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(This category highlights potential health issues from fragrance chemicals and fragranced products.)
Download the poster to share: 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 products, hand sanitizers, lotions, laundry products, deodorant, air fresheners or any other scented items.

# PERFUME/COLOGNE/FRAGRANCE

*Body Sprays, Aftershave, Baby Cologne, Bottles of Perfume/Cologne, Fragrance Added to Any Product*

Any combination of over 4000 chemicals are used in the formulations of perfume/fragrances with little research on the toxic adverse effects of those combinations of chemicals or the effects of so many fragranced products in the air of a home. Many petro-chemicals have been grandfathered in by the EPA and used freely in 'trade secret' fragrance formulas. Today, there are still very few regulations on chemicals used in fragrance/perfume/parfum/aroma or scent.

**"**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

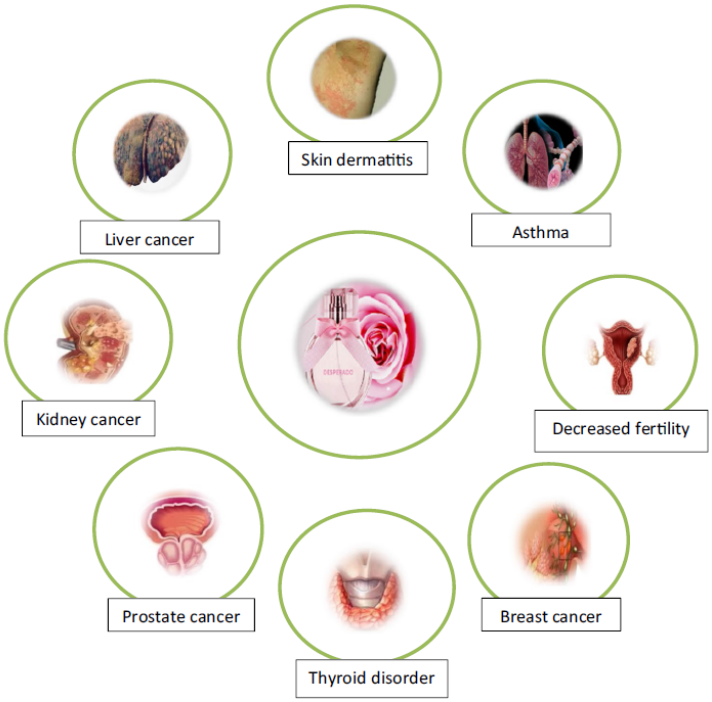
## 1. *Evaluation of pollutants in perfumes, colognes and health effects on the consumer: a systematic review*

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




**"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.**]**

## 2. *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.**"

## 3. *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/

"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."

## 4. *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."

## 5. *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."

## 6. *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."**

## *7. Erectile Dysfunction in Men on the Rise: Is There a Link with Endocrine Disrupting Chemicals?*

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. PMID: 34134123.
**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?**]**

## 8. *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**."

## 9. *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).”

## 10. *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].”

## 11. *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**.**”

## 12. *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.”

## 13. *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**."

## 14. *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."**

## 15. *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."

## 16. *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**."

## 17. *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.**]**

## 18. *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.**]**

## 19. *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.**"

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

Citation: Mohajer N, Du CY, Checkcinco C and Blumberg B (2021) Obesogens: How They Are Identified and Molecular Mechanisms Underlying Their Action. Front. Endocrinol. 12:780888. doi: 10.3389/fendo.2021.780888
**Article Link:** https://www.frontiersin.org/articles/10.3389/fendo.2021.780888/full

"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”.**]**

## 21. *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.**"

## 22. *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)."

**[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?**]**

## 23. *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**."

## 24. *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.”

## 25. *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.**”

## 26. *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**.”

## 27. *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.**"

## 28. *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**."

## 29. *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.**"

## 30. *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."

## 31. *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**."

“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”.**]**

## 32. *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 ….”

## 33. *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”.**]**

## 34. *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**]**

## 35. *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.**]**

## 36. *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."

## 37. *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**."

## 38. *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".**]**

## 39. *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."

## 40. *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**."

## 41. *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."**

## 42. *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."

“As a result, peer-reviewed journal publications largely failed to serve as an early warning or a preventive mechanism. The **humidifier disinfectant incident** in South Korea is a stark example that shows the potential vulnerability in chemical exposure through consumer products and its consequences, as well as the limited role for peer-reviewed journal publications to prevent them. It also **highlights the needs for understanding the risks of chemicals before putting them into consumer products**, while the rapidly growing diversity of synthetic chemicals often makes the generation of necessary data cost-prohibitive. As a result, we observed that scientific literature tends to appear only after the outbreak of major exposure incidents, or they tend to be concentrated in the chemicals or chemical groups of which human health risks have been previously reported. This is a structural problem that is poised to grow under the current practice.”

“We believe that there is an urgent need for creating the framework conditions that encourage more exploratory and speculative risk assessments and their publications in peer-reviewed journal space in the absence of known human health risks. Reducing the costs and time needed for toxicity and exposure assessments is a key, to which the developments in predictive toxicity and risk assessment techniques for screening-level assessment, as well as **the use of systematic prioritization for high-risk exposure pathways and chemicals in consumer products would be crucial.”**

## 43. *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?**]**

## 44. *Fragranced consumer products: exposures and effects from emissions*

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. PMID: 27867426; PMCID: PMC5093181.

**Article Link:** https://pubmed.ncbi.nlm.nih.gov/27867426/ - PDF

"Fragranced consumer products, such as cleaning supplies, **air fresheners**, and personal care products, **are a primary source of indoor air pollutants** and personal exposure…. The study investigated the prevalence and types of fragranced product exposures, associated health effects, awareness of product emissions, and preferences for fragrance-free policies and environments."

**"Secondhand scents** (as termed in this article) **refers to indirect or involuntary exposure to fragranced products (in an analogy to secondhand smoke). …** Individuals report **health problems when exposed to fragranced products in society**, other than through intentional use of products."

**"Fragranced products (even ones called green or organic) emit a range of volatile organic compounds,** including hazardous air pollutants, but relatively few are disclosed to the public (Steinemann 2015).... Further, 67.3 % were not aware that **fragranced products** typically **emit hazardous air pollutants such as formaldehyde**, and 72.6 % were not aware that even so-called natural, green, and organic fragranced products typically emit hazardous air pollutants."

## 45. *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**"

## 46. *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?**]**

## 47. 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**]**

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