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(This category highlights potential health issues from fragrance chemicals and fragranced products.)

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**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.

## **AIR “FRESHENERS”**

*Plug-ins, Sprays, Sticks, Gels*

**It is important to be aware that air fresheners do not actually clean the air, but instead, introduce pollutants into the environment that can be detrimental to human health.**

“If you suspect someone has swallowed, inhaled, or gotten an air freshener product in the eye or on the skin, immediately check the webPOISONCONTROL® online tool for help or call Poison Control at 1-800-222-1222.”

-Karen D. Dominguez, PharmD (Certified Specialist in Poison Information)

### **1. 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.”

### **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.58.10.633-41. 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. 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-chemicalso-emitted-from-air-fresheners-and-disinfectants> - PDF

(Note: This graphic is from preceding article)

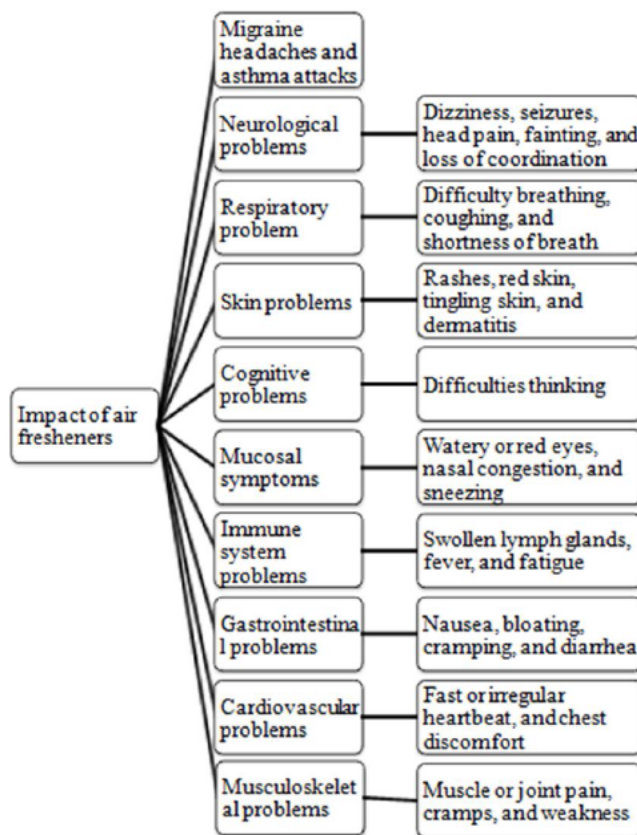


Figure 2: The diagram above illustrates the classification of illnesses brought on by exposure to air fresheners.

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### 4. 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 with atopic dermatitis. *Allergy Asthma Immunol Res.* 2014 Nov;6(6):517-24. doi: 10.4168/aaair.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 (NO<sub>2</sub>) 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 (PM<sub>10</sub>), **formaldehyde**, carbon dioxide (CO<sub>2</sub>), carbon monoxide (CO), nitrogen dioxide (NO<sub>2</sub>), **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.]**

## **5. Hazard assessment of chemical air contaminants measured in residences**

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. PMID: 21392118.

**Article Link:** <https://pubmed.ncbi.nlm.nih.gov/21392118/>

“Fifteen pollutants appear to exceed chronic health standards in a large fraction of homes. Nine other pollutants are identified as potential chronic health hazards in a substantial minority of homes, and an additional nine are identified as potential hazards in a very small percentage of homes. Nine pollutants are identified as priority hazards based on the robustness of measured concentration data and the fraction of residences that appear to be impacted: **acetaldehyde**; acrolein; **benzene**; 1,3-butadiene; 1,4-dichlorobenzene; **formaldehyde**; naphthalene; nitrogen dioxide; and PM<sub>2.5</sub>. Activity-based emissions are shown to pose potential acute health hazards for PM<sub>2.5</sub>, **formaldehyde**, CO, chloroform, and NO<sub>2</sub>.”

**[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: [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: [Benzene](#) is a reported fragrance ingredient in the [CSCP Product Database](#).]

[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.]

## 6. Ten questions concerning air fresheners and indoor built environments

Steinemann A, 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.

Art 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. 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.]

## **9. 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...**”

## **10. 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).”

## **11. 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<sub>10</sub>H<sub>16</sub>) 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/m<sup>3</sup> of benzene is 2.2–7.8 in a million (WHO 2010). The unit risk of **leukemia** per 1 µg/m<sup>3</sup> 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.]

## **12. 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?**]

### **13. 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).”

### **14. 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’](#).]

[**Note: IN THE NEWS** - On Dec. 29, 2022, the MOCRA - (Modernization of Cosmetic Regulation Act) was signed into law. This makes the U.S. catch up a little with the U.K. as far as listing fragrance allergens go, but this Act may tie the hands of states ability to make laws pertaining to disclosing other concerning fragrance ingredients.

To learn more, see what [Women’s Voices for the Earth \(WVE\)](#) figured out. To read the Act, go to [congress.gov link/PDF](#) (page 1396).]

## **15. 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**).”

## **16. 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/> - [PDE](#)

“...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.”

## 17. Evaluating air quality with and without air fresheners

Goodman N., Nematollahi N., Agosti G. Steinmann A. Evaluating air quality with and without air fresheners. *Air Qual Atmos Health* 13, 1–4 (2020). <https://doi.org/10.1007/s11869-019-00759-9>

Article Link: <https://researchonline.jcu.edu.au/60930/>

“This study indicated improvements to air quality, in terms of **D-limonene** concentrations, after discontinuing the use of air fresheners in restrooms. Reductions in air freshener use may also reduce the formation and concentrations of **secondary pollutants**. Findings from this study can provide an important foundation for future research to help reduce VOC emissions and exposures.”

## 18. Fragranced consumer products: exposures and effects from emissions

Steinmann 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 (Steinmann 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.”

## 19. Impact of room fragrance products on indoor air quality

Uhde E, Schulz N. Impact of room fragrance products on indoor air quality. *Atmospheric Environment*, Volume 106, 2015, Pages 492-502, ISSN 1352-2310, <https://doi.org/10.1016/j.atmosenv.2014.11.020>.

**Article Link:** <https://www.sciencedirect.com/science/article/abs/pii/S1352231014008796>

“Following a defined test protocol, the release of volatile organic compounds, ultrafine particles and NO<sub>x</sub> was monitored for each product. The potential for forming secondary organic aerosols under the influence of ozone was studied, and for a selection of products the long-term emission behavior was assessed. **Terpenoid** substances, **aldehydes** and lactones are common substances in scenting products, and a majority of the compounds used are reactive enough to be susceptible to indoor chemistry (Nazaroff and Weschler, 2004, Singer et al., 2006, Uhde and Salthammer, 2007).”

“Unlike fragranced detergents, cleaning products or cosmetics (Huang et al., 2011, Jo et al., 2008, Nazaroff and Weschler, 2004), the **air fresheners** have no other (primary) function; their **sole purpose is to odorize air** in a building. Their use therefore represents an **intended release of a – mostly unknown – substance mix in an indoor environment** (VITO, 2008).”

“The presented results show the great variety of substances that are released from room fragrance products. It also became evident during the study that these products can be substantial sources of air pollutants: Besides releasing scent substances in high concentrations, even higher concentrations could be found for some solvents. Considering the possible exposure time, which can reach weeks for the high volume diffusers, the use of such products in homes may impair indoor air quality notably.”

## **20. 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?](#)]

## **21. 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: [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”.]

## **22. Volatile emissions from common consumer products**

Steinemann, A. Volatile emissions from common consumer products. *Air Qual Atmos Health* 8, 273–281 (2015). <https://doi.org/10.1007/s11869-015-0327-6>

**Article Link:** <https://link.springer.com/article/10.1007/s11869-015-0327-6>

“This study investigates and compares **VOCs emitted from 37 common products (air fresheners, laundry products, cleaners, and personal care products)** including those with certifications and claims of green and organic.”

“For laundry products, cleaning supplies, and air fresheners, regulated under the US Consumer Product Safety Act (CPSA), **labels do not need to list all ingredients or the presence of a fragrance in the product** .... Fragrance ingredients are exempt from full disclosure in any product, not only in the USA but also internationally.”

“This study found **156 different VOCs emitted from the 37 products**, with an **average of 15 VOCs per product**. Of these 156 VOCs, **42 VOCs are classified as toxic or hazardous under US federal laws**, and each product emitted at least one of these chemicals.”

“The primary difference between the **fragranced** and fragrance-free versions is the presence of **terpenes (such as d-limonene,  $\beta$ -pinene,  $\alpha$ -pinene)** in the fragranced versions but not the fragrance-free versions... Consumer products used indoors, such as laundry supplies, **can affect outdoor air quality**, such as through dryer vent emissions...”

## **23. 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 men. 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?](#)]**

## **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. 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.]

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Back to top of [Air "Fresheners"](#)

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[www.fragrancefreecoalition.com](http://www.fragrancefreecoalition.com)