

# **Exposures and Effects from Fragranced Consumer Products in Germany**

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## **Exposures and Effects from Fragranced Consumer Products in Germany**

### **Abstract**

Fragranced consumer products—such as cleaning supplies, laundry products, perfumes, and air fresheners—have been associated with adverse human health effects and subsequent impacts in society. This study investigates effects associated with exposures to fragranced consumer products in Germany. Using a nationally representative population-based sample (n=1,102), data were collected in March 2019 using an online survey of adults in Germany. The study found that, across the German population, 19.9% report health problems, such as respiratory problems (55.3%), migraine headaches (25.1%), and asthma attacks (16.9%), when exposed to fragranced products. Of these reports of health effects, 33.8% could be considered potentially disabling. Further, 5.5% of the population have lost workdays or a job, in the past year, due to exposure to fragranced products in the workplace. A majority of Germans would prefer that workplaces, health care facilities and professionals, airplanes, and hotels were fragrance-free rather than fragranced. Results from this study provide new evidence that exposures to fragranced consumer products are associated with adverse health and societal effects among the German population, and that reducing exposures such as through fragrance-free policies could provide benefits.

**Keywords:** fragranced consumer product, fragrance, fragrance-free policy, health effects

## **Introduction**

Fragranced consumer products (or fragranced products, for brevity) are chemically formulated products that contain an added fragrance, aroma, or scent (Steinemann 2015), as well as products that are largely comprised of fragrance (Steinemann 2019a). Common products with fragrance include air fresheners, laundry detergents, cleaning supplies, personal care products, household items, soaps, hand sanitizers, essential oils, baby products, and cosmetics—among hundreds of items that are used by individuals, industries, and institutions every day.

In previous studies, nationally representative population-based surveys in the United States (Steinemann 2016), Australia (Steinemann 2017), United Kingdom (Steinemann 2018a), and Sweden (Steinemann 2018b), found that 34.7%, 33.0%, 28.7%, and 33.1% of adults (respectively) reported one or more types of adverse health effects from exposure to fragranced products (Steinemann 2019b). In Germany, while prior work has investigated the prevalence of contact allergies from fragrance mixtures (e.g., Diepgen et al. 2016; Schnuch et al. 2004; Uter et al. 2001), little is known about the range and impact of possible health problems associated with fragranced consumer products across the population.

This article reports results from a national study to investigate exposures and effects associated with fragranced consumer products in Germany. It complements recent national studies in the United States, Australia, United Kingdom, and Sweden by providing nationally representative population-based data for Germany.

## **Methods**

Using a random sample representative of age, gender, and region (n=1,102; confidence limit=95%, margin of error=3%), an on-line survey was conducted of the adult population (ages 18-65) in Germany. The survey instrument was developed and tested over a three-year period and used in four other national prevalence studies (Steinemann 2016, 2017, 2018a, b).

The survey was run in the official national language of German. The process of survey translation and implementation was performed by Survey Sampling International (SSI), a global survey research company and online panel provider. The survey was translated from English into German by a professional linguist and native speaker based in Germany, and checked by another professional linguist and native speaker based in the United Kingdom. The survey was then piloted with over 100 individuals before full implementation in March 2019.

The survey drew upon participants from a large web-based panel in Germany (approximately 650,000 people), developed and held by SSI, using multi-source samples to achieve a panel blend that reflects the heterogeneity of the study population. To minimize risk of bias, recruitment followed a three-stage randomization process to identify potential participants. For details on panel development, participant recruitment, survey design, and implementation, see Electronic Supplementary Material (ESM) ("ESM-SSI Methodologies"; "ESM-Survey Methods"). The survey completion rate was 83%, and all responses were anonymous. The research study received ethics approval from the University of Melbourne.

Survey questions investigated the following areas: fragranced product use and exposure; health effects associated with exposure to fragranced products; specific exposure situations; effects of fragranced product exposure in the workplace and in society; 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, dishwashing soap); (d) Laundry products (e.g., detergents, fabric softeners, dryer sheets); (e) Household products (e.g., scented candles, restroom paper, trash bags, baby products); (f) Fragrance (e.g., perfume, cologne, after-shave, essential oils); and (g) Other.

Exposure contexts included the following: air fresheners or deodorizers used within indoor environments; scented laundry products coming from a dryer vent; being in a room after it was cleaned with scented cleaning products; being near someone wearing a fragranced product; and exposure to other types of fragranced consumer products.

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

Societal impacts included the following: inability to access restrooms, businesses, public places, and other locations that use air fresheners or fragranced products; severity of health effects; lost workdays or lost jobs due to fragranced product exposure; and preferences for fragrance-free workplaces and environments.

## Results and Discussion

Main findings from the survey are summarized in this section, and in Tables 1-5. Complete data on responses to survey questions are provided as Electronic Supplementary Material ("ESM-Survey Data"). Demographic information is provided in Table 1.

### *Fragranced product use:*

Across the German population, 96.9% are exposed to fragranced products at least once a week from their own use: 46.0% air fresheners and deodorizers; 89.9% personal care products; 77.9% cleaning supplies; 81.1% laundry products; 72.0% household products; 73.4% fragrance; 4.5% other (ESM-Survey Data).

In addition, 82.1% are exposed to fragranced products at least once a week from others' use: 35.5% air fresheners and deodorizers; 55.2% personal care products; 44.3% cleaning supplies; 41.9% laundry products; 40.7% household products; 65.1% fragrance; 3.1% other (ESM-Survey Data).

Collectively, 97.6% are exposed to fragranced products at least once a week from their own use, others' use, or both: 55.8% air fresheners and deodorizers; 91.5% personal care products; 83.8% cleaning supplies; 85.4% laundry products; 77.0% household products; 83.2% fragrance; 5.6% other (ESM-Survey Data).

### *Health effects:*

Overall, 19.9% of the population report one or more types of adverse health effects from exposure to one or more types of fragranced products (Table 2, and ESM-Survey Data). The most common types of adverse health effects, among these fragrance sensitive individuals, are as follows: 55.3% respiratory problems; 35.6% mucosal symptoms; 32.0% skin problems; 27.4% neurological problems; 25.1% migraine headaches; 21.9% gastrointestinal problems; 18.7% cognitive problems; and 16.9% asthma attacks, among others (Table 2).

Of the 19.9% of the population that report adverse health effects (fragrance sensitive individuals), 49.8% are male and 50.2% are female, whereas the general population proportions are 50.3% male and 49.7% female (Table 1). Thus, proportionately more females than males are affected by fragrance sensitivity, relative to the general population. Among all gender and age group classifications (Table 1), proportionately more males ages 25-34 are affected by fragrance sensitivity (13.7%) relative to the general population (8.0%).

#### *Exposure situations:*

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

Cleaning products: 11.9% report health problems from being in a room after it has been cleaned with scented products. This compares to studies of the United States, Australia, United Kingdom, and Sweden (Steinemann 2016, 2017, 2018a, b) that found 19.7%, 15.3%, 14.0%, 13.8% (respectively) reported health problems from being in a room after it has been cleaned with scented products.

Fragranced person: 10.2% report health problems from being near someone who is wearing a fragranced product. This compares to studies of the United States, Australia, United

Kingdom, and Sweden (Steinemann 2016, 2017, 2018a, b) that found 23.6%, 19.4%, 13.7%, and 23.5% (respectively) reported health problems from being near someone who is wearing a fragranced product.

Air fresheners: 9.4% report health problems when exposed to air fresheners or deodorizers. This compares to studies of the United States, Australia, United Kingdom, and Sweden (Steinemann 2016, 2017, 2018a, b) that found 20.4%, 16.4%, 15.5%, and 17.3% (respectively) reported health problems when exposed to air fresheners or deodorizers.

Laundry products: 6.8% report health problems from the scent of laundry products coming from a dryer vent. This compares to studies of the United States, Australia, United Kingdom, and Sweden (Steinemann 2016, 2017, 2018a, b) that found 12.5%, 6.1%, 6.0%, and 5.6% (respectively) reported health problems from the scent of laundry products coming from a dryer vent.

Collectively, 19.9% of adults report one or more types of health problems from being exposed to one or more types of fragranced products. This compares to studies of the United States, Australia, United Kingdom, and Sweden (Steinemann 2016, 2017, 2018a, b) that found 34.7%, 33.0%, 27.8%, and 33.1% (respectively) reported health problems from exposure to fragranced products.

Severity of the health problems from exposure to one or more types of fragranced products was investigated, using language from the German Social Code (Sozialgesetzbuch) to assess disability: "Do any of these health problems cause your physical function, mental ability or mental health to deviate from the age-typical state of health and therefore affect your participation in society?" [English translation] (SGB 2017). Of those adversely affected by



fragranced products, 33.8% answered yes, indicating that the severity of effects from fragranced product exposure was potentially disabling (Table 2).

*Societal and workplace effects:*

Across the population, 18.0% have been prevented from going to some place because they would be exposed to a fragranced product that would make them sick; 16.0% are unable or reluctant to use the restrooms in a public place because of the presence of an air freshener, deodorizer, or scented product; 14.2% report that if they enter a business, and smell air fresheners or some fragranced product, they want to leave as quickly as possible; and 8.3% are unable or reluctant to wash their hands with soap in a public place because they know or suspect that the soap is fragranced (Table 4). Further, 5.5% of the population report that exposure to fragranced products in their work environment, in the past year, has caused them to become sick, lose workdays, or lose a job (Table 4).

Fragrance-free policies and scent-free indoor environments receive widespread support (Table 5). Of the population surveyed, 33.2% would be supportive of a fragrance-free policy in the workplace (compared to 30.6% that would not); and 46.4% would prefer that health care facilities and health care professionals were fragrance-free (compared to 29.8% that would not). In addition, if given a choice between flying on an airplane that pumped scented air throughout the passenger cabin or did not pump scented air, 57.0% would choose an airplane without scented air (compared to 15.7% with scented air). If given a choice between staying in a hotel with fragranced air, or without fragranced air, 58.4% would choose a hotel without fragranced air (compared to 18.1% with fragranced air).

Strengths of the study include the following: (a) the sample population is statistically representative of age, gender, and region in Germany (1,102 respondents, 95% confidence level, 3% margin of error); (b) the respondents were randomly recruited from a large web-

based panel, developed from multiple sources to reflect characteristics of the study population; (c) the survey questions paralleled four nationally representative studies previously conducted in other countries (Steinemann 2016, 2017, 2018a, b); and (d) the survey was run in the official national language of German.

Limitations include the following: (a) all possible products and health effects were not possible to include, although the percentage of responses in the "other" category were consistently the lowest; (b) health effects were limited to those that respondents could identify and report, (c) the study did not aim to quantify personal exposures to fragranced product chemicals; and (e) the survey population was focused on adults ages 18-65, which excludes data on effects of fragranced consumer products on children and the elderly.

## **Conclusions**

Results from this study provide evidence that fragranced consumer products are associated with a range of adverse health and societal effects across the German population. Nearly one-fifth of adults in Germany report one or more types of health problems when exposed to one or more types of common fragranced consumer products. Further, over one-third of those affected individuals report that the health problems can be potentially disabling. Importantly, 5.5% have lost workdays or a job, in the past year, due to fragranced product exposures in the workplace. A majority would support fragrance-free policies for workplaces and health care facilities, and would prefer airplanes and hotels that were fragrance-free rather than fragranced. This study, together with results from the United States, Australia, United Kingdom, and Sweden, point to a global implication that common fragranced products can be associated with health problems in the general population and costs in society, and that reducing exposure could provide benefits.

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## **References**

Diepgen TL, Ofenloch RF, Bruze M, Bertuccio P, Cazzaniga S, Coenraad, P-J, Elsner P, Goncalo M, Svensson A, Naldi L 2016. Prevalence of contact allergy in the general population in different European regions. *British Journal of Dermatology* 174(2): 319–329.

Schnuch A, Lessmann H, Geier J, Frosch PJ, Uter W 2004. Contact allergy to fragrances: frequencies of sensitization from 1996 to 2002. Results of the IVDK. *Dermatitis* 50(2):65–76.

SGB (Sozialgesetzbuch) 2017. § 2 SGB IX (1); Rehabilitation und Teilhabe behinderter Menschen; Behinderung [Disability] 29.3.2017.

Steinemann A 2019b. International Prevalence of Fragrance Sensitivity, Air Quality, Atmosphere and Health (01 Jun)

Steinemann A 2019a. Ten Questions Concerning Fragrance-Free Policies and Indoor Built Environments, Building and Environment (03 Apr)

Steinemann A 2018d. Fragranced Consumer Products: Effects on Autistic Adults in the United States, Australia, and United Kingdom. *Air Quality, Atmosphere, and Health*, Sept:1-6.

Steinemann A. 2018b. Exposures and Effects from Fragranced Consumer Products in Sweden. *Air Quality, Atmosphere, and Health* 11(5):485–491.

Steinemann A. 2018a. Fragranced Consumer Products: Sources of Emissions, Exposures, and Health Effects in the United Kingdom. *Air Quality, Atmosphere, and Health* 11(3):253-258.

Steinemann A. 2017. Health and Societal Effects from Fragranced Consumer Products. *Preventive Medicine Reports* 5:45-47.

Steinemann A. 2016. Fragranced Consumer Products: Exposures and Effects from Emissions. *Air Quality, Atmosphere, and Health* 9(8):861-866.

Steinemann A 2015. Volatile Emissions from Common Consumer Products. *Air Quality, Atmosphere and Health* 8(3):273-281.

Uter W, Schnuch A, Geier J, Pfahlberg A, Gefeller O, 2001. Association between occupation and contact allergy to the fragrance mix: a multifactorial analysis of national surveillance data. *Occup. Environ. Med.* 58 (6), 392–398.

Table 1: Demographic information.

	<i>General Population</i>	<i>Fragrance Sensitive</i>
	1,102	219
	100%	19.9%
<i>Male/Female</i>		
All Males	554	109
	50.3%	49.8%
All Females	548	110
	49.7%	50.2%
<i>Gender/Age</i>		
Male 18-24	62	23
	5.6%	10.5%
Male 25-34	88	30
	8.0%	13.7%
Male 35-44	119	17
	10.8%	7.8%
Male 45-54	141	20
	12.8%	9.1%
Male 55-65	144	19
	13.1%	8.7%
Female 18-24	82	15
	7.4%	6.8%
Female 25-34	123	31
	11.2%	14.2%
Female 35-44	129	28
	11.7%	12.8%
Female 45-54	125	23
	11.3%	10.5%
Female 55-65	89	13
	8.1%	5.9%

Table 2: Types and frequency of health problems associated with exposure to fragranced consumer products

Total (n)	1,102
<u>Health Problems from Fragranced Products (n, %)</u>	219
(Fragrance Sensitivity)	19.9%
<u>Types of health problems from exposure to fragranced consumer products:</u>	
<i>Respiratory problems</i> (e.g., difficulty breathing, coughing, shortness of breath)	55.3%
<i>Mucosal symptoms</i> (e.g., watery or red eyes, nasal congestion, sneezing)	35.6%
<i>Skin problems</i> (e.g., rashes, hives, red skin, tingling skin, dermatitis)	32.0%
<i>Neurological problems</i> (e.g., dizziness, seizures, head pain, fainting, loss of coordination)	27.4%
<i>Migraine headaches</i>	25.1%
<i>Gastrointestinal problems</i> (e.g., nausea, bloating, cramping, diarrhea)	21.9%
<i>Cognitive problems</i> (e.g., difficulties thinking, concentrating, or remembering)	18.7%
<i>Asthma attacks</i>	16.9%
<i>Cardiovascular problems</i> (e.g., fast or irregular heartbeat, jitteriness, chest discomfort)	14.6%
<i>Immune system problems</i> (e.g., swollen lymph glands, fever, fatigue)	13.2%
<i>Musculoskeletal problems</i> (e.g., muscle or joint pain, cramps, weakness)	9.6%
<i>Other</i>	3.2%
Health Problems from Fragranced Consumer Products are Potentially Disabling	33.8%

Table 3: Frequency and types of health problems associated with specific fragranced products and exposure situations: 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

	Cleaning Products (CP)	Fragranced Person (FP)	Air Fresheners (AF)	Laundry Products (LP)
Health Problems (n)	131	112	104	75
(% of general population)	11.9%	10.2%	9.4%	6.8%
<i>Type of Health Problem</i> (% of column total)				
Migraine headaches	23 17.6%	19 17.0%	21 20.2%	10 13.3%
Asthma attacks	16 12.2%	18 16.1%	17 16.3%	11 14.7%
Neurological problems	29 22.1%	26 23.2%	25 24.0%	10 13.3%
Respiratory problems	70 53.4%	51 45.5%	47 45.2%	18 24.0%
Skin problems	26 19.8%	20 17.9%	35 33.7%	23 30.7%
Cognitive problems	13 9.9%	18 16.1%	12 11.5%	12 16.0%
Mucosal symptoms	43 32.8%	37 33.0%	32 30.8%	17 22.7%
Immune system problems	14 10.7%	10 8.9%	7 6.7%	9 12.0%
Gastrointestinal problems	14 10.7%	13 11.6%	21 20.2%	11 14.7%
Cardiovascular problems	14 10.7%	14 12.5%	9 8.7%	9 12.0%
Musculoskeletal problems	10 7.6%	9 8.0%	7 6.7%	8 10.7%
Other	1 0.8%	4 3.6%	2 1.9%	3 4.0%

Table 4: Societal effects from exposure to fragranced consumer products

Total (n)	1,102
Health Problems from Fragranced Products (n, %) (Fragrance Sensitivity)	219 19.9%
Prevented from going to some place because of fragranced product	18.0%
Unable to use restrooms in public place because of air freshener or fragranced product	16.0%
Enter but then leave a business quickly because of fragranced product	14.2%
Unable to wash hands in public place because of fragranced soap	8.3%
Lost workdays or lost a job, in the past year, due to fragranced product exposure in workplace	5.5%



Table 5: Preferences for Fragrance-Free Workplaces and Environments

	Yes	No	Neutral/ not sure	Decline to answer
Supportive of fragrance-free policy in the workplace	33.2%	30.6%	35.3%	0.9%
Prefer fragrance-free health care facilities and professionals	46.4%	29.8%	23.4%	0.5%
Prefer airplane without fragranced air	57.0%	15.7%	26.7%	0.6%
Prefer hotel without fragranced air	58.4%	18.1%	23.1%	0.3%

## 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.

<b>Checklist for Reporting Results of Internet E-Surveys (CHERRIES)</b>		
<b>Item Category</b>	<b>Checklist Item</b>	<b>Explanation</b>
<b>Design</b>	Describe survey design	Target population: national random sample of adults (ages 18-65) in Germany, representative of age, gender, and region (n=1,102, confidence limit=95%, margin of error=3%). The survey drew upon participants from a large web-based panel (~650,000 participants) held by Survey Sampling International (SSI). Participant recruitment followed a three-stage randomization process: first, participants are randomly selected from SSI panels and invited to take a survey; second, participants are combined with others into SSI's Dynamix sampling platform and respond to randomly selected profiling questions; and third, prospective participants are then randomly assigned to a survey. All responses were anonymous.
	<b>IRB (Institutional Review Board) approval and informed consent process</b>	
	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 43-item questionnaire, developed and tested over a three-year period, including cognitive testing with 10 individuals and piloting with over 100 individuals, before full implementation in March 2019. The survey was implemented in German.

## 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. SSI uses multiple sources to achieve a sample blend that is characteristic of the population, and response quotas for specific variables (e.g., age, gender, and region) ensure proportions that are representative of the population. (See electronic supplementary material: "SSI Survey Methodologies.")

Contact mode

Closed survey (only SSI participants), general population, random sample nationally representative of demographics. The survey provider, SSI, provided an open invitation to potential participants. The survey targeted the general population rather than a specific cohort.

Advertising the survey

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 March 2019.

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 43 questions. Each page contained one question with multiple choice and open format response categories.

Number of screens (pages)

Overall, 44 to 52 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 "neutral/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 completion rate: 83%. Number of initial responses: 1,333; number of drop outs: 49; number of screen outs: 102; number of completes: 1,102; Panel size: ~650,000.

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)

Germany 83% (1,333 initial; 49 drop outs; 102 screen out; 1,102 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.

## Germany

### Population Responses

Total	1102	100.00%
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### Table 1

What is your gender?

Base: All Respondents

### Population Responses

Total	1102	100.00%
Male	554	50.30%
Female	548	49.70%
Other	0	-
SUM	1102	100.00%

**Table 2**

What is your age?

Base: All Respondents

	Population Responses
Total	1102 100.00%
18-24 (21)	144 13.10%
25-34 (29.5)	211 19.10%
35-44 (39.5)	248 22.50%
45-54 (49.5)	266 24.10%
55-65 (60)	233 21.10%
>65 (65)	0 -

**Table 3**

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

Base: All Respondents

	Population Responses
Total	1102 100.00%
Air fresheners and deodorizers (e.g., sprays, solids, oils, disks)	507 46.00%
Personal care products (e.g., soaps, hand sanitizer, lotions, deodorant, sunscreen, shampoos)	991 89.90%
Cleaning supplies (e.g., all-purpose cleaners, disinfectants, and dishwashing soap)	859 77.90%
Laundry products (e.g., detergents, fabric softeners, dryer sheets)	894 81.10%
Household products (e.g., scented candles, toilet paper, trash bags, baby products)	793 72.00%
Fragrance (e.g., perfume, cologne, after-shave)	809 73.40%
Other	50 4.50%
None	34 3.10%
SUM	4937 448.00%

**Table 4**

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

Base: All Respondents

	Population Responses
Total	1102 100.00%
Air fresheners and deodorizers (e.g., sprays, solids, oils, disks)	391 35.50%
Personal care products (e.g., soaps, hand sanitizer, lotions, deodorant, sunscreen, shampoos)	608 55.20%
Cleaning supplies (e.g., all-purpose cleaners, disinfectants, and dishwashing soap)	488 44.30%
Laundry products (e.g., detergents, fabric softeners, dryer sheets)	462 41.90%
Household products (e.g., scented candles, toilet paper, trash bags, baby products)	449 40.70%
Fragrance (e.g., perfume, cologne, after-shave)	717 65.10%
Other	34 3.10%
None	197 17.90%
SUM	3346 303.60%



**Table 5**

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

Base: All Respondents

	Population Responses
Total	1102 100.00%
Yes	104 9.40%
No	850 77.10%
Don't know/not sure	147 13.30%
Decline to answer	1 0.10%
SUM	1102 100.00%

**Table 6**

BA. Which of the following health problems do you (...)?

Base: Respondents who experienced below health problems when exposed to air fresheners or deodorizers

	Population Responses
Total	104 100.00%
Migraine headaches	21 20.20%
Asthma attacks	17 16.30%
Neurological problems (e.g., dizziness, seizures, head pain, fainting, loss of coordination)	25 24.00%
Respiratory problems (e.g., difficulty breathing, coughing, shortness of breath)	47 45.20%
Skin problems (e.g., rashes, hives, red skin, tingling skin, dermatitis)	35 33.70%
Cognitive problems (e.g., difficulties thinking, concentrating, or remembering)	12 11.50%
Mucosal symptoms (e.g., watery or red eyes, nasal congestion, sneezing)	32 30.80%
Immune system problems (e.g., swollen lymph glands, fever, fatigue)	7 6.70%
Gastrointestinal problems (e.g., nausea, bloating, cramping, diarrhea)	21 20.20%
Cardiovascular problems (e.g., fast or irregular heartbeat, jitteriness, chest discomfort)	9 8.70%
Musculoskeletal problems (e.g., muscle or joint pain, cramps, weakness)	7 6.70%
Other	2 1.90%
SUM	235 226.00%

**Table 7**

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

Base: All Respondents

	Population Responses
Total	1102 100.00%
Yes	75 6.80%
No	917 83.20%
Don't know/not sure	108 9.80%
Decline to answer	2 0.20%
SUM	1102 100.00%

**Table 8**

BA. Which of the following health problems do you (...)?

Base: Respondents who experienced below health problems from the scent of laundry products coming from a dryer vent

	Population Responses
Total	75 100.00%
Migraine headaches	10 13.30%
Asthma attacks	11 14.70%
Neurological problems (e.g., dizziness, seizures, head pain, fainting, loss of coordination)	10 13.30%
Respiratory problems (e.g., difficulty breathing, coughing, shortness of breath)	18 24.00%
Skin problems (e.g., rashes, hives, red skin, tingling skin, dermatitis)	23 30.70%
Cognitive problems (e.g., difficulties thinking, concentrating, or remembering)	12 16.00%
Mucosal symptoms (e.g., watery or red eyes, nasal congestion, sneezing)	17 22.70%
Immune system problems (e.g., swollen lymph glands, fever, fatigue)	9 12.00%
Gastrointestinal problems (e.g., nausea, bloating, cramping, diarrhea)	11 14.70%
Cardiovascular problems (e.g., fast or irregular heartbeat, jitteriness, chest discomfort)	9 12.00%
Musculoskeletal problems (e.g., muscle or joint pain, cramps, weakness)	8 10.70%
Other	3 4.00%
SUM	141 188.00%

**Table 9**

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

Base: All Respondents

	Population Responses
Total	1102 100.00%
Yes	131 11.90%
No	835 75.80%
Don't know/not sure	132 12.00%
Decline to answer	4 0.40%
SUM	1102 100.00%

**Table 10**

BA. Which of the following health problems do you (...)?

Base: Respondents who experienced below health problems from being in a room after it has been cleaned with scented products

	Population Responses
Total	131 100.00%
Migraine headaches	23 17.60%
Asthma attacks	16 12.20%
Neurological problems (e.g., dizziness, seizures, head pain, fainting, loss of coordination)	29 22.10%
Respiratory problems (e.g., difficulty breathing, coughing, shortness of breath)	70 53.40%
Skin problems (e.g., rashes, hives, red skin, tingling skin, dermatitis)	26 19.80%
Cognitive problems (e.g., difficulties thinking, concentrating, or remembering)	13 9.90%
Mucosal symptoms (e.g., watery or red eyes, nasal congestion, sneezing)	43 32.80%
Immune system problems (e.g., swollen lymph glands, fever, fatigue)	14 10.70%
Gastrointestinal problems (e.g., nausea, bloating, cramping, diarrhea)	14 10.70%
Cardiovascular problems (e.g., fast or irregular heartbeat, jitteriness, chest discomfort)	14 10.70%
Musculoskeletal problems (e.g., muscle or joint pain, cramps, weakness)	10 7.60%
Other	1 0.80%
SUM	273 208.40%

**Table 11**

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

Base: All Respondents

	Population Responses
Total	1102 100.00%
Yes	112 10.20%
No	883 80.10%
Don't know/not sure	106 9.60%
Decline to answer	1 0.10%
SUM	1102 100.00%

**Table 12**

BA. Which of the following health problems do you (...)?

Base: Respondents who experienced below health problems from being near someone who is wearing a fragranced product

	Population Responses
Total	112 100.00%
Migraine headaches	19 17.00%
Asthma attacks	18 16.10%
Neurological problems (e.g., dizziness, seizures, head pain, fainting, loss of coordination)	26 23.20%
Respiratory problems (e.g., difficulty breathing, coughing, shortness of breath)	51 45.50%
Skin problems (e.g., rashes, hives, red skin, tingling skin, dermatitis)	20 17.90%
Cognitive problems (e.g., difficulties thinking, concentrating, or remembering)	18 16.10%
Mucosal symptoms (e.g., watery or red eyes, nasal congestion, sneezing)	37 33.00%
Immune system problems (e.g., swollen lymph glands, fever, fatigue)	10 8.90%
Gastrointestinal problems (e.g., nausea, bloating, cramping, diarrhea)	13 11.60%
Cardiovascular problems (e.g., fast or irregular heartbeat, jitteriness, chest discomfort)	14 12.50%
Musculoskeletal problems (e.g., muscle or joint pain, cramps, weakness)	9 8.00%
Other	4 3.60%
SUM	239 213.40%



**Table 13**

Q5. In general, do you experience any health problems from exposure to any type of fragranced product?

Base: All Respondents

	Population Responses
Total	1102 100.00%
Yes	112 10.20%
No	880 79.90%
Don't know/not sure	107 9.70%
Decline to answer	3 0.30%
SUM	1102 100.00%

**Table 14**

BA. Which of the following health problems do you (...)?

Base: Respondents who experienced below health problems from exposure to any type of fragranced product

	Population Responses
Total	112 100.00%
Migraine headaches	27 24.10%
Asthma attacks	15 13.40%
Neurological problems (e.g., dizziness, seizures, head pain, fainting, loss of coordination)	24 21.40%
Respiratory problems (e.g., difficulty breathing, coughing, shortness of breath)	54 48.20%
Skin problems (e.g., rashes, hives, red skin, tingling skin, dermatitis)	33 29.50%
Cognitive problems (e.g., difficulties thinking, concentrating, or remembering)	17 15.20%
Mucosal symptoms (e.g., watery or red eyes, nasal congestion, sneezing)	39 34.80%
Immune system problems (e.g., swollen lymph glands, fever, fatigue)	17 15.20%
Gastrointestinal problems (e.g., nausea, bloating, cramping, diarrhea)	17 15.20%
Cardiovascular problems (e.g., fast or irregular heartbeat, jitteriness, chest discomfort)	15 13.40%
Musculoskeletal problems (e.g., muscle or joint pain, cramps, weakness)	12 10.70%
Other	1 0.90%
SUM	271 242.00%

**Table 15**

B2. Do any of these health problems ... affect your participation in society? (disability question)

Base: All Respondents

	Population Responses
Total	219 100.00%
Yes	74 33.80%
No	101 46.10%
Don't know/not sure	42 19.20%
Decline to answer	2 0.90%
SUM	219 100.00%

**Table 16**

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

Base: All Respondents

	Population Responses
Total	1102 100.00%
Yes	176 16.00%
No	848 77.00%
Neutral/not sure	77 7.00%
Decline to answer	1 0.10%
SUM	1102 100.00%

**Table 17**

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

	Population Responses
Total	1102 100.00%
Yes	156 14.20%
No	821 74.50%
Neutral/not sure	123 11.20%
Decline to answer	2 0.20%
SUM	1102 100.00%

**Table 18**

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

	Population Responses
Total	1102 100.00%
Yes	92 8.30%
No	927 84.10%
Neutral/not sure	80 7.30%
Decline to answer	3 0.30%
SUM	1102 100.00%

**Table 19**

**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

	Population Responses
Total	1102 100.00%
Yes	198 18.00%
No	753 68.30%
Don't know/not sure	146 13.20%
Decline to answer	5 0.50%
SUM	1102 100.00%

**Table 20**

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

	Population Responses
Total	1102 100.00%
Yes	61 5.50%
No	958 86.90%
Don't know/not sure	76 6.90%
Decline to answer	7 0.60%
SUM	1102 100.00%



**Table 21**

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

Base: All Respondents

	Population Responses
Total	1102 100.00%
Yes	366 33.20%
No	337 30.60%
Neutral/not sure	389 35.30%
Decline to answer	10 0.90%
SUM	1102 100.00%

**Table 22**

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

Base: All Respondents

	Population Responses
Total	1102 100.00%
Yes	511 46.40%
No	328 29.80%
Neutral/not sure	258 23.40%
Decline to answer	5 0.50%
SUM	1102 100.00%

**Table 23**

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

Base: All Respondents

	Population Responses
Total	1102 100.00%
Airplane with scented air	173 15.70%
Airplane without scented air	628 57.00%
Neutral/not sure	294 26.70%
Decline to answer	7 0.60%
SUM	1102 100.00%

**Table 24**

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

Base: All Respondents

	Population Responses
Total	1102
	100.00%
Hotel with fragranced air	200
	18.10%
Hotel without fragranced air	644
	58.40%
Neutral/not sure	255
	23.10%
Decline to answer	3
	0.30%
SUM	1102
	100.00%

**Table 25**

Who Answer "Yes" To One Or More Of These Options For Q1.

Base: All Respondents

	Population Responses
Total	1102 100.00%
Yes (Net)	1068 96.90%
Air fresheners and deodorizers (e.g., sprays, solids, oils, disks)	507 46.00%
Personal care products (e.g., soaps, hand sanitizer, lotions, deodorant, sunscreen, shampoo)	991 89.90%
Cleaning supplies (e.g., all-purpose cleaners, disinfectants, and dishwashing soap)	859 77.90%
Laundry products (e.g., detergents, fabric softeners, dryer sheets)	894 81.10%
Household products (e.g., scented candles, toilet paper, trash bags, baby products)	793 72.00%
Fragrance (e.g., perfume, cologne, after-shave)	809 73.40%
Other	50 4.50%
None	34 3.10%
SUM	4937 448.00%

**Table 26**

Who Answer "Yes" To One Or More Of These Options For Q1A.

Base: All Respondents

	Population Responses
Total	1102 100.00%
Yes (Net)	905 82.10%
Air fresheners and deodorizers (e.g., sprays, solids, oils, disks)	391 35.50%
Personal care products (e.g., soaps, hand sanitizer, lotions, deodorant, sunscreen, shampoo)	608 55.20%
Cleaning supplies (e.g., all-purpose cleaners, disinfectants, and dishwashing soap)	488 44.30%
Laundry products (e.g., detergents, fabric softeners, dryer sheets)	462 41.90%
Household products (e.g., scented candles, toilet paper, trash bags, baby products)	449 40.70%
Fragrance (e.g., perfume, cologne, after-shave)	717 65.10%
Other	34 3.10%
None	197 17.90%
SUM	3346 303.60%

**Table 27**

Q1/Q1a. Who Answer "Yes" To One Or More Of These Options For Q1/Q1A

Base: All Respondents

	Population Responses
Total	1102 100.00%
Yes (Net)	1076 97.60%
Air fresheners and deodorizers (e.g., sprays, solids, oils, disks)	615 55.80%
Personal care products (e.g., soaps, hand sanitizer, lotions, deodorant, sunscreen, shampoo)	1008 91.50%
Cleaning supplies (e.g., all-purpose cleaners, disinfectants, and dishwashing soap)	923 83.80%
Laundry products (e.g., detergents, fabric softeners, dryer sheets)	941 85.40%
Household products (e.g., scented candles, toilet paper, trash bags, baby products)	849 77.00%
Fragrance (e.g., perfume, cologne, after-shave)	917 83.20%
Other	62 5.60%
None	205 18.60%
SUM	5520 500.90%

**Table 28**

"Yes" To One Or More Of These Questions: Q2/Q3/Q4/Q5/Q6 (fragrance sensitive individuals).

Base: All Respondents

	Population Responses
Total	1102 100.00%
Yes	219 19.90%



**Table 29**

People who answer "Yes" to each type of health problem under BA  
Base: Fragrance Sensitive Individuals

	Population Responses
Total	1102 100.00%
Migraine headaches	55 25.1%
Asthma attacks	37 16.9%
Neurological problems (e.g., dizziness, seizures, head pain, fainting, loss of coordination)	60 27.4%
Respiratory problems (e.g., difficulty breathing, coughing, shortness of breath)	121 55.3%
Skin problems (e.g., rashes, hives, red skin, tingling skin, dermatitis)	70 32.0%
Cognitive problems (e.g., difficulties thinking, concentrating, or remembering)	41 18.7%
Mucosal symptoms (e.g., watery or red eyes, nasal congestion, sneezing)	78 35.6%
Immune system problems (e.g., swollen lymph glands, fever, fatigue)	29 13.2%
Gastrointestinal problems (e.g., nausea, bloating, cramping, diarrhea)	48 21.9%
Cardiovascular problems (e.g., fast or irregular heartbeat, jitteriness, chest discomfort)	32 14.6%
Musculoskeletal problems (e.g., muscle or joint pain, cramps, weakness)	21 9.6%
Other	7 3.2%

**Table 30**

## Demographics

Base: All Germany Respondents

	Population Responses
Total	1102 100.00%
Male/Female	
All Males	554 50.30%
All Females	548 49.70%
Gender vs Age	
Male 18-24	62 5.60%
Male 25-34	88 8.00%
Male 35-44	119 10.80%
Male 45-54	141 12.80%
Male 55-65	144 13.10%
Female 18-24	82 7.40%
Female 25-34	123 11.20%
Female 35-44	129 11.70%
Female 45-54	125 11.30%
Female 55-65	89 8.10%

**Table 31**

Demographics.

Base: Fragrance sensitive individuals (Yes to one or more of these questions: Q2, Q3, Q4, Q5, Q6)

	Population Responses
Total	219
	100.00%
Male/Female	
All Males	109
	49.80%
All Females	110
	50.20%
Gender vs Age	
Male 18-24	23
	10.50%
Male 25-34	30
	13.70%
Male 35-44	17
	7.80%
Male 45-54	20
	9.10%
Male 55-65	19
	8.70%
Female 18-24	15
	6.80%
Female 25-34	31
	14.20%
Female 35-44	28
	12.80%
Female 45-54	23
	10.50%
Female 55-65	13
	5.90%