AMA
AMERICAN MEDICAL ASSOCIATION

AMA House of Delegates Handbook

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MEMORANDUM FROM THE SPEAKER OF THE HOUSE OF DELEGATES

- **All Delegates, Alternate Delegates and others receiving this material are reminded that it refers only to items to be considered by the House.**

- **No action has been taken on anything herein contained, and it is informational only.**

- **Only those items that have been acted on finally by the House can be considered official.**

- **REMINDER*: Only the Resolve portions of the resolutions are considered by the House of Delegates. The Whereas portions or preambles are informational and explanatory only.***

AMA
AMERICAN MEDICAL ASSOCIATION

UNDERSTANDING THE RECORDING OF AMERICAN MEDICAL ASSOCIATION POLICY

Current American Medical Association (AMA) policy is catalogued in PolicyFinder, an electronic database that is updated after each AMA House of Delegates (HOD) meeting and available online. Each policy is assigned to a topical or subject category. Those category headings are alphabetical, starting with "abortion" and running to "women"; the former topic was assigned the number 5, and "women" was assigned 525. Within a category, policies are assigned a 3 digit number, descending from 999, meaning that older policies will *generally* have higher numbers within a category (eg, 35.999 was initially adopted before 35.984). A policy number is not affected when it is modified, however, so a higher number may have been altered more recently than a lower number. Numbers are deleted and not reused when policies are rescinded.

AMA policy is further categorized into one of four types, indicated by a prefix:

- "H" – for statements that one would consider positional or philosophical on an issue
- "D" – for statements that direct some specific activity or action. There can be considerable overlap between H and D statements, with the assignment made on the basis of the core nature of the statement.
- "G" – for statements related to AMA governance
- "E" – for ethical opinions, which are the recommendations put forward in reports prepared by the Council on Ethical and Judicial Affairs and adopted by the AMA-HOD

AMA policy can be accessed at https://policysearch.ama-assn.org/policyfinder.

The actions of the AMA-HOD in developing policy are recorded in the *Proceedings*, which are available online as well. Annotations at the end of each policy statement trace its development, from initial adoption through any changes. If based on a report, the annotation includes the following abbreviations:

BOT – Board of Trustees
CCB – Council on Constitution and Bylaws
CEJA – Council on Ethical and Judicial Affairs
CLRPD – Council on Long Range Planning and Development
CME – Council on Medical Education
CMS – Council on Medical Service
CSAPH – Council on Science and Public Health

If a resolution was involved, "Res" is indicated. The number of the report or resolution and meeting (A for Annual; I for Interim) and year (two digits) are also included (eg, BOT Rep. 1, A-14 or Res. 319, I-12).

AMA policy is recorded in the following categories, and any particular policy is recorded in only a single category.

5.000 Abortion	10.000 Accident Prevention/Unintentional Injuries
15.000 Accident Prevention: Motor Vehicles	20.000 Acquired Immunodeficiency Syndrome
25.000 Aging	30.000 Alcohol and Alcoholism
35.000 Allied Health Professions	40.000 Armed Forces
45.000 Aviation Medicine	50.000 Blood
55.000 Cancer	60.000 Children and Youth
65.000 Civil and Human Rights	70.000 Coding and Nomenclature
75.000 Contraception	80.000 Crime
85.000 Death and Vital Records	90.000 Disabled
95.000 Drug Abuse	100.000 Drugs
105.000 Drugs: Advertising	110.000 Drugs: Cost
115.000 Drugs: Labeling and Packaging	120.000 Drugs: Prescribing and Dispensing
125.000 Drugs: Substitution	130.000 Emergency Medical Services
135.000 Environmental Health	140.000 Ethics
145.000 Firearms: Safety and Regulation	150.000 Foods and Nutrition

155.000 Health Care Costs	160.000 Health Care Delivery
165.000 Health Care/System Reform	170.000 Health Education
175.000 Health Fraud	180.000 Health Insurance
185.000 Health Insurance: Benefits and Coverage	190.000 Health Insurance: Claim Forms and Claims Processing
195.000 Health Maintenance Organizations	200.000 Health Workforce
205.000 Health Planning	210.000 Home Health Services
215.000 Hospitals	220.000 Hospitals: Accreditation Standards
225.000 Hospitals: Medical Staff	230.000 Hospitals: Medical Staff - Credentialing and Privileges
235.000 Hospitals: Medical Staff - Organization	240.000 Hospitals: Reimbursement
245.000 Infant Health	250.000 International Health
255.000 International Medical Graduates	260.000 Laboratories
265.000 Legal Medicine	270.000 Legislation and Regulation
275.000 Licensure and Discipline	280.000 Long-Term Care
285.000 Managed Care	290.000 Medicaid and State Children's Health Insurance Programs
295.000 Medical Education	300.000 Medical Education: Continuing
305.000 Medical Education: Financing and Support	310.000 Medical Education: Graduate
315.000 Medical Records and Patient Privacy	320.000 Medical Review
330.000 Medicare	335.000 Medicare: Carrier Review
340.000 Medicare: PRO	345.000 Mental Health
350.000 Minorities	355.000 National Practitioner Data Bank
360.000 Nurses and Nursing	365.000 Occupational Health
370.000 Organ Donation and Transplantation	373.000 Patients
375.000 Peer Review	380.000 Physician Fees
383.000 Physician Negotiation	385.000 Physician Payment
390.000 Physician Payment: Medicare	400.000 Physician Payment: Medicare - RBRVS
405.000 Physicians	406.000 Physician-Specific Health Care Data
410.000 Practice Parameters	415.000 Preferred Provider Arrangements
420.000 Pregnancy and Childbirth	425.000 Preventive Medicine
430.000 Prisons	435.000 Professional Liability
440.000 Public Health	445.000 Public Relations
450.000 Quality of Care	455.000 Radiation and Radiology
460.000 Research	465.000 Rural Health
470.000 Sports and Physical Fitness	475.000 Surgery
478.000 Technology - Computer	480.000 Technology - Medical
485.000 Television	490.000 Tobacco Use, Prevention and Cessation
495.000 Tobacco Products	500.000 Tobacco: AMA Corporate Policies and Activities
505.000 Tobacco: Federal and International Policies	510.000 Veterans Medical Care
515.000 Violence and Abuse	520.000 War
525.000 Women	600.000 Governance: AMA House of Delegates
605.000 Governance: AMA Board of Trustees and Officers	610.000 Governance: Nominations, Elections, and Appointments
615.000 Governance: AMA Councils, Sections, and Committees	620.000 Governance: Federation of Medicine
625.000 Governance: Strategic Planning	630.000 Governance: AMA Administration and Programs
635.000 Governance: Membership	640.000 Governance: Advocacy and Political Action

REPORT OF THE COUNCIL ON SCIENCE AND PUBLIC HEALTH

CSAPH Report 6-A-25

Subject: Fragrance Regulation (Resolution 501-A-24)

Presented by: John T. Carlo, MD, MS, Chair

Referred to: Reference Committee D

INTRODUCTION

Resolution 501-I-24, "Fragrance Regulations" was referred by the House of Delegates. This resolution asked that our AMA: (1) recognize fragrance sensitivity as a disability; (2) encourage fragrance-free policies in hospitals, outpatient clinics, urgent cares, and other patient care areas inclusive of medical schools; (3) advocate for governmental regulatory bodies to recommend fragrance-free policies; (4) work with relevant parties to support the appropriate labeling of fragrance-containing personal care products, cosmetics, and drugs; and (5) support increased identification of hazardous chemicals in fragrance compounds, as well as research focused on fragrance sensitivity.

METHODS

English language reports were selected from searches of PubMed and Google Scholar databases using the search terms: "fragrance sensitivity," "fragrance-free policies" AND "fragrance regulations." Additional articles were identified by manual review of the reference lists of pertinent publications. There was also a review of state and federal regulations on fragrance regulations as well as case law on fragrance sensitivity, multiple chemical sensitivity, and disability. Web sites managed by federal agencies and applicable professional and advocacy organizations were also reviewed for relevant information.

BACKGROUND

Humans are exposed to thousands of chemicals in complex and dynamic mixtures everyday through fragrance materials that are pervasive in personal care and household cleaning consumer products.[1–6] Although fragrance materials must be generally regarded as safe for the intended use and dose, the ubiquity of exposure coupled with the limited transparency about the chemical constituents and reports of adverse health impacts after exposure raises the concerns about: 1) the harmful effects of fragrance chemicals on the skin including allergic contact dermatitis, phototoxicity, and photoallergy; (2) toxic effects (e.g., cancer, endocrine disruption, respiratory, immune, cardiovascular, neurological, reproductive, and developmental harm, etc.) that might arise through transdermal absorption, inhalation, or ingestion of fragrance chemicals; and (3) environmental consequences of fragrance chemicals on waste water and air quality.[4,7]

DISCUSSION

What is fragrance sensitivity?

Multiple names have been used to describe sensitivity to fragrances, chemicals, and the environment more broadly including: multiple chemical sensitivity (MCS), idiopathic environmental intolerance (IEI), environmental illness (IE), chemical intolerance (CI), chemical sensitivity (CS), toxicant-induced loss of tolerance (TILT), and fragrance sensitivity (FS).[8–16] The specifics of each condition vary, but they share two key elements: (1) environmental exposure at relatively low doses (e.g., below thresholds of harm for the average person) and (2) consequent recurrent symptoms that affect multiple and variable organ systems.

Conceptually, FS is the most narrowly defined, with a focus on fragranced chemicals.[16] MCS, CS, CI, and TILT are more expansive as they focus on chemicals which may or may not to be expressly fragranced. Finally, IEI and IE are the broadest definitions acknowledging any potential environmental exposure (e.g. fragrances, chemicals, electromagnetic forces, and radio signals). Additionally, while some researchers maintain that MCS, CS, and CI are really the same disorder, others suggest MCS is a more severe form of CI, and still others suggest that TILT is a two-stage disease mechanism (e.g., initiation and trigger), which can be used to explain and unite MCS, CS, CI, IEI, and IE.[14,17,18] There is still no consensus regarding naming; however, some researchers suggest that CI and TILT are being used with greater frequency now and that MCS, EI, and IEI are descriptive phases of the constellation of allergy-like symptoms, rather than distinct diseases.[14] Arguably, this naming inconsistency is indicative of the lack of consensus in the field, which ironically facilitates further uncertainty. For the purposes of this report, fragrance sensitivity is used as an umbrella term; however, when citing specific studies, deference is given to the language of the authors.

Diagnostic Criteria

One of the most important problems when diagnosing fragrance sensitivity is the variability of symptoms, the lack of symptomatic patterns in relation to frequency, sex or age of onset, and the breadth of distinct, but very similar conditions with similar and overlapping diagnostic criteria.[19] Despite over 50 years of research on the topic, including advances in understanding potential underlying mechanisms, there is also no single biomarker or test that can be used to definitively diagnose fragrance sensitivity.[15,20–23] The most frequently referenced diagnostic method for this disease is the QEESI (Quick Environmental Exposure and Sensitivity Inventory).[19,24–29] The instrument has four scales: Symptom Severity, Chemical Intolerances, Other Intolerances, and Life Impact. Each scale contains 10 items which are scored from 0 = “not a problem” to 10 = “severe or disabling problem.”[30]

Prevalence of Fragrance Sensitivity

Extensive self-reported data suggests exposure to fragrances and chemicals is associated with a variety of adverse health impacts including respiratory, eye, and skin irritation, mucosal symptoms, headaches and migraine, asthma exacerbation, and respiratory, cardiovascular, neurological, gastrointestinal, musculoskeletal, immune, and endocrine issues.[16,19,31–42] However, estimates of fragrance sensitivity prevalence vary. This is likely a product of: (1) the lack of consensus on what condition is being assessed (e.g., MCS, IEI, TILT, CI, CS, and FS); (2) variable study methods (e.g., reliance on self-report symptoms vs evidence of formal diagnosis); (3) environmental exposure variations based on socioeconomic, cultural, and societal differences; and (4) potential prevalence changes over time.

One international study comprised of nationally representative self-report surveys conducted between 2016 and 2017 in the U.S., Australia, the UK, and Sweden found that 34.7 percent, 33.0 percent, 28.7 percent, and 33.1 percent of the population, respectively, reported at least one adverse health effects from exposure to fragranced products.[32,37,39] The same survey found that across these four countries 19.9 percent of the population report chemical sensitivity, 7.4 percent report medically diagnosed MCS, 21.2 percent report chemical sensitivity and/or medically diagnosed MCS, and 32.2 percent report fragrance sensitivity.[37,39] These findings are emblematic of the overall variability of prevalence data due to uncertainty around disease definition (e.g. MCS, CS, CI, TILT, IEI, IE, and FS) and use of different methods (self-report of symptoms vs. diagnosis). For example, other self-report studies published between 1998 and 2015 in the U.S., Canada, Germany, Sweden, Finland, Australia, Korea and Japan found chemical intolerance prevalence estimates of 9–16 percent with lower rates of 0.5–3.9 percent reported for doctor-diagnosed MCS.[1,43–52] Additionally, it is possible some of the variability is a result of increases over time. Nationally representative U.S. population surveys conducted between 2002-2003, 2005-2006, and 2016-2017, by the same researchers who performed the study of international prevalence, found that self-reported chemical sensitivity and medically diagnosed MCS may have increased by more than 200 percent and 300 percent respectively, with chemical sensitivity prevalence increasing from (11.1-11.6 percent) to 26 percent and medically diagnosed MCS increasing from (2.5-3.9 percent) to 13 percent.[1,14,16,37,39,40]

There are also several demographic differences. Women are more likely to report fragrance sensitivity and chemical intolerance as are middle-aged individuals, and those who renovated their home in the past seven years.[13,19,27,42,53–57] There also appear to be high rates of self-reported CI and FS among individuals with asthma/asthma-like conditions and autism/autism spectrum disorder.[33,37,39,58] Finally, the evidence regarding socioeconomic status is mixed. A cross-sectional study of Danish adults showed increased risk of MCS among individuals with lower socioeconomic and subjective social status.[53] Other studies appear to suggest that on average individuals with MCS tend to be well-educated, of higher socioeconomic status, and middle aged.[42]

Sources of Fragrance Exposure

Fragrances are complex mixtures of organic chemicals – solvents, fixatives, essential oils, stabilizers, and preservatives – nearly all of which are either aromatic volatile organic compounds (VOCs) (e.g., ester, aldehydes, and alcohols) like limonene, alpha-pinene, beta-pinene, ethanol, acetone, and acetaldehyde that produce aromas, or semi-volatile organic compounds (SVOCs) like phthalates and parabens.[41,59,60] The complex and variable nature of fragrance means that the fragrance industry uses more than 3,000 chemical substances, both synthetic and naturally occurring, in personal care and other consumer products - a single perfume or fragrance may contain up to 300 different molecules.[4,31,41]

Most people are exposed to fragrance ingredients daily from personal care (e.g., perfumes, lotions, shampoos, bar soaps), air care (e.g., candles, environment fresheners), fabric care (e.g., detergents, fabric softeners), and home care products (kitchen, bathroom, and other household cleaners).[61,62] Scented products represent 89 percent of laundry, 79 percent of surface cleaning, and 99 percent of dish washing product sales in the U.S. and mouthwashes, toothpastes, soaps, and shampoos are the most frequently used scented products.[61,63,64] Fragrance exposures occur via direct contact, skin absorption, inhalation, and ingestion and once inside the body, the materials can impact any organ or system.[41,65]

Hazardous chemicals in consumer goods

There are more than 80,000 chemicals in thousands of regularly used consumer products and hazardous chemicals are commonly found in consumer products in the U.S.[36,66,67] One study used quantitative high throughput exposure assessment to evaluate the chemical content in common household products and found substantial risks associated with paints, paint strippers, pesticides, leave-on personal care products, and cleaning products.[67] Additionally, many of the ingredients commonly found in consumer goods are associated with asthma exacerbation, endocrine disruption, reproductive and developmental harm, cancer, immune system issues, nervous system damage, and headaches.[36,59]

Hazardous chemicals in fragranced consumer goods

Multiple studies have found evidence of endocrine disrupting chemicals (e.g., parabens and phthalates, bisphenol A), triclosan, and VOCs (e.g., ethanolamines, alkylphenols, fragrances, glycol ethers, cyclosiloxanes) in fragranced cleaners, synthetic detergents, fabric softeners, air fresheners, sunscreen, and deodorants for preservative properties.[34,68–80] Studies also suggest fragrance products have a higher concentration of these chemicals compared to non-fragranced products and that these chemicals are the most important contaminants in perfumes and colognes.[34,59] Furthermore, more frequent use of personal care products was associated with higher urinary concentrations of parabens.[68,72–74,77–80] Finally, exposures happen despite existing regulations and many detected chemicals were not listed on product labels.[34]

Social, cultural, and socioeconomic impacts on exposure

As noted earlier, social, cultural, and socioeconomic differences facilitate wildly disparate exposures and consequently risk from these exposures are not equally distributed.[36] Multiple studies have demonstrated that women have higher exposure to scented products than men, which may be driven by sociocultural forces that influence women to use more cosmetic, personal care, and cleaning products than men.[31,36,64,81,82] There is also some evidence of age differences, with individuals aged 40 years and older showing a significant lower exposure to scented products.[64] Additionally, individuals in The Netherlands and Germany had higher levels of exposure to scented products than individuals in Sweden.[64] Finally, there is evidence that products with more toxic ingredients are often marketed to marginalized communities, including racial minorities and low-income populations.[35,4036,83]

Workplace environments also impact exposure. Custodial professionals may use general-purpose cleaners, degreasers, detergents, and other household products more frequently than others.[36,41] Similarly, individuals working in the cosmetics industry including beauticians, nail and hair salon professionals, and aromatherapists are likely exposed to VOCs emitted from shampoos, styling products, lotions, nail products, cosmetics, and sanitizers.[36,41] The same is true for home and automobile maintenance and repair professionals who experience cumulative exposure to heavy-duty cleaners, degreasers, adhesives, lubricants, sealants, caulks, and paint strippers.[36] The highest intensity of VOC exposures in the workplace is expected during the use of floor strippers and general-purpose cleaners because they contain the highest concentrations of VOCs in the bulk.[84] Finally, there is some evidence of increased risk of fragrance allergy among individuals in professions with high workplace VOC exposure.[41,85,86]

A historical perspective on fragrance exposure

A brief look at history provides helpful context regarding the increased prevalence of exposures over time. MCS was first described in the 1950s, around the same time as the post-WWII expansion of the petrochemical industry including widespread production of organophosphate pesticides, solvents, dyes, and fragrances.[8,14] Sick building syndrome was first described in the 1970s, with MCS, IEI, and EI entering the popular press shortly thereafter to describe the myriad of symptoms reported internationally from exposures like: (1) employment in the U.S. Environmental Protection Agency (EPA) headquarters during renovation in 1987; (2) participation in the Gulf War in the 1990s; and (3) the World Trade Center tragedy.[14] By 1994, U.S. synthetic organics production reached over 460 billion pounds per year.[14] Moreover, as VOCs were becoming increasingly prevalent, people transitioned to spending more time indoors and building envelopes of homes and workplaces became better sealed to improve energy efficiency resulting in less fresh air circulation.[1,87,88] Consequently, indoor air quality is often worse than outdoor air quality with VOC concentrations approximately four times higher inside compared to outside.[88] Notably, mixed VOCs and SVOCs, followed by pesticides and combustion products were most prevalent across CI, MCS, and TILT initiation events.[1,14]

HEALTH, ENVIRONMENTAL, AND SOCIOECONOMIC IMPACTS

Self-report evidence suggests exposure to fragrances and chemicals are associated with a variety of adverse health impacts including skin irritation, mucosal symptoms, headaches and migraines, asthma exacerbation, and respiratory, cardiovascular, neurological, gastrointestinal, musculoskeletal, immune, cognitive and neurological issues (see Table 1).[16,16,19,31–40,42,89–96] Yet, understanding the potential health, environmental, and socioeconomic impacts of exposure to fragrances is extremely difficult because of the complexity of exposures, methodological limitations, and significant comorbidities and overlapping conditions. Currently, the strength of the evidence varies depending on the symptoms and organ system impacted.

Skin irritation and contact allergies

There is strong evidence that exposure to fragrances can cause skin irritation, contact dermatitis, contact urticaria, photosensitivity, phototoxicity, and photoallergy.[4,31,41,61,65,97–101] The prevalence of fragrance allergy appears to range between 1 and 9 percent depending on the population and the allergen test used.[41,97,98,102] In one meta-analysis, an estimated 4.5 percent of the general adult population was estimated to be allergic to fragrance materials (e.g., fragrance mix 1), and 1.9 percent has clinically relevant fragrance contact allergies.[41,103] Another systematic review found that the overall prevalence of sensitization to fragrance mix I (FM I) was 6.81 percent and FM II was 3.64 percent and among pediatric dermatitis patients, sensitization prevalence for FM I and FM II was 4.09 percent and 2.17 percent.[98]

The strong, consistent evidence of contact allergy associated with fragrances is not surprising considering more than 150 fragrance ingredients used in personal care and household cleaning products are known to cause contact allergies.[41,97,104] Nevertheless, neither the U.S. nor the European Union requires disclosure for all 150 known allergens. In the U.S., the Food and Drug Administration (FDA) has identified fragrance allergies, but has not yet published the list of allergens that must be included on labels, despite the original proposed June 2024 release date.[105–108] In contrast, the European Union recently updated the list of fragrance allergies required on labels from 26 products to 82.[102] There is also evidence that endocrine disrupting chemicals, many of which are found in fragranced products, may cause skin sensitization and allergic responses.[75,76]

Comorbid conditions, overlapping symptoms, and shared triggers

An important factor that complicates the ability to understand the health impacts of fragrance exposure is that there are numerous comorbid conditions (e.g., fibromyalgia, Sjogren's, autism, chronic fatigue, asthma, and migraine) with overlapping symptoms (e.g., fatigue, nausea, headache, etc.), and shared triggers.[1,1,8,13,31,42,59,109–115]
For instance, there are conditions like migraine that have osmophobia, sensitivity to odor, as a symptom, as well as exposure to fragrance as a trigger.[31,35,60,60,91,114,115] Specifically, there is evidence from retrospective comparison and cross-sectional studies of migraine patients that fragrances trigger migraine at high rates (70 percent and 90.2 percent), with perfume being the most common trigger (95.1 percent), followed by cleaning products (81.3 percent), cigarette smoke (71.5 percent), and motor vehicle exhaust (70.5 percent).[113–115]

Similarly, fragrance and fragranced consumer products have been linked to asthma, asthma exacerbation, and respiratory reactions in the respiratory tract that range from acute temporary upper airway irritation to obstructive lung disease.[16,31,34,39,54,61,65,97,116] As noted earlier, patients with asthma report that fragrances, in particular perfumes (56 percent), air fresheners (32 percent), and scented detergent (28 percent), can worsen their asthma symptoms.[31,117]

There is also some evidence that MCS patients often have comorbid autoimmune diseases (e.g., Hashimoto's thyroiditis, systemic lupus erythematosus (SLE), Sjogren's syndrome).[8,118] Similarly, autoimmunity may be linked to postural tachycardia syndrome (POTS) and myalgic encephalomyelitis/chronic fatigue syndrome (ME/CFS), which are associated with IEI and SBS.[119] One study found close correspondence between symptom patterns for mast cell activation syndrome (MCAS) and TILT such that as the likelihood of patients having CI increases, so did the likelihood of having MCAS.[120] This suggests that mast cell sensitization could be an underlying cause for both TILT and MCAS.[121,122]

Finally, there are extensive studies showing an association between mental illness and MCS, CI, CS, and FS.[9,13,15,42,123–131] Some research suggests that roughly half of MCS subjects meet the criteria for at least one mental health condition in their lifetime as well as significantly higher rates of depression and anxiety.[13,17] Additionally, one study found that 68 percent of the chemically intolerant women surveyed reported a past diagnosis of depression, anxiety, or panic disorder, which was significantly higher than those without chemical intolerance.[13,17,132] Likewise, a cross-sectional study of the association between MCS and mental illness among Canadian adults also found that individuals with MCS were more likely to have major depressive disorder, generalized anxiety disorder, major depressive disorder and generalized anxiety disorder, severe distress, and languishing/moderate mental wellbeing.[13]

Although the evidence on comorbidities, overlapping symptoms, and shared triggers does not provide much additional clarity on fragrance sensitivity, it does shed light on potential mechanism (e.g., inflammatory sensitization, immune dysfunction), illustrate some of the challenges in studying and understanding complex conditions like fragrance sensitivity, and highlight the value of efforts to reduce exposure to fragrances – as it may improve the health and well-being of individuals with shared triggers and comorbid conditions.

Epidemiological evidence of health impacts

Fragranced products often contain endocrine disruptors, carcinogens, and other toxic materials; however, the evidence connecting exposure to these materials in consumer and personal products to health impacts is limited and often weak or attenuated. There is limited evidence suggesting the ingredients in fragranced household products are associated with increased cancer risk as sixty percent of the chemical combinations in household products have hazard quotients exceeding 1, and 9 percent have lifetime cancer risks exceeding 10.[4,67] Similarly, there are epidemiological associations between MCS and tachycardia, arrhythmia, a mitral valve prolapses and electrocardiogram abnormalities.[8,133–135] Finally, there is some epidemiological evidence that MCS is associated with endocrinological disorders (i.e., hyposurrenalism, dysthyroidism and hyperprolactinemia).[8,136–139] Similarly, endocrine disrupting chemicals (EDCs), which are often found in fragranced products, may have synergistic endocrine disruption.[75,76] However, aside from the evidence that synthetic musks have been shown to have estrogenic effects, the evidence connecting EDCs in fragranced personal care and household cleaning products to endocrine disorders and disruption is weak.[34,140–142] However, in each of these examples the evidence is weak and attenuated.

Environmental Impacts

In addition to the multiple direct and immediate health risks associated with exposure to fragrances, there are also environmental impacts. One study found that fragrance substances are continuously discharged in large amounts into the environment, especially via wastewater.[143] Furthermore, fragrances and in particular musks are ubiquitous, persistent, bioaccumulative pollutants that can be highly toxic.[35,143] Yet, evaluating the overall impact is difficult because data on persistence, bioconcentration, and aquatic toxicity is only available for ~0.2 percent, one percent, and 11 percent respectively of chemicals registered in the European Union.[144–148] There is also concern that because many fragrance compounds are identical to those which are signal substances of environmental organisms at very low concentrations it is potentially impacting the ecosystem balance.[143,145,146] Additionally, fragrance VOCs and SVOCs contribute to air pollution and decrease air quality.[35,65]

Social and economic impacts

There is strong self-reported evidence that people with fragrance sensitivities report avoiding certain places because of potential exposure.[32,33,91,111,149]Specifically, individuals who experienced chemicals triggering adverse physical symptoms avoided social and occupational settings because of widespread use of chemicals.[149] Similarly, there is self-reported evidence suggesting that exposure to fragrances results in stigma, missed work, loss of income, and occasionally loss of employment.[111,149] One study found that those with fragrance sensitivity reported missing 7.4 workdays on average due to illness from fragranced product exposure in the workplace.[32] Moreover, one study found that of the individuals surveyed with a hypersensitivity to fragrance, 13.5 percent (1.8 percent of the entire sample) reported losing their jobs because of their hypersensitivity.[111]

PATHOPHYSIOLOGICAL THEORIES OF FRAGRANCE SENSITIVITY

Fragrance sensitivity is a complex condition and despite decades of research there is no consensus around a unified theory of fragrance sensitivity pathophysiology. However, there are multiple rationally grounded hypotheses about the underlying mechanisms of fragrance sensitivity (e.g., neural sensitization/hyperresponsivity/central sensitization, limbic system dysfunction, neurogenic inflammation, immune system dysregulation, and psychological theories) as well as cross-cutting themes and common ground for many of these theories (e.g., the importance of genetic and immune factors, altered metabolic capacity, and oxidative stress). [1,8,12,14,15,17,42,109,110,112,121,150,151]

Neurogenic Inflammation

Neurogenic inflammation is a type of inflammation that is triggered by the activation of sensory neurons. Under the neurogenic inflammation hypothesis, fragrances trigger the responses of unmyelinated c-fiber neurons in the respiratory mucosa, leading to central nervous system (CNS) inflammation, and eventually symptoms like headache or tachycardia.[42,152–158]

Limbic system dysregulation and neural sensitization

Limbic system dysregulation and neural sensitization are parallel processes that involve acquired hyper-responsiveness manifested in several body systems. Limbic system dysfunction hypothesis focuses on hyper-responsiveness in the limbic system. Specifically, recurrent low-level intermittent exposure to chemicals, could produce something similar to kindling, where an increased electrical response in the brain following repeated low-level electrical stimulations of limbic structures can permanently lower the seizure threshold.[42,150,159–164] Neural sensitization, sometimes referred to as hyperresponsivity or central sensitization, also involves increased responsiveness of neurons, but with a focus on non-limbic areas in the CNS. For instance, with neural sensitization increased EEG activity and changes in skin conductance occurred after repeated intermittent exposures to chemicals in chemically sensitive women compared to normal controls.[42,137,165,166] There is some evidence of both sensitization events and clear cellular-level impacts from fragrance and chemical exposure in the central and peripheral nervous and immune systems.[1,14,167] This is grounded in the notion that the olfactory nerve acts as a vector for neurotoxic agents to be transported into the central nervous system bypassing the blood brain barrier.[150,159] Neuroimaging studies support the idea that the development of MCS may be attributed to neural sensitization.[1,153,168–173] [150,173]

Immune dysregulation

Allergic response and immune system dysregulation is another proposed etiological mechanism to explain fragrance sensitivity.[8,112,119,121,150,174] Some researchers theorize that mast cell degranulation and mediator release, caused by indoor air contaminants (e.g., volatile organic chemicals outgassing from new construction and remodeling materials, pesticides, mold, disinfectants, and cleaning agents) at extremely high levels, could provide an explanation for the myriad illnesses and symptoms associated with MCS, TILT, and IEI as well as the comorbid and often overlapping conditions (e.g., fibromyalgia, chronic fatigue, depression, asthma, eczema, and neurodivergence).[120–122,175–177] One study demonstrated that individuals with MCS displayed a distinct systemic immune mediator profile suggestive of low-grade systemic inflammation, as plasma levels of interleukin-1β, -2, -4, and -6 were significantly increased in the MCS group compared with controls.[112]

Psychogenic theory

The psychogenic theory of MCS hypothesizes that MCS patients, who often have high levels of depression, anxiety, and mental distress, have a greater sensitization towards environmental stimuli, which they then focus their attention on to explain their psychological symptoms.[9,13,15,26,42,95,123–129,131,178–180] This is further complicated by the fact that some psychiatric disorders (e.g., panic disorder, and PTSD) share many of the same symptoms or features of MCS.

Other common factors to consider

Although not expressly tied to a given pathophysiological theory, there is also consistent evidence of the importance of genetic and immune factors, altered metabolic capacity, and oxidative stress. For instance, the clinical manifestations of MCS may be associated with a variety of genetic polymorphism many of which result in alterations in metabolic capacity.[19,181 8,18,23,109,150,182–186] There is also some evidence suggesting these polymorphisms could increase oxidative stress.[8,15,17,18,183,186–188] Therefore, it is possible that gene expression is epigenetically modulated by exposure, leading to potential hypersensitivity and MCS.[8,182–186]

LEGISLATIVE AND REGULATORY LANDSCAPE

Federal Legislation and Administrative Oversight

Historically there have been few regulations regarding fragrances and a patchwork of federal agencies that have authority over different products with fragrances. The FDA has the authority to regulate the safety of food, drugs, medical devices, and cosmetics. Additionally, The Fair Packaging and Labeling Act (FPLA or Act) directs the Federal Trade Commission (FTC) and the FDA to issue regulations requiring that all "consumer commodities" be labeled to disclose net contents, identity of commodity, and name and place of business of the product's manufacturer, packer, or distributor.[189] In the U.S., most cleaning products are regulated by the Consumer Product Safety Commission, which does not require full fragrance ingredients or even the presence of fragrances on either the product label or the material safety data sheet (MSDS).[65] Personal care products are regulated by the FDA, which requires ingredients on the product label, but not on the MSDS. Notably, the FDA does not require companies to disclose “trade secrets,” of which fragrance formulas are likely to be. Consequently, fragrance ingredients were simply listed as “fragrance,” rather than disclosed on an individual basis.[7,190,191] In short, the FDA required finished cosmetic products to be safe when used by customers in accordance with product labeling or customary usage and to not be misbranded or adulterated while the FPLA required cosmetics marketed on a retail basis to consumers in interstate commerce to be honestly and informatively labeled.[65,190] Together the FDCA and FPLA were the primary pieces of federal legislation governing fragrance chemicals in personal care products, cosmetics, and consumer goods until the Modernization of Cosmetics Regulation Act of 2022 (MoCRA) was passed.

The goal of MoCRA was to expand the FDA’s authority to regulate cosmetics. Specifically, the new powers provided to the FDA under MoCRA include: (1) expanded adverse event reporting and transparency; (2) recall authority; (3) requiring manufacturers and processors to register with the FDA; (4) good manufacturing processes (GMP); (5) expanded labeling requirements (e.g., contact for adverse event reporting and disclosure of fragrance allergens); (6) maintenance records supporting safety substantiation; (7) screening Talc-containing products for asbestos; and (8) assessment of per- and polyfluoroalkyl substances (PFAS) safety in personal care products (e.g., summary report in collaboration with National Center for Toxicological Research) issued within

three years.[190,192,193] Many of the new requirements became effective on December 29, 2023, but FDA delayed enforcement until July 1, 2024.[194,195]

Despite the improvements brought by MoCRA, there are still clear gaps and areas of improvement. First, although the new label requirements include the disclosure of fragrance allergens, which is a step in the right direction, as of the writing of this report, the FDA has not published a list of fragrance allergens. Additionally, fragrance ingredients that are not on the list of allergens may still be identified only as, "fragrance" to protect company trade secrets. Second, there are some exemptions under MoCRA. Specifically, certain small businesses (e.g., companies whose average gross annual sales of cosmetic products in the U.S. for the past three years is less than $1 million) are exempt from compliance with GMP, registration requirements, and adverse event record retention. However, the exemption does not apply to facilities that manufacture or process products that: (1) regularly come into contact with the mucus membrane of the eye; (2) are injected; (3) are intended for internal use; or (4) are intended to alter appearance for more than 24 hours.[194] MoCRA does preserve the authority of states to ban or regulate chemicals of concern in personal care products. Thus, the hard work of regulating specific ingredients now falls to the states.[193]

State Legislation

Currently, twenty states have passed laws limiting certain substances in cosmetics, including California, Colorado, Florida, Hawaii, Illinois, Iowa, Maryland, Minnesota, Montana, Mississippi, Nevada, New Jersey, New Mexico, New York, Ohio, Oregon, Vermont, Virginia, Washington and Wisconsin.[193] These states have stricter limits on some chemicals (e.g. 1,4-dioxane, cadmium, color additives, formaldehyde, mercury, parabens, PFAS, phthalates, methyl alcohol and methyl methacrylate) due to concerns about their potential health effects.[193]

California is a leader in consumer safeguards, specifically, regarding protection against harmful substances in personal care products, and therefore the best example of successful fragrance regulation at the state level. In 1986, the state passed Proposition 65, the Safe Cosmetics Act, which required manufacturers to reveal the presence of Proposition 65 chemicals. The Prop 65 list currently includes 624 carcinogens and 323 reproductive/developmental toxicants; however, it does not include other hazard endpoints, such as neurotoxicity, asthmagenicity, or endocrine disruption.[36,66] Then California passed the Professional Cosmetics Labeling Requirements Act, which mandated ingredient labels on professional salon products. Next, in 2020 the Toxic-Free Cosmetics Act banned 24 toxic chemicals sold in California and the Cosmetic Fragrance and Flavor Ingredient Right to Know Act was passed, requiring disclosure of fragrance mixture ingredients in personal care products. Finally, in 2022, California banned intentionally added PFAS chemicals from personal care products, effective on January 1, 2025.

Industry Self-Regulation

The final regulatory mechanism is industry self-regulation. The Research Institute for Fragrance Materials (RIFM) and the International Fragrance Association (IFRA) make up the international self-regulation system for the fragrance industry.[4] RIFM was formed as a member-supported nonprofit organization in 1966 and in 1967 RIFM established their Expert Panel for Fragrance Safety as an independent team of researchers and academics (e.g., dermatologists, pathologists, toxicologists, and environmental scientists) that review and approve all RIFM work. This includes the RIFM database which provides information (e.g., chemical features, safety assessment, genotoxicity, repeated dose and reproductive toxicity, skin sensitization, photoirritation and photoallergenicity, local respiratory toxicity, mutagenicity, carcinogenicity, metabolism and toxicokinetics, and environmental consequences) on 7,000 raw fragrance materials. However,

RIFM does not evaluate final fragrance formations and the database is only available to members.[4,65] IFRA was founded in 1973 and acts as the official representative body of the international fragrance industry. As such they represent the collective interests of the industry. The primary activity of IFRA is the publication of the list of usage standards for fragrance materials, based on the findings of RIFM. The most recent publication (the 51st Amendment) was implemented in January 2024 and updates are scheduled to occur every three years.[196] Ultimately, industry self-regulation is helpful, but labeling transparency and disclosure of all fragrance ingredients in consumer products may not be in their best interest.

Although the enactment of MoCRA and state legislation to either prohibit or provide notice of certain harmful ingredients in personal care and household cleaning consumer goods are actions that will likely help reduce exposure to potentially harmful chemicals and fragrances, other mechanisms may yield better results.

LEGAL LANDSCAPE AROUND FRAGRANCE SENSITIVITY AND DISABILITY

In the absence of more stringent state and federal legislation around fragrance regulation, the most likely tool to reduce exposure to fragrances for those who experience fragrance sensitivity is either: (1) exercising rights under the Americans with Disabilities Act (ADA) or (2) relying on organizations to pursue self-regulation and implementation of fragrance-free policies.[197]

ADA and third-party accommodations

Under the ADA, a disability means: (1) a physical or mental impairment that substantially limits one or more major life activities of such individual; (2) a record of such an impairment; or (3) being regarded as having such an impairment.[198]

The ADA uses the concept of reasonable accommodation to establish a form of positive rights. Specifically, the ADA affirmatively requires public and private entities to make reasonable modifications to physical environments, rules, and policies to make spaces accessible.[197] Generally, interpretation of what constitutes reasonable accommodation focuses on two parties, the individual seeking the accommodation to achieve equitable access and the employer or public/private actor who is being asked to engage in or refrain from certain behaviors. However, fragrance-free policies would require third-party accommodations, because other individuals using the shared space would also need to accommodate.[197] Third-party accommodation can be both passive behaviors (such as prohibiting peanuts in schools) as well as active behaviors (such as washing hands or wearing a mask).[197] In the case of fragrance-free policies, the accommodation would require multiple third parties to refrain from using certain fragranced products.

Often the criticism of third-party accommodations (and disability accommodations in general), is that they may be viewed as special rights that infringe on the rights of third parties. However, there are examples of successful third-party accommodation, starting with smoke-free policies that paved the way as both a disability accommodation as well as a general public health practice.[197,199] This provides hope for the potential success of other third-party accommodations.

Smoke-free policies as accommodations

Historically, courts have been sympathetic to claims of secondhand smoke-related disabilities and acknowledged employers should have granted reasonable accommodation such as prohibition of smoking on the job or inside the building.[197,200] Importantly, the standard courts have taken to evaluate the reasonableness of third-party accommodations, is whether the accommodation creates undue burden for others. For instance, smoke-free workplace policies and laws have been considered reasonable because they are inexpensive to implement and do not harm or burden businesses that have implemented them.[197,201]

Food allergy bans and mask requirements as accommodations

As with smoke-free policies, there has been evolution over the years with respect to accommodating food allergies and mask requirements – particularly in education, air travel, and the workplace. Section 504 is the primary statutory framework used to accommodate students with disabilities in schools and it has been used to accommodate students with food allergies and immune conditions.[197,202] Regarding food allergies, reasonable accommodations include allergen-free lunch tables, handwashing requirements, an allergen-free classroom, and self-carry epinephrine (EpiPen).[197,203] Although, there has been occasional resistance from parents of non-allergic kids, generally food bans as accommodations are well accepted and practiced with many schools banning nuts schoolwide.[197,199] In contrast, mask requirements in schools as a reasonable disability accommodation have had mixed results with circuit courts split.[197] One researcher theorizes that some courts are resistance to blanket mask requirement policies because they lack flexibility, applying mask requirements to everyone regardless of whether they come into contact with the student in need of accommodation. In contrast, a third-party accommodation argument and more importantly policy, which can be tailored to the specific needs of the individual being accommodated as well as the other parties, may be more successful in these circuits.[197]

Food allergies and self-regulation to avoid tort liability

The airline industry has shown similar successes regarding making planes safer for individuals with food allergies (specifically peanuts); however, it has taken the form of self-regulation. In the absence of federal or industry regulation banning peanuts, many airlines (but not all) decided to stop serving them to prevent potential tort liability.[197,204] Consequently, the current landscape theoretically gives consumers enough room to choose the safest airline for them. However, this sort of informal self-regulation, which is driven by the desire to avoid potential tort liability, has not been perfect – with reports of families being removed from planes when they raise questions regarding exposure or situations when the airline determines the severity of an allergy made it unsafe for them to fly.[197,205,206] In this way, the airline industry provides a cautionary example for informal self-regulation as opposed to formal regulation.

Third-party accommodations and fragrance sensitivity?

Smoke-free policies, mask requirements, and bans on food allergens provide a potential roadmap for fragrance sensitivity. Moreover, in many ways the current situation with fragrance sensitivity mirrors what was going on with food allergies 70 years ago. People with fragrance sensitivity experience symptoms when exposed to fragrances, but there is not a proven biological mechanism

or clear clinical biomarker. Likewise, prior to the discovery of immunoglobulin E (IgE) as an indicator allergy in the mid-1960s, food allergy was considered a controversial condition.[197,207] This is particularly interesting as successful ADA and Section 504 challenges for food allergy accommodations helped normalize narrowly applied third-party accommodations such that more widespread nut bans in schools are now more well accepted. At the same time, to avoid liability, the airline industry has relied on self-regulation to give consumers choice. It is not yet clear whether fragrance-free policies will have a similar divide.

ADA cases involving fragrance sensitivity

Initial efforts of individuals with MCS to exercise their rights under the ADA were largely unsuccessful. A study of 17 early ADA cases involving MCS (between 1995 and 2003) found that motions for summary judgment by the defendant were granted or affirmed in 14 cases.[197,208] Similarly, a review of cases involving MCS prior to the 2008 Americans with Disabilities Act Amendments Act (ADAAA), which broadened the definition of disability, demonstrate that courts regularly questioned whether the plaintiffs were truthful about the presence or severity of their condition.[197,209] Moreover, in 2022, with the ADAAA in place for some time, the Eastern District Court of Virginia still excluded from evidence a medical diagnosis of the condition because it "lacked reliability and the medical community has not accepted MCS as a diagnosis."[197,210,211] This suggests courts are reticent to acknowledge MCS as a condition meriting accommodation.

Moreover, even in cases where courts acknowledge fragrance sensitivity as a disability meriting accommodation, there remains the question of whether fragrance-free policies are considered a reasonable accommodation that does not unduly burden third parties. For instance, the Minnesota District Court decided that fragrance-free policies "impose an undue financial and administrative burden on employers, because they are very difficult to enforce."[197,212] Similarly, when evaluating the reasonableness of a fragrance-free policy in a public school, the court determined that, "a public school could never be free from any objectionable smell or any deodorant, perfume, cologne, hand lotion, or cleaning products."[197,211] At the same time there have been some successful ADA cases involving MCS.[213–216] In short, while there is a pathway under the ADA to ensure accommodations for individuals with fragrance sensitivity, evidence suggests the court system may not be the best tool to achieve equity.

Self-regulation and implementation of fragrance-free policies

Fragrance-free policies, which often apply to both individuals and spaces, aim to make spaces more accessible for individuals with MCS, as well as those with other conditions with symptoms that may be triggered by fragrance.[217] For instance, efforts are taken to promote the use of fragrance-free cleaning products, and people coming into those spaces asked to avoid or limit wearing perfume, using fragranced laundry detergent/dryer sheets, applying personal care products that contain fragrances, or refrain from using fragranced products when in fragrance-free spaces.[217]

As illustrated above, some blanket fragrance-free policies have been struck down by courts. Consequently, it is important to consider what sorts of fragrance-free policies might be the most successful.

Where are fragrance-free policies being implemented?

Fragrance-free polices are gaining traction in workplaces and schools. Since 2009, the Centers for Disease Control (CDC) has encouraged employees to be as fragrance-free as possible.[218] The rational for the policy was to establish guidance and procedures to protect and maintain safe indoor environmental quality for all CDC employees at all CDC work areas. Importantly, the policy does not expressly prohibit individuals from using fragranced products, but it does prohibit carrying or using such products inside the CDC.[218] Therefore, it is a good example of a flexible policy. There have also been efforts to implement and advocate for fragrance free spaces and product options elsewhere by the CDC, the American Lung Association, the Job Accommodation Network (JAN), and the U.S. EPA.[218–221] Additionally, University of Illinois Chicago (UIC) and University of California Los Angelas both advocate and provide resources for implementing fragrance-free policies on their campuses and Portland was the first city to ban fragrance.[141,217,222,223] Importantly, Portland's ban, like CDC's policy, is flexible. It applies only to City of Portland employees who are asked, "to refrain from the use of personal scented products in the workplace where the sole purpose is to produce a scent, such as perfume, after shave, and cologne and to avoid the use of strongly scented personal hygiene products such as laundry soap, dryer sheets hand lotion, powder, hair spray, and deodorant."[223]

It is not clear if increased implementation of fragrance-free spaces is based predominantly on the strength of the scientific evidence, the precautionary principle, or the legal landscape regarding MCS as a disability. However, currently fragrance-free policies appear to be the most effective method for reducing exposure to fragrances, particularly when the policies are flexible, creative, and voluntary rather than focusing on strict bans.[224]

CURRENT AMA POLICY

Our AMA does not currently have any policy related to fragrance regulations or fragrance-free policies. However, policy H-440.855, "National Cosmetics Registry and Regulation," does support the creation of a publicly available registry of all cosmetics and their ingredients. Additionally, although it is not a formal policy the AMA does discuss the complex medical and legal nature of disability. For instance, HOD policy supports the designation of alcohol use disorder as a disability and opposes the classification of obesity as a disability.

CONCLUSION

Fragrance sensitivity is a controversial, unexplained, and complex disorder. There is extensive self-report evidence suggesting that fragrance sensitivity is a serious problem for a significant portion of the population. Yet, the heterogeneity of symptoms and exposures coupled with the sheer volume of ingredients in fragranced products (and consumer products more broadly) makes understanding the relationship between fragrance exposure and health impacts extremely difficult. Most of the evidence, which varies wildly in quality, falls into three categories: (1) self-report of exposure to fragrance followed by a constellation of symptoms; (2) toxicological and epidemiological associations between chemicals found in fragranced products and potential risk of harm; and (3) analysis of potential mechanisms in individuals with a diagnosis of fragrance sensitivity. It is possible to connect the evidence to form a compelling narrative of how exposure to harmful chemicals from personal care and household cleaning products causes serious adverse health effects through several plausible mechanisms. However, the throughline between these categories of research is often attenuated, weak, or based on limited data.

This clearly illustrates the need for more research on fragrance sensitivity (e.g., diagnostic tools, mechanisms, health impacts, impacts of fragrance on other diseases, and fragrance-free interventions). Although more research is needed, inaction means that those with fragrance sensitivity will continue to be misdiagnosed, offered health care solutions with limited or no effect, or be met with mistrust and doubt. Furthermore, efforts to reduce exposure to fragrances and other chemicals will likely benefit individuals with fragrance sensitivity, as well as those with comorbidities and shared triggers that are also negatively impacted by exposure to fragrances. Therefore, it is worth pursuing efforts to reduce exposure.

It is unlikely that either federal regulation or industry self-regulation will bring significant changes or improvements regarding labeling transparency or ingredient bans, but some states have been making promising progress in these areas suggesting this may be an area worth more focus. Likewise, there is a viable mechanism for accommodation under the ADA, though decisions are mixed. Instead, the most effective approach has been self-regulation in the form of implementation of fragrance-free policies. Notably the most successful fragrance-free policies and third-party accommodations appear to be those that afford flexibility and creativity rather than blanket bans.

RECOMMENDATIONS

The Council on Science and Public Health recommends that the following be adopted, and the remainder of the report be filed.

Our American Medical Association:

(1) recognizes that some environmental exposures may have the potential to substantially limit major life activities of an individual with fragrance sensitivity and related disorders.

(2) encourages health care facilities, government agencies, and nonprofit organizations to adopt and promote fragrance-free policies that recommend individuals avoid or limit use of fragrances and support the use of fragrance-free products when feasible.

(3) encourages research on fragrance sensitivity to (a) improve diagnostic tools; (b) understand the impact of fragrances on other diseases; (c) evaluate the impact of fragrances on health; and (d) evaluate the impact of fragrance-free intervention.

(4) supports the identification of fragrance allergens and disclosure of fragrance ingredients as part of labeling of personal care products, cosmetics, and drugs. (New HOD Policy)

Fiscal Note: less than $1,000

Table 1. Variations is self-report symptom prevalence (%) across different populations and subgroups

	Steinemann*					Steinemann*	Steinemann*	Caress*	Fares-Medina*		Andresson**	Caress**	Hausteiner**	Borchein***	Klascha****		
	US	AU	UK	SE	AVG	US	US	US	ES-w	ES-m	nr	US	DE	nr	DE-FS	DE-Autists	DE-Asthmatics
Migraine headaches	15.7	10	8.4	16.1	12.6	8.4	15.7	7.2	19		66	88	58	33	25.1	22.4	12
Asthma attacks	8	7.6	6.8	5.5	7	6.8	8	4.7		29	59				16.9	20.4	13.8
Neurological problems (e.g., dizziness, seizures, head pain, fainting, loss of coordination)	7.2	4.5	3.7	5	5.1		7.2	3.2	10		22	7.2-46	22	19	27.4	30.6	11.1
Respiratory problems (e.g., difficulty breathing, coughing, shortness of breath)	18.6	16.7	11.6	20	16.7	11.6	18.6	9.5		47-60					55.3	30.6	24.4
Skin problems (e.g., rashes, hives, red skin, tingling skin, dermatitis)	10.6	9.5	9.8	6.5	9.1	9.8	10.6	5.7	15	1	30		19		32	34.7	16
Cognitive problems (e.g., difficulties thinking, concentrating, or remembering)	5.8	4.1	2.8	4.5	4.3	2.8	5.8		2-9		21-51	32	17-46	13-27	18.7	28.6	12.4
Mucosal symptoms (e.g., watery or red eyes, nasal congestion, sneezing)	16.2	14	9.2	13.5	13.2	9.2	16.2	7.6	42	2	22-65	59-77	11	12	35.6	28.6	14.2
Immune system problems (e.g., swollen lymph glands, fever, fatigue)	4	3.3	1.9	1.5	2.7	1.9	3.8					17.4			13.2	38.8	9.3
Gastrointestinal problems (e.g., nausea, bloating, cramping, diarrhea)	5.5	3.3	3	3.5	3.8	3	5.5		20	2	25-26		30	15	21.9	24.5	10.2
Cardiovascular problems (e.g., fast or irregular heartbeat, jitteriness, chest discomfort)	4.4	3	3.2	2.1	3.2	3.2	4.4		3		21-30	46-55	14-27	19-Dec	14.6	24.5	8
Musculoskeletal problems (e.g., muscle or joint pain, cramps, weakness)	3.8	2.6	2	1.5	2.5	2	1.7		17	2		30.4		19-21	9.6	24.5	6.7
Other	1.7	1.9	2.1	2.2	2		1.7					50.7			3.2		1.3

nr = not reported, AVG = average

**General popluation/nationally representative sample*

***Individuals with self reported chemical intolerance*

****Individuals with a diagnosis of MCS*

*****German subpopulations (FS = fragrance sensitive individuals, autists, and asthmatics)*

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