of Peru)** are in the **top 11 allergens** of the NACDG 2013–2014…”

“**Fragrance mix I** contains eight allergens:
cinnamic alcohol, cinnamic aldehyde, α-amylcinnamal aldehyde, eugenol, isoeugenol, hydroxycitronellal, geraniol, and oakmoss absolute…”

“…**fragrance mix II** was introduced with six more compounds:
hydroxyisohexyl-3-Cyclohexene- carboxaldehyde (HICC), citral, farnesol, coumarin, citronellol, and α-hexylcinnamal …”

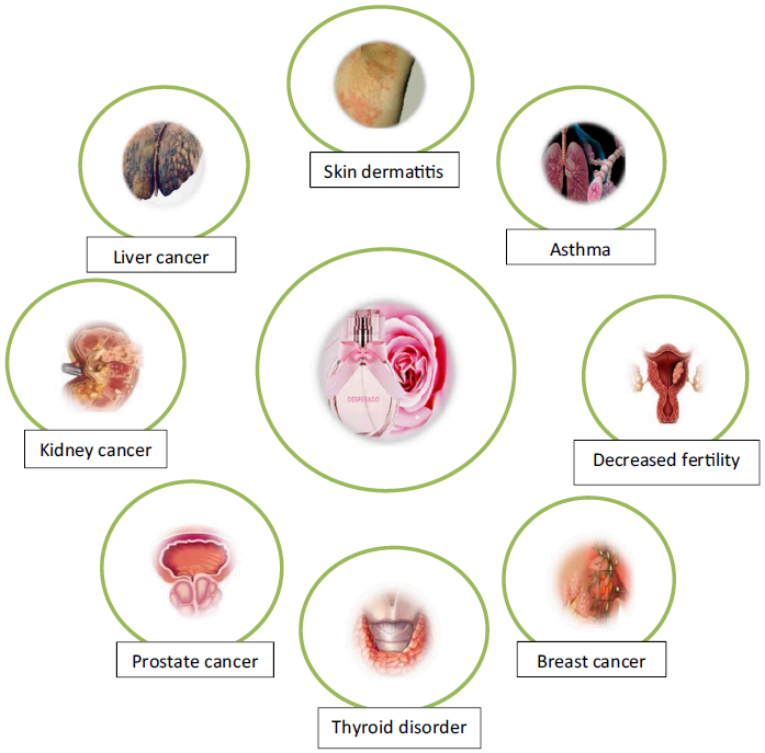
[Note: also see, **Airborne Contact Dermatitis**, these reactions are happening to people when fragrance chemicals float around and are simply present in the air. For example, someone can react if their caregiver or person next to them uses fragranced laundry products.**]**

18. *Evaluation of pollutants in perfumes, colognes and health effects on the consumer: a systematic review*

Kazemi Z, Aboutaleb E, Shahsavani A, Kermani M, Kazemi Z. Evaluation of pollutants in perfumes, colognes and health effects on the consumer: a systematic review. J Environ Health Sci Eng. 2022 Feb 3;20(1):589-598. doi: 10.1007/s40201-021-00783-x. PMID: 35669814; PMCID: PMC9163252.
Article Link: https://pubmed.ncbi.nlm.nih.gov/35669814/ **-** PDF

(Note: Graphic is from preceding article) (Creative Commons Attribution 4.0 International license).

Fig. 2 Effects of exposure to perfumes and colognes



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"Diethyl phthalate is a chemical used to **make perfumes last longer.** The U.S. Clean Water Act lists it as a **toxic** and priority pollutant."

"Complications of using perfume include **neuropathy (depression, autism), neoplasms (breast cancer, prostate cancer), effects on the liver, migraine headaches, asthma attacks, mucosal symptoms (watery or red eyes, sneezing), neurological problems (dizziness, convulsions, headache, fainting, imbalance), respiratory (cough, shortness of breath), skin (skin rash, urticaria, redness of the skin, skin tingling, dermatitis), immune system (swollen lymph nodes, fever, fatigue), gastrointestinal tract (nausea, bloating, diarrhea)** and c**ardiovascular (rapid** or **irregular heartbeat, tremors, chest discomfort**)"

"**Contaminants in perfumes and colognes** and their health effects on the consumer were systematically reviewed. It was found that the most attention of researchers was to identify the compounds in perfumes and colognes and their concentrations. Among the most common pollutants **phthalates** and their derivatives can be mentioned. Other pollutants included **parabens, triclosan, salicylates, terpenes, aldehydes, benzene, toluene, styrene, and aluminum-based salts**. These pollutants have also been shown to have adverse effects on consumer health such as **asthma and allergies, cardiovascular disease, central nervous system damage, breast cancer, endocrine cancer, respiratory disorders, reproduction, thyroid, adrenal gland function and immune system."**

[Note: Graphic lists “effects of exposure to perfumes and colognes”: Kidney Cancer, Liver Cancer, Prostate Cancer, Thyroid Disorder, Breast Cancer, Decreased Fertility, Asthma and Skin Dermatitis.**]**

19. *Toxic Chemicals Emitted from Air fresheners & Disinfectants*

Geetha Balasubramani, Paul Pradeep, J Nisitha S. Toxic Chemicals Emitted from Air fresheners & Disinfectants. IJRASET. Volume 10 Issue X Oct 2022, Pgs 1338-1345. ISSN : 2321-9653 *IJRASET47180*

Article Link:

https://www.ijraset.com/research-paper/toxic-chemicals-emitted-from-air-fresheners-and-disinfectants - PDF

(Note: This graphic is from preceding article**)**

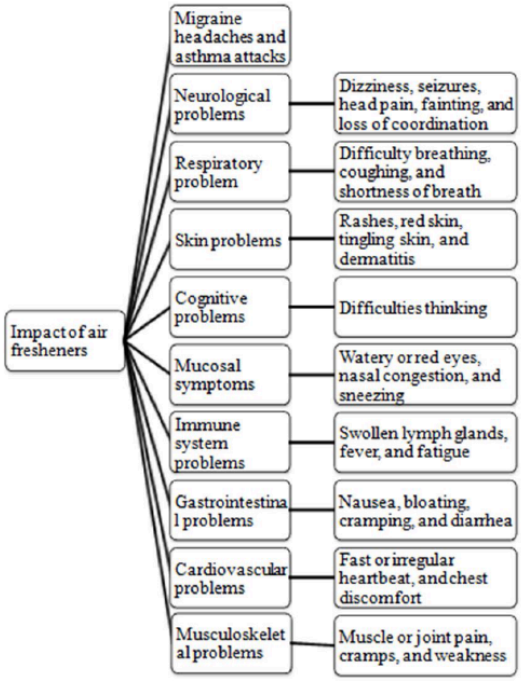

Figure 2: The diagram above illustrates the classification of illnesses brought on by exposure to air fresheners.

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20. *Relationship between indoor air pollutant levels and residential environment in children with atopic dermatitis*

Lee JH, Lee HS, Park MR, Lee SW, Kim EH, Cho JB, Kim J, Han Y, Jung K, Cheong HK, Lee SI, Ahn K. Relationship between indoor air pollutant levels and residential environment in children withatopic dermatitis. Allergy Asthma Immunol Res. 2014 Nov;6(6):517-24. doi: 10.4168/aair.2014.6.6.517. Epub 2014 Sep 11. PMID: 25374751; PMCID: PMC4214972.

Article Link: https://pubmed.ncbi.nlm.nih.gov/25374751/ - PDF

“The prevalence of AD (Atopic Dermatitis) is currently increasing and the incidence in children is reported to range from 15-30% worldwide….”

“**Exposure to volatile organic compounds (VOCs) can damage the epidermal barrier** and enhance adverse effects of house dust mites on sensitized subjects with AD. Exposure to formaldehyde and nitrogen dioxide (NO2) at domestic concentration can cause **skin barrier function impairment** in patients with AD.”

“Indoor air pollutant concentrations were measured including particulate matter with diameter less than 10 μm (PM10), **formaldehyde**, carbon dioxide (CO2), carbon monoxide (CO), nitrogen dioxide (NO2), **total volatile organic compound (TVOC)**, **benzene**, **toluene**, ethyl-benzene, **xylene**, **styrene**, bacterial aerosols and airborne fungi.”

“In conclusion,…To alleviate AD symptoms, identifying aggravating factors including indoor air quality is important. In this regard, simple questioning about aspects of residential environment such as visible fungus on the walls and **the use of artificial air freshener** are helpful to assess the possibility of increased indoor air pollutant levels when direct measurement is not feasible.”

[Note: Benzene is a reported fragrance ingredient in the CSCP Product Database.**]**
[Note: Toluene (often a nail polish thinner) is used as a solvent or fragrance in perfume and bath products on the CSPC Product Database. Toluene is on the IFRA list and on the EPA’s Priority Pollutant List.**]**
[Note: Xylene “occurs naturally in petroleum and coal tar, and is major component of gasoline and fuel oil”. Xylene is used as a musk fragrance. Xylene is on IFRA.**]**
[Note: Styrene is “primarily a synthetic chemical**”** used in fragrance. It is on the CSPC list as ‘parfum/fragrance’ and also on the IFRA list.**]**

21. *Airborne contact dermatitis - current perspectives in etiopathogenesis and management*

Handa S, De D, Mahajan R. Airborne contact dermatitis - current perspectives in etiopathogenesis and management. Indian J Dermatol. 2011 Nov;56(6):700-6. doi: 10.4103/0019-5154.91832. PMID: 22345774; PMCID: PMC3276900.
Article Link: https://pubmed.ncbi.nlm.nih.gov/22345774/ - Full Text

“Airborne contact dermatitis (ABCD) is a morphological diagnosis that encompasses all acute or chronic dermatoses predominantly of exposed parts of body, which are caused by substances which when released into the air, settle on the exposed skin.”
“In airborne allergic dermatitis, initially there is a refractory phase where there is a periodic or continuous contact with allergen but no response. This is followed by an induction phase where the hapten penetrates skin, conjugates with epidermal protein, comes in contact with antigen presenting cells, migrates to draining lymph nodes followed by stimulation of naive T cells. This leads to proliferation of activated T cells to produce effector and memory cells which then enter the circulation. Re-exposure to the specific hapten leads to the release of mediators producing skin inflammation. A persistent inflammation is produced due to continued presence of effector cells.”

“The common allergens … include various acids and alkalis, metals and powders of metallic salts, cement, industrial solvents, glass fibers, sewage sludge, ammonia, vegetable and wood allergens, plastics, rubbers and glues, insecticides, **pesticides**, animal feed additives and many others. The airborne contactants can also be classified on the basis of their physical state as **volatile airborne contactants** like acids, alkalis, ammonia and pesticides; droplets like insecticides, **perfumes** and **hair sprays**; powders which include aluminum, anhydrous calcium silicate, and metallic oxides; and particles like tree sawing particles, wool and plastics.”
“Dooms-Goossens classified airborne dermatitis into five different types, namely, airborne irritant contact dermatitis, airborne allergic contact dermatitis, airborne phototoxic reactions, airborne photoallergic reactions and airborne contact urticaria.[33] Rare presentations include **acne like**, **lichenoid eruptions**, fixed drug eruptions, **exfoliative dermatitis**, **telengiectases**, **paresthesias**, **purpura**, e**rythema multiforme** like eruption, pellagra like dermatitis and **lymphomatoid CD**. Some agents cause more than one type of reaction.

P. hysterophorus can produce allergic CD, photocontact dermatitis and a lichenoid eruption. Similarly, **formaldehyde** and phosphorus sesquisulfide can lead to an **airborne irritant** or **allergic CD** and **contact urticaria**."

"In the classical airborne allergic contact dermatitis, there is involvement of exposed areas of face, "V" of neck, hands and forearms, "Wilkinson's triangle," both eyelids, nasolabial folds and under the chin. The involvement of both light-exposed and protected areas helps to differentiate ABCD from a photo-related dermatitis. Another close differential is atopic eczema as both ABCD and atopic eczema have predominant flexural and skin crease involvement. Initially, there is an acute flare of the dermatitis during the plant growing season but, with repeated exposure, the flare becomes prolonged and produces a chronic lichenified eczema associated with secondary infection, fissuring and **hypo or hyperpigmentation**…. Some patients present with **facial swelling** before manifesting classical eczematous lesions."

22. *Fragrance allergic contact dermatitis*

Cheng J, Zug KA. Fragrance allergic contact dermatitis. Dermatitis. 2014 Sep-Oct;25(5):232-45. Doi: 10.1097/DER.0000000000000067. PMID: 25207685.
Article Link: https://pubmed.ncbi.nlm.nih.gov/25207685/

"Growing recognition of the widespread use of fragrances in modern society has fueled attempts to prevent sensitization through improved allergen identification, labeling, and consumer education. This review provides an overview and update on **fragrance allergy.** Fragrance materials are used as flavoring agents in oral hygiene products, foods, and drinks. In industrial products, they are found in paints, rubber, plastics, insecticides, and herbicides; in the household, in paper products, fabric and clothes, sunscreens, as well as topical medicaments."

"Within its more commonly known realm of use in cosmetics and toiletries, fragrances are present in lip balms, lipsticks, deodorants, lotions, creams, wet wipes, and a variety of baby products. **Nearly everyone is exposed to fragrances and mostly on a daily basis.** Not surprisingly fragrances are the most common cause of **allergic contact dermatitis** (ACD) from cosmetic products and are the second most common cause of positive patch test results after nickel."

23. *A pilot study of total personal exposure to volatile organic compounds among Hispanic female domestic cleaners*

Oyer-Peterson K, Gimeno Ruiz de Porras D, Han I, Delclos GL, Brooks EG, Afshar M, Whitworth KW. A pilot study of total personal exposure to volatile organic compounds among Hispanic female domestic cleaners. J Occup Environ Hyg. 2022 Jan;19(1):1-11. doi: 10.1080/15459624.2021.2000615. Epub 2022 Jan 28. PMID: 34731075; PMCID: PMC8813894.
Article Link: https://pubmed.ncbi.nlm.nih.gov/34731075/ - PDF

"Cleaners have an elevated risk for the development or exacerbation of **asthma** and other **respiratory** conditions, possibly due to exposure to cleaning products containing **volatile organic compounds (VOCs)** leading to **inflammation** and **oxidative stress**. …29% and 20% reported suffering from **skin irritation** and **trouble breathing**…"

"...the highest exposures experienced by the women were from **d-limonene** (mean = 22.5 ppb; median = 4.3 ppb), followed by **toluene** (mean = 1.5 ppb; median = 1.1 ppb), **α-pinene** (mean = 0.8 ppb; median = 0.7 ppb) and **β-pinene** (mean = 0.7 ppb; median = 0.6 ppb)..."

"Additionally, while they are exposed to myriad **VOCs**, these women were particularly exposed to **terpene compounds**, which are often **found in scented cleaning products.**"

24. *Fragranced consumer products: effects on autistic adults in the United States, Australia, and United Kingdom*

Steinemann A. Fragranced consumer products: effects on autistic adults in the United States, Australia, and United Kingdom. Air Qual Atmos Health. 2018;11(10):1137-1142. doi: 10.1007/s11869-018-0625-x. Epub 2018 Sep 25. PMID: 30546500; PMCID: PMC6244938
Article Link: https://pubmed.ncbi.nlm.nih.gov/30546500/ - PDF

"Fragranced consumer products are ubiquitous in society and emit numerous volatile organic compounds including hazardous air pollutants."

"Health effects were categorized as follows:
(a) migraine headaches;
(b) asthma attacks;
(c) neurological problems (e.g., dizziness, seizures, head pain, fainting, loss of coordination);
(d) respiratory problems (e.g., difficulty breathing, coughing, shortness of breath);
(e) skin problems (e.g., rashes, hives, red skin, tingling skin, dermatitis);
(f) cognitive problems (e.g., difficulties thinking, concentrating, or remembering);
(g) mucosal symptoms (e.g., watery or red eyes, nasal congestion, sneezing);
(h) immune system problems (e.g., swollen lymph glands, fever, fatigue);
(i) gastrointestinal problems (e.g., nausea, bloating, cramping, diarrhea);
(j) cardiovascular problems (e.g., fast or irregular heartbeat, jitteriness, chest discomfort);
(k) musculoskeletal problems (e.g., muscle or joint pain, cramps, weakness); and
(l) other."

"Specific problematic exposures, associated with adverse health effects for autistic adults, include but are not limited to the following: …air fresheners and deodorizers (62.9%), the scent of laundry products coming from a dryer vent (57.5%), being in a room recently cleaned with scented products (65.9%), **being near someone wearing a fragranced product** (60.5%), and other types of fragranced consumer products (64.3%)… Among autistic adults reporting health effects, 74.1% across the three countries (85.4% US, 82.4% AU, 54.5% UK) report that the severity of these health effects from fragranced products was potentially disabling. Among non-autistic adults, the prevalence of potentially disabling effects was 25.4%."

"...62.1% of autistic adults are unable or reluctant to use the restrooms in a public place if it has an air freshener, deodorizer, or scented product; 59.8% are unable or reluctant to wash their hands with soap in a public place if the soap is fragranced; 58.7% enter a business and then want to leave as quickly as possible if they smell air fresheners or a fragranced product; and **66.7% have been prevented from going someplace because they would be exposed to a fragranced product that would make them sick…"**

"Involuntary exposure is a concern. Autistic individuals are prevented from accessing public restrooms, societal venues, businesses, and workplaces due to adverse health effects from fragranced products. Further, 59.4% of

autistic adults have lost workdays, in the past year, due to fragranced product exposure in the workplace. **A strong majority of autistic as well as non-autistic adults would prefer that workplaces, health care facilities, and health care professionals were fragrance-free than fragranced.**"

25. *Ten questions concerning air fresheners and indoor built environments*

Anne Steinemann, Ten questions concerning air fresheners and indoor built environments, Building and Environment, Volume 111, 2017, Pages 279-284, ISSN 0360-1323, https://doi.org/10.1016/j.buildenv.2016.11.009.
Article Link: https://www.sciencedirect.com/science/article/pii/S0360132316304334?via%3Dihub - PDF

"This article investigates the seeming paradox that **products designed to improve the indoor environment can pose unintended and unknown risks.** It examines the science, health, and policy perspectives, and provides recommendations and research directions."

"Air fresheners can contribute to indoor hazardous air pollutants, both through direct emissions and secondary reaction products… Within buildings and other indoor environments, the use of air fresheners has a strong association with high indoor levels of **terpenes, benzene, toluene**, ethyl-benzene, m,p-xylene, and **total volatile organic compounds**…"

"Air fresheners can contribute to human exposure to primary and secondary air pollutants… Air freshener exposures, **even at low levels**, have been associated with a range of adverse health effects, which include **migraine headaches, asthma attacks, breathing difficulties, respiratory difficulties, mucosal symptoms, dermatitis, infant diarrhea and earache, neurological problems, and ventricular fibrillation**..."
"In addition to population based studies, specific air freshener chemicals (VOCs such as acetaldehyde, SVOCs such as phthalates, and ultrafine particles) emitted from air fresheners have been associated with adverse effects to the **neurological, cardiovascular, respiratory, reproductive, immune, and endocrine systems, and with cancer**. For instance, acetaldehyde, which can be both a primary and secondary emission from air fresheners, is associated with both **acute and chronic hazards to the respiratory system**, and classified as a carcinogenic hazardous air pollutant in the US…"

26. *An atlas of fragrance chemicals in children's products*

Ravichandran J, Karthikeyan BS, Jost J, Samal A. An atlas of fragrance chemicals in children's products. Sci Total Environ. 2022 Apr 20;818:151682. doi: 10.1016/j.scitotenv.2021.151682. Epub 2021 Nov 15. PMID: 34793786.
Article Link: https://pubmed.ncbi.nlm.nih.gov/34793786/

"We find that several **fragrance chemicals in children's products are potential carcinogens, endocrine disruptors, neurotoxicants, phytotoxins and skin sensitizers.**"
Fragrance chemicals have been linked to the onset and exacerbation of **several allergic** and **non-allergic disease conditions** in humans."

"Exposure of children to hazardous chemicals via any route is a significant concern due to the potential **impact on the growth and development** during early childhood."
****FCCP Chemical Database:** FCCP A repository of Fragrance Chemicals in Children's Products
****FCCP Chemical Classification Data Compilation:** Graphical Abstract

27. *Newborn chemical exposure from over-the-counter skin care products*

Cetta F, Lambert GH, Ros SP. Newborn chemical exposure from over-the-counter skin care products. Clin Pediatr (Phila). 1991 May;30(5):286-9. doi: 10.1177/000992289103000504. PMID: 2044337.
Article Link: https://pubmed.ncbi.nlm.nih.gov/2044337/

"...many product ingredient labels list & fragrances. **The chemical composition and potential toxicity of these fragrances is not publicly available.**"
"In light of the relative **permeability of newborn skin**, the potential hazards of repetitive environmental chemical exposure from OTC skin care products need to be addressed."
"**This study documents the large number of chemicals, some of which are toxic, to which the average newborn is exposed during the first month of life**."

28. *Contact Dermatitis to Medications and Skin Products*

Nguyen HL, Yiannias JA. Contact Dermatitis to Medications and Skin Products. Clin Rev Allergy Immunol. 2019 Feb;56(1):41-59. doi: 10.1007/s12016-018-8705-0. PMID: 30145645.
Article Link: https://pubmed.ncbi.nlm.nih.gov/30145645/

"Today, consumer products, such as soaps, moisturizing creams, cosmetics, household cleaners, fragrances, **topical medication**, and others, contain a myriad of ingredients that can **cause skin allergy.** When these products contact the skin, they can produce **eczematous pruritic reactions** known as contact dermatitis…"
"…the prevalence of contact dermatitis has been increasing worldwide for the past few decades."

"**Fragrance mix I**, **fragrance mix II**, and **Myroxylon pereirae resin (Balsam of Peru)** are in the **top 11 allergens** of the NACDG 2013–2014…"

"**Fragrance mix I** contains eight allergens:
cinnamic alcohol, cinnamic aldehyde, α-amylcinnamal aldehyde, eugenol, isoeugenol, hydroxycitronellal, geraniol, and oakmoss absolute…"

"…**fragrance mix II** was introduced with six more compounds:
hydroxyisohexyl-3-Cyclohexene- carboxaldehyde (HICC), citral, farnesol, coumarin, citronellol, and α-hexylcinnamal …"

[Note: also see, **Airborne Contact Dermatitis**, these reactions are happening to people when fragrance chemicals float around and are simply present in the air. For example, someone can react if their caregiver or person next to them uses fragranced laundry products.**]**

29. *Airborne contact dermatitis: common causes in the USA*

Schloemer JA, Zirwas MJ, Burkhart CG. Airborne contact dermatitis: common causes in the USA. Int J Dermatol. 2015 Mar;54(3):271-4. doi: 10.1111/ijd.12692. Epub 2014 Jul 1. PMID: 24981079.
Article Link: https://pubmed.ncbi.nlm.nih.gov/24981079/ PDF

"**Airborne contact dermatitis (ABCD)** is an **inflammatory reaction** caused by exposure to particles suspended in air…. Airborne contact dermatitis can be classified as either allergic or irritant contact dermatitis,

depending on its etiology and the mechanism of inflammation…. Many **allergens** and **chemicals** have been documented as causative agents of ABCD."

"Many other agents responsible for causing ABCD have been reported in the literature.… Others include ammonia, anhydrous calcium sulfate, cleaning products, and **formaldehyde**."

"Of note, the incidence of ABCD caused by chemicals of the isothiazolinone family, including **methylisothiazolinone** and **methylchloroisothiazolinone**, is on the rise as these chemicals are used increasingly as preservatives in many household products. Additionally, **dermatitis** resulting from methylisothiazolinone and related compounds may be allergic in nature, as evidenced by positive patch testing.

"Occupational hazards such as exposure to irritating chemicals and repetitive friction or abrasions to the surface of the skin can also pose a potential gateway for ABCD."

[Note: Limonene is a common skin sensitizer and known allergen in fragrance and fragranced products. Limonene (natural or synthetic) is a terpene. Terpenes can create formaldehyde and particulate matter in air as secondary pollutants. Limonene is on the IFRA list as a fragrance ingredient.**]**
[Note: Methylchloroisothiazolinone and Methylisothiazolinone (MCI-MI) are preservatives and known allergens used in air fresheners and personal care products.**]**

30. *Cosmetic Habits and Cosmetic Contact Dermatitis in Children*

Goossens, A. Cosmetic Habits and Cosmetic Contact Dermatitis in Children. *Curr Treat Options Allergy* 2, 228–234 (2015). https://doi.org/10.1007/s40521-015-0057-x
Article Link: https://link.springer.com/article/10.1007/s40521-015-0057-x - PDF

"Almost all cosmetic ingredients may be responsible for allergic **contact dermatitis**. Emulsifiers and other vehicle compounds, such as wool alcohols (lanolin), are possible allergenic culprits in cosmetics; however, **fragrance components** (fragrance mix, myroxylon pereirae, and colophonium), hair dye chemicals, and preservative agents are certainly the most important allergens"
"Although guidelines for the maximum concentration of fragrances (and preservatives) in cosmetics have been provided, it has been previously demonstrated that, for example, **cosmetic "toys" may contain much higher concentrations of fragrances**."

"**Allergic contact dermatitis from cosmetics in children and adolescents has recently become more frequently observed and recognized**. Fragrances, hair dyes, sunscreen agents, and preservative agents, particularly methylisothiazolinone, are the most important **allergens**."
"It remains an important task for the cosmetic industry to avoid the main allergens known from the literature and to formulate cosmetics intended to be used in this age group as safely as possible."

31. *Allergic contact dermatitis from fragrance components in specific topical pharmaceutical products in Belgium*

Nardelli A, D'Hooghe E, Drieghe J, Dooms M, Goossens A. Allergic contact dermatitis from fragrance components in specific topical pharmaceutical products in Belgium. Contact Dermatitis. 2009 Jun;60(6):303-13. doi: 10.1111/j.1600-0536.2009.01542.x. PMID: 19489964.

Article Link: https://pubmed.ncbi.nlm.nih.gov/19489964/

"Three hundred and seventy (10%) of 3280 of the topical pharmaceutical products were found to contain a total of 66 fragrance substances. Among 3378 patients suffering from iatrogenic allergic contact dermatitis, 127 were found to react to 48 specific products, for which 38 different fragrance substances gave relevant positive reactions. Women were more affected than men, and legs, hands, and face were the most commonly affected body sites."

"**Fragrances**, the presence of which is in most cases **unnecessary**, do contribute to iatrogenic allergic contact dermatitis. Moreover, **sensitized patients have difficulties in avoiding their specific allergens because standardized labelling of the ingredients in pharmaceutical products is lacking**."

[Note: In the EU, 26 known fragrance allergens have been a labeling requirement since 2009, but as of 2022 the EU is planning to add 56 more fragrance allergens.**]**

[Note: IN THE U.S. NEWS - On Dec. 29, 2022, the MOCRA - (Modernization of Cosmetic Regulation Act) was signed into law. In a few years, the U.S. should start listing fragrance allergens in cosmetics, but this Act may tie the hands of states' ability to make a law pertaining to disclosing the over 3,000 other potentially concerning fragrance ingredients (like California did).
To learn more, see what **Women's Voices for the Earth (WVE)** have figured out.
To read the Act, go to congress.gov link/PDF (page 1396).

What to know:
Which products qualify as 'cosmetics' and Who regulates what??
Items such as fragranced laundry products, air fresheners, carpet fragrance, fragrance in cleaning products or car / car wash fragrances are not considered cosmetics, therefore, it is safe to say that companies who sell these products will not be obligated to list the known fragrance allergens in their products.**]**

32. *Environmental factors and allergic diseases*

Jenerowicz D, Silny W, Dańczak-Pazdrowska A, Polańska A, Osmola-Mańkowska A, Olek-Hrab K. Environmental factors and allergic diseases. Ann Agric Environ Med. 2012;19(3):475-81. PMID: 23020042.
Article Link: https://pubmed.ncbi.nlm.nih.gov/23020042/ - PDF

"It has been estimated, that over 85 000 chemicals are recognized in the human environment and they may act as contact allergens or irritants, causing allergic or non-allergic contact dermatitis. Among them metals, **fragrances**, preservatives, botanicals and paraphenylenediamine are considered as the most significant."
"According to data from North America and Western Europe, 12.5%-40.6% of the population are diagnosed as allergic to at least one chemical."

"Cosmetics, fragrances, and botanicals are also important causes of both **irritant** and **allergic contact dermatitis**… Fragrances are important sources of **allergic contact dermatitis**. Fragrances are found in various types of cosmetics – most traditionally in perfume or cologne form. Fragrances, including fragrance mix, balsam of Peru, and cinnamic aldehyde, are the most commonly identified **allergens** in cosmetic-induced contact **hypersensitivity reactions**."

33. *Environmental Distribution of Personal Care Products and Their Effects on Human Health*

Khalid M, Abdollahi M. Environmental Distribution of Personal Care Products and Their Effects on Human Health. Iran J Pharm Res. 2021 Winter;20(1):216-253. doi: 10.22037/ijpr.2021.114891.15088. PMID: 34400954; PMCID: PMC8170769.
Article Link: https://pubmed.ncbi.nlm.nih.gov/34400954/ - PDF

"**Chemicals in PCPs (personal care products) have a high health risk to human and aquatic life** (14). Little information is available about exposures from PCPs and some ingredients of PCPs known as EDCs and involved in abnormal developmental and reproductive ability."

"**There are 50-300 different chemicals used as fragrances for PCPs**. Such chemicals may be **acetals, alcohols, aldehydes, amides, amines, carboxylic acids, coumarins, dioxanes, epoxides, esters, ethers, heterocyclics, hydrocarbons, ketones, lactones, musks, nitriles, phenols, pyrans, pyrazines, quinolines, or Schiff's bases**. Several PCPs such as **detergents, soaps, cleaners, and fabric softeners** contain various fragrances…"

"Fragrances are a mixture of VOCs that tend to break and mix with the dust or pollutants to form harmful secondary products or toxic air pollutants that are potentially more irritating or allergenic than the original substance. For example, **terpenes from PCPs may react with indoor ozone to form secondary pollutants such as formaldehyde."**

"Fragrances exacerbate symptoms of **asthmatic** patients and may induce **atopic asthma**. Fragrances with significant absorption in the UV range of 290-400 nm can cause **phototoxicity** and **photoallergy** resulting in dermal irritation and contact dermatitis. Dermatological patients often complain about **hand eczema and allergy**, mostly due to the ubiquitous usage of fragrances. Fragrance chemicals are also responsible for **airborne contact** and **facial dermatitis**. The incidence of **allergic contact dermatitis**, **hypersensitivity**, and **skin sensitization** found to be higher among women than men due to their frequency of use of PCPs and ubiquitous presence of fragrance chemicals."

[Note: Endocrine Disrupting Chemicals (EDC's) are commonly used in perfumes and fragranced products as preservatives or fragrance. What are EDC's and how can they affect us?**]**

34. *Health risks of chemicals in consumer products: A review*

Li D, Suh S. Health risks of chemicals in consumer products: A review. Environ Int. 2019 Feb;123:580-587. doi: 10.1016/j.envint.2018.12.033. Epub 2019 Jan 7. PMID: 30622082.
Article Link: https://pubmed.ncbi.nlm.nih.gov/30622082/ - Full Text

"It should also be noted that some chemicals have multiple functional uses, while we chose the most dominant functional use for each chemical. An example is the grouping of **phthalates**. Despite categorized as plasticizer together in this review, several phthalates such as **diethyl phthalate and dimethyl phthalate are used as solvents in personal care products and cosmetics as carriers of fragrance** (Schettler, 2006)."

"…we found that the volume of the peer-reviewed literature that addresses human health risks of the chemicals in consumer products did grow over the last two decades, while its growth could by no means match the speed of increasing volume and diversity of the chemicals produced and used in consumer products by the society. This **growing gap between increasing reliance on chemicals in consumer products and our knowledge**

on their human health risks raises a potential public health concern, given the pervasive nature of today's mass production and consumption practice."

35. *Airborne contact dermatitis: common causes in the USA*

Schloemer JA, Zirwas MJ, Burkhart CG. Airborne contact dermatitis: common causes in the USA. Int J Dermatol. 2015 Mar;54(3):271-4. doi: 10.1111/ijd.12692. Epub 2014 Jul 1. PMID: 24981079.
Article Link: https://pubmed.ncbi.nlm.nih.gov/24981079/ PDF

"Airborne contact dermatitis (ABCD) is an inflammatory reaction caused by exposure to particles suspended in air…. Airborne contact dermatitis can be classified as either allergic or irritant contact dermatitis, depending on its etiology and the mechanism of inflammation…. Many **allergens** and **chemicals** have been documented as causative agents of ABCD."

"Many other agents responsible for causing ABCD have been reported in the literature.… Others include ammonia, anhydrous calcium sulfate, cleaning products, and **formaldehyde**."

"Of note, the incidence of ABCD caused by chemicals of the isothiazolinone family, including methylisothiazolinone and methylchloroisothiazolinone, is on the rise as these chemicals are used increasingly as preservatives in many household products. Additionally, dermatitis resulting from methylisothiazolinone and related compounds may be allergic in nature, as evidenced by positive patch testing.

"Occupational hazards such as exposure to irritating chemicals and repetitive friction or abrasions to the surface of the skin can also pose a potential gateway for ABCD."

[Note: Limonene is a common skin sensitizer and known allergen in fragrance and fragranced products. Limonene (natural or synthetic) is a terpene. Terpenes can create formaldehyde and particulate matter in air as secondary pollutants. Limonene is on the IFRA list as a fragrance ingredient.**]**
[Note: Methylchloroisothiazolinone and Methylisothiazolinone (MCI-MI) are preservatives and known allergens used in air fresheners and personal care products.**]**

36. ALSO SEE SECTIONS: Airborne Contact Dermatitis, Allergies, Respiratory/Pulmonary, Liver Disease

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Website: https://www.fragrancefreecoalitionusa.com/

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Poster and Document are for reference and educational purposes only.

DIABETES

Insulin Resistance, Neuropathy, Hyperglycemia

1. *Need of the hour: to raise awareness on vicious fragrances and synthetic musks*

Patel, S., Homaei, A. & Sharifian, S. Need of the hour: to raise awareness on vicious fragrances and synthetic musks. Environ Dev Sustain 23, 4764–4781 (2021). https://doi.org/10.1007/s10668-020-00829-4
Article Link: https://link.springer.com/article/10.1007/s10668-020-00829-4

"The exposure to the **synthetic fragrances and musks**, which are produced in quantities of thousands of tons per year, has been shown to **elicit several pathologies**."

"The **fragrance compounds** are regarded as **toxins by the human immune system**, and to eliminate them, cytochrome enzymes, especially aromatases, are overexpressed. These enzymes also **convert androgens into estrogens,** but **excess estrogen production affects the endocrine system** in both males and females."

"It is increasingly being evident that all diseases have common roots, i.e., **inflammation**."

"**The unprecedented prevalence of diabetes, obesity, cancer, and depression, among others pathologies, is tied to the limitless usage of fragrance compounds."**

2. *Disparities in Environmental Exposures to Endocrine-Disrupting Chemicals and Diabetes Risk in Vulnerable Populations*

Ruiz D, Becerra M, Jagai JS, Ard K, Sargis RM. Disparities in Environmental Exposures to Endocrine-Disrupting Chemicals and Diabetes Risk in Vulnerable Populations. Diabetes Care. 2018 Jan;41(1):193-205. doi: 10.2337/dc16-2765. Epub 2017 Nov 15. PMID: 29142003; PMCID: PMC5741159.
Article Link: https://pubmed.ncbi.nlm.nih.gov/29142003/ - PDF

"Scientific evidence linking **EDCs** with the **development of diabetes** and other **metabolic disorders** continues to grow. Of note, exposures to several toxicants have been prospectively linked to diabetes risk, including PCBs, organochlorine (OC) pesticides, **various chemical constituents of air pollution,** bisphenol A (BPA), and **phthalates** (Table 1);...
moreover, exposure to these EDCs is higher among African Americans, Latinos, and low-income individuals (Supplementary Table 1). These unequal exposures raise the possibility that EDCs are underappreciated contributors to diabetes disparities."

"In this analysis, **metabolites of butyl phthalates and diethylhexyl phthalate (DEHP) were associated with diabetes** (OR 3.16 [95% CI 1.68–5.95] and 1.91 [95% CI 1.04–3.49], respectively)."

(the following quote is from Table 3 in the full document**)**
"Phthalates:... (are found in) Personal care products, such as **perfumes**, hair sprays, deodorants, nail polishes, insect repellants, and **most consumer products containing fragrances**, including shampoos, air fresheners, and laundry detergents"

[Note: Phthalates are synthetic odorless plasticizers used as solvents, binders or fixatives in many fragrances. Why are phthalates in the news? Phthalates are considered Endocrine Disrupting Chemicals.
On the California Safe Cosmetics Program Product Database: DEP, DIDP, and DBP are reported as fragrance while DEHP and DBP are perfume solvents. IFRA lists DEP and DMP, as "reported fragrance ingredients".**]**

[Note: Endocrine Disrupting Chemicals (EDC's) are commonly used in perfumes and fragranced products as preservatives or fragrance. What are EDC's and how can they affect us?**]**

3. *Is the Diabetes Epidemic Primarily Due to Toxins?*

Pizzorno J. Is the Diabetes Epidemic Primarily Due to Toxins? Integr Med (Encinitas). 2016 Aug;15(4):8-17. PMID: 27574488; PMCID: PMC4991654.
Article Link: https://pubmed.ncbi.nlm.nih.gov/27574488/ - PDF

"The incidence of diabetes has increased 7 to 10-fold in the past 50 y. Although increased sugar consumption, obesity, and lack of exercise certainly contribute, the effect of environmental toxins may be far greater. The data are so compelling that some researchers now label these toxins as ***diabetogens*.** This editorial summarizes the research showing which toxins are the worst offenders, how they disrupt blood sugar control, where they come from, how to assess body load, and strategies for detoxification and excretion."

"Another possibility is the increased incidence of obesity which is a known major risk factor for diabetes. However, the **obesity epidemic appears because of the same causes as diabetes: diabetogens,** many of which are also called ***obesogens***. Of particular significance is the surprising observation that obese people with low levels of persistent organic pollutants (POPs) **do not** have an increased risk of diabetes.3 In contrast, as can be seen in Figure 3, the diabetes epidemic does correlate with the rate of release of POPs into the environment…. More convincing is the correlation between body load of POPs and risk of metabolic syndrome as seen in Figure 4, and the association is synergistic. When POP levels versus diabetes risk is examined, the case becomes even more compelling, as shown in Figure 5.'

"Adding up the numbers shows potentially the **whole epidemic is apparently due to the massive increase in body load of toxins**. A big caveat is that there is a real problem with nonindependence of the correlations and that many of these **diabetogens** are also being labeled ***obesogens***, as there is substantial overlap of mechanisms of damage. Nonetheless, even if we do not know the exact percentage contribution of each toxin, their role in the epidemic appears undeniable."

"**Phthalates** are a family of organic chemicals used as plasticizers (to increase flexibility, transparency, and durability) and for multiple manufactured product purposes, such as **to solubilize and stabilize fragrances** in cosmetics."

"**Diethyl phthalate** and **dibutyl phthalate are especially common in health and beauty aids, except in Europe where they have now been banned due the very large amount of research showing their toxicity**, regardless of the source. As can be seen in Figure 11, **phthalate levels in the blood directly correlate with use of health and beauty aids**."

4. *Endocrine disruptor chemicals as obesogen and diabetogen: Clinical and mechanistic evidence*

Kurşunoğlu NE, Sarer Yurekli BP. Endocrine disruptor chemicals as obesogen and diabetogen: Clinical and mechanistic evidence. World J Clin Cases. 2022 Nov 6;10(31):11226-11239. doi: 10.12998/wjcc.v10.i31.11226. PMID: 36387809; PMCID: PMC9649566.
Article Link: https://pubmed.ncbi.nlm.nih.gov/36387809/

"Besides the **obesogenic effect**, **EDCs** can cause **type 2 diabetes mellitus** through alteration in ß cell function and morphology and **insulin resistance**."

Medical devices, including parenteral feeding tubes, **personal care products** such as nail polish and **perfume,** food packaging, and toys contain various **phthalates**[49]. Unfortunately, phthalates are poorly bio-degradable and highly bioaccumulative in the food chain[50].

"High phthalate exposure has been linked with increased threat of obesity and **infertility**, **increased body mass index** (BMI) and **waist circumference**, **insulin resistance**, and a **change in thyroid hormones**[49,52]".

"In this context, **perinatal exposure** can be important as far as the permanent and transgenerational effects are concerned. **EDCs promote adipogenesis leading to fat accumulation**, which causes **alteration in lipid metabolism and satiety as obesogens**. EDCs have shown the potential to induce adipose tissue dysfunction not only in white adipocytes but in brown and beige fat as well."

[Note: Endocrine Disrupting Chemicals (EDC's) are commonly used in perfumes and fragranced products as preservatives or fragrance. What are EDC's and how can they affect us?**]**

[Note: Phthalates are synthetic odorless plasticizers used as solvents, binders or fixatives in many fragrances. Why are phthalates in the news? Phthalates are considered Endocrine Disrupting Chemicals.
On the California Safe Cosmetics Program Product Database: DEP, DIDP, and DBP are reported as fragrance while DEHP and DBP are perfume solvents. IFRA lists DEP and DMP, as "reported fragrance ingredients".**]**

5. *Overview of air pollution and endocrine disorders*

Darbre PD. Overview of air pollution and endocrine disorders. Int J Gen Med. 2018 May 23;11:191-207. doi: 10.2147/IJGM.S102230. PMID: 29872334; PMCID: PMC5973437.
Article Link: https://pubmed.ncbi.nlm.nih.gov/29872334/ - PDF

"Abstract: Over recent years, **many environmental pollutant chemicals have been shown to possess the ability to interfere in the functioning of the endocrine system and have been termed endocrine disrupting chemicals (EDCs).** These compounds exist in air as volatile or semi-volatile compounds in the gas phase or attached to particulate matter. They include components of plastics (**phthalates**, bisphenol A), components of consumer goods (parabens, triclosan, **alkylphenols, fragrance compounds**,… This review summarizes current knowledge concerning the sources of EDCs in air, measurements of levels of EDCs in air, and the potential for adverse effects of EDCs in air on human endocrine health."

"Whilst much has been written over the past two decades of the actions of EDCs from oral and dermal exposure, research is increasingly documenting their presence in air which opens a debate on the potential for adverse consequences from inhalation of EDCs."

"Since estrogens and androgens regulate reproductive functions, many of the reported effects of the exposure to EDCs have been on adverse consequences for **reproductive health**. However, physiological consequences

have been demonstrated as resulting from disruption to **thyroid function** and alterations to **thyroid hormone levels**. More widely, adverse effects have also been reported as resulting from alterations to adrenocortical function, impairment of the immune system, and the loss of control on energy metabolism including development of **obesity, diabetes,** and **cardiovascular disease.**"

"**Prior** to and **just after birth** are especially **vulnerable times for exposure to EDCs** because disruption of hormonal activity in the developing embryo/fetus or young baby can have **consequences for health in adult life** most notably on **reproductive abilities, brain function, immunity, and metabolic programming**."

"**Man-made EDCs** are contained within many agricultural, industrial, and **consumer products,** which due to their widespread use, have become ubiquitous environmental pollutants. This includes components of pesticides and herbicides used both in an agricultural setting and in urban environments…. EDCs are also widely used in **personal care products** (PCPs) for purposes of preservation, deodorant, antiperspirant, conditioning, and **fragrance**."

"**EDCs** are contained in domestic pesticide sprays, **air fresheners**, **laundry detergents**, **household cleaners**, paints, adhesives, and plastics, all of which may be used routinely indoors…. As a result, **many EDCs are now measurable in indoor air and in indoor dust, often at higher levels than in outdoor air**…"

6. *Obesogenic endocrine disrupting chemicals: identifying knowledge gaps*

Veiga-Lopez A, Pu Y, Gingrich J, Padmanabhan V. Obesogenic Endocrine Disrupting Chemicals: Identifying Knowledge Gaps. Trends Endocrinol Metab. 2018 Sep;29(9):607-625. doi: 10.1016/j.tem.2018.06.003. Epub 2018 Jul 13. PMID: 30017741; PMCID: PMC6098722.

Article Link: https://pubmed.ncbi.nlm.nih.gov/30017741/ - PDF

"**EDCs are chemicals that interfere with the endocrine system**, including **adipose tissue.** Historically considered as an organ whose main function is energy storage, the adipose tissue secretes numerous hormones and other factors such as leptin, adiponectin, resistin, adipsin, angiotensin, and free fatty acids. These are involved in a broad range of physiological actions including **glucose and lipid metabolism**, **appetite control**, **vascular tone control**, **angiogenesis**, and **immunity** [11]. EDCs that not only increase adipose mass / adipogenesis but also result in other **metabolic dysfunctions** are also referred to as **metabolic disrupting chemicals** (MDCs) [12]."

"Diesters of 1,2-benzenedicarboxylic acid, or **phthalates**, are used as industrial plasticizers of polyvinyl chloride to be used in floorings, vinyl upholstery, **car interiors**, and **toys** [72], plastic food packaging [73], as well as in **cosmetic products** such as **lotions and perfumes** [74]...."

The CHAMACOS cohort study reported a positive association between early life exposure (at 14 and 26 weeks of gestation) to **diethyl phthalate (DEP)**, **dibutyl phthalate (DBP)** and **di-(2-ethylhexyl)-phthalate (DEHP)** and **increase in childhood body weight, BMI, waist circumference,** and **percent body fat in 5–12 year old children,** supportive of **phthalates being developmental obesogens** [78]."

"Another study also found a positive association between mono-3-carboxypropyl phthalate at 27 to 34 weeks of gestation and **overweight/obese status in 4–7 year-old children** [79]."

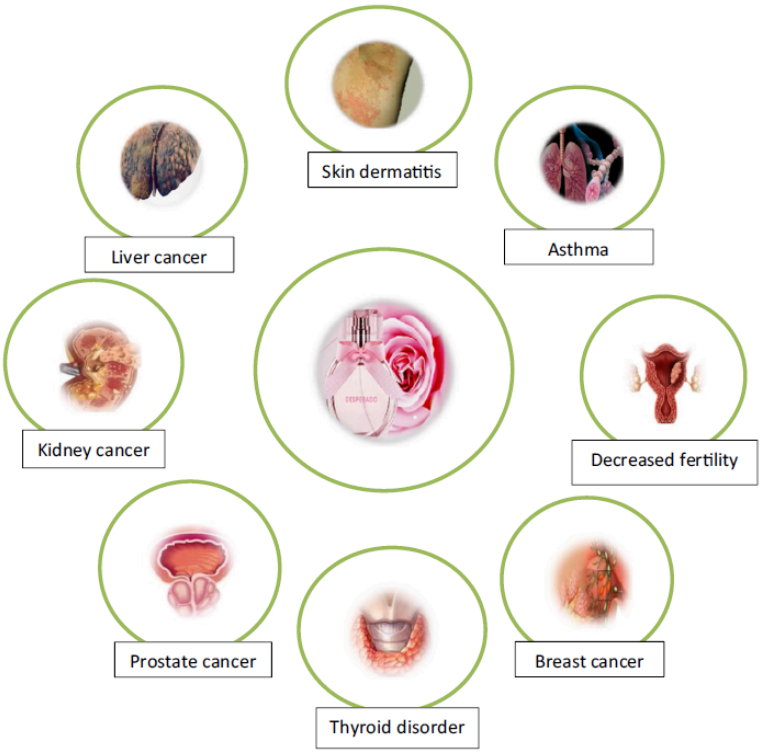
7. *Evaluation of pollutants in perfumes, colognes and health effects on the consumer: a systematic review*

Kazemi Z, Aboutaleb E, Shahsavani A, Kermani M, Kazemi Z. Evaluation of pollutants in perfumes, colognes and health effects on the consumer: a systematic review. J Environ Health Sci Eng. 2022 Feb 3;20(1):589-598. doi: 10.1007/s40201-021-00783-x. PMID: 35669814; PMCID: PMC9163252.

Article Link: https://pubmed.ncbi.nlm.nih.gov/35669814/ - PDF

(Note: Graphic is from preceding article**) (**Creative Commons Attribution 4.0 International license**).**

Fig. 2 Effects of exposure to perfumes and colognes



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"Diethyl phthalate is a chemical used to **make perfumes last longer.** The U.S. Clean Water Act lists it as a **toxic** and priority pollutant."

"Complications of using perfume include **neuropathy (depression, autism), neoplasms (breast cancer, prostate cancer), effects on the liver, migraine headaches, asthma attacks, mucosal symptoms (watery or red eyes, sneezing), neurological problems (dizziness, convulsions, headache, fainting, imbalance), respiratory (cough, shortness of breath), skin (skin rash, urticaria, redness of the skin, skin tingling, dermatitis), immune system (swollen lymph nodes, fever, fatigue), gastrointestinal tract (nausea, bloating, diarrhea)** and c**ardiovascular (rapid** or **irregular heartbeat, tremors, chest discomfort**)"

"**Contaminants in perfumes and colognes** and their health effects on the consumer were systematically reviewed. It was found that the most attention of researchers was to identify the compounds in perfumes and colognes and their concentrations. Among the most common pollutants **phthalates** and their derivatives can

be mentioned. Other pollutants included **parabens, triclosan, salicylates, terpenes, aldehydes, benzene, toluene, styrene, and aluminum-based salts**. These pollutants have also been shown to have adverse effects on consumer health such as **asthma and allergies, cardiovascular disease, central nervous system damage, breast cancer, endocrine cancer, respiratory disorders, reproduction, thyroid, adrenal gland function and immune system."**

[Note: Graphic lists "effects of exposure to perfumes and colognes": Kidney Cancer, Liver Cancer, Prostate Cancer, Thyroid Disorder, Breast Cancer, Decreased Fertility, Asthma and Skin Dermatitis.**]**

[Note: Fragrance is considered the new 'second hand smoke', **"**The parallels between second-hand smoke and synthetic fragrance use are many. At its core, both are battles over indoor air quality **"** - quote and link from De Vader, Christy L. & Barker, Paxson.
Chemicals that cigarettes/cigarette smoke and fragranced products can have in common are: Acetone, Formaldehyde, Benzene, acetaldehyde, terpenoids and phenols.**]**

8. *Long-Term Outcomes after Phthalate Exposure: Food Intake, Weight Gain, Fat Storage, and Fertility in Mice*

Holtcamp W. Long-term outcomes after phthalate exposure: food intake, weight gain, fat storage, and fertility in mice. Environ Health Perspect. 2012 Aug;120(8):a320. doi: 10.1289/ehp.120-a320a. PMID: 22854284; PMCID: PMC3440097.
Article Link: https://pubmed.ncbi.nlm.nih.gov/22854284/ - PDF

"Exposure to **endocrine-disrupting chemicals (EDCs)**, particularly **in utero**, is suspected to contribute to **obesity**, **diabetes**, **hypertension**, and **reproductive abnormalities**. Di(2-ethylhexyl) phthalate **(DEHP)**, a plasticizer found in **cosmetics**, **fragrances,** food packaging, and polyvinyl chloride, is one such EDC. Human studies have found associations between urinary metabolites of DEHP and other phthalates and **increased body mass in humans**, and maternal exposure to DEHP has been associated with **impaired gonadal development and fertility** in baby boys."

[Note: Endocrine Disrupting Chemicals (EDC's) are commonly used in perfumes and fragranced products as preservatives or fragrance. What are EDC's and how can they affect us?**]**

9. *Obesogens: How They Are Identified and Molecular Mechanisms Underlying Their Action*

Mohajer N, Du CY, Checkcinco C, Blumberg B. Obesogens: How They Are Identified and Molecular Mechanisms Underlying Their Action. Front Endocrinol (Lausanne). 2021 Nov 25;12:780888. doi: 10.3389/fendo.2021.780888. PMID: 34899613; PMCID: PMC8655100.
Article Link: https://pubmed.ncbi.nlm.nih.gov/34899613/ - PDF

"Increasing evidence has linked chemical exposure, ingestion, and inhalation of industrial compounds to obesity and other metabolic and endocrine related diseases."

" A subset of **EDCs act as obesogens** – chemicals that lead to increased fat storage, in vivo after exposure [reviewed in (22–24)]. The environmental obesogen model proposes that obesogens cause greater susceptibility to weight gain, lipid storage, and energy imbalances that lead to obesity (25). In 2015, the Parma consensus broadened the definition of obesogens to include EDCs that affect other obesity related metabolic

conditions that drive **metabolic syndrome**, such as **insulin resistance**, **hypertension**, **dyslipidemia**, and **hyperglycemia** (26).… Many chemical obesogens have been identified and numerous reviews have been written about them in recent years (22–24, 28). ”

“Obesity Is More Than Calories In/Out”

“**Dibutyl phthalate (DBP)** is a plasticizer found in plastic products such as toothbrushes, food wrappers, and in common household items as a **fragrance-enhancing additive**. DBP is a known EDC and obesogen that can affect fat accumulation and metabolic processes. DBP activates multiple receptors including the estrogen receptor, constitutive androstane receptor (CAR), the pregnane X receptor (PXR), and peroxisome proliferator-activated receptor subtypes (PPARα, -β, and -γ), which regulate the expression of genes encoding metabolic enzymes.”

“The study of EDCs offers insights into how normal metabolic processes can be disrupted, and why the population is becoming unhealthier, particularly with respect to **metabolic disease**.”

“Avoidance of exposure through ingestion, inhalation, and direct contact is a definitive way to prevent metabolic disruption caused by EDCs before disease develops. In vivo transgenerational studies, which were only briefly discussed in this review, revealed **epigenomic reprogramming** effects and **phenotypical metabolic effects**.… The existence of such “generational toxicity” demands further education about exposure prevention and transparency to keep the public and future generations safe from the effects of exposure to harmful chemicals.”

[Note: Table 1 from this article mentions Tonalide, “a musk compound used as a synthetic perfume”.**]**
[Note: Endocrine Disrupting Chemicals (EDC’s) are commonly used in perfumes and fragranced products as preservatives or fragrance. What are EDC’s and how can they affect us?**]**

[Note: Phthalates are synthetic odorless plasticizers used as solvents, binders or fixatives in many fragrances. Why are phthalates in the news? Phthalates are considered Endocrine Disrupting Chemicals.
On the California Safe Cosmetics Program Product Database: DEP, DIDP, and DBP are reported as fragrance while DEHP and DBP are perfume solvents. IFRA lists DEP and DMP, as “reported fragrance ingredients”.**]**

10. *Immune System: An Emerging Player in Mediating Effects of Endocrine Disruptors on Metabolic Health*

Bansal A, Henao-Mejia J, Simmons RA. Immune System: An Emerging Player in Mediating Effects of Endocrine Disruptors on Metabolic Health. Endocrinology. 2018 Jan 1;159(1):32-45. doi: 10.1210/en.2017-00882. PMID: 29145569; PMCID: PMC5761609.
Article Link: https://pubmed.ncbi.nlm.nih.gov/29145569/ - Full Article

“The incidence of metabolic disorders like type 2 diabetes and obesity continues to increase. In addition to the well-known contributors to these disorders, such as food intake and sedentary lifestyle, recent research in the exposure science discipline provides evidence that exposure to endocrine-disrupting chemicals like bisphenol A and **phthalates** via multiple routes (e.g., food, drink, **skin contact**) also contribute to the increased risk of metabolic disorders. Endocrine-disrupting chemicals (EDCs) can disrupt any aspect of hormone action. It is becoming increasingly clear that **EDCs** not only affect **endocrine function** but also **adversely affect immune system function.”**

“Similarly, EDCs have been shown to increase endoplasmic reticulum stress in in vitro and in vivo studies involving kidney (104), pancreas (105, 106), and liver (107). Mitochondrial dysfunction and endoplasmic reticulum stress are associated with increased oxidative stress (108) and metabolic dysfunction (109). Increased oxidative stress can activate various inflammatory pathways and increases the risk of metabolic abnormalities such as **insulin resistance**, **diabetes**, and **obesity** (Fig. 3).”

“Possible routes of EDC action on the immune system contributing to metabolic disorders. **By interacting with various receptors, altering the gut microbiome, inducing oxidative stress via mitochondrial dysfunction and/or endoplasmic reticulum stress, or via circadian disruption, EDCs trigger immune dysfunction in various tissues.** Together, this may contribute toward a perturbed metabolic health. See Fig. 3 legend for expansion of abbreviation

[Note: Endocrine Disrupting Chemicals (EDC’s) are commonly used in perfumes and fragranced products as preservatives or fragrance. What are EDC’s and how can they affect us?**]**

11. *Concentrations of Urinary Phthalate Metabolites Are Associated with Increased Waist Circumference and Insulin Resistance in Adult U.S. Males*

Stahlhut RW, van Wijngaarden E, Dye TD, Cook S, Swan SH. Concentrations of urinary phthalate metabolites are associated with increased waist circumference and insulin resistance in adult U.S. males. Environ Health Perspect. 2007 Jun;115(6):876-82. doi: 10.1289/ehp.9882. Epub 2007 Mar 14. Erratum in: Environ Health Perspect. 2007 Sep;115(9):A443. PMID: 17589594; PMCID: PMC1892109.

Article Link: https://pubmed.ncbi.nlm.nih.gov/17589594/ - PDF

“BACKGROUND: **Phthalates** impair rodent testicular function and have been associated with **anti-androgenic effects in humans**, including **decreased testosterone levels**. Low testosterone in adult human males has been associated with increased prevalence of **obesity**, **insulin resistance**, and **diabetes**.”

“CONCLUSIONS: In this national cross-section of U.S. men, concentrations of several prevalent phthalate metabolites showed statistically significant correlations with abdominal obesity and insulin resistance. If confirmed by longitudinal studies, our findings would suggest that exposure to these phthalates may contribute to the population burden of obesity, insulin resistance, and related clinical disorders.”

[Note: Phthalates are synthetic odorless plasticizers used as solvents, binders or fixatives in many fragrances. Why are phthalates in the news? Phthalates are considered Endocrine Disrupting Chemicals.
On the California Safe Cosmetics Program Product Database: DEP, DIDP, and DBP are reported as fragrance while DEHP and DBP are perfume solvents. IFRA lists DEP and DMP, as “reported fragrance ingredients”.**]**

12. *The associations between phthalate exposure and insulin resistance, β-cell function and blood glucose control in a population-based sample*

Dales RE, Kauri LM, Cakmak S. The associations between phthalate exposure and insulin resistance, β-cell function and blood glucose control in a population-based sample. Sci Total Environ. 2018 Jan 15;612:1287-1292. doi: 10.1016/j.scitotenv.2017.09.009. Epub 2017 Sep 8. PMID: 28898934.

Article Link: https://pubmed.ncbi.nlm.nih.gov/28898934/

"**DEHP metabolites** were also associated with **increased glucose** concentrations, and **indicators of β-cell function** and **insulin resistance**. Our results suggest that exposure to **phthalates** may possibly **impair control of blood glucose** and thereby **predispose to pre-diabetes**."

[Note: Phthalates are synthetic odorless plasticizers used as solvents, binders or fixatives in many fragrances. Why are phthalates in the news? Phthalates are considered Endocrine Disrupting Chemicals.
On the California Safe Cosmetics Program Product Database: DEP, DIDP, and DBP are reported as fragrance while DEHP and DBP are perfume solvents. IFRA lists DEP and DMP, as "reported fragrance ingredients".**]**

13. *Developmental Exposure to Endocrine Disrupting Chemicals and Its Impact on Cardio-Metabolic-Renal Health*

Singh RD, Koshta K, Tiwari R, Khan H, Sharma V, Srivastava V. Developmental Exposure to Endocrine Disrupting Chemicals and Its Impact on Cardio-Metabolic-Renal Health. Front Toxicol. 2021 Jul 5;3:663372. doi: 10.3389/ftox.2021.663372. PMID: 35295127; PMCID: PMC8915840.
Article Link: https://pubmed.ncbi.nlm.nih.gov/35295127/ - Free Full Text

"Endocrine disrupting chemicals (EDCs) include **phenols**, **phthalates**, parabens, flame retardants, heavy metals, pesticides, perfluorinated chemicals, UV filter components, triclosan, and organochlorines."

"**Cumulative exposure to mixtures of EDCs can lead to adverse effects on the health of the exposed individuals** (Crews et al., 2003). Multiple studies, including the studies of the National Health and Nutrition Examination Survey (NHANES), have shown that **about 75–97% of US and Asian adults have detectable levels of phthalates and phenols [bisphenol A (BPA) and polyfluoroalkyl chemicals] in their urine** (Silva et al., 2004; Calafat et al., 2007, 2008; Vandenberg et al., 2010; Zhang et al., 2011; Husøy et al., 2019)."

"Epidemiological and experimental studies have also linked **adult exposure to EDCs** with **abnormal male and female reproductive health**, **diabetes**, **obesity**, **cardiovascular** and **metabolic disorders**, **thyroid function**, and **hormone sensitive cancers** (Howard and Lee, 2012; Bodin et al., 2015; Heindel et al., 2015, 2017)."

"Children are also vulnerable to EDCs (Calafat et al., 2017; Hendryx and Luo, 2018), **making EDC exposure a major health concern for all age groups**."

"**Chronic kidney disease** is a growing health problem among children and adults. The incidence and the prevalence of chronic kidney disease (CKD) **among children have been steadily increasing since the 1980s**…. A number of traditional risk factors associated with CKD in children include hypertension, obesity, diabetes, and aberrant divalent mineral metabolism…. There is growing evidence that **links exposure to EDCs with early progression to end-stage renal disease** (ESRD) (Kataria et al., 2015)...."

"Early-life exposure to EDCs was associated with elevated levels of kidney toxicity markers such as albumin-to-creatinine ratio (ACR), estimated glomerular filtration rate (eGFR), and urinary protein-to-creatinine ratio (UPCR) in some human population studies (Li et al., 2012; Trasande et al., 2013a, 2014; Malits et al., 2018)."

[Note: Phthalates are synthetic odorless plasticizers used as solvents, binders or fixatives in many fragrances. Why are phthalates in the news? Phthalates are considered Endocrine Disrupting Chemicals.

On the California Safe Cosmetics Program Product Database: DEP, DIDP, and DBP are reported as fragrance while DEHP and DBP are perfume solvents. IFRA lists DEP and DMP, as "reported fragrance ingredients".**]**

[Note: Endocrine Disrupting Chemicals (EDC's) are commonly used in perfumes and fragranced products as preservatives or fragrance. What are EDC's and how can they affect us?**]**

14. *Household air pollution and its effects on health*

Apte K, Salvi S. Household air pollution and its effects on health. F1000Res. 2016 Oct 28;5:F1000 Faculty Rev-2593. doi: 10.12688/f1000research.7552.1. PMID: 27853506; PMCID: PMC508913

Article Link: https://pubmed.ncbi.nlm.nih.gov/27853506/ - PDF

"Cigarette smoke contains 7,357 different chemical compounds such as **benzene**, CO, PAHs, heterocyclic amines, cyanide, **formaldehyde**, **terpenoids**, **phenols**, nicotine, and heavy metals."

"Various studies have reported that toxic levels of air pollutants are emitted when these **fragrances** are burnt. … Among the Chinese, 76.9% currently burn incense at home every day and over 90% of the population has been using these for over 20 years. **Burning of these fragrances emits high levels of** PAHs**, benzene,** nitrous oxide, and CO**.** … Household air pollution begins to affect a human even during **fetal** life. **Increased household air pollution increases oxidative stress,** which has been implicated in **decreased fertility** or, in some cases, even **infertility**. Increased oxidative stress leads to **decreased sperm motility** and **poor zygote quality**. It also plays an important role in **increasing insulin resistance**, which is associated with **polycystic ovarian disease**, a major cause of infertility."

"...a study of 10 **newborn infants** in New York by the Environmental Work Group revealed that these infants, born to mothers exposed to pollutants, had as many as **232 pollutants circulating in the cord blood collected at birth….**Similarly, another study reported that increased exposure to polycyclic aromatic hydrocarbons and heavy metals (especially lead and mercury) in the second trimester of pregnancy resulted in decreased length of the baby at birth…. They also have lower heights, which do not recover later in life…. The effect of perinatal exposure to PAHs has also been studied, revealing compromised lung function in otherwise-healthy children… Household air pollutants are also implicated in cognitive and judgmental skills …."

15. *The new kids on the block: emerging obesogens*

Chamorro-Garcia R, Veiga-Lopez A. The new kids on the block: Emerging obesogens. Adv Pharmacol. 2021;92:457-484. doi: 10.1016/bs.apha.2021.05.003. Epub 2021 Jul 8. PMID: 34452694; PMCID: PMC8941623.

Article Link: https://pubmed.ncbi.nlm.nih.gov/34452694/

"Human urine levels of **alkylphenols** have been estimated in ~12 ng/ml (You et al. 2011) **Alkylphenols** are considered **xenoestrogens** (Soto et al. 1991) and their **effects on the nervous and immune systems have been widely studied** (Acir and Guenther 2018). Because **alkylphenols accumulate in human adipose tissue** (Lopez-Espinosa et al. 2009; Muller et al. 1998) non-ethoxylated alkylphenols, such as 4-nonyphenol and octylphenol have been studied in the context of **adipogenesis**."

"Using the 3T3-L1 cell model, Kassotis et al., 2018 (Kassotis et al. 2018b) tested a mixture of 23 commonly used unconventional oil and gas chemicals (UOG), including acrylamide**, alkylphenols, benzenes**, bronopol, **diethanolamine**, **ethanols**, ethylene glycol, **propylene glycol**, **styrene**, **toluene**, and **xylens**. This **mixture**

resulted in an increase in tryglyceride accumulation and preadipocyte proliferation at 10 µM and 1 µM, respectively (Kassotis et al. 2018b)."

"These findings further demonstrate that chemicals that can independently promote adipogenesis, such as acrylamide and **alkylphenols** (Kassotis et al. 2018a; Lee and Pyo 2019) **can act as obesogens in environmentally collected samples containing a complex chemical mixture**. **However, developmental exposure to a similar UOG mixture altered body weight and energy expenditure, but not body composition in C57BL/6 mice (Balise et al. 2019a; Balise et al. 2019b), which highlights the need to validate in vitro findings using animal models**."

"**Alteration of adipose tissue size and homeostasis play an important role not only in obesity, but also in the development of other metabolic co-morbidities such as type 2 diabetes and cardiovascular diseases** (Bluher 2020). To note, obesity also induces wide-reaching systemic effects on other systems, such as the **reproductive and the immune system** (Francisco et al. 2018; Leisegang et al. 2021; Snider and Wood 2019)."

[Note: Alkylphenols are synthetic and used as building blocks for fragrance. Two alkylphenols on IFRA's list are propylphenol and butylphenol. With synthetic chemicals, Aquatic environment health is a concern.**]**
[Note: Benzene is a reported fragrance ingredient in the CSCP Product Database.**]**
[Note: Styrene is "primarily a synthetic chemical**"** used in fragrance. It is on the CSPC list as 'parfum/fragrance' and also on the IFRA list.**]**

[Note: Toluene (often a nail polish thinner) is used as a solvent or fragrance in perfume and bath products on the CSPC Product Database. Toluene is on the IFRA list and on the EPA's Priority Pollutant List.**]**
[Note: Xylene "occurs naturally in petroleum and coal tar, and is major component of gasoline and fuel oil". Xylene is used as a musk fragrance. Xylene is on IFRA.**]**

[Note: Fragrance is considered the new 'second hand smoke', **"**The parallels between second-hand smoke and synthetic fragrance use are many. At its core, both are battles over indoor air quality **"** - quote and link from De Vader, Christy L. & Barker, Paxson.
Chemicals that cigarettes/cigarette smoke and fragranced products can have in common are: Acetone, Formaldehyde, Benzene, acetaldehyde, terpenoids and phenols.**]**

16. *Health risks of chemicals in consumer products: A review*

Li D, Suh S. Health risks of chemicals in consumer products: A review. Environ Int. 2019 Feb;123:580-587. doi: 10.1016/j.envint.2018.12.033. Epub 2019 Jan 7. PMID: 30622082.
Article Link: https://pubmed.ncbi.nlm.nih.gov/30622082/ - Full Text

"It should also be noted that some chemicals have multiple functional uses, while we chose the most dominant functional use for each chemical. An example is the grouping of **phthalates**. Despite categorized as plasticizer together in this review, several phthalates such as **diethyl phthalate and dimethyl phthalate are used as solvents in personal care products and cosmetics as carriers of fragrance** (Schettler, 2006)."

"…we found that the volume of the peer-reviewed literature that addresses human health risks of the chemicals in consumer products did grow over the last two decades, while its growth could by no means match the speed of increasing volume and diversity of the chemicals produced and used in consumer products by the society.

This **growing gap between increasing reliance on chemicals in consumer products and our knowledge on their human health risks raises a potential public health concern**, given the pervasive nature of today's mass production and consumption practice."

17. *The associations between personal care products use and urinary concentrations of phthalates, parabens, and triclosan in various age groups: The Korean National Environmental Health Survey Cycle 3 2015-2017*

Lim S. The associations between personal care products use and urinary concentrations of phthalates, parabens, and triclosan in various age groups: The Korean National Environmental Health Survey Cycle 3 2015-2017. Sci Total Environ. 2020 Nov 10;742:140640. doi: 10.1016/j.scitotenv.2020.140640. Epub 2020 Jul 2. PMID: 32721747.

Article Link: https://pubmed.ncbi.nlm.nih.gov/32721747/ - PDF

"**Phthalates** and parabens are ubiquitous chemicals of public concern… Furthermore, the use of **fragrance products**, makeup, and **air fresheners** significantly increased the exposure risk to EtP in **preschoolers**."

"Furthermore, the exposure levels of many **phthalates**, parabens, and TCS are higher in children than adults(NIER, 2018; Wang et al., 2019) and **children are a susceptible population to these chemicals**. In the case of parabens, the estimated **dermal absorption** amount of parabens related with PCPs use in **infants** and **toddlers** was several times higher than that in adult women(Guo and Kennan, 2013)."

"Exposure to phthalates and parabens is an important public concern, especially with respect to the **potential endocrine disrupting effects of phthalates** (DEHP, DBP, and BBP) (European Commission, 2000) and the anti-androgenic effect of parabens (Orton et al., 2014). Additionally, **exposure to phthalates in the prenatal period was associated with asthma** (Berger et al., 2020) and **psychomotor development** (Qian et al., 2019) in children and was related to **allergic symptoms**, **sensitization (**Hoppin et al., 2013), **preterm birth**(Ferguson et al., 2019) and **type 2 diabetes** in adults (Sun et al., 2014).**"**

"This study showed the associations between PCPs use and urinary concentrations of phthalates, parabens, and TCS in various age groups in a nationally representative population in Korea. The exposure risks to these chemicals were different according to the patterns of PCPs use by age groups and gender. Female participants used all categories of PCPs more frequently than male participants in adolescents and adults, with statistical significance."

[Note: Endocrine Disrupting Chemicals (EDC's) are commonly used in perfumes and fragranced products as preservatives or fragrance. What are EDC's and how can they affect us?**]**
[Note: Phthalates are synthetic odorless plasticizers used as solvents, binders or fixatives in many fragrances. Why are phthalates in the news? Phthalates are considered Endocrine Disrupting Chemicals.
On the California Safe Cosmetics Program Product Database: DEP, DIDP, and DBP are reported as fragrance while DEHP and DBP are perfume solvents. IFRA lists DEP and DMP, as "reported fragrance ingredients".**]**

Environmental pollutants and type 2 diabetes: a review of mechanisms that can disrupt beta cell function.

Hectors, T.L.M., Vanparys, C., van der Ven, K. *et al.* Environmental pollutants and type 2 diabetes: a review of mechanisms that can disrupt beta cell function. *Diabetologia* 54, 1273–1290 (2011). https://doi.org/10.1007/s00125-011-2109-5

Article Link: https://link.springer.com/article/10.1007/s00125-011-2109-5

17. ALSO SEE SECTIONS: Respiratory/Pulmonary, Obesity, Inflammation

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Website: https://www.fragrancefreecoalitionusa.com/

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EARACHE

Infant Earache

1. *Symptoms of mothers and infants related to total volatile organic compounds in household products*

Farrow A, Taylor H, Northstone K, Golding J. Symptoms of mothers and infants related to total volatile organic compounds in household products. Arch Environ Health. 2003 Oct;58(10):633-41. doi: 10.3200/AEOH.58.10.633-641. PMID: 15562635.
Article Link: https://pubmed.ncbi.nlm.nih.gov/15562635/

"Higher TVOC levels were associated with air freshener and aerosol use. **Infant diarrhea** and **earache** were statistically significantly associated with air freshener use, and **diarrhea** and **vomiting** were significantly associated with aerosol use. **Headache** experienced by mothers 8 mo after birth was significantly associated with the use of **air fresheners** and aerosols; **maternal depression** was significantly associated with the use of air fresheners. The results of the study suggest a **link between the use of products that raise indoor levels of TVOCs and an increased risk of certain symptoms among infants and their mothers**."

[Note: Fragranced products emit VOC's that can contribute to higher particulate matter (PM) indoors and out.**]**

2. *Ten questions concerning air fresheners and indoor built environments*

Anne Steinemann, Ten questions concerning air fresheners and indoor built environments, Building and Environment, Volume 111, 2017, Pages 279-284, ISSN 0360-1323, https://doi.org/10.1016/j.buildenv.2016.11.009.
Article Link: https://www.sciencedirect.com/science/article/pii/S0360132316304334?via%3Dihub - PDF

"This article investigates the seeming paradox that **products designed to improve the indoor environment can pose unintended and unknown risks.** It examines the science, health, and policy perspectives, and provides recommendations and research directions."

"Air fresheners can contribute to indoor hazardous air pollutants, both through direct emissions and secondary reaction products… Within buildings and other indoor environments, the use of air fresheners has a strong association with high indoor levels of **terpenes, benzene, toluene**, ethyl-benzene, m,p-xylene, and **total volatile organic compounds**…"

"Air fresheners can contribute to human exposure to primary and secondary air pollutants… Air freshener exposures, **even at low levels**, have been associated with a range of adverse health effects, which include **migraine headaches, asthma attacks, breathing difficulties, respiratory difficulties, mucosal symptoms, dermatitis, infant diarrhea and earache, neurological problems, and ventricular fibrillation**..."
"In addition to population based studies, specific air freshener chemicals (VOCs such as acetaldehyde, SVOCs such as phthalates, and ultrafine particles) emitted from air fresheners have been associated with adverse effects to the **neurological, cardiovascular, respiratory, reproductive, immune, and endocrine systems, and with cancer**. For instance, acetaldehyde, which can be both a primary and secondary emission from air fresheners, is associated with both **acute and chronic hazards to the respiratory system**, and classified as a carcinogenic hazardous air pollutant in the US…"

[Note: Fragrance is considered the new 'second hand smoke', **"**The parallels between second-hand smoke and synthetic fragrance use are many. At its core, both are battles over indoor air quality **"** - quote and link from De Vader, Christy L. & Barker, Paxson.
Chemicals that cigarettes/cigarette smoke and fragranced products can have in common are: Acetone, Formaldehyde, Benzene, acetaldehyde, terpenoids and phenols.**]**

3. ALSO SEE SECTIONS: Prenatal, Respiratory/Pulmonary, Airborne Contact Dermatitis

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Website: https://www.fragrancefreecoalitionusa.com/

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Poster and Document are for reference and educational purposes only.

FATIGUE / MUSCLE OR JOINT PAIN

Sleepiness, Lethargy, Stress

1. *Toxic effects of air freshener emissions*

Anderson RC, Anderson JH. Toxic effects of air freshener emissions. Arch Environ Health. 1997 Nov-Dec;52(6):433-41. doi: 10.1080/00039899709602222. PMID: 9541364.
Article Link: https://pubmed.ncbi.nlm.nih.gov/9541364/

"The emissions of this **solid Air Freshener produced acute respiratory and neurotoxicity in mice**, and they did not lower the toxic impact of the other pollutants tested. Collectively, toxicity data, chemical data, and MSDS information predict that some humans exposed to emissions of the AF we studied might experience some combination of **eye, nose, and/or throat irritation**; **respiratory difficulty**; **bronchoconstriction** or an **asthma-like reaction**; and **CNS reactions** (e.g., **dizziness**, **incoordination**, **confusion**, **fatigue**)."

2. *Characterization of emissions composition for selected household products available in Korea*

Kwon KD, Jo WK, Lim HJ, Jeong WS. Characterization of emissions composition for selected household products available in Korea. J Hazard Mater. 2007 Sep 5;148(1-2):192-8. doi: 10.1016/j.jhazmat.2007.02.025. Epub 2007 Feb 15. PMID: 17376591.
Article Link: https://pubmed.ncbi.nlm.nih.gov/17376591/

"Several studies have implicated these consumer products as sources of indoor air pollutants…. **These compounds have been shown to cause symptoms similar to those characterized as Sick Building Syndrome**; this is a group of symptoms that includes **sleepiness, irritation, inability to concentrate**, and other health hazards… A major cause of health-related problems for building occupants is the inhalation of consumer-product constituents."

"Furthermore, **secondary toxic pollutants** are formed by the reaction of unsaturated organic constituents with oxidants such as ozone, hydroxyl radicals, and nitrogen oxides…. For example, **terpene**, a major constituent of household products such as cleaning products and air fresheners…, **reacts with ozone thus leading to the formation of formaldehyde**…"

"Of the 59 household products analyzed, 58 emitted one or more of the 72 compounds at chromatographic peak areas above 10(4). There were 11 analytes which occurred with a frequency of more than 10%: **limonene** (44.2%), **ethanol** (30.5%), **acetone** (18.6%), **alpha-pinene** (18.6%), **o,m,p-xylenes** (18.6%), **decane** (17.0%), **toluene** (17.0%), **beta-myrcene** (11.9%), ammonia (10.2%), **ethylbenzene** (10.2%), and hexane (10.2%)."

[Note: Fragrance is considered the new 'second hand smoke', **"**The parallels between second-hand smoke and synthetic fragrance use are many. At its core, both are battles over indoor air quality **"** - quote and link from De Vader, Christy L. & Barker, Paxson.
Chemicals that cigarettes/cigarette smoke and fragranced products can have in common are: Acetone, Formaldehyde, Benzene, acetaldehyde, terpenoids and phenols.**]**

[Note: Formaldehyde is a secondary pollutant from fragrance and fragranced products.
Also, a 2012 study, 21 out of 30 perfume samples were shown to release formaldehyde when tested but formaldehyde was not listed on any of the labels. Formaldehyde is a sensitizer and known allergen.**]**

[Note: Limonene is a common skin sensitizer and known allergen in fragrance and fragranced products. Limonene (natural or synthetic) is a terpene. Terpenes can create formaldehyde and particulate matter in air as secondary pollutants. Limonene is on the IFRA list as a fragrance ingredient.**]**
[Note: Toluene (often a nail polish thinner) is used as a solvent or fragrance in perfume and bath products on the CSPC Product Database. Toluene is on the IFRA list and on the EPA's Priority Pollutant List.**]**
[Note: Ethyl benzene is listed for purchase as a perfuming agent.**]**

3. *Spermatotoxicity in Animal Models Exposed to Fragrance Components*

Akunna GG, Saalu LG, Ogunlade B. Enye LA., (2014). Spermatotoxicity in Animal Models Exposed to Fragrance Components. Journal of Medical Sciences, 14: 46-50.
Article Link: https://scialert.net/fulltext/?doi=jms.2014.46.50 - PDF

"Various commonly-used products have been reported to contain chemicals that could **disrupt estrogen and testosterone hormone**. …The results obtained from this study showed a significant ($p<0.005$) decrease in body weight and absolute testicular weight of the rat models exposed to fragrance when compared to the control groups. It was also observed that the concentration, mobility, livability and morphology of spermatozoa from groups C, D, E and F were significantly lower ($p>0.005$) when compared to values of the control group A and B. Based on the spermiographic evaluation from this study, fragrance materials could have an adverse effect on spermatozoa of the intact male wistar rats."

"**It has been reported that through inhalation, ingestion and absorption, fragrance infiltrates the body and moves directly to the blood stream.** … Symptoms ranging from **severe mucosal discharge, sinus problems, tremor, asthmatic attack, sneezing, migraine headache, convulsions, hyperactivity, nausea, sore throat, cough, chest tightness to shortness of breath** after fragrance exposure have been vastly documented (Guin and Berry, 1980; De Groot, 1987; Schleuter et al., 1978)."

"Unswerving connection between memory and smell has been established (Rachel and Engen, 1996). This knowledge has resulted in **placement of fragrance in the category of psychoactive drugs and highlighted the ability of fragrance to cross the brain barrier thereby resulting in potential damage to brain tissue** (Andrea, 1997). **Linalool**, the most abundant fragrance substance has been indicated to cause **lethargy**, **depression** and **severe respiratory difficulties after exposure**."

4. *Physical and psychological stress along with candle fumes induced - cardiopulmonary injury mimicking restaurant kitchen workers*

Chandrasekaran VRM, Periasamy S, Chien SP, Tseng CH, Tsai PJ, Liu MY. Physical and psychological stress along with candle fumes induced-cardiopulmonary injury mimicking restaurant kitchen workers. Curr Res Toxicol. 2021 Jul 12;2:246-253. doi: 10.1016/j.crtox.2021.07.001. PMID: 34345867; PMCID: PMC8320639.
Article Link: https://pubmed.ncbi.nlm.nih.gov/34345867/ - PDF

"Social disruption stress (SDR) mice were exposed to scented candle fumes (4.5 h/d, 5 d/wk) in an exposure chamber for 8 weeks. Exposure to **burning scented candles failed to reduce serum corticosterone level**

and increased proinflammatory cytokines levels and NF-ƙB activity in the lung. In the present study, we evaluated the role of SDR in combination with exposure to scented candles as generally accepted to reduce stress. However, the **combined SDR and scented candle exposure were found to escalate the stress level.** This stress escalation might be due to the **cardiopulmonary inflammatory response** of the stress and candle fumes, which could be directly related to restaurant workers."

5. *Fragranced consumer products: effects on autistic adults in the United States, Australia, and United Kingdom*

Steinemann A. Fragranced consumer products: effects on autistic adults in the United States, Australia, and United Kingdom. Air Qual Atmos Health. 2018;11(10):1137-1142. doi: 10.1007/s11869-018-0625-x. Epub 2018 Sep 25. PMID: 30546500; PMCID: PMC6244938
Article Link: https://pubmed.ncbi.nlm.nih.gov/30546500/ - PDF

"Fragranced consumer products are ubiquitous in society and emit numerous volatile organic compounds including hazardous air pollutants."

"Health effects were categorized as follows:
(a) migraine headaches;
(b) asthma attacks;
(c) neurological problems (e.g., dizziness, seizures, head pain, fainting, loss of coordination);
(d) respiratory problems (e.g., difficulty breathing, coughing, shortness of breath);
(e) skin problems (e.g., rashes, hives, red skin, tingling skin, dermatitis);
(f) cognitive problems (e.g., difficulties thinking, concentrating, or remembering);
(g) mucosal symptoms (e.g., watery or red eyes, nasal congestion, sneezing);
(h) immune system problems (e.g., swollen lymph glands, fever, fatigue);
(i) gastrointestinal problems (e.g., nausea, bloating, cramping, diarrhea);
(j) cardiovascular problems (e.g., fast or irregular heartbeat, jitteriness, chest discomfort);
(k) musculoskeletal problems (e.g., muscle or joint pain, cramps, weakness); and
(l) other."

"Specific problematic exposures, associated with adverse health effects for autistic adults, include but are not limited to the following: …air fresheners and deodorizers (62.9%), the scent of laundry products coming from a dryer vent (57.5%), being in a room recently cleaned with scented products (65.9%), **being near someone wearing a fragranced product** (60.5%), and other types of fragranced consumer products (64.3%)… Among autistic adults reporting health effects, 74.1% across the three countries (85.4% US, 82.4% AU, 54.5% UK) report that the severity of these health effects from fragranced products was potentially disabling. Among non-autistic adults, the prevalence of potentially disabling effects was 25.4%."

"...62.1% of autistic adults are unable or reluctant to use the restrooms in a public place if it has an air freshener, deodorizer, or scented product; 59.8% are unable or reluctant to wash their hands with soap in a public place if the soap is fragranced; 58.7% enter a business and then want to leave as quickly as possible if they smell air fresheners or a fragranced product; and **66.7% have been prevented from going someplace because they would be exposed to a fragranced product that would make them sick…"**

"Involuntary exposure is a concern. Autistic individuals are prevented from accessing public restrooms, societal venues, businesses, and workplaces due to adverse health effects from fragranced products. Further, 59.4% of autistic adults have lost workdays, in the past year, due to fragranced product exposure in the workplace. **A**

strong majority of autistic as well as non-autistic adults would prefer that workplaces, health care facilities, and health care professionals were fragrance-free than fragranced."

6. *Evaluation of pollutants in perfumes, colognes and health effects on the consumer: a systematic review*

Kazemi Z, Aboutaleb E, Shahsavani A, Kermani M, Kazemi Z. Evaluation of pollutants in perfumes, colognes and health effects on the consumer: a systematic review. J Environ Health Sci Eng. 2022 Feb 3;20(1):589-598. doi: 10.1007/s40201-021-00783-x. PMID: 35669814; PMCID: PMC9163252.

Article Link: https://pubmed.ncbi.nlm.nih.gov/35669814/ - PDF

(Note: Graphic is from preceding article) (Creative Commons Attribution 4.0 International license).

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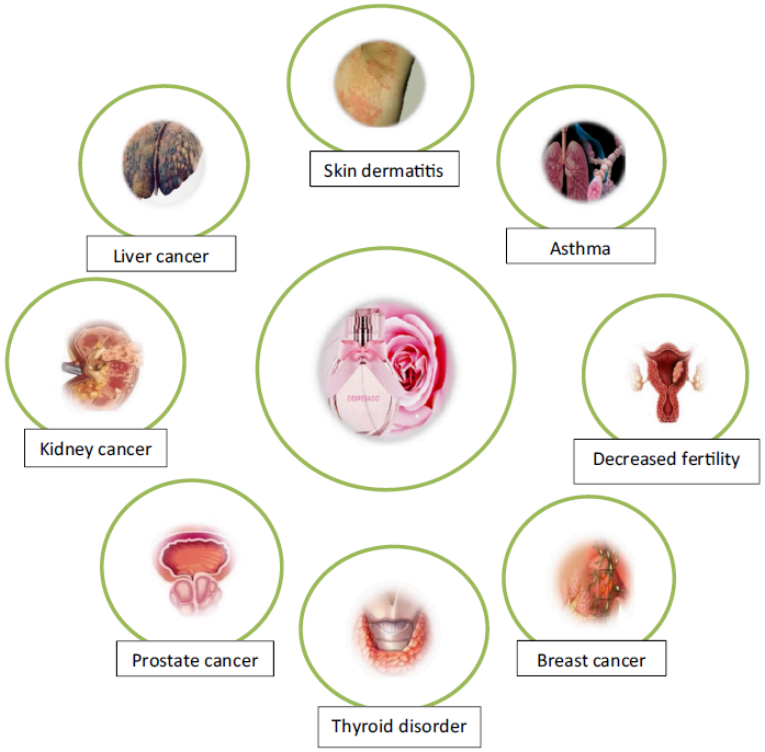
Fig. 2 Effects of exposure to perfumes and colognes



"Diethyl phthalate is a chemical used to **make perfumes last longer.** The U.S. Clean Water Act lists it as a **toxic** and priority pollutant."

"Complications of using perfume include **neuropathy (depression, autism), neoplasms (breast cancer, prostate cancer), effects on the liver, migraine headaches, asthma attacks, mucosal symptoms (watery or red eyes, sneezing), neurological problems (dizziness, convulsions, headache, fainting, imbalance), respiratory (cough, shortness of breath), skin (skin rash, urticaria, redness of the skin, skin tingling,**

dermatitis), immune system (swollen lymph nodes, fever, fatigue), gastrointestinal tract (nausea, bloating, diarrhea) and c**ardiovascular (rapid** or **irregular heartbeat, tremors, chest discomfort**)"

"**Contaminants in perfumes and colognes** and their health effects on the consumer were systematically reviewed. It was found that the most attention of researchers was to identify the compounds in perfumes and colognes and their concentrations. Among the most common pollutants **phthalates** and their derivatives can be mentioned. Other pollutants included **parabens, triclosan, salicylates, terpenes, aldehydes, benzene, toluene, styrene, and aluminum-based salts**. These pollutants have also been shown to have adverse effects on consumer health such as **asthma and allergies, cardiovascular disease, central nervous system damage, breast cancer, endocrine cancer, respiratory disorders, reproduction, thyroid, adrenal gland function and immune system."**

[Note: Graphic lists "effects of exposure to perfumes and colognes": Kidney Cancer, Liver Cancer, Prostate Cancer, Thyroid Disorder, Breast Cancer, Decreased Fertility, Asthma and Skin Dermatitis.**]**

7. *Health risks of chemicals in consumer products: A review*

Li D, Suh S. Health risks of chemicals in consumer products: A review. Environ Int. 2019 Feb;123:580-587. doi: 10.1016/j.envint.2018.12.033. Epub 2019 Jan 7. PMID: 30622082.
Article Link: https://pubmed.ncbi.nlm.nih.gov/30622082/ - PDF

"It should also be noted that some chemicals have multiple functional uses, while we chose the most dominant functional use for each chemical. An example is the grouping of **phthalates**. Despite categorized as plasticizer together in this review, several phthalates such as **diethyl phthalate and dimethyl phthalate are used as solvents in personal care products and cosmetics as carriers of fragrance** (Schettler, 2006)."

"…we found that the volume of the peer-reviewed literature that addresses human health risks of the chemicals in consumer products did grow over the last two decades, while its growth could by no means match the speed of increasing volume and diversity of the chemicals produced and used in consumer products by the society. This **growing gap between increasing reliance on chemicals in consumer products and our knowledge on their human health risks raises a potential public health concern**, given the pervasive nature of today's mass production and consumption practice.

The Association of Ambient Air Pollution with Sleep Apnea: The Multi-Ethnic Study of Atherosclerosis.

Billings ME, Gold D, Szpiro A, Aaron CP, Jorgensen N, Gassett A, Leary PJ, Kaufman JD, Redline SR. The Association of Ambient Air Pollution with Sleep Apnea: The Multi-Ethnic Study of Atherosclerosis. Ann Am Thorac Soc. 2019 Mar;16(3):363-370. doi: 10.1513/AnnalsATS.201804-248OC. PMID: 30571166; PMCID: PMC6394120.
Article Link: https://pubmed.ncbi.nlm.nih.gov/30571166/ **- PDF**

Air Pollution, Asthma, and Sleep Apnea: New Epidemiological Links?

Mutlu GM, Peker Y. Air Pollution, Asthma, and Sleep Apnea: New Epidemiological Links? Ann Am Thorac Soc. 2019 Mar;16(3):307-308. doi: 10.1513/AnnalsATS.201812-924ED. PMID: 31339334; PMCID: PMC7051530.
Article Link: https://pubmed.ncbi.nlm.nih.gov/31339334/ -

8. ALSO SEE SECTIONS: Gastrointestinal Tract, Hormone System / Endocrine

Back to top of Fatigue / Muscle or Joint Pain **Back to Table of Contents**

Website: https://www.fragrancefreecoalitionusa.com/

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GASTROINTESTINAL TRACT

Coughing, Nausea, Vomiting, Diarrhea, Bloating, Cramping, Mucosal Symptoms, Gastrointestinal Problems

1. *Coughing in Small Animal Patients*

Hsieh BM and Beets AK (2020) Coughing in Small Animal Patients. Front. Vet. Sci. 6:513. doi: 10.3389/fvets.2019.00513
Article Link: https://www.frontiersin.org/articles/10.3389/fvets.2019.00513/full

"Environmental factors play a large role in some **chronic airway disease** processes and can cause exacerbation of coughing. Owners should not smoke indoors and any possible **airborne irritants such as air fresheners, incense, perfumes, and noxious fumes should be eliminated.**"

"**Coughing is a common clinical problem in humans and veterinary patients** that is difficult to manage and severely impacts quality of life.… Current guidelines are largely based on expert opinion, anecdotal clinical evidence and relatively few rigorous clinical trials."

2. *Symptoms of mothers and infants related to total volatile organic compounds in household products*

Farrow A, Taylor H, Northstone K, Golding J. Symptoms of mothers and infants related to total volatile organic compounds in household products. Arch Environ Health. 2003 Oct;58(10):633-41. doi: 10.3200/AEOH.58.10.633-641. PMID: 15562635.
Article Link: https://pubmed.ncbi.nlm.nih.gov/15562635/

"Higher TVOC levels were associated with air freshener and aerosol use. **Infant diarrhea** and **earache** were statistically significantly associated with air freshener use, and **diarrhea** and **vomiting** were significantly associated with aerosol use. **Headache** experienced by mothers 8 mo after birth was significantly associated with the use of **air fresheners** and aerosols; **maternal depression** was significantly associated with the use of air fresheners. The results of the study suggest a **link between the use of products that raise indoor levels of TVOCs and an increased risk of certain symptoms among infants and their mothers**."
[Note: Fragranced products emit VOC's that can contribute to higher particulate matter (PM) indoors and out.**]**

3. *Evaluation of pollutants in perfumes, colognes and health effects on the consumer: a systematic review*

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Article Link: https://pubmed.ncbi.nlm.nih.gov/35669814/ **-** PDF

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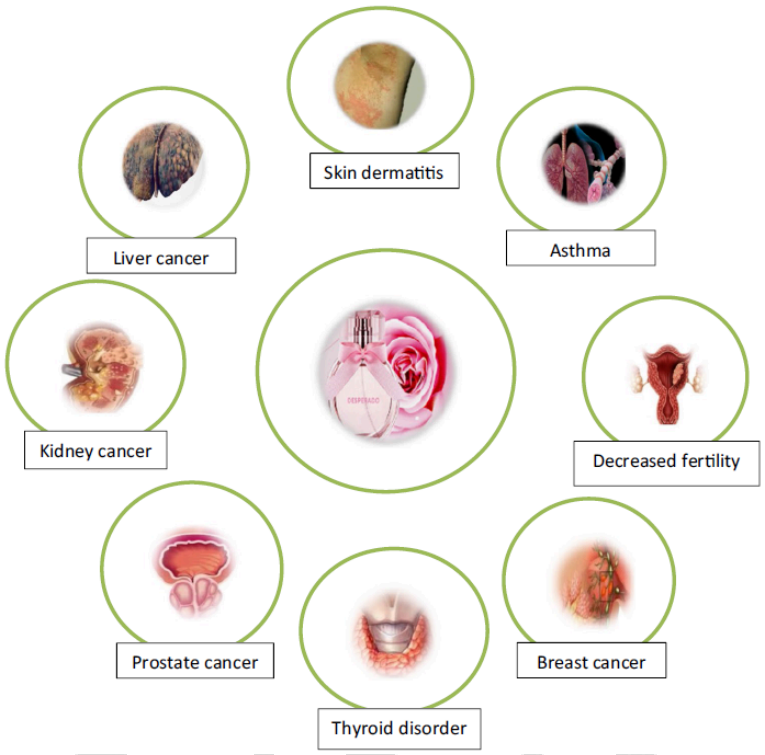
Fig. 2 Effects of exposure to perfumes and colognes



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"Diethyl phthalate is a chemical used to **make perfumes last longer.** The U.S. Clean Water Act lists it as a **toxic** and priority pollutant."

"Complications of using perfume include **neuropathy (depression, autism), neoplasms (breast cancer, prostate cancer), effects on the liver, migraine headaches, asthma attacks, mucosal symptoms (watery or red eyes, sneezing), neurological problems (dizziness, convulsions, headache, fainting, imbalance), respiratory (cough, shortness of breath), skin (skin rash, urticaria, redness of the skin, skin tingling, dermatitis), immune system (swollen lymph nodes, fever, fatigue), gastrointestinal tract (nausea, bloating, diarrhea)** and **cardiovascular (rapid** or **irregular heartbeat, tremors, chest discomfort**)"

"**Contaminants in perfumes and colognes** and their health effects on the consumer were systematically reviewed. It was found that the most attention of researchers was to identify the compounds in perfumes and colognes and their concentrations. Among the most common pollutants **phthalates** and their derivatives can be mentioned. Other pollutants included **parabens, triclosan, salicylates, terpenes, aldehydes, benzene, toluene, styrene, and aluminum-based salts**. These pollutants have also been shown to have adverse effects on consumer health such as **asthma and allergies, cardiovascular disease, central nervous system damage, breast cancer, endocrine cancer, respiratory disorders, reproduction, thyroid, adrenal gland function and immune system."**

[Note: Graphic lists "effects of exposure to perfumes and colognes": Kidney Cancer, Liver Cancer, Prostate Cancer, Thyroid Disorder, Breast Cancer, Decreased Fertility, Asthma and Skin Dermatitis.**]**

[Note: Fragrance is considered the new 'second hand smoke', **"**The parallels between second-hand smoke and synthetic fragrance use are many. At its core, both are battles over indoor air quality **"** - quote and link from De Vader, Christy L. & Barker, Paxson.
Chemicals that cigarettes/cigarette smoke and fragranced products can have in common are: Acetone, Formaldehyde, Benzene, acetaldehyde, terpenoids and phenols.**]**

4. *Toxic Chemicals Emitted from Air fresheners & Disinfectants*

Geetha Balasubramani, Paul Pradeep, J Nisitha S. Toxic Chemicals Emitted from Air fresheners & Disinfectants. IJRASET. Volume 10 Issue X Oct 2022, Pgs 1338-1345. ISSN : 2321-9653 IJRASET47180

Article Link:
https://www.ijraset.com/research-paper/toxic-chemicals-emitted-from-air-fresheners-and-disinfectants - PDF

(Note: This graphic is from preceding article**)**

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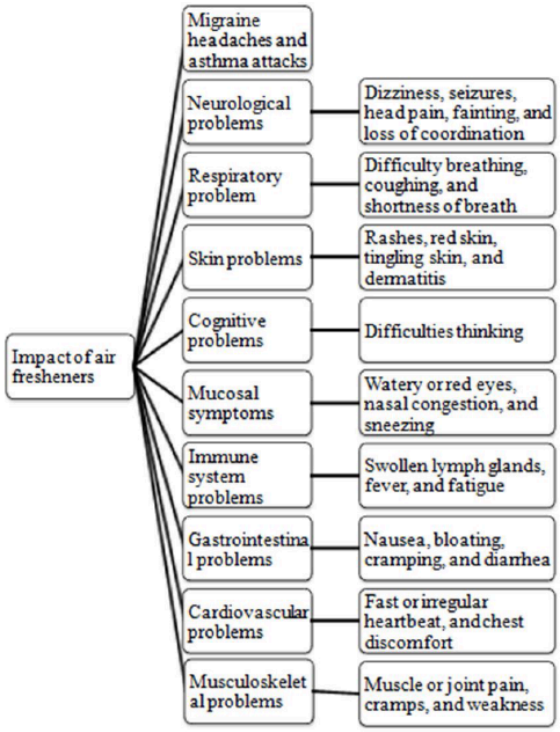

Figure 2: The diagram above illustrates the classification of illnesses brought on by exposure to air fresheners.

5. *Emission characteristics of VOCs emitted from consumer and commercial products and their ozone formation potential*

Dinh TV, Kim SY, Son YS, Choi IY, Park SR, Sunwoo Y, Kim JC. Emission characteristics of VOCs emitted from consumer and commercial products and their ozone formation potential. Environ Sci Pollut Res Int. 2015 Jun;22(12):9345-55. doi: 10.1007/s11356-015-4092-8. Epub 2015 Jan 21. PMID: 25601614.

Article Link: https://pubmed.ncbi.nlm.nih.gov/25601614/

“The characteristics of volatile organic compounds (VOCs) emitted from several consumer and commercial products (body wash, dishwashing detergent, air freshener, windshield washer fluid, lubricant, hair spray, and insecticide) were studied and compared.”

“In the spray products, 21.6–96.4 % of the VOCs were propane, iso-butane, and n-butane, which are the components of liquefied petroleum gas. **Monoterpene** (C10H16) was the dominant component of the VOCs in the non-spray products (e.g., body wash, 53–88 %).”

“Besides comprising **hazardous VOCs**, VOCs from consumer products were also **ozone precursors**.”
“The TVOCs from spray products (insecticide, hair spray, and lubricant) were higher than those from the liquid products such as the windshield washer fluid, dishwashing detergent, **body wash**, and air freshener.”

“Limonene and 1-propanol were the components of one dishwashing detergent. In contrast, another dishwashing detergent comprised **1,3-dioxane**, **ethanol**, **ethyl acetate**, **limonene**, **β-myrcene**, 3-pentanol, and **α-pinene** (Kwon et al. 2007, 2008).”

“**Benzene, n-hexane**, and **ethylbenzene** were observed in the **body washes** and the **air fresheners.** Benzene was classified as Group A of the US EPA lists of **known human carcinogen** (WHO 2010). The unit cancer risk of 1 μg/m3 of benzene is 2.2–7.8 in a million (WHO 2010). The unit risk of **leukemia** per 1 μg/m3 air concentration is 6 in a million. Therefore, **long-term exposure to a considerable amount of benzene in those products might cause health risk,** which should be investigated in future researchers.”

“A **longterm exposure of n-hexane may damage the nervous system**. Exposure to 650 ppm **n-hexane** for 2–4 months causes numbness of the arms and legs (Pohanish 2012). **Ethylbenzene** irritates the eyes, skin, and respiratory tract. A **long-term exposure of ethylbenzene may cause kidney and liver disease**….”

“**Toluene and styrene were detected in body washes,** dishwashing detergents, and windshield washer fluids. It was reported that inhalation of 200–500 ppm **toluene may cause headache, nausea, and loss of appetite** (Pohanish 2012).”

“Styrene is considered as a possible carcinogenic to humans. Inhalation of above 100 ppm **styrene may cause headache, inflammation of the lung, kidney and liver damage, and death** (Pohanish 2012). Since **body washes** are used popularly and frequently, **longterm exposure to the above compounds may cause health damage.**”

[Note: Limonene is a common skin sensitizer and known allergen in fragrance and fragranced products. Limonene (natural or synthetic) is a terpene. Terpenes can create formaldehyde and particulate matter in air as secondary pollutants. Limonene is on the IFRA list as a fragrance ingredient.**]**
[Note: Benzene is a reported fragrance ingredient in the CSCP Product Database.**]**
[Note: N-Hexane is used to extract fragrances and was on the IFRA list until 2015.**]**
[Note: Toluene (often a nail polish thinner) is used as a solvent or fragrance in perfume and bath products on the CSPC Product Database. Toluene is on the IFRA list and on the EPA’s Priority Pollutant List.**]**
[Note: Styrene is “primarily a synthetic chemical**”** used in fragrance. It is on the CSPC list as ‘parfum/fragrance’ and also on the IFRA list.**]**
[Note: Ethyl benzene is listed for purchase as a perfuming agent.**]**

6. *Ten questions concerning air fresheners and indoor built environments*

Anne Steinemann, Ten questions concerning air fresheners and indoor built environments, Building and Environment, Volume 111, 2017, Pages 279-284, ISSN 0360-1323, https://doi.org/10.1016/j.buildenv.2016.11.009.
Article Link: https://www.sciencedirect.com/science/article/pii/S0360132316304334?via%3Dihub - PDF

"This article investigates the seeming paradox that **products designed to improve the indoor environment can pose unintended and unknown risks.** It examines the science, health, and policy perspectives, and provides recommendations and research directions."

"Air fresheners can contribute to indoor hazardous air pollutants, both through direct emissions and secondary reaction products… Within buildings and other indoor environments, the use of air fresheners has a strong association with high indoor levels of **terpenes, benzene, toluene**, ethyl-benzene, m,p-xylene, and **total volatile organic compounds**…"

"Air fresheners can contribute to human exposure to primary and secondary air pollutants… Air freshener exposures, **even at low levels**, have been associated with a range of adverse health effects, which include **migraine headaches, asthma attacks, breathing difficulties, respiratory difficulties, mucosal symptoms, dermatitis, infant diarrhea and earache, neurological problems, and ventricular fibrillation**..."
"In addition to population based studies, specific air freshener chemicals (VOCs such as acetaldehyde, SVOCs such as phthalates, and ultrafine particles) emitted from air fresheners have been associated with adverse effects to the **neurological, cardiovascular, respiratory, reproductive, immune, and endocrine systems, and with cancer**. For instance, acetaldehyde, which can be both a primary and secondary emission from air fresheners, is associated with both **acute and chronic hazards to the respiratory system**, and classified as a carcinogenic hazardous air pollutant in the US…"

7. *Qualitative Analysis of Air Freshener Spray*

Ibrahim ALshaer F, Fuad ALBaharna D, Ahmed HO, Ghiyath Anas M, Mohammed ALJassmi J. Qualitative Analysis of Air Freshener Spray. J Environ Public Health. 2019 Nov 5;2019:9316707. doi: 10.1155/2019/9316707. PMID: 31781257; PMCID: PMC6874985.
Article Link: https://pubmed.ncbi.nlm.nih.gov/31781257/ - PDF

"Information lacks concerning the gaseous emissions of fragrance products in spite of the extensive indoor exposure and widespread use of fragrances to them. In addition, **95 percent of the chemicals are synthetic compounds in fragrances that are derived from petroleum**."

"Some chemicals after analysis turned out to be noted as **skin allergens** or **irritants** and even chemicals that may interfere with **bodily functions**."

"The present study has identified the presence of different compounds in spray air fresheners that were not disclosed on the product's label. The results depicted common compounds in both low- and high-cost air fresheners. **Chemicals found in this study were not revealed on the product label as manufacturers are not required to list all ingredients**. These chemicals usually tend to be listed on the product label as "parfum" or "fragrance". There should be a law that strictly indicates whether the products contain any synthetic chemicals for people to be aware of what they are exposed to, although, manufacturers are not required to reveal all hidden ingredients on the label as stated by the Consumer Product Safety Commission (CPSC)."

8. *Toxic effects of air freshener emissions*

Anderson RC, Anderson JH. Toxic effects of air freshener emissions. Arch Environ Health. 1997 Nov-Dec;52(6):433-41. doi: 10.1080/00039899709602222. PMID: 9541364.
Article Link: https://pubmed.ncbi.nlm.nih.gov/9541364/

"The emissions of this **solid Air Freshener produced acute respiratory and neurotoxicity in mice**, and they did not lower the toxic impact of the other pollutants tested. Collectively, toxicity data, chemical data, and MSDS information predict that some humans exposed to emissions of the AF we studied might experience some combination of **eye, nose, and/or throat irritation**; **respiratory difficulty**; **bronchoconstriction** or an **asthma-like reaction**; and **CNS reactions** (e.g., **dizziness**, **incoordination**, **confusion**, **fatigue**)."

9. *Fragranced consumer products: effects on autistic adults in the United States, Australia, and United Kingdom*

Steinemann A. Fragranced consumer products: effects on autistic adults in the United States, Australia, and United Kingdom. Air Qual Atmos Health. 2018;11(10):1137-1142. doi: 10.1007/s11869-018-0625-x. Epub 2018 Sep 25. PMID: 30546500; PMCID: PMC6244938
Article Link: https://pubmed.ncbi.nlm.nih.gov/30546500/ - PDF

"Fragranced consumer products are ubiquitous in society and emit numerous volatile organic compounds including hazardous air pollutants."

"Health effects were categorized as follows:
(a) migraine headaches;
(b) asthma attacks;
(c) neurological problems (e.g., dizziness, seizures, head pain, fainting, loss of coordination);
(d) respiratory problems (e.g., difficulty breathing, coughing, shortness of breath);
(e) skin problems (e.g., rashes, hives, red skin, tingling skin, dermatitis);
(f) cognitive problems (e.g., difficulties thinking, concentrating, or remembering);
(g) mucosal symptoms (e.g., watery or red eyes, nasal congestion, sneezing);
(h) immune system problems (e.g., swollen lymph glands, fever, fatigue);
(i) gastrointestinal problems (e.g., nausea, bloating, cramping, diarrhea);
(j) cardiovascular problems (e.g., fast or irregular heartbeat, jitteriness, chest discomfort);
(k) musculoskeletal problems (e.g., muscle or joint pain, cramps, weakness); and
(l) other."

"Specific problematic exposures, associated with adverse health effects for autistic adults, include but are not limited to the following: …air fresheners and deodorizers (62.9%), the scent of laundry products coming from a dryer vent (57.5%), being in a room recently cleaned with scented products (65.9%), **being near someone wearing a fragranced product** (60.5%), and other types of fragranced consumer products (64.3%)… Among autistic adults reporting health effects, 74.1% across the three countries (85.4% US, 82.4% AU, 54.5% UK) report that the severity of these health effects from fragranced products was potentially disabling. Among non-autistic adults, the prevalence of potentially disabling effects was 25.4%."

"...62.1% of autistic adults are unable or reluctant to use the restrooms in a public place if it has an air freshener, deodorizer, or scented product; 59.8% are unable or reluctant to wash their hands with soap in a public place if the soap is fragranced; 58.7% enter a business and then want to leave as quickly as possible if

they smell air fresheners or a fragranced product; and **66.7% have been prevented from going someplace because they would be exposed to a fragranced product that would make them sick…"**

"Involuntary exposure is a concern. Autistic individuals are prevented from accessing public restrooms, societal venues, businesses, and workplaces due to adverse health effects from fragranced products. Further, 59.4% of autistic adults have lost workdays, in the past year, due to fragranced product exposure in the workplace. **A strong majority of autistic as well as non-autistic adults would prefer that workplaces, health care facilities, and health care professionals were fragrance-free than fragranced.**"

10. *Health risks of chemicals in consumer products: A review*

Li D, Suh S. Health risks of chemicals in consumer products: A review. Environ Int. 2019 Feb;123:580-587. doi: 10.1016/j.envint.2018.12.033. Epub 2019 Jan 7. PMID: 30622082.
Article Link: https://pubmed.ncbi.nlm.nih.gov/30622082/ - Full Text

"It should also be noted that some chemicals have multiple functional uses, while we chose the most dominant functional use for each chemical. An example is the grouping of **phthalates**. Despite categorized as plasticizer together in this review, several phthalates such as **diethyl phthalate and dimethyl phthalate are used as solvents in personal care products and cosmetics as carriers of fragrance** (Schettler, 2006)."

"…we found that the volume of the peer-reviewed literature that addresses human health risks of the chemicals in consumer products did grow over the last two decades, while its growth could by no means match the speed of increasing volume and diversity of the chemicals produced and used in consumer products by the society. This **growing gap between increasing reliance on chemicals in consumer products and our knowledge on their human health risks raises a potential public health concern**, given the pervasive nature of today's mass production and consumption practice.

11. ALSO SEE SECTIONS: Obesity, Migraine(s) / Headache(s), Asthma

Back to top of Gastrointestinal Tract **Back to Table of Contents**

Website: https://www.fragrancefreecoalitionusa.com/

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HORMONE SYSTEM / ENDOCRINE / NEUROENDOCRINE

Thyroid Hormone Disruption, Decreased Testosterone Levels, Precocious Puberty, Hormone Disruption, Alteration of Hormone Levels, "mimicking or disrupting natural estrogen, Significant Increase in Body Weight, testosterone and thyroid pathways, anti-androgenic

1. *Identification of combinations of endocrine disrupting chemicals in household chemical products that require mixture toxicity testing*

Lee I, Ji K. Identification of combinations of endocrine disrupting chemicals in household chemical products that require mixture toxicity testing. Ecotoxicol Environ Saf. 2022 Jul 15;240:113677. doi: 10.1016/j.ecoenv.2022.113677. Epub 2022 May 26. PMID: 35642859.
Article Link: https://pubmed.ncbi.nlm.nih.gov/35642859/ - PDF

"The present study listed the ingredients contained in 11064 household chemical products from a publicly available database, and identified **EDCs** related to **estrogenicity**, **androgenicity**, **thyroid hormone disruption**, and **changes in steroidogenesis**."

"A total of 293 chemicals were related to **endocrine disruption**, and **nearly two-thirds of the products contained more than one of these chemicals**. Cleaning products, synthetic detergents, fabric softeners, air fresheners, and deodorants have several hotspots for **fragrances**, isothiazolinones, glycol ethers, and parabens. The **three most prevalent EDCs** in household chemical products were **added to act** as **fragrances** and preservatives."

"The most frequently observed EDCs in the five product groups are hexyl cinnamaldehyde, geraniol, citronellol, 2-(4-tert-butylbenzyl)propionaldehyde (CAS no. 80-54-6)**, and benzyl benzoate** (CAS no. 120-51-4). **These EDCs** are commonly **used to add fragrance."**

"The most frequently identified combinations were benzisothiazolinone and **butylated hydroxytoluene** (CAS no. 128-37-0) in cleaners, benzisothiazolinone and **hexyl cinnamaldehyde** in synthetic detergents, **2-(4-tert-butylbenzyl)propionaldehyde** and **citronellol** in fabric softeners, **benzyl benzoate** and **hexyl cinnamaldehyde** in air fresheners, and **geraniol** and **citral** (CAS no. 5392-40-5) in deodorants. The EDCs in these products were mostly included to act as **fragrances** and preservatives."

"Consistent with the results of this study, Wieck et al. (2018) reported that 26 fragrances were named approximately 2000 times on the ingredient list of 1447 household detergents, and **fragrances** such as **limonene, linalool, hexyl cinnamaldehyde, 2-(4-tert-butylbenzyl)propionaldehyde,** and **citronellol** were frequently mentioned (Wieck et al., 2018, Yazar et al., 2011).... **Geraniol** appeared to have the potential to **interact with estrogen receptors** in estrogen-inducible yeast expressing the human estrogen receptor (Howes et al., 2002).... **Benzyl benzoate** and **2-(4-tert-butylbenzyl)propionaldehyde** added to **synthetic detergents, fabric softeners, and air fresheners** were **reported to induce estrogenic responses in MCF-7 human breast cancer cell line** (Charles and Darbre, 2009).

"This study confirmed that DEHP, DINP, and DBP were used in cleaners, synthetic detergents, coating agents, adhesives, **air fresheners**, and paints. **Exposure to DEHP or DBP at levels seen in human populations**

has been **linked to male reproductive defects**, such as **poor semen quality** and **abnormal genital development** (Radke et al., 2018)."

2. *Histo-morphometric Evidences for Testicular Derangement in animal models submitted to chronic and Sub-chronic Inhalation of Fragrance*

Akunna GG, Saalu LC, Ogunlade B, Akingbade AM, Anderson LE, Olusolade FS, Histo-morphometric evidences for testicular derangement in animal models submitted to chronic and sub-chronic inhalation of fragrance. American Journal of Research Communication, 2015, 3(1): 85-101} www.usa-journals.com, ISSN: 2325-4076.

Article Link:
https://www.researchgate.net/publication/315065887_Histo-morphometric_Evidences_for_Testicular_Derangement_in_animal_models_submitted_to_chronic_and_Sub-chronic_Inhalation_of_Fragrance - PDF

"Copious documentations have indicated that **82 percent of perfumes labeled "natural ingredients" actually contain synthetic fragrances** (Rastogi et al.,1996). Such chemicals that affect **male reproductive** hormones may be a factor in **infertility** and has been known as **endocrine disruptors**.(Giudice, 2006, Saalu et al., 2010, Akunna et al., 2013)".

"It has been reported that perfumes, colognes, body sprays and care products contained an average of four potential hormone-disrupting chemicals. In male reproductive anatomy, **endocrine disruptors** have severally been implicated as teratogens, resulting in **cryptorchidism**, **hypospadias** and **impairment of body function** normally regulated by natural hormone signaling (Wang and Baskin, 2008, Akunna et al., 2011, Akunna et al., 2013). Studies have shown that these chemicals causes damage by **mimicking or disrupting natural estrogen**, **testosterone and thyroid pathways** (Soto et al., 2009). Although the implication of subsequent exposure to these chemicals have not been critically understood, recent findings has clearly demonstrated disruption in **spermatogenesis**,(Akunna et al., 2014) **liver damage** (Akunna et al., 2011) and **other tissue toxicity in animals** exposed to fragrance components(Johansen et al., 2003, Elberling et al., 2004, Breast Cancer Fund, 2008, Schnuch et al., 2010). In animal model studies, fragrance exposure has lead to **spermatotoxicity** and **infertility**, **congenital malformation in penises and abnormal testes** (Akunna et al., 2014)."

"According to published scientific studies, **diethyl phthalate** and octinoxate which are major components of perfume and sunscreen respectively has been implicated in **sperm damage**, **apoptosis** and **interference with estrogen and androgens** in human respectively (Giudice, 2006, Wang and Baskin, 2008, Silva et al., 2004 ,Schreurs et al., 2005, Swan, 2008, CDC, 2009)."

"From our studies on fragrance, we can conclude herein that fragrance components are **testiculotoxic** in rat."
[Note: Definition - Teratogens are substances that people are exposed to (in utero) that may lead to birth defects, miscarriages, pre-term labor or stillbirth.. **Cryptorchidism** (undescended testicals) may also increase the risk for testicular cancer. **Hypospadias** is a birth defect where boys have an altered location of the opening of the urethra.**]**

3. *Overview of air pollution and endocrine disorders*

Darbre PD. Overview of air pollution and endocrine disorders. Int J Gen Med. 2018 May 23;11:191-207. doi: 10.2147/IJGM.S102230. PMID: 29872334; PMCID: PMC5973437.

Article Link: https://pubmed.ncbi.nlm.nih.gov/29872334/ - PDF

"Abstract: Over recent years, **many environmental pollutant chemicals have been shown to possess the ability to interfere in the functioning of the endocrine system and have been termed endocrine disrupting chemicals (EDCs).** These compounds exist in air as volatile or semi-volatile compounds in the gas phase or attached to particulate matter. They include components of plastics (**phthalates**, bisphenol A), components of consumer goods (parabens, triclosan, **alkylphenols, fragrance compounds**,… This review summarizes current knowledge concerning the sources of EDCs in air, measurements of levels of EDCs in air, and the potential for adverse effects of EDCs in air on human endocrine health."

"Whilst much has been written over the past two decades of the actions of EDCs from oral and dermal exposure, research is increasingly documenting their presence in air which opens a debate on the potential for adverse consequences from inhalation of EDCs."

"Since estrogens and androgens regulate reproductive functions, many of the reported effects of the exposure to EDCs have been on adverse consequences for **reproductive health**. However, physiological consequences have been demonstrated as resulting from disruption to **thyroid function** and alterations to **thyroid hormone levels**. More widely, adverse effects have also been reported as resulting from alterations to adrenocortical function, impairment of the immune system, and the loss of control on energy metabolism including development of **obesity, diabetes,** and **cardiovascular disease.**"

"**Prior** to and **just after birth** are especially **vulnerable times for exposure to EDCs** because disruption of hormonal activity in the developing embryo/fetus or young baby can have **consequences for health in adult life** most notably on **reproductive abilities, brain function, immunity, and metabolic programming**."

"**Man-made EDCs** are contained within many agricultural, industrial, and **consumer products,** which due to their widespread use, have become ubiquitous environmental pollutants. This includes components of pesticides and herbicides used both in an agricultural setting and in urban environments…. EDCs are also widely used in **personal care products** (PCPs) for purposes of preservation, deodorant, antiperspirant, conditioning, and **fragrance**."

"**EDCs** are contained in domestic pesticide sprays, **air fresheners**, **laundry detergents**, **household cleaners**, paints, adhesives, and plastics, all of which may be used routinely indoors…. As a result, **many EDCs are now measurable in indoor air and in indoor dust, often at higher levels than in outdoor air**…"

4. *Concentrations of Urinary Phthalate Metabolites Are Associated with Increased Waist Circumference and Insulin Resistance in Adult U.S. Males*

Stahlhut RW, van Wijngaarden E, Dye TD, Cook S, Swan SH. Concentrations of urinary phthalate metabolites are associated with increased waist circumference and insulin resistance in adult U.S. males. Environ Health Perspect. 2007 Jun;115(6):876-82. doi: 10.1289/ehp.9882. Epub 2007 Mar 14. Erratum in: Environ Health Perspect. 2007 Sep;115(9):A443. PMID: 17589594; PMCID: PMC1892109.

Article Link: https://pubmed.ncbi.nlm.nih.gov/17589594/ - PDF

"BACKGROUND: **Phthalates** impair rodent testicular function and have been associated with **anti-androgenic effects in humans**, including **decreased testosterone levels**. Low testosterone in adult human males has been associated with increased prevalence of **obesity**, **insulin resistance**, and **diabetes**."

"CONCLUSIONS: In this national cross-section of U.S. men, concentrations of several prevalent phthalate

metabolites showed statistically significant correlations with abdominal obesity and insulin resistance. If confirmed by longitudinal studies, our findings would suggest that exposure to these phthalates may contribute to the population burden of obesity, insulin resistance, and related clinical disorders."

[Note: Phthalates are synthetic odorless plasticizers used as solvents, binders or fixatives in many fragrances. Why are phthalates in the news? Phthalates are considered Endocrine Disrupting Chemicals.
On the California Safe Cosmetics Program Product Database: DEP, DIDP, and DBP are reported as fragrance while DEHP and DBP are perfume solvents. IFRA lists DEP and DMP, as "reported fragrance ingredients".**]**

5. *Erectile Dysfunction in Men on the Rise: Is There a Link with Endocrine Disrupting Chemicals?*

Cripps S, M, Mattiske D, M, Pask A, J: Erectile Dysfunction in Men on the Rise: Is There a Link with Endocrine Disrupting Chemicals? Sex Dev 2021;15:187-212. doi: 10.1159/000516600
Article Link: https://pubmed.ncbi.nlm.nih.gov/34134123/ - PDF

"**Erectile dysfunction (ED)** is one of the **most prevalent chronic conditions affecting me**n. ED can arise from **disruptions during development**, affecting the patterning of erectile tissues in the penis and/or **disruptions in adulthood** that impact sexual stimuli, neural pathways, molecular changes, and **endocrine signalling** that are required to drive erection."

"Androgen signalling is critical for erectile function through its role in **penis development** and in regulating the physiological processes driving erection in the adult. Interestingly,**estrogen signalling is also implicated in penis development** and potentially in processes which regulate erectile function during adulthood."

"Given that **endocrine signalling has a prominent role in erectile function**, it is **likely that exposure to endocrine disrupting chemicals (EDCs) is a risk factor for ED**, although this is an under-researched field. Thus, our review provides a detailed description of the underlying biology of erectile function with a focus on the role of endocrine signalling, exploring the **potential link between EDCs and ED based on animal and human studies**." © 2021 S. Karger AG, Basel

[Note: Endocrine Disrupting Chemicals (EDC's) are commonly used in perfumes and fragranced products as preservatives or fragrance. What are EDC's and how can they affect us?**]**

6. *Endocrine disruptor chemicals as obesogen and diabetogen: Clinical and mechanistic evidence*

Kurşunoğlu NE, Sarer Yurekli BP. Endocrine disruptor chemicals as obesogen and diabetogen: Clinical and mechanistic evidence. World J Clin Cases. 2022 Nov 6;10(31):11226-11239. doi: 10.12998/wjcc.v10.i31.11226. PMID: 36387809; PMCID: PMC9649566.
Article Link: https://pubmed.ncbi.nlm.nih.gov/36387809/

"Besides the **obesogenic effect**, **EDCs** can cause **type 2 diabetes mellitus** through alteration in ß cell function and morphology and **insulin resistance**."

Medical devices, including parenteral feeding tubes, **personal care products** such as nail polish and **perfume,** food packaging, and toys contain various **phthalates**[49]. Unfortunately, phthalates are poorly bio-degradable and highly bioaccumulative in the food chain[50].

"High phthalate exposure has been linked with increased threat of obesity and **infertility**, **increased body mass index** (BMI) and **waist circumference**, **insulin resistance**, and a **change in thyroid hormones**[49,52]".

"In this context, **perinatal exposure** can be important as far as the permanent and transgenerational effects are concerned. **EDCs promote adipogenesis leading to fat accumulation**, which causes **alteration in lipid metabolism and satiety as obesogens**. EDCs have shown the potential to induce adipose tissue dysfunction not only in white adipocytes but in brown and beige fat as well."

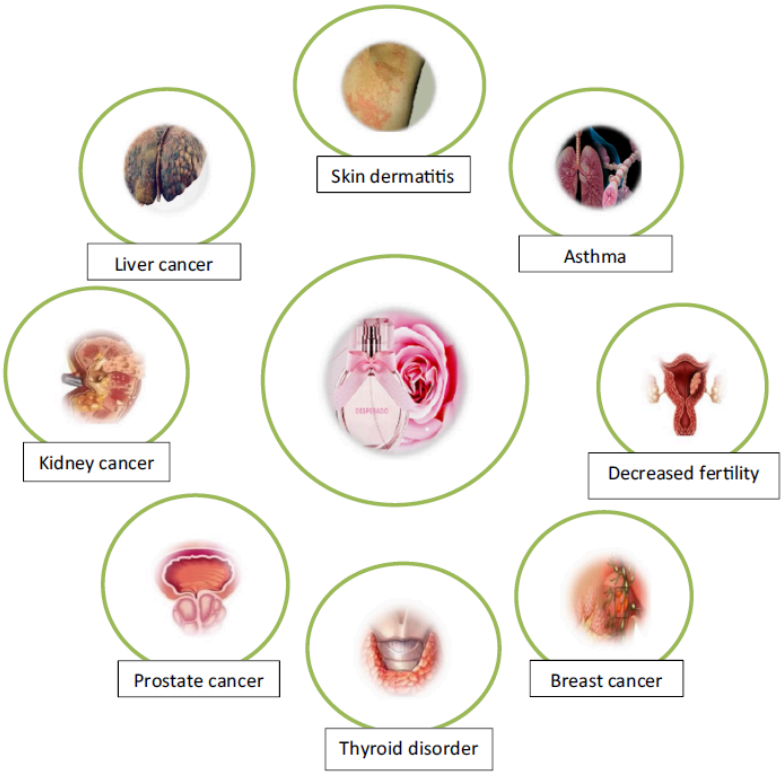
[Note: Endocrine Disrupting Chemicals (EDC's) are commonly used in perfumes and fragranced products as preservatives or fragrance. What are EDC's and how can they affect us?**]**
[Note: Phthalates are synthetic odorless plasticizers used as solvents, binders or fixatives in many fragrances. Why are phthalates in the news? Phthalates are considered Endocrine Disrupting Chemicals.
On the California Safe Cosmetics Program Product Database: DEP, DIDP, and DBP are reported as fragrance while DEHP and DBP are perfume solvents. IFRA lists DEP and DMP, as "reported fragrance ingredients".**]**

7. *Evaluation of pollutants in perfumes, colognes and health effects on the consumer: a systematic review*

Kazemi Z, Aboutaleb E, Shahsavani A, Kermani M, Kazemi Z. Evaluation of pollutants in perfumes, colognes and health effects on the consumer: a systematic review. J Environ Health Sci Eng. 2022 Feb 3;20(1):589-598. doi: 10.1007/s40201-021-00783-x. PMID: 35669814; PMCID: PMC9163252.
Article Link: https://pubmed.ncbi.nlm.nih.gov/35669814/ - PDF

(Note: Graphic is from preceding article**) (**Creative Commons Attribution 4.0 International license**).**

Fig. 2 Effects of exposure to perfumes and colognes



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"Diethyl phthalate is a chemical used to **make perfumes last longer.** The U.S. Clean Water Act lists it as a **toxic** and priority pollutant."

"Complications of using perfume include **neuropathy (depression, autism), neoplasms (breast cancer, prostate cancer), effects on the liver, migraine headaches, asthma attacks, mucosal symptoms (watery or red eyes, sneezing), neurological problems (dizziness, convulsions, headache, fainting, imbalance), respiratory (cough, shortness of breath), skin (skin rash, urticaria, redness of the skin, skin tingling, dermatitis), immune system (swollen lymph nodes, fever, fatigue), gastrointestinal tract (nausea, bloating, diarrhea)** and **cardiovascular (rapid** or **irregular heartbeat, tremors, chest discomfort**)"

"**Contaminants in perfumes and colognes** and their health effects on the consumer were systematically reviewed. It was found that the most attention of researchers was to identify the compounds in perfumes and colognes and their concentrations. Among the most common pollutants **phthalates** and their derivatives can be mentioned. Other pollutants included **parabens, triclosan, salicylates, terpenes, aldehydes, benzene, toluene, styrene, and aluminum-based salts**. These pollutants have also been shown to have adverse effects on consumer health such as **asthma and allergies, cardiovascular disease, central nervous system damage, breast cancer, endocrine cancer, respiratory disorders, reproduction, thyroid, adrenal gland function and immune system."**

[Note: Graphic lists "effects of exposure to perfumes and colognes": Kidney Cancer, Liver Cancer, Prostate Cancer, Thyroid Disorder, Breast Cancer, Decreased Fertility, Asthma and Skin Dermatitis.**]**

[Note: Fragrance is considered the new 'second hand smoke', **"**The parallels between second-hand smoke and synthetic fragrance use are many. At its core, both are battles over indoor air quality **"** - quote and link from De Vader, Christy L. & Barker, Paxson.
Chemicals that cigarettes/cigarette smoke and fragranced products can have in common are: Acetone, Formaldehyde, Benzene, acetaldehyde, terpenoids and phenols.**]**

8. *An atlas of fragrance chemicals in children's products*

Ravichandran J, Karthikeyan BS, Jost J, Samal A. An atlas of fragrance chemicals in children's products. Sci Total Environ. 2022 Apr 20;818:151682. doi: 10.1016/j.scitotenv.2021.151682. Epub 2021 Nov 15. PMID: 34793786.
Article Link: https://pubmed.ncbi.nlm.nih.gov/34793786/

"We find that several **fragrance chemicals in children's products are potential carcinogens, endocrine disruptors, neurotoxicants, phytotoxins and skin sensitizers.**"
Fragrance chemicals have been linked to the onset and exacerbation of **several allergic** and **non-allergic disease conditions** in humans."
"Exposure of children to hazardous chemicals via any route is a significant concern due to the potential **impact on the growth and development** during early childhood."
****FCCP Chemical Database:** FCCP A repository of Fragrance Chemicals in Children's Products
****FCCP Chemical Classification Data Compilation:** Graphical Abstract

9. *Occurrence and Distribution of Phthalates in Sanitary Napkins from Six Countries: Implications for Women's Health*

Tang Z, Chai M, Cheng J, Wang Y, Huang Q. Occurrence and Distribution of Phthalates in Sanitary Napkins from Six Countries: Implications for Women's Health. Environ Sci Technol. 2019 Dec 3;53(23):13919-13928. doi: 10.1021/acs.est.9b03838. Epub 2019 Nov 18. PMID: 31694371.

Article Link: https://pubmed.ncbi.nlm.nih.gov/31694371/

"Chemicals in feminine hygiene products can exert adverse health effects as a result of strong absorptive capacity of the vagina and vulva. We measured the concentrations of 15 phthalates in sanitary napkins collected from six countries and found total concentrations in the range of 1733-11942 ng/g. Di(isobutyl)phthalate (DiBP), bis(2-ethylhexyl)phthalate (DEHP), and di-*n*-butyl phthalate (DnBP) were the dominant congeners, representing a median of 27.3, 26.7, and 20.4% of the total median phthalate concentrations across all countries, respectively…. The estimated intake (at the 90th percentile) of DiBP, DnBP, and DEHP from sanitary napkins approximately represented 6.35-23.6, 3.35-9.90, and 1.06-9.57%, respectively, of the total exposure, indicating that sanitary napkins are a relevant source of exposure to these chemicals."

"Phthalates are widely used in the production of plastics and other polymers to improve their flexibility and versatility.1,2 Phthalates are also used extensively as industrial solvents and in personal care products and cosmetics, surfactants, detergents, and textiles….Most phthalates are used as additives that are not chemically bound to the product matrix and therefore can easily migrate and enter the human body. Exposure to phthalates can exert serious adverse effects on human health, including **estrogenic effects that impair the endocrine system**…. In addition, some phthalates can cause various **reproductive and developmental conditions**…. Hauser et al. found that urinary concentrations of bis(2-ethylhexyl)- phthalate (DEHP) metabolites in women undergoing in vitro fertilization were inversely associated with oocyte yield and clinical pregnancy. Some epidemiologic studies have reported associations between prenatal exposure to phthalates and adverse outcomes at birth, such as congenital diseases and developmental delays…. Lien et al. reported that **prenatal exposure to some phthalates can increase aggressive behavior problems** in 8-year-old children."

"**Phthalates readily accumulate in biological tissues** owing to their higher lipophilicity,4 and dietary intake has been estimated as the main route of human exposure…. Increasing evidence shows that **dermal contact from the use of cosmetics and personal care products is another relevant route of exposure to phthalates.** Sanitary napkins are used to absorb menstrual blood, and their constituents may be contaminated with phthalates. In addition, some chemical additives, likely consisting of, containing, or contaminated with phthalates, are typically used in the manufacturing process of sanitary napkins…. Sanitary napkins come into direct contact with the vulva, and the **mucous membranes in the vagina and vulva can rapidly absorb chemicals without metabolizing them**…. Serum estradiol levels following the vaginal application of estradiol have been shown to be 10-fold higher than levels following oral dosing,... indicating possible health risks from this exposure route"

[Note: Phthalates are synthetic odorless plasticizers used as solvents, binders or fixatives in many fragrances. Why are phthalates in the news? Phthalates are considered Endocrine Disrupting Chemicals.
On the California Safe Cosmetics Program Product Database: DEP, DIDP, and DBP are reported as fragrance while DEHP and DBP are perfume solvents. IFRA lists DEP and DMP, as "reported fragrance ingredients".**]**

10. *Rapid and green determination of 58 fragrance allergens in plush toys*

Wang Z, Zhang Q, Li H, Lv Q, Wang W, Bai H. Rapid and green determination of 58 fragrance allergens in plush toys. J Sep Sci. 2018 Feb;41(3):657-668. doi: 10.1002/jssc.201700556. Epub 2017 Dec 14. PMID: 29150895.
Article Link: https://pubmed.ncbi.nlm.nih.gov/29150895/

"**Toys are scented** to cover unpleasant odors or to enhance their attractiveness to consumers. However, **some fragrances are important sources of allergens**, which can **trigger respiratory illnesses (asthma and rhinitis), migraine headaches, neurotoxicity, endocrine-disrupting activities,** and other negative effects."

11. *Association of phthalates, parabens and phenols found in personal care products with pubertal timing in girls and boys*

Harley KG, Berger KP, Kogut K, Parra K, Lustig RH, Greenspan LC, Calafat AM, Ye X, Eskenazi B. Association of phthalates, parabens and phenols found in personal care products with pubertal timing in girls and boys. Hum Reprod. 2019 Jan 1;34(1):109-117. doi: 10.1093/humrep/dey337. PMID: 30517665; PMCID: PMC6295961.
Article Link: https://pubmed.ncbi.nlm.nih.gov/30517665/ - PDF

"Several chemicals that are commonly used in cosmetics, personal care products and other **scented** household items have been shown to exhibit **endocrine disrupting** properties (Witorsch and Thomas, 2010). These chemicals include certain low molecular weight phthalates, such as diethyl phthalate (DEP), which is found in **scented** products such as **perfumes**, deodorants, soaps and shampoo, and di-n-butyl phthalate (DnBP) and di-isobutyl phthalate (DiBP), which can be used in nail polish and cosmetics (Dodson et al., 2012). In animal studies, developmental exposure to DnBP and DiBP induces **anti-androgenic effects** including **feminized traits**, **abnormal reproductive development** and **later puberty** in male rats, although the effects are less strong in females (Mylchreest et al., 2000; Saillenfait et al., 2008)."

"**We found evidence that prenatal and peripubertal exposure to certain phthalates, parabens and phenols present in personal care and consumer products was associated with pubertal timing in girls, but less so in boys.**

12. *Characterization of air freshener emission: the potential health effect*

Kim S, Hong SH, Bong CK, Cho MH. Characterization of air freshener emission: the potential health effects. J Toxicol Sci. 2015;40(5):535-50. doi: 10.2131/jts.40.535. PMID: 26354370.
Article Link: https://pubmed.ncbi.nlm.nih.gov/26354370/ - PDF

"The use of these products (air fresheners) may be associated with an increase in the measured level of **terpene**, such as **xylene** and other volatile air freshener components, including **aldehydes**, and **esters**. Air freshener is usually used indoors, and thus some compounds emitted from air freshener may have potentially harmful health impacts, including **sensory irritation**, **respiratory symptoms**, and **dysfunction of the lungs**."

"**The constituents of air fresheners can react with ozone to produce secondary pollutants such as formaldehyde, secondary organic aerosol (SOA), oxidative product, and ultrafine particles.** These pollutants then adversely affect human health, in many ways such as **damage to the central nervous**

system, alteration of hormone levels, etc. In particular, the ultrafine particles may induce **severe adverse effects on diverse organs**, including the **pulmonary and cardiovascular systems."**

"This review suggests that exposure to air freshener compounds, such as **VOCs that react with ozone to form secondary pollutants**, cause diverse health issues. In addition, **several key compounds such as benzene, terpenes, and phthalate etc. of air pollutants are related to air freshener use**. **We suggest that the use of air fresheners should be avoided**, and there is a need to reduce chemical components which are potentially reactive with ozone in air fresheners."

13. *Ten questions concerning air fresheners and indoor built environments*

Anne Steinemann, Ten questions concerning air fresheners and indoor built environments, Building and Environment, Volume 111, 2017, Pages 279-284, ISSN 0360-1323, https://doi.org/10.1016/j.buildenv.2016.11.009.
Article Link: https://www.sciencedirect.com/science/article/pii/S0360132316304334?via%3Dihub - PDF

"This article investigates the seeming paradox that **products designed to improve the indoor environment can pose unintended and unknown risks.** It examines the science, health, and policy perspectives, and provides recommendations and research directions."

"Air fresheners can contribute to indoor hazardous air pollutants, both through direct emissions and secondary reaction products… Within buildings and other indoor environments, the use of air fresheners has a strong association with high indoor levels of **terpenes, benzene, toluene**, ethyl-benzene, m,p-xylene, and **total volatile organic compounds**…"

"Air fresheners can contribute to human exposure to primary and secondary air pollutants… Air freshener exposures, **even at low levels**, have been associated with a range of adverse health effects, which include **migraine headaches, asthma attacks, breathing difficulties, respiratory difficulties, mucosal symptoms, dermatitis, infant diarrhea and earache, neurological problems, and ventricular fibrillation**..."
"In addition to population based studies, specific air freshener chemicals (VOCs such as acetaldehyde, SVOCs such as phthalates, and ultrafine particles) emitted from air fresheners have been associated with adverse effects to the **neurological, cardiovascular, respiratory, reproductive, immune, and endocrine systems, and with cancer**. For instance, acetaldehyde, which can be both a primary and secondary emission from air fresheners, is associated with both **acute and chronic hazards to the respiratory system**, and classified as a carcinogenic hazardous air pollutant in the US…"

14. *Ubiquity, Hazardous Effects, and Risk Assessment of Fragrances in Consumer Products*

Pastor-Nieto MA, Gatica-Ortega ME. Ubiquity, Hazardous Effects, and Risk Assessment of Fragrances in Consumer Products. Curr Treat Options Allergy. 2021;8(1):21-41. doi: 10.1007/s40521-020-00275-7. Epub 2021 Jan 23. PMID: 33520600; PMCID: PMC7825391.
Article Link: https://pubmed.ncbi.nlm.nih.gov/33520600/ - PDF

"Fragrances are the most frequent chemicals causing contact dermatitis. … It is difficult for sensitized patients to avoid contact with fragrances, due to their ubiquity and because **manufacturers are not willing to volunteer information regarding fragrance ingredients.**"

“The patient should understand that avoiding perfume means to avoid all scented goods and not just perfumes.”

“A perfume also contains solvents, fixatives to influence its persistence…. Fragrances are ubiquitous and may cause detrimental health or environmental effects including **contact allergy**.”
“Some fragrances are carcinogens, mutagens, and **toxic to reproduction** (CMR substances), thus classified with H341, H351, or H360. **Respiratory**, **neuroendocrine**, and **psychological effects** have also been discussed…. Fragrances have **neurotoxic** and **neurostimulatory effects**.”

“Certain perfumes may be **cytotoxic to human fetal brain development** based on in vitro research with neuroblastoma cell lines…. Ingredients in perfumes with presumed **hormonal activities** are octinoxate and butylated hydroxytoluene (**thyroid and androgen-like activities**) and octinoxalate, oxybenzone, benzophenone-1, diethyl phthalate, galaxolide, tonalide, musk ketone, benzyl salicylate, and butylphenyl methylproprional (**estrogen or androgen activity**). Diethyl phthalate, a fragrance solvent, can cause **abnormal development of reproductive organs** in infant males**, attention deficit disorder** in children, and **sperm damage** in adults**….** According to one study, most perfumes exhibited some degree of **mutagenic potential** compared with 4-nitro-1,2-diaminobenzene, a highly mutagenic positive control**.**”

15. *Environmental factors in the development of autism spectrum disorders*

Sealey LA, Hughes BW, Sriskanda AN, Guest JR, Gibson AD, Johnson-Williams L, Pace DG, Bagasra O. Environmental factors in the development of autism spectrum disorders. Environ Int. 2016 Mar;88:288-298. doi: 10.1016/j.envint.2015.12.021. Epub 2016 Jan 28. PMID: 26826339.
Article Link: https://pubmed.ncbi.nlm.nih.gov/26826339/ - PDF

“Many modern companies do not disclose the industrial secrets in many of their fragrances that are, in reality, a complex concoction of synthetic chemicals and natural essences, which often have been found to be petrochemicals.”

“Among those are chemicals, such as **musk ketone** and **diethyl phthalate**, which are responsible for **allergic reactions and hormone disruption**…. Although these **chemicals have been found to accumulate in human tissues,** they have not yet been adequately analyzed for safety in products used by unsuspecting humans. **As a result of a giant loophole in the Federal Fair Packaging and Labeling Act of 1973**, which explicitly exempts fragrance producers from having to disclose cosmetic ingredients on product labels, fragrance concealment is not illegal and is often used by the industry to hide from the public the full list of ingredients, even substances that can cause grave health problems (Environmental Working Group (EWG), 2005). It is a common practice for businesses to list the chemicals as simply “fragrance,” which may mean that **the majority of the ingredients are never revealed to buyers**.”

“Even worse, people who use cologne, fragrances, body spray, and other scented cosmetics are blindly exposed to dangerous chemicals since the Food and Drug Administration lacks authority to control mandates to manufacturers that require testing of all fragrances for safety, before being released to the public.”

“Also, during pregnancy, the use of fragrances and other cosmetics may actually expose the developing fetus to **diethyl phthalate (DEP)**, a common fragrance solvent that can cause **abnormal development of reproductive organs in infant males**, **Attention Deficit Disorder** in children, and **sperm damage in adults**.”

"The role of environmental factors like **fragrances**, glyphosate **and other synthetic chemicals derived from petrochemicals containing carcinogenic, mutagenic, hormones disturbing and neuromodifying capabilities** in the molecular and cellular pathogeneses of ASD has not been evaluated. This is partly due to the 1973 FDA decision to exempt fragrances and cosmetics from appropriate testing, which is generally required for any consumer item that enters the human body and is metabolized by human metabolic pathways."

16. *Screening of phthalate esters in 47 branded perfumes*

Al-Saleh I, Elkhatib R. Screening of phthalate esters in 47 branded perfumes. Environ Sci Pollut Res Int. 2016 Jan;23(1):455-68. doi: 10.1007/s11356-015-5267-z. Epub 2015 Aug 28. PMID: 26310707.
Article Link: https://pubmed.ncbi.nlm.nih.gov/26310707/

"The results of this study are alarming and definitely need to be brought to the attention of the public and health regulators. Although some phthalate compounds are still used in cosmetics, many scientists and environmental activists have argued that **phthalates** are **endocrine-disrupting** chemicals that have not been yet proven to be safe for any use, including cosmetics. Phthalates may also have different degrees of **estrogenic** modes of action. Furthermore, we should not dismiss the widespread use of phthalates in everyday products and exposure to these chemicals from sources such as food, medications, and other personal care products."

17. *History of the Obesogen Field: Looking Back to Look Forward*

Heindel JJ. History of the Obesogen Field: Looking Back to Look Forward. Front Endocrinol (Lausanne). 2019 Jan 29;10:14. doi: 10.3389/fendo.2019.00014. PMID: 30761083; PMCID: PMC6362096.
Article Link: https://pubmed.ncbi.nlm.nih.gov/30761083/

"Exposure to EDCs during early development (DOHaD) has been shown to **increase susceptibility to a variety of diseases including infertility, asthma, breast and prostate cancer, early puberty, susceptibility to infections, heart disease, autoimmune disease, and attention deficit hyperactivity disorder/learning disability**. The chemicals that she noted as having the ability to cause weight gain include organochlorine pesticides, carbamates, polychlorinated biphenols, plastics such as **phthalates** and bisphenol A (BPA), heavy metals and solvents.**"**

"EDCs are found in a wide variety of products including pesticides/herbicides/fungicides, flame retardants, surfactants, plastics, **sunscreens, cosmetics,** and **personal care products,** etc. [reviewed in (5)]."

"Originally, **EDCs** were shown to interfere with **estrogen, androgen and thyroid hormone signaling (7, 8) resulting in diseases and dysfunctions in reproduction, learning, memory, and behavior."**

[Note: Endocrine Disrupting Chemicals (EDC's) are commonly used in perfumes and fragranced products as preservatives or fragrance. What are EDC's and how can they affect us?**]**

18. *Exposures to Endocrine Disrupting Chemicals in Consumer Products - A Guide for Pediatricians*

Wong KH, Durrani TS. Exposures to Endocrine Disrupting Chemicals in Consumer Products - A Guide for Pediatricians. Curr Probl Pediatr Adolesc Health Care. 2017 May;47(5):107-118. doi: 10.1016/j.cppeds.2017.04.002. Epub 2017 May 17. PMID: 28526231.

Article Link: https://pubmed.ncbi.nlm.nih.gov/28526231/

“Infants can be exposed to endocrine disrupting chemicals via breast milk or infant formula.”
“One study has found links between monoethyl phthalate concentrations in perinatal breast milk and changes in reproductive hormones in breastfed infants.”

“One study found an association between exposure to infant care products (i.e., **lotion, powder, and shampoo**) and **increased urinary levels of phthalate metabolites**. Phthalates also are found in personal care products because they help to dissolve ingredients in the product and impart flexibility that, for example, makes nail polish less brittle. They are commonly found in personal care products such as nail polish, shampoo, hairspray, **fragrances**, and after shave lotion. Baby care products such as baby lotion, diaper cream, body wash, wet wipes, shampoo, and baby oils also have detectable levels of phthalates.”

“Phthalates are non-covalently bonded to their parent materials and can readily leach into the environment. This property, combined with **widespread use in consumer products, accounts for widespread exposure** in the American population (phthalate metabolites are detected in urine samples of 89-98% of Americans sampled).”

“Avoiding Products with phthalates, parabens, triclosan, and **fragrances** have been proven to reduce urinary concentrations of phthalates and parabens… **Consumers should avoid products that have fragrance because they are likely to contain phthalates**.”

19. *Human exposure to nitro musks and the evaluation of their potential toxicity: an overview*

Taylor KM, Weisskopf M, Shine J. Human exposure to nitro musks and the evaluation of their potential toxicity: an overview. Environ Health. 2014 Mar 11;13(1):14. doi: 10.1186/1476-069X-13-14. PMID: 24618224; PMCID: PMC4007519.
Article Link: https://pubmed.ncbi.nlm.nih.gov/24618224/ - PDF

“Synthetic nitro musks are **fragrant chemicals found in household and personal care products**. The use of these products leads to direct exposures via dermal absorption, as well as inhalation of contaminated dust and volatilized fragrances. As these compounds are lipophilic, they and their metabolites, **have been found** not only in **blood**, but also **breast milk and adipose tissue**…. “

“Ketone musk and musk xylene continue to be used as additives in detergents, fabric softener, household cleaning products and other fragrant non-cosmetic products with musk xylene being the most widely used nitro musk…. **The body of literature supports the conclusion that not only are we being exposed to nitro musks, we are also bioaccumulating them and passing them on to our offspring through breast milk and perinatal exposures.**”

20. *Occurrence of personal care products as emerging chemicals of concern in water resources*

Montes-Grajales D, Fennix-Agudelo M, Miranda-Castro W. Occurrence of personal care products as emerging chemicals of concern in water resources: A review. Sci Total Environ. 2017 Oct 1;595:601-614. doi: 10.1016/j.scitotenv.2017.03.286. Epub 2017 Apr 8. PMID: 28399499.
Article Link: https://pubmed.ncbi.nlm.nih.gov/28399499/

"**Personal care products (PCPs)** are a diverse group of common household substances used for health, beauty and cleaning purposes. These include disinfectants, **fragrances**, insect repellents, preservatives and UV filters, among others. Some of them are considered chemicals of emerging concern due to their presence and negative impact on aquatic ecosystems, specially related to **endocrine disruption** and **reproductive disorders**."

"PCPs (personal care products) include a large number of **synthetic chemicals** used in everyday products such as **soaps**, **lotions**, toothpaste, **fragrances**, cosmetics and sunscreens. The extensive use of them, improperly disposal, and inefficient treatment of urban wastewater contribute to the contamination of water bodies by PCPs and their metabolite."

"The contamination of the water reservoirs by PCPs is of interest due to their potential **toxicity to aquatic ecosystems and human beings**, as many of them have been reported as **environmental persistent, bioactive, bioaccumulative and endocrine disrupting compounds**."
"PCPs have been found in all the continents in aquatic ecosystems, even at concentrations above the toxicity threshold for some species."
[Note: Galaxolide is a musk, along with thousands of other chemicals of varying toxicity, used in fragrance.**]**

21. Fragrance compounds: The wolves in sheep's clothings

Patel S. Fragrance compounds: The wolves in sheep's clothings. Med Hypotheses. 2017 May;102:106-111. doi: 10.1016/j.mehy.2017.03.025. Epub 2017 Mar 22. PMID: 28478814.
Article Title: https://pubmed.ncbi.nlm.nih.gov/28478814/

"It is deplorable and alarming that awareness of the threats of perfume allergy is very low. Tricked by aggressive advertisement and to improve aesthetic appeal, people are exposing themselves to multiple chemical fragrance compounds. Further, it is a matter of concern that an alert individual cannot escape the perils of fragrances by mere lifestyle revision, and avoidance of the chemicals. Like the harms of passive smoking, passive exposure to the perfumes occurs in a number of public places. In realization of the dangers of peanut allergy to vulnerable individuals, peanut was pulled off from the food platter in passenger planes. Similar awareness and action is needed for perfumes as well.… An aware individual does not deserve to get the brunt of someone else's reckless lifestyle choices. Also, the cleaning staff in public places must be trained so as to ensure prevention of perfume abuse i.e. excess usage."

"A study found traces of **musk fragrances** such as **galaxolide**, **tonalide**, **cashmeran,** and UV-filters in marine species (mussel, clam, flounder, herring and mullet) and macroalgae, which constitute seafood. These **bioaccumulated xenobiotics** will ultimately reach to the human body via the food chain"

"Perfume manufacturers do not disclose the ingredients and quantity of the fragrance compounds in the name of 'trade secret'. Though they ought to abide by ethics, for profit and the goals of high market share, they forgo those. With the help of unscrupulous advertisements and sponsored research reports, they keep luring naive and unaware consumers.… It is appalling that even if people know the threats, they continue using these toxins, resonating the ''death wish" concept discussed in the popular TV series ''Mad men".... The fragrance compounds so ubiquitous in modern times initiate vicious cycles of 'exposure – pathologies – drugs', which must be understood, information disseminated and terminated. Based on the review work and hypotheses, it

can be stated that perfumes and other fragrance compounds in day-to-day consumer products are 'slow killers with fatal punch'.

"Growing recognition of the widespread use of fragrances in modern society is alarming. These pleasant-seeming deleterious compounds are the causal factors of a wide array of **immuneneural**- **hormonal health issues**. **Allergy**, **irritation**, **migraine**, **asthma**, **depression**, **high blood pressure**, **diabetes** and other symptoms should not be trivialized. Unheeded, and continued, the fragrance compounds can lead to **gynaecomastia**, **cancers**, **gender manipulation**, **teratogenicity**."

"**Creating public awareness is essential to avoid grave health consequences**. Toxicology research on perfumes must be prioritized, just like other urgent topics like 'antibiotics-drug resistance' and 'pesticide-food safety'. This review 'though barely scratches the surface' of the enormous health threats of 'synthetic fragrances' is expected to evoke alertness."
[Note: Gynaecomastia is enlarged male breast tissue**]**

22. *Obesogens: An Environmental Link to Obesity*

Holtcamp W. Obesogens: an environmental link to obesity. Environ Health Perspect. 2012 Feb;120(2):a62-8. doi: 10.1289/ehp.120-a62. PMID: 22296745; PMCID: PMC3279464.
Article Link: https://pubmed.ncbi.nlm.nih.gov/22296745/

"Most known or suspected **obesogens** are **endocrine disruptors**. Many are widespread, and exposures are suspected or confirmed to be quite common.".

"Phthalates, plasticizers that also have been related to obesity in humans, occur in many PVC items as well as in **scented items such as air fresheners, laundry products,** and **personal care products."**

[Note: Phthalates are endocrine disruptors. **Endocrine Disrupting Chemicals** (EDC's) are commonly used in perfumes and fragranced products as preservatives or fragrance. What are EDC's and how can they affect us?**]**

23. *Endocrine Disruptors and Asthma-Associated Chemicals in Consumer Products*

Dodson RE, Nishioka M, Standley LJ, Perovich LJ, Brody JG, Rudel RA. Endocrine disruptors and asthma-associated chemicals in consumer products. Environ Health Perspect. 2012 Jul;120(7):935-43. doi: 10.1289/ehp.1104052. Epub 2012 Mar 8. PMID: 22398195; PMCID: PMC3404651..
Article Link: https://pubmed.ncbi.nlm.nih.gov/22398195/ - PDF

"Laboratory and human studies raise concerns about endocrine disruption and asthma resulting from exposure to chemicals in consumer products… Analytes included parabens, **phthalates**, bisphenol A (BPA), triclosan, ethanolamines, alkylphenols, **fragrances**, glycol ethers, cyclosiloxanes, and ultraviolet (UV) filters."
"In other products, the highest concentrations and numbers of detects were in fragranced products (e.g., perfume, air fresheners, and **dryer sheets**) and sunscreen."

"**Some products that did not contain the well-known endocrine-disrupting phthalates contained other less-studied phthalates** (dicyclohexyl phthalate, diisononyl phthalate, and di-n-propyl phthalate; also endocrine-disrupting compounds), suggesting a substitution. Many detected chemicals were not listed on

product labels."

"**Endocrine Disrupting compounds (EDCs) are chemicals that can alter hormonal signaling and have potential effects on developing reproductive and nervous systems, metabolism, and cancer** (Colborn et al. 1993). Some phthalates inhibit testosterone synthesis (Howdeshell et al. 2008)..."

"**Fragrances have been shown to exacerbate asthma**. …The phthalate bis(2-ethylhexyl) phthalate (DEHP) in dust was associated with **asthma and wheezing in children**…"

"Our results also indicate that use of multiple products can lead to **exposure to an even larger mixture of compounds,** even if a consumer selected products considered alternative according to our criteria. For example, a consumer who used the alternative surface cleaner, tub and tile cleaner, **laundry detergent**, bar soap, shampoo and conditioner, facial cleanser and lotion, and toothpaste (a plausible array of product types for an individual) would potentially be exposed to at least 19 compounds: two parabens, three **phthalates**, MEA, DEA, five alkylphenols, and seven **fragrances**."

[Note: Fragrance chemicals listed in Figure 1 are: Benzylacetate, Eugenol, Hexyl cinnemal, Limonene, Linalool, Methyl eugenol, Methyl salicylate, Pinene, Terpineol, AHTN, Bucina,l Diphenyl ether, DPMI, HHCB, Isobornyl acetate, Methyl ionone, Musk ketone, Musk xylene, Phenethyl alcohol**]**
[Note: Endocrine Disrupting Chemicals (EDC's) are commonly used in perfumes and fragranced products as preservatives or fragrance. What are EDC's and how can they affect us?**]**

[Note: Phthalates are synthetic odorless plasticizers used as solvents, binders or fixatives in many fragrances. Why are phthalates in the news? Phthalates are considered Endocrine Disrupting Chemicals.
On the California Safe Cosmetics Program Product Database: DEP, DIDP, and DBP are reported as fragrance while DEHP and DBP are perfume solvents. IFRA lists DEP and DMP, as "reported fragrance ingredients".**]**

24. *Symptom-trigger factors other than allergens in asthma and allergy*

Claeson AS, Palmquist E, Lind N, Nordin S. Symptom-trigger factors other than allergens in asthma and allergy. Int J Environ Health Res. 2016 Aug;26(4):448-57. doi: 10.1080/09603123.2015.1135314. Epub 2016 Jan 20. PubMed PMID: 26788835.
Article Link: https://pubmed.ncbi.nlm.nih.gov/26788835/

"Data from a population-based study, the Västerbotten Environmental Health Study, were used to compare persons with **asthma**, **allergic rhinitis**, **allergic dermatitis**, multiple diagnoses of asthma/allergy and no asthma or allergy. Persons with asthma and multiple diagnoses reported odorous/pungent and building-related environmental factors to trigger symptoms to a larger extent than did the reference group, mainly due to **perfume** and odors from flowers. They also **reported behavioral disruptions and affective reactions to odorous/pungent environments**. These findings increase the understanding of the role of odorants in symptom development and thereby the prevention of health problems in asthma and allergy in indoor air."

"Environmental exposures of particular interest for indoor air quality, such as exposure to odorants, have also been referred to as triggers of asthma and allergy, although the exposure in some cases may result in allergic symptoms without clinical signs (e.g. **bronchoconstriction**). For example, a condition with **asthma-like overreaction** in the lower airways, called **sensory hyperreactivity**, has been identified in which patients display normal pulmonary function and negative allergy tests, and is **typically not treated by their ordinated**

asthma medication (Millqvist et al. 1998). **The symptoms in these patients are often induced by non-specific trigger factors, such as perfumes**."

25. *Spermatotoxicity in Animal Models Exposed to Fragrance Components*

Akunna GG, Saalu LG, Ogunlade B. Enye LA., (2014). Spermatotoxicity in Animal Models Exposed to Fragrance Components. Journal of Medical Sciences, 14: 46-50.
Article Link: https://scialert.net/fulltext/?doi=jms.2014.46.50 - PDF

"Various commonly-used products have been reported to contain chemicals that could **disrupt estrogen and testosterone hormone**. …The results obtained from this study showed a significant ($p<0.005$) decrease in body weight and absolute testicular weight of the rat models exposed to fragrance when compared to the control groups. It was also observed that the concentration, mobility, livability and morphology of spermatozoa from groups C, D, E and F were significantly lower ($p>0.005$) when compared to values of the control group A and B. Based on the spermiographic evaluation from this study, fragrance materials could have an adverse effect on spermatozoa of the intact male wistar rats."

"**It has been reported that through inhalation, ingestion and absorption, fragrance infiltrates the body and moves directly to the blood stream.** … Symptoms ranging from **severe mucosal discharge, sinus problems, tremor, asthmatic attack, sneezing, migraine headache, convulsions, hyperactivity, nausea, sore throat, cough, chest tightness to shortness of breath** after fragrance exposure have been vastly documented (Guin and Berry, 1980; De Groot, 1987; Schleuter et al., 1978)."

"Unswerving connection between memory and smell has been established (Rachel and Engen, 1996). This knowledge has resulted in **placement of fragrance in the category of psychoactive drugs and highlighted the ability of fragrance to cross the brain barrier thereby resulting in potential damage to brain tissue** (Andrea, 1997). **Linalool**, the most abundant fragrance substance has been indicated to cause **lethargy**, **depression** and **severe respiratory difficulties after exposure**."

"Synthetic musk fragrance ingredients which are widely highly distributed in many consumer products have been examined in human blood, milk and fatty tissue. They represent a new group of human contaminants which are **comparable with that of certain pesticides.** Despite several reports on the toxic effect of **fragrance,** there is a dearth of literature ascertaining its **effects on male fertility and testicular development** (Thompson and Wansker, 1981)."

26. *Health risks of chemicals in consumer products: A review*

Li D, Suh S. Health risks of chemicals in consumer products: A review. Environ Int. 2019 Feb;123:580-587. doi: 10.1016/j.envint.2018.12.033. Epub 2019 Jan 7. PMID: 30622082.
Article Link: https://pubmed.ncbi.nlm.nih.gov/30622082/ - Full Text

"It should also be noted that some chemicals have multiple functional uses, while we chose the most dominant functional use for each chemical. An example is the grouping of **phthalates**. Despite categorized as plasticizer together in this review, several phthalates such as **diethyl phthalate and dimethyl phthalate are used as solvents in personal care products and cosmetics as carriers of fragrance** (Schettler, 2006)."

"…we found that the volume of the peer-reviewed literature that addresses human health risks of the chemicals in consumer products did grow over the last two decades, while its growth could by no means match the speed of increasing volume and diversity of the chemicals produced and used in consumer products by the society. This **growing gap between increasing reliance on chemicals in consumer products and our knowledge on their human health risks raises a potential public health concern**, given the pervasive nature of today's mass production and consumption practice."

27. *Occurrence and Distribution of Phthalates in Sanitary Napkins from Six Countries: Implications for Women's Health*

Tang Z, Chai M, Cheng J, Wang Y, Huang Q. Occurrence and Distribution of Phthalates in Sanitary Napkins from Six Countries: Implications for Women's Health. Environ Sci Technol. 2019 Dec 3;53(23):13919-13928. doi: 10.1021/acs.est.9b03838. Epub 2019 Nov 18. PMID: 31694371.

Article Link: https://pubmed.ncbi.nlm.nih.gov/31694371/

"Chemicals in feminine hygiene products **can exert adverse health effects as a result of strong absorptive capacity of the vagina and vulva**. We measured the concentrations of 15 phthalates in sanitary napkins collected from six countries and found total concentrations in the range of 1733-11942 ng/g. **Di(isobutyl)phthalate (DiBP)**, **bis(2-ethylhexyl)phthalate (DEHP)**, and di-*n*-butyl phthalate (DnBP) were the dominant congeners, representing a median of 27.3, 26.7, and 20.4% of the total median phthalate concentrations across all countries, respectively…. The estimated intake (at the 90th percentile) of **DiBP,** DnBP, and **DEHP** from sanitary napkins approximately represented 6.35-23.6, 3.35-9.90, and 1.06-9.57%, respectively, of the total exposure, indicating that sanitary napkins are a relevant source of exposure to these chemicals."

"Most phthalates are used as additives that are not chemically bound to the product matrix and therefore can easily migrate and enter the human body. Exposure to phthalates can exert serious adverse effects on human health, including **estrogenic effects that impair the endocrine system**…. In addition, some phthalates can cause various **reproductive and developmental conditions**…."

"Hauser et al. found that urinary concentrations of **bis(2-ethylhexyl)- phthalate (DEHP)** metabolites in women undergoing in vitro fertilization were **inversely associated with oocyte yield and clinical pregnancy**. Some epidemiologic studies have reported associations between **prenatal exposure to phthalates** and adverse outcomes at birth, such as **congenital diseases** and **developmental delays**…. Lien et al. reported that **prenatal exposure to some phthalates can increase aggressive behavior problems** in 8-year-old children."

"**Phthalates readily accumulate in biological tissues** owing to their higher lipophilicity… Increasing evidence shows that **dermal contact from the use of cosmetics and personal care products is another relevant route of exposure to phthalates.** Sanitary napkins are used to absorb menstrual blood, and their constituents may be contaminated with phthalates. … Sanitary napkins come into direct contact with the vulva, and the **mucous membranes in the vagina and vulva can rapidly absorb chemicals without metabolizing them**…. Serum estradiol levels following the vaginal application of estradiol have been shown to be 10-fold higher than levels following oral dosing,... indicating possible health risks from this exposure route"

[Note: Phthalates are synthetic odorless plasticizers used as solvents, binders or fixatives in many fragrances. Why are phthalates in the news? Phthalates are considered Endocrine Disrupting Chemicals.

On the California Safe Cosmetics Program Product Database: DEP, DIDP, and DBP are reported as fragrance while DEHP and DBP are perfume solvents. IFRA lists DEP and DMP, as "reported fragrance ingredients".**]**

28. *Exposing covert fragrance chemicals*

Scheinman PL. Exposing covert fragrance chemicals. Am J Contact Dermat. 2001 Dec;12(4):225-8. doi: 10.1053/ajcd.2001.28697. PMID: 11753900.
Article Link: https://pubmed.ncbi.nlm.nih.gov/11753900/

"**Fragrance is the most common cosmetic allergen found when dermatitis patients are patch tested** in the United States and in many places worldwide. Fragrances are ubiquitous in our daily lives and are present in items ranging from toiletries to toilet tissue. Although fragrances enhance the smell or mask unpleasant odors of various cosmetics and household items, it becomes very difficult for fragrance-allergic patients to find products they can use. Many items labeled unscented and fragrance-free contain esoteric fragrance chemicals that most consumers would not recognize. This article details some covert fragrance agents to help physicians better educate their fragrance-sensitive patients."

29. *Phthalates*, bisphenols, parabens*, and triclocarban in feminine hygiene products from the United States and their implications for human exposure*

Gao CJ, Kannan K. Phthalates, bisphenols, parabens, and triclocarban in feminine hygiene products from the United States and their implications for human exposure. Environ Int. 2020 Mar;136:105465. doi: 10.1016/j.envint.2020.105465. Epub 2020 Jan 13. PMID: 31945693
Article Link: https://pubmed.ncbi.nlm.nih.gov/31945693/ - PDF

"The estimated exposure doses of **phthalates**, parabens, and bisphenols through the dermal absorption pathway from the use of pads, panty liners, and tampons were significant."

"Elevated exposure to phthalates has been associated with **precocious puberty, endometriosis, female genital tumors,** and **ovulation disorders.** …**high concentrations phthalates have been measured in sanitary pads.**"

"In addition, pads, panty liners, and tampons are made from polypropylene (PP) and polyethylene (PE) materials, which can contain plasticizers such as phthalates, to increase the products' flexibility. Dimethyl phthalate* (DMP), **diethyl phthalate* (DEP), dibutyl phthalate* (DBP)**, **di-iso-butyl phthalate (DIBP),** di(2-ethylhexyl) **phthalate* (DEHP),** methyl paraben (MeP), and ethyl paraben (EtP) were found in all pad, panty liner, and tampon samples."

[Note: Phthalates are synthetic odorless plasticizers used as solvents, binders or fixatives in many fragrances. Why are phthalates in the news? Phthalates are considered Endocrine Disrupting Chemicals.
On the California Safe Cosmetics Program Product Database: DEP, DIDP, and DBP are reported as fragrance while DEHP and DBP are perfume solvents. IFRA lists DEP and DMP, as "reported fragrance ingredients".**]**

30. *Feminine Hygiene Products-A Neglected Source of Phthalate Exposure in Women*

Gao CJ, Wang F, Shen HM, Kannan K, Guo Y. Feminine Hygiene Products-A Neglected Source of Phthalate Exposure in Women. Environ Sci Technol. 2020 Jan 21;54(2):930-937. doi: 10.1021/acs.est.9b03927. Epub 2020 Jan 9. PMID: 31859481.

Article Link: https://pubmed.ncbi.nlm.nih.gov/31859481/

"**Phthalates have been associated with reproductive toxicity and precocious puberty in females,** but the occurrence of these toxicants in feminine hygiene products is rarely reported. In this study, eight phthalates were determined in 120 feminine hygiene products (56 feminine care products and 64 sanitary napkins) collected from China. **Phthalates** were **found** in **86% and 98% of feminine care products and sanitary napkins,** respectively, with the total concentrations varying between not detectable and 813 μg/g (median: 0.26 μg/g) and 0.25 and 8.76 μg/g (1.43 μg/g), respectively. **Diethyl phthalate**, dibutyl phthalate, and bis(2-ethylhexyl)phthalate were the major compounds, accounting for >60% of the total concentrations."

[Note: Phthalates are synthetic odorless plasticizers used as solvents, binders or fixatives in many fragrances. Why are phthalates in the news? Phthalates are considered Endocrine Disrupting Chemicals.
On the California Safe Cosmetics Program Product Database: DEP, DIDP, and DBP are reported as fragrance while DEHP and DBP are perfume solvents. IFRA lists DEP and DMP, as "reported fragrance ingredients".**]**

31. *Sanitary pads and diapers contain higher phthalate contents than those in common commercial plastic products*

Park CJ, Barakat R, Ulanov A, Li Z, Lin PC, Chiu K, Zhou S, Perez P, Lee J, Flaws J, Ko CJ. Sanitary pads and diapers contain higher phthalate contents than those in common commercial plastic products. Reprod Toxicol. 2019 Mar;84:114-121. doi: 10.1016/j.reprotox.2019.01.005. Epub 2019 Jan 16. PMID: 30659930; PMCID: PMC6504186.
Article Link: https://pubmed.ncbi.nlm.nih.gov/30659930/

"Exposure to phthalates is known to affect the development and functions of the cardiovascular, reproductive and endocrine systems."
"This study found that most of sanitary pads or diapers surveyed contained both **VOCs** and **phthalates**."

[Note: Phthalates are synthetic odorless plasticizers used as solvents, binders or fixatives in many fragrances. Why are phthalates in the news? Phthalates are considered Endocrine Disrupting Chemicals.
On the California Safe Cosmetics Program Product Database: DEP, DIDP, and DBP are reported as fragrance while DEHP and DBP are perfume solvents. IFRA lists DEP and DMP, as "reported fragrance ingredients".**]**

32. *Developmental Exposure to Endocrine Disrupting Chemicals and Its Impact on Cardio-Metabolic-Renal Health*

Singh RD, Koshta K, Tiwari R, Khan H, Sharma V, Srivastava V. Developmental Exposure to Endocrine Disrupting Chemicals and Its Impact on Cardio-Metabolic-Renal Health. Front Toxicol. 2021 Jul 5;3:663372. doi: 10.3389/ftox.2021.663372. PMID: 35295127; PMCID: PMC8915840.
Article Link: https://pubmed.ncbi.nlm.nih.gov/35295127/ - Free Full Text

"**Endocrine disrupting chemicals** (EDCs) include **phenols**, **phthalates**, parabens, flame retardants, heavy metals, pesticides, perfluorinated chemicals, UV filter components, triclosan, and organochlorines."

"**Cumulative exposure to mixtures of EDCs can lead to adverse effects on the health of the exposed individuals** (Crews et al., 2003). Multiple studies, including the studies of the National Health and Nutrition Examination Survey (NHANES), have shown that **about 75–97% of US and Asian adults have detectable**

levels of phthalates and phenols [bisphenol A (BPA) and polyfluoroalkyl chemicals] in their urine (Silva et al., 2004; Calafat et al., 2007, 2008; Vandenberg et al., 2010; Zhang et al., 2011; Husøy et al., 2019)."

"Epidemiological and experimental studies have also linked **adult exposure to EDCs** with **abnormal male and female reproductive health**, **diabetes**, **obesity**, **cardiovascular** and **metabolic disorders**, **thyroid function**, and **hormone sensitive cancers** (Howard and Lee, 2012; Bodin et al., 2015; Heindel et al., 2015, 2017)."

"Children are also vulnerable to EDCs (Calafat et al., 2017; Hendryx and Luo, 2018), **making EDC exposure a major health concern for all age groups**."

"**Chronic kidney disease** is a growing health problem among children and adults. The incidence and the prevalence of chronic kidney disease (CKD) **among children have been steadily increasing since the 1980s**…. A number of traditional risk factors associated with CKD in children include hypertension, obesity, diabetes, and aberrant divalent mineral metabolism…. There is growing evidence that **links exposure to EDCs with early progression to end-stage renal disease** (ESRD) (Kataria et al., 2015)...."

"Early-life exposure to EDCs was associated with elevated levels of kidney toxicity markers such as albumin-to-creatinine ratio (ACR), estimated glomerular filtration rate (eGFR), and urinary protein-to-creatinine ratio (UPCR) in some human population studies (Li et al., 2012; Trasande et al., 2013a, 2014; Malits et al., 2018)."

[Note: Phthalates are synthetic odorless plasticizers used as solvents, binders or fixatives in many fragrances. Why are phthalates in the news? Phthalates are considered Endocrine Disrupting Chemicals.
On the California Safe Cosmetics Program Product Database: DEP, DIDP, and DBP are reported as fragrance while DEHP and DBP are perfume solvents. IFRA lists DEP and DMP, as "reported fragrance ingredients".**]**

[Note: Endocrine Disrupting Chemicals (EDC's) are commonly used in perfumes and fragranced products as preservatives or fragrance. What are EDC's and how can they affect us?**]**

33. *Effects of Di(2-ethylhexyl) Phthalate (DEHP) on Female Fertility and Adipogenesis in C3H/N Mice*

Schmidt JS, Schaedlich K, Fiandanese N, Pocar P, Fischer B. Effects of di(2-ethylhexyl) phthalate (DEHP) on female fertility and adipogenesis in C3H/N mice. Environ Health Perspect. 2012 Aug;120(8):1123-9. doi: 10.1289/ehp.1104016. Epub 2012 May 15. PMID: 22588786; PMCID: PMC3440070.
Article Link: https://pubmed.ncbi.nlm.nih.gov/22588786/ - PDF

"Background**: Di(2-ethylhexyl) phthalate (DEHP)** and its metabolites are known to affect **lipid metabolism** and **adipogenesis**, mainly by activation of peroxisome proliferator-activated receptors (PPARs). Exposure to DEHP has been linked with **testicular impairment** and **male subfertility**. However, the effects of DEHP on female reproductive health and metabolism have not been studied in detail."

"Objective: We examined the effects of dietary DEHP exposure on **metabolism** and **fertility** in female mice."
"Results: In study I, DEHP-exposed F0 females (all dose groups) had a **significant increase in body weight**, food intake, and visceral adipose tissue compared with controls. In the 500-mg DEHP group, PPARα and PPARγ transcripts were **significantly changed in liver tissue**. In the same group, PPARγ mRNA was

significantly reduced in liver but not in fat tissue. In addition, leptin and FABP4 (fatty acid binding protein 4) mRNA were increased in adipose tissue, whereas adiponectin was decreased. In study II, we detected a **100% abortion rate** in F0 dams in the 500-mg group. **F1 offspring exposed in utero and during lactation had an increase in visceral fat tissue and body weight**."

[Note: Phthalates are synthetic odorless plasticizers used as solvents, binders or fixatives in many fragrances. Why are phthalates in the news? Phthalates are considered Endocrine Disrupting Chemicals.
On the California Safe Cosmetics Program Product Database: DEP, DIDP, and DBP are reported as fragrance while DEHP and DBP are perfume solvents. IFRA lists DEP and DMP, as "reported fragrance ingredients".**]**

34. ALSO SEE SECTIONS: Infertility, Cognitive, Fatigue / Muscle or Joint Pain

Back to top of Hormone System / Endocrine **Back to Table of Contents**

Website: https://www.fragrancefreecoalitionusa.com/

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INFERTILITY / REPRODUCTION

Erectile Dysfunction, Poor Zygote Quality, Sperm Damage in adults, Decreased Fertility, Polycystic Ovarian Disease, Abnormal Development of Reproductive Organs in Infant Males, Reduced Sperm Numbers and Motility, Abnormal Male and Female Reproductive Health
Also see: Prenatal

1. *Histo-morphometric Evidences for Testicular Derangement in animal models submitted to chronic and Sub-chronic Inhalation of Fragrance*

Akunna GG, Saalu LC, Ogunlade B, Akingbade AM, Anderson LE, Olusolade FS, Histo-morphometric evidences for testicular derangement in animal models submitted to chronic and sub-chronic inhalation of fragrance. American Journal of Research Communication, 2015, 3(1): 85-101} www.usa-journals.com, ISSN: 2325-4076.

Article Link:
https://www.researchgate.net/publication/315065887_Histo-morphometric_Evidences_for_Testicular_Derangement_in_animal_models_submitted_to_chronic_and_Sub-chronic_Inhalation_of_Fragrance - PDF

"Copious documentations have indicated that **82 percent of perfumes labeled "natural ingredients" actually contain synthetic fragrances** (Rastogi et al.,1996). Such chemicals that affect **male reproductive** hormones may be a factor in **infertility** and has been known as **endocrine disruptors**.(Giudice, 2006, Saalu et al., 2010, Akunna et al., 2013)".

"It has been reported that perfumes, colognes, body sprays and care products contained an average of four potential hormone-disrupting chemicals. In male reproductive anatomy, **endocrine disruptors** have severally been implicated as teratogens, resulting in **cryptorchidism**, **hypospadias** and **impairment of body function** normally regulated by natural hormone signaling (Wang and Baskin, 2008, Akunna et al., 2011, Akunna et al., 2013). Studies have shown that these chemicals causes damage by **mimicking or disrupting natural estrogen**, **testosterone and thyroid pathways** (Soto et al., 2009). Although the implication of subsequent exposure to these chemicals have not been critically understood, recent findings has clearly demonstrated disruption in **spermatogenesis**,(Akunna et al., 2014) **liver damage** (Akunna et al., 2011) and **other tissue toxicity in animals** exposed to fragrance components(Johansen et al., 2003, Elberling et al., 2004, Breast Cancer Fund, 2008, Schnuch et al., 2010). In animal model studies, fragrance exposure has lead to **spermatotoxicity** and **infertility**, **congenital malformation in penises and abnormal testes** (Akunna et al., 2014)."

"According to published scientific studies, **diethyl phthalate** and octinoxate which are major components of perfume and sunscreen respectively has been implicated in **sperm damage**, **apoptosis** and **interference with estrogen and androgens** in human respectively (Giudice, 2006, Wang and Baskin, 2008, Silva et al., 2004 ,Schreurs et al., 2005, Swan, 2008, CDC, 2009)."

"From our studies on fragrance, we can conclude herein that fragrance components are **testiculotoxic** in rat."
[Note: Definition - Teratogens are substances that people are exposed to (in utero) that may lead to birth defects, miscarriages, pre-term labor or stillbirth.. **Cryptorchidism** (undescended testicals) may also increase the risk for testicular cancer. **Hypospadias** is a birth defect where boys have an altered location of the opening of the urethra.**]**

2. *Overview of air pollution and endocrine disorders*

Darbre PD. Overview of air pollution and endocrine disorders. Int J Gen Med. 2018 May 23;11:191-207. doi: 10.2147/IJGM.S102230. PMID: 29872334; PMCID: PMC5973437.

Article Link: https://pubmed.ncbi.nlm.nih.gov/29872334/ - PDF

"Abstract: Over recent years, **many environmental pollutant chemicals have been shown to possess the ability to interfere in the functioning of the endocrine system and have been termed endocrine disrupting chemicals (EDCs).** These compounds exist in air as volatile or semi-volatile compounds in the gas phase or attached to particulate matter. They include components of plastics (**phthalates**, bisphenol A), components of consumer goods (parabens, triclosan, **alkylphenols, fragrance compounds**,… This review summarizes current knowledge concerning the sources of EDCs in air, measurements of levels of EDCs in air, and the potential for adverse effects of EDCs in air on human endocrine health."

"Whilst much has been written over the past two decades of the actions of EDCs from oral and dermal exposure, research is increasingly documenting their presence in air which opens a debate on the potential for adverse consequences from inhalation of EDCs."

"Since estrogens and androgens regulate reproductive functions, many of the reported effects of the exposure to EDCs have been on adverse consequences for **reproductive health**. However, physiological consequences have been demonstrated as resulting from disruption to **thyroid function** and alterations to **thyroid hormone levels**. More widely, adverse effects have also been reported as resulting from alterations to adrenocortical function, impairment of the immune system, and the loss of control on energy metabolism including development of **obesity, diabetes,** and **cardiovascular disease.**"

"**Prior** to and **just after birth** are especially **vulnerable times for exposure to EDCs** because disruption of hormonal activity in the developing embryo/fetus or young baby can have **consequences for health in adult life** most notably on **reproductive abilities, brain function, immunity, and metabolic programming**."

"**Man-made EDCs** are contained within many agricultural, industrial, and **consumer products,** which due to their widespread use, have become ubiquitous environmental pollutants. This includes components of pesticides and herbicides used both in an agricultural setting and in urban environments…. EDCs are also widely used in **personal care products** (PCPs) for purposes of preservation, deodorant, antiperspirant, conditioning, and **fragrance**."

"**EDCs** are contained in domestic pesticide sprays, **air fresheners**, **laundry detergents**, **household cleaners**, paints, adhesives, and plastics, all of which may be used routinely indoors…. As a result, **many EDCs are now measurable in indoor air and in indoor dust, often at higher levels than in outdoor air**…"

3. *Identification of combinations of endocrine disrupting chemicals in household chemical products that require mixture toxicity testing*

Lee I, Ji K. Identification of combinations of endocrine disrupting chemicals in household chemical products that require mixture toxicity testing. Ecotoxicol Environ Saf. 2022 Jul 15;240:113677. doi: 10.1016/j.ecoenv.2022.113677. Epub 2022 May 26. PMID: 35642859.

Article Link: https://pubmed.ncbi.nlm.nih.gov/35642859/ - PDF

“The present study listed the ingredients contained in 11064 household chemical products from a publicly available database, and identified **EDCs** related to **estrogenicity**, **androgenicity**, **thyroid hormone disruption**, and **changes in steroidogenesis**.”

“A total of 293 chemicals were related to **endocrine disruption**, and **nearly two-thirds of the products contained more than one of these chemicals**. Cleaning products, synthetic detergents, fabric softeners, air fresheners, and deodorants have several hotspots for **fragrances**, isothiazolinones, glycol ethers, and parabens. The **three most prevalent EDCs** in household chemical products were **added to act** as **fragrances** and preservatives.”

“The most frequently observed EDCs in the five product groups are hexyl cinnamaldehyde, geraniol, citronellol, 2-(4-tert-butylbenzyl)propionaldehyde (CAS no. 80-54-6)**, and benzyl benzoate** (CAS no. 120-51-4). **These EDCs** are commonly **used to add fragrance.”**

“The most frequently identified combinations were benzisothiazolinone and **butylated hydroxytoluene** (CAS no. 128-37-0) in cleaners, benzisothiazolinone and **hexyl cinnamaldehyde** in synthetic detergents, **2-(4-tert-butylbenzyl)propionaldehyde** and **citronellol** in fabric softeners, **benzyl benzoate** and **hexyl cinnamaldehyde** in air fresheners, and **geraniol** and **citral** (CAS no. 5392-40-5) in deodorants. The EDCs in these products were mostly included to act as **fragrances** and preservatives.”

“Consistent with the results of this study, Wieck et al. (2018) reported that 26 fragrances were named approximately 2000 times on the ingredient list of 1447 household detergents, and **fragrances** such as **limonene, linalool, hexyl cinnamaldehyde, 2-(4-tert-butylbenzyl)propionaldehyde,** and **citronellol** were frequently mentioned (Wieck et al., 2018, Yazar et al., 2011)....**Geraniol** appeared to have the potential to **interact with estrogen receptors** in estrogen-inducible yeast expressing the human estrogen receptor (Howes et al., 2002).... **Benzyl benzoate** and **2-(4-tert-butylbenzyl)propionaldehyde** added to **synthetic detergents, fabric softeners, and air fresheners** were **reported to induce estrogenic responses in MCF-7 human breast cancer cell line** (Charles and Darbre, 2009).

“This study confirmed that DEHP, DINP, and DBP were used in cleaners, synthetic detergents, coating agents, adhesives, **air fresheners**, and paints. **Exposure to DEHP or DBP at levels seen in human populations** has been **linked to male reproductive defects**, such as **poor semen quality** and **abnormal genital development** (Radke et al., 2018).”

4. Endocrine-Disrupting Chemicals & Reproductive Health

Zlatnik MG. Endocrine-Disrupting Chemicals and Reproductive Health. J Midwifery Womens Health. 2016 Jul;61(4):442-55. doi: 10.1111/jmwh.12500. Epub 2016 Jul 8. PMID: 27391253; PMCID: PMC6701840.

Article Link: https://pubmed.ncbi.nlm.nih.gov/27391253/ - PDF

“**Phthalates** are another class of chemicals that have been implicated as **endocrine disrupters**. **Phthalates** are used in multiple consumer applications, including **personal care products** such as **lotion** or **shampoo**, often as **“fragrance”**, and as plasticizers to change the physical characteristics of base plastics, including products made with polyvinyl chloride, such as flooring, shower curtains, packaging, and some medical equipment.”

"Human cohort and experimental animal studies have demonstrated possible **adverse effects on reproduction**, including associations with **poor semen quality** and **miscarriage.**"

"Prenatal phthalate exposure, as measured by phthalate metabolite levels in maternal urine, has been associated with **abnormal male genital development in the fetus**. In animal models, anogenital distance is a sensitive index of demasculinization of the male reproductive tract. Multiple epidemiologic studies, including prospective cohort studies, have shown a **shortened anogenital distance** (suggesting anti-androgenic influence) **in boys whose mothers had higher urinary phthalate levels during pregnancy**. Some cohort studies have shown an association with **smaller penile size** as well. These findings are reproducible in experimental studies with rodents."

"Prenatal phthalate exposure has also been associated with reduced "masculine play" in boys, as indicated in a follow-up study of a cohort of couples who had given blood and urine samples during pregnancy. At age 5, the boys' (n=74) play activities were assessed with a validated inventory of play styles (Pre-School Activities Inventory). **An association was seen between prenatal exposure to anti-androgenic phthalates and less male-typical play behavior in boys."**

"A recent systematic review of 11 human **studies suggests that higher levels of prenatal exposure to phthalate metabolites**, measured as urinary concentrations, are associated with **poorer cognitive and behavioral outcomes in children, especially boys**."
[Note: This article suggests you purchase fragrance free personal care products and avoid air fresheners and scented candles.**]**

5. Erectile Dysfunction in Men on the Rise: Is There a Link with Endocrine Disrupting Chemicals?

Cripps S, M, Mattiske D, M, Pask A, J: Erectile Dysfunction in Men on the Rise: Is There a Link with Endocrine Disrupting Chemicals? Sex Dev 2021;15:187-212. doi: 10.1159/000516600
Article Link: https://pubmed.ncbi.nlm.nih.gov/34134123/ - PDF

"**Erectile dysfunction (ED)** is one of the **most prevalent chronic conditions affecting me**n. ED can arise from **disruptions during development**, affecting the patterning of erectile tissues in the penis and/or **disruptions in adulthood** that impact sexual stimuli, neural pathways, molecular changes, and **endocrine signalling** that are required to drive erection."

"Androgen signalling is critical for erectile function through its role in **penis development** and in regulating the physiological processes driving erection in the adult. Interestingly,**estrogen signalling is also implicated in penis development** and potentially in processes which regulate erectile function during adulthood."

"Given that **endocrine signalling has a prominent role in erectile function**, it is **likely that exposure to endocrine disrupting chemicals (EDCs) is a risk factor for ED**, although this is an under-researched field. Thus, our review provides a detailed description of the underlying biology of erectile function with a focus on the role of endocrine signalling, exploring the **potential link between EDCs and ED based on animal and human studies**." © 2021 S. Karger AG, Basel

[Note: Endocrine Disrupting Chemicals (EDC's) are commonly used in perfumes and fragranced products as preservatives or fragrance. What are EDC's and how can they affect us?**]**

6. *Effects of Di(2-ethylhexyl) Phthalate (DEHP) on Female Fertility and Adipogenesis in C3H/N Mice*

Schmidt JS, Schaedlich K, Fiandanese N, Pocar P, Fischer B. Effects of di(2-ethylhexyl) phthalate (DEHP) on female fertility and adipogenesis in C3H/N mice. Environ Health Perspect. 2012 Aug;120(8):1123-9. doi: 10.1289/ehp.1104016. Epub 2012 May 15. PMID: 22588786; PMCID: PMC3440070.

Article Link: https://pubmed.ncbi.nlm.nih.gov/22588786/ - PDF

"Background**: Di(2-ethylhexyl) phthalate (DEHP)** and its metabolites are known to affect **lipid metabolism** and **adipogenesis**, mainly by activation of peroxisome proliferator-activated receptors (PPARs). Exposure to DEHP has been linked with **testicular impairment** and **male subfertility**. However, the effects of DEHP on female reproductive health and metabolism have not been studied in detail."

"Objective: We examined the effects of dietary DEHP exposure on **metabolism** and **fertility** in female mice."
"Results: In study I, DEHP-exposed F0 females (all dose groups) had a **significant increase in body weight**, food intake, and visceral adipose tissue compared with controls. In the 500-mg DEHP group, PPARα and PPARγ transcripts were **significantly changed in liver tissue**. In the same group, PPARγ mRNA was significantly reduced in liver but not in fat tissue. In addition, leptin and FABP4 (fatty acid binding protein 4) mRNA were increased in adipose tissue, whereas adiponectin was decreased. In study II, we detected a **100% abortion rate** in F0 dams in the 500-mg group. **F1 offspring exposed in utero and during lactation had an increase in visceral fat tissue and body weight**."

[Note: Phthalates are synthetic odorless plasticizers used as solvents, binders or fixatives in many fragrances. Why are phthalates in the news? Phthalates are considered Endocrine Disrupting Chemicals.
On the California Safe Cosmetics Program Product Database: DEP, DIDP, and DBP are reported as fragrance while DEHP and DBP are perfume solvents. IFRA lists DEP and DMP, as "reported fragrance ingredients".**]**

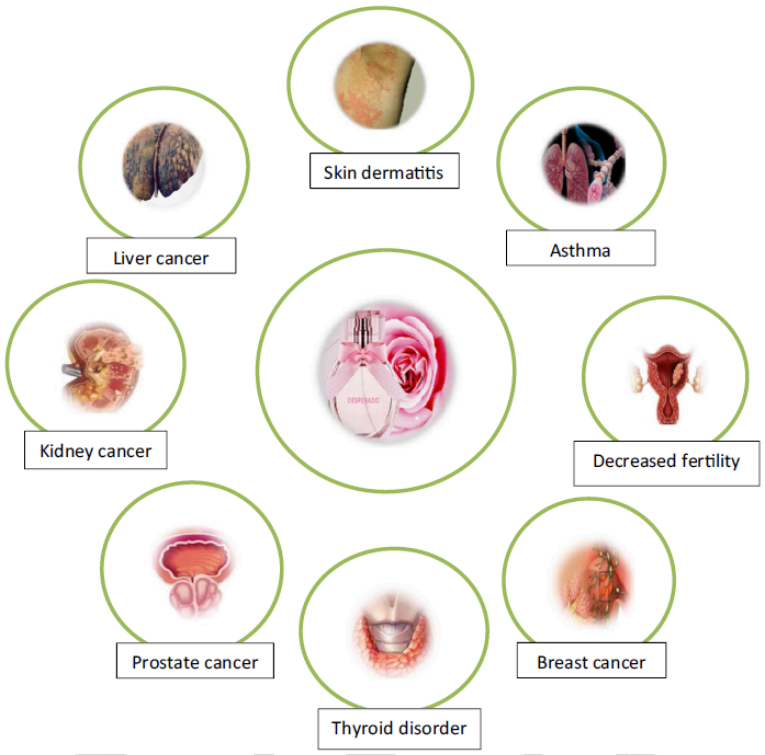
7. *Evaluation of pollutants in perfumes, colognes and health effects on the consumer: a systematic review*

Kazemi Z, Aboutaleb E, Shahsavani A, Kermani M, Kazemi Z. Evaluation of pollutants in perfumes, colognes and health effects on the consumer: a systematic review. J Environ Health Sci Eng. 2022 Feb 3;20(1):589-598. doi: 10.1007/s40201-021-00783-x. PMID: 35669814; PMCID: PMC9163252.

Article Link: https://pubmed.ncbi.nlm.nih.gov/35669814/ - PDF

(Note: Graphic is from preceding article**) (**Creative Commons Attribution 4.0 International license**).**
(Journal of Environmental Health Science and Engineering articles are published open access under a CC BY licence (Creative Commons Attribution 4.0 International licence). The CC BY licence is the most open licence available and considered the industry 'gold standard' for open access; it is also preferred by many funders. This licence allows readers to copy and redistribute the material in any medium or format, and to alter, transform, or build upon the material, including for commercial use, providing the original author is credited.**)** https://www.springer.com/journal/40201/how-to-publish-with-us#Fees%20and%20Funding

Fig. 2 Effects of exposure to perfumes and colognes



"Diethyl phthalate is a chemical used to **make perfumes last longer.** The U.S. Clean Water Act lists it as a **toxic** and priority pollutant."

"Complications of using perfume include **neuropathy (depression, autism), neoplasms (breast cancer, prostate cancer), effects on the liver, migraine headaches, asthma attacks, mucosal symptoms (watery or red eyes, sneezing), neurological problems (dizziness, convulsions, headache, fainting, imbalance), respiratory (cough, shortness of breath), skin (skin rash, urticaria, redness of the skin, skin tingling, dermatitis), immune system (swollen lymph nodes, fever, fatigue), gastrointestinal tract (nausea, bloating, diarrhea)** and **cardiovascular (rapid** or **irregular heartbeat, tremors, chest discomfort**)"

"**Contaminants in perfumes and colognes** and their health effects on the consumer were systematically reviewed. It was found that the most attention of researchers was to identify the compounds in perfumes and colognes and their concentrations. Among the most common pollutants **phthalates** and their derivatives can be mentioned. Other pollutants included **parabens, triclosan, salicylates, terpenes, aldehydes, benzene, toluene, styrene, and aluminum-based salts**. These pollutants have also been shown to have adverse effects on consumer health such as **asthma and allergies, cardiovascular disease, central nervous system damage, breast cancer, endocrine cancer, respiratory disorders, reproduction, thyroid, adrenal gland function and immune system."**

[Note: Graphic lists "effects of exposure to perfumes and colognes": Kidney Cancer, Liver Cancer, Prostate Cancer, Thyroid Disorder, Breast Cancer, Decreased Fertility, Asthma and Skin Dermatitis.**]**

8. *Head-space, small-chamber and in-vehicle tests for volatile organic compounds (VOCs) emitted from air fresheners for the Korean market*

Jo WK, Lee JH, Kim MK. Head-space, small-chamber and in-vehicle tests for volatile organic compounds (VOCs) emitted from air fresheners for the Korean market. Chemosphere. 2008 Feb;70(10):1827-34. doi: 10.1016/j.chemosphere.2007.08.021. Epub 2007 Sep 21. PMID: 17889253.
Article Link: https://pubmed.ncbi.nlm.nih.gov/17889253/

"Five toxic or hazardous analytes were found in the headspace phase of AFs (**toluene**, **benzene**, **ethyl benzene**, and **m,p-xylene**) at a frequency of more than 50%. **Limonene** and **linalool**, which are known to be unsaturated ozone-reactive VOCs, were detected at a frequency of 58 and 35%, respectively."
"Previous studies have implicated several consumer products as being sources of indoor air pollution (Habib et al., 2006; Singer et al., 2006; Su et al., 2007)...."

"AFs work by using a nerve-deadening chemical that interferes with the human sense of smell, coating the nasal passage with an oily film, masking an offending odor with a different odor, or by deactivating the odor (EHANS, 2004). Certain VOCs emitted from AFs such as **ethanol, benzaldehyde, α-terpineol,** and **benzyl acetate** showed toxic effects at dose levels between 9 and 14 mg/kg (Cooper et al., 1995), however, **AFs emit significant amounts of VOCs when applied indoors** (Salthammer, 1999; Zhu et al., 2001; Singer et al., 2006)."

"Synthetic, chemical-based AFs contain a number of chemicals including **carcinogens** and **sensitizers**, possible **reproductive toxins**, and **neurotoxins** (EHANS, 2004). Moreover, unsaturated organic constituents emitted from AFs produce **secondary toxic pollutants** via reactions with oxidants such as ozone, hydroxyl radicals, and nitrogen oxides (Weschler and Shields, 1999; Atkinson and Arey, 2003)."

[Note: Fragrance is considered the new 'second hand smoke', **"**The parallels between second-hand smoke and synthetic fragrance use are many. At its core, both are battles over indoor air quality **"** - quote and link from De Vader, Christy L. & Barker, Paxson.
Chemicals that cigarettes/cigarette smoke and fragranced products can have in common are: Acetone, Formaldehyde, Benzene, acetaldehyde, terpenoids and phenols.**]**

[Note: Toluene (often a nail polish thinner) is used as a solvent or fragrance in perfume and bath products on the CSPC Product Database. Toluene is on the IFRA list and on the EPA's Priority Pollutant List.**]**
[Note: Benzene is a reported fragrance ingredient in the CSCP Product Database.**]**
[Note: Xylene "occurs naturally in petroleum and coal tar, and is major component of gasoline and fuel oil". Xylene is used as a musk fragrance. Xylene is on IFRA.**]**

[Note: Limonene is a common skin sensitizer and known allergen in fragrance and fragranced products. Limonene (natural or synthetic) is a terpene. Terpenes can create formaldehyde and particulate matter in air as secondary pollutants. Limonene is on the IFRA list as a fragrance ingredient.**]**
[Note: Linalool is a common ingredient in fragranced products.. Linalool is a sensitizer after it is exposed to air and can cause contact allergies.**]**
[Note: Ethyl benzene is listed for purchase as a perfuming agent.**]**

9. *Companion animals get close to the toxic aspects of antropogenic world: cytotoxicity of phthalates and bisphenol A on dog testicular primary cells*

Tekin K, Arslan P, Cil B, Filazi A, Akçay E, Yurdakok-Dikmen B. Companion animals get close to the toxic aspects of antropogenic world: cytotoxicity of phthalates and bisphenol A on dog testicular primary cells. Cytotechnology. 2020 Oct;72(5):629-638. doi: 10.1007/s10616-020-00401-y. Epub 2020 May 20. PMID: 32435861; PMCID: PMC7547924

Article Link: https://pubmed.ncbi.nlm.nih.gov/32435861/ - PDF

"This study aimed to reveal and compare the cytotoxic effects of selected phthalates… According to cytotoxicity results, **DEHP was found to be the most toxic phthalate**… Further studies should focus on morphological, physiological and molecular differences to comprehend the mechanisms involved as well as decreasing the risk for impaired **spermatogenesis** caused by environmental toxicants in companion animal medicine"

"• Human and dog share similar environment where pollutants such as plasticizers lead reproductive disorders in both species.
• DEHP was the most toxic on primary testicular cell culture of dog.
• Comparative evaluation of endocrine disrupters on male reproductive system would allow us to understand the protective mechanisms involved."

"**Phthalates** and Bisphenol A (BPA) are the most common synthetic chemicals, widely used in automotive, **personal care consumer product and medical industries**. Phthalates, also called plasticizers, are a group of chemical substances used to soften plastics. Some phthalates have shown detrimental effects on the endocrine and reproductive system…"

"Environmental concentrations of DEHP and DBP have been linked with **decreased sperm motility** both in vivo and in vitro in humans as well."

[Note: Phthalates are synthetic odorless plasticizers used as solvents, binders or fixatives in many fragrances. Why are phthalates in the news? Phthalates are considered Endocrine Disrupting Chemicals.
On the California Safe Cosmetics Program Product Database: DEP, DIDP, and DBP are reported as fragrance while DEHP and DBP are perfume solvents. IFRA lists DEP and DMP, as "reported fragrance ingredients".**]**

10. *Spermatotoxicity in Animal Models Exposed to Fragrance Components*

Akunna GG, Saalu LG, Ogunlade B. Enye LA., (2014). Spermatotoxicity in Animal Models Exposed to Fragrance Components. Journal of Medical Sciences, 14: 46-50.
Article Link: https://scialert.net/fulltext/?doi=jms.2014.46.50 - PDF

"Various commonly-used products have been reported to contain chemicals that could **disrupt estrogen and testosterone hormone**. …The results obtained from this study showed a significant ($p<0.005$) decrease in body weight and absolute testicular weight of the rat models exposed to fragrance when compared to the control groups. It was also observed that the concentration, mobility, livability and morphology of spermatozoa from groups C, D, E and F were significantly lower ($p>0.005$) when compared to values of the control group A and B. Based on the spermiographic evaluation from this study, fragrance materials could have an adverse effect on spermatozoa of the intact male wistar rats."

"**It has been reported that through inhalation, ingestion and absorption, fragrance infiltrates the body and moves directly to the blood stream.** … Symptoms ranging from **severe mucosal discharge, sinus problems, tremor, asthmatic attack, sneezing, migraine headache, convulsions, hyperactivity, nausea, sore throat, cough, chest tightness to shortness of breath** after fragrance exposure have been vastly documented (Guin and Berry, 1980; De Groot, 1987; Schleuter et al., 1978)."

“Unswerving connection between memory and smell has been established (Rachel and Engen, 1996). This knowledge has resulted in **placement of fragrance in the category of psychoactive drugs and highlighted the ability of fragrance to cross the brain barrier thereby resulting in potential damage to brain tissue** (Andrea, 1997). **Linalool**, the most abundant fragrance substance has been indicated to cause **lethargy**, **depression** and **severe respiratory difficulties after exposure**.”

“Synthetic musk fragrance ingredients which are widely highly distributed in many consumer products have been examined in human blood, milk and fatty tissue. They represent a new group of human contaminants which are **comparable with that of certain pesticides.** Despite several reports on the toxic effect of **fragrance,** there is a dearth of literature ascertaining its **effects on male fertility and testicular development** (Thompson and Wansker, 1981).”

11. *Developmental Exposure to Endocrine Disrupting Chemicals and Its Impact on Cardio-Metabolic-Renal Health*

Singh RD, Koshta K, Tiwari R, Khan H, Sharma V, Srivastava V. Developmental Exposure to Endocrine Disrupting Chemicals and Its Impact on Cardio-Metabolic-Renal Health. Front Toxicol. 2021 Jul 5;3:663372. doi: 10.3389/ftox.2021.663372. PMID: 35295127; PMCID: PMC8915840.

Article Link: https://pubmed.ncbi.nlm.nih.gov/35295127/ - Free Full Text

“**Endocrine disrupting chemicals** (EDCs) include **phenols**, **phthalates**, parabens, flame retardants, heavy metals, pesticides, perfluorinated chemicals, UV filter components, triclosan, and organochlorines.”

“**Cumulative exposure to mixtures of EDCs can lead to adverse effects on the health of the exposed individuals** (Crews et al., 2003). Multiple studies, including the studies of the National Health and Nutrition Examination Survey (NHANES), have shown that **about 75–97% of US and Asian adults have detectable levels of phthalates and phenols [bisphenol A (BPA) and polyfluoroalkyl chemicals] in their urine** (Silva et al., 2004; Calafat et al., 2007, 2008; Vandenberg et al., 2010; Zhang et al., 2011; Husøy et al., 2019).”

“Epidemiological and experimental studies have also linked **adult exposure to EDCs** with **abnormal male and female reproductive health**, **diabetes**, **obesity**, **cardiovascular** and **metabolic disorders**, **thyroid function**, and **hormone sensitive cancers** (Howard and Lee, 2012; Bodin et al., 2015; Heindel et al., 2015, 2017).”

“Children are also vulnerable to EDCs (Calafat et al., 2017; Hendryx and Luo, 2018), **making EDC exposure a major health concern for all age groups**.”

“**Chronic kidney disease** is a growing health problem among children and adults. The incidence and the prevalence of chronic kidney disease (CKD) **among children have been steadily increasing since the 1980s**…. A number of traditional risk factors associated with CKD in children include hypertension, obesity, diabetes, and aberrant divalent mineral metabolism…. There is growing evidence that **links exposure to EDCs with early progression to end-stage renal disease** (ESRD) (Kataria et al., 2015)....”

“Early-life exposure to EDCs was associated with elevated levels of kidney toxicity markers such as albumin-to-creatinine ratio (ACR), estimated glomerular filtration rate (eGFR), and urinary protein-to-creatinine ratio (UPCR) in some human population studies (Li et al., 2012; Trasande et al., 2013a, 2014; Malits et al., 2018).”

[Note: Phthalates are synthetic odorless plasticizers used as solvents, binders or fixatives in many fragrances. Why are phthalates in the news? Phthalates are considered Endocrine Disrupting Chemicals.
On the California Safe Cosmetics Program Product Database: DEP, DIDP, and DBP are reported as fragrance while DEHP and DBP are perfume solvents. IFRA lists DEP and DMP, as "reported fragrance ingredients".**]**

[Note: Endocrine Disrupting Chemicals (EDC's) are commonly used in perfumes and fragranced products as preservatives or fragrance. What are EDC's and how can they affect us?**]**

12. *Endocrine disruptor chemicals as obesogen and diabetogen: Clinical and mechanistic evidence*

Kurşunoğlu NE, Sarer Yurekli BP. Endocrine disruptor chemicals as obesogen and diabetogen: Clinical and mechanistic evidence. World J Clin Cases. 2022 Nov 6;10(31):11226-11239. doi: 10.12998/wjcc.v10.i31.11226. PMID: 36387809; PMCID: PMC9649566.
Article Link: https://pubmed.ncbi.nlm.nih.gov/36387809/

"Besides the **obesogenic effect**, **EDCs** can cause **type 2 diabetes mellitus** through alteration in ß cell function and morphology and **insulin resistance**."

Medical devices, including parenteral feeding tubes, **personal care products** such as nail polish and **perfume,** food packaging, and toys contain various **phthalates**[49]. Unfortunately, phthalates are poorly bio-degradable and highly bioaccumulative in the food chain[50].

"High phthalate exposure has been linked with increased threat of obesity and **infertility**, **increased body mass index** (BMI) and **waist circumference**, **insulin resistance**, and a **change in thyroid hormones**[49,52]".

"In this context, **perinatal exposure** can be important as far as the permanent and transgenerational effects are concerned. **EDCs promote adipogenesis leading to fat accumulation**, which causes **alteration in lipid metabolism and satiety as obesogens**. EDCs have shown the potential to induce adipose tissue dysfunction not only in white adipocytes but in brown and beige fat as well."

[Note: Endocrine Disrupting Chemicals (EDC's) are commonly used in perfumes and fragranced products as preservatives or fragrance. What are EDC's and how can they affect us?**]**

[Note: Phthalates are synthetic odorless plasticizers used as solvents, binders or fixatives in many fragrances. Why are phthalates in the news? Phthalates are considered Endocrine Disrupting Chemicals.
On the California Safe Cosmetics Program Product Database: DEP, DIDP, and DBP are reported as fragrance while DEHP and DBP are perfume solvents. IFRA lists DEP and DMP, as "reported fragrance ingredients".**]**

13. *Household air pollution and its effects on health*

Apte K, Salvi S. Household air pollution and its effects on health. F1000Res. 2016 Oct 28;5:F1000 Faculty Rev-2593. doi: 10.12688/f1000research.7552.1. PMID: 27853506; PMCID: PMC508913
Article Link: https://pubmed.ncbi.nlm.nih.gov/27853506/ - PDF

“Cigarette smoke contains 7,357 different chemical compounds such as **benzene**, CO, PAHs, heterocyclic amines, cyanide, **formaldehyde**, **terpenoids**, **phenols**, nicotine, and heavy metals.”

“Various studies have reported that toxic levels of air pollutants are emitted when these **fragrances** are burnt. … Among the Chinese, 76.9% currently burn incense at home every day and over 90% of the population has been using these for over 20 years. **Burning of these fragrances emits high levels of** PAHs**, benzene,** nitrous oxide, and CO**.** … Household air pollution begins to affect a human even during **fetal** life. **Increased household air pollution increases oxidative stress,** which has been implicated in **decreased fertility** or, in some cases, even **infertility**. Increased oxidative stress leads to **decreased sperm motility** and **poor zygote quality**. It also plays an important role in **increasing insulin resistance**, which is associated with **polycystic ovarian disease**, a major cause of infertility.”

“...a study of 10 **newborn infants** in New York by the Environmental Work Group revealed that these infants, born to mothers exposed to pollutants, had as many as **232 pollutants circulating in the cord blood collected at birth….**Similarly, another study reported that increased exposure to polycyclic aromatic hydrocarbons and heavy metals (especially lead and mercury) in the second trimester of pregnancy resulted in decreased length of the baby at birth…. They also have lower heights, which do not recover later in life…. The effect of perinatal exposure to PAHs has also been studied, revealing compromised lung function in otherwise-healthy children… Household air pollutants are also implicated in cognitive and judgmental skills ….”

14. *Environmental factors in the development of autism spectrum disorders*

Sealey LA, Hughes BW, Sriskanda AN, Guest JR, Gibson AD, Johnson-Williams L, Pace DG, Bagasra O. Environmental factors in the development of autism spectrum disorders. Environ Int. 2016 Mar;88:288-298. doi: 10.1016/j.envint.2015.12.021. Epub 2016 Jan 28. PMID: 26826339.

Article Link: https://pubmed.ncbi.nlm.nih.gov/26826339/ - PDF

“Many modern companies do not disclose the industrial secrets in many of their fragrances that are, in reality, a complex concoction of synthetic chemicals and natural essences, which often have been found to be petrochemicals.”

“Among those are chemicals, such as **musk ketone** and **diethyl phthalate**, which are responsible for **allergic reactions and hormone disruption**…. Although these **chemicals have been found to accumulate in human tissues,** they have not yet been adequately analyzed for safety in products used by unsuspecting humans. **As a result of a giant loophole in the Federal Fair Packaging and Labeling Act of 1973**, which explicitly exempts fragrance producers from having to disclose cosmetic ingredients on product labels, fragrance concealment is not illegal and is often used by the industry to hide from the public the full list of ingredients, even substances that can cause grave health problems (Environmental Working Group (EWG), 2005). It is a common practice for businesses to list the chemicals as simply “fragrance,” which may mean that **the majority of the ingredients are never revealed to buyers**.”

“Even worse, people who use cologne, fragrances, body spray, and other scented cosmetics are blindly exposed to dangerous chemicals since the Food and Drug Administration lacks authority to control mandates to manufacturers that require testing of all fragrances for safety, before being released to the public.”

"Also, during pregnancy, the use of fragrances and other cosmetics may actually expose the developing fetus to **diethyl phthalate (DEP)**, a common fragrance solvent that can cause **abnormal development of reproductive organs in infant males**, **Attention Deficit Disorder** in children, and **sperm damage in adults**."

"The role of environmental factors like **fragrances**, glyphosate **and other synthetic chemicals derived from petrochemicals containing carcinogenic, mutagenic, hormones disturbing and neuromodifying capabilities** in the molecular and cellular pathogeneses of ASD has not been evaluated. This is partly due to the 1973 FDA decision to exempt fragrances and cosmetics from appropriate testing, which is generally required for any consumer item that enters the human body and is metabolized by human metabolic pathways."

15. *Phthalates*, bisphenols, parabens*, and triclocarban in feminine hygiene products from the United States and their implications for human exposure*

Gao CJ, Kannan K. Phthalates, bisphenols, parabens, and triclocarban in feminine hygiene products from the United States and their implications for human exposure. Environ Int. 2020 Mar;136:105465. doi: 10.1016/j.envint.2020.105465. Epub 2020 Jan 13. PMID: 31945693

Article Link: https://pubmed.ncbi.nlm.nih.gov/31945693/ - PDF

"The estimated exposure doses of **phthalates**, parabens, and bisphenols through the dermal absorption pathway from the use of pads, panty liners, and tampons were significant."

"Elevated exposure to phthalates has been associated with **precocious puberty, endometriosis, female genital tumors,** and **ovulation disorders.** …**high concentrations phthalates have been measured in sanitary pads.**"

"In addition, pads, panty liners, and tampons are made from polypropylene (PP) and polyethylene (PE) materials, which can contain plasticizers such as phthalates, to increase the products' flexibility. Dimethyl phthalate* (DMP), **diethyl phthalate* (DEP), dibutyl phthalate* (DBP)**, **di-iso-butyl phthalate (DIBP),** di(2-ethylhexyl) **phthalate* (DEHP),** methyl paraben (MeP), and ethyl paraben (EtP) were found in all pad, panty liner, and tampon samples."

[Note: Phthalates are synthetic odorless plasticizers used as solvents, binders or fixatives in many fragrances. Why are phthalates in the news? Phthalates are considered Endocrine Disrupting Chemicals.
On the California Safe Cosmetics Program Product Database: DEP, DIDP, and DBP are reported as fragrance while DEHP and DBP are perfume solvents. IFRA lists DEP and DMP, as "reported fragrance ingredients".**]**

16. *Sanitary pads and diapers contain higher phthalate contents than those in common commercial plastic products*

Park CJ, Barakat R, Ulanov A, Li Z, Lin PC, Chiu K, Zhou S, Perez P, Lee J, Flaws J, Ko CJ. Sanitary pads and diapers contain higher phthalate contents than those in common commercial plastic products. Reprod Toxicol. 2019 Mar;84:114-121. doi: 10.1016/j.reprotox.2019.01.005. Epub 2019 Jan 16. PMID: 30659930; PMCID: PMC6504186.

Article Link: https://pubmed.ncbi.nlm.nih.gov/30659930/

"Exposure to phthalates is known to affect the development and functions of the cardiovascular, reproductive and endocrine systems."

"This study found that most of sanitary pads or diapers surveyed contained both **VOCs** and **phthalates**."

[Note: Phthalates are synthetic odorless plasticizers used as solvents, binders or fixatives in many fragrances. Why are phthalates in the news? Phthalates are considered Endocrine Disrupting Chemicals.
On the California Safe Cosmetics Program Product Database: DEP, DIDP, and DBP are reported as fragrance while DEHP and DBP are perfume solvents. IFRA lists DEP and DMP, as "reported fragrance ingredients".**]**

[Note: Toluene (often a nail polish thinner) is used as a solvent or fragrance in perfume and bath products on the CSPC Product Database. Toluene is on the IFRA list and on the EPA's Priority Pollutant List.**]**

17. *Volatile organic compounds in feminine hygiene products sold in the US market: A survey of products and health risks*

Lin N, Ding N, Meza-Wilson E, Manuradha Devasurendra A, Godwin C, Kyun Park S, Batterman S. Volatile organic compounds in feminine hygiene products sold in the US market: A survey of products and health risks. Environ Int. 2020 Nov;144:105740. doi: 10.1016/j.envint.2020.105740. Epub 2020 Aug 28. PMID: 32866732; PMCID: PMC7958867.
Article Link: https://pubmed.ncbi.nlm.nih.gov/32866732/ - PDF

"**VOCs** are components of FHPs (feminine hygiene products) that **are added as fragrances**, adsorbents, moisture barriers, adhesives, and binders…Most of the larger non-target peaks were identified as **fragrances, such as linalool, eucalyptol and benzyl acetate**. Feminine hygiene products (FHPs) are used on highly permeable and sensitive vaginal and vulvar tissues by many women. These products contain a variety of chemicals, and few regulations require disclosure of their ingredients…."

"Products labeled as "organic," "natural," or "for sensitive skin" did not necessarily have lower VOC concentrations**….menstrual pads had hazard ratios** of up to 11, **sprays and powders** had hazard ratios of up to 2.2 and excess cancer risks of up to 2.1 × 10−6, and **washes** had **excess cancer risks** of up to 3.3 × 10−6. Our data suggest that **all tested FHPs contained some toxic VOCs**..."

"Exposure to high concentrations or long-term exposure of VOCs has been associated with many known or suspected effects including **irritation to eyes, skin and nose**; **damage to the respiratory system, liver and kidney; reproductive effect**s; and **carcinogenicity**"

"Examples of notable VOCs include **benzene**, a known carcinogen (US EPA, 1998), 1,4-dioxane, a likely carcinogen (US EPA, 2013), and naphthalene, a possible carcinogen due to possible genetic toxicity (Schreiner, 2003; US EPA, 1999). Health risks (carcinogenic or non-carcinogenic) related to the use of FHPs over the lifecourse remain unanswered."

18. *Occurrence and Distribution of Phthalates in Sanitary Napkins from Six Countries: Implications for Women's Health*

Tang Z, Chai M, Cheng J, Wang Y, Huang Q. Occurrence and Distribution of Phthalates in Sanitary Napkins from Six Countries: Implications for Women's Health. Environ Sci Technol. 2019 Dec 3;53(23):13919-13928. doi: 10.1021/acs.est.9b03838. Epub 2019 Nov 18. PMID: 31694371.
Article Link: https://pubmed.ncbi.nlm.nih.gov/31694371/

“Chemicals in feminine hygiene products can exert adverse health effects as a result of strong absorptive capacity of the vagina and vulva. We measured the concentrations of 15 phthalates in sanitary napkins collected from six countries and found total concentrations in the range of 1733-11942 ng/g. Di(isobutyl)phthalate (DiBP), bis(2-ethylhexyl)phthalate (DEHP), and di-*n*-butyl phthalate (DnBP) were the dominant congeners, representing a median of 27.3, 26.7, and 20.4% of the total median phthalate concentrations across all countries, respectively…. The estimated intake (at the 90th percentile) of DiBP, DnBP, and DEHP from sanitary napkins approximately represented 6.35-23.6, 3.35-9.90, and 1.06-9.57%, respectively, of the total exposure, indicating that sanitary napkins are a relevant source of exposure to these chemicals.”

“Phthalates are widely used in the production of plastics and other polymers to improve their flexibility and versatility.1,2 Phthalates are also used extensively as industrial solvents and in personal care products and cosmetics, surfactants, detergents, and textiles….Most phthalates are used as additives that are not chemically bound to the product matrix and therefore can easily migrate and enter the human body. Exposure to phthalates can exert serious adverse effects on human health, including **estrogenic effects that impair the endocrine system**…. In addition, some phthalates can cause various **reproductive and developmental conditions**…. Hauser et al. found that urinary concentrations of bis(2-ethylhexyl)- phthalate (DEHP) metabolites in women undergoing in vitro fertilization were inversely associated with oocyte yield and clinical pregnancy. Some epidemiologic studies have reported associations between prenatal exposure to phthalates and adverse outcomes at birth, such as congenital diseases and developmental delays…. Lien et al. reported that **prenatal exposure to some phthalates can increase aggressive behavior problems** in 8-year-old children.”

“**Phthalates readily accumulate in biological tissues** owing to their higher lipophilicity,4 and dietary intake has been estimated as the main route of human exposure…. Increasing evidence shows that **dermal contact from the use of cosmetics and personal care products is another relevant route of exposure to phthalates.** Sanitary napkins are used to absorb menstrual blood, and their constituents may be contaminated with phthalates. In addition, some chemical additives, likely consisting of, containing, or contaminated with phthalates, are typically used in the manufacturing process of sanitary napkins…. Sanitary napkins come into direct contact with the vulva, and the **mucous membranes in the vagina and vulva can rapidly absorb chemicals without metabolizing them**…. Serum estradiol levels following the vaginal application of estradiol have been shown to be 10-fold higher than levels following oral dosing,... indicating possible health risks from this exposure route”

[Note: Phthalates are synthetic odorless plasticizers used as solvents, binders or fixatives in many fragrances. Why are phthalates in the news? Phthalates are considered Endocrine Disrupting Chemicals.
On the California Safe Cosmetics Program Product Database: DEP, DIDP, and DBP are reported as fragrance while DEHP and DBP are perfume solvents. IFRA lists DEP and DMP, as “reported fragrance ingredients”.**]**

19. *Feminine Hygiene Products-A Neglected Source of Phthalate Exposure in Women*

Gao CJ, Wang F, Shen HM, Kannan K, Guo Y. Feminine Hygiene Products-A Neglected Source of Phthalate Exposure in Women. Environ Sci Technol. 2020 Jan 21;54(2):930-937. doi: 10.1021/acs.est.9b03927. Epub 2020 Jan 9. PMID: 31859481.
Article Link: https://pubmed.ncbi.nlm.nih.gov/31859481/

“**Phthalates have been associated with reproductive toxicity and precocious puberty in females,** but the occurrence of these toxicants in feminine hygiene products is rarely reported. In this study, eight phthalates were determined in 120 feminine hygiene products (56 feminine care products and 64 sanitary napkins)

collected from China. **Phthalates** were **found** in **86% and 98% of feminine care products and sanitary napkins,** respectively, with the total concentrations varying between not detectable and 813 µg/g (median: 0.26 µg/g) and 0.25 and 8.76 µg/g (1.43 µg/g), respectively. **Diethyl phthalate**, dibutyl phthalate, and bis(2-ethylhexyl)phthalate were the major compounds, accounting for >60% of the total concentrations."

[Note: Phthalates are synthetic odorless plasticizers used as solvents, binders or fixatives in many fragrances. Why are phthalates in the news? Phthalates are considered Endocrine Disrupting Chemicals.
On the California Safe Cosmetics Program Product Database: DEP, DIDP, and DBP are reported as fragrance while DEHP and DBP are perfume solvents. IFRA lists DEP and DMP, as "reported fragrance ingredients".**]**

20. *Long-Term Outcomes after Phthalate Exposure: Food Intake, Weight Gain, Fat Storage, and Fertility in Mice*

Holtcamp W. Long-term outcomes after phthalate exposure: food intake, weight gain, fat storage, and fertility in mice. Environ Health Perspect. 2012 Aug;120(8):a320. doi: 10.1289/ehp.120-a320a. PMID: 22854284; PMCID: PMC3440097.
Article Link: https://pubmed.ncbi.nlm.nih.gov/22854284/ - PDF

"Exposure to **endocrine-disrupting chemicals (EDCs)**, particularly **in utero**, is suspected to contribute to **obesity**, **diabetes**, **hypertension**, and **reproductive abnormalities**. Di(2-ethylhexyl) phthalate **(DEHP)**, a plasticizer found in **cosmetics**, **fragrances,** food packaging, and polyvinyl chloride, is one such EDC. Human studies have found associations between urinary metabolites of DEHP and other phthalates and **increased body mass** in humans, and maternal exposure to DEHP has been associated with **impaired gonadal development and fertility** in baby boys."

[Note: Endocrine Disrupting Chemicals (EDC's) are commonly used in perfumes and fragranced products as preservatives or fragrance. What are EDC's and how can they affect us?**]**

21. *Health risks of chemicals in consumer products: A review*

Li D, Suh S. Health risks of chemicals in consumer products: A review. Environ Int. 2019 Feb;123:580-587. doi: 10.1016/j.envint.2018.12.033. Epub 2019 Jan 7. PMID: 30622082.
Article Link: https://pubmed.ncbi.nlm.nih.gov/30622082/ - Full Text

"It should also be noted that some chemicals have multiple functional uses, while we chose the most dominant functional use for each chemical. An example is the grouping of **phthalates**. Despite categorized as plasticizer together in this review, several phthalates such as **diethyl phthalate and dimethyl phthalate are used as solvents in personal care products and cosmetics as carriers of fragrance** (Schettler, 2006)."

"…we found that the volume of the peer-reviewed literature that addresses human health risks of the chemicals in consumer products did grow over the last two decades, while its growth could by no means match the speed of increasing volume and diversity of the chemicals produced and used in consumer products by the society. This **growing gap between increasing reliance on chemicals in consumer products and our knowledge on their human health risks raises a potential public health concern**, given the pervasive nature of today's mass production and consumption practice."

22. *Volatile organic compounds in feminine hygiene products sold in the US market: A survey of products and health risks*

Lin N, Ding N, Meza-Wilson E, Manuradha Devasurendra A, Godwin C, Kyun Park S, Batterman S. Volatile organic compounds in feminine hygiene products sold in the US market: A survey of products and health risks. Environ Int. 2020 Nov;144:105740. doi: 10.1016/j.envint.2020.105740. Epub 2020 Aug 28. PMID: 32866732; PMCID: PMC7958867.

Article Link: https://pubmed.ncbi.nlm.nih.gov/32866732/ - PDF

"**VOCs** are components of FHPs (feminine hygiene products) that **are added as fragrances**, adsorbents, moisture barriers, adhesives, and binders…Most of the larger non-target peaks were identified as **fragrances, such as linalool, eucalyptol and benzyl acetate**. Feminine hygiene products (FHPs) are used on highly permeable and sensitive vaginal and vulvar tissues by many women. These products contain a variety of chemicals, and few regulations require disclosure of their ingredients…."

"Products labeled as "organic," "natural," or "for sensitive skin" did not necessarily have lower VOC concentrations.**…menstrual pads had hazard ratios** of up to 11, **sprays and powders** had hazard ratios of up to 2.2 and excess cancer risks of up to 2.1 × 10−6, and **washes** had **excess cancer risks** of up to 3.3 × 10−6. Our data suggest that **all tested FHPs contained some toxic VOCs**..."

"Exposure to high concentrations or long-term exposure of VOCs has been associated with many known or suspected effects including **irritation to eyes, skin and nose**; **damage to the respiratory system, liver and kidney; reproductive effects**; and **carcinogenicity**"

"Examples of notable VOCs include **benzene**, a known carcinogen (US EPA, 1998), 1,4-dioxane, a likely carcinogen (US EPA, 2013), and naphthalene, a possible carcinogen due to possible genetic toxicity (Schreiner, 2003; US EPA, 1999). Health risks (carcinogenic or non-carcinogenic) related to the use of FHPs over the lifecourse remain unanswered."

23. *Sanitary pads and diapers contain higher phthalate contents than those in common commercial plastic products*

Park CJ, Barakat R, Ulanov A, Li Z, Lin PC, Chiu K, Zhou S, Perez P, Lee J, Flaws J, Ko CJ. Sanitary pads and diapers contain higher phthalate contents than those in common commercial plastic products. Reprod Toxicol. 2019 Mar;84:114-121. doi: 10.1016/j.reprotox.2019.01.005. Epub 2019 Jan 16. PMID: 30659930; PMCID: PMC6504186.

Article Link: https://pubmed.ncbi.nlm.nih.gov/30659930/

"VOCs increase the risk for neurocognitive impairment, asthma, congenital disability, and cancer. Notably, exposure to methylene chloride, **toluene**, and **xylene** are known to **negatively affect the development and function of reproductive system**."

"…sanitary pads in direct contact with the skin around the external genitalia were likely causing **menstrual irregularities.** The skin of this area tends to be thinner and more absorbent than those…such as the hands."
"Exposure to phthalates is known to **affect the development and functions of the cardiovascular, reproductive and endocrine systems**."

"...daily absorption of **toluene** from sanitary pad reached to the maximum of 38.4% RfD. **Given the fact that women are exposed to various chemicals through various routes, consideration should be given to the risks of chemicals that are additionally absorbed from the sanitary pad."**

[Note: Phthalates are synthetic odorless plasticizers used as solvents, binders or fixatives in many fragrances. Why are phthalates in the news? Phthalates are considered Endocrine Disrupting Chemicals.
On the California Safe Cosmetics Program Product Database: DEP, DIDP, and DBP are reported as fragrance while DEHP and DBP are perfume solvents. IFRA lists DEP and DMP, as "reported fragrance ingredients".**]**

[Note: Toluene (often a nail polish thinner) is used as a solvent or fragrance in perfume and bath products on the CSPC Product Database. Toluene is on the IFRA list and on the EPA's Priority Pollutant List.**]**

24. *Occurrence and Distribution of Phthalates in Sanitary Napkins from Six Countries: Implications for Women's Health*

Tang Z, Chai M, Cheng J, Wang Y, Huang Q. Occurrence and Distribution of Phthalates in Sanitary Napkins from Six Countries: Implications for Women's Health. Environ Sci Technol. 2019 Dec 3;53(23):13919-13928. doi: 10.1021/acs.est.9b03838. Epub 2019 Nov 18. PMID: 31694371.
Article Link: https://pubmed.ncbi.nlm.nih.gov/31694371/

"Chemicals in feminine hygiene products **can exert adverse health effects as a result of strong absorptive capacity of the vagina and vulva**. We measured the concentrations of 15 phthalates in sanitary napkins collected from six countries and found total concentrations in the range of 1733-11942 ng/g. **Di(isobutyl)phthalate (DiBP)**, **bis(2-ethylhexyl)phthalate (DEHP)**, and di-*n*-butyl phthalate (DnBP) were the dominant congeners, representing a median of 27.3, 26.7, and 20.4% of the total median phthalate concentrations across all countries, respectively…. The estimated intake (at the 90th percentile) of **DiBP,** DnBP, and **DEHP** from sanitary napkins approximately represented 6.35-23.6, 3.35-9.90, and 1.06-9.57%, respectively, of the total exposure, indicating that sanitary napkins are a relevant source of exposure to these chemicals."

"Most phthalates are used as additives that are not chemically bound to the product matrix and therefore can easily migrate and enter the human body. Exposure to phthalates can exert serious adverse effects on human health, including **estrogenic effects that impair the endocrine system**…. In addition, some phthalates can cause various **reproductive and developmental conditions**…."

"Hauser et al. found that urinary concentrations of **bis(2-ethylhexyl)- phthalate (DEHP)** metabolites in women undergoing in vitro fertilization were **inversely associated with oocyte yield and clinical pregnancy**. Some epidemiologic studies have reported associations between **prenatal exposure to phthalates** and adverse outcomes at birth, such as **congenital diseases** and **developmental delays**…. Lien et al. reported that **prenatal exposure to some phthalates can increase aggressive behavior problems** in 8-year-old children."

"**Phthalates readily accumulate in biological tissues** owing to their higher lipophilicity… Increasing evidence shows that **dermal contact from the use of cosmetics and personal care products is another relevant route of exposure to phthalates.** Sanitary napkins are used to absorb menstrual blood, and their constituents may be contaminated with phthalates. … Sanitary napkins come into direct contact with the vulva, and the **mucous membranes in the vagina and vulva can rapidly absorb chemicals without metabolizing them**…. Serum estradiol levels following the vaginal application of estradiol have been shown to be 10-fold higher than levels following oral dosing,... indicating possible health risks from this exposure route"

[Note: Phthalates are synthetic odorless plasticizers used as solvents, binders or fixatives in many fragrances. Why are phthalates in the news? Phthalates are considered Endocrine Disrupting Chemicals.
On the California Safe Cosmetics Program Product Database: DEP, DIDP, and DBP are reported as fragrance while DEHP and DBP are perfume solvents. IFRA lists DEP and DMP, as "reported fragrance ingredients".**]**

25. *Exposure to Dibutyl Phthalate and Reproductive-Related Outcomes in Animal Models: Evidence From Rodents Study*

Wang J, Zhang X, Li Y, Liu Y, Tao L. Exposure to Dibutyl Phthalate and Reproductive-Related Outcomes in Animal Models: Evidence From Rodents Study. Front Physiol. 2021 Dec 8;12:684532. doi: 10.3389/fphys.2021.684532. PMID: 34955869; PMCID: PMC8692859.
Article Link: https://pubmed.ncbi.nlm.nih.gov/34955869/ - PDF

"**Dibutyl phthalate (DBP)** was an endocrine disruptor, which may lead to cancer and affects reproductive function when accumulated in the body…The results of this paper showed that **DBP had a significant negative effect on the weight of testis, epididymis, and seminal vesicles.** Second, it was mainly found that it **harmed** the sperm parameters: **sperm motility**, **sperm morphology**, and **sperm count**. In addition, lower than the safe dose of DBP still showed negative effects on reproductive system outcomes."

[Note: Endocrine Disrupting Chemicals (EDC's) are commonly used in perfumes and fragranced products as preservatives or fragrance. What are EDC's and how can they affect us?**]**

[Note: Phthalates are synthetic odorless plasticizers used as solvents, binders or fixatives in many fragrances. Why are phthalates in the news? Phthalates are considered Endocrine Disrupting Chemicals.
On the California Safe Cosmetics Program Product Database: DEP, DIDP, and DBP are reported as fragrance while DEHP and DBP are perfume solvents. IFRA lists DEP and DMP, as "reported fragrance ingredients".**]**

26. *Comparative toxicological evaluation of phthalate diesters and metabolites in Sprague-Dawley male rats for risk assessment*

Kwack SJ, Kim KB, Kim HS, Lee BM. Comparative toxicological evaluation of phthalate diesters and metabolites in Sprague-Dawley male rats for risk assessment. J Toxicol Environ Health A. 2009;72(21-22):1446-54. doi: 10.1080/15287390903212923. PMID: 20077217.
Article Link: https://pubmed.ncbi.nlm.nih.gov/20077217/

"**Liver weights were significantly increased** in groups treated with DEHP, DBP, BBP, DIDP, DINP, MEHP, and MBuP compared to the control. **Testes weights were significantly reduced** only in DEHP, DBP, and MEHP-treated groups compared to the control. Significant **decreases in red blood cell** (RBC) and hematocrit (Ht) levels were observed in DEHP-treated rats, whereas **significant increases in mean corpuscular hemoglobin (MCH), mean corpuscular hemoglobin concentration (MCHC), and platelet (PLT) levels** were found in the DEHP-treated group. Hemoglobin (Hb) level was reduced only in the DMP group. Similar to effects on testis and epididymal weights, DEHP and MEHP significantly **reduced sperm numbers and motility**."

[Note: Phthalates are synthetic odorless plasticizers used as solvents, binders or fixatives in many fragrances. Why are phthalates in the news? Phthalates are considered Endocrine Disrupting Chemicals.
On the California Safe Cosmetics Program Product Database: DEP, DIDP, and DBP are reported as fragrance while DEHP and DBP are perfume solvents. IFRA lists DEP and DMP, as "reported fragrance ingredients".**]**

27. *Companion animals get close to the toxic aspects of antropogenic world: cytotoxicity of phthalates and bisphenol A on dog testicular primary cells*

Tekin K, Arslan P, Cil B, Filazi A, Akçay E, Yurdakok-Dikmen B. Companion animals get close to the toxic aspects of antropogenic world: cytotoxicity of phthalates and bisphenol A on dog testicular primary cells. Cytotechnology. 2020 Oct;72(5):629-638. doi: 10.1007/s10616-020-00401-y. Epub 2020 May 20. PMID: 32435861; PMCID: PMC7547924

Article Link: https://pubmed.ncbi.nlm.nih.gov/32435861/ - PDF

"This study aimed to reveal and compare the cytotoxic effects of selected phthalates… According to cytotoxicity results, **DEHP was found to be the most toxic phthalate**… Further studies should focus on morphological, physiological and molecular differences to comprehend the mechanisms involved as well as decreasing the risk for impaired **spermatogenesis** caused by environmental toxicants in companion animal medicine"

"• Human and dog share similar environment where pollutants such as plasticizers lead reproductive disorders in both species.
• DEHP was the most toxic on primary testicular cell culture of dog.
• Comparative evaluation of endocrine disrupters on male reproductive system would allow us to understand the protective mechanisms involved."

"Phthalates and Bisphenol A (BPA) are the most common synthetic chemicals, widely used in automotive, **personal care consumer product and medical industries**. Phthalates, also called plasticizers, are a group of chemical substances used to soften plastics. Some phthalates have shown detrimental effects on the endocrine and reproductive system…"

"Environmental concentrations of **DEHP and DBP have been linked with decreased sperm motility both in vivo and in vitro in humans as well**."

[Note: Phthalates are synthetic odorless plasticizers used as solvents, binders or fixatives in many fragrances. Why are phthalates in the news? Phthalates are considered Endocrine Disrupting Chemicals.
On the California Safe Cosmetics Program Product Database: DEP, DIDP, and DBP are reported as fragrance while DEHP and DBP are perfume solvents. IFRA lists DEP and DMP, as "reported fragrance ingredients".**]**

28. ALSO SEE SECTIONS: Prenatal, Airborne Contact Dermatitis, Inflammation

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Website: https://www.fragrancefreecoalitionusa.com/

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INFLAMMATION

Inflammatory Th2 Response, Facial Swelling, Swollen Lymph Nodes, Muscle or Joint Pain, Increased Proinflammatory Cytokines Levels and NF-kB activity in the Lung, Persistent Inflammation, Skin Inflammation

1. *A pilot study of total personal exposure to volatile organic compounds among Hispanic female domestic cleaners*

Oyer-Peterson K, Gimeno Ruiz de Porras D, Han I, Delclos GL, Brooks EG, Afshar M, Whitworth KW. A pilot study of total personal exposure to volatile organic compounds among Hispanic female domestic cleaners. J Occup Environ Hyg. 2022 Jan;19(1):1-11. doi: 10.1080/15459624.2021.2000615. Epub 2022 Jan 28. PMID: 34731075; PMCID: PMC8813894.
Article Link: https://pubmed.ncbi.nlm.nih.gov/34731075/ - PDF

"Cleaners have an elevated risk for the development or exacerbation of **asthma** and other **respiratory** conditions, possibly due to exposure to cleaning products containing **volatile organic compounds (VOCs)** leading to **inflammation** and **oxidative stress**. …29% and 20% reported suffering from **skin irritation** and **trouble breathing**…"

"...the highest exposures experienced by the women were from **d-limonene** (mean = 22.5 ppb; median = 4.3 ppb), followed by **toluene** (mean = 1.5 ppb; median = 1.1 ppb), **α-pinene** (mean = 0.8 ppb; median = 0.7 ppb) and **β-pinene** (mean = 0.7 ppb; median = 0.6 ppb)..."

"Additionally, while they are exposed to myriad **VOCs**, these women were particularly exposed to **terpene compounds**, which are often **found in scented cleaning products.**"

2. *Need of the hour: to raise awareness on vicious fragrances and synthetic musks*

Patel, S., Homaei, A. & Sharifian, S. Need of the hour: to raise awareness on vicious fragrances and synthetic musks. Environ Dev Sustain 23, 4764–4781 (2021). https://doi.org/10.1007/s10668-020-00829-4
Article Link: https://link.springer.com/article/10.1007/s10668-020-00829-4

"The exposure to the **synthetic fragrances and musks**, which are produced in quantities of thousands of tons per year, has been shown to **elicit several pathologies**."

"The **fragrance compounds** are regarded as **toxins by the human immune system**, and to eliminate them, cytochrome enzymes, especially aromatases, are overexpressed. These enzymes also **convert androgens into estrogens,** but **excess estrogen production affects the endocrine system** in both males and females."

"It is increasingly being evident that all diseases have common roots, i.e., **inflammation**."

"**The unprecedented prevalence of diabetes, obesity, cancer, and depression, among others pathologies, is tied to the limitless usage of fragrance compounds."**

3. *Airborne contact dermatitis: common causes in the USA*

Schloemer JA, Zirwas MJ, Burkhart CG. Airborne contact dermatitis: common causes in the USA. Int J Dermatol. 2015 Mar;54(3):271-4. doi: 10.1111/ijd.12692. Epub 2014 Jul 1. PMID: 24981079.
Article Link: https://pubmed.ncbi.nlm.nih.gov/24981079/ PDF

"**Airborne contact dermatitis (ABCD)** is an **inflammatory reaction** caused by exposure to particles suspended in air…. Airborne contact dermatitis can be classified as either allergic or irritant contact dermatitis, depending on its etiology and the mechanism of inflammation…. Many **allergens** and **chemicals** have been documented as causative agents of ABCD."

"Many other agents responsible for causing ABCD have been reported in the literature…. Others include ammonia, anhydrous calcium sulfate, cleaning products, and **formaldehyde**."

"Of note, the incidence of ABCD caused by chemicals of the isothiazolinone family, including **methylisothiazolinone** and **methylchloroisothiazolinone**, is on the rise as these chemicals are used increasingly as preservatives in many household products. Additionally, **dermatitis** resulting from methylisothiazolinone and related compounds may be allergic in nature, as evidenced by positive patch testing.

"Occupational hazards such as exposure to irritating chemicals and repetitive friction or abrasions to the surface of the skin can also pose a potential gateway for ABCD."

[Note: Limonene is a common skin sensitizer and known allergen in fragrance and fragranced products. Limonene (natural or synthetic) is a terpene. Terpenes can create formaldehyde and particulate matter in air as secondary pollutants. Limonene is on the IFRA list as a fragrance ingredient.**]**
[Note: Methylchloroisothiazolinone and Methylisothiazolinone (MCI-MI) are preservatives and known allergens used in air fresheners and personal care products.**]**

4. *Emission characteristics of VOCs emitted from consumer and commercial products and their ozone formation potential*

Dinh TV, Kim SY, Son YS, Choi IY, Park SR, Sunwoo Y, Kim JC. Emission characteristics of VOCs emitted from consumer and commercial products and their ozone formation potential. Environ Sci Pollut Res Int. 2015 Jun;22(12):9345-55. doi: 10.1007/s11356-015-4092-8. Epub 2015 Jan 21. PMID: 25601614.
Article Link: https://pubmed.ncbi.nlm.nih.gov/25601614/

"The characteristics of volatile organic compounds (VOCs) emitted from several consumer and commercial products (body wash, dishwashing detergent, **air freshener**, windshield washer fluid, lubricant, hair spray, and insecticide) were studied and compared."

"In the spray products, 21.6–96.4 % of the VOCs were propane, iso-butane, and n-butane, which are the components of liquefied petroleum gas. **Monoterpene** ($C_{10}H_{16}$) was the dominant component of the VOCs in the non-spray products (e.g., body wash, 53–88 %)."

"Besides comprising **hazardous VOCs**, VOCs from consumer products were also **ozone precursors**."
"The TVOCs from spray products (insecticide, **hair spray**, and lubricant) were higher than those from the liquid products such as the windshield washer fluid, dishwashing detergent, **body wash**, and **air freshener**."

“Limonene and 1-propanol were the components of one dishwashing detergent. In contrast, another dishwashing detergent comprised **1,3-dioxane**, **ethanol**, **ethyl acetate**, **limonene**, **β-myrcene**, 3-pentanol, and **α-pinene** (Kwon et al. 2007, 2008).”

“**Benzene, n-hexane**, and **ethylbenzene** were observed in the **body washes** and the **air fresheners.** Benzene was classified as Group A of the US EPA lists of **known human carcinogen** (WHO 2010). The unit cancer risk of 1 μg/m3 of benzene is 2.2–7.8 in a million (WHO 2010). The unit risk of **leukemia** per 1 μg/m3 air concentration is 6 in a million. Therefore, **long-term exposure to a considerable amount of benzene in those products might cause health risk,** which should be investigated in future researchers. A **longterm exposure of n-hexane may damage the nervous system**. Exposure to 650 ppm **n-hexane** for 2–4 months causes numbness of the arms and legs (Pohanish 2012).”

“**Ethylbenzene** irritates the eyes, skin, and respiratory tract. A **long-term exposure of ethylbenzene may cause kidney and liver disease**….”

“**Toluene and styrene were detected in body washes, dishwashing detergents**, and windshield washer fluids. It was reported that inhalation of 200–500 ppm **toluene may cause headache, nausea, and loss of appetite** (Pohanish 2012).

Styrene is considered as a possible carcinogenic to humans. Inhalation of above 100 ppm **styrene may cause headache, inflammation of the lung, kidney and liver damage, and death** (Pohanish 2012). Since body washes are used popularly and frequently, longterm exposure to the above compounds may cause health damage.”

[Note: Fragrance is considered the new ‘second hand smoke’, **“**The parallels between second-hand smoke and synthetic fragrance use are many. At its core, both are battles over indoor air quality **“** - quote and link from De Vader, Christy L. & Barker, Paxson.
Chemicals that cigarettes/cigarette smoke and fragranced products can have in common are: Acetone, Formaldehyde, Benzene, acetaldehyde, terpenoids and phenols.**]**

[Note: Limonene is a common skin sensitizer and known allergen in fragrance and fragranced products. Limonene (natural or synthetic) is a terpene. Terpenes can create formaldehyde and particulate matter in air as secondary pollutants. Limonene is on the IFRA list as a fragrance ingredient.**]**
[Note: Benzene is a reported fragrance ingredient in the CSCP Product Database.**]**
[Note: N-Hexane is used to extract fragrances and was on the IFRA list until 2015.**]**
[Note: Toluene (often a nail polish thinner) is used as a solvent or fragrance in perfume and bath products on the CSPC Product Database. Toluene is on the IFRA list and on the EPA’s Priority Pollutant List.**]**
[Note: Styrene is “primarily a synthetic chemical**”** used in fragrance. It is on the CSPC list as ‘parfum/fragrance’ and also on the IFRA list.**]**
[Note: Ethyl benzene is listed for purchase as a perfuming agent.**]**

5. *Airborne contact dermatitis - current perspectives in etiopathogenesis and management*

Handa S, De D, Mahajan R. Airborne contact dermatitis - current perspectives in etiopathogenesis and management. Indian J Dermatol. 2011 Nov;56(6):700-6. doi: 10.4103/0019-5154.91832. PMID: 22345774; PMCID: PMC3276900.

Article Link: https://pubmed.ncbi.nlm.nih.gov/22345774/ - Full Text

“Airborne contact dermatitis (ABCD) is a morphological diagnosis that encompasses **all acute or chronic dermatoses** predominantly of exposed parts of body, which are caused by substances which when released into the air, settle on the exposed skin.”
“In airborne allergic dermatitis, initially there is a refractory phase where there is a periodic or continuous contact with allergen but no response. This is followed by an induction phase where the hapten penetrates skin, conjugates with epidermal protein, comes in contact with antigen presenting cells, migrates to draining lymph nodes followed by stimulation of naive T cells. This leads to proliferation of activated T cells to produce effector and memory cells which then enter the circulation. Re-exposure to the specific hapten leads to the release of mediators producing **skin inflammation**. A persistent **inflammation** is produced due to continued presence of effector cells.”

“The common allergens … include various acids and alkalis, metals and powders of metallic salts, cement, industrial solvents, glass fibers, sewage sludge, ammonia, vegetable and wood allergens, plastics, rubbers and glues, insecticides, **pesticides**, animal feed additives and many others. The airborne contactants can also be classified on the basis of their physical state as **volatile airborne contactants** like acids, alkalis, ammonia and pesticides; droplets like insecticides, **perfumes** and **hair sprays**; powders which include aluminum, anhydrous calcium silicate, and metallic oxides; and particles like tree sawing particles, wool and plastics.”

“Dooms-Goossens classified airborne dermatitis into five different types, namely, airborne irritant contact dermatitis, airborne allergic contact dermatitis, airborne phototoxic reactions, airborne photoallergic reactions and airborne contact urticaria.[33] Rare presentations include **acne like**, **lichenoid eruptions**, fixed drug eruptions, **exfoliative dermatitis**, **telengiectases**, **paresthesias**, **purpura**, e**rythema multiforme** like eruption, pellagra like dermatitis and **lymphomatoid CD**. Some agents cause more than one type of reaction. P. hysterophorus can produce allergic CD, photocontact dermatitis and a lichenoid eruption. Similarly, **formaldehyde** and phosphorus sesquisulfide can lead to an **airborne irritant** or **allergic CD** and **contact urticaria**.”

“In the classical airborne allergic contact dermatitis, there is involvement of exposed areas of face, “V” of neck, hands and forearms, “Wilkinson's triangle,” both eyelids, nasolabial folds and under the chin. The involvement of both light-exposed and protected areas helps to differentiate ABCD from a photo-related dermatitis. Another close differential is atopic eczema as both ABCD and atopic eczema have predominant flexural and skin crease involvement. Initially, there is an acute flare of the dermatitis during the plant growing season but, with repeated exposure, the flare becomes prolonged and produces a chronic lichenified eczema associated with secondary infection, fissuring and **hypo or hyperpigmentation**.... Some patients present with **facial swelling** before manifesting classical eczematous lesions.“

6. *Physical and psychological stress along with candle fumes induced - cardiopulmonary injury mimicking restaurant kitchen workers*

Chandrasekaran VRM, Periasamy S, Chien SP, Tseng CH, Tsai PJ, Liu MY. Physical and psychological stress along with candle fumes induced-cardiopulmonary injury mimicking restaurant kitchen workers. Curr Res Toxicol. 2021 Jul 12;2:246-253. doi: 10.1016/j.crtox.2021.07.001. PMID: 34345867; PMCID: PMC8320639.
Article Link: https://pubmed.ncbi.nlm.nih.gov/34345867/ - PDF

“Social disruption stress (SDR) mice were exposed to scented candle fumes (4.5 h/d, 5 d/wk) in an exposure chamber for 8 weeks. Exposure to **burning scented candles failed to reduce serum corticosterone level and increased proinflammatory cytokines levels and NF-kB activity in the lung**. In the present study, we evaluated the role of SDR in combination with exposure to scented candles as generally accepted to reduce stress. However, the **combined SDR and scented candle exposure were found to escalate the stress level.** This stress escalation might be due to the **cardiopulmonary inflammatory response** of the stress and candle fumes, which could be directly related to restaurant workers.”

7. *Prevalence and predictors of occupational asthma among workers in detergent and cleaning products industry and its impact on quality of life in El Asher Men Ramadan, Egypt*

Ahmed AS, Ibrahim DA, Hassan TH, Abd-El-Azem WG. Prevalence and predictors of occupational asthma among workers in detergent and cleaning products industry and its impact on quality of life in El Asher Men Ramadan, Egypt. Environ Sci Pollut Res Int. 2022 May;29(23):33901-33908. doi: 10.1007/s11356-022-18558-8. Epub 2022 Jan 15. PMID: 35034305; PMCID: PMC8761047.

Article Link: https://pubmed.ncbi.nlm.nih.gov/35034305/ - PDF

“Cleaning products are mixtures of many chemical ingredients that are known to contain sensitizers, disinfectants, and **fragrances**, as well as **strong airway irritants** which associated with **lower respiratory tract** and **asthma symptoms**.”

“Workers in detergent and cleaning products industry are vulnerable group for developing occupational asthma and other **respiratory problems** as they are exposed to a wide range of irritants and sensitizers in the chemical substances used, besides common indoor allergens and pollutants (Quirce & Barranco, 2010).”

“**When the airway epithelium is damaged as a result of repeated irritating exposure, the inflammatory Th2 response is triggered** (Tarlo & Lemiere, 2014).”

8. *Evaluation of pollutants in perfumes, colognes and health effects on the consumer: a systematic review*

Kazemi Z, Aboutaleb E, Shahsavani A, Kermani M, Kazemi Z. Evaluation of pollutants in perfumes, colognes and health effects on the consumer: a systematic review. J Environ Health Sci Eng. 2022 Feb 3;20(1):589-598. doi: 10.1007/s40201-021-00783-x. PMID: 35669814; PMCID: PMC9163252.

Article Link: https://pubmed.ncbi.nlm.nih.gov/35669814/ - PDF

(Note: Graphic is from preceding article**) (**Creative Commons Attribution 4.0 International license**).**

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Fig. 2 Effects of exposure to perfumes and colognes

"Diethyl phthalate is a chemical used to **make perfumes last longer.** The U.S. Clean Water Act lists it as a **toxic** and priority pollutant."

"Complications of using perfume include **neuropathy (depression, autism), neoplasms (breast cancer, prostate cancer), effects on the liver, migraine headaches, asthma attacks, mucosal symptoms (watery or red eyes, sneezing), neurological problems (dizziness, convulsions, headache, fainting, imbalance), respiratory (cough, shortness of breath), skin (skin rash, urticaria, redness of the skin, skin tingling, dermatitis), immune system (swollen lymph nodes, fever, fatigue), gastrointestinal tract (nausea, bloating, diarrhea)** and c**ardiovascular (rapid** or **irregular heartbeat, tremors, chest discomfort**)"

"**Contaminants in perfumes and colognes** and their health effects on the consumer were systematically reviewed. It was found that the most attention of researchers was to identify the compounds in perfumes and colognes and their concentrations. Among the most common pollutants **phthalates** and their derivatives can be mentioned. Other pollutants included **parabens, triclosan, salicylates, terpenes, aldehydes, benzene, toluene, styrene, and aluminum-based salts**. These pollutants have also been shown to have adverse effects on consumer health such as **asthma and allergies, cardiovascular disease, central nervous system damage, breast cancer, endocrine cancer, respiratory disorders, reproduction, thyroid, adrenal gland function and immune system."**

[Note: Graphic lists "effects of exposure to perfumes and colognes": Kidney Cancer, Liver Cancer, Prostate Cancer, Thyroid Disorder, Breast Cancer, Decreased Fertility, Asthma and Skin Dermatitis.**]**

9. *Health risks of chemicals in consumer products: A review*

Li D, Suh S. Health risks of chemicals in consumer products: A review. Environ Int. 2019 Feb;123:580-587. doi: 10.1016/j.envint.2018.12.033. Epub 2019 Jan 7. PMID: 30622082.

Article Link: https://pubmed.ncbi.nlm.nih.gov/30622082/ - Full Text

"It should also be noted that some chemicals have multiple functional uses, while we chose the most dominant functional use for each chemical. An example is the grouping of **phthalates**. Despite categorized as plasticizer together in this review, several phthalates such as **diethyl phthalate and dimethyl phthalate are used as solvents in personal care products and cosmetics as carriers of fragrance** (Schettler, 2006)."

"…we found that the volume of the peer-reviewed literature that addresses human health risks of the chemicals in consumer products did grow over the last two decades, while its growth could by no means match the speed of increasing volume and diversity of the chemicals produced and used in consumer products by the society. This **growing gap between increasing reliance on chemicals in consumer products and our knowledge on their human health risks raises a potential public health concern**, given the pervasive nature of today's mass production and consumption practice."

10. *Toxic Chemicals Emitted from Air fresheners & Disinfectants*

Geetha Balasubramani, Paul Pradeep, J Nisitha S. Toxic Chemicals Emitted from Air fresheners & Disinfectants. IJRASET. Volume 10 Issue X Oct 2022, Pgs 1338-1345. ISSN : 2321-9653 IJRASET47180

Article Link:

https://www.ijraset.com/research-paper/toxic-chemicals-emitted-from-air-fresheners-and-disinfectants - PDF

(Note: This graphic is from preceding article**)**

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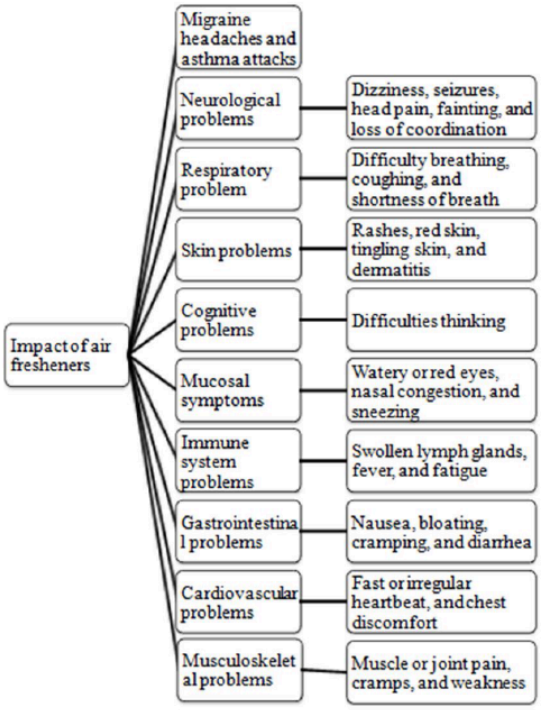

Figure 2: The diagram above illustrates the classification of illnesses brought on by exposure to air fresheners.

11. ALSO SEE SECTIONS: Migraine(s) / Headache(s), Respiratory/Pulmonary (Nose & Lungs)

Back to top of Inflammation **Back to Table of Contents**

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KIDNEY DISEASE

Kidney Damage, Kidney Cancer, Bladder Cancer

1. *Adverse Impact of Environmental Chemicals on Developmental Origins of Kidney Disease and Hypertension*

Hsu CN, Tain YL. Adverse Impact of Environmental Chemicals on Developmental Origins of Kidney Disease and Hypertension. Front Endocrinol (Lausanne). 2021 Oct 14;12:745716. doi: 10.3389/fendo.2021.745716. PMID: 34721300; PMCID: PMC8551449.
Article Link: https://pubmed.ncbi.nlm.nih.gov/34721300/ - PDF

"Here, we focus on environmental chemicals that pregnant mothers are likely to be exposed, including dioxins, bisphenol A (BPA), **phthalates**, per- and polyfluoroalkyl substances (PFAS), polycyclic aromatic hydrocarbons (PAH), heavy metals, and **air pollution**."

(note: Graphic is from preceding article**)**

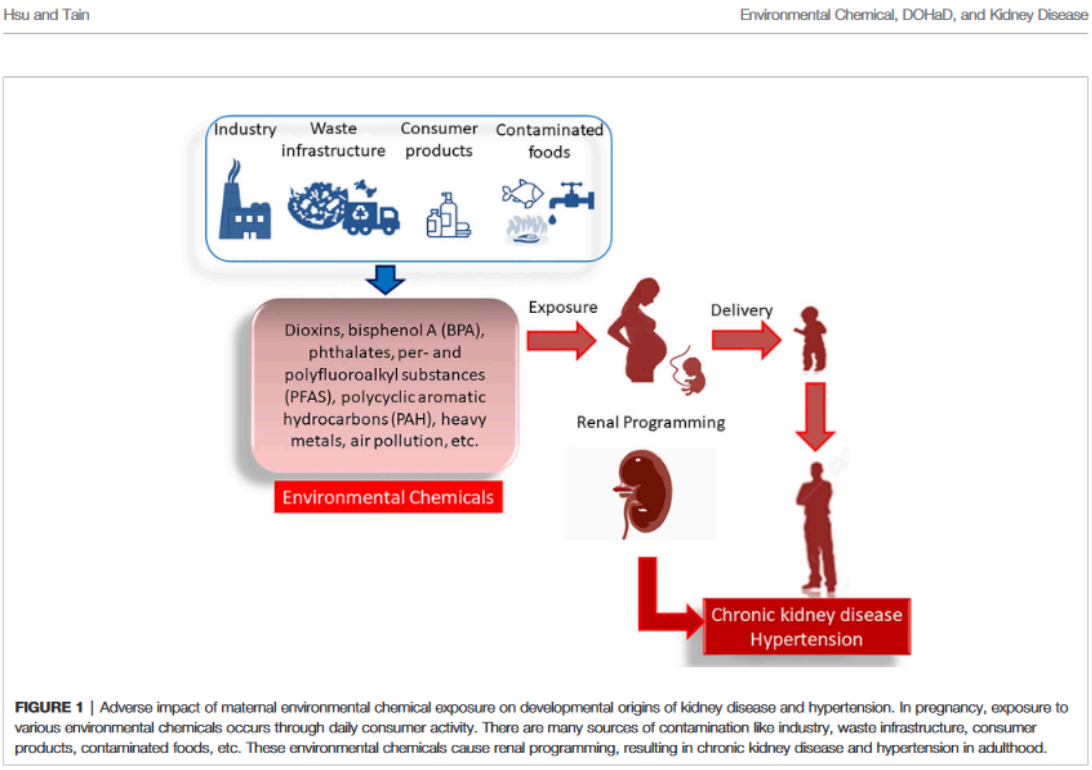

FIGURE 1 | Adverse impact of maternal environmental chemical exposure on developmental origins of kidney disease and hypertension. In pregnancy, exposure to various environmental chemicals occurs through daily consumer activity. There are many sources of contamination like industry, waste infrastructure, consumer products, contaminated foods, etc. These environmental chemicals cause renal programming, resulting in chronic kidney disease and hypertension in adulthood.

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"In pregnancy, exposure to various environmental chemicals occurs through daily consumer activity. There are many sources of contamination like industry, waste infrastructure, **consumer products**, contaminated foods, etc. These **environmental chemicals cause renal programming**, resulting in **chronic kidney disease and hypertension** in adulthood."

“Phthalates can be delivered to the human body through diet, **inhalation, and skin contact**. Di-2-ethylhexylphthalate (**DEHP**) and di-n-butyl phthalate (DBP) are the primary phthalate ester pollutants in the environment. The metabolites of phthalates can **cross the placenta and be transferred to the fetus**. Epidemiological studies demonstrated that high urinary DEHP levels are **associated with high BP, low eGFR and albuminuria.** As phthalates have estrogenic or antiandrogenic properties, emerging evidence suggests the associations between prenatal phthalate exposure and adverse offspring outcomes. Following these findings, steps should be taken to explore the effect of phthalate exposure during pregnancy on offspring kidneys.”

[Note: Phthalates are synthetic odorless plasticizers used as solvents, binders or fixatives in many fragrances. Why are phthalates in the news? Phthalates are considered Endocrine Disrupting Chemicals.
On the California Safe Cosmetics Program Product Database: DEP, DIDP, and DBP are reported as fragrance while DEHP and DBP are perfume solvents. IFRA lists DEP and DMP, as “reported fragrance ingredients”.**]**

2. *Emission characteristics of VOCs emitted from consumer and commercial products and their ozone formation potential*

Dinh TV, Kim SY, Son YS, Choi IY, Park SR, Sunwoo Y, Kim JC. Emission characteristics of VOCs emitted from consumer and commercial products and their ozone formation potential. Environ Sci Pollut Res Int. 2015 Jun;22(12):9345-55. doi: 10.1007/s11356-015-4092-8. Epub 2015 Jan 21. PMID: 25601614.
Article Link: https://pubmed.ncbi.nlm.nih.gov/25601614/

“The characteristics of volatile organic compounds (VOCs) emitted from several consumer and commercial products (body wash, dishwashing detergent, **air freshener**, windshield washer fluid, lubricant, hair spray, and insecticide) were studied and compared.”

“In the spray products, 21.6–96.4 % of the VOCs were propane, iso-butane, and n-butane, which are the components of liquefied petroleum gas. **Monoterpene** (C10H16) was the dominant component of the VOCs in the non-spray products (e.g., body wash, 53–88 %).”

“Besides comprising **hazardous VOCs**, VOCs from consumer products were also **ozone precursors**.”
“The TVOCs from spray products (insecticide, **hair spray**, and lubricant) were higher than those from the liquid products such as the windshield washer fluid, dishwashing detergent, **body wash**, and **air freshener**.”

“Limonene and 1-propanol were the components of one dishwashing detergent. In contrast, another dishwashing detergent comprised **1,3-dioxane**, **ethanol**, **ethyl acetate**, **limonene**, **β-myrcene**, 3-pentanol, and **α-pinene** (Kwon et al. 2007, 2008).”

“**Benzene, n-hexane**, and **ethylbenzene** were observed in the **body washes** and the **air fresheners.** Benzene was classified as Group A of the US EPA lists of **known human carcinogen** (WHO 2010). The unit cancer risk of 1 μg/m3 of benzene is 2.2–7.8 in a million (WHO 2010). The unit risk of **leukemia** per 1 μg/m3 air concentration is 6 in a million. Therefore, **long-term exposure to a considerable amount of benzene in those products might cause health risk,** which should be investigated in future researchers.”

“A **longterm exposure of n-hexane may damage the nervous system**. Exposure to 650 ppm **n-hexane** for 2–4 months causes numbness of the arms and legs (Pohanish 2012).”

“Ethylbenzene irritates the eyes, skin, and respiratory tract. A **long-term exposure of ethylbenzene may cause kidney and liver disease**….”

“**Toluene and styrene were detected in body washes, dishwashing detergents**, and windshield washer fluids. It was reported that inhalation of 200–500 ppm **toluene may cause headache, nausea, and loss of appetite** (Pohanish 2012).

Styrene is considered as a possible carcinogenic to humans. Inhalation of above 100 ppm styrene may cause **headache, inflammation of the lung, kidney and liver damage, and death** (Pohanish 2012). Since body washes are used popularly and frequently, longterm exposure to the above compounds may cause health damage.”

[Note: Fragrance is considered the new ‘second hand smoke’, **“**The parallels between second-hand smoke and synthetic fragrance use are many. At its core, both are battles over indoor air quality **“** - quote and link from De Vader, Christy L. & Barker, Paxson.
Chemicals that cigarettes/cigarette smoke and fragranced products can have in common are: Acetone, Formaldehyde, Benzene, acetaldehyde, terpenoids and phenols.**]**

[Note: Limonene is a common skin sensitizer and known allergen in fragrance and fragranced products. Limonene (natural or synthetic) is a terpene. Terpenes can create formaldehyde and particulate matter in air as secondary pollutants. Limonene is on the IFRA list as a fragrance ingredient.**]**
[Note: Benzene is a reported fragrance ingredient in the CSCP Product Database.**]**
[Note: N-Hexane is used to extract fragrances and was on the IFRA list until 2015.**]**
[Note: Toluene (often a nail polish thinner) is used as a solvent or fragrance in perfume and bath products on the CSPC Product Database. Toluene is on the IFRA list and on the EPA’s Priority Pollutant List.**]**
[Note: Styrene is “primarily a synthetic chemical**”** used in fragrance. It is on the CSPC list as ‘parfum/fragrance’ and also on the IFRA list.**]**
[Note: Ethyl benzene is listed for purchase as a perfuming agent.**]**

3. *Scented Candles as an Unrecognized Factor that Increases the Risk of Bladder Cancer; Is There Enough Evidence to Raise a Red Flag?*

Adamowicz J, Juszczak K, Poletajew S, Van Breda SV, Pokrywczynska M, Drewa T. Scented Candles as an Unrecognized Factor that Increases the Risk of Bladder Cancer; Is There Enough Evidence to Raise a Red Flag? Cancer Prev Res (Phila). 2019 Oct;12(10):645-652. doi: 10.1158/1940-6207.CAPR-19-0093. Epub 2019 Aug 9. PMID: 31399420.
Article: https://pubmed.ncbi.nlm.nih.gov/31399420/ - PDF

“Manufacturers of scented products, including candles or plug-in air freshener are not required to disclose all ingredients in the United States and European Union.”
“**Scented** candles are a heterogenic group of products which are the source of indoor pollution. In this situation, public awareness of the potential relationship between substances emitted by scented candles and **bladder cancer** is an essential step for better prevention.”
(Note: When scents/fragrances inside of a house aren’t solely coming from candles, how much is ‘too much’?)

4. *Evaluation of pollutants in perfumes, colognes and health effects on the consumer: a systematic review*

Kazemi Z, Aboutaleb E, Shahsavani A, Kermani M, Kazemi Z. Evaluation of pollutants in perfumes, colognes and health effects on the consumer: a systematic review. J Environ Health Sci Eng. 2022 Feb 3;20(1):589-598. doi: 10.1007/s40201-021-00783-x. PMID: 35669814; PMCID: PMC9163252.

Article Link: https://pubmed.ncbi.nlm.nih.gov/35669814/ - PDF

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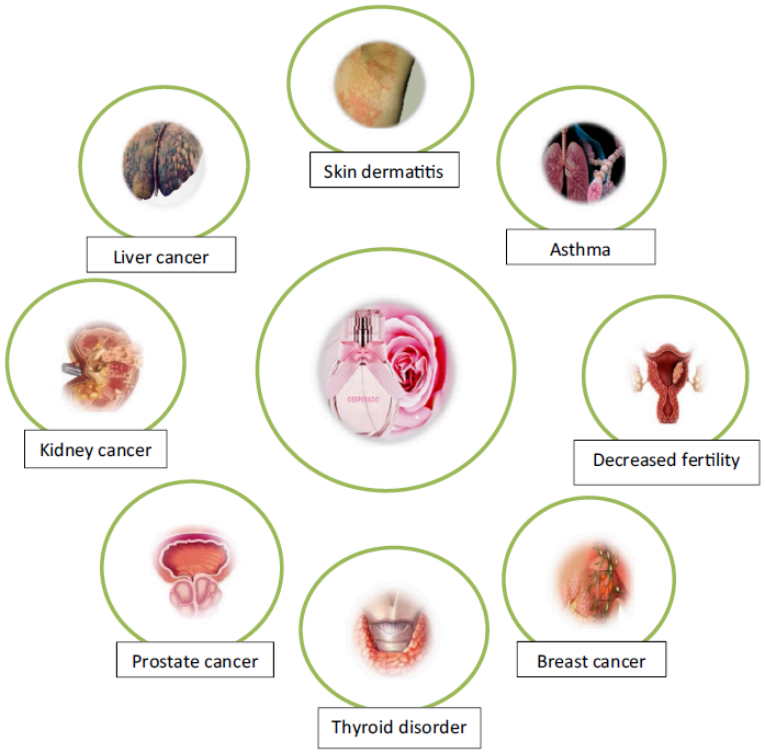
Fig. 2 Effects of exposure to perfumes and colognes



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"Diethyl phthalate is a chemical used to **make perfumes last longer.** The U.S. Clean Water Act lists it as a **toxic** and priority pollutant."

"Complications of using perfume include **neuropathy (depression, autism), neoplasms (breast cancer, prostate cancer), effects on the liver, migraine headaches, asthma attacks, mucosal symptoms (watery or red eyes, sneezing), neurological problems (dizziness, convulsions, headache, fainting, imbalance), respiratory (cough, shortness of breath), skin (skin rash, urticaria, redness of the skin, skin tingling, dermatitis), immune system (swollen lymph nodes, fever, fatigue), gastrointestinal tract (nausea, bloating, diarrhea)** and c**ardiovascular (rapid** or **irregular heartbeat, tremors, chest discomfort**)"

"**Contaminants in perfumes and colognes** and their health effects on the consumer were systematically reviewed. It was found that the most attention of researchers was to identify the compounds in perfumes and colognes and their concentrations. Among the most common pollutants **phthalates** and their derivatives can

be mentioned. Other pollutants included **parabens, triclosan, salicylates, terpenes, aldehydes, benzene, toluene, styrene, and aluminum-based salts**. These pollutants have also been shown to have adverse effects on consumer health such as **asthma and allergies, cardiovascular disease, central nervous system damage, breast cancer, endocrine cancer, respiratory disorders, reproduction, thyroid, adrenal gland function and immune system."**

[Note: Graphic lists "effects of exposure to perfumes and colognes": Kidney Cancer, Liver Cancer, Prostate Cancer, Thyroid Disorder, Breast Cancer, Decreased Fertility, Asthma and Skin Dermatitis.**]**

5. *Volatile organic compounds in feminine hygiene products sold in the US market: A survey of products and health risks*

Lin N, Ding N, Meza-Wilson E, Manuradha Devasurendra A, Godwin C, Kyun Park S, Batterman S. Volatile organic compounds in feminine hygiene products sold in the US market: A survey of products and health risks. Environ Int. 2020 Nov;144:105740. doi: 10.1016/j.envint.2020.105740. Epub 2020 Aug 28. PMID: 32866732; PMCID: PMC7958867.
Article Link: https://pubmed.ncbi.nlm.nih.gov/32866732/ - PDF

"**VOCs** are components of FHPs (feminine hygiene products) that **are added as fragrances**, adsorbents, moisture barriers, adhesives, and binders…Most of the larger non-target peaks were identified as **fragrances, such as linalool, eucalyptol and benzyl acetate**. Feminine hygiene products (FHPs) are used on highly permeable and sensitive vaginal and vulvar tissues by many women. These products contain a variety of chemicals, and few regulations require disclosure of their ingredients…."

"Products labeled as "organic," "natural," or "for sensitive skin" did not necessarily have lower VOC concentrations.**…menstrual pads had hazard ratios** of up to 11, **sprays and powders** had hazard ratios of up to 2.2 and excess cancer risks of up to 2.1 × 10−6, and **washes** had **excess cancer risks** of up to 3.3 × 10−6. Our data suggest that **all tested FHPs contained some toxic VOCs**..."

"Exposure to high concentrations or long-term exposure of VOCs has been associated with many known or suspected effects including **irritation to eyes, skin and nose**; **damage to the respiratory system, liver and kidney; reproductive effect**s; and **carcinogenicity**"

"Examples of notable VOCs include **benzene**, a known carcinogen (US EPA, 1998), 1,4-dioxane, a likely carcinogen (US EPA, 2013), and naphthalene, a possible carcinogen due to possible genetic toxicity (Schreiner, 2003; US EPA, 1999). Health risks (carcinogenic or non-carcinogenic) related to the use of FHPs over the lifecourse remain unanswered."

6. *Developmental Exposure to Endocrine Disrupting Chemicals and Its Impact on Cardio-Metabolic-Renal Health*

Singh RD, Koshta K, Tiwari R, Khan H, Sharma V, Srivastava V. Developmental Exposure to Endocrine Disrupting Chemicals and Its Impact on Cardio-Metabolic-Renal Health. Front Toxicol. 2021 Jul 5;3:663372. doi: 10.3389/ftox.2021.663372. PMID: 35295127; PMCID: PMC8915840.
Article Link: https://pubmed.ncbi.nlm.nih.gov/35295127/ - Free Full Text

"**Endocrine disrupting chemicals** (EDCs) include **phenols**, **phthalates**, parabens, flame retardants, heavy metals, pesticides, perfluorinated chemicals, UV filter components, triclosan, and organochlorines."

"**Cumulative exposure to mixtures of EDCs can lead to adverse effects on the health of the exposed individuals** (Crews et al., 2003). Multiple studies, including the studies of the National Health and Nutrition Examination Survey (NHANES), have shown that **about 75–97% of US and Asian adults have detectable levels of phthalates and phenols [bisphenol A (BPA) and polyfluoroalkyl chemicals] in their urine** (Silva et al., 2004; Calafat et al., 2007, 2008; Vandenberg et al., 2010; Zhang et al., 2011; Husøy et al., 2019)."

"Epidemiological and experimental studies have also linked **adult exposure to EDCs** with **abnormal male and female reproductive health**, **diabetes**, **obesity**, **cardiovascular** and **metabolic disorders**, **thyroid function**, and **hormone sensitive cancers** (Howard and Lee, 2012; Bodin et al., 2015; Heindel et al., 2015, 2017)."

"Children are also vulnerable to EDCs (Calafat et al., 2017; Hendryx and Luo, 2018), **making EDC exposure a major health concern for all age groups**."

"**Chronic kidney disease** is a growing health problem among children and adults. The incidence and the prevalence of chronic kidney disease (CKD) **among children have been steadily increasing since the 1980s**…. A number of traditional risk factors associated with CKD in children include hypertension, obesity, diabetes, and aberrant divalent mineral metabolism…. There is growing evidence that **links exposure to EDCs with early progression to end-stage renal disease** (ESRD) (Kataria et al., 2015)...."

"Early-life exposure to EDCs was associated with elevated levels of kidney toxicity markers such as albumin-to-creatinine ratio (ACR), estimated glomerular filtration rate (eGFR), and urinary protein-to-creatinine ratio (UPCR) in some human population studies (Li et al., 2012; Trasande et al., 2013a, 2014; Malits et al., 2018)."

[Note: Phthalates are synthetic odorless plasticizers used as solvents, binders or fixatives in many fragrances. Why are phthalates in the news? Phthalates are considered Endocrine Disrupting Chemicals.
On the California Safe Cosmetics Program Product Database: DEP, DIDP, and DBP are reported as fragrance while DEHP and DBP are perfume solvents. IFRA lists DEP and DMP, as "reported fragrance ingredients".**]**

[Note: Endocrine Disrupting Chemicals (EDC's) are commonly used in perfumes and fragranced products as preservatives or fragrance. What are EDC's and how can they affect us?**]**

7. *Qualitative Analysis of Air Freshener Spray*

Ibrahim ALshaer F, Fuad ALBaharna D, Ahmed HO, Ghiyath Anas M, Mohammed ALJassmi J. Qualitative Analysis of Air Freshener Spray. J Environ Public Health. 2019 Nov 5;2019:9316707. doi: 10.1155/2019/9316707. PMID: 31781257; PMCID: PMC6874985.
Article Link: https://pubmed.ncbi.nlm.nih.gov/31781257/ - PDF

"Information lacks concerning the gaseous emissions of fragrance products in spite of the extensive indoor exposure and widespread use of fragrances to them. In addition, **95 percent of the chemicals are synthetic compounds in fragrances that are derived from petroleum**."

"Some chemicals after analysis turned out to be noted as **skin allergens** or **irritants** and even chemicals that may interfere with **bodily functions**."

"The present study has identified the presence of different compounds in spray air fresheners that were not disclosed on the product's label. The results depicted common compounds in both low- and high-cost air fresheners. **Chemicals found in this study were not revealed on the product label as manufacturers are not required to list all ingredients**. These chemicals usually tend to be listed on the product label as "parfum" or "fragrance". There should be a law that strictly indicates whether the products contain any synthetic chemicals for people to be aware of what they are exposed to, although, manufacturers are not required to reveal all hidden ingredients on the label as stated by the Consumer Product Safety Commission (CPSC)."

8. *Health risks of chemicals in consumer products: A review*

Li D, Suh S. Health risks of chemicals in consumer products: A review. Environ Int. 2019 Feb;123:580-587. doi: 10.1016/j.envint.2018.12.033. Epub 2019 Jan 7. PMID: 30622082.
Article Link: https://pubmed.ncbi.nlm.nih.gov/30622082/ - Full Text

"It should also be noted that some chemicals have multiple functional uses, while we chose the most dominant functional use for each chemical. An example is the grouping of **phthalates**. Despite categorized as plasticizer together in this review, several phthalates such as **diethyl phthalate and dimethyl phthalate are used as solvents in personal care products and cosmetics as carriers of fragrance** (Schettler, 2006)."

"…we found that the volume of the peer-reviewed literature that addresses human health risks of the chemicals in consumer products did grow over the last two decades, while its growth could by no means match the speed of increasing volume and diversity of the chemicals produced and used in consumer products by the society. This **growing gap between increasing reliance on chemicals in consumer products and our knowledge on their human health risks raises a potential public health concern**, given the pervasive nature of today's mass production and consumption practice."

9. ALSO SEE SECTIONS: Dermatological, Inflammation, Liver Disease

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LIVER DISEASE

Liver Damage, Liver Cancer, Hepatic Inflammation,
Non-Alcoholic Fatty Liver Disease (NAFLD), Liver Fibrosis

1. *Inhaled exposure to air fresheners aggravated liver injury in a murine model of nonalcoholic fatty acid liver disease*

Kim S, Lee AY, Cho MH. Inhaled exposure to air fresheners aggravated liver injury in a murine model of nonalcoholic fatty acid liver disease. Heliyon. 2021 Mar 18;7(3):e06452. doi: 10.1016/j.heliyon.2021.e06452. PMID: 33817364; PMCID: PMC8010405.
Article Link: https://pubmed.ncbi.nlm.nih.gov/33817364/ - PDF

"...our scientific purpose of this study was to evaluate potential effects of fast-growing **AF (Air Freshener) products on the increasing incidence of NAFLD (Non-Alcoholic Fatty Liver Disease)**.

"The continuing trend for personal use of AFs at the global level has been increasing markedly year-on-year. Air fresheners are not only used for air care (malodor management), deodorant, and **fragrance**, but also for interior decoration (candles, votive and diffusers). The use of AFs has dramatically increased not only in homes, but also in offices, public places, and cars in Korea as well."

"…The results clearly demonstrated that AF exposure induced **severe hepatic damage** and **liver fibrosis in High Fructose-fed mice**, which are known to be NASH-like phenotypes characterized by hepatic steatosis, inflammation, and liver fibrosis."

Air freshener exposure:
"...induces **insulin resistance** in normal diet mice."
"...promotes **hepatic steatosis** in high fructose mice."
"Induces **hepatic inflammation** in high fructose diet mice…"
"Leads to **liver fibrosis** in high fructose fed mice…"
"…In summary, the current study demonstrated that a mixture of diverse chemicals emitted from **AF caused and aggravated liver damage** in a NAFLD murine model."

2. *Emission characteristics of VOCs emitted from consumer and commercial products and their ozone formation potential*

Dinh TV, Kim SY, Son YS, Choi IY, Park SR, Sunwoo Y, Kim JC. Emission characteristics of VOCs emitted from consumer and commercial products and their ozone formation potential. Environ Sci Pollut Res Int. 2015 Jun;22(12):9345-55. doi: 10.1007/s11356-015-4092-8. Epub 2015 Jan 21. PMID: 25601614.
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"The characteristics of volatile organic compounds (VOCs) emitted from several consumer and commercial products (body wash, dishwashing detergent, **air freshener**, windshield washer fluid, lubricant, hair spray, and insecticide) were studied and compared."

"In the spray products, 21.6–96.4 % of the VOCs were propane, iso-butane, and n-butane, which are the components of liquefied petroleum gas. **Monoterpene** (C10H16) was the dominant component of the VOCs in

the non-spray products (e.g., body wash, 53–88 %)."

"Besides comprising **hazardous VOCs**, VOCs from consumer products were also **ozone precursors**."
"The TVOCs from spray products (insecticide, **hair spray**, and lubricant) were higher than those from the liquid products such as the windshield washer fluid, dishwashing detergent, **body wash**, and **air freshener**."

"Limonene and 1-propanol were the components of one dishwashing detergent. In contrast, another dishwashing detergent comprised **1,3-dioxane**, **ethanol**, **ethyl acetate**, **limonene**, **β-myrcene**, 3-pentanol, and **α-pinene** (Kwon et al. 2007, 2008)."

"**Benzene, n-hexane,** and **ethylbenzene** were observed in the body washes and the **air fresheners.** Benzene was classified as Group A of the US EPA lists of **known human carcinogen** (WHO 2010). The unit cancer risk of 1 μg/m3 of benzene is 2.2–7.8 in a million (WHO 2010). The unit risk of **leukemia** per 1 μg/m3 air concentration is 6 in a million. Therefore, **long-term exposure to a considerable amount of benzene in those products might cause health risk,** which should be investigated in future researchers."

"A **longterm exposure of n-hexane may damage the nervous system**. Exposure to 650 ppm **n-hexane** for 2–4 months causes numbness of the arms and legs (Pohanish 2012). **Ethylbenzene i**rritates the eyes, skin, and respiratory tract. A **long-term exposure of ethylbenzene may cause kidney and liver disease**…."

"**Toluene and styrene were detected in body washes, dishwashing detergents**, and windshield washer fluids. It was reported that inhalation of 200–500 ppm **toluene may cause headache, nausea, and loss of appetite** (Pohanish 2012).

Styrene is considered as a possible carcinogenic to humans. Inhalation of above 100 ppm **styrene may cause headache, inflammation of the lung, kidney and liver damage, and death** (Pohanish 2012). Since body washes are used popularly and frequently, longterm exposure to the above compounds may cause health damage."

[Note: Limonene is a common skin sensitizer and known allergen in fragrance and fragranced products. Limonene (natural or synthetic) is a terpene. Terpenes can create formaldehyde and particulate matter in air as secondary pollutants. Limonene is on the IFRA list as a fragrance ingredient.**]**
[Note: Benzene is a reported fragrance ingredient in the CSCP Product Database.**]**
[Note: N-Hexane is used to extract fragrances and was on the IFRA list until 2015.**]**
[Note: Toluene (often a nail polish thinner) is used as a solvent or fragrance in perfume and bath products on the CSPC Product Database. Toluene is on the IFRA list and on the EPA's Priority Pollutant List.**]**
[Note: Styrene is "primarily a synthetic chemical**"** used in fragrance. It is on the CSPC list as 'parfum/fragrance' and also on the IFRA list.**]**
[Note: Ethyl benzene is listed for purchase as a perfuming agent.**]**

3. *Evaluation of pollutants in perfumes, colognes and health effects on the consumer: a systematic review*

Kazemi Z, Aboutaleb E, Shahsavani A, Kermani M, Kazemi Z. Evaluation of pollutants in perfumes, colognes and health effects on the consumer: a systematic review. J Environ Health Sci Eng. 2022 Feb 3;20(1):589-598. doi: 10.1007/s40201-021-00783-x. PMID: 35669814; PMCID: PMC9163252.
Article Link: https://pubmed.ncbi.nlm.nih.gov/35669814/ **-** PDF

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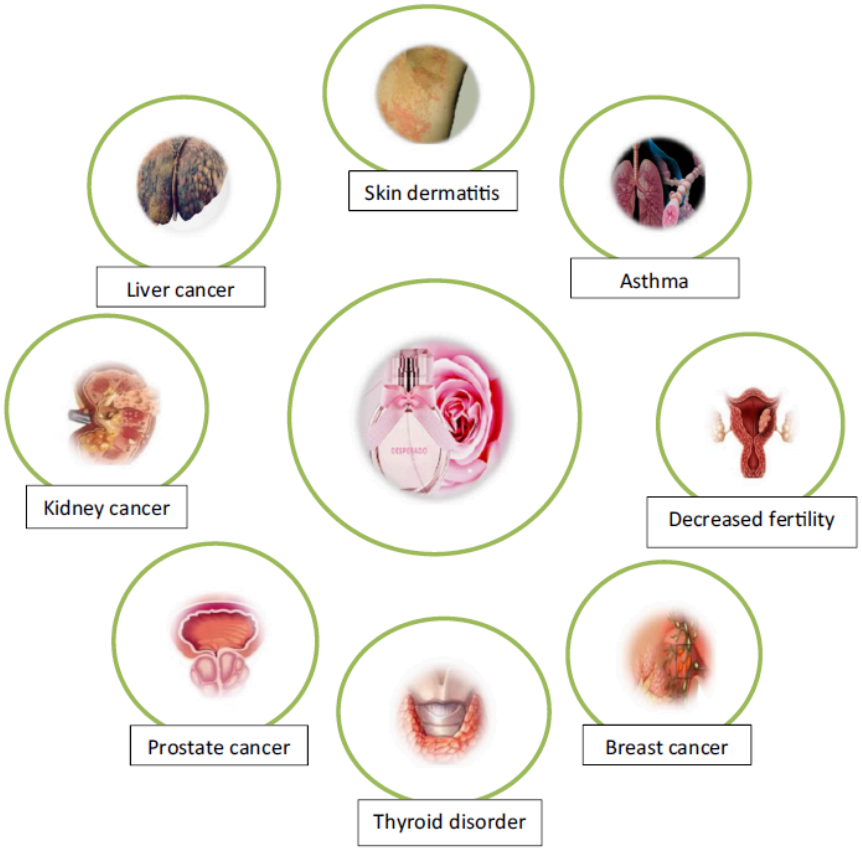
Fig. 2 Effects of exposure to perfumes and colognes



"Diethyl phthalate is a chemical used to **make perfumes last longer.** The U.S. Clean Water Act lists it as a **toxic** and priority pollutant."

"Complications of using perfume include **neuropathy (depression, autism), neoplasms (breast cancer, prostate cancer), effects on the liver, migraine headaches, asthma attacks, mucosal symptoms (watery or red eyes, sneezing), neurological problems (dizziness, convulsions, headache, fainting, imbalance), respiratory (cough, shortness of breath), skin (skin rash, urticaria, redness of the skin, skin tingling, dermatitis), immune system (swollen lymph nodes, fever, fatigue), gastrointestinal tract (nausea, bloating, diarrhea)** and **cardiovascular (rapid** or **irregular heartbeat, tremors, chest discomfort**)"

"**Contaminants in perfumes and colognes** and their health effects on the consumer were systematically reviewed. It was found that the most attention of researchers was to identify the compounds in perfumes and colognes and their concentrations. Among the most common pollutants **phthalates** and their derivatives can be mentioned. Other pollutants included **parabens, triclosan, salicylates, terpenes, aldehydes, benzene, toluene, styrene, and aluminum-based salts**. These pollutants have also been shown to have adverse effects on consumer health such as **asthma and allergies, cardiovascular disease, central nervous system damage, breast cancer, endocrine cancer, respiratory disorders, reproduction, thyroid, adrenal gland function and immune system."**

[Note: Graphic lists “effects of exposure to perfumes and colognes”: Kidney Cancer, Liver Cancer, Prostate Cancer, Thyroid Disorder, Breast Cancer, Decreased Fertility, Asthma and Skin Dermatitis.**]**

4. *Volatile organic compounds in feminine hygiene products sold in the US market: A survey of products and health risks*

Lin N, Ding N, Meza-Wilson E, Manuradha Devasurendra A, Godwin C, Kyun Park S, Batterman S. Volatile organic compounds in feminine hygiene products sold in the US market: A survey of products and health risks. Environ Int. 2020 Nov;144:105740. doi: 10.1016/j.envint.2020.105740. Epub 2020 Aug 28. PMID: 32866732; PMCID: PMC7958867.

Article Link: https://pubmed.ncbi.nlm.nih.gov/32866732/ - PDF

“**VOCs** are components of FHPs (feminine hygiene products) that **are added as fragrances**, adsorbents, moisture barriers, adhesives, and binders…Most of the larger non-target peaks were identified as **fragrances, such as linalool, eucalyptol and benzyl acetate**. Feminine hygiene products (FHPs) are used on highly permeable and sensitive vaginal and vulvar tissues by many women. These products contain a variety of chemicals, and few regulations require disclosure of their ingredients….”

“Products labeled as “organic,” “natural,” or “for sensitive skin” did not necessarily have lower VOC concentrations.**…menstrual pads had hazard ratios** of up to 11, **sprays and powders** had hazard ratios of up to 2.2 and excess cancer risks of up to 2.1 × 10−6, and **washes** had **excess cancer risks** of up to 3.3 × 10−6. Our data suggest that **all tested FHPs contained some toxic VOCs**...”

“Exposure to high concentrations or long-term exposure of VOCs has been associated with many known or suspected effects including **irritation to eyes, skin and nose**; **damage to the respiratory system, liver and kidney; reproductive effects**; and **carcinogenicity**”

“Examples of notable VOCs include **benzene**, a known carcinogen (US EPA, 1998), 1,4-dioxane, a likely carcinogen (US EPA, 2013), and naphthalene, a possible carcinogen due to possible genetic toxicity (Schreiner, 2003; US EPA, 1999). Health risks (carcinogenic or non-carcinogenic) related to the use of FHPs over the lifecourse remain unanswered.”

[Note: Fragrance is considered the new ‘second hand smoke’, **“**The parallels between second-hand smoke and synthetic fragrance use are many. At its core, both are battles over indoor air quality **“** - quote and link from De Vader, Christy L. & Barker, Paxson.
Chemicals that cigarettes/cigarette smoke and fragranced products can have in common are: Acetone, Formaldehyde, **Benzene**, acetaldehyde, terpenoids and phenols.**]**

5. *Disparities in Environmental Exposures to Endocrine-Disrupting Chemicals and Diabetes Risk in Vulnerable Populations*

Ruiz D, Becerra M, Jagai JS, Ard K, Sargis RM. Disparities in Environmental Exposures to Endocrine-Disrupting Chemicals and Diabetes Risk in Vulnerable Populations. Diabetes Care. 2018 Jan;41(1):193-205. doi: 10.2337/dc16-2765. Epub 2017 Nov 15. PMID: 29142003; PMCID: PMC5741159.

Article Link: https://pubmed.ncbi.nlm.nih.gov/29142003/ - PMD

“Scientific evidence linking **EDCs** with the **development of diabetes** and other **metabolic disorders** continues to grow. Of note, exposures to several toxicants have been prospectively linked to diabetes risk, including PCBs, organochlorine (OC) pesticides, **various chemical constituents of air pollution,** bisphenol A (BPA), and **phthalates** (Table 1);...
moreover, exposure to these EDCs is higher among African Americans, Latinos, and low-income individuals (Supplementary Table 1). These unequal exposures raise the possibility that EDCs are underappreciated contributors to diabetes disparities.”

“In this analysis, **metabolites of butyl phthalates and diethylhexyl phthalate (DEHP) were associated with diabetes** (OR 3.16 [95% CI 1.68–5.95] and 1.91 [95% CI 1.04–3.49], respectively).”

(the following quote is from Table 3 in the full document**)**
“Phthalates:... (are found in) Personal care products, such as **perfumes**, hair sprays, deodorants, nail polishes, insect repellants, and **most consumer products containing fragrances**, including shampoos, air fresheners, and laundry detergents”

[Note: Phthalates are synthetic odorless plasticizers used as solvents, binders or fixatives in many fragrances. Why are phthalates in the news? Phthalates are considered Endocrine Disrupting Chemicals.
On the California Safe Cosmetics Program Product Database: DEP, DIDP, and DBP are reported as fragrance while DEHP and DBP are perfume solvents. IFRA lists DEP and DMP, as “reported fragrance ingredients”.**]**
[Note: Endocrine Disrupting Chemicals (EDC’s) are commonly used in perfumes and fragranced products as preservatives or fragrance. What are EDC’s and how can they affect us?**]**

6. *Histo-morphometric Evidences for Testicular Derangement in animal models submitted to chronic and Sub-chronic Inhalation of Fragrance*

Akunna GG, Saalu LC, Ogunlade B, Akingbade AM, Anderson LE, Olusolade FS, Histo-morphometric evidences for testicular derangement in animal models submitted to chronic and sub-chronic inhalation of fragrance. American Journal of Research Communication, 2015, 3(1): 85-101} www.usa-journals.com, ISSN: 2325-4076.
Article Link:
https://www.researchgate.net/publication/315065887_Histo-morphometric_Evidences_for_Testicular_Derangement_in_animal_models_submitted_to_chronic_and_Sub-chronic_Inhalation_of_Fragrance - PDF

“Copious documentations have indicated that **82 percent of perfumes labeled “natural ingredients” actually contain synthetic fragrances** (Rastogi et al.,1996). Such chemicals that affect **male reproductive** hormones may be a factor in **infertility** and has been known as **endocrine disruptors**.(Giudice, 2006, Saalu et al., 2010, Akunna et al., 2013)”.

“It has been reported that perfumes, colognes, body sprays and care products contained an average of four potential hormone-disrupting chemicals. In male reproductive anatomy, **endocrine disruptors** have severally been implicated as teratogens, resulting in **cryptorchidism**, **hypospadias** and **impairment of body function** normally regulated by natural hormone signaling (Wang and Baskin, 2008, Akunna et al., 2011, Akunna et al., 2013). Studies have shown that these chemicals causes damage by **mimicking or disrupting natural estrogen**, **testosterone and thyroid pathways** (Soto et al., 2009). Although the implication of subsequent exposure to these chemicals have not been critically understood, recent findings has clearly demonstrated disruption in **spermatogenesis**,(Akunna et al., 2014) **liver damage** (Akunna et al., 2011) and **other tissue toxicity in animals** exposed to fragrance components (Johansen et al., 2003, Elberling et al., 2004, Breast

Cancer Fund, 2008, Schnuch et al., 2010). In animal model studies, fragrance exposure has lead to **spermatotoxicity** and **infertility**, **congenital malformation in penises and abnormal testes** (Akunna et al., 2014)."

"According to published scientific studies, **diethyl phthalate** and octinoxate which are major components of perfume and sunscreen respectively has been implicated in **sperm damage**, **apoptosis** and **interference with estrogen and androgens** in human respectively (Giudice, 2006, Wang and Baskin, 2008, Silva et al., 2004 ,Schreurs et al., 2005, Swan, 2008, CDC, 2009)."

"From our studies on fragrance, we can conclude herein that fragrance components are **testiculotoxic** in rat."
[Note: Definition - Teratogens are substances that people are exposed to (in utero) that may lead to birth defects, miscarriages, pre-term labor or stillbirth.. **Cryptorchidism** (undescended testicals) may also increase the risk for testicular cancer. **Hypospadias** is a birth defect where boys have an altered location of the opening of the urethra.**]**

7. *Effects of Di(2-ethylhexyl) Phthalate (DEHP) on Female Fertility and Adipogenesis in C3H/N Mice*

Schmidt JS, Schaedlich K, Fiandanese N, Pocar P, Fischer B. Effects of di(2-ethylhexyl) phthalate (DEHP) on female fertility and adipogenesis in C3H/N mice. Environ Health Perspect. 2012 Aug;120(8):1123-9. doi: 10.1289/ehp.1104016. Epub 2012 May 15. PMID: 22588786; PMCID: PMC3440070.
Article Link: https://pubmed.ncbi.nlm.nih.gov/22588786/ - PDF

"Background**: Di(2-ethylhexyl) phthalate (DEHP)** and its metabolites are known to affect **lipid metabolism** and **adipogenesis**, mainly by activation of peroxisome proliferator-activated receptors (PPARs). Exposure to DEHP has been linked with **testicular impairment** and **male subfertility**. However, the effects of DEHP on female reproductive health and metabolism have not been studied in detail."

"Objective: We examined the effects of dietary DEHP exposure on **metabolism** and **fertility** in female mice."
"Results: In study I, DEHP-exposed F0 females (all dose groups) had a **significant increase in body weight**, food intake, and visceral adipose tissue compared with controls. In the 500-mg DEHP group, PPARα and PPARγ transcripts were **significantly changed in liver tissue**. In the same group, PPARγ mRNA was significantly reduced in liver but not in fat tissue. In addition, leptin and FABP4 (fatty acid binding protein 4) mRNA were increased in adipose tissue, whereas adiponectin was decreased. In study II, we detected a **100% abortion rate** in F0 dams in the 500-mg group. **F1 offspring exposed in utero and during lactation had an increase in visceral fat tissue and body weight**."

[Note: Phthalates are synthetic odorless plasticizers used as solvents, binders or fixatives in many fragrances.
Why are phthalates in the news? Phthalates are considered Endocrine Disrupting Chemicals.
On the California Safe Cosmetics Program Product Database: DEP, DIDP, and DBP are reported as fragrance while DEHP and DBP are perfume solvents. IFRA lists DEP and DMP, as "reported fragrance ingredients".**]**

8. *Immune System: An Emerging Player in Mediating Effects of Endocrine Disruptors on Metabolic Health*

Bansal A, Henao-Mejia J, Simmons RA. Immune System: An Emerging Player in Mediating Effects of Endocrine Disruptors on Metabolic Health. Endocrinology. 2018 Jan 1;159(1):32-45. doi: 10.1210/en.2017-00882. PMID: 29145569; PMCID: PMC5761609.

Article Link: https://pubmed.ncbi.nlm.nih.gov/29145569/ - Full Article

"The incidence of metabolic disorders like type 2 diabetes and obesity continues to increase. In addition to the well-known contributors to these disorders, such as food intake and sedentary lifestyle, recent research in the exposure science discipline provides evidence that exposure to endocrine-disrupting chemicals like bisphenol A and **phthalates** via multiple routes (e.g., food, drink, **skin contact**) also contribute to the increased risk of metabolic disorders. Endocrine-disrupting chemicals (EDCs) can disrupt any aspect of hormone action. It is becoming increasingly clear that **EDCs** not only affect **endocrine function** but also **adversely affect immune system function."**

"Similarly, EDCs have been shown to increase endoplasmic reticulum stress in in vitro and in vivo studies involving kidney (104), pancreas (105, 106), and liver (107). Mitochondrial dysfunction and endoplasmic reticulum stress are associated with increased oxidative stress (108) and metabolic dysfunction (109). Increased oxidative stress can activate various inflammatory pathways and increases the risk of metabolic abnormalities such as **insulin resistance**, **diabetes**, and **obesity** (Fig. 3)."

"Possible routes of EDC action on the immune system contributing to metabolic disorders. **By interacting with various receptors, altering the gut microbiome, inducing oxidative stress via mitochondrial dysfunction and/or endoplasmic reticulum stress, or via circadian disruption, EDCs trigger immune dysfunction in various tissues.** Together, this may contribute toward a perturbed metabolic health. See Fig. 3 legend for expansion of abbreviation

[Note: Endocrine Disrupting Chemicals (EDC's) are commonly used in perfumes and fragranced products as preservatives or fragrance. What are EDC's and how can they affect us?**]**

9. *Comparative toxicological evaluation of phthalate diesters and metabolites in Sprague-Dawley male rats for risk assessment*

Kwack SJ, Kim KB, Kim HS, Lee BM. Comparative toxicological evaluation of phthalate diesters and metabolites in Sprague-Dawley male rats for risk assessment. J Toxicol Environ Health A. 2009;72(21-22):1446-54. doi: 10.1080/15287390903212923. PMID: 20077217.

Article Link: https://pubmed.ncbi.nlm.nih.gov/20077217/

"**Liver weights were significantly increased** in groups treated with DEHP, DBP, BBP, DIDP, DINP, MEHP, and MBuP compared to the control. **Testes weights were significantly reduced** only in DEHP, DBP, and MEHP-treated groups compared to the control. Significant **decreases in red blood cell** (RBC) and hematocrit (Ht) levels were observed in DEHP-treated rats, whereas **significant increases in mean corpuscular hemoglobin (MCH), mean corpuscular hemoglobin concentration (MCHC), and platelet (PLT) levels** were found in the DEHP-treated group. Hemoglobin (Hb) level was reduced only in the DMP group. Similar to effects on testis and epididymal weights, DEHP and MEHP significantly **reduced sperm numbers and motility**."

[Note: Phthalates are synthetic odorless plasticizers used as solvents, binders or fixatives in many fragrances. Why are phthalates in the news? Phthalates are considered Endocrine Disrupting Chemicals.
On the California Safe Cosmetics Program Product Database: DEP, DIDP, and DBP are reported as fragrance while DEHP and DBP are perfume solvents. IFRA lists DEP and DMP, as "reported fragrance ingredients".**]**

10. ALSO SEE SECTIONS: Gastrointestinal Tract, Kidney Disease, Cancer

Back to top of Liver Disease **Back to Table of Contents**

Website: https://www.fragrancefreecoalitionusa.com/

Nephro and Hepatotoxic Effect of Air-Freshener in Wistar Rats.

Airaodion AI, Alabi OJ, Ogbuagu EO, Atiba FA, Olawoyin DS. Nephro and Hepatotoxic Effect of Air-Freshener in Wistar Rats. Asian Journal of Research in Nephrology. 3(1): 42-50, 2020; Article no.AJRN.58662.

Article Link: https://www.journalajrn.com/index.php/AJRN/article/view/32 - PDF

"Air-fresheners are consumer products that emit **fragrance** to introduce an aroma into the air, to mask an odour, or both [1]. They have become a staple in many Nigerian homes and offices, marketed with the promise of creating a clean, healthy, and pleasurable aroma that eliminate or mask bad odours in the space. Nonetheless, consumers are unaware that the release of this **fragrance** can emit and generate a wide range of potentially hazardous chemicals that can pollute the air and pose a threat to human health"

"Conclusion: The results of this study suggest that frequent exposure to air-fresheners poses a dangerous risk to the health of the **liver and kidney**. This is due to the presence of toxic chemicals such as the volatile organic compounds, which are toxic even at very low concentration, thus proper awareness should be conducted to educate consumers on the risk associated with the frequent use of this product."

DISCLAIMER:
Poster and Document are for reference and educational purposes only.

MIGRAINE(s) / HEADACHE(s)

Nausea, Vomiting, Diarrhea, Dizzy

1. *Toxic Chemicals Emitted from Air fresheners & Disinfectants*

Geetha Balasubramani, Paul Pradeep, J Nisitha S. Toxic Chemicals Emitted from Air fresheners & Disinfectants. IJRASET. Volume 10 Issue X Oct 2022, Pgs 1338-1345. ISSN : 2321-9653 IJRASET47180

Article Link:
https://www.ijraset.com/research-paper/toxic-chemicals-emitted-from-air-fresheners-and-disinfectants - PDF

(Note: This graphic is from preceding article)

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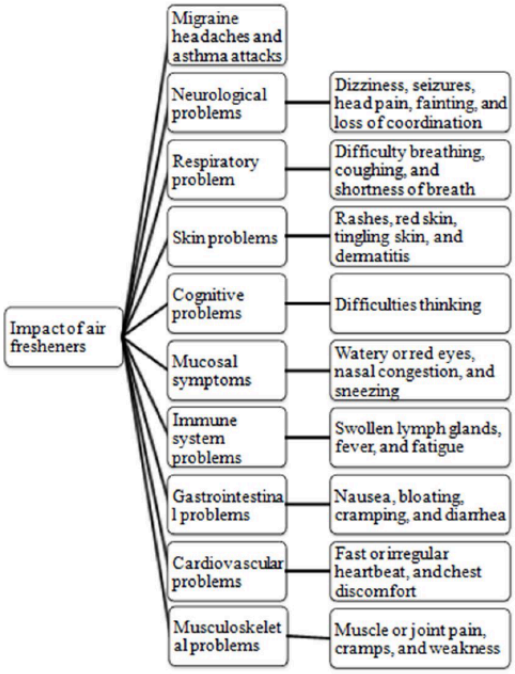

Figure 2: The diagram above illustrates the classification of illnesses brought on by exposure to air fresheners.

2. *Symptoms of mothers and infants related to total volatile organic compounds in household products*

Farrow A, Taylor H, Northstone K, Golding J. Symptoms of mothers and infants related to total volatile organic compounds in household products. Arch Environ Health. 2003 Oct;58(10):633-41. doi: 10.3200/AEOH.58.10.633-641. PMID: 15562635.

Article Link: https://pubmed.ncbi.nlm.nih.gov/15562635/

"Higher TVOC levels were associated with air freshener and aerosol use. **Infant diarrhea** and **earache** were statistically significantly associated with air freshener use, and **diarrhea** and **vomiting** were significantly associated with aerosol use. **Headache** experienced by mothers 8 mo after birth was significantly associated

with the use of **air fresheners** and aerosols; **maternal depression** was significantly associated with the use of air fresheners. The results of the study suggest a **link between the use of products that raise indoor levels of TVOCs and an increased risk of certain symptoms among infants and their mothers**."
[Note: Fragranced products emit VOC's that can contribute to higher particulate matter (PM) indoors and out.**]**

3. *Ten questions concerning air fresheners and indoor built environments*

Anne Steinemann, Ten questions concerning air fresheners and indoor built environments, Building and Environment, Volume 111, 2017, Pages 279-284, ISSN 0360-1323, https://doi.org/10.1016/j.buildenv.2016.11.009.
Article Link: https://www.sciencedirect.com/science/article/pii/S0360132316304334?via%3Dihub - PDF

"This article investigates the seeming paradox that **products designed to improve the indoor environment can pose unintended and unknown risks.** It examines the science, health, and policy perspectives, and provides recommendations and research directions."

"Air fresheners can contribute to indoor hazardous air pollutants, both through direct emissions and secondary reaction products… Within buildings and other indoor environments, the use of air fresheners has a strong association with high indoor levels of **terpenes, benzene, toluene**, ethyl-benzene, m,p-xylene, and **total volatile organic compounds**…"

"Air fresheners can contribute to human exposure to primary and secondary air pollutants… Air freshener exposures, **even at low levels**, have been associated with a range of adverse health effects, which include **migraine headaches, asthma attacks, breathing difficulties, respiratory difficulties, mucosal symptoms, dermatitis, infant diarrhea and earache, neurological problems, and ventricular fibrillation**..."
"In addition to population based studies, specific air freshener chemicals (VOCs such as acetaldehyde, SVOCs such as phthalates, and ultrafine particles) emitted from air fresheners have been associated with adverse effects to the **neurological, cardiovascular, respiratory, reproductive, immune, and endocrine systems, and with cancer**. For instance, acetaldehyde, which can be both a primary and secondary emission from air fresheners, is associated with both **acute and chronic hazards to the respiratory system**, and classified as a carcinogenic hazardous air pollutant in the US…"

[Note: Fragrance is considered the new 'second hand smoke', **"**The parallels between second-hand smoke and synthetic fragrance use are many. At its core, both are battles over indoor air quality **"** - quote and link from De Vader, Christy L. & Barker, Paxson.
Chemicals that cigarettes/cigarette smoke and fragranced products can have in common are: Acetone, Formaldehyde, Benzene, acetaldehyde, terpenoids and phenols.**]**

4. *Fragranced consumer products: effects on asthmatics*

Steinemann A. Fragranced consumer products: effects on asthmatics. Air Qual Atmos Health. 2018;11(1):3-9. doi: 10.1007/s11869-017-0536-2. Epub 2017 Dec 11. PMID: 29391919; PMCID: PMC5773620
Article Link: https://pubmed.ncbi.nlm.nih.gov/29391919/ **-** PDF

"Fragranced consumer products, such as **cleaning supplies**, air fresheners, and personal care products, can emit a range of air pollutants and trigger adverse health effects…"

"...41.0% of asthmatics report **health problems** from air fresheners or deodorizers, 28.9% from scented laundry products coming from a dryer vent, **42.3% from being in a room cleaned with scented products,** and 46.2% from being near someone wearing a fragranced product."

"**Fragranced consumer products pervade society and emit numerous volatile organic compounds, such as limonene, alpha-pinene, beta-pinene, acetaldehyde, and formaldehyde…"**

"Fragranced products have been associated with a range of adverse health effects including work-related asthma (Weinberg et al. 2017), asthmatic exacerbations (Kumar et al. 1995; Millqvist and Löwhagen 1996), **respiratory difficulties** (Caress 2009), **mucosal symptoms** (Elberling et al. 2005)**, migraine headaches** (Kelman 2004), and **contact dermatitis** (Rastogi et al. 2007; Johansen 2003), as well as **neurological, cardiovascular, cognitive, musculoskeletal, and immune system problems** (Steinemann 2016)."

"Results indicate that 64.3% of asthmatics report one or more types of adverse health effects from fragranced products, including **respiratory problems** (43.3%), **migraine headaches** (28.2%), and **asthma attacks** (27.9%)..."

5. *Fragranced consumer products: effects on asthmatic Australians*

Steinemann A, Wheeler AJ, Larcombe A. Fragranced consumer products: effects on asthmatic Australians. Air Qual Atmos Health. 2018;11(4):365-371. doi: 10.1007/s11869-018-0560-x. Epub 2018 Mar 17. PMID: 29780436; PMCID: PMC5954056.
Article Link: https://pubmed.ncbi.nlm.nih.gov/29780436/ - PDF

"Exposure to fragranced consumer products is associated with adverse health effects such as **asthma attacks, breathing difficulties, and migraine headaches….** Nationally, 55.6% of asthmatics, and 23.9% of non-asthmatics, report adverse health effects after exposure to fragranced products."

"Overall, the majority of asthmatics and non-asthmatics were unaware of **potentially hazardous chemicals emitted from fragranced products**, even ones called green or organic, and would not continue to use a fragranced product if they knew it emitted these pollutants…. Most asthmatics (67.1%) and non-asthmatics (69.2%) were not aware that **fragrance chemicals do not need to be fully disclosed** on the product label or material safety data sheet."

"A majority of asthmatics (62.6%) and non-asthmatics (55.8%) **would prefer an airplane without scented air pumped through the passenger cabin…** Nearly half of both asthmatics (50.2%) and non-asthmatics (40.4%) **would prefer that healthcare facilities and healthcare professionals were fragrance-free."**
"More than half of asthmatics (50.5%) and nearly half of non-asthmatics (39.7%) **would support a fragrance-free policy in the workplace**…**prefer a hotel without scented air"**

"…55.6% of "asthmatics" in our study who report adverse health effects due to fragranced product exposure would represent over 2.2 million adult Australians (ABS 2016). Combining this with the **23.9% of "non-asthmatics" (71.5%) who also report adverse health effects** would represent over 4.5 million adult Australians affected adversely **by fragranced consumer products."**

"Results from this study show that **voluntary and involuntary exposure to fragranced products** is widespread in Australian society, that **exposure is associated with a range of potentially serious and adverse health effects,**…In addition to the adverse health consequences, exposure to fragranced products

imposes significant **adverse impacts** on workplace productivity and quality of life, **including the ability to access public places such as restrooms."**

"**A straightforward approach to reduce undesirable effects would be to reduce or avoid use of fragranced products**, **especially in public places that would impose involuntary risks**, and to **implement fragrance-free policies in workplaces, healthcare facilities, and other environments."**

6. *Fragranced consumer products: effects on autistic adults in the United States, Australia, and United Kingdom*

Steinemann A. Fragranced consumer products: effects on autistic adults in the United States, Australia, and United Kingdom. Air Qual Atmos Health. 2018;11(10):1137-1142. doi: 10.1007/s11869-018-0625-x. Epub 2018 Sep 25. PMID: 30546500; PMCID: PMC6244938
Article Link: https://pubmed.ncbi.nlm.nih.gov/30546500/ - PDF

"Fragranced consumer products are ubiquitous in society and emit numerous volatile organic compounds including hazardous air pollutants."

"Health effects were categorized as follows:
(a) migraine headaches;
(b) asthma attacks;
(c) neurological problems (e.g., dizziness, seizures, head pain, fainting, loss of coordination);
(d) respiratory problems (e.g., difficulty breathing, coughing, shortness of breath);
(e) skin problems (e.g., rashes, hives, red skin, tingling skin, dermatitis);
(f) cognitive problems (e.g., difficulties thinking, concentrating, or remembering);
(g) mucosal symptoms (e.g., watery or red eyes, nasal congestion, sneezing);
(h) immune system problems (e.g., swollen lymph glands, fever, fatigue);
(i) gastrointestinal problems (e.g., nausea, bloating, cramping, diarrhea);
(j) cardiovascular problems (e.g., fast or irregular heartbeat, jitteriness, chest discomfort);
(k) musculoskeletal problems (e.g., muscle or joint pain, cramps, weakness); and
(l) other."

"Specific problematic exposures, associated with adverse health effects for autistic adults, include but are not limited to the following: …air fresheners and deodorizers (62.9%), the scent of laundry products coming from a dryer vent (57.5%), being in a room recently cleaned with scented products (65.9%), **being near someone wearing a fragranced product** (60.5%), and other types of fragranced consumer products (64.3%)… Among autistic adults reporting health effects, 74.1% across the three countries (85.4% US, 82.4% AU, 54.5% UK) report that the severity of these health effects from fragranced products was potentially disabling. Among non-autistic adults, the prevalence of potentially disabling effects was 25.4%."

"...62.1% of autistic adults are unable or reluctant to use the restrooms in a public place if it has an air freshener, deodorizer, or scented product; 59.8% are unable or reluctant to wash their hands with soap in a public place if the soap is fragranced; 58.7% enter a business and then want to leave as quickly as possible if they smell air fresheners or a fragranced product; and **66.7% have been prevented from going someplace because they would be exposed to a fragranced product that would make them sick…"**

"Involuntary exposure is a concern. Autistic individuals are prevented from accessing public restrooms, societal venues, businesses, and workplaces due to adverse health effects from fragranced products. Further, 59.4% of

autistic adults have lost workdays, in the past year, due to fragranced product exposure in the workplace. **A strong majority of autistic as well as non-autistic adults would prefer that workplaces, health care facilities, and health care professionals were fragrance-free than fragranced.**"

7. *Emission characteristics of VOCs emitted from consumer and commercial products and their ozone formation potential*

Dinh TV, Kim SY, Son YS, Choi IY, Park SR, Sunwoo Y, Kim JC. Emission characteristics of VOCs emitted from consumer and commercial products and their ozone formation potential. Environ Sci Pollut Res Int. 2015 Jun;22(12):9345-55. doi: 10.1007/s11356-015-4092-8. Epub 2015 Jan 21. PMID: 25601614.

Article Link: https://pubmed.ncbi.nlm.nih.gov/25601614/

"The characteristics of volatile organic compounds (VOCs) emitted from several consumer and commercial products (body wash, dishwashing detergent, **air freshener**, windshield washer fluid, lubricant, hair spray, and insecticide) were studied and compared."

"In the spray products, 21.6–96.4 % of the VOCs were propane, iso-butane, and n-butane, which are the components of liquefied petroleum gas. **Monoterpene** (C10H16) was the dominant component of the VOCs in the non-spray products (e.g., body wash, 53–88 %)."

"Besides comprising **hazardous VOCs**, VOCs from consumer products were also **ozone precursors**."
"The TVOCs from spray products (insecticide, **hair spray**, and lubricant) were higher than those from the liquid products such as the windshield washer fluid, dishwashing detergent, **body wash**, and **air freshener**."

"Limonene and 1-propanol were the components of one dishwashing detergent. In contrast, another dishwashing detergent comprised **1,3-dioxane**, **ethanol**, **ethyl acetate**, **limonene**, **β-myrcene**, 3-pentanol, and **α-pinene** (Kwon et al. 2007, 2008)."

"**Benzene, n-hexane**, and **ethylbenzene** were observed in the body washes and the **air fresheners.** Benzene was classified as Group A of the US EPA lists of **known human carcinogen** (WHO 2010). The unit cancer risk of 1 μg/m3 of benzene is 2.2–7.8 in a million (WHO 2010). The unit risk of **leukemia** per 1 μg/m3 air concentration is 6 in a million. Therefore, **long-term exposure to a considerable amount of benzene in those products might cause health risk,** which should be investigated in future researchers."

"A **longterm exposure of n-hexane may damage the nervous system**. Exposure to 650 ppm **n-hexane** for 2–4 months causes numbness of the arms and legs (Pohanish 2012). **Ethylbenzene** irritates the eyes, skin, and respiratory tract. A **long-term exposure of ethylbenzene may cause kidney and liver disease**…."

"**Toluene and styrene were detected in body washes, dishwashing detergents**, and windshield washer fluids. It was reported that inhalation of 200–500 ppm **toluene may cause headache, nausea, and loss of appetite** (Pohanish 2012).

Styrene is considered as a possible carcinogenic to humans. Inhalation of above 100 ppm **styrene may cause headache, inflammation of the lung, kidney and liver damage, and death** (Pohanish 2012). Since body washes are used popularly and frequently, longterm exposure to the above compounds may cause health damage."

[Note: Limonene is a common skin sensitizer and known allergen in fragrance and fragranced products. Limonene (natural or synthetic) is a terpene. Terpenes can create formaldehyde and particulate matter in air as secondary pollutants. Limonene is on the IFRA list as a fragrance ingredient.**]**
[Note: Benzene is a reported fragrance ingredient in the CSCP Product Database.**]**
[Note: N-Hexane is used to extract fragrances and was on the IFRA list until 2015.**]**
[Note: Toluene (often a nail polish thinner) is used as a solvent or fragrance in perfume and bath products on the CSPC Product Database. Toluene is on the IFRA list and on the EPA's Priority Pollutant List.**]**
[Note: Styrene is "primarily a synthetic chemical**"** used in fragrance. It is on the CSPC list as 'parfum/fragrance' and also on the IFRA list.**]**
[Note: Ethyl benzene is listed for purchase as a perfuming agent.**]**

8. *Rapid and green determination of 58 fragrance allergens in plush toys*

Wang Z, Zhang Q, Li H, Lv Q, Wang W, Bai H. Rapid and green determination of 58 fragrance allergens in plush toys. J Sep Sci. 2018 Feb;41(3):657-668. doi: 10.1002/jssc.201700556. Epub 2017 Dec 14. PMID: 29150895.
Article Link: https://pubmed.ncbi.nlm.nih.gov/29150895/

"**Toys are scented** to cover unpleasant odors or to enhance their attractiveness to consumers. However, **some fragrances are important sources of allergens**, which can **trigger respiratory illnesses (asthma and rhinitis), migraine headaches, neurotoxicity, endocrine-disrupting activities,** and other negative effects."

9. *Fragranced laundry products and emissions from dryer vents: implications for air quality and health*

Goodman N, Nematollahi N and Steinemann A (2021) Fragranced laundry products and emissions from dryer vents: implications for air quality and health. Air Quality, Atmosphere and Health, 14. pp. 245-249.
Article Link: https://researchonline.jcu.edu.au/64706/ - PDF

"The study pursues three main objectives: (a) to determine the frequency and types of health problems associated with exposure to fragranced laundry products from dryer vents, (b) to assess and compare the VOCs from fragranced and fragrance-free laundry products, and (c) to calculate potential reductions in **limonene** emissions from dryer vents by switching from fragranced to fragrance-free laundry products. Results can provide a scientific foundation and practical approach to reduce pollutants and potential health risks associated with the use of laundry products and their emissions through dryer vents."

"Among the general population in the US and AU, 12.5% and 6.1% of adults report health problems when exposed to **scented laundry products** from dryer vents. Adverse health effects include **respiratory problems (the most frequently reported, collectively), mucosal symptoms, skin problems, asthma attacks, migraine headaches, neurological problems**, among others."

"Dryer vent emissions from seven households were analyzed for their limonene concentrations…"
"In households that switched from fragranced products to fragrance-free products, emissions of limonene were reduced within two weeks by up to 99.7% (average 79.1%)."

"At a regional level, during use of fragranced laundry products, limonene emissions from dryer vents across metropolitan Melbourne is estimated at 1.99 tons/year."

“In this same analytical approach, applied to the state of California, limonene emissions from dryer vents across the state was estimated at 10.95 tons/year”

“This study indicates that fragranced laundry products emitted from dryer vents can be sources of indoor and outdoor air pollutants and health risks. The study also indicates that switching from fragranced to fragrance-free laundry products can generate potential improvements for air quality and health.”

10. Emissions from dryer vents during use of fragranced and fragrance-free laundry products

Goodman, N.B., Wheeler, A.J., Paevere, P.J. et al. Emissions from dryer vents during use of fragranced and fragrance-free laundry products. Air Qual Atmos Health 12, 289–295 (2019). https://doi.org/10.1007/s11869-018-0643-8

Article Link: https://link.springer.com/article/10.1007/s11869-018-0643-8 - PDF

“The study focused on D-limonene because it is (a) a prevalent and dominant VOC in fragranced laundry products as well as other fragranced consumer products, (b) a suitable marker as it is generally found in fragranced laundry products but not in fragrance-free laundry products, (c) associated with a range of adverse human health and environmental effects, and classified as a potentially hazardous compound (SWA 2018), and (d) a terpene that readily reacts with ozone to generate a range of hazardous secondary air pollutants.”
(note: Graphic is from preceding article)

Table 3 GC/MS headspace analysis of VOCs emitted from the fragranced laundry detergent and the fragrance-free laundry detergent used in this study, listed according to retention time

Compound	CAS #	Fragranced detergent	Fragrance-free detergent
Acetaldehyde*	75-07-0	✓	✓
Ethanol*	64-17-5	✓	
Acetone*	67-64-1	✓	✓
2-methyl-Pentane*	107-83-5	✓	
2-methyl-2-Propanol	75-65-0		✓
2-Propen-1-ol*	107-18-6	✓	
2-methyl-Hexane*	591-76-4	✓	
2,3-dimethyl-Pentane*	565-59-3	✓	
3-methyl-Hexane*	589-34-4	✓	
1,3-dimethyl-Cyclopentane	2453-00-1	✓	
Ethylbenzene*	100-41-4		✓
Heptane*	142-82-5	✓	
methyl-Cyclohexane*	108-87-2	✓	
2,3,4-trimethyl-Hexane	921-47-1	✓	
(E)-3-Hexen-1-ol	928-97-2	✓	
1-Hexanol*	111-27-3	✓	
α-Pinene	80-56-8	✓	
2-methyl-ethyl ester Pentanoic acid	39255-32-8	✓	
Sabinene	3387-41-5	✓	
3-Carene	13466-78-9	✓	
β-Myrcene	123-35-3	✓	
β-Ocimene	3779-61-1	✓	
4-Hexen-1-ol, acetate	72237-36-6	✓	
Acetic acid, hexyl ester	142-92-7	✓	
Octanal	124-13-0	✓	
D-Limonene*	5989-27-5	✓	
β-Phellandrene	555-10-2	✓	
2,6-dimethy-l-5-Heptenal	106-72-9	✓	
2,6-dimethyl-7-Octen-2-ol	18479-58-8	✓	
1,3,4-Trimethyl-3-cyclohexenyl-1-carboxaldehyde	40702-26-9	✓	
Linalool*	78-70-6	✓	
3-methyl-5-propyl-Nonane	31081-18-2		✓
(E)- 7-Tetradecene	41446-63-3		✓
Cyclododecane	294-62-2		✓
Benzyl acetone	2550-26-7	✓	
4-tert-Butylcyclohexyl acetate	104-05-2	✓	
α-Terpinyl acetate	98-55-5	✓	
2-Carene	554-61-0	✓	
Lilial*	80-54-6	✓	

* Classified as hazardous under Safe Work Australia, Hazardous Chemical Information System (SWA 2018)

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"This study demonstrated the **improvements to air quality after switching from fragranced to fragrance-free products.** It found that, by a change to fragrance-free laundry products, concentrations of D-limonene can be almost completely eliminated from the dryer vent emissions. This strategy may also reduce the formation and concentrations of secondary pollutants such as **formaldehyde**, **acetaldehyde**, and ultrafine particles. Findings from this study can provide an important foundation for future research, and for demonstrating cost-effective strategies to reduce VOC emissions and personal exposures."

11. Fragrance compounds: The wolves in sheep's clothings

Patel S. Fragrance compounds: The wolves in sheep's clothings. Med Hypotheses. 2017 May;102:106-111. doi: 10.1016/j.mehy.2017.03.025. Epub 2017 Mar 22. PMID: 28478814.

Article Title: https://pubmed.ncbi.nlm.nih.gov/28478814/

"It is deplorable and alarming that awareness of the threats of perfume allergy is very low. Tricked by aggressive advertisement and to improve aesthetic appeal, people are exposing themselves to multiple chemical fragrance compounds. Further, it is a matter of concern that an alert individual cannot escape the perils of fragrances by mere lifestyle revision, and avoidance of the chemicals. Like the harms of passive smoking, passive exposure to the perfumes occurs in a number of public places. In realization of the dangers of peanut allergy to vulnerable individuals, peanut was pulled off from the food platter in passenger planes. Similar awareness and action is needed for perfumes as well.… An aware individual does not deserve to get the brunt of someone else's reckless lifestyle choices. Also, the cleaning staff in public places must be trained so as to ensure prevention of perfume abuse i.e. excess usage."

"A study found traces of musk fragrances such as galaxolide, tonalide, cashmeran, and UV-filters in marine species (mussel, clam, flounder, herring and mullet) and macroalgae, which constitute seafood. These bioaccumulated xenobiotics will ultimately reach to the human body via the food chain"

"Perfume manufacturers do not disclose the ingredients and quantity of the fragrance compounds in the name of 'trade secret'. Though they ought to abide by ethics, for profit and the goals of high market share, they forgo those. With the help of unscrupulous advertisements and sponsored research reports, they keep luring naive and unaware consumers.… It is appalling that even if people know the threats, they continue using these toxins, resonating the ''death wish" concept discussed in the popular TV series "Mad men".... The fragrance compounds so ubiquitous in modern times initiate vicious cycles of 'exposure – pathologies – drugs', which must be understood, information disseminated and terminated. Based on the review work and hypotheses, it can be stated that perfumes and other fragrance compounds in day-to-day consumer products are 'slow killers with fatal punch'.

"Growing recognition of the widespread use of fragrances in modern society is alarming. These pleasant-seeming deleterious compounds are the causal factors of a wide array of **immuneneural**- **hormonal health issues**. **Allergy**, **irritation**, **migraine**, **asthma**, **depression**, **high blood pressure**, **diabetes** and other symptoms should not be trivialized. Unheeded, and continued, the fragrance compounds can lead to **gynaecomastia**, **cancers**, **gender manipulation**, **teratogenicity**."

"**Creating public awareness is essential to avoid grave health consequences**. Toxicology research on perfumes must be prioritized, just like other urgent topics like 'antibiotics-drug resistance' and 'pesticide-food safety'. This review 'though barely scratches the surface' of the enormous health threats of 'synthetic fragrances' is expected to evoke alertness."
[Note: Gynaecomastia is enlarged male breast tissue**]**

12. *Health risks of chemicals in consumer products: A review*

Li D, Suh S. Health risks of chemicals in consumer products: A review. Environ Int. 2019 Feb;123:580-587. doi: 10.1016/j.envint.2018.12.033. Epub 2019 Jan 7. PMID: 30622082.
Article Link: https://pubmed.ncbi.nlm.nih.gov/30622082/ - Full Text

"It should also be noted that some chemicals have multiple functional uses, while we chose the most dominant functional use for each chemical. An example is the grouping of **phthalates**. Despite categorized as plasticizer together in this review, several phthalates such as **diethyl phthalate and dimethyl phthalate are used as solvents in personal care products and cosmetics as carriers of fragrance** (Schettler, 2006)."

"…we found that the volume of the peer-reviewed literature that addresses human health risks of the chemicals in consumer products did grow over the last two decades, while its growth could by no means match the speed of increasing volume and diversity of the chemicals produced and used in consumer products by the society. This **growing gap between increasing reliance on chemicals in consumer products and our knowledge on their human health risks raises a potential public health concern**, given the pervasive nature of today's mass production and consumption practice."

13. *Emission characteristics of VOCs emitted from consumer and commercial products and their ozone formation potential*

Dinh TV, Kim SY, Son YS, Choi IY, Park SR, Sunwoo Y, Kim JC. Emission characteristics of VOCs emitted from consumer and commercial products and their ozone formation potential. Environ Sci Pollut Res Int. 2015 Jun;22(12):9345-55. doi: 10.1007/s11356-015-4092-8. Epub 2015 Jan 21. PMID: 25601614.
Article Link: https://pubmed.ncbi.nlm.nih.gov/25601614/

"The characteristics of volatile organic compounds (VOCs) emitted from several consumer and commercial products (**body wash**, dishwashing detergent, air freshener, windshield washer fluid, lubricant, hair spray, and insecticide) were studied and compared."

"In the spray products, 21.6–96.4 % of the VOCs were propane, iso-butane, and n-butane, which are the components of liquefied petroleum gas. **Monoterpene** (C10H16) was the dominant component of the VOCs in the non-spray products (e.g., body wash, 53–88 %)."

"Besides comprising **hazardous VOCs**, VOCs from consumer products were also **ozone precursors**."
"The TVOCs from spray products (insecticide, **hair spray**, and lubricant) were higher than those from the liquid products such as the windshield washer fluid, dishwashing detergent, **body wash**, and air freshener."

"Limonene and 1-propanol were the components of one dishwashing detergent. In contrast, another dishwashing detergent comprised **1,3-dioxane**, **ethanol**, **ethyl acetate**, **limonene**, **β-myrcene**, 3-pentanol,

and **α-pinene** (Kwon et al. 2007, 2008)."

"**Benzene, n-hexane,** and **ethylbenzene** were observed in the **body washes** and the **air fresheners.** Benzene was classified as Group A of the US EPA lists of **known human carcinogen** (WHO 2010). The unit cancer risk of 1 μg/m3 of benzene is 2.2–7.8 in a million (WHO 2010). The unit risk of **leukemia** per 1 μg/m3 air concentration is 6 in a million. Therefore, **long-term exposure to a considerable amount of benzene in those products might cause health risk,** which should be investigated in future researchers."

"A **longterm exposure of n-hexane may damage the nervous system**. Exposure to 650 ppm **n-hexane** for 2–4 months causes numbness of the arms and legs (Pohanish 2012). **Ethylbenzene** irritates the eyes, skin, and respiratory tract. A **long-term exposure of ethylbenzene may cause kidney and liver disease**…."

"**Toluene and styrene were detected in body washes,** dishwashing detergents, and windshield washer fluids. It was reported that inhalation of 200–500 ppm **toluene may cause headache, nausea, and loss of appetite** (Pohanish 2012)."

"Styrene is considered as a possible carcinogenic to humans. Inhalation of above 100 ppm **styrene may cause headache, inflammation of the lung, kidney and liver damage, and death** (Pohanish 2012). Since **body washes** are used popularly and frequently, **longterm exposure to the above compounds may cause health damage."**

[Note: Limonene is a common skin sensitizer and known allergen in fragrance and fragranced products. Limonene (natural or synthetic) is a terpene. Terpenes can create formaldehyde and particulate matter in air as secondary pollutants. Limonene is on the IFRA list as a fragrance ingredient.**]**
[Note: Benzene is a reported fragrance ingredient in the CSCP Product Database.**]**
[Note: N-Hexane is used to extract fragrances and was on the IFRA list until 2015.**]**
[Note: Toluene (often a nail polish thinner) is used as a solvent or fragrance in perfume and bath products on the CSPC Product Database. Toluene is on the IFRA list and on the EPA's Priority Pollutant List.**]**
[Note: Styrene is "primarily a synthetic chemical**"** used in fragrance. It is on the CSPC list as 'parfum/fragrance' and also on the IFRA list.**]**
[Note: Ethyl benzene is listed for purchase as a perfuming agent.**]**

Classification of odors associated with migraine attacks: a cross-sectional study.

Imai N, Osanai A, Moriya A, Katsuki M, Kitamura E. Classification of odors associated with migraine attacks: a cross-sectional study. Sci Rep. 2023 May 25;13(1):8469. doi: 10.1038/s41598-023-35211-7. PMID: 37230996; PMCID: PMC10213061.
Article Link: https://pubmed.ncbi.nlm.nih.gov/37230996/ - PDF

"The most frequently reported odors associated with migraine attacks were **perfume (55.4%),** tobacco (47.5%), **fabric softener (32.7%),** body odor (32.7%), garbage (24.8%), hairdressing products (22.8%), cars (22.8%), and sweat (19.8%) (Table 2). No patient reported migraine attacks associated with the scent of lemon, tangerine, or apple. The most frequent odors aside from the 35 items of the questionnaire were ikebana (Japanese flower arrangement) (5.9%) and gasoline (3.0%)."

14. ALSO SEE SECTIONS: Respiratory/Pulmonary (Nose & Lungs), Inflammation

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Website: https://www.fragrancefreecoalitionusa.com/

DISCLAIMER:
Poster and Document are for reference and educational purposes only.

OBESITY

Metabolic Dysfunction, Adipose Tissue Dysfunction, Overweight, Adipogenesis

1. *Obesogenic endocrine disrupting chemicals: identifying knowledge gaps*

Veiga-Lopez A, Pu Y, Gingrich J, Padmanabhan V. Obesogenic Endocrine Disrupting Chemicals: Identifying Knowledge Gaps. Trends Endocrinol Metab. 2018 Sep;29(9):607-625. doi: 10.1016/j.tem.2018.06.003. Epub 2018 Jul 13. PMID: 30017741; PMCID: PMC6098722.
Article Link: https://pubmed.ncbi.nlm.nih.gov/30017741/ - PDF

"**EDCs are chemicals that interfere with the endocrine system**, including **adipose tissue.** Historically considered as an organ whose main function is energy storage, the adipose tissue secretes numerous hormones and other factors such as leptin, adiponectin, resistin, adipsin, angiotensin, and free fatty acids. These are involved in a broad range of physiological actions including **glucose and lipid metabolism**, **appetite control**, **vascular tone control**, **angiogenesis**, and **immunity** [11]. EDCs that not only increase adipose mass / adipogenesis but also result in other **metabolic dysfunctions** are also referred to as **metabolic disrupting chemicals** (MDCs) [12]."

"Diesters of 1,2-benzenedicarboxylic acid, or **phthalates**, are used as industrial plasticizers of polyvinyl chloride to be used in floorings, vinyl upholstery, **car interiors**, and **toys** [72], plastic food packaging [73], as well as in **cosmetic products** such as **lotions and perfumes** [74]...."

The CHAMACOS cohort study reported a positive association between early life exposure (at 14 and 26 weeks of gestation) to **diethyl phthalate (DEP)**, **dibutyl phthalate (DBP)** and **di-(2-ethylhexyl)-phthalate (DEHP)** and **increase in childhood body weight, BMI, waist circumference,** and **percent body fat in 5–12 year old children,** supportive of **phthalates being developmental obesogens** [78]."

"Another study also found a positive association between mono-3-carboxypropyl phthalate at 27 to 34 weeks of gestation and **overweight/obese status in 4–7 year-old children** [79]."

2. *Endocrine disruptor chemicals as obesogen and diabetogen: Clinical and mechanistic evidence*

Kurşunoğlu NE, Sarer Yurekli BP. Endocrine disruptor chemicals as obesogen and diabetogen: Clinical and mechanistic evidence. World J Clin Cases. 2022 Nov 6;10(31):11226-11239. doi: 10.12998/wjcc.v10.i31.11226. PMID: 36387809; PMCID: PMC9649566.
Article Link: https://pubmed.ncbi.nlm.nih.gov/36387809/

"Besides the **obesogenic effect**, **EDCs** can cause **type 2 diabetes mellitus** through alteration in ß cell function and morphology and **insulin resistance**."

Medical devices, including parenteral feeding tubes, **personal care products** such as nail polish and **perfume,** food packaging, and toys contain various **phthalates**[49]. Unfortunately, phthalates are poorly bio-degradable and highly bioaccumulative in the food chain[50].

"High phthalate exposure has been linked with increased threat of obesity and **infertility**, **increased body mass index** (BMI) and **waist circumference**, **insulin resistance**, and a **change in thyroid hormones**[49,52]".

"In this context, **perinatal exposure** can be important as far as the permanent and transgenerational effects are concerned. **EDCs promote adipogenesis leading to fat accumulation**, which causes **alteration in lipid metabolism and satiety as obesogens**. EDCs have shown the potential to induce adipose tissue dysfunction not only in white adipocytes but in brown and beige fat as well."

[Note: Endocrine Disrupting Chemicals (EDC's) are commonly used in perfumes and fragranced products as preservatives or fragrance. What are EDC's and how can they affect us?**]**

[Note: Phthalates are synthetic odorless plasticizers used as solvents, binders or fixatives in many fragrances. Why are phthalates in the news? Phthalates are considered Endocrine Disrupting Chemicals.
On the California Safe Cosmetics Program Product Database: DEP, DIDP, and DBP are reported as fragrance while DEHP and DBP are perfume solvents. IFRA lists DEP and DMP, as "reported fragrance ingredients".**]**

3. *Need of the hour: to raise awareness on vicious fragrances and synthetic musks*

Patel, S., Homaei, A. & Sharifian, S. Need of the hour: to raise awareness on vicious fragrances and synthetic musks. Environ Dev Sustain 23, 4764–4781 (2021). https://doi.org/10.1007/s10668-020-00829-4
Article Link: https://link.springer.com/article/10.1007/s10668-020-00829-4

"The exposure to the **synthetic fragrances and musks**, which are produced in quantities of thousands of tons per year, has been shown to **elicit several pathologies**."

"The **fragrance compounds** are regarded as **toxins by the human immune system**, and to eliminate them, cytochrome enzymes, especially aromatases, are overexpressed. These enzymes also **convert androgens into estrogens,** but **excess estrogen production affects the endocrine system** in both males and females."

"It is increasingly being evident that all diseases have common roots, i.e., **inflammation**."

"**The unprecedented prevalence of diabetes, obesity, cancer, and depression, among others pathologies, is tied to the limitless usage of fragrance compounds."**

4. *Obesogens: How They Are Identified and Molecular Mechanisms Underlying Their Action*

Mohajer N, Du CY, Checkcinco C, Blumberg B. Obesogens: How They Are Identified and Molecular Mechanisms Underlying Their Action. Front Endocrinol (Lausanne). 2021 Nov 25;12:780888. doi: 10.3389/fendo.2021.780888. PMID: 34899613; PMCID: PMC8655100.
Article Link: https://pubmed.ncbi.nlm.nih.gov/34899613/ - PDF

"Increasing evidence has linked chemical exposure, ingestion, and inhalation of industrial compounds to obesity and other metabolic and endocrine related diseases."

“ A subset of **EDCs act as obesogens** – chemicals that lead to increased fat storage, in vivo after exposure [reviewed in (22–24)]. The environmental obesogen model proposes that obesogens cause greater susceptibility to weight gain, lipid storage, and energy imbalances that lead to obesity (25). In 2015, the Parma consensus broadened the definition of obesogens to include EDCs that affect other obesity related metabolic conditions that drive **metabolic syndrome**, such as **insulin resistance**, **hypertension**, **dyslipidemi**a, and **hyperglycemia** (26).… Many chemical obesogens have been identified and numerous reviews have been written about them in recent years (22–24, 28). ”

“Obesity Is More Than Calories In/Out”

“**Dibutyl phthalate (DBP)** is a plasticizer found in plastic products such as toothbrushes, food wrappers, and in common household items as a **fragrance-enhancing additive**. DBP is a known EDC and obesogen that can affect fat accumulation and metabolic processes. DBP activates multiple receptors including the estrogen receptor, constitutive androstane receptor (CAR), the pregnane X receptor (PXR), and peroxisome proliferator-activated receptor subtypes (PPARα, -β, and -γ), which regulate the expression of genes encoding metabolic enzymes.”

“The study of EDCs offers insights into how normal metabolic processes can be disrupted, and why the population is becoming unhealthier, particularly with respect to **metabolic disease**.”

“Avoidance of exposure through ingestion, inhalation, and direct contact is a definitive way to prevent metabolic disruption caused by EDCs before disease develops. In vivo transgenerational studies, which were only briefly discussed in this review, revealed **epigenomic reprogramming** effects and **phenotypical metabolic effects**…. The existence of such “generational toxicity” demands further education about exposure prevention and transparency to keep the public and future generations safe from the effects of exposure to harmful chemicals.”

[Note: Table 1 from this article mentions Tonalide, “a musk compound used as a synthetic perfume”.**]**
[Note: Endocrine Disrupting Chemicals (EDC’s) are commonly used in perfumes and fragranced products as preservatives or fragrance. What are EDC’s and how can they affect us?**]**

[Note: Phthalates are synthetic odorless plasticizers used as solvents, binders or fixatives in many fragrances. Why are phthalates in the news? Phthalates are considered Endocrine Disrupting Chemicals.
On the California Safe Cosmetics Program Product Database: DEP, DIDP, and DBP are reported as fragrance while DEHP and DBP are perfume solvents. IFRA lists DEP and DMP, as “reported fragrance ingredients”.**]**

5. *Obesogens: An Environmental Link to Obesity*

Holtcamp W. Obesogens: an environmental link to obesity. Environ Health Perspect. 2012 Feb;120(2):a62-8. doi: 10.1289/ehp.120-a62. PMID: 22296745; PMCID: PMC3279464.
Article Link: https://pubmed.ncbi.nlm.nih.gov/22296745/

“Most known or suspected **obesogens** are **endocrine disruptors**. Many are widespread, and exposures are suspected or confirmed to be quite common.”.

“Phthalates, plasticizers that also have been related to obesity in humans, occur in many PVC items as well as in **scented items such as air fresheners, laundry products,** and **personal care products.”**

[Note: Endocrine Disrupting Chemicals (EDC's) are commonly used in perfumes and fragranced products as preservatives or fragrance. What are EDC's and how can they affect us?**]**

[Note: Phthalates are synthetic odorless plasticizers used as solvents, binders or fixatives in many fragrances. Why are phthalates in the news? Phthalates are considered Endocrine Disrupting Chemicals.
On the California Safe Cosmetics Program Product Database: DEP, DIDP, and DBP are reported as fragrance while DEHP and DBP are perfume solvents. IFRA lists DEP and DMP, as "reported fragrance ingredients".**]**

6. *History of the Obesogen Field: Looking Back to Look Forward*

Heindel JJ. History of the Obesogen Field: Looking Back to Look Forward. Front Endocrinol (Lausanne). 2019 Jan 29;10:14. doi: 10.3389/fendo.2019.00014. PMID: 30761083; PMCID: PMC6362096.
Article Link: https://pubmed.ncbi.nlm.nih.gov/30761083/

"Exposure to EDCs during early development (DOHaD) has been shown to **increase susceptibility to a variety of diseases including infertility, asthma, breast and prostate cancer, early puberty, susceptibility to infections, heart disease, autoimmune disease, and attention deficit hyperactivity disorder/learning disability**. The chemicals that she noted as having the ability to cause weight gain include organochlorine pesticides, carbamates, polychlorinated biphenols, plastics such as **phthalates** and bisphenol A (BPA), heavy metals and solvents.**"**

"EDCs are found in a wide variety of products including pesticides/herbicides/fungicides, flame retardants, surfactants, plastics, **sunscreens, cosmetics,** and **personal care products,** etc. [reviewed in (5)]."

"Originally, **EDCs** were shown to interfere with **estrogen, androgen and thyroid hormone signaling (7, 8) resulting in diseases and dysfunctions in reproduction, learning, memory, and behavior."**

[Note: Endocrine Disrupting Chemicals (EDC's) are commonly used in perfumes and fragranced products as preservatives or fragrance. What are EDC's and how can they affect us?**]**

7. *Is the Diabetes Epidemic Primarily Due to Toxins?*

Pizzorno J. Is the Diabetes Epidemic Primarily Due to Toxins? Integr Med (Encinitas). 2016 Aug;15(4):8-17. PMID: 27574488; PMCID: PMC4991654.
Article Link: https://pubmed.ncbi.nlm.nih.gov/27574488/ - PDF

"The incidence of diabetes has increased 7 to 10-fold in the past 50 y. Although increased sugar consumption, obesity, and lack of exercise certainly contribute, the effect of environmental toxins may be far greater. The data are so compelling that some researchers now label these toxins as ***diabetogens*.** This editorial summarizes the research showing which toxins are the worst offenders, how they disrupt blood sugar control, where they come from, how to assess body load, and strategies for detoxification and excretion."

"Another possibility is the increased incidence of obesity which is a known major risk factor for diabetes. However, the **obesity epidemic appears because of the same causes as diabetes: diabetogens,** many of which are also called ***obesogens***. Of particular significance is the surprising observation that obese people with low levels of persistent organic pollutants (POPs) **do not** have an increased risk of diabetes.3 In contrast,

as can be seen in Figure 3, the diabetes epidemic does correlate with the rate of release of POPs into the environment…. More convincing is the correlation between body load of POPs and risk of metabolic syndrome as seen in Figure 4, and the association is synergistic. When POP levels versus diabetes risk is examined, the case becomes even more compelling, as shown in Figure 5.'

"Adding up the numbers shows potentially the **whole epidemic is apparently due to the massive increase in body load of toxins**. A big caveat is that there is a real problem with nonindependence of the correlations and that many of these **diabetogens** are also being labeled ***obesogens***, as there is substantial overlap of mechanisms of damage. Nonetheless, even if we do not know the exact percentage contribution of each toxin, their role in the epidemic appears undeniable."

"**Phthalates** are a family of organic chemicals used as plasticizers (to increase flexibility, transparency, and durability) and for multiple manufactured product purposes, such as **to solubilize and stabilize fragrances** in cosmetics."

"**Diethyl phthalate** and **dibutyl phthalate are especially common in health and beauty aids, except in Europe where they have now been banned due the very large amount of research showing their toxicity**, regardless of the source. As can be seen in Figure 11, **phthalate levels in the blood directly correlate with use of health and beauty aids**."

8. *The new kids on the block: emerging obesogens*

Chamorro-Garcia R, Veiga-Lopez A. The new kids on the block: Emerging obesogens. Adv Pharmacol. 2021;92:457-484. doi: 10.1016/bs.apha.2021.05.003. Epub 2021 Jul 8. PMID: 34452694; PMCID: PMC8941623.
Article Link: https://pubmed.ncbi.nlm.nih.gov/34452694/

"Human urine levels of **alkylphenols** have been estimated in ~12 ng/ml (You et al. 2011) **Alkylphenols** are considered **xenoestrogens** (Soto et al. 1991) and their **effects on the nervous and immune systems have been widely studied** (Acir and Guenther 2018). Because **alkylphenols accumulate in human adipose tissue** (Lopez-Espinosa et al. 2009; Muller et al. 1998) non-ethoxylated alkylphenols, such as 4-nonyphenol and octylphenol have been studied in the context of **adipogenesis**."

"Using the 3T3-L1 cell model, Kassotis et al., 2018 (Kassotis et al. 2018b) tested a mixture of 23 commonly used unconventional oil and gas chemicals (UOG), including acrylamide, **alkylphenols**, **benzenes**, bronopol, **diethanolamine**, **ethanols**, ethylene glycol, **propylene glycol**, **styrene**, **toluene**, and **xylens**. This **mixture resulted in an increase in tryglyceride accumulation and preadipocyte proliferation at 10 µM and 1 µM,** respectively (Kassotis et al. 2018b)."

"These findings further demonstrate that chemicals that can independently promote adipogenesis, such as acrylamide and **alkylphenols** (Kassotis et al. 2018a; Lee and Pyo 2019) **can act as obesogens in environmentally collected samples containing a complex chemical mixture**. **However, developmental exposure to a similar UOG mixture altered body weight and energy expenditure, but not body composition in C57BL/6 mice (Balise et al. 2019a; Balise et al. 2019b), which highlights the need to validate in vitro findings using animal models**."

"**Alteration of adipose tissue size and homeostasis play an important role not only in obesity, but also in the development of other metabolic co-morbidities such as type 2 diabetes and cardiovascular**

diseases (Bluher 2020). To note, obesity also induces wide-reaching systemic effects on other systems, such as the **reproductive and the immune system** (Francisco et al. 2018; Leisegang et al. 2021; Snider and Wood 2019)."

[Note: Alkylphenols are synthetic and used as building blocks for fragrance. Two alkylphenols on IFRA's list are propylphenol and butylphenol. With synthetic chemicals, Aquatic environment health is a concern.**]**
[Note: Benzene is a reported fragrance ingredient in the CSCP Product Database.**]**
[Note: Styrene is "primarily a synthetic chemical**"** used in fragrance. It is on the CSPC list as 'parfum/fragrance' and also on the IFRA list.**]**

[Note: Toluene (often a nail polish thinner) is used as a solvent or fragrance in perfume and bath products on the CSPC Product Database. Toluene is on the IFRA list and on the EPA's Priority Pollutant List.**]**
[Note: Xylene "occurs naturally in petroleum and coal tar, and is major component of gasoline and fuel oil". Xylene is used as a musk fragrance. Xylene is on IFRA.**]**

[Note: Fragrance is considered the new 'second hand smoke', **"**The parallels between second-hand smoke and synthetic fragrance use are many. At its core, both are battles over indoor air quality **"** - quote and link from De Vader, Christy L. & Barker, Paxson.
Chemicals that cigarettes/cigarette smoke and fragranced products can have in common are: Acetone, Formaldehyde, Benzene, acetaldehyde, terpenoids and phenols.**]**

9. *Long-Term Outcomes after Phthalate Exposure: Food Intake, Weight Gain, Fat Storage, and Fertility in Mice*

Holtcamp W. Long-term outcomes after phthalate exposure: food intake, weight gain, fat storage, and fertility in mice. Environ Health Perspect. 2012 Aug;120(8):a320. doi: 10.1289/ehp.120-a320a. PMID: 22854284; PMCID: PMC3440097.
Article Link: https://pubmed.ncbi.nlm.nih.gov/22854284/ - PDF

"Exposure to **endocrine-disrupting chemicals (EDCs)**, particularly **in utero**, is suspected to contribute to **obesity**, **diabetes**, **hypertension**, and **reproductive abnormalities**. Di(2-ethylhexyl) phthalate **(DEHP)**, a plasticizer found in **cosmetics**, **fragrances,** food packaging, and polyvinyl chloride, is one such EDC. Human studies have found associations between urinary metabolites of DEHP and other phthalates and **increased body mass** in humans, and maternal exposure to DEHP has been associated with **impaired gonadal development and fertility** in baby boys."

[Note: Endocrine Disrupting Chemicals (EDC's) are commonly used in perfumes and fragranced products as preservatives or fragrance. What are EDC's and how can they affect us?**]**

10. *Health risks of chemicals in consumer products: A review*

Li D, Suh S. Health risks of chemicals in consumer products: A review. Environ Int. 2019 Feb;123:580-587. doi: 10.1016/j.envint.2018.12.033. Epub 2019 Jan 7. PMID: 30622082.
Article Link: https://pubmed.ncbi.nlm.nih.gov/30622082/ - Full Text

"It should also be noted that some chemicals have multiple functional uses, while we chose the most dominant functional use for each chemical. An example is the grouping of **phthalates**. Despite categorized as plasticizer

together in this review, several phthalates such as **diethyl phthalate and dimethyl phthalate are used as solvents in personal care products and cosmetics as carriers of fragrance** (Schettler, 2006)."

"…we found that the volume of the peer-reviewed literature that addresses human health risks of the chemicals in consumer products did grow over the last two decades, while its growth could by no means match the speed of increasing volume and diversity of the chemicals produced and used in consumer products by the society. This **growing gap between increasing reliance on chemicals in consumer products and our knowledge on their human health risks raises a potential public health concern**, given the pervasive nature of today's mass production and consumption practice."

11. *Overview of air pollution and endocrine disorders*

Darbre PD. Overview of air pollution and endocrine disorders. Int J Gen Med. 2018 May 23;11:191-207. doi: 10.2147/IJGM.S102230. PMID: 29872334; PMCID: PMC5973437.
Article Link: https://pubmed.ncbi.nlm.nih.gov/29872334/ - PDF

"Abstract: Over recent years, **many environmental pollutant chemicals have been shown to possess the ability to interfere in the functioning of the endocrine system and have been termed endocrine disrupting chemicals (EDCs).** These compounds exist in air as volatile or semi-volatile compounds in the gas phase or attached to particulate matter. They include components of plastics (**phthalates**, bisphenol A), components of consumer goods (parabens, triclosan, **alkylphenols, fragrance compounds**,… This review summarizes current knowledge concerning the sources of EDCs in air, measurements of levels of EDCs in air, and the potential for adverse effects of EDCs in air on human endocrine health."

"Whilst much has been written over the past two decades of the actions of EDCs from oral and dermal exposure, research is increasingly documenting their presence in air which opens a debate on the potential for adverse consequences from inhalation of EDCs."

"Since estrogens and androgens regulate reproductive functions, many of the reported effects of the exposure to EDCs have been on adverse consequences for **reproductive health**. However, physiological consequences have been demonstrated as resulting from disruption to **thyroid function** and alterations to **thyroid hormone levels**. More widely, adverse effects have also been reported as resulting from alterations to adrenocortical function, impairment of the immune system, and the loss of control on energy metabolism including development of **obesity, diabetes,** and **cardiovascular disease.**"

"**Prior** to and **just after birth** are especially **vulnerable times for exposure to EDCs** because disruption of hormonal activity in the developing embryo/fetus or young baby can have **consequences for health in adult life** most notably on **reproductive abilities, brain function, immunity, and metabolic programming**."

"**Man-made EDCs** are contained within many agricultural, industrial, and **consumer products,** which due to their widespread use, have become ubiquitous environmental pollutants. This includes components of pesticides and herbicides used both in an agricultural setting and in urban environments…. EDCs are also widely used in **personal care products** (PCPs) for purposes of preservation, deodorant, antiperspirant, conditioning, and **fragrance**."

"**EDCs** are contained in domestic pesticide sprays, **air fresheners**, **laundry detergents**, **household cleaners**, paints, adhesives, and plastics, all of which may be used routinely indoors…. As a result, **many EDCs are now measurable in indoor air and in indoor dust, often at higher levels than in outdoor air**…"

12. *Effects of Di(2-ethylhexyl) Phthalate (DEHP) on Female Fertility and Adipogenesis in C3H/N Mice*

Schmidt JS, Schaedlich K, Fiandanese N, Pocar P, Fischer B. Effects of di(2-ethylhexyl) phthalate (DEHP) on female fertility and adipogenesis in C3H/N mice. Environ Health Perspect. 2012 Aug;120(8):1123-9. doi: 10.1289/ehp.1104016. Epub 2012 May 15. PMID: 22588786; PMCID: PMC3440070.

Article Link: https://pubmed.ncbi.nlm.nih.gov/22588786/ - PDF

"Background**: Di(2-ethylhexyl) phthalate (DEHP)** and its metabolites are known to affect **lipid metabolism** and **adipogenesis**, mainly by activation of peroxisome proliferator-activated receptors (PPARs). Exposure to DEHP has been linked with **testicular impairment** and **male subfertility**. However, the effects of DEHP on female reproductive health and metabolism have not been studied in detail."

"Objective: We examined the effects of dietary DEHP exposure on **metabolism** and **fertility** in female mice."
"Results: In study I, DEHP-exposed F0 females (all dose groups) had a **significant increase in body weight**, food intake, and visceral adipose tissue compared with controls. In the 500-mg DEHP group, PPARα and PPARγ transcripts were **significantly changed in liver tissue**. In the same group, PPARγ mRNA was significantly reduced in liver but not in fat tissue. In addition, leptin and FABP4 (fatty acid binding protein 4) mRNA were increased in adipose tissue, whereas adiponectin was decreased. In study II, we detected a **100% abortion rate** in F0 dams in the 500-mg group. **F1 offspring exposed in utero and during lactation had an increase in visceral fat tissue and body weight**."

[Note: Phthalates are synthetic odorless plasticizers used as solvents, binders or fixatives in many fragrances. Why are phthalates in the news? Phthalates are considered Endocrine Disrupting Chemicals.
On the California Safe Cosmetics Program Product Database: DEP, DIDP, and DBP are reported as fragrance while DEHP and DBP are perfume solvents. IFRA lists DEP and DMP, as "reported fragrance ingredients".**]**

13. *Developmental Exposure to Endocrine Disrupting Chemicals and Its Impact on Cardio-Metabolic-Renal Health*

Singh RD, Koshta K, Tiwari R, Khan H, Sharma V, Srivastava V. Developmental Exposure to Endocrine Disrupting Chemicals and Its Impact on Cardio-Metabolic-Renal Health. Front Toxicol. 2021 Jul 5;3:663372. doi: 10.3389/ftox.2021.663372. PMID: 35295127; PMCID: PMC8915840.

Article Link: https://pubmed.ncbi.nlm.nih.gov/35295127/ - Free Full Text

"**Endocrine disrupting chemicals** (EDCs) include **phenols**, **phthalates**, parabens, flame retardants, heavy metals, pesticides, perfluorinated chemicals, UV filter components, triclosan, and organochlorines."

"**Cumulative exposure to mixtures of EDCs can lead to adverse effects on the health of the exposed individuals** (Crews et al., 2003). Multiple studies, including the studies of the National Health and Nutrition Examination Survey (NHANES), have shown that **about 75–97% of US and Asian adults have detectable levels of phthalates and phenols [bisphenol A (BPA) and polyfluoroalkyl chemicals] in their urine** (Silva et al., 2004; Calafat et al., 2007, 2008; Vandenberg et al., 2010; Zhang et al., 2011; Husøy et al., 2019)."

"Epidemiological and experimental studies have also linked **adult exposure to EDCs** with **abnormal male and female reproductive health**, **diabetes**, **obesity**, **cardiovascular** and **metabolic disorders**, **thyroid function**, and **hormone sensitive cancers** (Howard and Lee, 2012; Bodin et al., 2015; Heindel et al., 2015, 2017)."

"Children are also vulnerable to EDCs (Calafat et al., 2017; Hendryx and Luo, 2018), **making EDC exposure a major health concern for all age groups**."

"**Chronic kidney disease** is a growing health problem among children and adults. The incidence and the prevalence of chronic kidney disease (CKD) **among children have been steadily increasing since the 1980s**…. A number of traditional risk factors associated with CKD in children include hypertension, obesity, diabetes, and aberrant divalent mineral metabolism…. There is growing evidence that **links exposure to EDCs with early progression to end-stage renal disease** (ESRD) (Kataria et al., 2015)...."

"Early-life exposure to EDCs was associated with elevated levels of kidney toxicity markers such as albumin-to-creatinine ratio (ACR), estimated glomerular filtration rate (eGFR), and urinary protein-to-creatinine ratio (UPCR) in some human population studies (Li et al., 2012; Trasande et al., 2013a, 2014; Malits et al., 2018)."

[Note: Phthalates are synthetic odorless plasticizers used as solvents, binders or fixatives in many fragrances. Why are phthalates in the news? Phthalates are considered Endocrine Disrupting Chemicals.
On the California Safe Cosmetics Program Product Database: DEP, DIDP, and DBP are reported as fragrance while DEHP and DBP are perfume solvents. IFRA lists DEP and DMP, as "reported fragrance ingredients".**]**

[Note: Endocrine Disrupting Chemicals (EDC's) are commonly used in perfumes and fragranced products as preservatives or fragrance. What are EDC's and how can they affect us?**]**

14. *Immune System: An Emerging Player in Mediating Effects of Endocrine Disruptors on Metabolic Health*

Bansal A, Henao-Mejia J, Simmons RA. Immune System: An Emerging Player in Mediating Effects of Endocrine Disruptors on Metabolic Health. Endocrinology. 2018 Jan 1;159(1):32-45. doi: 10.1210/en.2017-00882. PMID: 29145569; PMCID: PMC5761609.
Article Link: https://pubmed.ncbi.nlm.nih.gov/29145569/ - Full Article

"The incidence of metabolic disorders like type 2 diabetes and obesity continues to increase. In addition to the well-known contributors to these disorders, such as food intake and sedentary lifestyle, recent research in the exposure science discipline provides evidence that exposure to endocrine-disrupting chemicals like bisphenol A and **phthalates** via multiple routes (e.g., food, drink, **skin contact**) also contribute to the increased risk of metabolic disorders. Endocrine-disrupting chemicals (EDCs) can disrupt any aspect of hormone action. It is becoming increasingly clear that **EDCs** not only affect **endocrine function** but also **adversely affect immune system function."**

"Similarly, EDCs have been shown to increase endoplasmic reticulum stress in in vitro and in vivo studies involving kidney (104), pancreas (105, 106), and liver (107). Mitochondrial dysfunction and endoplasmic reticulum stress are associated with increased oxidative stress (108) and metabolic dysfunction (109).

Increased oxidative stress can activate various inflammatory pathways and increases the risk of metabolic abnormalities such as **insulin resistance**, **diabetes**, and **obesity** (Fig. 3)."

"Possible routes of EDC action on the immune system contributing to metabolic disorders. **By interacting with various receptors, altering the gut microbiome, inducing oxidative stress via mitochondrial dysfunction and/or endoplasmic reticulum stress, or via circadian disruption, EDCs trigger immune dysfunction in various tissues.** Together, this may contribute toward a perturbed metabolic health. See Fig. 3 legend for expansion of abbreviation

[Note: Endocrine Disrupting Chemicals (EDC's) are commonly used in perfumes and fragranced products as preservatives or fragrance. What are EDC's and how can they affect us?**]**

Obesogens: an environmental link to obesity. Environ Health Perspect

Holtcamp W. Obesogens: an environmental link to obesity. Environ Health Perspect. 2012 Feb;120(2):a62-8. doi: 10.1289/ehp.120-a62. PMID: 22296745; PMCID: PMC3279464.
https://pubmed.ncbi.nlm.nih.gov/22296745/ - PDF

"Phthalates, plasticizers that also have been related to obesity in humans,[31] occur in many PVC items as well as in scented items such as air fresheners, laundry products, and personal care products."

"Most known or suspected obesogens are endocrine disruptors. Many are widespread,[29] and exposures are suspected or confirmed to be quite common."

15. ALSO SEE SECTIONS: Respiratory / Pulmonary, Diabetes, Airborne Contact Dermatitis

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Website: https://www.fragrancefreecoalitionusa.com/

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Poster and Document are for reference and educational purposes only.

PRENATAL

In Utero, DNA Damage, teratogens, cryptorchidism, hypospadias, anti-androgenic
"May be Cytotoxic to Human Fetal Brain Development"
Also see: Infertility

1. *Environmental factors in the development of autism spectrum disorders*

Sealey LA, Hughes BW, Sriskanda AN, Guest JR, Gibson AD, Johnson-Williams L, Pace DG, Bagasra O. Environmental factors in the development of autism spectrum disorders. Environ Int. 2016 Mar;88:288-298. doi: 10.1016/j.envint.2015.12.021. Epub 2016 Jan 28. PMID: 26826339.
Article Link: https://pubmed.ncbi.nlm.nih.gov/26826339/ - PDF

"Many modern companies do not disclose the industrial secrets in many of their fragrances that are, in reality, a complex concoction of synthetic chemicals and natural essences, which often have been found to be petrochemicals."

"Among those are chemicals, such as **musk ketone** and **diethyl phthalate**, which are responsible for **allergic reactions and hormone disruption**…. Although these **chemicals have been found to accumulate in human tissues,** they have not yet been adequately analyzed for safety in products used by unsuspecting humans. **As a result of a giant loophole in the Federal Fair Packaging and Labeling Act of 1973**, which explicitly exempts fragrance producers from having to disclose cosmetic ingredients on product labels, fragrance concealment is not illegal and is often used by the industry to hide from the public the full list of ingredients, even substances that can cause grave health problems (Environmental Working Group (EWG), 2005). It is a common practice for businesses to list the chemicals as simply "fragrance," which may mean that **the majority of the ingredients are never revealed to buyers**."

"Even worse, people who use cologne, fragrances, body spray, and other scented cosmetics are blindly exposed to dangerous chemicals since the Food and Drug Administration lacks authority to control mandates to manufacturers that require testing of all fragrances for safety, before being released to the public."

"Also, during pregnancy, the use of fragrances and other cosmetics may actually expose the developing fetus to **diethyl phthalate (DEP)**, a common fragrance solvent that can cause **abnormal development of reproductive organs in infant males**, **Attention Deficit Disorder** in children, and **sperm damage in adults**."

"The role of environmental factors like **fragrances**, glyphosate **and other synthetic chemicals derived from petrochemicals containing carcinogenic, mutagenic, hormones disturbing and neuromodifying capabilities** in the molecular and cellular pathogeneses of ASD has not been evaluated. This is partly due to the 1973 FDA decision to exempt fragrances and cosmetics from appropriate testing, which is generally required for any consumer item that enters the human body and is metabolized by human metabolic pathways."

2. *Endocrine disruptor chemicals as obesogen and diabetogen: Clinical and mechanistic evidence*

Kurşunoğlu NE, Sarer Yurekli BP. Endocrine disruptor chemicals as obesogen and diabetogen: Clinical and mechanistic evidence. World J Clin Cases. 2022 Nov 6;10(31):11226-11239. doi: 10.12998/wjcc.v10.i31.11226. PMID: 36387809; PMCID: PMC9649566.
Article Link: https://pubmed.ncbi.nlm.nih.gov/36387809/

"Besides the **obesogenic effect**, **EDCs** can cause **type 2 diabetes mellitus** through alteration in ß cell function and morphology and **insulin resistance**."

Medical devices, including parenteral feeding tubes, **personal care products** such as nail polish and **perfume,** food packaging, and toys contain various **phthalates**[49]. Unfortunately, phthalates are poorly bio-degradable and highly bioaccumulative in the food chain[50].

"High phthalate exposure has been linked with increased threat of obesity and **infertility**, **increased body mass index** (BMI) and **waist circumference**, **insulin resistance**, and a **change in thyroid hormones**[49,52]".

"In this context, **perinatal exposure** can be important as far as the permanent and transgenerational effects are concerned. **EDCs promote adipogenesis leading to fat accumulation**, which causes **alteration in lipid metabolism and satiety as obesogens**. EDCs have shown the potential to induce adipose tissue dysfunction not only in white adipocytes but in brown and beige fat as well."

[Note: Endocrine Disrupting Chemicals (EDC's) are commonly used in perfumes and fragranced products as preservatives or fragrance. What are EDC's and how can they affect us?**]**

[Note: Phthalates are synthetic odorless plasticizers used as solvents, binders or fixatives in many fragrances. Why are phthalates in the news? Phthalates are considered Endocrine Disrupting Chemicals.
On the California Safe Cosmetics Program Product Database: DEP, DIDP, and DBP are reported as fragrance while DEHP and DBP are perfume solvents. IFRA lists DEP and DMP, as "reported fragrance ingredients".**]**

3. *Ubiquity, Hazardous Effects, and Risk Assessment of Fragrances in Consumer Products*

Pastor-Nieto MA, Gatica-Ortega ME. Ubiquity, Hazardous Effects, and Risk Assessment of Fragrances in Consumer Products. Curr Treat Options Allergy. 2021;8(1):21-41. doi: 10.1007/s40521-020-00275-7. Epub 2021 Jan 23. PMID: 33520600; PMCID: PMC7825391.
Article Link: https://pubmed.ncbi.nlm.nih.gov/33520600/ - PDF

"A **perfume** also contains solvents, fixatives to influence its persistence…. **Fragrances** are ubiquitous and may cause detrimental health or environmental effects including **contact allergy**."
"Some **fragrances** are carcinogens, mutagens, and **toxic to reproduction** (CMR substances), thus classified with H341, H351, or H360. **Respiratory**, **neuroendocrine**, and **psychological effects** have also been discussed…. Fragrances have **neurotoxic** and **neurostimulatory effects**."

"Certain perfumes may be **cytotoxic to human fetal brain development** based on in vitro research with neuroblastoma cell lines…. Ingredients in perfumes with presumed **hormonal activities** are octinoxate and butylated hydroxytoluene (**thyroid and androgen-like activities**) and octinoxalate, oxybenzone,

benzophenone-1, diethyl phthalate, galaxolide, tonalide, musk ketone, benzyl salicylate, and butylphenyl methylproprional (**estrogen or androgen activity**). Diethyl phthalate, a fragrance solvent, can cause **abnormal development of reproductive organs** in infant males**, attention deficit disorder** in children, and **sperm damage** in adults**….** According to one study, most perfumes exhibited some degree of **mutagenic potential** compared with 4-nitro-1,2-diaminobenzene, a highly mutagenic positive control**.**"

4. *Association of Prenatal Phthalate Exposure With Language Development in Early Childhood*

Bornehag CG, Lindh C, Reichenberg A, Wikström S, Unenge Hallerback M, Evans SF, Sathyanarayana S, Barrett ES, Nguyen RHN, Bush NR, Swan SH. Association of Prenatal Phthalate Exposure With Language Development in Early Childhood. JAMA Pediatr. 2018 Dec 1;172(12):1169-1176. doi: 10.1001/jamapediatrics.2018.3115. Erratum in: JAMA Pediatr. 2018 Dec 1;172(12):1205. PMID: 30383084; PMCID: PMC6583016.

Article Link: https://pubmed.ncbi.nlm.nih.gov/30383084/ - PDF

"Prenatal exposure to phthalates has been associated with **neurodevelopmental outcomes**… First-trimester phthalate exposure (particularly to DBP and possibly to BBzP) appears to be associated with **poorer language development in children** aged 2.5 to 3 years. In findings from this study**,** prenatal exposure to dibutyl phthalate and butyl benzyl phthalate was statistically significantly associated with **language delay** in children in both the SELMA study and TIDES."

[Note: Phthalates are synthetic odorless plasticizers used as solvents, binders or fixatives in many fragrances. Why are phthalates in the news? Phthalates are considered Endocrine Disrupting Chemicals.
On the California Safe Cosmetics Program Product Database: DEP, DIDP, and DBP are reported as fragrance while DEHP and DBP are perfume solvents. IFRA lists DEP and DMP, as "reported fragrance ingredients".**]**

5. *Evaluating the potential genotoxicity of phthalates esters (PAEs) in perfumes using in vitro assays*

Al-Saleh I, Al-Rajudi T, Al-Qudaihi G, Manogaran P. Evaluating the potential genotoxicity of phthalates esters (PAEs) in perfumes using in vitro assays. Environ Sci Pollut Res Int. 2017 Oct;24(30):23903-23914. doi: 10.1007/s11356-017-9978-1. Epub 2017 Sep 5. PMID: 28875446.

Article Link: https://pubmed.ncbi.nlm.nih.gov/28875446/

"The role of PAEs as endocrine disruptors has been well documented, but their effect on genotoxic behavior has received little attention."

"All perfumes induced more DNA damage than a negative control (NEG), ≥ 90% of the samples caused more damage than cells treated with the vehicles possibly used in perfume's preparations such as methanol (ME) and ethanol (ET), and 11.6% of the perfumes caused more DNA damage than a positive control (hydrogen peroxide)."

"**This study demonstrates for the first time the possible contribution of PAEs in perfumes to DNA damage and suggests that their use as solvents or fixatives should be regulated.** Other ingredients with mutagenic/genotoxic properties, however, may also have contributed to the DNA damage."

6. *Endocrine-Disrupting Chemicals & Reproductive Health*

Zlatnik MG. Endocrine-Disrupting Chemicals and Reproductive Health. J Midwifery Womens Health. 2016 Jul;61(4):442-55. doi: 10.1111/jmwh.12500. Epub 2016 Jul 8. PMID: 27391253; PMCID: PMC6701840.
Article Link: https://pubmed.ncbi.nlm.nih.gov/27391253/ - PDF

"**Phthalates** are another class of chemicals that have been implicated as **endocrine disrupters**. **Phthalates** are used in multiple consumer applications, including **personal care products** such as **lotion** or **shampoo**, often as **"fragrance"**, and as plasticizers to change the physical characteristics of base plastics, including products made with polyvinyl chloride, such as flooring, shower curtains, packaging, and some medical equipment."

"Human cohort and experimental animal studies have demonstrated possible **adverse effects on reproduction**, including associations with **poor semen quality** and **miscarriage.**"

"Prenatal phthalate exposure, as measured by phthalate metabolite levels in maternal urine, has been associated with **abnormal male genital development in the fetus**. In animal models, anogenital distance is a sensitive index of demasculinization of the male reproductive tract. Multiple epidemiologic studies, including prospective cohort studies, have shown a **shortened anogenital distance** (suggesting anti-androgenic influence) **in boys whose mothers had higher urinary phthalate levels during pregnancy**. Some cohort studies have shown an association with **smaller penile size** as well. These findings are reproducible in experimental studies with rodents."

"Prenatal phthalate exposure has also been associated with reduced "masculine play" in boys, as indicated in a follow-up study of a cohort of couples who had given blood and urine samples during pregnancy. At age 5, the boys' (n=74) play activities were assessed with a validated inventory of play styles (Pre-School Activities Inventory). **An association was seen between prenatal exposure to anti-androgenic phthalates and less male-typical play behavior in boys."**

"A recent systematic review of 11 human **studies suggests that higher levels of prenatal exposure to phthalate metabolites**, measured as urinary concentrations, are associated with **poorer cognitive and behavioral outcomes in children, especially boys**."
[Note: This article suggests that you purchase fragrance free personal care products and avoid air fresheners and scented candles.**]**

7. *Household air pollution and its effects on health*

Apte K, Salvi S. Household air pollution and its effects on health. F1000Res. 2016 Oct 28;5:F1000 Faculty Rev-2593. doi: 10.12688/f1000research.7552.1. PMID: 27853506; PMCID: PMC508913
Article Link: https://pubmed.ncbi.nlm.nih.gov/27853506/ - PDF

"Cigarette smoke contains 7,357 different chemical compounds such as **benzene**, CO, PAHs, heterocyclic amines, cyanide, **formaldehyde**, **terpenoids**, **phenols**, nicotine, and heavy metals."

"Various studies have reported that toxic levels of air pollutants are emitted when these **fragrances** are burnt. … Among the Chinese, 76.9% currently burn incense at home every day and over 90% of the population has been using these for over 20 years. **Burning of these fragrances emits high levels of** PAHs**, benzene,** nitrous oxide, and CO**.** … Household air pollution begins to affect a human even during **fetal** life. **Increased**

household air pollution increases oxidative stress, which has been implicated in **decreased fertility** or, in some cases, even **infertility**. Increased oxidative stress leads to **decreased sperm motility** and **poor zygote quality**. It also plays an important role in **increasing insulin resistance**, which is associated with **polycystic ovarian disease**, a major cause of infertility."

"...a study of 10 **newborn infants** in New York by the Environmental Work Group revealed that these infants, born to mothers exposed to pollutants, had as many as **232 pollutants circulating in the cord blood collected at birth….**Similarly, another study reported that increased exposure to polycyclic aromatic hydrocarbons and heavy metals (especially lead and mercury) in the second trimester of pregnancy resulted in decreased length of the baby at birth…. They also have lower heights, which do not recover later in life…. The effect of perinatal exposure to PAHs has also been studied, revealing compromised lung function in otherwise-healthy children… Household air pollutants are also implicated in cognitive and judgmental skills …."

[Note: Fragrance is considered the new 'second hand smoke', **"**The parallels between second-hand smoke and synthetic fragrance use are many. At its core, both are battles over indoor air quality **"** - quote and link from De Vader, Christy L. & Barker, Paxson.
Chemicals that cigarettes/cigarette smoke and fragranced products can have in common are: Acetone, Formaldehyde, Benzene, acetaldehyde, terpenoids and phenols.**]**

8. *Neurotoxicity of Ortho-Phthalates: Recommendations for Critical Policy Reforms to Protect Brain Development in Children*

Stephanie M. Engel, Heather B. Patisaul, Charlotte Brody, Russ Hauser, Ami R. Zota, Deborah H. Bennet, Maureen Swanson, and Robin M. Whyatt, 2021: Neurotoxicity of Ortho-Phthalates: Recommendations for Critical Policy Reforms to Protect Brain Development in Children American Journal of Public Health 111, 687_695, https://doi.org/10.2105/AJPH. 2020.306014
Article link: https://ajph.aphapublications.org/doi/abs/10.2105/AJPH.2020.306014?role=tab - PDF

"There are robust data from longitudinal birth cohort studies conducted over the last decade that have shown associations between prenatal exposures to ortho-phthalates and **attention-deficit hyperactivity disorder (ADHD)**, other **behavioral problems**, **adverse cognitive development** including **lower IQ**, **poorer psychomotor development**, and **impaired social communication**. This growing body of evidence, along with the known **adverse effects on male reproductive tract development** of ortho-phthalates, calls for immediate action."

"Phthalates including **DEP** and DBPs are commonly used in cosmetics and other personal care products, and are sometimes used as excipients in **medications** and **supplements** (see the box on page 689). For example, DEP and DBPs are used in a wide range of personal care products including **nail polish, lotions, fragrances**, and **hair-styling products.**… **Phthalates are readily transferred from mother to fetus during pregnancy**."

"**There is no longer any basis for the agency to conclude that there is "reasonable certainty of no harm" from these uses… All of the phthalates that have been associated with adverse child neurodevelopment, discussed previously, are currently approved by FDA for food contact use."**

"Authority to regulate phthalates in cosmetics (which are defined broadly to include many personal care products) also falls under **FDA jurisdiction**. However, **the agency's authority is much less comprehensive and health protective than its authority to ensure the safety of food or drugs. This needs to be rectified**

by congressional action."

"Substantial evidence links exposure to phthalates with increased risks for **child learning, attention**, and **behavioral problems**. We therefore recommend that phthalates be eliminated from products that may lead to exposure of women of reproductive age, pregnant women, infants, and children."

[Note: Phthalates are synthetic odorless plasticizers used as solvents, binders or fixatives in many fragrances. Why are phthalates in the news? Phthalates are considered Endocrine Disrupting Chemicals.
On the California Safe Cosmetics Program Product Database: DEP, DIDP, and DBP are reported as fragrance while DEHP and DBP are perfume solvents. IFRA lists DEP and DMP, as "reported fragrance ingredients".**]**

9. *Environmental factors may contribute to autism development and male bias: Effects of fragrances on developing neurons*

Sealey LA, Hughes BW, Pestaner JP, Steinemann A, Pace DG, Bagasra O. Environmental factors may contribute to autism development and male bias: Effects of fragrances on developing neurons. Environ Res. 2015 Oct;142:731-8. doi: 10.1016/j.envres.2015.08.025. PMID: 26408793.
Article Link: https://pubmed.ncbi.nlm.nih.gov/26408793/

"We investigated whether the development of autism could be related to exposure to fragrances, which are complex mixtures of chemicals, including hormone disruptors (Parlett et al., 2013; Dodson et al., 2012; Braun et al., 2014; NIH, 2010). **Previously, we analyzed over 90 fragrances** and demonstrated that commonly used fragrances have potential to cause neurological damage to a developing fetus by introducing mutations and depleting selected neuronal subtypes, which potentially may interfere with normal brain development (NIH, 2010)."

"Numerous investigations have sought to identify potential causes of ASD. In particular, the development of the **OXYRþ and AVPRþ neurons, found to be underdeveloped in the brains of autistic children**, and **influenced by the environment in which the brain develops**, may provide clues about the etiology of ASD. **We provide evidence that exposure to minuscule concentrations of fragrances induce significant reduction in AVPRþ and OXYRþ neurons in male fetal NBC, and marked changes of neurons in both male and female NBC.** Our study brings forth a new way of looking at the pathogenesis of ASD and role of fragrances, which are pervasive in modern society and may be an important contributing factor in the development and male bias of ASD."

10. *Histo-morphometric Evidences for Testicular Derangement in animal models submitted to chronic and Sub-chronic Inhalation of Fragrance*

Akunna GG, Saalu LC, Ogunlade B, Akingbade AM, Anderson LE, Olusolade FS, Histo-morphometric evidences for testicular derangement in animal models submitted to chronic and sub-chronic inhalation of fragrance. American Journal of Research Communication, 2015, 3(1): 85-101} www.usa-journals.com, ISSN: 2325-4076.
Article Link:
https://www.researchgate.net/publication/315065887_Histo-morphometric_Evidences_for_Testicular_Derangement_in_animal_models_submitted_to_chronic_and_Sub-chronic_Inhalation_of_Fragrance - PDF

"Copious documentations have indicated that **82 percent of perfumes labeled "natural ingredients" actually contain synthetic fragrances** (Rastogi et al.,1996). Such chemicals that affect male reproductive

hormones may be a factor in **infertility** and has been known as **endocrine disruptors**.(Giudice, 2006, Saalu et al., 2010, Akunna et al., 2013)".

"It has been reported that perfumes, colognes, body sprays and care products contained an average of four potential hormone-disrupting chemicals. In male reproductive anatomy, **endocrine disruptors** have severally been implicated as **teratogens**, resulting in **cryptorchidism**, **hypospadias** and **impairment of body function** normally regulated by natural hormone signaling (Wang and Baskin, 2008, Akunna et al., 2011, Akunna et al., 2013). Studies have shown that these chemicals causes damage by **mimicking or disrupting natural estrogen**, **testosterone and thyroid pathways** (Soto et al., 2009). Although the implication of subsequent exposure to these chemicals have not been critically understood, recent findings has clearly demonstrated disruption in **spermatogenesis**,(Akunna et al., 2014) **liver damage**(Akunna et al., 2011) and **other tissue toxicity in animals** exposed to fragrance components(Johansen et al., 2003, Elberling et al., 2004, Breast Cancer Fund, 2008, Schnuch et al., 2010). In animal model studies, fragrance exposure has lead to **spermatotoxicity** and **infertility**, **congenital malformation in penises and abnormal testes** (Akunna et al., 2014)."

"According to published scientific studies, **diethyl phthalate** and octinoxate which are major components of perfume and sunscreen respectively has been implicated in **sperm damage**, **apoptosis** and **interference with estrogen and androgens** in human respectively (Giudice, 2006, Wang and Baskin, 2008, Silva et al., 2004 ,Schreurs et al., 2005, Swan, 2008, CDC, 2009)."

"From our studies on fragrance, we can conclude herein that fragrance components are **testiculotoxic** in rat."
[Note: Definition - Teratogens are substances that people are exposed to (in utero) that may lead to birth defects, miscarriages, pre-term labor or stillbirth.. **Cryptorchidism** (undescended testicals) may also increase the risk for testicular cancer. **Hypospadias** is a birth defect where boys have an altered location of the opening of the urethra.**]**

11. *The associations between personal care products use and urinary concentrations of phthalates, parabens, and triclosan in various age groups: The Korean National Environmental Health Survey Cycle 3 2015-2017*

Lim S. The associations between personal care products use and urinary concentrations of phthalates, parabens, and triclosan in various age groups: The Korean National Environmental Health Survey Cycle 3 2015-2017. Sci Total Environ. 2020 Nov 10;742:140640. doi: 10.1016/j.scitotenv.2020.140640. Epub 2020 Jul 2. PMID: 32721747.
Article Link: https://pubmed.ncbi.nlm.nih.gov/32721747/ - PDF

"**Phthalates** and parabens are ubiquitous chemicals of public concern… Furthermore, the use of **fragrance products**, makeup, and **air fresheners** significantly increased the exposure risk to EtP in **preschoolers**."

"Furthermore, the exposure levels of many **phthalates**, parabens, and TCS are higher in children than adults(NIER, 2018; Wang et al., 2019) and **children are a susceptible population to these chemicals**. In the case of parabens, the estimated **dermal absorption** amount of parabens related with PCPs use in **infants** and **toddlers** was several times higher than that in adult women(Guo and Kennan, 2013)."

"Exposure to phthalates and parabens is an important public concern, especially with respect to the **potential endocrine disrupting effects of phthalates** (DEHP, DBP, and BBP) (European Commission, 2000) and the anti-androgenic effect of parabens (Orton et al., 2014). Additionally, **exposure to phthalates in the prenatal**

period was associated with asthma (Berger et al., 2020) and **psychomotor development** (Qian et al., 2019)in children and was related to **allergic symptoms**, **sensitization (**Hoppin et al., 2013), **preterm birth** (Ferguson et al., 2019) and **type 2 diabetes** in adults (Sun et al., 2014).**"**

"This study showed the associations between PCPs use and urinary concentrations of phthalates, parabens, and TCS in various age groups in a nationally representative population in Korea. The exposure risks to these chemicals were different according to the patterns of PCPs use by age groups and gender. Female participants used all categories of PCPs more frequently than male participants in adolescents and adults, with statistical significance."

[Note: Endocrine Disrupting Chemicals (EDC's) are commonly used in perfumes and fragranced products as preservatives or fragrance. What are EDC's and how can they affect us?**]**
[Note: Phthalates are synthetic odorless plasticizers used as solvents, binders or fixatives in many fragrances. Why are phthalates in the news? Phthalates are considered Endocrine Disrupting Chemicals.
On the California Safe Cosmetics Program Product Database: DEP, DIDP, and DBP are reported as fragrance while DEHP and DBP are perfume solvents. IFRA lists DEP and DMP, as "reported fragrance ingredients".**]**

12. *Human exposure to nitro musks and the evaluation of their potential toxicity: an overview*

Taylor KM, Weisskopf M, Shine J. Human exposure to nitro musks and the evaluation of their potential toxicity: an overview. Environ Health. 2014 Mar 11;13(1):14. doi: 10.1186/1476-069X-13-14. PMID: 24618224; PMCID: PMC4007519.
Article Link: https://pubmed.ncbi.nlm.nih.gov/24618224/ - PDF

"Synthetic nitro musks are **fragrant chemicals found in household and personal care products**. The use of these products leads to direct exposures via dermal absorption, as well as inhalation of contaminated dust and volatilized fragrances. As these compounds are lipophilic, they and their metabolites, **have been found** not only in **blood**, but also **breast milk and adipose tissue**…. "

"Ketone musk and musk xylene continue to be used as additives in detergents, fabric softener, household cleaning products and other fragrant non-cosmetic products with musk xylene being the most widely used nitro musk…. **The body of literature supports the conclusion that not only are we being exposed to nitro musks, we are also bioaccumulating them and passing them on to our offspring through breast milk and perinatal exposures.**"

13. *Association of phthalates, parabens and phenols found in personal care products with pubertal timing in girls and boys*

Harley KG, Berger KP, Kogut K, Parra K, Lustig RH, Greenspan LC, Calafat AM, Ye X, Eskenazi B. Association of phthalates, parabens and phenols found in personal care products with pubertal timing in girls and boys. Hum Reprod. 2019 Jan 1;34(1):109-117. doi: 10.1093/humrep/dey337. PMID: 30517665; PMCID: PMC6295961.
Article Link: https://pubmed.ncbi.nlm.nih.gov/30517665/ - PDF

"Several chemicals that are commonly used in cosmetics, personal care products and other **scented** household items have been shown to exhibit **endocrine disrupting** properties (Witorsch and Thomas, 2010). These chemicals include certain low molecular weight phthalates, such as diethyl phthalate (DEP), which is found in **scented** products such as **perfumes**, deodorants, soaps and shampoo, and di-n-butyl phthalate

(DnBP) and di-isobutyl phthalate (DiBP), which can be used in nail polish and cosmetics (Dodson et al., 2012). In animal studies, developmental exposure to DnBP and DiBP induces **anti-androgenic effects** including **feminized traits**, **abnormal reproductive development** and **later puberty** in male rats, although the effects are less strong in females (Mylchreest et al., 2000; Saillenfait et al., 2008)."

"**We found evidence that prenatal and peripubertal exposure to certain phthalates, parabens and phenols present in personal care and consumer products was associated with pubertal timing in girls, but less so in boys.**

14. Fragrance compounds: The wolves in sheep's clothings

Patel S. Fragrance compounds: The wolves in sheep's clothings. Med Hypotheses. 2017 May;102:106-111. doi: 10.1016/j.mehy.2017.03.025. Epub 2017 Mar 22. PMID: 28478814.

Article Title: https://pubmed.ncbi.nlm.nih.gov/28478814/

"It is deplorable and alarming that awareness of the threats of perfume allergy is very low. Tricked by aggressive advertisement and to improve aesthetic appeal, people are exposing themselves to multiple chemical fragrance compounds. Further, it is a matter of concern that an alert individual cannot escape the perils of fragrances by mere lifestyle revision, and avoidance of the chemicals. Like the harms of passive smoking, passive exposure to the perfumes occurs in a number of public places. In realization of the dangers of peanut allergy to vulnerable individuals, peanut was pulled off from the food platter in passenger planes. Similar awareness and action is needed for perfumes as well.… An aware individual does not deserve to get the brunt of someone else's reckless lifestyle choices. Also, the cleaning staff in public places must be trained so as to ensure prevention of perfume abuse i.e. excess usage."

"A study found traces of **musk fragrances** such as **galaxolide**, **tonalide**, **cashmeran,** and UV-filters in marine species (mussel, clam, flounder, herring and mullet) and macroalgae, which constitute seafood. These **bioaccumulated xenobiotics** will ultimately reach to the human body via the food chain"

"Perfume manufacturers do not disclose the ingredients and quantity of the fragrance compounds in the name of 'trade secret'. Though they ought to abide by ethics, for profit and the goals of high market share, they forgo those. With the help of unscrupulous advertisements and sponsored research reports, they keep luring naive and unaware consumers.… It is appalling that even if people know the threats, they continue using these toxins, resonating the "death wish" concept discussed in the popular TV series "Mad men".... The fragrance compounds so ubiquitous in modern times initiate vicious cycles of 'exposure – pathologies – drugs', which must be understood, information disseminated and terminated. Based on the review work and hypotheses, it can be stated that perfumes and other fragrance compounds in day-to-day consumer products are 'slow killers with fatal punch'.

"Growing recognition of the widespread use of fragrances in modern society is alarming. These pleasant-seeming deleterious compounds are the causal factors of a wide array of **immuneneural**- **hormonal health issues**. **Allergy**, **irritation**, **migraine**, **asthma**, **depression**, **high blood pressure**, **diabetes** and other symptoms should not be trivialized. Unheeded, and continued, the fragrance compounds can lead to **gynaecomastia**, **cancers**, **gender manipulation**, **teratogenicity**."

"**Creating public awareness is essential to avoid grave health consequences**. Toxicology research on perfumes must be prioritized, just like other urgent topics like 'antibiotics-drug resistance' and 'pesticide-food

safety'. This review 'though barely scratches the surface' of the enormous health threats of 'synthetic fragrances' is expected to evoke alertness."
[Note: Gynaecomastia is enlarged male breast tissue**]**

15. *Adverse Impact of Environmental Chemicals on Developmental Origins of Kidney Disease and Hypertension*

Hsu CN, Tain YL. Adverse Impact of Environmental Chemicals on Developmental Origins of Kidney Disease and Hypertension. Front Endocrinol (Lausanne). 2021 Oct 14;12:745716. doi: 10.3389/fendo.2021.745716. PMID: 34721300; PMCID: PMC8551449.
Article Link: https://pubmed.ncbi.nlm.nih.gov/34721300/ - PDF

"Here, we focus on environmental chemicals that pregnant mothers are likely to be exposed, including dioxins, bisphenol A (BPA), **phthalates**, per- and polyfluoroalkyl substances (PFAS), polycyclic aromatic hydrocarbons (PAH), heavy metals, and **air pollution**."

(note: Graphic is from preceding article**)**

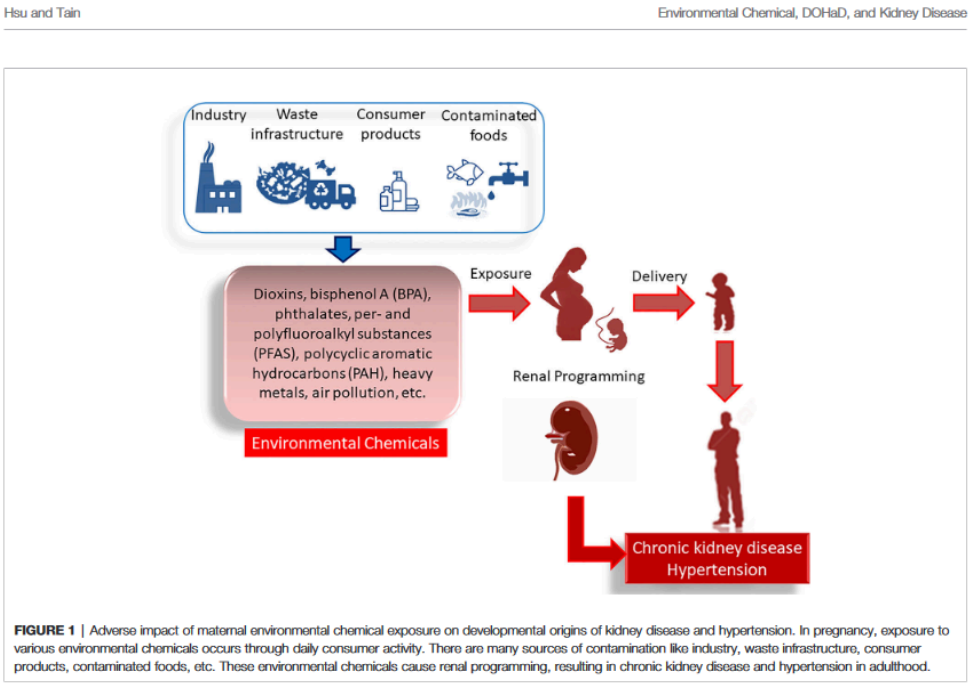

FIGURE 1 | Adverse impact of maternal environmental chemical exposure on developmental origins of kidney disease and hypertension. In pregnancy, exposure to various environmental chemicals occurs through daily consumer activity. There are many sources of contamination like industry, waste infrastructure, consumer products, contaminated foods, etc. These environmental chemicals cause renal programming, resulting in chronic kidney disease and hypertension in adulthood.

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"In pregnancy, exposure to various environmental chemicals occurs through daily consumer activity. There are many sources of contamination like industry, waste infrastructure, **consumer products**, contaminated foods, etc. These **environmental chemicals cause renal programming**, resulting in **chronic kidney disease and hypertension** in adulthood."

"Phthalates can be delivered to the human body through diet, **inhalation, and skin contact**. Di-2-ethylhexylphthalate (**DEHP**) and di-n-butyl phthalate (DBP) are the primary phthalate ester pollutants in the environment. The metabolites of phthalates can **cross the placenta and be transferred to the fetus**. Epidemiological studies demonstrated that high urinary DEHP levels are **associated with high BP, low eGFR**

and albuminuria. As phthalates have estrogenic or antiandrogenic properties, emerging evidence suggests the associations between prenatal phthalate exposure and adverse offspring outcomes. Following these findings, steps should be taken to explore the effect of phthalate exposure during pregnancy on offspring kidneys."

[Note: Phthalates are synthetic odorless plasticizers used as solvents, binders or fixatives in many fragrances. Why are phthalates in the news? Phthalates are considered Endocrine Disrupting Chemicals.
On the California Safe Cosmetics Program Product Database: DEP, DIDP, and DBP are reported as fragrance while DEHP and DBP are perfume solvents. IFRA lists DEP and DMP, as "reported fragrance ingredients".**]**

16. *Long-Term Outcomes after Phthalate Exposure: Food Intake, Weight Gain, Fat Storage, and Fertility in Mice*

Holtcamp W. Long-term outcomes after phthalate exposure: food intake, weight gain, fat storage, and fertility in mice. Environ Health Perspect. 2012 Aug;120(8):a320. doi: 10.1289/ehp.120-a320a. PMID: 22854284; PMCID: PMC3440097.
Article Link: https://pubmed.ncbi.nlm.nih.gov/22854284/ - PDF

"Exposure to **endocrine-disrupting chemicals (EDCs)**, particularly **in utero**, is suspected to contribute to **obesity**, **diabetes**, **hypertension**, and **reproductive abnormalities**. Di(2-ethylhexyl) phthalate **(DEHP)**, a plasticizer found in **cosmetics**, **fragrances,** food packaging, and polyvinyl chloride, is one such EDC. Human studies have found associations between urinary metabolites of DEHP and other phthalates and **increased body mass** in humans, and maternal exposure to DEHP has been associated with **impaired gonadal development and fertility** in baby boys."

[Note: Endocrine Disrupting Chemicals (EDC's) are commonly used in perfumes and fragranced products as preservatives or fragrance. What are EDC's and how can they affect us?**]**

17. *Development and Validation of the Prevention of Toxic Chemicals in the Environment for Children Tool: A Questionnaire for Examining the Community's Knowledge of and Preferences Toward Toxic Chemicals and Children's Brain Development*

Green R, Lanphear B, Phipps E, Goodman C, Joy J, Rihani S, Flora D and Till C (2022) Development and Validation of the Prevention of Toxic Chemicals in the Environment for Children Tool: A Questionnaire for Examining the Community's Knowledge of and Preferences Toward Toxic Chemicals and Children's Brain Development. Front. Public Health 10:863071. doi: 10.3389/fpubh.2022.863071
Article Link: https://www.frontiersin.org/articles/10.3389/fpubh.2022.863071/full - free full text

"Toxic chemicals are an insidious threat to children. **Toxic chemicals elevate the risk for neurodevelopmental disorders, including learning disabilities, attention deficit hyperactivity disorder (ADHD), and autism spectrum disorder (ASD)**. The developing brain is particularly vulnerable to **toxic chemicals, even at low doses** that might not have an adverse effect on adults. Therefore, early identification and recognition by the public of potential sources of exposure to toxic chemicals are crucial to protect children."

"One recent American study found that greater parental concern about toxic chemicals was associated with lower urinary concentrations of **phthalates** and **phenols** in children's urine."

[Note: Phenol used in fragrance is mostly synthetic derived from benzene/petro. It is an EDC and declared as fragrance on the CSCP list and on the IFRA fragrance transparency list. Phenol is on the Washington State List of Chemicals of High Concern to Children and Priority Pollutant List.**]**

[Note: Phthalates are synthetic odorless plasticizers used as solvents, binders or fixatives in many fragrances. Why are phthalates in the news? Phthalates are considered Endocrine Disrupting Chemicals.
On the California Safe Cosmetics Program Product Database: DEP, DIDP, and DBP are reported as fragrance while DEHP and DBP are perfume solvents. IFRA lists DEP and DMP, as "reported fragrance ingredients".**]**

18. *Exposure to widespread environmental toxicants and children's cognitive development and behavioral problems*

Jurewicz, Joanna et al. "Exposure to widespread environmental toxicants and children's cognitive development and behavioral problems." International Journal of Occupational Medicine and Environmental Health, vol. 26, no. 2, 2013, pp. 185-204. doi:10.2478/s13382-013-0099-x.
Article link: https://pubmed.ncbi.nlm.nih.gov/23715930/ - PDF

"The results from the presented studies suggest that there are strong and rather consistent indications that the developing nervous system is particularly vulnerable to insult from low levels of exposure to widespread environmental contaminants such as: **phthalates**, bisphenol A, brominated flame retardants, polycyclic aromatic hydrocarbons, gas cooking."

[Note: Phthalates are synthetic odorless plasticizers used as solvents, binders or fixatives in many fragrances. Why are phthalates in the news? Phthalates are considered Endocrine Disrupting Chemicals.
On the California Safe Cosmetics Program Product Database: DEP, DIDP, and DBP are reported as fragrance while DEHP and DBP are perfume solvents. IFRA lists DEP and DMP, as "reported fragrance ingredients".**]**

19. *Health risks of chemicals in consumer products: A review*

Li D, Suh S. Health risks of chemicals in consumer products: A review. Environ Int. 2019 Feb;123:580-587. doi: 10.1016/j.envint.2018.12.033. Epub 2019 Jan 7. PMID: 30622082.
Article Link: https://pubmed.ncbi.nlm.nih.gov/30622082/ - Full Text

"It should also be noted that some chemicals have multiple functional uses, while we chose the most dominant functional use for each chemical. An example is the grouping of **phthalates**. Despite categorized as plasticizer together in this review, several phthalates such as **diethyl phthalate and dimethyl phthalate are used as solvents in personal care products and cosmetics as carriers of fragrance** (Schettler, 2006)."

"…we found that the volume of the peer-reviewed literature that addresses human health risks of the chemicals in consumer products did grow over the last two decades, while its growth could by no means match the speed of increasing volume and diversity of the chemicals produced and used in consumer products by the society. This **growing gap between increasing reliance on chemicals in consumer products and our knowledge on their human health risks raises a potential public health concern**, given the pervasive nature of today's mass production and consumption practice."

20. *Endocrine Disruptors and Asthma-Associated Chemicals in Consumer Products*

Dodson RE, Nishioka M, Standley LJ, Perovich LJ, Brody JG, Rudel RA. Endocrine disruptors and asthma-associated chemicals in consumer products. Environ Health Perspect. 2012 Jul;120(7):935-43. doi: 10.1289/ehp.1104052. Epub 2012 Mar 8. PMID: 22398195; PMCID: PMC3404651..

Article Link: https://pubmed.ncbi.nlm.nih.gov/22398195/ - PDF

"Laboratory and human studies raise concerns about endocrine disruption and asthma resulting from exposure to chemicals in consumer products… Analytes included parabens, **phthalates**, bisphenol A (BPA), triclosan, ethanolamines, alkylphenols, **fragrances**, glycol ethers, cyclosiloxanes, and ultraviolet (UV) filters."
"In other products, the highest concentrations and numbers of detects were in fragranced products (e.g., perfume, air fresheners, and **dryer sheets**) and sunscreen."

"**Some products that did not contain the well-known endocrine-disrupting phthalates contained other less-studied phthalates** (dicyclohexyl phthalate, diisononyl phthalate, and di-n-propyl phthalate; also endocrine-disrupting compounds), suggesting a substitution. Many detected chemicals were not listed on product labels."

"**Endocrine Disrupting compounds (EDCs) are chemicals that can alter hormonal signaling and have potential effects on developing reproductive and nervous systems, metabolism, and cancer** (Colborn et al. 1993). Some phthalates inhibit testosterone synthesis (Howdeshell et al. 2008)..."

"**Fragrances have been shown to exacerbate asthma**. …The phthalate bis(2-ethylhexyl) phthalate (DEHP) in dust was associated with **asthma and wheezing in children**…"

"Our results also indicate that use of multiple products can lead to **exposure to an even larger mixture of compounds,** even if a consumer selected products considered alternative according to our criteria. For example, a consumer who used the alternative surface cleaner, tub and tile cleaner, **laundry detergent**, bar soap, shampoo and conditioner, facial cleanser and lotion, and toothpaste (a plausible array of product types for an individual) would potentially be exposed to at least 19 compounds: two parabens, three **phthalates**, MEA, DEA, five alkylphenols, and seven **fragrances**."

[Note: Fragrance chemicals listed in Figure 1 are: Benzylacetate, Eugenol, Hexyl cinnemal, Limonene, Linalool, Methyl eugenol, Methyl salicylate, Pinene, Terpineol, AHTN, Bucina,l Diphenyl ether, DPMI, HHCB, Isobornyl acetate, Methyl ionone, Musk ketone, Musk xylene, Phenethyl alcohol**]**

[Note: Endocrine Disrupting Chemicals (EDC's) are commonly used in perfumes and fragranced products as preservatives or fragrance. What are EDC's and how can they affect us?**]**

[Note: Phthalates are synthetic odorless plasticizers used as solvents, binders or fixatives in many fragrances. Why are phthalates in the news? Phthalates are considered Endocrine Disrupting Chemicals.
On the California Safe Cosmetics Program Product Database: DEP, DIDP, and DBP are reported as fragrance while DEHP and DBP are perfume solvents. IFRA lists DEP and DMP, as "reported fragrance ingredients".**]**

21. *Sanitary pads and diapers contain higher phthalate contents than those in common commercial plastic products*

Park CJ, Barakat R, Ulanov A, Li Z, Lin PC, Chiu K, Zhou S, Perez P, Lee J, Flaws J, Ko CJ. Sanitary pads and diapers contain higher phthalate contents than those in common commercial plastic products. Reprod Toxicol. 2019 Mar;84:114-121. doi: 10.1016/j.reprotox.2019.01.005. Epub 2019 Jan 16. PMID: 30659930; PMCID: PMC6504186.
Article Link: https://pubmed.ncbi.nlm.nih.gov/30659930/

"VOCs increase the risk for neurocognitive impairment, asthma, congenital disability, and cancer. Notably, exposure to methylene chloride, **toluene**, and **xylene** are known to **negatively affect the development and function of reproductive system**."

"…sanitary pads in direct contact with the skin around the external genitalia were likely causing **menstrual irregularities.** The skin of this area tends to be thinner and more absorbent than those…such as the hands."
"Exposure to phthalates is known to **affect the development and functions of the cardiovascular, reproductive and endocrine systems**."

"...daily absorption of **toluene** from sanitary pad reached to the maximum of 38.4% RfD. **Given the fact that women are exposed to various chemicals through various routes, consideration should be given to the risks of chemicals that are additionally absorbed from the sanitary pad."**

[Note: Phthalates are synthetic odorless plasticizers used as solvents, binders or fixatives in many fragrances. Why are phthalates in the news? Phthalates are considered Endocrine Disrupting Chemicals.
On the California Safe Cosmetics Program Product Database: DEP, DIDP, and DBP are reported as fragrance while DEHP and DBP are perfume solvents. IFRA lists DEP and DMP, as "reported fragrance ingredients".**]**

[Note: Toluene (often a nail polish thinner) is used as a solvent or fragrance in perfume and bath products on the CSPC Product Database. Toluene is on the IFRA list and on the EPA's Priority Pollutant List.**]**

22. *Occurrence and Distribution of Phthalates in Sanitary Napkins from Six Countries: Implications for Women's Health*

Tang Z, Chai M, Cheng J, Wang Y, Huang Q. Occurrence and Distribution of Phthalates in Sanitary Napkins from Six Countries: Implications for Women's Health. Environ Sci Technol. 2019 Dec 3;53(23):13919-13928. doi: 10.1021/acs.est.9b03838. Epub 2019 Nov 18. PMID: 31694371.
Article Link: https://pubmed.ncbi.nlm.nih.gov/31694371/

"Chemicals in feminine hygiene products **can exert adverse health effects as a result of strong absorptive capacity of the vagina and vulva**. We measured the concentrations of 15 phthalates in sanitary napkins collected from six countries and found total concentrations in the range of 1733-11942 ng/g. **Di(isobutyl)phthalate (DiBP)**, **bis(2-ethylhexyl)phthalate (DEHP)**, and di-*n*-butyl phthalate (DnBP) were the dominant congeners, representing a median of 27.3, 26.7, and 20.4% of the total median phthalate concentrations across all countries, respectively…. The estimated intake (at the 90th percentile) of **DiBP,** DnBP, and **DEHP** from sanitary napkins approximately represented 6.35-23.6, 3.35-9.90, and 1.06-9.57%, respectively, of the total exposure, indicating that sanitary napkins are a relevant source of exposure to these chemicals."

“Most phthalates are used as additives that are not chemically bound to the product matrix and therefore can easily migrate and enter the human body. Exposure to phthalates can exert serious adverse effects on human health, including **estrogenic effects that impair the endocrine system**…. In addition, some phthalates can cause various **reproductive and developmental conditions**….”

“Hauser et al. found that urinary concentrations of **bis(2-ethylhexyl)- phthalate (DEHP)** metabolites in women undergoing in vitro fertilization were **inversely associated with oocyte yield and clinical pregnancy**. Some epidemiologic studies have reported associations between **prenatal exposure to phthalates** and adverse outcomes at birth, such as **congenital diseases** and **developmental delays**…. Lien et al. reported that **prenatal exposure to some phthalates can increase aggressive behavior problems** in 8-year-old children.”

“**Phthalates readily accumulate in biological tissues** owing to their higher lipophilicity… Increasing evidence shows that **dermal contact from the use of cosmetics and personal care products is another relevant route of exposure to phthalates.** Sanitary napkins are used to absorb menstrual blood, and their constituents may be contaminated with phthalates. … Sanitary napkins come into direct contact with the vulva, and the **mucous membranes in the vagina and vulva can rapidly absorb chemicals without metabolizing them**…. Serum estradiol levels following the vaginal application of estradiol have been shown to be 10-fold higher than levels following oral dosing,... indicating possible health risks from this exposure route”

[Note: Phthalates are synthetic odorless plasticizers used as solvents, binders or fixatives in many fragrances. Why are phthalates in the news? Phthalates are considered Endocrine Disrupting Chemicals.
On the California Safe Cosmetics Program Product Database: DEP, DIDP, and DBP are reported as fragrance while DEHP and DBP are perfume solvents. IFRA lists DEP and DMP, as “reported fragrance ingredients”.**]**

23. Overview of air pollution and endocrine disorders

Darbre PD. Overview of air pollution and endocrine disorders. Int J Gen Med. 2018 May 23;11:191-207. doi: 10.2147/IJGM.S102230. PMID: 29872334; PMCID: PMC5973437.
Article Link: https://pubmed.ncbi.nlm.nih.gov/29872334/ - PDF

“Abstract: Over recent years, **many environmental pollutant chemicals have been shown to possess the ability to interfere in the functioning of the endocrine system and have been termed endocrine disrupting chemicals (EDCs).** These compounds exist in air as volatile or semi-volatile compounds in the gas phase or attached to particulate matter. They include components of plastics (**phthalates**, bisphenol A), components of consumer goods (parabens, triclosan, **alkylphenols, fragrance compounds**,… This review summarizes current knowledge concerning the sources of EDCs in air, measurements of levels of EDCs in air, and the potential for adverse effects of EDCs in air on human endocrine health.”

“Whilst much has been written over the past two decades of the actions of EDCs from oral and dermal exposure, research is increasingly documenting their presence in air which opens a debate on the potential for adverse consequences from inhalation of EDCs.”

“Since estrogens and androgens regulate reproductive functions, many of the reported effects of the exposure to EDCs have been on adverse consequences for **reproductive health**. However, physiological consequences have been demonstrated as resulting from disruption to **thyroid function** and alterations to **thyroid hormone levels**. More widely, adverse effects have also been reported as resulting from alterations to adrenocortical

function, impairment of the immune system, and the loss of control on energy metabolism including development of **obesity, diabetes,** and **cardiovascular disease.**"

"**Prior** to and **just after birth** are especially **vulnerable times for exposure to EDCs** because disruption of hormonal activity in the developing embryo/fetus or young baby can have **consequences for health in adult life** most notably on **reproductive abilities, brain function, immunity, and metabolic programming**."

"**Man-made EDCs** are contained within many agricultural, industrial, and **consumer products,** which due to their widespread use, have become ubiquitous environmental pollutants. This includes components of pesticides and herbicides used both in an agricultural setting and in urban environments…. EDCs are also widely used in **personal care products** (PCPs) for purposes of preservation, deodorant, antiperspirant, conditioning, and **fragrance**."

"**EDCs** are contained in domestic pesticide sprays, **air fresheners**, **laundry detergents**, **household cleaners**, paints, adhesives, and plastics, all of which may be used routinely indoors…. As a result, **many EDCs are now measurable in indoor air and in indoor dust, often at higher levels than in outdoor air**…"

24. *Characterization of odorants in inflatable aquatic toys and swimming learning devices-which substances are causative for the characteristic odor and potentially harmful?*

Wiedmer C, Velasco-Schön C, Buettner A. Characterization of odorants in inflatable aquatic toys and swimming learning devices-which substances are causative for the characteristic odor and potentially harmful? Anal Bioanal Chem. 2017 Jun;409(16):3905-3916. doi: 10.1007/s00216-017-0330-x. Epub 2017 Apr 12. PMID: 28401289.

Article Link: https://pubmed.ncbi.nlm.nih.gov/28401289/

"Toys can exhibit strong offensive smells that might also indicate the presence of other odorless hazardous chemicals in the affected product. Inflatable water toys such as beach balls or air mattresses are commonly known to be odor-active. Nevertheless, published data on the causative odorants and their origin are rare. … It is also interesting to note that not all inflatable polyvinyl chloride (PVC) products for children's use in water are termed as toys. The legal basis for this differentiation between toys and other products in Europe is the European Toy Safety Directive 2009/48/EC."

"**Phenol**, which was also found in all samples, is classified as category 2 **mutagen** (substances suspected of causing **genetic defects**) and as being **acutely toxic (Category 3)**."

"Cyclohexanone, which was found in three of the four investigated samples, is classified as **harmful if inhaled (acute toxicity Category 4)**. In view of this, it needs to be stated that the signals corresponding to isophorone and cyclohexanone were amongst the highest peaks in the respective chromatograms, indicating that these compounds were present in relatively high concentrations."

[Note: Phenol used in fragrance is mostly synthetic derived from benzene/petro. It is an EDC and declared as fragrance on the CSCP list and on the IFRA fragrance transparency list. Phenol is on the Washington State List of Chemicals of High Concern to Children and Priority Pollutant List. **Cyclohexanone** is on the IFRA list, it smells like peppermint.**]**

25. *Identification of combinations of endocrine disrupting chemicals in household chemical products that require mixture toxicity testing*

Lee I, Ji K. Identification of combinations of endocrine disrupting chemicals in household chemical products that require mixture toxicity testing. Ecotoxicol Environ Saf. 2022 Jul 15;240:113677. doi: 10.1016/j.ecoenv.2022.113677. Epub 2022 May 26. PMID: 35642859.
Article Link: https://pubmed.ncbi.nlm.nih.gov/35642859/ - PDF

"The present study listed the ingredients contained in 11064 household chemical products from a publicly available database, and identified **EDCs** related to **estrogenicity**, **androgenicity**, **thyroid hormone disruption**, and **changes in steroidogenesis**."

"A total of 293 chemicals were related to **endocrine disruption**, and **nearly two-thirds of the products contained more than one of these chemicals**. Cleaning products, synthetic detergents, fabric softeners, air fresheners, and deodorants have several hotspots for **fragrances**, isothiazolinones, glycol ethers, and parabens. The **three most prevalent EDCs** in household chemical products were **added to act** as **fragrances** and preservatives."

"The most frequently observed EDCs in the five product groups are hexyl cinnamaldehyde, geraniol, citronellol, 2-(4-tert-butylbenzyl)propionaldehyde (CAS no. 80-54-6)**, and benzyl benzoate** (CAS no. 120-51-4). **These EDCs** are commonly **used to add fragrance."**

"The most frequently identified combinations were benzisothiazolinone and **butylated hydroxytoluene** (CAS no. 128-37-0) in cleaners, benzisothiazolinone and **hexyl cinnamaldehyde** in synthetic detergents, **2-(4-tert-butylbenzyl)propionaldehyde** and **citronellol** in fabric softeners, **benzyl benzoate** and **hexyl cinnamaldehyde** in air fresheners, and **geraniol** and **citral** (CAS no. 5392-40-5) in deodorants. The EDCs in these products were mostly included to act as **fragrances** and preservatives."

"Consistent with the results of this study, Wieck et al. (2018) reported that 26 fragrances were named approximately 2000 times on the ingredient list of 1447 household detergents, and **fragrances** such as **limonene, linalool, hexyl cinnamaldehyde, 2-(4-tert-butylbenzyl)propionaldehyde,** and **citronellol** were frequently mentioned (Wieck et al., 2018, Yazar et al., 2011)....**Geraniol** appeared to have the potential to **interact with estrogen receptors** in estrogen-inducible yeast expressing the human estrogen receptor (Howes et al., 2002).... **Benzyl benzoate** and **2-(4-tert-butylbenzyl)propionaldehyde** added to **synthetic detergents, fabric softeners, and air fresheners** were **reported to induce estrogenic responses in MCF-7 human breast cancer cell line** (Charles and Darbre, 2009).

"This study confirmed that DEHP, DINP, and DBP were used in cleaners, synthetic detergents, coating agents, adhesives, **air fresheners**, and paints. **Exposure to DEHP or DBP at levels seen in human populations** has been **linked to male reproductive defects**, such as **poor semen quality** and **abnormal genital development** (Radke et al., 2018)."

26. *History of the Obesogen Field: Looking Back to Look Forward*

Heindel JJ. History of the Obesogen Field: Looking Back to Look Forward. Front Endocrinol (Lausanne). 2019 Jan 29;10:14. doi: 10.3389/fendo.2019.00014. PMID: 30761083; PMCID: PMC6362096.
Article Link: https://pubmed.ncbi.nlm.nih.gov/30761083/

"Exposure to EDCs during early development (DOHaD) has been shown to **increase susceptibility to a variety of diseases including infertility, asthma, breast and prostate cancer, early puberty, susceptibility to infections, heart disease, autoimmune disease, and attention deficit hyperactivity disorder/learning disability**. The chemicals that she noted as having the ability to cause weight gain include organochlorine pesticides, carbamates, polychlorinated biphenols, plastics such as **phthalates** and bisphenol A (BPA), heavy metals and solvents.**"**

"EDCs are found in a wide variety of products including pesticides/herbicides/fungicides, flame retardants, surfactants, plastics, **sunscreens, cosmetics,** and **personal care products,** etc. [reviewed in (5)]."

"Originally, **EDCs** were shown to interfere with **estrogen, androgen and thyroid hormone signaling (7, 8) resulting in diseases and dysfunctions in reproduction, learning, memory, and behavior."**

[Note: Endocrine Disrupting Chemicals (EDC's) are commonly used in perfumes and fragranced products as preservatives or fragrance. What are EDC's and how can they affect us?**]**

27. *Symptoms of mothers and infants related to total volatile organic compounds in household products*

Farrow A, Taylor H, Northstone K, Golding J. Symptoms of mothers and infants related to total volatile organic compounds in household products. Arch Environ Health. 2003 Oct;58(10):633-41. doi: 10.3200/AEOH.58.10.633-641. PMID: 15562635.
Article Link: https://pubmed.ncbi.nlm.nih.gov/15562635/

"Higher TVOC levels were associated with air freshener and aerosol use. **Infant diarrhea** and **earache** were statistically significantly associated with air freshener use, and **diarrhea** and **vomiting** were significantly associated with aerosol use. **Headache** experienced by mothers 8 mo after birth was significantly associated with the use of **air fresheners** and aerosols; **maternal depression** was significantly associated with the use of air fresheners. The results of the study suggest a **link between the use of products that raise indoor levels of TVOCs and an increased risk of certain symptoms among infants and their mothers**."
[Note: Fragranced products emit VOC's that can contribute to higher particulate matter (PM) indoors and out.**]**

28. *An atlas of fragrance chemicals in children's products*

Ravichandran J, Karthikeyan BS, Jost J, Samal A. An atlas of fragrance chemicals in children's products. Sci Total Environ. 2022 Apr 20;818:151682. doi: 10.1016/j.scitotenv.2021.151682. Epub 2021 Nov 15. PMID: 34793786.
Article Link: https://pubmed.ncbi.nlm.nih.gov/34793786/

"We find that several **fragrance chemicals in children's products are potential carcinogens, endocrine disruptors, neurotoxicants, phytotoxins and skin sensitizers.**"
Fragrance chemicals have been linked to the onset and exacerbation of **several allergic** and **non-allergic disease conditions** in humans."
"Exposure of children to hazardous chemicals via any route is a significant concern due to the potential **impact on the growth and development** during early childhood."
****FCCP Chemical Database:** FCCP A repository of Fragrance Chemicals in Children's Products
****FCCP Chemical Classification Data Compilation:** Graphical Abstract

29. ALSO SEE SECTIONS: Infertility / Reproduction, Hormone System / Endocrine, Respiratory/Pulmonary (Nose & Lungs)

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Website: https://www.fragrancefreecoalitionusa.com/

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RESPIRATORY / PULMONARY (Nose and Lungs)

Coughing, Shortness of Breath, Congestion, Difficulty Breathing, Sneezing, Wheezing, Mouth and Throat Irritation, Mucosal Symptoms, Anaphylactic Reaction, Airway Obstruction, Chest Tightening, Asthma like Symptoms Pulmonary Inflammation, Respiratory Illness (Rhinitis/Asthma), Nasal Irritation,
Also see: Asthma

1. *Acute toxic effects of fragrance products*

Anderson RC, Anderson JH. Acute toxic effects of fragrance products. Arch Environ Health. 1998 Mar-Apr;53(2):138-46. doi: 10.1080/00039896.1998.10545975. PMID: 9577937.
Article Link: https://pubmed.ncbi.nlm.nih.gov/9577937/

"The emissions of these fragrance products caused various combinations of **sensory irritation**, **pulmonary irritation, decreases in expiratory airflow** velocity, as well as alterations of the functional observational battery indicative of neurotoxicity. **Neurotoxicity** was more severe after mice were repeatedly exposed to the fragrance products… Collectively, the experimental data and chemistry predict that some humans exposed to these FPs might experience some combination of **eye, nose, and/or throat irritation; respiratory difficulty; possibly bronchoconstriction or asthma-like reaction; and central nervous systems reactions (e.g., dizziness, incoordination, confusion, fatigue**)."

"The results of our study might help explain why some individuals report an intolerance to FPs and why some **FPs can exacerbate airflow limitation in some asthmatics**."

2. *Coughing in Small Animal Patients*

Hsieh BM and Beets AK (2020) Coughing in Small Animal Patients. Front. Vet. Sci. 6:513. doi: 10.3389/fvets.2019.00513
Article Link: https://www.frontiersin.org/articles/10.3389/fvets.2019.00513/full

"Environmental factors play a large role in some **chronic airway disease** processes and can cause exacerbation of coughing. Owners should not smoke indoors and any possible **airborne irritants such as air fresheners, incense, perfumes, and noxious fumes should be eliminated.**"

"**Coughing is a common clinical problem in humans and veterinary patients** that is difficult to manage and severely impacts quality of life.… Current guidelines are largely based on expert opinion, anecdotal clinical evidence and relatively few rigorous clinical trials."

3. *Occupational acute anaphylactic reaction to assault by perfume spray in the face*

Lessenger JE. Occupational acute anaphylactic reaction to assault by perfume spray in the face. J Am Board Fam Pract. 2001 Mar-Apr;14(2):137-40. PMID: 11314921.
Article Link: https://pubmed.ncbi.nlm.nih.gov/11314921/ - PDF

"**Fragrances** have been found to cause exacerbations of symptoms and **airway obstruction** in asthmatic patients, including **chest tightening** and **wheezing**, and are a common cause of cosmetic allergic contact dermatitis. In many work settings the use of fragrances is limited. Workers should be prepared to take immediate steps should an employee go into **anaphylactic shock**."

4. *Increased release of histamine in patients with respiratory symptoms related to perfume.*

Elberling J, Skov PS, Mosbech H, Holst H, Dirksen A, Johansen JD. Increased release of histamine in patients with respiratory symptoms related to perfume. Clin Exp Allergy. 2007 Nov;37(11):1676-80. doi: 10.1111/j.1365-2222.2007.02824.x. Epub 2007 Sep 17. PMID: 17877753.

Article Link: https://pubmed.ncbi.nlm.nih.gov/17877753/

"The present study demonstrated that fragrance chemicals have the capacity to induce HR from peripheral blood basophils in a dose-dependent manner."

"Because **antihistamine treatment seems to be rarely effective**, the basophil reactivity to perfume may involve release of other **cytokines** e.g. **prostaglandins**, **leukotrienes** or substance P with importance for the development of clinical symptoms."

"In summary, this is the **first study suggesting that perfume induces a dose-dependent non-IgE-mediated histamine release from human peripheral blood basophils.**"

5. *Mucosal symptoms elicited by fragrance products in a population-based sample in relation to atopy and bronchial hyper-reactivity*

Elberling J, Linneberg A, Dirksen A, Johansen JD, Frølund L, Madsen F, Nielsen NH, Mosbech H. Mucosal symptoms elicited by fragrance products in a population-based sample in relation to atopy and bronchial hyper-reactivity. Clin Exp Allergy. 2005 Jan;35(1):75-81. doi: 10.1111/j.1365-2222.2005.02138.x. PMID: 15649270.

Article Link: https://pubmed.ncbi.nlm.nih.gov/15649270/

"Exposure to perfume and fragrance products may, in some individuals, cause symptoms from the eyes and airways."

"Objective: To investigate both the localization and character of symptoms from the eyes and airways elicited by fragrance products, and the associations between such symptoms and skin prick test reactivity (atop), methacholine **bronchial hyper-reactivity (BHR)**, **allergic rhinitis** and **asthma.**"

"The response rate was 79.6%. Symptoms from the **eyes and airways** elicited by 42%. **Mucosal symptoms from the eyes and airways** were common in this population. BHR was a significant and independent predictor of these symptoms. … The lack of association withatop suggested that IgE- mediated allergic mechanisms do not play a major role in the development of these symptoms."

6. *Laundry detergents and detergent residue after rinsing directly disrupt tight junction barrier integrity in human bronchial epithelial cells*

Wang M, Tan G, Eljaszewicz A, Meng Y, Wawrzyniak P, Acharya S, Altunbulakli C, Westermann P, Dreher A, Yan L, Wang C, Akdis M, Zhang L, Nadeau KC, Akdis CA. Laundry detergents and detergent residue after rinsing directly disrupt tight junction barrier integrity in human bronchial epithelial cells. J Allergy Clin Immunol. 2019 May;143(5):1892-1903. doi: 10.1016/j.jaci.2018.11.016. Epub 2018 Nov 27. PMID: 30500342.

Article Link: https://pubmed.ncbi.nlm.nih.gov/30500342/ - PDF

"Our data demonstrated that **both laundry detergents and detergent residue after rinsing showed high cytotoxicity and directly impaired barrier integrity of bronchial epithelial cells. …** the **effect of broadly used detergents on airway epithelium** could be one important reason of **increased prevalence of asthma** in the past few decades."

"Fragrance can also cause exacerbations of symptoms and airway obstruction in asthmatic patients."
"Considering the high concentration and large amount of detergent residue in clothing and the close contact with human organs, the irritative and sensitized ingredients of **laundry detergents** can be easily **inhaled** into the airways and reach the lung from newly washed clothing."

"It must be noted that contents of **household detergents, carpet cleaners, dishwashers, and laundry detergents** are quite similar, indicating extensive exposure to detergents. Therefore the problem of long-term high exposure to detergent in daily life should receive attention for public health. **Epigenetic** mechanisms are thought to play a role in different complex diseases of the lungs, such as **asthma** and **COPD**, which are strongly influenced by environmental factors, such as cigarette smoke. Although we showed a negligible effect of laundry detergents on chromatin accessibility and DNA methylation in HBECs, these data helped us reach the conclusion that laundry detergents directly attack barrier integrity, without affecting the epigenome in short-term exposure. However, we cannot rule out the possibility that a longer time period and more chronic daily exposure to detergent could influence **DNA methylation**. In line with this concept, one recent study demonstrated that exposure of HBECs to diesel exhaust had minimal effects on DNA methylation at 48 hours; however, when the same lung was exposed to diesel exhaust but separated by 4 weeks, significant changes in DNA methylation were observed."

7. *Fragrances: Contact Allergy and Other Adverse Effects*

de Groot AC. Fragrances: Contact Allergy and Other Adverse Effects. Dermatitis. 2020 Jan/Feb;31(1):13-35. doi: 10.1097/DER.0000000000000463. PMID: 31433384.

Article Link: https://pubmed.ncbi.nlm.nih.gov/31433384/

"In the general adult population, up to 4.5% may be allergic to fragrance materials, and in consecutive patients patch tested for suspected contact dermatitis, the frequency may reach 20% to 25%...

"Fragrances are an important and frequent cause of contact allergy and allergic contact dermatitis, notably from their presence in fragranced products such as deodorants, **fine fragrances** and aftershaves, other cosmetics (**both leave-on and rinse-off products**), household products, topical pharmaceuticals, essential oils, foods, and, to a lesser degree, industrial products."

"Other adverse effects reported from fragrances include immediate type reactions (mostly nonimmune immediate contact reactions, contact urticaria), **photosensitivity**, **respiratory disorders**, and miscellaneous adverse effects including irritant **contact dermatitis**, **depigmentation**, and **systemic adverse effects**."

“Fragrances are volatile, and therefore, in addition to skin exposure, a perfume also exposes the **eyes and nasorespiratory tract**. Already 35 years ago, it was suspected and later confirmed that fragrances can induce or worsen respiratory problems including **asthmatic attacks**.”

“People may experience symptoms not only from wearing perfume themselves but also around cosmetic counters, candle shops, and from perfumes worn by other people. Currently, it is estimated that 2% to 4% of the adult population is affected by respiratory or eye symptoms from such exposures. Frequently reported **symptoms include dry, itching, or watery eyes; nasal irritation; congestion; and sneezing; as well as mouth and throat irritation, shortness of breath, and cough.**”

8. *Characterization of air freshener emission: the potential health effect*

Kim S, Hong SH, Bong CK, Cho MH. Characterization of air freshener emission: the potential health effects. J Toxicol Sci. 2015;40(5):535-50. doi: 10.2131/jts.40.535. PMID: 26354370.

Article Link: https://pubmed.ncbi.nlm.nih.gov/26354370/ - PDF

“The use of these products (air fresheners) may be associated with an increase in the measured level of **terpene**, such as **xylene** and other volatile air freshener components, including **aldehydes**, and **esters**. Air freshener is usually used indoors, and thus some compounds emitted from air freshener may have potentially harmful health impacts, including **sensory irritation**, **respiratory symptoms**, and **dysfunction of the lungs**.”

“**The constituents of air fresheners can react with ozone to produce secondary pollutants such as formaldehyde, secondary organic aerosol (SOA), oxidative product, and ultrafine particles.** These pollutants then adversely affect human health, in many ways such as **damage to the central nervous system, alteration of hormone levels,** etc. In particular, the ultrafine particles may induce **severe adverse effects on diverse organs**, including the **pulmonary and cardiovascular systems.”**

“This review suggests that exposure to air freshener compounds, such as **VOCs that react with ozone to form secondary pollutants**, cause diverse health issues. In addition, **several key compounds such as benzene, terpenes, and phthalate etc. of air pollutants are related to air freshener use**. **We suggest that the use of air fresheners should be avoided**, and there is a need to reduce chemical components which are potentially reactive with ozone in air fresheners.”

[Note: Fragrance is considered the new ‘second hand smoke’, **“**The parallels between second-hand smoke and synthetic fragrance use are many. At its core, both are battles over indoor air quality **“** - quote and link from De Vader, Christy L. & Barker, Paxson.
Chemicals that cigarettes/cigarette smoke and fragranced products can have in common are: Acetone, Formaldehyde, Benzene, acetaldehyde, terpenoids and phenols.**]**

9. *Ethanol-based disinfectant sprays drive rapid changes in the chemical composition of indoor air in residential buildings*

Jiang J, Ding X, Isaacson KP, Tasoglou A, Huber H, Shah AD, Jung N, Boor BE. Ethanol-based disinfectant sprays drive rapid changes in the chemical composition of indoor air in residential buildings. J Hazard Mater Lett. 2021 Nov;2:100042. doi: 10.1016/j.hazl.2021.100042. Epub 2021 Sep 8. PMID: 34977843; PMCID: PMC8423670.

Article Link: https://pubmed.ncbi.nlm.nih.gov/34977843/ - PDF

“Preclinical studies on animals revealed potential **neural, hepatic, pulmonary**, and **cardiovascular risks** of inhalation of **ethanol** and 2-propanol…. Epidemiological studies have identified associations between **inhalation exposure to VOCs** and numerous **respiratory diseases** VOC exposures in residential and office buildings have been related to various adverse human health outcomes.”

“Products A and B contained ethanol at 30–60 %wt. and 58 % wt., respectively. Both sprays utilized alkanes as propellants (A, B: propane (C3H8), A: isobutane (i-C4H10), B: n-butane (n-C4H10)) and included **fragrances**.”

“Monoterpenes and monoterpenoids are common fragrance ingredients in disinfectants and could cause occupational asthma…. Epidemiological studies have identified associations between **inhalation exposure to VOCs** and **numerous respiratory diseases….** VOC exposures in residential and office buildings have been related to various adverse human health outcomes….”

10. *Fragranced consumer products: effects on asthmatics*

Steinemann A. Fragranced consumer products: effects on asthmatics. Air Qual Atmos Health. 2018;11(1):3-9. doi: 10.1007/s11869-017-0536-2. Epub 2017 Dec 11. PMID: 29391919; PMCID: PMC5773620

Article Link: https://pubmed.ncbi.nlm.nih.gov/29391919/ **-** PDF

“Fragranced consumer products, such as **cleaning supplies**, air fresheners, and personal care products, can emit a range of air pollutants and trigger adverse health effects…”

“...41.0% of asthmatics report **health problems** from air fresheners or deodorizers, 28.9% from scented laundry products coming from a dryer vent, **42.3% from being in a room cleaned with scented products,** and 46.2% from being near someone wearing a fragranced product.”

“**Fragranced consumer products pervade society and emit numerous volatile organic compounds, such as limonene, alpha-pinene, beta-pinene, acetaldehyde, and formaldehyde…”**

“Fragranced products have been associated with a range of adverse health effects including work-related asthma (Weinberg et al. 2017), asthmatic exacerbations (Kumar et al. 1995; Millqvist and Löwhagen 1996), **respiratory difficulties** (Caress 2009), **mucosal symptoms** (Elberling et al. 2005)**, migraine headaches** (Kelman 2004), and **contact dermatitis** (Rastogi et al. 2007; Johansen 2003), as well as **neurological, cardiovascular, cognitive, musculoskeletal, and immune system problems** (Steinemann 2016).”

“Results indicate that 64.3% of asthmatics report one or more types of adverse health effects from fragranced products, including **respiratory problems** (43.3%), **migraine headaches** (28.2%), and **asthma attacks** (27.9%)...”

11. *Cleaning Agents and Asthma*

Quirce S, Barranco P. Cleaning agents and asthma. J Investig Allergol Clin Immunol. 2010;20(7):542-50; quiz 2p following 550. PMID: 21313993.

Article Link: https://pubmed.ncbi.nlm.nih.gov/21313993/ - PDF

“Perfumes and scents are components common of many cleaning products. **Pine scent** containing **terpenes can** act as a **sensitizer**, as can **limonene**, **eugenol**, and **other fragrances**. The main sensitizers contained in

cleaning products are **disinfectants**, quaternary ammonium compounds (such as benzalkonium chloride), amine compounds, and fragrances…. Exposure to the ingredients of cleaning products may give rise to both **new-onset asthma**, with or without a latency period, and **work exacerbated asthma**. High-level exposure to irritants may induce reactive airways dysfunction syndrome."

"Terpenes can cause secondary emissions due to reactions of the primary exposures with oxidizers present in indoor air. These reactions can **release secondary ultrafine particles** that may be responsible for **respiratory irritation** symptoms."

"Exposure to different cleaning compounds, including **fragrances**, has been reported to **cause asthma-like symptoms** with no significant changes in lung function. High-level **respiratory irritant exposures** can **induce new onset of asthma** with no latency period, namely, **reactive airways dysfunction syndrome.**"

"Most of the cleaning agents associated with asthma like symptoms have harmful irritative and/or sensitizing properties and may be involved in the development of chronic respiratory symptoms.
Sensitizers
• Amine compounds (eg, monoethanolamine)
• Disinfectants (eg, **aldehydes**)
• Quaternary ammonium compounds (eg, benzalkonium chloride)
• Scents containing terpenes (eg, pinene, d-limonene), eugenol
• Isothiazolinones, **formaldehyde** (preservatives)
• Others: natural rubber latex "
"The main chemical classes of disinfectants are alcohols (eg, ethanol, isopropanol), **aldehydes** (glutaraldehyde, orthophthalaldehyde), oxidizers (eg, sodium hypochlorite, H2O2), phenolics (phenol, thymol, o-phenylphenol), and quaternary ammonium compounds. **Disinfectants have been identified as the most hazardous group of cleaning agents."**

[Note: Fragrance does not clean or disinfect, yet many cleaning products are unnecessarily scented.**]**

12. *A pilot study of total personal exposure to volatile organic compounds among Hispanic female domestic cleaners*

Oyer-Peterson K, Gimeno Ruiz de Porras D, Han I, Delclos GL, Brooks EG, Afshar M, Whitworth KW. A pilot study of total personal exposure to volatile organic compounds among Hispanic female domestic cleaners. J Occup Environ Hyg. 2022 Jan;19(1):1-11. doi: 10.1080/15459624.2021.2000615. Epub 2022 Jan 28. PMID: 34731075; PMCID: PMC8813894.
Article Link: https://pubmed.ncbi.nlm.nih.gov/34731075/ - PDF

"Cleaners have an elevated risk for the development or exacerbation of **asthma** and other **respiratory** conditions, possibly due to exposure to cleaning products containing **volatile organic compounds (VOCs)** leading to **inflammation** and **oxidative stress**. …29% and 20% reported suffering from **skin irritation** and **trouble breathing**…"

"...the highest exposures experienced by the women were from **d-limonene** (mean = 22.5 ppb; median = 4.3 ppb), followed by **toluene** (mean = 1.5 ppb; median = 1.1 ppb), **α-pinene** (mean = 0.8 ppb; median = 0.7 ppb) and **β-pinene** (mean = 0.7 ppb; median = 0.6 ppb)..."

“Additionally, while they are exposed to myriad **VOCs**, these women were particularly exposed to **terpene compounds**, which are often **found in scented cleaning products.**”

13. *Toxic Chemicals Emitted from Air fresheners & Disinfectants*

Geetha Balasubramani, Paul Pradeep, J Nisitha S. Toxic Chemicals Emitted from Air fresheners & Disinfectants. IJRASET. Volume 10 Issue X Oct 2022, Pgs 1338-1345. ISSN : 2321-9653 *IJRASET47180*

Article Link:

https://www.ijraset.com/research-paper/toxic-chemicals-emitted-from-air-fresheners-and-disinfectants - PDF

(Note: This graphic is from preceding article**)**

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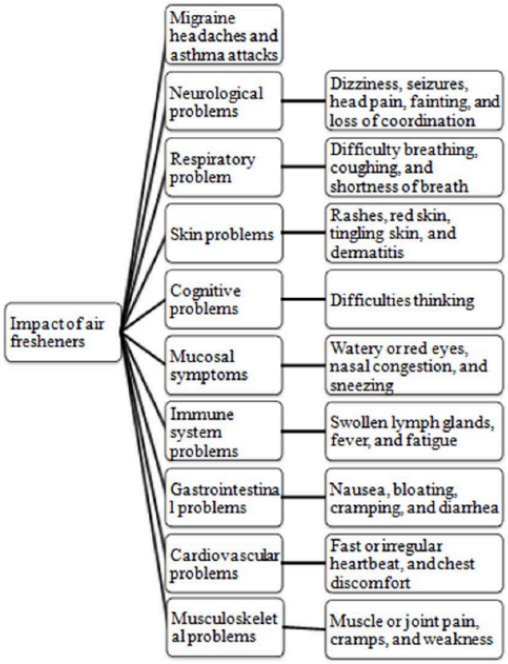


Figure 2: The diagram above illustrates the classification of illnesses brought on by exposure to air fresheners.

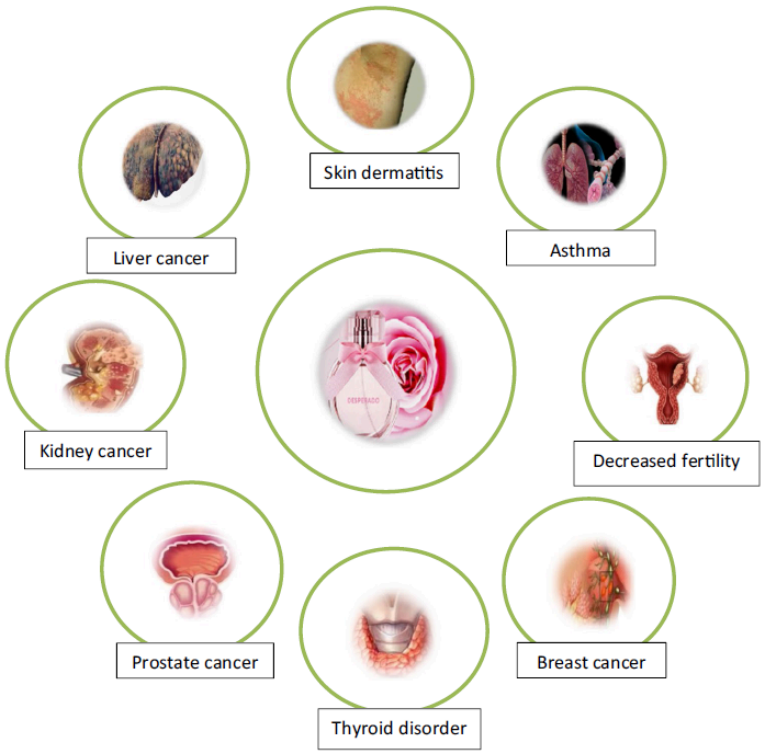
14. *Evaluation of pollutants in perfumes, colognes and health effects on the consumer: a systematic review*

Kazemi Z, Aboutaleb E, Shahsavani A, Kermani M, Kazemi Z. Evaluation of pollutants in perfumes, colognes and health effects on the consumer: a systematic review. J Environ Health Sci Eng. 2022 Feb 3;20(1):589-598. doi: 10.1007/s40201-021-00783-x. PMID: 35669814; PMCID: PMC9163252.

Article Link: https://pubmed.ncbi.nlm.nih.gov/35669814/ - PDF

(Note: Graphic is from preceding article**) (**Creative Commons Attribution 4.0 International license**).**

Fig. 2 Effects of exposure to perfumes and colognes



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"Diethyl phthalate is a chemical used to **make perfumes last longer.** The U.S. Clean Water Act lists it as a **toxic** and priority pollutant."

"Complications of using perfume include **neuropathy (depression, autism), neoplasms (breast cancer, prostate cancer), effects on the liver, migraine headaches, asthma attacks, mucosal symptoms (watery or red eyes, sneezing), neurological problems (dizziness, convulsions, headache, fainting, imbalance), respiratory (cough, shortness of breath), skin (skin rash, urticaria, redness of the skin, skin tingling, dermatitis), immune system (swollen lymph nodes, fever, fatigue), gastrointestinal tract (nausea, bloating, diarrhea)** and **cardiovascular (rapid** or **irregular heartbeat, tremors, chest discomfort**)"

"**Contaminants in perfumes and colognes** and their health effects on the consumer were systematically reviewed. It was found that the most attention of researchers was to identify the compounds in perfumes and colognes and their concentrations. Among the most common pollutants **phthalates** and their derivatives can be mentioned. Other pollutants included **parabens, triclosan, salicylates, terpenes, aldehydes, benzene, toluene, styrene, and aluminum-based salts**. These pollutants have also been shown to have adverse effects on consumer health such as **asthma and allergies, cardiovascular disease, central nervous system damage, breast cancer, endocrine cancer, respiratory disorders, reproduction, thyroid, adrenal gland function and immune system."**

[Note: Graphic lists "effects of exposure to perfumes and colognes": Kidney Cancer, Liver Cancer, Prostate Cancer, Thyroid Disorder, Breast Cancer, Decreased Fertility, Asthma and Skin Dermatitis.**]**

15. *Ten questions concerning air fresheners and indoor built environments*

Anne Steinemann, Ten questions concerning air fresheners and indoor built environments, Building and Environment, Volume 111, 2017, Pages 279-284, ISSN 0360-1323, https://doi.org/10.1016/j.buildenv.2016.11.009.
Article Link: https://www.sciencedirect.com/science/article/pii/S0360132316304334?via%3Dihub - PDF

"This article investigates the seeming paradox that **products designed to improve the indoor environment can pose unintended and unknown risks.** It examines the science, health, and policy perspectives, and provides recommendations and research directions."

"Air fresheners can contribute to indoor hazardous air pollutants, both through direct emissions and secondary reaction products… Within buildings and other indoor environments, the use of air fresheners has a strong association with high indoor levels of **terpenes, benzene, toluene**, ethyl-benzene, m,p-xylene, and **total volatile organic compounds**…"

"Air fresheners can contribute to human exposure to primary and secondary air pollutants… Air freshener exposures, **even at low levels**, have been associated with a range of adverse health effects, which include **migraine headaches, asthma attacks, breathing difficulties, respiratory difficulties, mucosal symptoms, dermatitis, infant diarrhea and earache, neurological problems, and ventricular fibrillation**..."
"In addition to population based studies, specific air freshener chemicals (VOCs such as acetaldehyde, SVOCs such as phthalates, and ultrafine particles) emitted from air fresheners have been associated with adverse effects to the **neurological, cardiovascular, respiratory, reproductive, immune, and endocrine systems, and with cancer**. For instance, acetaldehyde, which can be both a primary and secondary emission from air fresheners, is associated with both **acute and chronic hazards to the respiratory system**, and classified as a carcinogenic hazardous air pollutant in the US…"

16. *Ubiquity, Hazardous Effects, and Risk Assessment of Fragrances in Consumer Products*

Pastor-Nieto MA, Gatica-Ortega ME. Ubiquity, Hazardous Effects, and Risk Assessment of Fragrances in Consumer Products. Curr Treat Options Allergy. 2021;8(1):21-41. doi: 10.1007/s40521-020-00275-7. Epub 2021 Jan 23. PMID: 33520600; PMCID: PMC7825391.
Article Link: https://pubmed.ncbi.nlm.nih.gov/33520600/ - PDF

"Fragrances are the most frequent chemicals causing contact dermatitis. … It is difficult for sensitized patients to avoid contact with fragrances, due to their ubiquity and because **manufacturers are not willing to volunteer information regarding fragrance ingredients.**"
"The patient should understand that avoiding perfume means to avoid all scented goods and not just perfumes."

"A perfume also contains solvents, fixatives to influence its persistence…. Fragrances are ubiquitous and may cause detrimental health or environmental effects including **contact allergy**."
"Some fragrances are carcinogens, mutagens, and **toxic to reproduction** (CMR substances), thus classified with H341, H351, or H360. **Respiratory**, **neuroendocrine**, and **psychological effects** have also been discussed…. Fragrances have **neurotoxic** and **neurostimulatory effects**."

"Certain perfumes may be **cytotoxic to human fetal brain development** based on in vitro research with neuroblastoma cell lines…. Ingredients in perfumes with presumed **hormonal activities** are octinoxate and butylated hydroxytoluene (**thyroid and androgen-like activities**) and octinoxalate, oxybenzone, benzophenone-1, diethyl phthalate, galaxolide, tonalide, musk ketone, benzyl salicylate, and butylphenyl methylproprional (**estrogen or androgen activity**). Diethyl phthalate, a fragrance solvent, can cause **abnormal development of reproductive organs** in infant males**, attention deficit disorder** in children, and **sperm damage** in adults**….** According to one study, most perfumes exhibited some degree of **mutagenic potential** compared with 4-nitro-1,2-diaminobenzene, a highly mutagenic positive control**.**"

17. *Qualitative Analysis of Air Freshener Spray*

Ibrahim ALshaer F, Fuad ALBaharna D, Ahmed HO, Ghiyath Anas M, Mohammed ALJassmi J. Qualitative Analysis of Air Freshener Spray. J Environ Public Health. 2019 Nov 5;2019:9316707. doi: 10.1155/2019/9316707. PMID: 31781257; PMCID: PMC6874985.
Article Link: https://pubmed.ncbi.nlm.nih.gov/31781257/ - PDF

"Information lacks concerning the gaseous emissions of fragrance products in spite of the extensive indoor exposure and widespread use of fragrances to them. In addition, **95 percent of the chemicals are synthetic compounds in fragrances that are derived from petroleum**."

"Some chemicals after analysis turned out to be noted as **skin allergens** or **irritants** and even chemicals that may interfere with **bodily functions**."

"The present study has identified the presence of different compounds in spray air fresheners that were not disclosed on the product's label. The results depicted common compounds in both low- and high-cost air fresheners. **Chemicals found in this study were not revealed on the product label as manufacturers are not required to list all ingredients**. These chemicals usually tend to be listed on the product label as "parfum" or "fragrance". There should be a law that strictly indicates whether the products contain any synthetic chemicals for people to be aware of what they are exposed to, although, manufacturers are not required to reveal all hidden ingredients on the label as stated by the Consumer Product Safety Commission (CPSC)."

18. *Indoor secondary organic aerosols formation from ozonolysis of monoterpene: An example of d-limonene with ammonia and potential impacts on pulmonary inflammations*

Niu X, Ho SSH, Ho KF, Huang Y, Cao J, Shen Z, Sun J, Wang X, Wang Y, Lee S, Huang R. Indoor secondary organic aerosols formation from ozonolysis of monoterpene: An example of d-limonene with ammonia and potential impacts on pulmonary inflammations. Sci Total Environ. 2017 Feb 1;579:212-220. doi: 10.1016/j.scitotenv.2016.11.018. Epub 2016 Nov 11. PMID: 27842959.
Article Link: https://pubmed.ncbi.nlm.nih.gov/27842959/

"**Monoterpene** is one class of biogenic volatile organic compounds (BVOCs) which widely presents in **household cleaning products** and **air fresheners**. It plays reactive role in **secondary organic aerosols (SOAs) formation with ozone (O3) in indoor environments.** Such ozonolysis can be influenced by the presence of gaseous pollutants such as ammonia (NH3). This study focuses on investigations of ozone-initiated formation of indoor SOAs with **d-limonene**, one of the most abundant indoor **monoterpenes**, in a large environmental chamber…. The results indicated that there was 22-39% stronger **pulmonary inflammatory** effect on the particles generated with NH3 (ammonia)…"

[Note: Limonene is a common skin sensitizer and known allergen in fragrance and fragranced products. Limonene (natural or synthetic) is a terpene. Terpenes can create formaldehyde and particulate matter in air as secondary pollutants. Limonene is on the IFRA list as a fragrance ingredient.**]**

19. *Prevalence and predictors of occupational asthma among workers in detergent and cleaning products industry and its impact on quality of life in El Asher Men Ramadan, Egypt*

Ahmed AS, Ibrahim DA, Hassan TH, Abd-El-Azem WG. Prevalence and predictors of occupational asthma among workers in detergent and cleaning products industry and its impact on quality of life in El Asher Men Ramadan, Egypt. Environ Sci Pollut Res Int. 2022 May;29(23):33901-33908. doi: 10.1007/s11356-022-18558-8. Epub 2022 Jan 15. PMID: 35034305; PMCID: PMC8761047.
Article Link: https://pubmed.ncbi.nlm.nih.gov/35034305/ - PDF

"Cleaning products are mixtures of many chemical ingredients that are known to contain sensitizers, disinfectants, and **fragrances**, as well as **strong airway irritants** which associated with **lower respiratory tract** and **asthma symptoms**."

"Workers in detergent and cleaning products industry are vulnerable group for developing occupational asthma and other **respiratory problems** as they are exposed to a wide range of irritants and sensitizers in the chemical substances used, besides common indoor allergens and pollutants (Quirce & Barranco, 2010)."

"**When the airway epithelium is damaged as a result of repeated irritating exposure, the inflammatory Th2 response is triggered** (Tarlo & Lemiere, 2014)."

20. *Effects of indoor environment and lifestyle on respiratory health of children in Chongqing, China*

Li W, Liu Q, Chen Y, Yang B, Huang X, Li Y, Zhang JJ. Effects of indoor environment and lifestyle on respiratory health of children in Chongqing, China. J Thorac Dis. 2020 Oct;12(10):6327-6341. doi: 10.21037/jtd.2020.03.102. PMID: 33209472; PMCID: PMC7656398.
Article Link: https://pubmed.ncbi.nlm.nih.gov/33209472/ - PDF

"Frequent use of **air fresheners** is associated with **reduced lung function** in children."

"According to an WHO report, 100 thousand people die of **asthma** every year due to indoor air pollution around the world, of which 35% are children."

"A study conducted in American adults found that 1,4-dichlorobenzene (1,4-DCB) was associated with reduced pulmonary function… 1,4-DCB was commonly found in air fresheners, toilet bowl deodorants, and mothballs."

"Air fresheners have also been found to increase lung irritation and toxic effects on mice in acute toxicity experiments on mice. There are numerous types of air fresheners, which traditionally consist of diethyl ether and **aromatic flavor ingredients**. Besides, propane, butane, dimethyl ether and other ingredients are added to high-pressure canned products and these ingredients could **impair children's lung function**. **The use of air fresheners does not improve indoor air quality. Instead, it could exacerbate indoor pollution."**

[Note: The chemicals used in fragrance in products, including air fresheners, qualify as 'trade secrets'.**]**

21. *Fragranced consumer products: effects on asthmatic Australians*

Steinemann A, Wheeler AJ, Larcombe A. Fragranced consumer products: effects on asthmatic Australians. Air Qual Atmos Health. 2018;11(4):365-371. doi: 10.1007/s11869-018-0560-x. Epub 2018 Mar 17. PMID: 29780436; PMCID: PMC5954056.

Article Link: https://pubmed.ncbi.nlm.nih.gov/29780436/ - PDF

"Exposure to fragranced consumer products is associated with adverse health effects such as **asthma attacks, breathing difficulties, and migraine headaches….** Nationally, 55.6% of asthmatics, and 23.9% of non-asthmatics, report adverse health effects after exposure to fragranced products."

"Overall, the majority of asthmatics and non-asthmatics were unaware of **potentially hazardous chemicals emitted from fragranced products**, even ones called green or organic, and would not continue to use a fragranced product if they knew it emitted these pollutants…. Most asthmatics (67.1%) and non-asthmatics (69.2%) were not aware that **fragrance chemicals do not need to be fully disclosed** on the product label or material safety data sheet."

"A majority of asthmatics (62.6%) and non-asthmatics (55.8%) **would prefer an airplane without scented air pumped through the passenger cabin…** Nearly half of both asthmatics (50.2%) and non-asthmatics (40.4%) **would prefer that healthcare facilities and healthcare professionals were fragrance-free."**
"More than half of asthmatics (50.5%) and nearly half of non-asthmatics (39.7%) **would support a fragrance-free policy in the workplace**…**prefer a hotel without scented air"**

"…55.6% of "asthmatics" in our study who report adverse health effects due to fragranced product exposure would represent over 2.2 million adult Australians (ABS 2016). Combining this with the **23.9% of "non-asthmatics" (71.5%) who also report adverse health effects** would represent over 4.5 million adult Australians affected adversely **by fragranced consumer products."**

"Results from this study show that **voluntary and involuntary exposure to fragranced products** is widespread in Australian society, that **exposure is associated with a range of potentially serious and adverse health effects,**…In addition to the adverse health consequences, exposure to fragranced products imposes significant **adverse impacts** on workplace productivity and quality of life, **including the ability to access public places such as restrooms."**

"**A straightforward approach to reduce undesirable effects would be to reduce or avoid use of fragranced products**, **especially in public places that would impose involuntary risks**, and to **implement fragrance-free policies in workplaces, healthcare facilities, and other environments."**

22. *Toxic effects of air freshener emissions*

Anderson RC, Anderson JH. Toxic effects of air freshener emissions. Arch Environ Health. 1997 Nov-Dec;52(6):433-41. doi: 10.1080/00039899709602222. PMID: 9541364.

Article Link: https://pubmed.ncbi.nlm.nih.gov/9541364/

"The emissions of this **solid Air Freshener produced acute respiratory and neurotoxicity in mice**, and they did not lower the toxic impact of the other pollutants tested. Collectively, toxicity data, chemical data, and MSDS information predict that some humans exposed to emissions of the AF we studied might experience

some combination of **eye, nose, and/or throat irritation**; **respiratory difficulty**; **bronchoconstriction** or an **asthma-like reaction**; and **CNS reactions** (e.g., **dizziness**, **incoordination**, **confusion**, **fatigue**)."

23. *Fragranced consumer products: effects on autistic adults in the United States, Australia, and United Kingdom*

Steinemann A. Fragranced consumer products: effects on autistic adults in the United States, Australia, and United Kingdom. Air Qual Atmos Health. 2018;11(10):1137-1142. doi: 10.1007/s11869-018-0625-x. Epub 2018 Sep 25. PMID: 30546500; PMCID: PMC6244938

Article Link: https://pubmed.ncbi.nlm.nih.gov/30546500/ - PDF

"Fragranced consumer products are ubiquitous in society and emit numerous volatile organic compounds including hazardous air pollutants."

"Health effects were categorized as follows:
(a) migraine headaches;
(b) asthma attacks;
(c) neurological problems (e.g., dizziness, seizures, head pain, fainting, loss of coordination);
(d) respiratory problems (e.g., difficulty breathing, coughing, shortness of breath);
(e) skin problems (e.g., rashes, hives, red skin, tingling skin, dermatitis);
(f) cognitive problems (e.g., difficulties thinking, concentrating, or remembering);
(g) mucosal symptoms (e.g., watery or red eyes, nasal congestion, sneezing);
(h) immune system problems (e.g., swollen lymph glands, fever, fatigue);
(i) gastrointestinal problems (e.g., nausea, bloating, cramping, diarrhea);
(j) cardiovascular problems (e.g., fast or irregular heartbeat, jitteriness, chest discomfort);
(k) musculoskeletal problems (e.g., muscle or joint pain, cramps, weakness); and
(l) other."

"Specific problematic exposures, associated with adverse health effects for autistic adults, include but are not limited to the following: …air fresheners and deodorizers (62.9%), the scent of laundry products coming from a dryer vent (57.5%), being in a room recently cleaned with scented products (65.9%), **being near someone wearing a fragranced product** (60.5%), and other types of fragranced consumer products (64.3%)… Among autistic adults reporting health effects, 74.1% across the three countries (85.4% US, 82.4% AU, 54.5% UK) report that the severity of these health effects from fragranced products was potentially disabling. Among non-autistic adults, the prevalence of potentially disabling effects was 25.4%."

"...62.1% of autistic adults are unable or reluctant to use the restrooms in a public place if it has an air freshener, deodorizer, or scented product; 59.8% are unable or reluctant to wash their hands with soap in a public place if the soap is fragranced; 58.7% enter a business and then want to leave as quickly as possible if they smell air fresheners or a fragranced product; and **66.7% have been prevented from going someplace because they would be exposed to a fragranced product that would make them sick…"**

"Involuntary exposure is a concern. Autistic individuals are prevented from accessing public restrooms, societal venues, businesses, and workplaces due to adverse health effects from fragranced products. Further, 59.4% of autistic adults have lost workdays, in the past year, due to fragranced product exposure in the workplace. **A strong majority of autistic as well as non-autistic adults would prefer that workplaces, health care facilities, and health care professionals were fragrance-free than fragranced.**"

24. *Fragranced laundry products and emissions from dryer vents: implications for air quality and health*

Goodman N, Nematollahi N and Steinemann A (2021) Fragranced laundry products and emissions from dryer vents: implications for air quality and health. Air Quality, Atmosphere and Health, 14. pp. 245-249.
Article Link: https://researchonline.jcu.edu.au/64706/ - PDF

"The study pursues three main objectives: (a) to determine the frequency and types of health problems associated with exposure to fragranced laundry products from dryer vents, (b) to assess and compare the VOCs from fragranced and fragrance-free laundry products, and (c) to calculate potential reductions in **limonene** emissions from dryer vents by switching from fragranced to fragrance-free laundry products. Results can provide a scientific foundation and practical approach to reduce pollutants and potential health risks associated with the use of laundry products and their emissions through dryer vents."

"Among the general population in the US and AU, 12.5% and 6.1% of adults report health problems when exposed to **scented laundry products** from dryer vents. Adverse health effects include **respiratory problems (the most frequently reported, collectively), mucosal symptoms, skin problems, asthma attacks, migraine headaches, neurological problems**, among others."

"Dryer vent emissions from seven households were analyzed for their limonene concentrations…"
"In households that switched from fragranced products to fragrance-free products, emissions of limonene were reduced within two weeks by up to 99.7% (average 79.1%)."

"At a regional level, during use of fragranced laundry products, limonene emissions from dryer vents across metropolitan Melbourne is estimated at 1.99 tons/year."
"In this same analytical approach, applied to the state of California, limonene emissions from dryer vents across the state was estimated at 10.95 tons/year"

"This study indicates that fragranced laundry products emitted from dryer vents can be sources of indoor and outdoor air pollutants and health risks. The study also indicates that switching from fragranced to fragrance-free laundry products can generate potential improvements for air quality and health."

25. *Indoor Exposure to Selected Air Pollutants in the Home Environment:* A Systematic Review

Vardoulakis S, Giagloglou E, Steinle S, Davis A, Sleeuwenhoek A, Galea KS, Dixon K, Crawford JO. Indoor Exposure to Selected Air Pollutants in the Home Environment: A Systematic Review. Int J Environ Res Public Health. 2020 Dec 2;17(23):8972. doi: 10.3390/ijerph17238972. PMID: 33276576; PMCID: PMC7729884.
Article Link: https://pubmed.ncbi.nlm.nih.gov/33276576/ - PDF

"There is increasing awareness that the quality of the **indoor environment** affects our health and well-being…. Identified indoor **$PM_{2.5}$** sources include smoking, cooking, heating, use of **incense, candles,** and **insecticides**, while **cleaning**, housework, presence of pets and movement of people were the main sources of coarse particles….Household characteristics and occupant activities play a large role in indoor exposure, particularly cigarette smoking for PM2.5, gas appliances for NO2, and **household products** for **VOCs** and PAHs."

"Typical **VOCs** found in the indoor environment include **benzene**, **toluene**, **ethylbenzene** and **xylenes (BTEX)** from fuel combustion and evaporation, and house renovations; benzene and **styrene** from cigarette smoking; alkanes from natural gas; 1,4-dichlorobenzene from moth repellents; **a-pinene** from wood-based building materials; and **limonene** from **fragranced** household **cleaning and laundry products**… Reported **VOC concentrations were generally higher indoors than outdoors**, including for **benzene**, particularly in colder seasons due to reduced ventilation and the use of oil and gas heaters."

"Indoor sources were dominant for most **VOCs** and particularly for **limonene, a-pinene, hexanal**, pentanal, **o-xylene**, and **n-dodecane**. Use of **artificial air freshener was significantly associated with total VOC (TVOC), benzene**, **toluene** and **ethylbenzene**."

"Indoor air quality (IAQ) in particular has an impact on multiple health outcomes, including **respiratory** and **cardiovascular illness, allergic symptoms, cancers,** and **premature mortality."**

26. *Rapid and green determination of 58 fragrance allergens in plush toys*

Wang Z, Zhang Q, Li H, Lv Q, Wang W, Bai H. Rapid and green determination of 58 fragrance allergens in plush toys. J Sep Sci. 2018 Feb;41(3):657-668. doi: 10.1002/jssc.201700556. Epub 2017 Dec 14. PMID: 29150895.
Article Link: https://pubmed.ncbi.nlm.nih.gov/29150895/

"**Toys are scented** to cover unpleasant odors or to enhance their attractiveness to consumers. However, **some fragrances are important sources of allergens**, which can **trigger respiratory illnesses (asthma and rhinitis), migraine headaches, neurotoxicity, endocrine-disrupting activities,** and other negative effects."

27. *Emissions from dryer vents during use of fragranced and fragrance-free laundry products*

Goodman, N.B., Wheeler, A.J., Paevere, P.J. et al. Emissions from dryer vents during use of fragranced and fragrance-free laundry products. Air Qual Atmos Health 12, 289–295 (2019). https://doi.org/10.1007/s11869-018-0643-8
Article Link: https://link.springer.com/article/10.1007/s11869-018-0643-8 - PDF

"The study focused on D-limonene because it is (a) a prevalent and dominant VOC in fragranced laundry products as well as other fragranced consumer products, (b) a suitable marker as it is generally found in fragranced laundry products but not in fragrance-free laundry products, (c) associated with a range of adverse human health and environmental effects, and classified as a potentially hazardous compound (SWA 2018), and (d) a terpene that readily reacts with ozone to generate a range of hazardous secondary air pollutants."

(note: Graphic is from preceding article**)**

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Table 3 GC/MS headspace analysis of VOCs emitted from the fragranced laundry detergent and the fragrance-free laundry detergent used in this study, listed according to retention time

Compound	CAS #	Fragranced detergent	Fragrance-free detergent
Acetaldehyde*	75-07-0	✓	✓
Ethanol*	64-17-5	✓	
Acetone*	67-64-1	✓	✓
2-methyl-Pentane*	107-83-5	✓	
2-methyl-2-Propanol	75-65-0		✓
2-Propen-1-ol*	107-18-6	✓	
2-methyl-Hexane*	591-76-4	✓	
2,3-dimethyl-Pentane*	565-59-3	✓	
3-methyl-Hexane*	589-34-4	✓	
1,3-dimethyl-Cyclopentane	2453-00-1	✓	
Ethylbenzene*	100-41-4		✓
Heptane*	142-82-5	✓	
methyl-Cyclohexane*	108-87-2	✓	
2,3,4-trimethyl-Hexane	921-47-1	✓	
(E)-3-Hexen-1-ol	928-97-2	✓	
1-Hexanol*	111-27-3	✓	
α-Pinene	80-56-8	✓	
2-methyl-ethyl ester Pentanoic acid	39255-32-8	✓	
Sabinene	3387-41-5	✓	
3-Carene	13466-78-9	✓	
β-Myrcene	123-35-3	✓	
β-Ocimene	3779-61-1	✓	
4-Hexen-1-ol, acetate	72237-36-6	✓	
Acetic acid, hexyl ester	142-92-7	✓	
Octanal	124-13-0	✓	
D-Limonene*	5989-27-5	✓	
β-Phellandrene	555-10-2	✓	
2,6-dimethy-l-5-Heptenal	106-72-9	✓	
2,6-dimethyl-7-Octen-2-ol	18479-58-8	✓	
1,3,4-Trimethyl-3-cyclohexenyl-1-carboxaldehyde	40702-26-9	✓	
Linalool*	78-70-6	✓	
3-methyl-5-propyl-Nonane	31081-18-2		✓
(E)- 7-Tetradecene	41446-63-3		✓
Cyclododecane	294-62-2		✓
Benzyl acetone	2550-26-7	✓	
4-tert-Butylcyclohexyl acetate	104-05-2	✓	
α-Terpinyl acetate	98-55-5	✓	
2-Carene	554-61-0	✓	
Lilial*	80-54-6	✓	

* Classified as hazardous under Safe Work Australia, Hazardous Chemical Information System (SWA 2018)

"This study demonstrated the **improvements to air quality after switching from fragranced to fragrance-free products.** It found that, by a change to fragrance-free laundry products, concentrations of D-limonene can be almost completely eliminated from the dryer vent emissions. This strategy may also reduce the formation and concentrations of secondary pollutants such as **formaldehyde**, **acetaldehyde**, and ultrafine particles. Findings from this study can provide an important foundation for future research, and for demonstrating cost-effective strategies to reduce VOC emissions and personal exposures.

28. *Health risks of chemicals in consumer products: A review*

Li D, Suh S. Health risks of chemicals in consumer products: A review. Environ Int. 2019 Feb;123:580-587. doi: 10.1016/j.envint.2018.12.033. Epub 2019 Jan 7. PMID: 30622082.

Article Link: https://pubmed.ncbi.nlm.nih.gov/30622082/ - Full Text

"It should also be noted that some chemicals have multiple functional uses, while we chose the most dominant functional use for each chemical. An example is the grouping of **phthalates**. Despite categorized as plasticizer together in this review, several phthalates such as **diethyl phthalate and dimethyl phthalate are used as solvents in personal care products and cosmetics as carriers of fragrance** (Schettler, 2006)."

"…we found that the volume of the peer-reviewed literature that addresses human health risks of the chemicals in consumer products did grow over the last two decades, while its growth could by no means match the speed of increasing volume and diversity of the chemicals produced and used in consumer products by the society. This **growing gap between increasing reliance on chemicals in consumer products and our knowledge on their human health risks raises a potential public health concern**, given the pervasive nature of today's mass production and consumption practice."

29. *Volatile organic compounds in feminine hygiene products sold in the US market: A survey of products and health risks*

Lin N, Ding N, Meza-Wilson E, Manuradha Devasurendra A, Godwin C, Kyun Park S, Batterman S. Volatile organic compounds in feminine hygiene products sold in the US market: A survey of products and health risks. Environ Int. 2020 Nov;144:105740. doi: 10.1016/j.envint.2020.105740. Epub 2020 Aug 28. PMID: 32866732; PMCID: PMC7958867.

Article Link: https://pubmed.ncbi.nlm.nih.gov/32866732/ - PDF

"**VOCs** are components of FHPs (feminine hygiene products) that **are added as fragrances**, adsorbents, moisture barriers, adhesives, and binders…Most of the larger non-target peaks were identified as **fragrances, such as linalool, eucalyptol and benzyl acetate**. Feminine hygiene products (FHPs) are used on highly permeable and sensitive vaginal and vulvar tissues by many women. These products contain a variety of chemicals, and few regulations require disclosure of their ingredients…."

"Products labeled as "organic," "natural," or "for sensitive skin" did not necessarily have lower VOC concentrations.**…menstrual pads had hazard ratios** of up to 11, **sprays and powders** had hazard ratios of up to 2.2 and excess cancer risks of up to 2.1 × 10−6, and **washes** had **excess cancer risks** of up to 3.3 × 10−6. Our data suggest that **all tested FHPs contained some toxic VOCs**..."

"Exposure to high concentrations or long-term exposure of VOCs has been associated with many known or suspected effects including **irritation to eyes, skin and nose**; **damage to the respiratory system, liver and kidney; reproductive effect**s; and **carcinogenicity**"

"Examples of notable VOCs include **benzene**, a known carcinogen (US EPA, 1998), 1,4-dioxane, a likely carcinogen (US EPA, 2013), and naphthalene, a possible carcinogen due to possible genetic toxicity (Schreiner, 2003; US EPA, 1999). Health risks (carcinogenic or non-carcinogenic) related to the use of FHPs over the lifecourse remain unanswered."

30. *Acetaldehyde at a low concentration synergistically exacerbates allergic airway inflammation as an endocrine-disrupting chemical and as a volatile organic compound*

Kawano T, Matsuse H, Fukahori S, Tsuchida T, Nishino T, Fukushima C, Kohno S. Acetaldehyde at a low concentration synergistically exacerbates allergic airway inflammation as an endocrine-disrupting chemical and as a volatile organic compound. Respiration. 2012;84(2):135-41. doi: 10.1159/000337112. Epub 2012 Apr 25. PMID: 22538484.
Article Link: https://pubmed.ncbi.nlm.nih.gov/22538484/

"Acetaldehyde is an endocrine-disrupting chemical (EDC) and a volatile organic compound (VOC). It is also a **carcinogen** and **teratogen** that causes **bronchoconstriction** in a subset of **asthmatics**. However, the mechanism through which acetaldehyde acts as an EDC/VOC causing **allergic airway inflammation** remains unknown."

"Conclusions: **Exposure to acetaldehyde can enhance allergic airway inflammation in asthma**."

[Note: Acetaldehyde is on the **IFRA** list. It is on the Carcinogens and Reproductive Toxicants List.
"Acetaldehyde at a low concentration synergistically exacerbates allergic airway inflammation as an endocrine-disrupting chemical and as a volatile organic compound" **]**
[Note: Endocrine Disrupting Chemicals (EDC's) are commonly used in perfumes and fragranced products as preservatives or fragrance. What are EDC's and how can they affect us?**]**

31. *Emission characteristics of VOCs emitted from consumer and commercial products and their ozone formation potential*

Dinh TV, Kim SY, Son YS, Choi IY, Park SR, Sunwoo Y, Kim JC. Emission characteristics of VOCs emitted from consumer and commercial products and their ozone formation potential. Environ Sci Pollut Res Int. 2015 Jun;22(12):9345-55. doi: 10.1007/s11356-015-4092-8. Epub 2015 Jan 21. PMID: 25601614.
Article Link: https://pubmed.ncbi.nlm.nih.gov/25601614/

"The characteristics of volatile organic compounds (VOCs) emitted from several consumer and commercial products (**body wash**, dishwashing detergent, air freshener, windshield washer fluid, lubricant, hair spray, and insecticide) were studied and compared."

"In the spray products, 21.6–96.4 % of the VOCs were propane, iso-butane, and n-butane, which are the components of liquefied petroleum gas. **Monoterpene** (C10H16) was the dominant component of the VOCs in the non-spray products (e.g., body wash, 53–88 %)."

"Besides comprising **hazardous VOCs**, VOCs from consumer products were also **ozone precursors**."
"The TVOCs from spray products (insecticide, **hair spray**, and lubricant) were higher than those from the liquid products such as the windshield washer fluid, dishwashing detergent, **body wash**, and air freshener."

"Limonene and 1-propanol were the components of one dishwashing detergent. In contrast, another dishwashing detergent comprised **1,3-dioxane**, **ethanol**, **ethyl acetate**, **limonene**, **β-myrcene**, 3-pentanol, and **α-pinene** (Kwon et al. 2007, 2008)."

"**Benzene, n-hexane,** and **ethylbenzene** were observed in the **body washes** and the **air fresheners.** Benzene was classified as Group A of the US EPA lists of **known human carcinogen** (WHO 2010). The unit cancer risk of 1 μg/m3 of benzene is 2.2–7.8 in a million (WHO 2010). The unit risk of **leukemia** per 1 μg/m3

air concentration is 6 in a million. Therefore, **long-term exposure to a considerable amount of benzene in those products might cause health risk,** which should be investigated in future researchers."

"A **longterm exposure of n-hexane may damage the nervous system**. Exposure to 650 ppm **n-hexane** for 2–4 months causes numbness of the arms and legs (Pohanish 2012). **Ethylbenzene** irritates the eyes, skin, and respiratory tract. A **long-term exposure of ethylbenzene may cause kidney and liver disease**…."

"**Toluene and styrene were detected in body washes,** dishwashing detergents, and windshield washer fluids. It was reported that inhalation of 200–500 ppm **toluene may cause headache, nausea, and loss of appetite** (Pohanish 2012)."

"Styrene is considered as a possible carcinogenic to humans. Inhalation of above 100 ppm **styrene may cause headache, inflammation of the lung, kidney and liver damage, and death** (Pohanish 2012). Since **body washes** are used popularly and frequently, **longterm exposure to the above compounds may cause health damage.**"

[Note: Limonene is a common skin sensitizer and known allergen in fragrance and fragranced products. Limonene (natural or synthetic) is a terpene. Terpenes can create formaldehyde and particulate matter in air as secondary pollutants. Limonene is on the IFRA list as a fragrance ingredient.**]**
[Note: Benzene is a reported fragrance ingredient in the CSCP Product Database.**]**
[Note: N-Hexane is used to extract fragrances and was on the IFRA list until 2015.**]**
[Note: Toluene (often a nail polish thinner) is used as a solvent or fragrance in perfume and bath products on the CSPC Product Database. Toluene is on the IFRA list and on the EPA's Priority Pollutant List.**]**
[Note: Styrene is "primarily a synthetic chemical**"** used in fragrance. It is on the CSPC list as 'parfum/fragrance' and also on the IFRA list.**]**
[Note: Ethyl benzene is listed for purchase as a perfuming agent.**]**

32. *Simplified speciation and atmospheric volatile organic compound emission rates from non-aerosol personal care products*

Yeoman AM, Shaw M, Carslaw N, Murrells T, Passant N, Lewis AC. Simplified speciation and atmospheric volatile organic compound emission rates from non-aerosol personal care products. Indoor Air. 2020 May;30(3):459-472. doi: 10.1111/ina.12652. Epub 2020 Feb 26. PMID: 32034823; PMCID: PMC7217173.
Article Link: https://pubmed.ncbi.nlm.nih.gov/32034823/ - PDF

"Volatile organic compounds (VOCs) emitted from personal care products (PCPs) can affect indoor air quality and outdoor air quality when ventilated."
"Additionally, as **VOCs are a precursor to ozone and a sub-component of PM 2.5, they contribute to poor air quality** and related health effects such as **pulmonary inflammation** and **respiratory illness**."

"Less thought has been paid to the VOCs emitted from the use of PCPs (personal care products) and HCPs (household cleaning products) which, along with other domestic emissions of VOCs, are now known to be a substantial contributor to overall VOC emissions."

"Shower gels and **liquid foundation** were found to have the highest rates of VOC emissions, dominated by **limonene** (representing all monoterpenes) for the former and D5 cVMS for the latter."
"…the **exposure of an individual to air pollution is comprised of the sum of short-lived, individual**

exposures to high concentrations of VOCs from activities such as **showering**, cooking, cleaning, and walking along a busy road, **in addition to low levels of continuous exposure.**"

[Note: Limonene is a common skin sensitizer and known allergen in fragrance and fragranced products. Limonene (natural or synthetic) is a terpene. Terpenes can create formaldehyde and particulate matter in air as secondary pollutants. Limonene is on the IFRA list as a fragrance ingredient.**]**

33. *Characterization of odorants in inflatable aquatic toys and swimming learning devices-which substances are causative for the characteristic odor and potentially harmful?*

Wiedmer C, Velasco-Schön C, Buettner A. Characterization of odorants in inflatable aquatic toys and swimming learning devices-which substances are causative for the characteristic odor and potentially harmful? Anal Bioanal Chem. 2017 Jun;409(16):3905-3916. doi: 10.1007/s00216-017-0330-x. Epub 2017 Apr 12. PMID: 28401289.
Article Link: https://pubmed.ncbi.nlm.nih.gov/28401289/

"Toys can exhibit strong offensive smells that might also indicate the presence of other odorless hazardous chemicals in the affected product. Inflatable water toys such as beach balls or air mattresses are commonly known to be odor-active. Nevertheless, published data on the causative odorants and their origin are rare. … It is also interesting to note that not all inflatable polyvinyl chloride (PVC) products for children's use in water are termed as toys. The legal basis for this differentiation between toys and other products in Europe is the European Toy Safety Directive 2009/48/EC."

"**Phenol**, which was also found in all samples, is classified as category 2 **mutagen** (substances suspected of causing **genetic defects**) and as being **acutely toxic (Category 3)**."

"Cyclohexanone, which was found in three of the four investigated samples, is classified as **harmful if inhaled (acute toxicity Category 4)**. In view of this, it needs to be stated that the signals corresponding to isophorone and cyclohexanone were amongst the highest peaks in the respective chromatograms, indicating that these compounds were present in relatively high concentrations."

[Note: Phenol used in fragrance is mostly synthetic derived from benzene/petro. It is an EDC and declared as fragrance on the CSCP list and on the IFRA fragrance transparency list. Phenol is on the Washington State List of Chemicals of High Concern to Children and Priority Pollutant List. **Cyclohexanone** is on the IFRA list, it smells like peppermint.**]**

34. *Qualitative Analysis of Air Freshener Spray*

Ibrahim ALshaer F, Fuad ALBaharna D, Ahmed HO, Ghiyath Anas M, Mohammed ALJassmi J. Qualitative Analysis of Air Freshener Spray. J Environ Public Health. 2019 Nov 5;2019:9316707. doi: 10.1155/2019/9316707. PMID: 31781257; PMCID: PMC6874985.
Article Link: https://pubmed.ncbi.nlm.nih.gov/31781257/ - PDF

"Information lacks concerning the gaseous emissions of fragrance products in spite of the extensive indoor exposure and widespread use of fragrances to them. In addition, **95 percent of the chemicals are synthetic compounds in fragrances that are derived from petroleum**."

“Some chemicals after analysis turned out to be noted as **skin allergens** or **irritants** and even chemicals that may interfere with **bodily functions**.“

“The present study has identified the presence of different compounds in spray air fresheners that were not disclosed on the product’s label. The results depicted common compounds in both low- and high-cost air fresheners. **Chemicals found in this study were not revealed on the product label as manufacturers are not required to list all ingredients**. These chemicals usually tend to be listed on the product label as “parfum” or “fragrance”. There should be a law that strictly indicates whether the products contain any synthetic chemicals for people to be aware of what they are exposed to, although, manufacturers are not required to reveal all hidden ingredients on the label as stated by the Consumer Product Safety Commission (CPSC).”

Association of use of cleaning products with respiratory health in a Canadian birth cohort

Parks J, McCandless L, Dharma C, Brook J, Turvey SE, Mandhane P, Becker AB, Kozyrskyj AL, Azad MB, Moraes TJ, Lefebvre DL, Sears MR, Subbarao P, Scott J, Takaro TK. Association of use of cleaning products with respiratory health in a Canadian birth cohort. CMAJ. 2020 Feb 18;192(7):E154-E161. doi: 10.1503/cmaj.190819. PMID: 32071106; PMCID: PMC7030878.
Article Link: https://pubmed.ncbi.nlm.nih.gov/32071106/ PDF

“Our report involving a national Canadian birth cohort showed that frequent use of household cleaning products in early infancy is associated with an increased risk for childhood wheeze and asthma…”
“...it is important that parents read labels and be informed about the risks associated with the use of cleaning products. The benefits of alternatives to spray and aerosol cleaners, the effect of cleaning products on the microbiome 38 and identification of improved exposure measurement methods warrant further research.”

35. ALSO SEE SECTIONS: Asthma, Airborne Contact Dermatitis, Inflammation

Back to top of Respiratory / Pulmonary **Back to Table of Contents**

Website: https://www.fragrancefreecoalitionusa.com/

DISCLAIMER:
Poster and Document are for reference and educational purposes only.

VISION

Red Eyes, Dry, Itching, or Watery Eyes, Irritation to Eyes, Mucosal Symptoms

1. *Acute toxic effects of fragrance products*

Anderson RC, Anderson JH. Acute toxic effects of fragrance products. Arch Environ Health. 1998 Mar-Apr;53(2):138-46. doi: 10.1080/00039896.1998.10545975. PMID: 9577937.
Article Link: https://pubmed.ncbi.nlm.nih.gov/9577937/

"The emissions of these fragrance products caused various combinations of **sensory irritation**, **pulmonary irritation, decreases in expiratory airflow** velocity, as well as alterations of the functional observational battery indicative of neurotoxicity. **Neurotoxicity** was more severe after mice were repeatedly exposed to the fragrance products… Collectively, the experimental data and chemistry predict that some humans exposed to these FPs might experience some combination of **eye, nose, and/or throat irritation; respiratory difficulty; possibly bronchoconstriction or asthma-like reaction; and central nervous systems reactions (e.g., dizziness, incoordination, confusion, fatigue**)."

"The results of our study might help explain why some individuals report an intolerance to FPs and why some **FPs can exacerbate airflow limitation in some asthmatics**."

2. *Mucosal symptoms elicited by fragrance products in a population-based sample in relation to atopy and bronchial hyper-reactivity*

Elberling J, Linneberg A, Dirksen A, Johansen JD, Frølund L, Madsen F, Nielsen NH, Mosbech H. Mucosal symptoms elicited by fragrance products in a population-based sample in relation to atopy and bronchial hyper-reactivity. Clin Exp Allergy. 2005 Jan;35(1):75-81. doi: 10.1111/j.1365-2222.2005.02138.x. PMID: 15649270.
Article Link: https://pubmed.ncbi.nlm.nih.gov/15649270/

"Exposure to perfume and fragrance products may, in some individuals, cause symptoms from the eyes and airways."

"Objective: To investigate both the localization and character of symptoms from the eyes and airways elicited by fragrance products, and the associations between such symptoms and skin prick test reactivity (atop), methacholine **bronchial hyper-reactivity (BHR)**, **allergic rhinitis** and **asthma.**"

"The response rate was 79.6%. Symptoms from the **eyes and airways** elicited by 42%. **Mucosal symptoms from the eyes and airways** were common in this population. BHR was a significant and independent predictor of these symptoms. … The lack of association withatop suggested that IgE- mediated allergic mechanisms do not play a major role in the development of these symptoms."

3. *A link between skin and airways regarding sensitivity to fragrance products?*

Elberling J, Linneberg A, Mosbech H, Dirksen A, Frølund L, Madsen F, Nielsen NH, Johansen JD. A link between skin and airways regarding sensitivity to fragrance products? Br J Dermatol. 2004 Dec;151(6):1197-203. doi: 10.1111/j.1365-2133.2004.06251.x. PMID: 15606515.

Article Link: https://pubmed.ncbi.nlm.nih.gov/15606515/

"**Contact sensitization to fragrances is one of the commonest causes of contact allergy in the general population**… as well as among patients with eczema. Exposure to volatile fragrances is commonplace and may be related to various **eye and airway symptoms**. Skin exposure to fragrances is known to cause **perfume contact allergy** and **eczema…."**

"Positive, independent and **significant associations were found between eye and airway symptoms** elicited by fragrance products and perfume contact allergy and hand eczema…. Individuals with perfume contact allergy and/or hand eczema, as opposed to those without, have more frequent and **more severe eye or airway symptoms after exposure to volatile fragrance products**."

"We show consistent and significant associations between perfume contact allergy diagnosed by patch testing and symptoms elicited by fragrance products from the eyes and airways. The symptoms were mostly reported as elicited **within seconds and minutes after airborne exposure to fragrance products**."

4. *Airborne contact dermatitis - current perspectives in etiopathogenesis and management*

Handa S, De D, Mahajan R. Airborne contact dermatitis - current perspectives in etiopathogenesis and management. Indian J Dermatol. 2011 Nov;56(6):700-6. doi: 10.4103/0019-5154.91832. PMID: 22345774; PMCID: PMC3276900.
Article Link: https://pubmed.ncbi.nlm.nih.gov/22345774/ - Full Text

"Airborne contact dermatitis (ABCD) is a morphological diagnosis that encompasses **all acute or chronic dermatoses** predominantly of exposed parts of body, which are caused by substances which when released into the air, settle on the exposed skin."

"In airborne allergic dermatitis, initially there is a refractory phase where there is a periodic or continuous contact with allergen but no response. This is followed by an induction phase where the hapten penetrates skin, conjugates with epidermal protein, comes in contact with antigen presenting cells, migrates to draining lymph nodes followed by stimulation of naive T cells. This leads to proliferation of activated T cells to produce effector and memory cells which then enter the circulation. Re-exposure to the specific hapten leads to the release of mediators producing **skin inflammation**. A **persistent inflammation** is produced due to continued presence of effector cells."

"The common allergens … include various acids and alkalis, metals and powders of metallic salts, cement, industrial solvents, glass fibers, sewage sludge, ammonia, vegetable and wood allergens, plastics, rubbers and glues, insecticides, pesticides, animal feed additives and many others. The airborne contactants can also be classified on the basis of their physical state as **volatile airborne contactants** like acids, alkalis, ammonia and pesticides; droplets like insecticides, **perfumes** and **hair sprays**; powders which include aluminum, anhydrous calcium silicate, and metallic oxides; and particles like tree sawing particles, wool and plastics."

"Dooms-Goossens classified airborne dermatitis into five different types, namely, **airborne irritant contact dermatitis**, **airborne allergic contact dermatitis**, **airborne phototoxic reactions**, **airborne photoallergic reactions** and **airborne contact urticaria**.[33]"

“Rare presentations include **acne like**, **lichenoid eruptions**, fixed drug eruptions, **exfoliative dermatitis**, **telengiectases**, **paresthesias**, **purpura**, **erythema multiforme like eruption**, pellagra like dermatitis and **lymphomatoid CD**. Some agents cause more than one type of reaction. P. hysterophorus can produce allergic CD, photocontact dermatitis and a lichenoid eruption. Similarly, **formaldehyde** and phosphorus sesquisulfide can lead to an **airborne irritant** or **allergic CD** and **contact urticaria**.”

“In the classical airborne allergic contact dermatitis, there is involvement of exposed areas of face, “V” of neck, hands and forearms, **“Wilkinson's triangle,”** both eyelids, nasolabial folds and under the chin. The involvement of both light-exposed and protected areas helps to differentiate ABCD from a photo-related dermatitis. Another close differential is **atopic eczema** as both ABCD and atopic eczema have predominant flexural and skin crease involvement. Initially, there is an acute flare of the dermatitis during the plant growing season but, with repeated exposure, the flare becomes prolonged and produces a chronic lichenified eczema associated with secondary infection, fissuring and **hypo or hyperpigmentation**…. Some patients present with **facial swelling** before manifesting classical **eczematous lesions**.“

[Note: Fragrance is considered the new ‘second hand smoke’, **“**The parallels between second-hand smoke and synthetic fragrance use are many. At its core, both are battles over indoor air quality **“** - quote and link from De Vader, Christy L. & Barker, Paxson.
Chemicals that cigarettes/cigarette smoke and fragranced products can have in common are: Acetone, Formaldehyde, Benzene, acetaldehyde, terpenoids and phenols.**]**

5. *Volatile organic compounds in feminine hygiene products sold in the US market: A survey of products and health risks*

Lin N, Ding N, Meza-Wilson E, Manuradha Devasurendra A, Godwin C, Kyun Park S, Batterman S. Volatile organic compounds in feminine hygiene products sold in the US market: A survey of products and health risks. Environ Int. 2020 Nov;144:105740. doi: 10.1016/j.envint.2020.105740. Epub 2020 Aug 28. PMID: 32866732; PMCID: PMC7958867.
Article Link: https://pubmed.ncbi.nlm.nih.gov/32866732/ - PDF

“**VOCs** are components of FHPs (feminine hygiene products) that **are added as fragrances**, adsorbents, moisture barriers, adhesives, and binders…Most of the larger non-target peaks were identified as **fragrances, such as linalool, eucalyptol and benzyl acetate**. Feminine hygiene products (FHPs) are used on highly permeable and sensitive vaginal and vulvar tissues by many women. These products contain a variety of chemicals, and few regulations require disclosure of their ingredients….”

“Products labeled as “organic,” “natural,” or “for sensitive skin” did not necessarily have lower VOC concentrations**….menstrual pads had hazard ratios** of up to 11, **sprays and powders** had hazard ratios of up to 2.2 and excess cancer risks of up to 2.1 × 10−6, and **washes** had **excess cancer risks** of up to 3.3 × 10−6. Our data suggest that **all tested FHPs contained some toxic VOCs**...”

“Exposure to high concentrations or long-term exposure of VOCs has been associated with many known or suspected effects including **irritation to eyes, skin and nose**; **damage to the respiratory system, liver and kidney; reproductive effects**; and **carcinogenicity**”

“Examples of notable VOCs include **benzene**, a known carcinogen (US EPA, 1998), 1,4-dioxane, a likely carcinogen (US EPA, 2013), and naphthalene, a possible carcinogen due to possible genetic toxicity

(Schreiner, 2003; US EPA, 1999). Health risks (carcinogenic or non-carcinogenic) related to the use of FHPs over the lifecourse remain unanswered."

6. *Evaluation of pollutants in perfumes, colognes and health effects on the consumer: a systematic review*

Kazemi Z, Aboutaleb E, Shahsavani A, Kermani M, Kazemi Z. Evaluation of pollutants in perfumes, colognes and health effects on the consumer: a systematic review. J Environ Health Sci Eng. 2022 Feb 3;20(1):589-598. doi: 10.1007/s40201-021-00783-x. PMID: 35669814; PMCID: PMC9163252.

Article Link: https://pubmed.ncbi.nlm.nih.gov/35669814/ - PDF

(Note: Graphic is from preceding article) (Creative Commons Attribution 4.0 International license).

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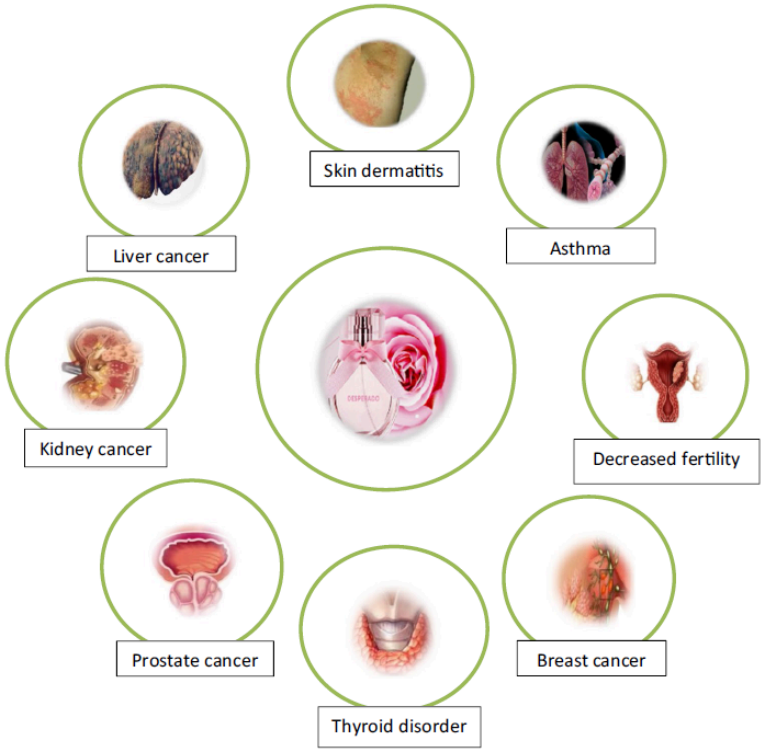
Fig. 2 Effects of exposure to perfumes and colognes



"Diethyl phthalate is a chemical used to **make perfumes last longer.** The U.S. Clean Water Act lists it as a **toxic** and priority pollutant."

"Complications of using perfume include **neuropathy (depression, autism), neoplasms (breast cancer, prostate cancer), effects on the liver, migraine headaches, asthma attacks, mucosal symptoms (watery or red eyes, sneezing), neurological problems (dizziness, convulsions, headache, fainting, imbalance), respiratory (cough, shortness of breath), skin (skin rash, urticaria, redness of the skin, skin tingling,**

dermatitis), immune system (swollen lymph nodes, fever, fatigue), gastrointestinal tract (nausea, bloating, diarrhea) and c**ardiovascular (rapid** or **irregular heartbeat, tremors, chest discomfort**)"

"**Contaminants in perfumes and colognes** and their health effects on the consumer were systematically reviewed. It was found that the most attention of researchers was to identify the compounds in perfumes and colognes and their concentrations. Among the most common pollutants **phthalates** and their derivatives can be mentioned. Other pollutants included **parabens, triclosan, salicylates, terpenes, aldehydes, benzene, toluene, styrene, and aluminum-based salts**. These pollutants have also been shown to have adverse effects on consumer health such as **asthma and allergies, cardiovascular disease, central nervous system damage, breast cancer, endocrine cancer, respiratory disorders, reproduction, thyroid, adrenal gland function and immune system."**
[Note: Graphic lists "effects of exposure to perfumes and colognes": Kidney Cancer, Liver Cancer, Prostate Cancer, Thyroid Disorder, Breast Cancer, Decreased Fertility, Asthma and Skin Dermatitis.**]**

7. *Fragrances: Contact Allergy and Other Adverse Effects*

de Groot AC. Fragrances: Contact Allergy and Other Adverse Effects. Dermatitis. 2020 Jan/Feb;31(1):13-35. doi: 10.1097/DER.0000000000000463. PMID: 31433384.
Article Link: https://pubmed.ncbi.nlm.nih.gov/31433384/

"In the general adult population, up to 4.5% may be allergic to fragrance materials, and in consecutive patients patch tested for suspected contact dermatitis, the frequency may reach 20% to 25%...

"Fragrances are an important and frequent cause of contact allergy and allergic contact dermatitis, notably from their presence in fragranced products such as deodorants, **fine fragrances** and aftershaves, other cosmetics (**both leave-on and rinse-off products**), household products, topical pharmaceuticals, essential oils, foods, and, to a lesser degree, industrial products."

"Other adverse effects reported from fragrances include immediate type reactions (mostly nonimmune immediate contact reactions, contact urticaria), **photosensitivity**, **respiratory disorders**, and miscellaneous adverse effects including irritant **contact dermatitis**, **depigmentation**, and **systemic adverse effects**."

"Fragrances are volatile, and therefore, in addition to skin exposure, a perfume also exposes the **eyes and nasorespiratory tract**. Already 35 years ago, it was suspected and later confirmed that fragrances can induce or worsen respiratory problems including **asthmatic attacks**."

"People may experience symptoms not only from wearing perfume themselves but also around cosmetic counters, candle shops, and from perfumes worn by other people. Currently, it is estimated that 2% to 4% of the adult population is affected by respiratory or eye symptoms from such exposures. Frequently reported **symptoms include dry, itching, or watery eyes; nasal irritation; congestion; and sneezing; as well as mouth and throat irritation, shortness of breath, and cough.**"

8. *Toxic effects of air freshener emissions*

Anderson RC, Anderson JH. Toxic effects of air freshener emissions. Arch Environ Health. 1997 Nov-Dec;52(6):433-41. doi: 10.1080/00039899709602222. PMID: 9541364.
Article Link: https://pubmed.ncbi.nlm.nih.gov/9541364/

"The emissions of this **solid Air Freshener produced acute respiratory and neurotoxicity in mice**, and they did not lower the toxic impact of the other pollutants tested. Collectively, toxicity data, chemical data, and MSDS information predict that some humans exposed to emissions of the AF we studied might experience some combination of **eye, nose, and/or throat irritation**; **respiratory difficulty**; **bronchoconstriction** or an **asthma-like reaction**; and **CNS reactions** (e.g., **dizziness**, **incoordination**, **confusion**, **fatigue**)."

9. *Fragranced consumer products: effects on autistic adults in the United States, Australia, and United Kingdom*

Steinemann A. Fragranced consumer products: effects on autistic adults in the United States, Australia, and United Kingdom. Air Qual Atmos Health. 2018;11(10):1137-1142. doi: 10.1007/s11869-018-0625-x. Epub 2018 Sep 25. PMID: 30546500; PMCID: PMC6244938
Article Link: https://pubmed.ncbi.nlm.nih.gov/30546500/ - PDF

"Fragranced consumer products are ubiquitous in society and emit numerous volatile organic compounds including hazardous air pollutants."

"Health effects were categorized as follows:
(a) migraine headaches;
(b) asthma attacks;
(c) neurological problems (e.g., dizziness, seizures, head pain, fainting, loss of coordination);
(d) respiratory problems (e.g., difficulty breathing, coughing, shortness of breath);
(e) skin problems (e.g., rashes, hives, red skin, tingling skin, dermatitis);
(f) cognitive problems (e.g., difficulties thinking, concentrating, or remembering);
(g) mucosal symptoms (e.g., watery or red eyes, nasal congestion, sneezing);
(h) immune system problems (e.g., swollen lymph glands, fever, fatigue);
(i) gastrointestinal problems (e.g., nausea, bloating, cramping, diarrhea);
(j) cardiovascular problems (e.g., fast or irregular heartbeat, jitteriness, chest discomfort);
(k) musculoskeletal problems (e.g., muscle or joint pain, cramps, weakness); and
(l) other."

"Specific problematic exposures, associated with adverse health effects for autistic adults, include but are not limited to the following: …air fresheners and deodorizers (62.9%), the scent of laundry products coming from a dryer vent (57.5%), being in a room recently cleaned with scented products (65.9%), **being near someone wearing a fragranced product** (60.5%), and other types of fragranced consumer products (64.3%)… Among autistic adults reporting health effects, 74.1% across the three countries (85.4% US, 82.4% AU, 54.5% UK) report that the severity of these health effects from fragranced products was potentially disabling. Among non-autistic adults, the prevalence of potentially disabling effects was 25.4%."

"...62.1% of autistic adults are unable or reluctant to use the restrooms in a public place if it has an air freshener, deodorizer, or scented product; 59.8% are unable or reluctant to wash their hands with soap in a public place if the soap is fragranced; 58.7% enter a business and then want to leave as quickly as possible if they smell air fresheners or a fragranced product; and **66.7% have been prevented from going someplace because they would be exposed to a fragranced product that would make them sick…"**

"Involuntary exposure is a concern. Autistic individuals are prevented from accessing public restrooms, societal venues, businesses, and workplaces due to adverse health effects from fragranced products. Further, 59.4% of

autistic adults have lost workdays, in the past year, due to fragranced product exposure in the workplace. **A strong majority of autistic as well as non-autistic adults would prefer that workplaces, health care facilities, and health care professionals were fragrance-free than fragranced.**"

10. *Health risks of chemicals in consumer products: A review*

Li D, Suh S. Health risks of chemicals in consumer products: A review. Environ Int. 2019 Feb;123:580-587. doi: 10.1016/j.envint.2018.12.033. Epub 2019 Jan 7. PMID: 30622082.

Article Link: https://pubmed.ncbi.nlm.nih.gov/30622082/ - Full Text

"It should also be noted that some chemicals have multiple functional uses, while we chose the most dominant functional use for each chemical. An example is the grouping of **phthalates**. Despite categorized as plasticizer together in this review, several phthalates such as **diethyl phthalate** and **dimethyl phthalate** are used as solvents in personal care products and cosmetics as **carriers of fragrance** (Schettler, 2006)."

"…we found that the volume of the peer-reviewed literature that addresses human health risks of the chemicals in consumer products did grow over the last two decades, while its growth could by no means match the speed of increasing volume and diversity of the chemicals produced and used in consumer products by the society. This **growing gap between increasing reliance on chemicals in consumer products and our knowledge on their human health risks raises a potential public health concern**, given the pervasive nature of today's mass production and consumption practice."

11. ALSO SEE SECTIONS: Migraine(s) / Headache(s), Respiratory/Pulmonary (Nose & Lungs)

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https://www.fragrancefreecoalitionusa.com/

Bibliography

· Adamowicz J, Juszczak K, Poletajew S, Van Breda SV, Pokrywczynska M, Drewa T. Scented Candles as an Unrecognized Factor that Increases the Risk of Bladder Cancer: Is There Enough Evidence to Raise a Red Flag? Cancer Prev Res (Phila). 2019 Oct;12(10):645-652. doi: 10.1158/1940-6207.CAPR-19-0093. Epub 2019 Aug 9. Review. PubMed PMID: 31399420.

· Ahmed AS, Ibrahim DA, Hassan TH, Abd-El-Azem WG. Prevalence and predictors of occupational asthma among workers in detergent and cleaning products industry and its impact on quality of life in El Asher Men Ramadan, Egypt. Environ Sci Pollut Res Int. 2022 May;29(23):33901-33908. doi: 10.1007/s11356-022-18558-8. Epub 2022 Jan 15. PubMed PMID: 35034305; PubMed Central PMCID: PMC8761047.

· Ahn JH, Kim KH, Kim YH, Kim BW. Characterization of hazardous and odorous volatiles emitted from scented candles before lighting and when lit. J Hazard Mater. 2015 Apr 9;286:242-51. doi: 10.1016/j.jhazmat.2014.12.040. Epub 2014 Dec 31. PubMed PMID: 25588193.

· Akunna GG, Saalu LC, Ogunlade B, Enye LA. Spermatotoxicity in Animal Models Exposed to Fragrance Components. Journal of Medical Sciences. 2014 January; 14:46-50. doi: 10.3923/jms.2014.46.50.

· Akunna GG, Saalu LC, Ogunlade B, Akingbade AM, Anderson LE, Olusolade FS. Histo-morphometric Evidences for Testicular Derangement in animal models submitted to chronic and Sub-chronic Inhalation of Fragrance. American Journal of Research Communication. 2015 January; 3(1).

· Al-Saleh I, Al-Rajudi T, Al-Qudaihi G, Manogaran P. Evaluating the potential genotoxicity of phthalates esters (PAEs) in perfumes using in vitro assays. Environ Sci Pollut Res Int. 2017 Oct;24(30):23903-23914. doi: 10.1007/s11356-017-9978-1. Epub 2017 Sep 5. PubMed PMID: 28875446.

· Al-Saleh I, Elkhatib R. Screening of phthalate esters in 47 branded perfumes. Environ Sci Pollut Res Int. 2016 Jan;23(1):455-68. doi: 10.1007/s11356-015-5267-z. Epub 2015 Aug 28. PubMed PMID: 26310707.

· Anderson RC, Anderson JH. Toxic effects of air freshener emissions. Arch Environ Health. 1997 Nov-Dec;52(6):433-41. doi: 10.1080/00039899709602222. PubMed PMID: 9541364.

· Anderson RC, Anderson JH. Acute toxic effects of fragrance products. Arch Environ Health. 1998 Mar-Apr;53(2):138-46. doi: 10.1080/00039896.1998.10545975. PubMed PMID: 9577937.

· Apte K, Salvi S. Household air pollution and its effects on health. F1000Res. 2016;5. doi: 10.12688/f1000research.7552.1. eCollection 2016. Review. PubMed PMID: 27853506; PubMed Central PMCID: PMC5089137.

· Aurisano N, Huang L, Milà I Canals L, Jolliet O, Fantke P. Chemicals of concern in plastic toys. Environ Int. 2021 Jan;146:106194. doi: 10.1016/j.envint.2020.106194. Epub 2020 Oct 22. PubMed PMID: 33115697.

· Bagasra O, Golkar Z, Garcia M, Rice LN, Pace DG. Role of perfumes in pathogenesis of autism. Med Hypotheses. 2013 Jun;80(6):795-803. doi: 10.1016/j.mehy.2013.03.014. Epub 2013 Apr 8. PubMed PMID: 23578362.

· Bagasra O, Pace DG. Smell of autism: Synthetic fragrances and cause for allergies, asthma, cancer and autism. OA Autism 2013 Jun 19;1(2):15.

· Bai H, Tam I, Yu J. Contact Allergens in Top-Selling Textile-care Products. Dermatitis. 2020 Jan/Feb;31(1):53-58. doi: 10.1097/DER.0000000000000566. PubMed PMID: 31905182.

· Bansal A, Henao-Mejia J, Simmons RA. Immune System: An Emerging Player in Mediating Effects of Endocrine Disruptors on Metabolic Health. Endocrinology. 2018 Jan 1;159(1):32-45. doi: 10.1210/en.2017-00882. Review. PubMed PMID: 29145569; PubMed Central PMCID: PMC5761609.

· Bennike NH, Oturai NB, Müller S, Kirkeby CS, Jørgensen C, Christensen AB, Zachariae C, Johansen JD. Fragrance contact allergens in 5588 cosmetic products identified through a novel smartphone application. J Eur Acad Dermatol Venereol. 2018 Jan;32(1):79-85. doi: 10.1111/jdv.14513. Epub 2017 Sep 11. PubMed PMID: 28796916.

· Bornehag CG, Lindh C, Reichenberg A, Wikström S, Unenge Hallerback M, Evans SF, Sathyanarayana S, Barrett ES, Nguyen RHN, Bush NR, Swan SH. Association of Prenatal Phthalate Exposure With Language Development in Early Childhood. JAMA Pediatr. 2018 Dec 1;172(12):1169-1176. doi: 10.1001/jamapediatrics.2018.3115. PubMed PMID: 30383084; PubMed Central PMCID: PMC6583016.

· Bukowski JA, Wartenberg D. An alternative approach for investigating the carcinogenicity of indoor air pollution: pets as sentinels of environmental cancer risk. Environ Health Perspect. 1997 Dec;105(12):1312-9. doi: 10.1289/ehp.971051312. Review. PubMed PMID: 9405322; PubMed Central PMCID: PMC1470413.

· Celeiro M, Lamas JP, Garcia-Jares C, Llompart M. Pressurized liquid extraction-gas chromatography-mass spectrometry analysis of fragrance allergens, musks, phthalates and preservatives in baby wipes. J Chromatogr A. 2015 Mar 6;1384:9-21. doi: 10.1016/j.chroma.2015.01.049. Epub 2015 Jan 22. PubMed PMID: 25662066.

· Cetta F, Lambert GH, Ros SP. Newborn chemical exposure from over-the-counter skin care products. Clin Pediatr (Phila). 1991 May;30(5):286-9. doi: 10.1177/000992289103000504. PubMed PMID: 2044337.

· Chamorro-Garcia R, Veiga-Lopez A. The new kids on the block: Emerging obesogens. Adv Pharmacol. 2021;92:457-484. doi: 10.1016/bs.apha.2021.05.003. Epub 2021 Jul 8. Review. PubMed PMID: 34452694; PubMed Central PMCID: PMC8941623.

· Chandrasekaran VRM, Periasamy S, Chien SP, Tseng CH, Tsai PJ, Liu MY. Physical and psychological stress along with candle fumes induced-cardiopulmonary injury mimicking restaurant kitchen workers. Curr Res Toxicol. 2021;2:246-253. doi: 10.1016/j.crtox.2021.07.001. eCollection 2021. PubMed PMID: 34345867; PubMed Central PMCID: PMC8320639.

· Charles AK, Darbre PD. Oestrogenic activity of benzyl salicylate, benzyl benzoate and butylphenylmethylpropional (Lilial) in MCF7 human breast cancer cells in vitro. J Appl Toxicol. 2009 Jul;29(5):422-34. doi: 10.1002/jat.1429. PubMed PMID: 19338011.

· Cheng J, Zug KA. Fragrance allergic contact dermatitis. Dermatitis. 2014 Sep-Oct;25(5):232-45. doi: 10.1097/DER.0000000000000067. Review. PubMed PMID: 25207685.

· Chinthakindi S, Kannan K. Urinary and fecal excretion of aromatic amines in pet dogs and cats from the United States. Environ Int. 2022 May;163:107208. doi: 10.1016/j.envint.2022.107208. Epub 2022 Mar 30. PubMed PMID: 35366557; PubMed Central PMCID: PMC9035069.

· Claeson AS, Palmquist E, Lind N, Nordin S. Symptom-trigger factors other than allergens in asthma and allergy. Int J Environ Health Res. 2016 Aug;26(4):448-57. doi: 10.1080/09603123.2015.1135314. Epub 2016 Jan 20. PubMed PMID: 26788835.

· Cripps SM, Mattiske DM, Pask AJ. Erectile Dysfunction in Men on the Rise: Is There a Link with Endocrine Disrupting Chemicals?. Sex Dev. 2021;15(1-3):187-212. doi: 10.1159/000516600. Epub 2021 Jun 16. Review. PubMed PMID: 34134123.

· Dales RE, Kauri LM, Cakmak S. The associations between phthalate exposure and insulin resistance, β-cell function and blood glucose control in a population-based sample. Sci Total Environ. 2018 Jan 15;612:1287-1292. doi: 10.1016/j.scitotenv.2017.09.009. Epub 2017 Sep 8. PubMed PMID: 28898934.

· Darbre PD. Overview of air pollution and endocrine disorders. Int J Gen Med. 2018;11:191-207. doi: 10.2147/IJGM.S102230. eCollection 2018. Review. PubMed PMID: 29872334; PubMed Central PMCID: PMC5973437.

· Denk P, Velasco-Schön C, Buettner A. Resolving the chemical structures of off-odorants and potentially harmful substances in toys-example of children's swords. Anal Bioanal Chem. 2017 Sep;409(22):5249-5258. doi: 10.1007/s00216-017-0469-5. Epub 2017 Jul 11. PubMed PMID: 28695232.

· Derudi M, Gelosa S, Sliepcevich A, Cattaneo A, Rota R, Cavallo D, Nano G. Emissions of air pollutants from scented candles burning in a test chamber. Atmospheric Environment. 2012 August; 55:257-262. doi: https://doi.org/10.1016/j.atmosenv.2012.03.027.

· Desmedt B, Marcelis Q, Zhilivoda D, Deconinck E. Sensitizing fragrances in absorbent hygiene products. Contact Dermatitis. 2020 May;82(5):279-282. doi: 10.1111/cod.13472. Epub 2020 Feb 5. PubMed PMID: 31951286.

· Dinh TV, Kim SY, Son YS, Choi IY, Park SR, Sunwoo Y, Kim JC. Emission characteristics of VOCs emitted from consumer and commercial products and their ozone formation potential. Environ Sci Pollut Res Int. 2015 Jun;22(12):9345-55. doi: 10.1007/s11356-015-4092-8. Epub 2015 Jan 21. PubMed PMID: 25601614.

· Dodson RE, Nishioka M, Standley LJ, Perovich LJ, Brody JG, Rudel RA. Endocrine disruptors and asthma-associated chemicals in consumer products. Environ Health Perspect. 2012 Jul;120(7):935-43. doi: 10.1289/ehp.1104052. Epub 2012 Mar 8. PubMed PMID: 22398195; PubMed Central PMCID: PMC3404651.

· Elberling J, Linneberg A, Mosbech H, Dirksen A, Frølund L, Madsen F, Nielsen NH, Johansen JD. A link between skin and airways regarding sensitivity to fragrance products?. Br J Dermatol. 2004 Dec;151(6):1197-203. doi: 10.1111/j.1365-2133.2004.06251.x. PubMed PMID: 15606515.

· Elberling J, Skov PS, Mosbech H, Holst H, Dirksen A, Johansen JD. Increased release of histamine in patients with respiratory symptoms related to perfume. Clin Exp Allergy. 2007 Nov;37(11):1676-80. doi: 10.1111/j.1365-2222.2007.02824.x. Epub 2007 Sep 17. PubMed PMID: 17877753.

· Elberling J, Linneberg A, Dirksen A, Johansen JD, Frølund L, Madsen F, Nielsen NH, Mosbech H. Mucosal symptoms elicited by fragrance products in a population-based sample in relation to atopy and bronchial hyper-reactivity. Clin Exp Allergy. 2005 Jan;35(1):75-81. doi: 10.1111/j.1365-2222.2005.02138.x. PubMed PMID: 15649270.

· Engel SM, Patisaul HB, Brody C, Hauser R, Zota AR, Bennet DH, Swanson M, Whyatt RM. Neurotoxicity of Ortho-Phthalates: Recommendations for Critical Policy Reforms to Protect Brain Development in Children. American Journal of Public Health. 2020 October; 111:687-695. doi: https://doi.org/10.2105/AJPH.2020.306014.

· Farrow A, Taylor H, Northstone K, Golding J. Symptoms of mothers and infants related to total volatile organic compounds in household products. Arch Environ Health. 2003 Oct;58(10):633-41. doi: 10.3200/AEOH.58.10.633-641. PubMed PMID: 15562635.

· Folletti I, Siracusa A, Paolocci G. Update on asthma and cleaning agents. Curr Opin Allergy Clin Immunol. 2017 Apr;17(2):90-95. doi: 10.1097/ACI.0000000000000349. Review. PubMed PMID: 28141626.

· Fucic A, Gamulin M, Ferencic Z, Katic J, Krayer von Krauss M, Bartonova A, Merlo DF. Environmental exposure to xenoestrogens and oestrogen related cancers: reproductive system, breast, lung, kidney, pancreas, and brain. Environ Health. 2012 Jun 28;11 Suppl 1:S8. doi: 10.1186/1476-069X-11-S1-S8. Review. PubMed PMID: 22759508; PubMed Central PMCID: PMC3388472.

· Gao CJ, Wang F, Shen HM, Kannan K, Guo Y. Feminine Hygiene Products-A Neglected Source of Phthalate Exposure in Women. Environ Sci Technol. 2020 Jan 21;54(2):930-937. doi: 10.1021/acs.est.9b03927. Epub 2020 Jan 9. PubMed PMID: 31859481.

· Gao CJ, Kannan K. Phthalates, bisphenols, parabens, and triclocarban in feminine hygiene products from the United States and their implications for human exposure. Environ Int. 2020 Mar;136:105465. doi: 10.1016/j.envint.2020.105465. Epub 2020 Jan 13. PubMed PMID: 31945693.

· Geiss O, Tirendi S, Barrero-Moreno J, Kotzias D. Investigation of volatile organic compounds and phthalates present in the cabin air of used private cars. Environ Int. 2009 Nov;35(8):1188-95. doi: 10.1016/j.envint.2009.07.016. Epub 2009 Sep 3. PubMed PMID: 19729200.

· Ghosh S. Airborne-contact dermatitis of non-plant origin: an overview. Indian J Dermatol. 2011 Nov;56(6):711-4. doi: 10.4103/0019-5154.91834. PubMed PMID: 22345776; PubMed Central PMCID: PMC3276902.

· Goodman N, Nematollahi N, Agosti G, Steinemann A. Evaluating air quality with and without air fresheners. Air Quality, Atmosphere, and Health. 2020 January; 13(1):1-4.

· Goodman N. Fragranced laundry products and emissions from dryer vents: implications for air quality and health. Air Quality, Atmosphere, and Health. 2020 September; 14:245.

· Goodman N. Emissions from dryer vents during use of fragranced and fragrance-free laundry products. Air Quality, Atmosphere, and Health. 2018 November; 12:289.

· Goossens A. Cosmetic Habits and Cosmetic Contact Dermatitis in Children. Current Treatment Options in Allergy. 2015 June; 2:pages 228–234.

· Green R, Lanphear B, Phipps E, Goodman C, Joy J, Rihani S, Flora D, Till C. Development and Validation of the Prevention of Toxic Chemicals in the Environment for Children Tool: A Questionnaire for Examining the Community's Knowledge of and Preferences Toward Toxic Chemicals and Children's Brain Development. Frontiers in Public Health. 2022 May; 10. doi: https://www.frontiersin.org/articles/10.3389/fpubh.2022.863071/full.

· Guin JD, Kincannon J, Church FL. Baby-wipe dermatitis: preservative-induced hand eczema in parents and persons using moist towelettes. Am J Contact Dermat. 2001 Dec;12(4):189-92. doi: 10.1053/ajcd.2001.28052. PubMed PMID: 11753890.

· Handa S, De D, Mahajan R. Airborne contact dermatitis - current perspectives in etiopathogenesis and management. Indian J Dermatol. 2011 Nov;56(6):700-6. doi: 10.4103/0019-5154.91832. PubMed PMID: 22345774; PubMed Central PMCID: PMC3276900.

· Harley KG, Berger KP, Kogut K, Parra K, Lustig RH, Greenspan LC, Calafat AM, Ye X, Eskenazi B. Association of phthalates, parabens and phenols found in personal care products with pubertal timing in girls and boys. Hum Reprod. 2019 Jan 1;34(1):109-117. doi: 10.1093/humrep/dey337. PubMed PMID: 30517665; PubMed Central PMCID: PMC6295961.

· Heindel JJ. History of the Obesogen Field: Looking Back to Look Forward. Front Endocrinol (Lausanne). 2019;10:14. doi: 10.3389/fendo.2019.00014. eCollection 2019. Review. PubMed PMID: 30761083; PubMed Central PMCID: PMC6362096.

· Heisterberg MV, Menné T, Andersen KE, Avnstorp C, Kristensen B, Kristensen O, Kaaber K, Laurberg G, Henrik Nielsen N, Sommerlund M, Thormann J, Veien NK, Vissing S, Johansen JD. Deodorants are the leading cause of allergic contact dermatitis to fragrance ingredients. Contact Dermatitis. 2011 May;64(5):258-64. doi: 10.1111/j.1600-0536.2011.01889.x. PubMed PMID: 21480912.

· Helm JS, Nishioka M, Brody JG, Rudel RA, Dodson RE. Measurement of endocrine disrupting and asthma-associated chemicals in hair products used by Black women. Environ Res. 2018 Aug;165:448-458. doi: 10.1016/j.envres.2018.03.030. Epub 2018 Apr 25. PMID: 29705122.

· Holtcamp W. Obesogens: an environmental link to obesity. Environ Health Perspect. 2012 Feb;120(2):a62-8. doi: 10.1289/ehp.120-a62. PubMed PMID: 22296745; PubMed Central PMCID: PMC3279464.

· Holtcamp W. Long-term outcomes after phthalate exposure: food intake, weight gain, fat storage, and fertility in mice. Environ Health Perspect. 2012 Aug;120(8):a320. doi: 10.1289/ehp.120-a320a. PubMed PMID: 22854284; PubMed Central PMCID: PMC3440097.

· Hsieh BM, Beets AK. Coughing in Small Animal Patients. Frontiers in Veterinary Science. 2020 January; 6:513. doi: doi: 10.3389/fvets.2019.00513.

· Hsu CN, Tain YL. Adverse Impact of Environmental Chemicals on Developmental Origins of Kidney Disease and Hypertension. Front Endocrinol (Lausanne). 2021 Oct 14;12:745716. doi: 10.3389/fendo.2021.745716. PMID: 34721300; PMCID: PMC8551449.

· Ibrahim ALshaer F, Fuad ALBaharna D, Ahmed HO, Ghiyath Anas M, Mohammed ALJassmi J. Qualitative Analysis of Air Freshener Spray. J Environ Public Health. 2019;2019:9316707. doi: 10.1155/2019/9316707. eCollection 2019. PubMed PMID: 31781257; PubMed Central PMCID: PMC6874985.

· Jenerowicz D, Silny W, Dańczak-Pazdrowska A, Polańska A, Osmola-Mańkowska A, Olek-Hrab K. Environmental factors and allergic diseases. Ann Agric Environ Med. 2012;19(3):475-81. Review. PubMed PMID: 23020042.

· Jensen OC, Petersen I. [Occupational asthma caused by scented gravel in cat litter boxes]. Ugeskr Laeger. 1991 Mar 25;153(13):939-40. PubMed PMID: 2024303.

· Jiang J, Ding X, Isaacson KP, Tasoglou A, Huber H, Shah AD, Jung N, Boor BE. Ethanol-based disinfectant sprays drive rapid changes in the chemical composition of indoor air in residential buildings. J Hazard Mater Lett. 2021 Nov;2:100042. doi: 10.1016/j.hazl.2021.100042. Epub 2021 Sep 8. PubMed PMID: 34977843; PubMed Central PMCID: PMC8423670.

· Jo WK, Lee JH, Kim MK. Head-space, small-chamber and in-vehicle tests for volatile organic compounds (VOCs) emitted from air fresheners for the Korean market. Chemosphere. 2008 Feb;70(10):1827-34. doi: 10.1016/j.chemosphere.2007.08.021. Epub 2007 Sep 21. PubMed PMID: 17889253.

· Johnson PI, Favela K, Jarin J, Le AM, Clark PY, Fu L, Gillis AD, Morga N, Nguyen C, Harley KG. Chemicals of concern in personal care products used by women of color in three communities of California. J Expo Sci Environ Epidemiol. 2022 Nov;32(6):864-876. doi: 10.1038/s41370-022-00485-y. Epub 2022 Nov 2. PMID: 36323919; PMCID: PMC9628299.

· Jurewicz J, Polańska K, Hanke W. Exposure to widespread environmental toxicants and children's cognitive development and behavioral problems. Int J Occup Med Environ Health. 2013 Apr;26(2):185-204. doi: 10.2478/s13382-013-0099-x. Epub 2013 May 28. Review. PubMed PMID: 23715930.

· Karlberg AT, Börje A, Duus Johansen J, Lidén C, Rastogi S, Roberts D, Uter W, White IR. Activation of non-sensitizing or low-sensitizing fragrance substances into potent sensitizers - prehaptens and prohaptens. Contact Dermatitis. 2013 Dec;69(6):323-34. doi: 10.1111/cod.12127. Epub 2013 Sep 20. Review. PubMed PMID: 24107147.

· Karthikraj R, Lee S, Kannan K. Urinary concentrations and distribution profiles of 21 phthalate metabolites in pet cats and dogs. Sci Total Environ. 2019 Nov 10;690:70-75. doi: 10.1016/j.scitotenv.2019.06.522. Epub 2019 Jul 2. PubMed PMID: 31284197.

· Kawano T, Matsuse H, Fukahori S, Tsuchida T, Nishino T, Fukushima C, Kohno S. Acetaldehyde at a low concentration synergistically exacerbates allergic airway inflammation as an endocrine-disrupting chemical and as a volatile organic compound. Respiration. 2012;84(2):135-41. doi: 10.1159/000337112. Epub 2012 Apr 25. PubMed PMID: 22538484.

· Kazemi Z, Aboutaleb E, Shahsavani A, Kermani M, Kazemi Z. Evaluation of pollutants in perfumes, colognes and health effects on the consumer: a systematic review. J Environ Health Sci Eng. 2022 Jun;20(1):589-598. doi: 10.1007/s40201-021-00783-x. eCollection 2022 Jun. Review. PubMed PMID: 35669814; PubMed Central PMCID: PMC9163252.

· Khalid M, Abdollahi M. Environmental Distribution of Personal Care Products and Their Effects on Human Health. Iran J Pharm Res. 2021 Winter;20(1):216-253. doi: 10.22037/ijpr.2021.114891.15088. Review. PubMed PMID: 34400954; PubMed Central PMCID: PMC8170769.

· Kim S, Hong SH, Bong CK, Cho MH. Characterization of air freshener emission: the potential health effects. J Toxicol Sci. 2015;40(5):535-50. doi: 10.2131/jts.40.535. Review. PubMed PMID: 26354370.

· Kim S, Lee AY, Cho MH. Inhaled exposure to air fresheners aggravated liver injury in a murine model of nonalcoholic fatty acid liver disease. Heliyon. 2021 Mar;7(3):e06452. doi: 10.1016/j.heliyon.2021.e06452. eCollection 2021 Mar. PubMed PMID: 33817364; PubMed Central PMCID: PMC8010405.

· Kumar M, Devi A, Sharma M, Kaur P, Mandal UK. Review on perfume and present status of its associated allergens. J Cosmet Dermatol. 2021 Feb;20(2):391-399. doi: 10.1111/jocd.13507. Epub 2020 Jun 16. Review. PubMed PMID: 32445606.

· Kumar P, Caradonna-Graham VM, Gupta S, Cai X, Rao PN, Thompson J. Inhalation challenge effects of perfume scent strips in patients with asthma. Ann Allergy Asthma Immunol. 1995 Nov;75(5):429-33. PubMed PMID: 7583865.

· Kurşunoğlu NE, Sarer Yurekli BP. Endocrine disruptor chemicals as obesogen and diabetogen: Clinical and mechanistic evidence. World J Clin Cases. 2022 Nov 6;10(31):11226-11239. doi: 10.12998/wjcc.v10.i31.11226. Review. PubMed PMID: 36387809; PubMed Central PMCID: PMC9649566.

· Kwack SJ, Kim KB, Kim HS, Lee BM. Comparative toxicological evaluation of phthalate diesters and metabolites in Sprague-Dawley male rats for risk assessment. J Toxicol Environ Health A. 2009;72(21-22):1446-54. doi: 10.1080/15287390903212923. PubMed PMID: 20077217.

· Kwon KD, Jo WK, Lim HJ, Jeong WS. Characterization of emissions composition for selected household products available in Korea. J Hazard Mater. 2007 Sep 5;148(1-2):192-8. doi: 10.1016/j.jhazmat.2007.02.025. Epub 2007 Feb 15. PubMed PMID: 17376591.

· Lee I, Ji K. Identification of combinations of endocrine disrupting chemicals in household chemical products that require mixture toxicity testing. Ecotoxicol Environ Saf. 2022 Jul 15;240:113677. doi: 10.1016/j.ecoenv.2022.113677. Epub 2022 May 26. PubMed PMID: 35642859.

· Lee JH, Lee HS, Park MR, Lee SW, Kim EH, Cho JB, Kim J, Han Y, Jung K, Cheong HK, Lee SI, Ahn K. Relationship between indoor air pollutant levels and residential environment in children with atopic dermatitis. Allergy Asthma Immunol Res. 2014 Nov;6(6):517-24. doi: 10.4168/aair.2014.6.6.517. Epub 2014 Sep 11. PubMed PMID: 25374751; PubMed Central PMCID: PMC4214972.

· Lessenger JE. Occupational acute anaphylactic reaction to assault by perfume spray in the face. J Am Board Fam Pract. 2001 Mar-Apr;14(2):137-40. PubMed PMID: 11314921.

· Li D, Suh S. Health risks of chemicals in consumer products: A review. Environ Int. 2019 Feb;123:580-587. doi: 10.1016/j.envint.2018.12.033. Epub 2019 Jan 7. Review. PubMed PMID: 30622082.

· Li W, Liu Q, Chen Y, Yang B, Huang X, Li Y, Zhang JJ. Effects of indoor environment and lifestyle on respiratory health of children in Chongqing, China. J Thorac Dis. 2020 Oct;12(10):6327-6341. doi: 10.21037/jtd.2020.03.102. PubMed PMID: 33209472; PubMed Central PMCID: PMC7656398.

· Lim S. The associations between personal care products use and urinary concentrations of phthalates, parabens, and triclosan in various age groups: The Korean National Environmental Health Survey Cycle 3 2015-2017. Sci Total Environ. 2020 Nov 10;742:140640. doi: 10.1016/j.scitotenv.2020.140640. Epub 2020 Jul 2. PubMed PMID: 32721747.

· Lin CH, Lo PY, Wu HD, Chang C, Wang LC. Association between indoor air pollution and respiratory disease in companion dogs and cats. J Vet Intern Med. 2018 May;32(3):1259-1267. doi: 10.1111/jvim.15143. Epub 2018 Apr 21. PubMed PMID: 29681128; PubMed Central PMCID: PMC5980393.

· Lin CH, Lo PY, Wu HD. An observational study of the role of indoor air pollution in pets with naturally acquired bronchial/lung disease. Vet Med Sci. 2020 Aug;6(3):314-320. doi: 10.1002/vms3.231. Epub 2020 Jan 3. PubMed PMID: 31901015; PubMed Central PMCID: PMC7397909.

· Lin N, Ding N, Meza-Wilson E, Manuradha Devasurendra A, Godwin C, Kyun Park S, Batterman S. Volatile organic compounds in feminine hygiene products sold in the US market: A survey of products and health risks. Environ Int. 2020 Nov;144:105740. doi: 10.1016/j.envint.2020.105740. Epub 2020 Aug 28. PubMed PMID: 32866732; PubMed Central PMCID: PMC7958867.

· Logue JM, McKone TE, Sherman MH, Singer BC. Hazard assessment of chemical air contaminants measured in residences. Indoor Air. 2011 Apr;21(2):92-109. doi: 10.1111/j.1600-0668.2010.00683.x. PubMed PMID: 21392118.

· Marcelis Q, Gatzios A, Deconinck E, Rogiers V, Vanhaecke T, Desmedt B. Development and application of a novel method to assess exposure levels of sensitizing and irritating substances leaching from menstrual hygiene products https://www.ncbi.nlm.nih.gov/myncbi/collections/mybibliography/?sortby=author&sdirection=ascending. Emerging Contaminants. 2021 March; 7:116-123. doi: https://doi.org/10.1016/j.emcon.2021.02.004.

· Minciullo PL, Imbesi S, Tigano V, Gangemi S. Airborne contact dermatitis to drugs. Allergol Immunopathol (Madr). 2013 Mar-Apr;41(2):121-6. doi: 10.1016/j.aller.2012.01.004. Epub 2012 Mar 24. Review. PubMed PMID: 22445186.

· Mohajer N, Du CY, Checkcinco C, Blumberg B. Obesogens: How They Are Identified and Molecular Mechanisms Underlying Their Action. Front Endocrinol (Lausanne). 2021 Nov 25;12:780888. doi: 10.3389/fendo.2021.780888. PMID: 34899613; PMCID: PMC8655100.

· Montes-Grajales D, Fennix-Agudelo M, Miranda-Castro W. Occurrence of personal care products as emerging chemicals of concern in water resources: A review. Sci Total Environ. 2017 Oct 1;595:601-614. doi: 10.1016/j.scitotenv.2017.03.286. Epub 2017 Apr 8. Review. PubMed PMID: 28399499.

· Müller AK, Nielsen E, Ladefoged O, Dalgaard M, Hass U. Evaluation of the health risk to animals playing with phthalates containing toys. [Print]. Department of Toxicology and Risk Assessment & -Danish Institute for Food and Veterinary Research; 2006. Miljøstyrelsen. Survey of Chemical Substances in Consumer Products No. 74. Available from: https://www2.mst.dk/udgiv/publications/2006/87-7052-192-1/pdf/87-7052-194-8.pdf.

· Nardelli A, Drieghe J, Claes L, Boey L, Goossens A. Fragrance allergens in 'specific' cosmetic products. Contact Dermatitis. 2011 Apr;64(4):212-9. doi: 10.1111/j.1600-0536.2011.01877.x. PubMed PMID: 21392029.

· Nardelli A, D'Hooghe E, Drieghe J, Dooms M, Goossens A. Allergic contact dermatitis from fragrance components in specific topical pharmaceutical products in Belgium. Contact Dermatitis. 2009 Jun;60(6):303-13. doi: 10.1111/j.1600-0536.2009.01542.x. PubMed PMID: 19489964.

· Neale H, Garza-Mayers AC, Tam I, Yu J. Pediatric allergic contact dermatitis. Part I: Clinical features and common contact allergens in children. J Am Acad Dermatol. 2021 Feb;84(2):235-244. doi: 10.1016/j.jaad.2020.11.002. Epub 2020 Nov 17. Review. PubMed PMID: 33217510.

· Nguyen HL, Yiannias JA. Contact Dermatitis to Medications and Skin Products. Clin Rev Allergy Immunol. 2019 Feb;56(1):41-59. doi: 10.1007/s12016-018-8705-0. Review. PubMed PMID: 30145645.

· Niehoff NM, Gammon MD, Keil AP, Nichols HB, Engel LS, Sandler DP, White AJ. Airborne mammary carcinogens and breast cancer risk in the Sister Study. Environ Int. 2019 Sep;130:104897. doi: 10.1016/j.envint.2019.06.007. Epub 2019 Jun 18. PubMed PMID: 31226564; PubMed Central PMCID: PMC6679994.

· Nisitha S, Balasubramani G. A Review: Toxic Chemicals Emitted from Air fresheners & Disinfectants. Ijraset Journal For Research in Applied Science and Engineering Technology. 2022 October; 10(X):1338.

· Niu X, Ho SSH, Ho KF, Huang Y, Cao J, Shen Z, Sun J, Wang X, Wang Y, Lee S, Huang R. Indoor secondary organic aerosols formation from ozonolysis of monoterpene: An example of d-limonene with ammonia and potential impacts on pulmonary inflammations. Sci Total Environ. 2017 Feb 1;579:212-220. doi: 10.1016/j.scitotenv.2016.11.018. Epub 2016 Nov 11. PubMed PMID: 27842959.

· Oyer-Peterson K, Gimeno Ruiz de Porras D, Han I, Delclos GL, Brooks EG, Afshar M, Whitworth KW. A pilot study of total personal exposure to volatile organic compounds among Hispanic female domestic cleaners. J Occup Environ Hyg. 2022 Jan;19(1):1-11. doi: 10.1080/15459624.2021.2000615. Epub 2022 Jan 28. PubMed PMID: 34731075; PubMed Central PMCID: PMC8813894.

· Panico A, Serio F, Bagordo F, Grassi T, Idolo A, DE Giorgi M, Guido M, Congedo M, DE Donno A. Skin safety and health prevention: an overview of chemicals in cosmetic products. J Prev Med Hyg. 2019 Mar;60(1):E50-E57. doi: 10.15167/2421-4248/jpmh2019.60.1.1080. eCollection 2019 Mar. PubMed PMID: 31041411; PubMed Central PMCID: PMC6477564.

· Park CJ, Barakat R, Ulanov A, Li Z, Lin PC, Chiu K, Zhou S, Perez P, Lee J, Flaws J, Ko CJ. Sanitary pads and diapers contain higher phthalate contents than those in common commercial plastic products. Reprod Toxicol. 2019 Mar;84:114-121. doi: 10.1016/j.reprotox.2019.01.005. Epub 2019 Jan 16. PubMed PMID: 30659930; PubMed Central PMCID: PMC6504186.

· Pastor-Nieto MA, Gatica-Ortega ME. Ubiquity, Hazardous Effects, and Risk Assessment of Fragrances in Consumer Products. Curr Treat Options Allergy. 2021;8(1):21-41. doi: 10.1007/s40521-020-00275-7. Epub 2021 Jan 23. Review. PubMed PMID: 33520600; PubMed Central PMCID: PMC7825391.

· Patel S. Fragrance compounds: The wolves in sheep's clothings. Med Hypotheses. 2017 May;102:106-111. doi: 10.1016/j.mehy.2017.03.025. Epub 2017 Mar 22. Review. PubMed PMID: 28478814.

· Patel S, Sharifian S. Need of the hour: to raise awareness on vicious fragrances and synthetic musks. Environment, Development and Sustainability. 2020 June; 23:4764–4781. doi: https://doi.org/10.1007/s10668-020-00829-4.

· Pereira L, Mondal PK, Alves M. Pollutants in Buildings, Water and Living Organisms. Environmental Chemistry for a Sustainable World. In: Lichtfouse E, Schwarzbauer J, Robert D, editors. Pollutants in Buildings, Water and Living Organisms. [Internet] Springer International Publishing Switzerland: Springer, Cham; 2015. 297–346p. Available from: https://link.springer.com/chapter/10.1007/978-3-319-19276-5_7#citeas.

· Pinkas A, Gonçalves CL, Aschner M. Neurotoxicity of fragrance compounds: A review. Environ Res. 2017 Oct;158:342-349. doi: 10.1016/j.envres.2017.06.035. Epub 2017 Jul 3. Review. PubMed PMID: 28683407.

· Pizzorno J. Is the Diabetes Epidemic Primarily Due to Toxins?. Integr Med (Encinitas). 2016 Aug;15(4):8-17. PubMed PMID: 27574488; PubMed Central PMCID: PMC4991654.

· Pona A, Gonzalez CD, Walkosz BJ, Dellavalle RP. Scented lotions may cause scaring and premature fading of tattoos. Dermatol Online J. 2020 Oct 15;26(10). PubMed PMID: 33147671.

· Posnack NG, Swift LM, Kay MW, Lee NH, Sarvazyan N. Phthalate exposure changes the metabolic profile of cardiac muscle cells. Environ Health Perspect. 2012 Sep;120(9):1243-51. doi: 10.1289/ehp.1205056. Epub 2012 Jun 6. PubMed PMID: 22672789; PubMed Central PMCID: PMC3440133.

· Quirce S, Barranco P. Cleaning agents and asthma. J Investig Allergol Clin Immunol. 2010;20(7):542-50; quiz 2p following 550. Review. PubMed PMID: 21313993.

· Rastogi SC, Heydorn S, Johansen JD, Basketter DA. Fragrance chemicals in domestic and occupational products. Contact Dermatitis. 2001 Oct;45(4):221-5. doi: 10.1034/j.1600-0536.2001.450406.x. PubMed PMID: 11683833.

· Ravichandran J, Karthikeyan BS, Jost J, Samal A. An atlas of fragrance chemicals in children's products. Sci Total Environ. 2022 Apr 20;818:151682. doi: 10.1016/j.scitotenv.2021.151682. Epub 2021 Nov 15. PubMed PMID: 34793786.

· Ruiz D, Becerra M, Jagai JS, Ard K, Sargis RM. Disparities in Environmental Exposures to Endocrine-Disrupting Chemicals and Diabetes Risk in Vulnerable Populations. Diabetes Care. 2018 Jan;41(1):193-205. doi: 10.2337/dc16-2765. Epub 2017 Nov 15. Review. PubMed PMID: 29142003; PubMed Central PMCID: PMC5741159.

· Sanchez-Prado L, Llompart M, Lamas JP, Garcia-Jares C, Lores M. Multicomponent analytical methodology to control phthalates, synthetic musks, fragrance allergens and preservatives in perfumes. Talanta. 2011 Jul 15;85(1):370-9. doi: 10.1016/j.talanta.2011.03.079. Epub 2011 Apr 5. PubMed PMID: 21645712.

· Scheinman PL. Exposing covert fragrance chemicals. Am J Contact Dermat. 2001 Dec;12(4):225-8. doi: 10.1053/ajcd.2001.28697. Review. PubMed PMID: 11753900.

· Schloemer JA, Zirwas MJ, Burkhart CG. Airborne contact dermatitis: common causes in the USA. Int J Dermatol. 2015 Mar;54(3):271-4. doi: 10.1111/ijd.12692. Epub 2014 Jul 1. Review. PubMed PMID: 24981079.

· Schmidt JS, Schaedlich K, Fiandanese N, Pocar P, Fischer B. Effects of di(2-ethylhexyl) phthalate (DEHP) on female fertility and adipogenesis in C3H/N mice. Environ Health Perspect. 2012 Aug;120(8):1123-9. doi: 10.1289/ehp.1104016. Epub 2012 May 15. PubMed PMID: 22588786; PubMed Central PMCID: PMC3440070.

· Sealey LA, Hughes BW, Sriskanda AN, Guest JR, Gibson AD, Johnson-Williams L, Pace DG, Bagasra O. Environmental factors in the development of autism spectrum disorders. Environ Int. 2016 Mar;88:288-298. doi: 10.1016/j.envint.2015.12.021. Epub 2016 Jan 28. Review. PubMed PMID: 26826339.

· Sealey LA, Hughes BW, Pestaner JP, Steinemann A, Pace DG, Bagasra O. Environmental factors may contribute to autism development and male bias: Effects of fragrances on developing neurons. Environ Res. 2015 Oct;142:731-8. doi: 10.1016/j.envres.2015.08.025. PubMed PMID: 26408793.

· Singh RD, Koshta K, Tiwari R, Khan H, Sharma V, Srivastava V. Developmental Exposure to Endocrine Disrupting Chemicals and Its Impact on Cardio-Metabolic-Renal Health. Front Toxicol. 2021;3:663372. doi: 10.3389/ftox.2021.663372. eCollection 2021. Review. PubMed PMID: 35295127; PubMed Central PMCID: PMC8915840.

· Steinemann A. Fragranced consumer products: effects on autistic adults in the United States, Australia, and United Kingdom. Air Qual Atmos Health. 2018;11(10):1137-1142. doi: 10.1007/s11869-018-0625-x. Epub 2018 Sep 25. PubMed PMID: 30546500; PubMed Central PMCID: PMC6244938.

· Steinemann A, Wheeler AJ, Larcombe A. Fragranced consumer products: effects on asthmatic Australians. Air Qual Atmos Health. 2018;11(4):365-371. doi: 10.1007/s11869-018-0560-x. Epub 2018 Mar 17. PubMed PMID: 29780436; PubMed Central PMCID: PMC5954056.

· Steinemann A. Fragranced consumer products: effects on asthmatics. Air Qual Atmos Health. 2018;11(1):3-9. doi: 10.1007/s11869-017-0536-2. Epub 2017 Dec 11. PubMed PMID: 29391919; PubMed Central PMCID: PMC5773620.

· Steinemann A. Fragranced consumer products: exposures and effects from emissions. Air Qual Atmos Health. 2016;9(8):861-866. doi: 10.1007/s11869-016-0442-z. Epub 2016 Oct 20. PubMed PMID: 27867426; PubMed Central PMCID: PMC5093181.

· Steinemann A. Volatile emissions from common consumer products. Air Quality, Atmosphere, and Health. 2015 March; 8:273–281.

· Steinemann A. Ten questions concerning air fresheners and indoor built environments. The International Journal of Building Science and its Applications. 2017 January; 111:279https://www.sciencedirect.com/science/article/pii/S0360132316304334?via%3Dihub.

· Steinemann A, Nematollahi N, Weinberg J, Flattery J, Goodman N, Kolev S. Volatile chemical emissions from car air fresheners. Air Quality, Atmosphere and Health. 2020 August; 13:1329–1334. doi: https://doi.org/10.1007/s11869-020-00886-8.

· Steinemann A. Chemical emissions from residential dryer vents during use of fragranced laundry products. Air Quality, Atmosphere, and Health. 2011 August; 6:151.

· Tang Z, Chai M, Cheng J, Wang Y, Huang Q. Occurrence and Distribution of Phthalates in Sanitary Napkins from Six Countries: Implications for Women's Health. Environ Sci Technol. 2019 Dec 3;53(23):13919-13928. doi: 10.1021/acs.est.9b03838. Epub 2019 Nov 18. PubMed PMID: 31694371.

· Taylor KM, Weisskopf M, Shine J. Human exposure to nitro musks and the evaluation of their potential toxicity: an overview. Environ Health. 2014 Mar 11;13(1):14. doi: 10.1186/1476-069X-13-14. Review. PubMed PMID: 24618224; PubMed Central PMCID: PMC4007519.

· Tekin K, Arslan P, Cil B, Filazi A, Akçay E, Yurdakok-Dikmen B. Companion animals get close to the toxic aspects of antropogenic world: cytotoxicity of phthalates and bisphenol A on dog testicular primary cells. Cytotechnology. 2020 Oct;72(5):629-638. doi: 10.1007/s10616-020-00401-y. Epub 2020 May 20. PubMed PMID: 32435861; PubMed Central PMCID: PMC7547924.

· Uhde E, Schulz N. Impact of room fragrance products on indoor air quality. Atmospheric Environment. 2015 April; 106:492-502. doi: https://doi.org/10.1016/j.atmosenv.2014.11.020.

· Vardoulakis S, Giagloglou E, Steinle S, Davis A, Sleeuwenhoek A, Galea KS, Dixon K, Crawford JO. Indoor Exposure to Selected Air Pollutants in the Home Environment: A Systematic Review. Int J Environ Res Public Health. 2020 Dec 2;17(23). doi: 10.3390/ijerph17238972. PubMed PMID: 33276576; PubMed Central PMCID: PMC7729884.

· Veiga-Lopez A, Pu Y, Gingrich J, Padmanabhan V. Obesogenic Endocrine Disrupting Chemicals: Identifying Knowledge Gaps. Trends Endocrinol Metab. 2018 Sep;29(9):607-625. doi: 10.1016/j.tem.2018.06.003. Epub 2018 Jul 13. Review. PubMed PMID: 30017741; PubMed Central PMCID: PMC6098722.

· Wang J, Zhang X, Li Y, Liu Y, Tao L. Exposure to Dibutyl Phthalate and Reproductive-Related Outcomes in Animal Models: Evidence From Rodents Study. Front Physiol. 2021;12:684532. doi: 10.3389/fphys.2021.684532. eCollection 2021. Review. PubMed PMID: 34955869; PubMed Central PMCID: PMC8692859.

· Wang M, Tan G, Eljaszewicz A, Meng Y, Wawrzyniak P, Acharya S, Altunbulakli C, Westermann P, Dreher A, Yan L, Wang C, Akdis M, Zhang L, Nadeau KC, Akdis CA. Laundry detergents and detergent residue after rinsing directly disrupt tight junction barrier integrity in human bronchial epithelial cells. J Allergy Clin Immunol. 2019 May;143(5):1892-1903. doi: 10.1016/j.jaci.2018.11.016. Epub 2018 Nov 27. PubMed PMID: 30500342.

· Wang Z, Zhang Q, Li H, Lv Q, Wang W, Bai H. Rapid and green determination of 58 fragrance allergens in plush toys. J Sep Sci. 2018 Feb;41(3):657-668. doi: 10.1002/jssc.201700556. Epub 2017 Dec 14. PubMed PMID: 29150895.

· Wieck S, Olsson O, Kümmerer K, Klaschka U. Fragrance allergens in household detergents. Regul Toxicol Pharmacol. 2018 Aug;97:163-169. doi: 10.1016/j.yrtph.2018.06.015. Epub 2018 Jun 22. PubMed PMID: 29940212.

· Wiedmer C, Velasco-Schön C, Buettner A. Characterization of odorants in inflatable aquatic toys and swimming learning devices-which substances are causative for the characteristic odor and potentially harmful?. Anal Bioanal Chem. 2017 Jun;409(16):3905-3916. doi: 10.1007/s00216-017-0330-x. Epub 2017 Apr 12. PubMed PMID: 28401289.

· Wolkoff P, Schneider T, Kildesø J, Degerth R, Jaroszewski M, Schunk H. Risk in cleaning: chemical and physical exposure. Sci Total Environ. 1998 Apr 23;215(1-2):135-56. doi: 10.1016/s0048-9697(98)00110-7. Review. PubMed PMID: 9599458.

· Wong KH, Durrani TS. Exposures to Endocrine Disrupting Chemicals in Consumer Products-A Guide for Pediatricians. Curr Probl Pediatr Adolesc Health Care. 2017 May;47(5):107-118. doi: 10.1016/j.cppeds.2017.04.002. Epub 2017 May 17. Review. PubMed PMID: 28526231.

· Wooten KJ, Smith PN. Canine toys and training devices as sources of exposure to phthalates and bisphenol A: quantitation of chemicals in leachate and in vitro screening for endocrine activity. Chemosphere. 2013 Nov;93(10):2245-53. doi: 10.1016/j.chemosphere.2013.07.075. Epub 2013 Sep 3. PubMed PMID: 24007620.

· Yeoman AM, Shaw M, Carslaw N, Murrells T, Passant N, Lewis AC. Simplified speciation and atmospheric volatile organic compound emission rates from non-aerosol personal care products. Indoor Air. 2020 May;30(3):459-472. doi: 10.1111/ina.12652. Epub 2020 Feb 26. PubMed PMID: 32034823; PubMed Central PMCID: PMC7217173.

· Yu J, Treat J, Chaney K, Brod B. Potential Allergens in Disposable Diaper Wipes, Topical Diaper Preparations, and Disposable Diapers: Under-recognized Etiology of Pediatric Perineal Dermatitis. Dermatitis. 2016 May-Jun;27(3):110-8. doi: 10.1097/DER.0000000000000177. PubMed PMID: 27172304.

· Zlatnik MG. Endocrine-Disrupting Chemicals and Reproductive Health. J Midwifery Womens Health. 2016 Jul;61(4):442-55. doi: 10.1111/jmwh.12500. Epub 2016 Jul 8. Review. PubMed PMID: 27391253; PubMed Central PMCID: PMC6701840.

· de Groot AC. Fragrances: Contact Allergy and Other Adverse Effects. Dermatitis. 2020 Jan/Feb;31(1):13-35. doi: 10.1097/DER.0000000000000463. Review. PubMed PMID: 31433384.

· van Amerongen CCA, Ofenloch RF, Cazzaniga S, Elsner P, Gonçalo M, Naldi L, Svensson Å, Bruze M, Schuttelaar MLA. Skin exposure to scented products used in daily life and fragrance contact allergy in the European general population - The EDEN Fragrance Study. Contact Dermatitis. 2021 Jun;84(6):385-394. doi: 10.1111/cod.13807. Epub 2021 Mar 2. PubMed PMID: 33576005; PubMed Central PMCID: PMC8247875.