

Fragranced Consumer Products:

Sources of Emissions, Exposures, and Health Effects in the United Kingdom

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Emissions from Fragranced Consumer Products:

Sources of Emissions, Exposures, and Effects in the United Kingdom

Abstract

Common in society, fragranced consumer products such as cleaning supplies and air fresheners are a primary source of volatile emissions that contribute to pollutants indoors and to personal exposure. Further, fragranced products have been associated with adverse health effects. This study investigates the sources of emissions, human exposures, and health and societal impacts from fragranced consumer products in the United Kingdom (UK). It examines the prevalence and types of fragranced product use, associated health effects, exposure situations, awareness of product emissions, and preferences for fragrance-free policies and indoor environments. Using a nationally representative population sample (n=1,100), data were collected in June 2016 using an online survey of adults in the UK, comprising England, Wales, Northern Ireland, and Scotland. Across the UK population, 27.8% report health problems, such as migraine headaches (8.4%) and asthma attacks (6.8%), when exposed to fragranced products. Yet 99.3% of the population are exposed to fragranced products at least once a week. When given a choice, more people would prefer that workplaces, health care facilities and professionals, hotels, and airplanes were fragrance-free rather than fragranced. Although fragranced products, even ones called green and organic, can emit potentially hazardous yet undisclosed pollutants, 75.0% of the population were not aware of this, and more than half would stop using their product if they knew it emitted such pollutants. This study provides important evidence that the UK population is regularly exposed to fragranced products, that these exposures are associated with adverse and often serious health effects, and that the public is largely unaware of their potential exposures. While more research is needed, reducing exposure to fragranced products, such as through fragrance-free policies, can provide an immediate step to reduce health risks and improve air quality.

Keywords: fragranced consumer product, fragrance, fragrance-free policy, indoor air quality

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Introduction

"Fragranced consumer products" (or for brevity "fragranced products") are chemically formulated products with the addition of a fragrance or scent (Steinemann 2015), and include numerous everyday products such as air fresheners, cleaning supplies, soaps, lotions, hand sanitizers, laundry detergents, baby shampoo, household items, and cosmetics. Fragranced products are pervasive in society; used daily in homes, workplaces, schools, businesses, transportation, and other public and private buildings; and used by individuals, industries, and institutions (Steinemann 2009).

Fragranced consumer products emit a complex mixture of dozens of volatile organic compounds (VOCs), such as terpenes (e.g., limonene, alpha-pinene, beta-pinene), ethanol, acetone, and acetaldehyde (Steinemann 2015), which can dominate pollutants found indoors. A study of homes in the UK found "unexpectedly high" indoor concentrations of limonene and alpha-pinene (five-day average up to $1,439 \mu\text{g m}^{-3}$ and $229 \mu\text{g m}^{-3}$ respectively), which were also the most abundant compounds in 94% of the homes and related to fragranced product use (Wang et al. 2017). In addition, fragranced product emissions of terpenes can generate a range of secondary pollutants, which include acetaldehyde, formaldehyde, and secondary organic aerosols (e.g., Carslaw 2013; Nazaroff and Weschler 2004).

Fragranced products have been associated with adverse health effects including headaches and migraines (Steinemann 2016, 2017; Kelman 2004; Farrow et al. 2003), asthma and asthmatic reactions (Steinemann 2016, 2017; Weinberg et al. 2017), breathing difficulties (Caress and Steinemann 2009), mucosal symptoms (Elberling et al. 2005; Millqvist and Löwhagen, 1996), and contact dermatitis (Johansen 2003; Rastogi et al. 2007). In two other studies parallel to this one, nationally representative surveys in the USA (Steinemann 2016) and Australia (Steinemann 2017) found that 34.7% and 33.0% of the population

(respectively) reported one or more type of adverse health effects from exposure to fragranced products.

Emissions from fragranced consumer products are generally unknown and undisclosed to the public. Currently, no law in the UK, or in any other country, requires the disclosure of all ingredients in fragranced consumer products (Lunny et al. 2017). Protections on ingredient disclosure depend on the product. First, for cosmetics, the general term "fragrance" (or "parfum") can be listed on the label, rather than the specific and numerous ingredients in the added fragrance. Second, for other types of consumer products, such as air fresheners, laundry supplies, cleaning products, and household items, ingredients do not need to be fully listed on the product label, not even the general term "fragrance."

Emissions from fragranced products create risks for both voluntary exposure and involuntary exposure. In an analogy to secondhand smoke, "secondhand scents" (Steinemann 2016) refers to indirect exposure to others' use of fragranced products. As a response, fragrance-free policies (similar to smoke-free policies) have been implemented by businesses, agencies, and institutions in the UK and other countries (e.g., CDCP, 2009; CCOHS, 2015) to restrict the use of fragranced products within indoor environments such as workplaces, schools, hospitals, and public places.

This article reports results from a population-based study of the UK to investigate the sources of emissions, exposures, and effects from fragranced consumer products. New data on the extent of the problems point to opportunities to reduce the adverse effects by reducing exposure to these types of products.

Methods

Using a national random sample representative of age, gender, and region (n=1,100; confidence limit=95%, confidence interval=3%), an on-line survey was conducted of the adult UK population. The survey instrument was developed and tested over a two-year period before full implementation in June 2016. The survey drew upon participants from a large web-based UK panel (approximately 950,000 people) held by Survey Sampling International. Participant recruitment followed a randomized process as detailed in SSI (2016). All responses were anonymous. The survey response rate was 97%. The research study received ethics approval from the University of Melbourne. Demographic information is provided in Table 1. Details on the survey methodology, including the checklist for reporting results of internet e-surveys (CHERRIES, Eysenbach 2004), are provided in the Supplementary Material.

Survey questions investigated the following: use and exposure to fragranced products, both from one's own use and from others' use; health effects related to exposures to fragranced consumer products; specific exposure situations; impacts of fragranced product exposure in the workplace and in society; awareness of fragranced product ingredients and labelling; preferences for fragrance-free environments and policies; and demographic information.

Fragranced products were categorized as follows: (a) Air fresheners and deodorizers (e.g., sprays, solids, oils, disks); (b) Personal care products (e.g., soaps, hand sanitizer, lotions, deodorant, sunscreen, shampoos); (c) Cleaning supplies (e.g., all-purpose cleaners, disinfectants, and dishwashing soap); (d) Laundry products (e.g., detergents, fabric softeners, dryer sheets); (e) Household products (e.g., scented candles, toilet paper, trash bags, baby products); (f) Fragrance (e.g., perfume, cologne, after-shave); and (g) Other.

Health effects were categorized as follows: (a) Migraine headaches; (b) Asthma attacks; (c) Neurological problems (e.g., dizziness, seizures, head pain, fainting, loss of coordination); (d) Respiratory problems (e.g., difficulty breathing, coughing, shortness of breath); (e) Skin problems (e.g., rashes, hives, red skin, tingling skin, dermatitis); (f) Cognitive problems (e.g., difficulties thinking, concentrating, or remembering); (g) Mucosal symptoms (e.g., watery or red eyes, nasal congestion, sneezing); (h) Immune system problems (e.g., swollen lymph glands, fever, fatigue); (i) Gastrointestinal problems (e.g., nausea, bloating, cramping, diarrhea); (j) Cardiovascular problems (e.g., fast or irregular heartbeat, jitteriness, chest discomfort); (k) Musculoskeletal problems (e.g., muscle or joint pain, cramps, weakness); (j) Other.

Specific exposure contexts were investigated: air fresheners or deodorizers used in public restrooms and other places, scented laundry products vented outdoors, being in a room after it was cleaned with scented cleaning products, being near someone wearing a fragranced product, entering a business with the scent of fragranced products, fragranced soap used in public restrooms, and ability to access environments that used fragranced products.

In addition, questions investigated awareness of fragranced product emissions and ingredient disclosure, preferences for fragrance-free environments (e.g., workplaces, health care facilities, airplanes, and hotels), and lost workdays due to fragranced product exposure.

Demographic questions were asked regarding age, gender, household income, and region in the UK.

Results

Main findings are summarized in this section, with complete data for responses to the survey questions provided in the Supplementary Material.

Fragranced product use:

Of the general population surveyed in the UK, 98.5% are exposed to fragranced products at least once a week, from their own use: 71.4% air fresheners and deodorizers; 91.3% personal care products; 80.7% cleaning supplies; 83.7% laundry products; 77.3% household products; 75.7% fragrance; 2.0% other.

Further, 89.0% are exposed to fragranced product at least once a week, from others' use: 53.3% air fresheners and deodorizers; 60.0% personal care products; 49.4% cleaning supplies; 42.7% laundry products; 46.9% household products; 65.9% fragrance; 1.9% other.

Collectively, 99.3% of the population are exposed to fragranced products at least once a week from their own use, others' use, or both.

Health effects:

Overall, 27.8% of the population reported one or more types of adverse health effects from exposure to one or more types of fragranced products. The most common types of adverse effects were as follows: 11.6% respiratory problems; 9.2% mucosal symptoms; 8.4% migraine headaches; 9.8% skin problems; 6.8% asthma attacks; 3.7% neurological problems; 2.8% cognitive problems; 3.0% gastrointestinal problems; 3.2% cardiovascular problems; 1.9% immune system problems; 2.0% musculoskeletal problems; and 2.1% other. (See Table 2.)

Of the 27.8% of the population reporting adverse health effects, 53.9% are female and 46.1% are male. Thus, proportionately more females report adverse effects than males, relative to the general population (female 50.0%, male 50.0%). Among all gender and age group classifications, proportionately more females aged 35-44 report adverse effects (14.1%) relative to the general population (12.3%). (See Table 1.)

Specific fragranced products and exposure situations that trigger adverse health effects include the following (see Table 3):

Air fresheners and deodorizers: 15.5% reported health problems when exposed to air fresheners or deodorizers. This compares to studies of the USA and Australia (Steinemann 2016, 2017) that found 20.4% and 16.4% (respectively) reported health problems when exposed to air fresheners or deodorizers.

Scented laundry products vented outdoors: 6.0% reported health problems from the scent of laundry products coming from a dryer vent. This compares to studies of the USA and Australia (Steinemann 2016, 2017) that found 12.5% and 6.1% (respectively) reported health problems from the scent of laundry products coming from a dryer vent.

Fragranced cleaning products: 14.0% reported health problems from being in a room after it has been cleaned with scented products. This compares to studies of the USA and Australia (Steinemann 2016, 2017) that found 19.7% and 15.3% (respectively) reported health problems from being in a room after it has been cleaned with scented products.

Proximity to fragranced person: 13.7% reported health problems from being near someone who is wearing a fragranced product. This compares to studies of the USA and Australia

(Steinemann 2016, 2017) that found 23.6% and 19.4% (respectively) reported health problems from being near someone who is wearing a fragranced product.

Severity of the health problems resulting from exposure to one or more types of fragranced products was investigated, using language from the Equality Act (EA 2010) to determine disability: "Do any of these health problems cause a substantial, likely to recur, and adverse effect on your ability to carry out normal day-to-day activities?" Of those adversely affected by fragranced products, 25.5% answered yes, indicating that the severity of effects from fragranced product exposure was potentially disabling.

Ingredient disclosure and product claims:

Fragranced products, even ones called green or organic, typically emit numerous volatile organic compounds, including hazardous air pollutants, but relatively few are disclosed to the public (Steinemann 2015).

Of the general population surveyed, 68.4% were not aware that fragrance chemicals do not need to be fully disclosed on the product label or material safety data sheet. Also, 70.7% were not aware that fragranced products typically emit hazardous air pollutants such as formaldehyde, and 75.0% were not aware that even so-called natural, green, and organic fragranced products typically emit hazardous air pollutants. Yet 53.5% would not still use a fragranced product if they knew it emitted hazardous air pollutants.

Societal and workplace effects:

The use of fragranced products creates a cascade of effects throughout society. Of the general population, 12.1% are unable or reluctant to use the restrooms in a public place, because of the

presence of an air freshener, deodorizer, or scented product. Also, 10.3% are unable or reluctant to wash their hands with soap in a public place, because they know or suspect that the soap is fragranced. Further, 13.1% of the population reported that if they enter a business, and smell air fresheners or some fragranced product, they want to leave as quickly as possible. And 13.5% have been prevented from going to some place because they would be exposed to a fragranced product that would make them sick. Notably, 6.3% of the UK population reported that exposure to fragranced products in their work environment has caused them to become sick, lose workdays, or lose a job.

Fragrance-free policies receive support from nearly half of those surveyed. Of the population surveyed, 44.7% would be supportive of a fragrance-free policy in the workplace (compared to 23.3% that would not). Also, 43.3% would prefer that health care facilities and health care professionals be fragrance-free (compared to 26.7% that would not).

If given a choice between flying on an airplane that pumped scented air throughout the passenger cabin, or did not pump scented air throughout the passenger cabin, 61.9% would choose an airplane without scented air (compared to 18.4% with scented air). Thus, over 3 times more passengers would prefer an airplane without scented air than with scented air. Similarly, if given a choice between staying in a hotel with fragranced air, or without fragranced air, 53.8% would choose a hotel without fragranced air (compared to 28.1% with fragranced air). Thus, nearly 2 times more hotel guests would choose a hotel without fragranced air than with fragranced air.

Discussion

Emissions from fragranced consumer products can impair indoor air quality, as prior studies have shown. This study demonstrates they can also impair human health, workplace productivity, access in society, and quality of life. Over one-fourth of the population in the

UK suffer adverse health effects when exposed to fragranced products. In nearly one-fourth of those individuals, the effects can be potentially disabling.

Of particular concern are exposure situations, often involuntary, that impose health risks and restrict access in society: 12.1% of the population are unable to use restrooms in public places because of air fresheners or deodorizers, 10.3% unable to wash their hands with soap in public places because of fragranced soap, and 13.5% unable to go someplace because of the presence of a fragranced product.

In addition, 15.5% report health problems from air fresheners and deodorizers used in public restrooms and elsewhere, 6.0% from scented laundry products coming from a dryer vent, 14.0% from being in a room after it was cleaned with scented products, and 13.7% from being near someone wearing a fragranced product.

Nearly half of those surveyed would prefer fragrance-free environments than fragranced environments. And 13.1% would enter but then leave a business as quickly as possible if they smell fragranced products. Significantly, 6.3% have lost workdays or a job due to fragranced product exposures in the workplace. A sensible solution is to implement a fragrance-free policy for workplaces, health care facilities, and other indoor environments.

Limitations of the study include the following: (a) all possible products and health effects were not included, although the low percentages for responses in the "other" category indicates the survey captured the primary products and effects, (b) data were based on self-reports, although a standard method for survey research, it was not possible to measure emissions, exposures, and effects directly for each respondent, (c) the cross-sectional design of the study, which useful for determining prevalence, is limited in the ability to determine temporal relationships and trends.

Results of this study provide important evidence that common fragranced consumer products are associated with adverse effects on human health and society. Together with the results from the US (Steinemann 2016) and Australia (Steinemann 2017), indicating that 34.7% and 33.0% (respectively) report adverse health effects, exposure to common fragranced products can be considered a widespread public health problem. Significantly, further research is needed to understand the types of product ingredients, emissions, and concentrations that are associated with these health effects. However, in the meantime, a prudent and practical approach to reduce adverse effects would be to reduce exposure, both voluntary and involuntary, to fragranced consumer products.

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Table 1: Demographic information.

	Health Problems Fragranced Products		General Population
	N % of column total	N % of general population row	N % of column total
Total	306 100.0%	306 27.8%	1100 100.0%
Male/Female			
All Males	141 46.1%	141 25.6%	550 50.0%
All Females	165 53.9%	165 30.0%	550 50.0%
Gender-Age			
Male 18-24	20 6.5%	20 24.1%	83 7.5%
Male 25-34	39 12.7%	39 38.2%	102 9.3%
Male 35-44	30 9.8%	30 28.0%	107 9.7%
Male 45-54	27 8.8%	27 20.0%	135 12.3%
Male 55-65	25 8.2%	25 20.3%	123 11.2%
Female 18-24	22 7.2%	22 27.2%	81 7.4%
Female 25-34	41 13.4%	41 31.8%	129 11.7%
Female 35-44	43 14.1%	43 31.9%	135 12.3%
Female 45-54	33 10.8%	33 30.6%	108 9.8%
Female 55-65	26 8.5%	26 26.8%	97 8.8%

Table 2: Frequency and types of adverse health effects reported from exposure to fragranced consumer products.

Health Problems	Frequency (n) (% of general population)
Total	306 27.8%
<i>Type of Health Problem</i>	
Migraine headaches	92 8.4%
Asthma attacks	75 6.8%
Neurological problems	41 3.7%
Respiratory problems	128 11.6%
Skin problems	108 9.8%
Cognitive problems	31 2.8%
Mucosal symptoms	101 9.2%
Immune system problems	21 1.9%
Gastrointestinal problems	33 3.0%
Cardiovascular problems	35 3.2%
Musculoskeletal problems	22 2.0%
Other	23 2.1%

Table 3: Frequency and types of health problems from exposure to four types of fragranced consumer products. AF = air fresheners or deodorizers, LP = scent of laundry products coming from a dryer vent, CP = being in a room after it has been cleaned with scented products, FP = being near someone wearing a fragranced product. (% of general population)

	Air Fresheners (AF)	Laundry Products (LP)	Cleaning Products (CP)	Fragranced Person (FP)
Health Problems				
(n)	170	66	154	151
(% of general population)	15.5%	6.0%	14.0%	13.7%
<i>Type of Health Problem</i>				
Migraines	3.6%	1.4%	3.7%	3.4%
Asthma attacks	4.0%	2.1%	3.0%	2.3%
Neurological	1.4%	0.7%	1.6%	1.2%
Respiratory	6.9%	1.9%	6.0%	4.2%
Cognitive	1.3%	1.0%	1.5%	1.1%
Mucosal	4.5%	1.1%	3.7%	4.6%
Immune system	0.9%	0.8%	0.8%	0.5%
Gastrointestinal	1.5%	0.6%	1.0%	1.1%
Cardiovascular	2.1%	0.5%	1.0%	1.2%
Musculoskeletal	1.0%	0.7%	0.6%	1.0%
Other	0.6%	0.1%	0.8%	0.5%

Survey Methodology

Following Eysenbach G, 2004, Improving the Quality of Web Surveys: The Checklist for Reporting Results of Internet E-Surveys (CHERRIES), Journal of Medical Internet Research, Jul-Sep; 6(3): e34.

<i>Item Category</i>	Checklist for Reporting Results of Internet E-Surveys (CHERRIES)	
	<i>Checklist Item</i>	<i>Explanation</i>
Design	Describe survey design	Target population: national random sample of adults (ages 18-65) in the UK, representative of age, gender, and region (n=1,100, confidence limit=95%, margin of error=3%). The survey drew upon participants from a large web-based panel (~950,000 participants) held by Survey Sampling International (SSI). Participant recruitment followed a randomized process (Dynamix). All responses were anonymous. Survey completion time was approximately ten minutes.
	IRB (Institutional Review Board) approval and informed consent process	
	IRB approval	Ethics approval was obtained by the University of Melbourne, School of Engineering Human Ethics Advisory Group, application 1646894, on May 9, 2016.
	Informed consent	Participants had already provided informed consent as part of the SSI web-based panel. For this survey, participants were given the following introduction: aims of the study; principal researcher name, affiliation, and contact information; human ethics approval; length of survey (less than 15 minutes to complete); assurance that participation is completely voluntary and that all data provided are confidential; assurance that participants can withdraw at any time; outputs of research (findings will be provided through journal articles and website, free of charge); university human ethics contact information; and a specific question to indicate consent: "If you would like to participate in this project, please click the next button to proceed ('Go To Survey').".
	Data protection	Selected survey software and servers were used to ensure data protection. No personal information was linked to the survey results. The dataset (without any identifying information) is kept on password protected computers.

Development and pre-testing

Development and testing

The survey instrument was a 35-item questionnaire, developed and tested over a two-year period, including cognitive testing with 10 individuals and piloting with over 100 individuals, before full implementation in June 2016.

Recruitment process and description of the sample having access to the questionnaire

Open survey versus closed survey

The survey invitation is an open invitation, rather than a direct invite, to the pool of panelists available at the time. The pool is filtered to achieve a representative sample through a set of initial questions for basic demographic characteristics.

Contact mode

Closed survey (only SSI participants), general population, random sample nationally representative of demographics.

Advertising the survey

The survey provider, SSI, provided an open invitation to potential participants. The survey targeted the general population rather than a specific cohort.

An open invitation was issued to randomly selected members of the web-based panel. The survey was not advertised.

Survey administration

Web/E-mail

The survey was web-based, with multiple choice and open format answers. All responses were anonymous, and collected through the online survey platform and stored on local password protected servers.

Context

SSI is a survey research company and online panel provider.

Mandatory/voluntary

Voluntary. Prospective participants were randomly invited to the survey.

Incentives

Respondents were provided incentives for their participation by the panel provider, SSI, with points that can be redeemed for money or reward programs.

Time/Date

Data were collected within one week in June 2016.

Randomization of items or questionnaires

To prevent biases in response, five sets of questions were randomized for their multiple-choice items.

Adaptive questioning

Eight questions were conditionally displayed based on responses to other items.

Number of Items

The survey contained 35 questions. Each page contained one question with multiple choice and open format response categories.

Number of screens (pages)

Overall, 36 to 44 pages were presented (including the introductory page), depending on responses to conditional items.

Completeness check

All questions were required to be completed. All questions provided non-response options such as "don't know/not sure" and "decline to answer." Only completed surveys were included for analysis.

Review step

Respondents were allowed one attempt per question, once they click "next" to review the next question; they are not allowed to go back to the previous questions or answers.

Response rates

Unique site visitor

Survey response rate: 97%. Number of initial responses: 1,139; number of drop outs: 18; number of screen outs: 21; number of completes: 1,100; Panel size: ~950,000.

Each respondent goes through stringent verification of identity upon signing up on SSI panel (including name, contact details, and IP). Once opt-in process is completed, each respondent is tagged with unique panel ID.

View rate (Ratio of unique survey visitors/unique site visitors)

not applicable

Participation rate (Ratio of unique visitors who agreed to participate/unique first survey page visitors)

SSI respondents are invited to survey through general population random selection. Unique clicks or visitors to the first page of the survey can be those who complete survey, drop out, or screen out.

Completion rate (Ratio of users who finished the survey/users who agreed to participate)

UK 97% (1,139 initial; 18 drop outs; 21 screen out; 1,100 completes).

Preventing multiple entries from the same individual

Cookies used
IP check

not used

SSI programming software and sampling tool, Dynamix, controls the traffic and ensures unique entries. Using unique Panel ID and IP, each respondent can attempt the survey only once.

Log file analysis
Registration

not used

This is a closed survey for SSI respondents only. Survey invite is mailed specifically to the e-mail address used upon joining survey and verified.

Analysis

Handling of incomplete questionnaires
Questionnaires submitted with an atypical timestamp

Only completed questionnaires were included in the final dataset for analysis.

Minimum survey completion time was 5 minutes; average was 10 minutes. A small number of respondents were omitted for completing the items too quickly.

Statistical correction

All demographic subgroups obtained statistically valid numbers to ensure a national representativeness.

Table 1

D1. What is your gender?

Base: All Respondents

	GenPop
Total	1100 100.00%
Male	550 50.00%
Female	550 50.00%
Other	- -
SUM	1100 100.00%

Table 2

D2. What is your age?

Base: All Respondents

	GenPop
Total	1100 100.00%
18-24	164 14.90%
25-34	231 21.00%
35-44	242 22.00%
45-54	243 22.10%
55-65	220 20.00%
SUM	1100 100.00%

Table 3

D3c. In which region do you live?

Base: All GenPop Respondents

	GenPop
Total	1100 100.00%
East Anglia	99 9.00%
East Midlands	77 7.00%
London	154 14.00%
North East	44 4.00%
Northern Ireland	33 3.00%
North West	121 11.00%
Scotland	99 9.00%
South East	143 13.00%
South West	88 8.00%
Wales	55 5.00%
West Midlands	99 9.00%
Yorkshire	88 8.00%
SUM	1100 100.00%

Table 4

Q1. Which fragranced products are you exposed to, at least once a week, from your own use?

Base: All Respondents

	GenPop
Total	1100 100.00%
Air fresheners and deodorizers (e.g., sprays, solids, oils, disks)	785 71.40%
Personal care products (e.g., soaps, hand sanitizer, lotions, deodorant, sunscreen, shampoos)	1004 91.30%
Cleaning supplies (e.g., all-purpose cleaners, disinfectants, and dishwashing soap)	888 80.70%
Laundry products (e.g., detergents, fabric softeners, dryer sheets)	921 83.70%
Household products (e.g., scented candles, toilet paper, trash bags, baby products)	850 77.30%
Fragrance (e.g., perfume, cologne, after-shave)	833 75.70%
Other	22 2.00%
None	17 1.50%
SUM	5320 483.60%

Table 5

Q1a. Which fragranced products are you exposed to, at least once a week, from others' use?

Base: All Respondents

	GenPop
Total	1100 100.00%
Air fresheners and deodorizers (e.g., sprays, solids, oils, disks)	586 53.30%
Personal care products (e.g., soaps, hand sanitizer, lotions, deodorant, sunscreen, shampoos)	660 60.00%
Cleaning supplies (e.g., all-purpose cleaners, disinfectants, and dishwashing soap)	543 49.40%
Laundry products (e.g., detergents, fabric softeners, dryer sheets)	470 42.70%
Household products (e.g., scented candles, toilet paper, trash bags, baby products)	516 46.90%
Fragrance (e.g., perfume, cologne, after-shave)	725 65.90%
Other	21 1.90%
None	121 11.00%
SUM	3642 331.10%

Table 6

Q2. Do you experience any health problems when exposed to air fresheners or deodorizers?

Base: All Respondents

	GenPop
Total	1100 100.00%
Yes	170 15.50%
No	798 72.50%
Don't know/not sure	130 11.80%
Decline to answer	2 0.20%
SUM	1100 100.00%

Table 7**BA. Which of the following health problems do you do you experience?****Base: Respondents who experienced below health problems when exposed to air fresheners or deodorizers**

	GenPop
Total	170 100.00%
Migraine headaches	40 23.50%
Asthma attacks	44 25.90%
Neurological problems (e.g., dizziness, seizures, head pain, fainting, loss of coordination)	15 8.80%
Respiratory problems (e.g., difficulty breathing, coughing, shortness of breath)	76 44.70%
Skin problems (e.g., rashes, hives, red skin, tingling skin, dermatitis)	50 29.40%
Cognitive problems (e.g., difficulties thinking, concentrating, or remembering)	14 8.20%
Mucosal symptoms (e.g., watery or red eyes, nasal congestion, sneezing)	49 28.80%
Immune system problems (e.g., swollen lymph glands, fever, fatigue)	10 5.90%
Gastrointestinal problems (e.g., nausea, bloating, cramping, diarrhea)	17 10.00%
Cardiovascular problems (e.g., fast or irregular heartbeat, jitteriness, chest discomfort)	23 13.50%
Musculoskeletal problems (e.g., muscle or joint pain, cramps, weakness)	11 6.50%
Other	7 4.10%
SUM	356 209.40%

Table 8

Q3. Do you experience any health problems from the scent of laundry products coming from a dryer vent?

Base: All Respondents

	GenPop
Total	1100 100.00%
Yes	66 6.00%
No	926 84.20%
Don't know/not sure	107 9.70%
Decline to answer	1 0.10%
SUM	1100 100.00%

Table 9**BA. Which of the following health problems do you do you experience?****Base: Respondents who experienced below health problems from the scent of laundry products coming from a dryer vent**

	GenPop
Total	66 100.00%
Migraine headaches	15 22.70%
Asthma attacks	23 34.80%
Neurological problems (e.g., dizziness, seizures, head pain, fainting, loss of coordination)	8 12.10%
Respiratory problems (e.g., difficulty breathing, coughing, shortness of breath)	21 31.80%
Skin problems (e.g., rashes, hives, red skin, tingling skin, dermatitis)	17 25.80%
Cognitive problems (e.g., difficulties thinking, concentrating, or remembering)	11 16.70%
Mucosal symptoms (e.g., watery or red eyes, nasal congestion, sneezing)	12 18.20%
Immune system problems (e.g., swollen lymph glands, fever, fatigue)	9 13.60%
Gastrointestinal problems (e.g., nausea, bloating, cramping, diarrhea)	7 10.60%
Cardiovascular problems (e.g., fast or irregular heartbeat, jitteriness, chest discomfort)	6 9.10%
Musculoskeletal problems (e.g., muscle or joint pain, cramps, weakness)	8 12.10%
Other	1 1.50%
SUM	138 209.10%

Table 10

Q4. Do you experience any health problems from being in a room after it has been cleaned with scented products?

	GenPop
Total	1100 100.00%
Yes	154 14.00%
No	839 76.30%
Don't know/not sure	105 9.50%
Decline to answer	2 0.20%
SUM	1100 100.00%

Table 11**BA. Which of the following health problems do you do you experience?****Base: Respondents who experienced below health problems from being in a room after it has been cleaned with scented products**

	GenPop
Total	154 100.00%
Migraine headaches	41 26.60%
Asthma attacks	33 21.40%
Neurological problems (e.g., dizziness, seizures, head pain, fainting, loss of coordination)	18 11.70%
Respiratory problems (e.g., difficulty breathing, coughing, shortness of breath)	66 42.90%
Skin problems (e.g., rashes, hives, red skin, tingling skin, dermatitis)	36 23.40%
Cognitive problems (e.g., difficulties thinking, concentrating, or remembering)	16 10.40%
Mucosal symptoms (e.g., watery or red eyes, nasal congestion, sneezing)	41 26.60%
Immune system problems (e.g., swollen lymph glands, fever, fatigue)	9 5.80%
Gastrointestinal problems (e.g., nausea, bloating, cramping, diarrhea)	11 7.10%
Cardiovascular problems (e.g., fast or irregular heartbeat, jitteriness, chest discomfort)	11 7.10%
Musculoskeletal problems (e.g., muscle or joint pain, cramps, weakness)	7 4.50%
Other	9 5.80%
SUM	298 193.50%

Table 12

Q5. Do you experience any health problems from being near someone who is wearing a fragranced product?

Base: All Respondents

	GenPop
Total	1100 100.00%
Yes	151 13.70%
No	872 79.30%
Don't know/not sure	76 6.90%
Decline to answer	1 0.10%
SUM	1100 100.00%

Table 13**BA. Which of the following health problems do you do you experience?****Base: Respondents who experienced below health problems from being near someone who is wearing a fragranced product**

	GenPop
Total	151 100.00%
Migraine headaches	37 24.50%
Asthma attacks	25 16.60%
Neurological problems (e.g., dizziness, seizures, head pain, fainting, loss of coordination)	13 8.60%
Respiratory problems (e.g., difficulty breathing, coughing, shortness of breath)	46 30.50%
Skin problems (e.g., rashes, hives, red skin, tingling skin, dermatitis)	26 17.20%
Cognitive problems (e.g., difficulties thinking, concentrating, or remembering)	12 7.90%
Mucosal symptoms (e.g., watery or red eyes, nasal congestion, sneezing)	51 33.80%
Immune system problems (e.g., swollen lymph glands, fever, fatigue)	5 3.30%
Gastrointestinal problems (e.g., nausea, bloating, cramping, diarrhea)	12 7.90%
Cardiovascular problems (e.g., fast or irregular heartbeat, jitteriness, chest discomfort)	13 8.60%
Musculoskeletal problems (e.g., muscle or joint pain, cramps, weakness)	11 7.30%
Other	6 4.00%
SUM	257 170.20%

Table 14

Q6. In general, do you experience any health problems from exposure to any type of fragranced product?

Base: All Respondents

	GenPop
Total	1100 100.00%
Yes	153 13.90%
No	830 75.50%
Don't know/not sure	116 10.50%
Decline to answer	1 0.10%
SUM	1100 100.00%

Table 15**BA. Which of the following health problems do you do you experience?****Base: Respondents who experienced below health problems from exposure to any type of fragranced product**

	GenPop
Total	153 100.00%
Migraine headaches	33 21.60%
Asthma attacks	30 19.60%
Neurological problems (e.g., dizziness, seizures, head pain, fainting, loss of coordination)	15 9.80%
Respiratory problems (e.g., difficulty breathing, coughing, shortness of breath)	51 33.30%
Skin problems (e.g., rashes, hives, red skin, tingling skin, dermatitis)	45 29.40%
Cognitive problems (e.g., difficulties thinking, concentrating, or remembering)	13 8.50%
Mucosal symptoms (e.g., watery or red eyes, nasal congestion, sneezing)	48 31.40%
Immune system problems (e.g., swollen lymph glands, fever, fatigue)	11 7.20%
Gastrointestinal problems (e.g., nausea, bloating, cramping, diarrhea)	11 7.20%
Cardiovascular problems (e.g., fast or irregular heartbeat, jitteriness, chest discomfort)	13 8.50%
Musculoskeletal problems (e.g., muscle or joint pain, cramps, weakness)	10 6.50%
Other	10 6.50%
SUM	290 189.50%

Table 16

B3. Do any of these health problems cause a substantial, likely to recur, and adverse effect on your ability to carry out normal day-to-day activities?

Base: All Respondents who are experiencing health problems

	GenPop
Total	306 100.00%
Yes	78 25.50%
No	195 63.70%
Don't know/not sure	33 10.80%
Decline to answer	- -
SUM	306 100.00%

Table 17

**Have you ever been unable or reluctant to use the toilets in a public place, product?
because of the presence of an air freshener, deodorizer, or scented**

Base: All Respondents

	GenPop
Total	1100 100.00%
Yes	133 12.10%
No	891 81.00%
Neutral/not sure	72 6.50%
Decline to answer	4 0.40%
SUM	1100 100.00%

Table 18

If you enter a business, and you smell air fresheners or some fragranced product, do you want to leave as quickly as possible?

Base: All Respondents

	GenPop
Total	1100 100.00%
Yes	144 13.10%
No	827 75.20%
Neutral/not sure	125 11.40%
Decline to answer	4 0.40%
SUM	1100 100.00%

Table 19

Have you ever been unable or reluctant to wash your hands with soap in a public place, because you know or suspect that the soap is fragranced?

Base: All Respondents

	GenPop
Total	1100 100.00%
Yes	113 10.30%
No	899 81.70%
Neutral/not sure	82 7.50%
Decline to answer	6 0.50%
SUM	1100 100.00%

Table 20

Are you aware that fragrance chemicals do not need to be fully disclosed on the product label or material safety data sheet?

Base: All Respondents

	GenPop
Total	1100 100.00%
Yes	213 19.40%
No	752 68.40%
Don't know/not sure	128 11.60%
Decline to answer	7 0.60%
SUM	1100 100.00%

Table 21

Are you aware that fragranced products typically emit hazardous air pollutants such as formaldehyde?

Base: All Respondents

	GenPop
Total	1100 100.00%
Yes	207 18.80%
No	778 70.70%
Don't know/not sure	112 10.20%
Decline to answer	3 0.30%
SUM	1100 100.00%

Table 22

Are you aware that even so-called natural, green, and organic fragranced products typically emit hazardous air pollutants?

Base: All Respondents

	GenPop
Total	1100 100.00%
Yes	171 15.50%
No	825 75.00%
Don't know/not sure	100 9.10%
Decline to answer	4 0.40%
SUM	1100 100.00%

Table 23

If you knew that a fragranced product emitted hazardous air pollutants, would you still use it?

Base: All Respondents

	GenPop
Total	1100 100.00%
Yes	150 13.60%
No	588 53.50%
Don't know/not sure	354 32.20%
Decline to answer	8 0.70%
SUM	1100 100.00%

Table 24

Have you ever been prevented from going to some place because you would be exposed to a fragrance product that would make you sick?

Base: All Respondents

	GenPop
Total	1100 100.00%
Yes	148 13.50%
No	873 79.40%
Don't know/not sure	76 6.90%
Decline to answer	3 0.30%
SUM	1100 100.00%

Table 25

Has any exposure to fragranced products in your work environment caused you to become sick, lose work days, or lose a job?

Base: All Respondents

	GenPop
Total	1100 100.00%
Yes	69 6.30%
No	953 86.60%
Don't know/not sure	74 6.70%
Decline to answer	4 0.40%
SUM	1100 100.00%

Table 26

Would you be supportive of a fragrance-free policy in the workplace?

Base: All Respondents

	GenPop
Total	1100 100.00%
Yes	492 44.70%
No	256 23.30%
Neutral/not sure	344 31.30%
Decline to answer	8 0.70%
SUM	1100 100.00%

Table 27

Would you prefer that health care facilities and health care professionals be fragrance-free?

Base: All Respondents

	GenPop
Total	1100 100.00%
Yes	476 43.30%
No	294 26.70%
Neutral/not sure	324 29.50%
Decline to answer	6 0.50%
SUM	1100 100.00%

Table 28

**Flying On An Airplane That Pumped / Did Not Pump Scented Air Throughout The Passenger Cabin,
Which Would You Choose?**

Base: All Respondents

	GenPop
Total	1100 100.00%
Airplane with scented air	202 18.40%
Airplane without scented air	681 61.90%
Neutral/not sure	214 19.50%
Decline to answer	3 0.30%
SUM	1100 100.00%

Table 29

Staying In A Hotel With / Without Fragranced Air, Which Would You Choose?

Base: All Respondents

	GenPop
Total	1100 100.00%
Hotel with fragranced air	309 28.10%
Hotel without fragranced air	592 53.80%
Neutral/not sure	197 17.90%
Decline to answer	2 0.20%
SUM	1100 100.00%

Table 30**Q1/Q1a. Who Answer "Yes" To One Or More Of These Options For Q1/Q1A (own use, other's use).****Base: All Respondents**

	GenPop
Total	1100 100.00%
Yes (Net)	1092 99.30%
Air fresheners and deodorizers (e.g., sprays, solids, oils, disks)	868 78.90%
Personal care products (e.g., soaps, hand sanitizer, lotions, deodorant, sunscreen, shampoos)	1034 94.00%
Cleaning supplies (e.g., all-purpose cleaners, disinfectants, and dishwashing soap)	954 86.70%
Laundry products (e.g., detergents, fabric softeners, dryer sheets)	968 88.00%
Household products (e.g., scented candles, toilet paper, trash bags, baby products)	892 81.10%
Fragrance (e.g., perfume, cologne, after-shave)	912 82.90%
Other	31 2.80%
None	130 11.80%

Table 31

**Q2/Q3/Q4/Q5/Q6. People Who Answer "Yes" To One Or More Of These Questions:
Q2/Q3/Q4/Q5/Q6 (fragrance sensitive group).**

	FragSens
Total	1100 100.00%
Yes	306 27.80%

Table 32

BA-Q2/Q3/Q4/Q5/Q6. People who answer “Yes” to each type of health problem under BA for each of these questions Q2/Q3/Q4/Q5/Q6 (fragrance sensitive group)

Base: All Respondents

	FragSens
Total	1100 100.00%
Migraine headaches	92 8.40%
Asthma attacks	75 6.80%
Neurological problems (e.g., dizziness, seizures, head pain, fainting, loss of coordination)	41 3.70%
Respiratory problems (e.g., difficulty breathing, coughing, shortness of breath)	128 11.60%
Skin problems (e.g., rashes, hives, red skin, tingling skin, dermatitis)	108 9.80%
Cognitive problems (e.g., difficulties thinking, concentrating, or remembering)	31 2.80%
Mucosal symptoms (e.g., watery or red eyes, nasal congestion, sneezing)	101 9.20%
Immune system problems (e.g., swollen lymph glands, fever, fatigue)	21 1.90%
Gastrointestinal problems (e.g., nausea, bloating, cramping, diarrhea)	33 3.00%
Cardiovascular problems (e.g., fast or irregular heartbeat, jitteriness, chest discomfort)	35 3.20%
Musculoskeletal problems (e.g., muscle or joint pain, cramps, weakness)	22 2.00%
Other	23 2.10%

Table 33**Demographics by Age and Gender**

Base: All Respondents

	GenPop
Total	1100
	100.00%
Male/Female	
All Males	550
	50.00%
All Females	550
	50.00%
Gender vs Age	
Male 18-24	83
	7.50%
Male 25-34	102
	9.30%
Male 35-44	107
	9.70%
Male 45-54	135
	12.30%
Male 55-65	123
	11.20%
Female 18-24	81
	7.40%
Female 25-34	129
	11.70%
Female 35-44	135
	12.30%
Female 45-54	108
	9.80%
Female 55-65	97
	8.80%

Table 34

Demographics by Age and Gender

People who answer "Yes" to each type of health problem under BA for each of these questions Q2/Q3/Q4/Q5/Q6 (fragrance sensitive group)

	FragSens
Total	306
	100.00%
Male/Female	
All Males	141
	46.10%
All Females	165
	53.90%
Gender vs Age	
Male 18-24	20
	6.50%
Male 25-34	39
	12.70%
Male 35-44	30
	9.80%
Male 45-54	27
	8.80%
Male 55-65	25
	8.20%
Female 18-24	22
	7.20%
Female 25-34	41
	13.40%
Female 35-44	43
	14.10%
Female 45-54	33
	10.80%
Female 55-65	26
	8.50%