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Chemical Sensitivity, Asthma, and Effects from Fragranced Consumer Products:

National Population Study in the United Kingdom

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Chemical Sensitivity, Asthma, and Effects from Fragranced Consumer Products: National Population Study in the United Kingdom

Abstract

Consumer products, such as those with a fragrance, can adversely affect air quality and health. This national study in the United Kingdom (UK) investigated the prevalence of chemical sensitivity, a condition associated with chemical pollutant exposures, and the medical diagnosis of multiple chemical sensitivities (MCS). In addition, it investigated the co-occurrence of chemical sensitivity with asthma and asthma-like conditions, and with fragrance sensitivity (adverse health effects from fragranced consumer products). Using a nationally representative population sample (n=1,100), an online survey was conducted of adults in the UK, comprising England, Wales, Northern Ireland, and Scotland. The survey found that, across the UK population, 16.3% report chemical sensitivity; 6.6% medically diagnosed MCS; 25.3% are asthmatic, diagnosed with asthma (17.1%), an asthma-like condition (9.0%), or both; and 27.8% are fragrance sensitive. The conditions frequently co-occur: among the chemically sensitive, 57.0% are asthmatic and 77.7% are fragrance sensitive; and among asthmatics, 36.7% are chemically sensitive and 54.0% are fragrance sensitive. Air fresheners and deodorizers trigger health problems for 15.5% of the general population, 52.5% of chemically sensitive, and 38.8% of asthmatics. Disabling health problems can result from exposure to fragranced products for 41.7% of the chemically sensitive and 37.3% of asthmatics. Further, 21.2% of the chemically sensitive and 14.0% of asthmatics lost workdays or a job in the past year due to fragranced products in the workplace. Results indicate that chemical sensitivity is widespread in the UK, affecting over 5.7 million adults, with over 2.3 million diagnosed MCS, 8.9 million asthmatics, and 9.8 million fragrance sensitive. Reducing chemical exposure to problematic sources, such as fragranced consumer products, is a critical step to reduce adverse health and societal effects.

Keywords: United Kingdom, chemical sensitivity, asthma, fragranced consumer product, fragrance, fragrance-free policy, indoor air quality

1. Introduction

Common chemical products, such as those with a fragrance, have been implicated as a primary source of both outdoor and indoor air pollutants (McDonald et al. 2018; Ott et al. 2007), and associated with human health problems (Steinemann 2016, 2017, 2018c). Chemical sensitivity is a condition characterized by adverse health effects from exposure to common petrochemical products and pollutants, such as pesticides, new carpet and paint, renovation materials, diesel exhaust, and fragranced consumer products (Ashford and Miller 1998; Steinemann 2018a, 2018b). Health effects associated with exposure include headaches, dizziness, seizures, heart arrhythmia, gastrointestinal problems, breathing difficulties, and asthma attacks (Steinemann 2018a, 2018b; Ashford and Miller 1998).

While chemical sensitivity is a common and general term, the condition may also be diagnosed as multiple chemical sensitivities (MCS). Other terms include environmental illness (specific to chemical exposures), chemical intolerance, or toxicant induced loss of tolerance (Ashford and Miller 1998; Miller and Prihoda 1999). Individuals may not receive a specific diagnosis but nonetheless manifest and report characteristics of the condition of chemical sensitivity.

Relatively little is known about the prevalence of chemical sensitivity in the UK population or in vulnerable sub-populations. In two previous studies, Reid et al. (2002) and Reid et al. (2001) measured the prevalence of chemical sensitivities and MCS,

respectively, in three military cohorts: Gulf War deployed veterans (Gulf cohort, n=3,531), United Nations Bosnia peacekeeping forces (Bosnia cohort, n=2,050), and Gulf War active service veterans (Era cohort, n=2,614). Both studies used data obtained from a cross sectional postal survey of veterans, with an overall response rate of 65.1% (8,195/12,592).

In these studies of UK military personnel, to assess chemical sensitivity, respondents were asked whether exposure to any one or more of eleven chemical triggers brought about symptoms, and whether this sensitivity developed subsequent to deployment. A symptom was "an awareness of some discomfort or bothersome change." To assess MCS, cases were defined by symptoms reported in at least three organ systems, including the central nervous system, for a duration of three months or more, and reported sensitivity to four or more substances from the list of eleven substances.

Results of these studies found that chemical sensitivity following deployment was reported in 27.7% of the Gulf cohort (n=978), 12.7% of the Bosnia cohort (n=261), and 14.2% of the Era cohort (n=371). Among all cohorts, the most common triggers were smog or air pollution; vehicle exhaust or fumes; cigarette smoke; cosmetics, perfumes, hairspray, deodorants, soaps; organic chemicals, solvents, glues, paints, or fuel. The prevalence of MCS in these cohorts was 1.3% Gulf, 0.3% Bosnia, and 0.2% Era, respectively.

In another UK study (Steinemann 2018c), a nationally representative population survey (n=1,100), conducted in 2016, found 27.8% of adults in the UK report fragrance

sensitivity, or adverse health effects when exposed to fragranced products such as air fresheners, cleaning supplies, and personal care products.

In other countries: In the United States (US), a nationally representative population survey (n=1,037), conducted in 2016, found a prevalence of 25.9% self-reported chemical sensitivity and 12.8% medically diagnosed MCS (Steinemann 2018a). Earlier US national prevalence studies, conducted in 2002-2003 and 2005-2006 (Caress and Steinemann 2005, 2009b), found a prevalence of 11.2% and 11.6% self-reported chemical sensitivity and 2.5% and 3.9% medically diagnosed MCS, respectively. Thus, in the US, chemical sensitivity increased over 200% and medically diagnosed MCS increased over 300% in a decade.

In each of these three US studies, chemical sensitivity was investigated with the following question (based on Kreutzer et al. 1999): "Compared to other people, do you consider yourself allergic or unusually sensitive to everyday chemicals like those in household cleaning products, paints, perfumes, detergents, insect spray and things like that?" Diagnosed MCS was assessed with the question: "Has a doctor or health care professional ever told you that you have multiple chemical sensitivities?"

In Australia (AU), a nationally representative population survey (n=1,098), conducted in 2016, found a prevalence of 18.9% self-reported chemical sensitivity and 6.5% medically diagnosed MCS (Steinemann 2018b). Chemical sensitivity and medically diagnosed MCS were investigated using the same criteria as in the three US studies above.

In Sweden, a study of adults in Skövde (n=1,387) found a prevalence of 33% of being bothered by strong or pungent odours such as perfume, cleaning agents or flower scents (Johansson et al. 2005). A survey of adults in Skåne (n=13,604) found 10.1% experienced "some annoyance" and 2.4 percent "much annoyance" from breathing air that smells of chemicals (Carlsson et al. 2005). A survey of adults from Västerbotten (n=3,406) found 12.2% reported chemical intolerance to odorous pungent chemicals, such as perfumes and cleaning agents, and 3.3% were physician-diagnosed with chemical intolerance (Palmquist et al. 2014).

In Japan, a survey of adults (n=7,245) estimated a prevalence of 7.5% of chemical intolerance (Azuma et al. 2015). In Denmark, a study of adults (n=2,000) found a prevalence of 8.2% of chemical intolerance (Skovbjerg et al. 2012). Chemical intolerance was investigated in these two studies using the Quick Environmental Exposure and Sensitivity Inventory (QEESI) criteria (Miller and Prihoda 1999).

The aims of this present study are the following: (1) to determine the prevalence of chemical sensitivity and medically diagnosed MCS in the UK, (2) to investigate its co-occurrence with asthma or an asthma-like condition, and with fragrance sensitivity, and (3) to assess the effects of exposures to fragranced consumer products on health and societal access for chemically sensitive and asthmatic individuals.

2. Methods

A national cross-sectional survey was conducted of the UK population using a sample representative of the general population according to age, gender, and region (n=1,100; confidence limit=95%, confidence interval=3%). Using randomized participation recruitment (SSI 2016), the survey drew upon a large (over 900,000 people) web-based panel of adults ages 18-65 in the UK, held by Survey Sampling International (SSI), a global survey research company and online panel provider. The survey instrument was developed and tested over a three-year period and used in two other national studies (Steinemann 2016, 2017), and piloted with 100 individuals in the UK, before full implementation in the UK in June 2016. The survey response rate was 97%, and all responses were anonymous. The research study received ethics approval from the University of Melbourne.

Details on the survey methodology, including the checklist for reporting results of internet e-surveys (Eysenbach 2004), are provided in the Electronic Supplementary Material 1 (Survey Methodology). Full results of survey data and statistics are provided in Electronic Supplementary Material 2 (Survey Data). Results from the study of fragrance sensitivity in the UK population are provided in Steinemann (2018c), which this present study extends and deepens by investigating prevalence, co-occurrence, and health effects concerning sub-populations of chemically sensitive and asthmatic individuals.

Descriptive statistics and cross-tabulations determined percentages according to each response and sub-population. Chi-squared analyses compared percentages to determine whether statistically significant differences exist. Prevalence odds ratios (PORs) measured the strength of associations to determine whether one sub-population is proportionally more affected. All analyses were performed using a 95% confidence interval (CI).

To promote comparability and replicability, the survey employed questions from previous national studies of chemical sensitivity, MCS, asthma and asthma-like conditions, and fragrance sensitivity (Steinemann 2018a, 2018b; Caress and Steinemann 2005, 2009a, 2009b), as follows.

For chemical sensitivity, the survey asked, "Compared to other people, do you consider yourself allergic or unusually sensitive to everyday chemicals like those in household cleaning products, paints, perfumes, detergents, insect spray and things like that?" For medically diagnosed MCS, the survey asked, "Has a doctor or health care professional ever told you that you have multiple chemical sensitivities?"

For asthma or asthma-like conditions, the survey asked, "Has a doctor or health care professional ever told you that you have asthma or an asthma-like condition?" If respondent answered yes, the survey then asked to specify whether "asthma" or an "asthma-like condition" or both. (The term "asthmatic" will be used herein to include individuals with either asthma or an asthma-like condition or both.)

For fragrance sensitivity, the survey asked about exposure to different types of fragranced consumer products and health effects. An individual was considered to characterize fragrance sensitivity if they reported one or more types of health problems from exposure to one or more types of fragranced consumer products or exposure contexts (Steinemann 2016). A "fragranced consumer product" (or "fragranced product," for brevity) is a chemically formulated product with the addition of a fragrance or scent (Steinemann 2015).

Fragranced product types were categorized as follows: air fresheners and deodorizers, personal care products, cleaning supplies, laundry products, household products, fragrance, and other. Exposure contexts were as follows: air fresheners or deodorizers used in public restrooms and other 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: migraine headaches; asthma attacks; neurological problems; respiratory problems; skin problems; cognitive problems; mucosal symptoms; immune system problems; gastrointestinal problems; cardiovascular problems; musculoskeletal problems; and other.

3. Results

Across the UK population: 16.3% report chemical sensitivity; 6.60% medically diagnosed MCS; 25.3% are asthmatic, diagnosed with asthma (17.1%), an asthma-like condition (9.0%), or both; and 27.8% are fragrance sensitive.

Among the chemically sensitive, 57.0% are asthmatic and 77.7% are fragrance sensitive. Among asthmatics, 36.7% are chemically sensitive and 54.0% are fragrance sensitive. (Table 1.)

To compare with results from other countries, which used the same survey questions and criteria:

In the US (Steinemann 2016, 2018a, 2018d): 25.9% report chemical sensitivity, 12.8% medically diagnosed MCS, 26.8% are asthmatic, and 34.7% are fragrance sensitive. Among the chemically sensitive, 59.2% are asthmatic and 81.0% are fragrance sensitive. Among asthmatics, 57.0% are chemically sensitive and 64.3% are fragrance sensitive.

In Australia (Steinemann 2017, 2018b; Steinemann et al. 2018): 18.9% report chemical sensitivity, 6.5% medically diagnosed MCS, 28.5% are asthmatic, and 33.0% are fragrance sensitive. Among the chemically sensitive, 56.5% are asthmatic and 82.6% are fragrance sensitive. Among asthmatics, 37.4% are chemically sensitive and 55.6% are fragrance sensitive.

The co-occurrences of any two conditions are statistically similar across the three countries: US, AU, and UK ($p>0.05$, Chi-square test).

For chemically sensitive individuals, fragranced product exposures that are associated with health problems include the following: air fresheners and deodorizers (52.5%), scented laundry products coming from a dryer vent (25.7%), being in a room recently cleaned with scented products (52.5%), being near someone wearing a fragranced product (40.8%), and other types of fragranced consumer products (49.2%). (Table 2.)

Most common adverse health effects associated with these exposures, for chemically sensitive individuals, include respiratory problems (41.3%), skin problems (32.4%), asthma attacks (25.7%), mucosal symptoms (30.2%), migraine headaches (27.4%), cardiovascular problems (13.4%), among others. (Table 3.)

For instance, air fresheners or deodorizers can trigger health problems for 15.5% of the general population, 52.5% of the chemically sensitive, and 38.8% of asthmatics. Health problems for these individuals include migraine headaches (23.5% of the general population, 22.3% of chemically sensitive, 25.0% of asthmatics) and asthma attacks (25.9% of the general population, 34.0% of chemically sensitive, 39.8% of asthmatics)

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?"

Among those adversely affected, for 25.5% of the general population, 41.7% with chemical sensitivity, and 37.3% of asthmatics, the health effects from fragranced product exposure were reported as potentially disabling.

Fragranced products also restrict access in society. For individuals with chemical sensitivity, 38.5% are unable or reluctant to use public restrooms that have an air freshener, deodorizer, or scented product; 36.3% are unable or reluctant to wash hands in a public place if the soap is fragranced; 42.5% enter a business but then leave as quickly as possible due to a fragranced product; and 39.7% have been prevented from going someplace because a fragranced product would make them sick.

Lost workdays and lost jobs are also associated with exposure to fragranced products: 21.2% of chemically sensitive and 14.0% of asthmatics have lost workdays or lost a job, in the past year, due to illness from fragranced product exposure in the workplace.

A strong majority of chemically sensitive and asthmatic individuals would prefer fragrance-free (rather than fragranced) workplaces, health care facilities, and health care professionals. (See Table 4 and Electronic Supplementary Material.)

Among the chemically sensitive, 69.3% would support a fragrance-free policy in the workplace (compared to 15.1% that would not), and 68.2% would prefer that health care facilities and health care professionals were fragrance-free (compared to 16.8% that would not).

Among asthmatics, 54.7% would support a fragrance-free policy in the workplace (compared to 18.0% that would not), and 55.0% would prefer that health care facilities and health care professionals were fragrance-free (compared to 21.9% that would not).

Even among the general population, 44.7% would support a fragrance-free policy in the workplace (compared to 23.3% that would not), and 43.3% would prefer that health care facilities and health care professionals were fragrance-free (compared to 26.7% that would not).

Demographic proportions of chemical sensitivity are 47.5% male and 52.5% female, compared with the general population of 50.0% male and 50.0% female. Thus, chemical sensitivity has a female bias (+2.5%). Relative to gender and age, the highest bias (percentage chemical sensitivity greater than general population) is Male 25-34 (+2.4%).

4. Discussion

This study found that common chemical products, especially those with a fragrance, are associated with adverse health and societal effects across the UK population. Chemical sensitivity is widespread, affecting over 5.7 million adults, with nearly one-third of those individuals medically diagnosed with MCS (UK, 2018). In addition, nearly 10 million adults are fragrance sensitive, experiencing adverse health effects from fragranced products.

Chemically sensitive individuals are proportionally more likely to be asthmatic (POR 3.74; 95% CI 2.70-5.18) and fragrance sensitive (POR 9.02; 95% CI 6.19-13.13) than non-chemically sensitive. Similarly, asthmatics are proportionally more likely to be chemically sensitive (POR 2.98; 95% CI 2.23-3.99) and fragrance sensitive (POR 3.04; 95% CI 2.32-3.98) than non-asthmatics.

Study strengths include the following: (a) the sample population is statistically representative of age, gender, and region in the UK; (b) the 1,100 respondents were randomly recruited from a large web-based panel which reflects population characteristics; and (c) the survey replicated questions from national population studies in the US and AU (Steinemann 2018a, 2018b). Study limitations include the following: (a) only adults (ages 18-65) were surveyed, which excludes data from other age groups; (b) the survey relied on self-reported data, which is nonetheless a standard and widely accepted approach for epidemiological research; and (c) chemical sensitivity lacks standard diagnostic criteria, although the survey replicated questions from prior surveys to promote consistency and comparability.

5. Conclusion

Chemical sensitivity, a serious health condition associated with exposure to chemically formulated products, is pervasive across the United Kingdom. Fragranced consumer products, in particular, can induce a range of adverse health and societal effects. Reducing and avoiding exposure to these products, such as through fragrance-free policies and practices, can reduce the adverse effects and improve societal access for not only those with chemical sensitivity, but also for asthmatics and the general population.

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Table 1: Prevalence and Co-Occurrence of Chemical Sensitivity with Asthma/Asthma-Like Condition and Fragrance Sensitivity

	General Population	**Chemically Sensitive**	**Asthmatic**	**Fragrance Sensitive**
Total (N)	1100	179	278	306
(% relative to General Population)	100.0%	16.3%	25.3%	27.8%
	N % of column total	N % of column total	N % of column total	N % of column total
Chemically Sensitive	179	179	102	139
	16.3%	100.0%	36.7%	45.4%
Asthmatic	278	102	278	150
	25.3%	57.0%	100.0%	49.0%
Fragrance Sensitive	306	139	150	306
	27.8%	77.7%	54.0%	100.0%

Table 2: Exposures to fragranced consumer products and associated health problems

	General Population	**Chemically Sensitive**	**Asthmatic**
	N % of column total	N % of column total	N % of column total
Total	1100	179	278
	100.0%	16.3%	25.3%
Fragrance Sensitive	306	139	150
	27.8%	77.7%	54.0%
Health problems from exposure to:			
Air fresheners or deodorizers	170	94	108
	15.5%	52.5%	38.8%
Scented laundry products from a dryer vent	66	46	52
	6.0%	25.7%	18.7%
Room cleaned with scented products	154	94	89
	14.0%	52.5%	32.0%
Someone wearing a fragranced product	151	73	79
	13.7%	40.8%	28.4%
Other type of fragranced consumer product	153	88	81
	13.9%	49.2%	29.1%

Table 3: Health problems (frequency and type) reported from exposure to fragranced consumer products

	General Population	**Chemically Sensitive**	**Asthmatic**
Total (N)	1100	179	278
(% relative to General Population)	100.0%	16.3%	25.3%
	N % of column total	N % of column total	N % of column total
Total Fragrance Sensitive (N) (reporting one or more health problems)	306	139	150
(% relative to Sub-population)	27.8%	77.7%	54.0%
Type of health problem:			
* *Migraine headaches*	92	49	47
	8.4%	27.4%	16.9%
* *Asthma attacks*	75	46	71
	6.8%	25.7%	25.5%
* *Neurological problems* (e.g., dizziness, seizures,	41	24	24
head pain, fainting, loss of coordination)	3.7%	13.4%	8.6%
* *Respiratory problems* (e.g., difficulty breathing,	128	74	83
coughing, shortness of breath)	11.6%	41.3%	29.9%
* *Skin problems* (e.g., rashes, hives, red skin,	108	58	54
tingling skin, dermatitis)	9.8%	32.4%	19.4%
* *Cognitive problems* (e.g., difficulties thinking,	31	24	22
concentrating, or remembering)	2.8%	13.4%	7.9%
* *Mucosal symptoms* (e.g., watery or red eyes, nasal	101	54	52
congestion, sneezing)	9.2%	30.2%	18.7%
* *Immune system problems* (e.g., swollen lymph	21	14	11
glands, fever, fatigue)	1.9%	7.8%	4.0%
* *Gastrointestinal problems* (e.g., nausea, bloating,	33	19	22
cramping, diarrhea)	3.0%	10.6%	7.9%
* *Cardiovascular problems* (e.g., fast or irregular	35	24	27
heartbeat, jitteriness, chest discomfort)	3.2%	13.4%	9.7%
* *Musculoskeletal problems* (e.g., muscle or joint	22	17	20
pain, cramps, weakness)	2.0%	9.5%	7.2%
* *Other*	23	9	5
	2.1%	5.0%	1.8%

Table 4: Societal effects of fragranced consumer products

	General Population	Chemically Sensitive	Asthmatic
	N % of column total	N % of column total	N % of column total
Total	1100	179	278
	100.0%	16.3%	25.3%
Fragrance Sensitive	306	139	150
	27.8%	77.7%	54.0%
Disabling health effects from fragranced consumer products	78	58	56
	25.5%	41.7%	37.3%
Unable or reluctant to use restrooms in public place because of air freshener, deodorizer, or scented product	133	69	76
	12.1%	38.5%	27.3%
Unable or reluctant to wash hands because of fragranced soap	113	65	72
	10.3%	36.3%	25.9%
Want to leave a business quickly because of fragranced product	144	76	74
	13.1%	42.5%	26.6%
Prevented from going someplace because of fragranced product	148	71	77
	13.5%	39.7%	27.7%
Lost workdays or job in past year due to fragranced product exposure in workplace	69	38	39
	6.3%	21.2%	14.0%
Supportive of fragrance-free policy in the workplace	492	124	152
	44.7%	69.3%	54.7%
Prefer fragrance-free health care facilities and professionals	476	122	153
	43.3%	68.2%	55.0%

Table 5: Demographic information

	General Population	Chemically Sensitive	Asthmatic	Fragrance Sensitive
	N % of column total	N % of column total	N % of column total	N % of column total
Total	1100 100.0%	179 100.0%	278 100.0%	306 100.0%
Male/Female				
All Males	550 50.0%	85 47.5%	131 47.1%	141 46.1%
All Females	550 50.0%	94 52.5%	147 52.9%	165 53.9%
Gender vs Age				
Male 18-24	83 7.5%	16 8.9%	22 7.9%	20 6.5%
Male 25-34	102 9.3%	21 11.7%	33 11.9%	39 12.7%
Male 35-44	107 9.7%	20 11.2%	28 10.1%	30 9.8%
Male 45-54	135 12.3%	16 8.9%	29 10.4%	27 8.8%
Male 55-65	123 11.2%	12 6.7%	19 6.8%	25 8.2%
Female 18-24	81 7.4%	17 9.5%	27 9.7%	22 7.2%
Female 25-34	129 11.7%	24 13.4%	38 13.7%	41 13.4%
Female 35-44	135 12.3%	23 12.8%	27 9.7%	43 14.1%
Female 45-54	108 9.8%	14 7.8%	28 10.1%	33 10.8%
Female 55-65	97 8.8%	16 8.9%	27 9.7%	26 8.5%

Table 1

Country: UK

	GenPop	ChemSens	Asthmatic	FragSens
Total	1100	179	278	306
	100.0%	16.3%	25.3%	27.8%

Table 2

What is your gender?

	GenPop	ChemSens	Asthmatic	FragSens
Total	1100	179	278	306
	100.00%	100.00%	100.00%	100.00%
Male	550	85	131	141
	50.00%	47.50%	47.10%	46.10%
Female	550	94	147	165
	50.00%	52.50%	52.90%	53.90%

Table 3

What is your age?

	GenPop	ChemSens	Asthmatic	FragSens
Total	1100	179	278	306
	100.00%	100.00%	100.00%	100.00%
18-24 (21)	164	33	49	42
	14.90%	18.40%	17.60%	13.70%
25-34 (29.5)	231	45	71	80
	21.00%	25.10%	25.50%	26.10%
35-44 (39.5)	242	43	55	73
	22.00%	24.00%	19.80%	23.90%
45-54 (49.5)	243	30	57	60
	22.10%	16.80%	20.50%	19.60%
55-65 (60)	220	28	46	51
	20.00%	15.60%	16.50%	16.70%
65 (65)	-	-	-	-

Table 4

UK Region.

	GenPop	ChemSens	Asthmatic	FragSens
Total	1100	179	278	306
	100.00%	100.00%	100.00%	100.00%
East Anglia	99	14	27	26
	9.00%	7.80%	9.70%	8.50%
East Midlands	77	12	15	20
	7.00%	6.70%	5.40%	6.50%
London	154	25	39	36
	14.00%	14.00%	14.00%	11.80%
North East	44	7	12	17
	4.00%	3.90%	4.30%	5.60%
Northern Ireland	33	5	5	7
	3.00%	2.80%	1.80%	2.30%
North West	121	27	38	43
	11.00%	15.10%	13.70%	14.10%
Scotland	99	12	22	20
	9.00%	6.70%	7.90%	6.50%
South East	143	21	35	43
	13.00%	11.70%	12.60%	14.10%
South West	88	17	17	32
	8.00%	9.50%	6.10%	10.50%
Wales	55	8	15	12
	5.00%	4.50%	5.40%	3.90%
West Midlands	99	17	27	25
	9.00%	9.50%	9.70%	8.20%
Yorkshire & Humberside	88	14	26	25
	8.00%	7.80%	9.40%	8.20%

Table 5

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

	GenPop	ChemSens	Asthmatic	FragSens
Total	1100	179	278	306
	100.00%	100.00%	100.00%	100.00%
Yes	170	94	108	170
	15.50%	52.50%	38.80%	55.60%
No	798	49	129	92
	72.50%	27.40%	46.40%	30.10%
Don't know/not sure	130	36	41	44
	11.80%	20.10%	14.70%	14.40%
Decline to answer	2	-	-	-
	0.20%	-	-	-

Table 6

BA. Which of the following health problems do you experience?

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

	GenPop	ChemSens	Asthmatic	FragSens
Total	170	94	108	170
	100.00%	100.00%	100.00%	100.00%
Migraine headaches	40	21	27	40
	23.50%	22.30%	25.00%	23.50%
Asthma attacks	44	32	43	44
	25.90%	34.00%	39.80%	25.90%
Neurological problems (e.g., dizziness, seizures, head pain, fainting, loss of coordination)	15	10	8	15
	8.80%	10.60%	7.40%	8.80%
Respiratory problems (e.g., difficulty breathing, coughing, shortness of breath)	76	46	51	76
	44.70%	48.90%	47.20%	44.70%
Skin problems (e.g., rashes, hives, red skin, tingling skin, dermatitis)	50	34	33	50
	29.40%	36.20%	30.60%	29.40%
Cognitive problems (e.g., difficulties thinking, concentrating, or remembering)	14	10	9	14
	8.20%	10.60%	8.30%	8.20%
Mucosal symptoms (e.g., watery or red eyes, nasal congestion, sneezing)	49	27	29	49
	28.80%	28.70%	26.90%	28.80%
Immune system problems (e.g., swollen lymph glands, fever, fatigue)	10	9	7	10
	5.90%	9.60%	6.50%	5.90%
Gastrointestinal problems (e.g., nausea, bloating, cramping, diarrhea)	17	12	14	17
	10.00%	12.80%	13.00%	10.00%
Cardiovascular problems (e.g., fast or irregular heartbeat, jitteriness, chest discomfort)	23	18	20	23
	13.50%	19.10%	18.50%	13.50%
Musculoskeletal problems (e.g., muscle or joint pain, cramps, weakness)	11	7	9	11
	6.50%	7.40%	8.30%	6.50%
Other	7	3	1	7
	4.10%	3.20%	0.90%	4.10%

Table 7

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

	GenPop	ChemSens	Asthmatic	FragSens
Total	1100	179	278	306
	100.00%	100.00%	100.00%	100.00%
Yes	66	46	52	66
	6.00%	25.70%	18.70%	21.60%
No	926	98	191	187
	84.20%	54.70%	68.70%	61.10%
Don't know/not sure	107	35	35	53
	9.70%	19.60%	12.60%	17.30%
Decline to answer	1	-	-	-
	0.10%	-	-	-

Table 8

BA. Which of the following health problems do you experience?

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

	GenPop	ChemSens	Asthmatic	FragSens
Total	66	46	52	66
	100.00%	100.00%	100.00%	100.00%
Migraine headaches	15	13	12	15
	22.70%	28.30%	23.10%	22.70%
Asthma attacks	23	15	22	23
	34.80%	32.60%	42.30%	34.80%
Neurological problems (e.g., dizziness, seizures, head pain, fainting, loss of coordination)	8	7	7	8
	12.10%	15.20%	13.50%	12.10%
Respiratory problems (e.g., difficulty breathing, coughing, shortness of breath)	21	15	21	21
	31.80%	32.60%	40.40%	31.80%
Skin problems (e.g., rashes, hives, red skin, tingling skin, dermatitis)	17	12	10	17
	25.80%	26.10%	19.20%	25.80%
Cognitive problems (e.g., difficulties thinking, concentrating, or remembering)	11	9	8	11
	16.70%	19.60%	15.40%	16.70%
Mucosal symptoms (e.g., watery or red eyes, nasal congestion, sneezing)	12	9	10	12
	18.20%	19.60%	19.20%	18.20%
Immune system problems (e.g., swollen lymph glands, fever, fatigue)	9	7	6	9
	13.60%	15.20%	11.50%	13.60%
Gastrointestinal problems (e.g., nausea, bloating, cramping, diarrhea)	7	5	6	7
	10.60%	10.90%	11.50%	10.60%
Cardiovascular problems (e.g., fast or irregular heartbeat, jitteriness, chest discomfort)	6	5	6	6
	9.10%	10.90%	11.50%	9.10%
Musculoskeletal problems (e.g., muscle or joint pain, cramps, weakness)	8	7	7	8
	12.10%	15.20%	13.50%	12.10%
Other	1	1	1	1
	1.50%	2.20%	1.90%	1.50%

Table 9

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

	GenPop	ChemSens	Asthmatic	FragSens
Total	1100	179	278	306
	100.00%	100.00%	100.00%	100.00%
Yes	154	94	89	154
	14.00%	52.50%	32.00%	50.30%
No	839	60	149	113
	76.30%	33.50%	53.60%	36.90%
Don't know/not sure	105	24	39	38
	9.50%	13.40%	14.00%	12.40%
Decline to answer	2	1	1	1
	0.20%	0.60%	0.40%	0.30%

Table 10

BA. Which of the following health problems do you experience?

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

	GenPop	ChemSens	Asthmatic	FragSens
Total	154	94	89	154
	100.00%	100.00%	100.00%	100.00%
Migraine headaches	41	23	20	41
	26.60%	24.50%	22.50%	26.60%
Asthma attacks	33	25	31	33
	21.40%	26.60%	34.80%	21.40%
Neurological problems (e.g., dizziness, seizures, head pain, fainting, loss of coordination)	18	11	12	18
	11.70%	11.70%	13.50%	11.70%
Respiratory problems (e.g., difficulty breathing, coughing, shortness of breath)	66	45	42	66
	42.90%	47.90%	47.20%	42.90%
Skin problems (e.g., rashes, hives, red skin, tingling skin, dermatitis)	36	23	21	36
	23.40%	24.50%	23.60%	23.40%
Cognitive problems (e.g., difficulties thinking, concentrating, or remembering)	16	12	11	16
	10.40%	12.80%	12.40%	10.40%
Mucosal symptoms (e.g., watery or red eyes, nasal congestion, sneezing)	41	25	22	41
	26.60%	26.60%	24.70%	26.60%
Immune system problems (e.g., swollen lymph glands, fever, fatigue)	9	5	5	9
	5.80%	5.30%	5.60%	5.80%
Gastrointestinal problems (e.g., nausea, bloating, cramping, diarrhea)	11	8	10	11
	7.10%	8.50%	11.20%	7.10%
Cardiovascular problems (e.g., fast or irregular heartbeat, jitteriness, chest discomfort)	11	9	10	11
	7.10%	9.60%	11.20%	7.10%
Musculoskeletal problems (e.g., muscle or joint pain, cramps, weakness)	7	7	7	7
	4.50%	7.40%	7.90%	4.50%
Other	9	4	1	9
	5.80%	4.30%	1.10%	5.80%

Table 11

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

	GenPop	ChemSens	Asthmatic	FragSens
Total	1100	179	278	306
	100.00%	100.00%	100.00%	100.00%
Yes	151	73	79	151
	13.70%	40.80%	28.40%	49.30%
No	872	80	168	128
	79.30%	44.70%	60.40%	41.80%
Don't know/not sure	76	26	31	27
	6.90%	14.50%	11.20%	8.80%
Decline to answer	1	-	-	-
	0.10%	-	-	-

Table 12

BA. Which of the following health problems do you experience?

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

	GenPop	ChemSens	Asthmatic	FragSens
Total	151	73	79	151
	100.00%	100.00%	100.00%	100.00%
Migraine headaches	37	20	17	37
	24.50%	27.40%	21.50%	24.50%
Asthma attacks	25	14	24	25
	16.60%	19.20%	30.40%	16.60%
Neurological problems (e.g., dizziness, seizures, head pain, fainting, loss of coordination)	13	8	9	13
	8.60%	11.00%	11.40%	8.60%
Respiratory problems (e.g., difficulty breathing, coughing, shortness of breath)	46	25	31	46
	30.50%	34.20%	39.20%	30.50%
Skin problems (e.g., rashes, hives, red skin, tingling skin, dermatitis)	26	13	14	26
	17.20%	17.80%	17.70%	17.20%
Cognitive problems (e.g., difficulties thinking, concentrating, or remembering)	12	9	9	12
	7.90%	12.30%	11.40%	7.90%
Mucosal symptoms (e.g., watery or red eyes, nasal congestion, sneezing)	51	25	23	51
	33.80%	34.20%	29.10%	33.80%
Immune system problems (e.g., swollen lymph glands, fever, fatigue)	5	4	3	5
	3.30%	5.50%	3.80%	3.30%
Gastrointestinal problems (e.g., nausea, bloating, cramping, diarrhea)	12	5	6	12
	7.90%	6.80%	7.60%	7.90%
Cardiovascular problems (e.g., fast or irregular heartbeat, jitteriness, chest discomfort)	13	6	7	13
	8.60%	8.20%	8.90%	8.60%
Musculoskeletal problems (e.g., muscle or joint pain, cramps, weakness)	11	11	11	11
	7.30%	15.10%	13.90%	7.30%
Other	6	3	1	6
	4.00%	4.10%	1.30%	4.00%

Table 13

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

	GenPop	ChemSens	Asthmatic	FragSens
Total	1100	179	278	306
	100.00%	100.00%	100.00%	100.00%
Yes	153	88	81	153
	13.90%	49.20%	29.10%	50.00%
No	830	66	155	115
	75.50%	36.90%	55.80%	37.60%
Don't know/not sure	116	25	42	38
	10.50%	14.00%	15.10%	12.40%
Decline to answer	1	-	-	-
	0.10%	-	-	-

Table 14

BA. Which of the following health problems do you experience?

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

	GenPop	ChemSens	Asthmatic	FragSens
Total	153	88	81	153
	100.00%	100.00%	100.00%	100.00%
Migraine headaches	33	21	18	33
	21.60%	23.90%	22.20%	21.60%
Asthma attacks	30	23	29	30
	19.60%	26.10%	35.80%	19.60%
Neurological problems (e.g., dizziness, seizures, head pain, fainting, loss of coordination)	15	11	9	15
	9.80%	12.50%	11.10%	9.80%
Respiratory problems (e.g., difficulty breathing, coughing, shortness of breath)	51	34	33	51
	33.30%	38.60%	40.70%	33.30%
Skin problems (e.g., rashes, hives, red skin, tingling skin, dermatitis)	45	28	18	45
	29.40%	31.80%	22.20%	29.40%
Cognitive problems (e.g., difficulties thinking, concentrating, or remembering)	13	10	9	13
	8.50%	11.40%	11.10%	8.50%
Mucosal symptoms (e.g., watery or red eyes, nasal congestion, sneezing)	48	29	22	48
	31.40%	33.00%	27.20%	31.40%
Immune system problems (e.g., swollen lymph glands, fever, fatigue)	11	8	5	11
	7.20%	9.10%	6.20%	7.20%
Gastrointestinal problems (e.g., nausea, bloating, cramping, diarrhea)	11	10	9	11
	7.20%	11.40%	11.10%	7.20%
Cardiovascular problems (e.g., fast or irregular heartbeat, jitteriness, chest discomfort)	13	11	10	13
	8.50%	12.50%	12.30%	8.50%
Musculoskeletal problems (e.g., muscle or joint pain, cramps, weakness)	10	8	10	10
	6.50%	9.10%	12.30%	6.50%
Other	10	5	2	10
	6.50%	5.70%	2.50%	6.50%

Table 15

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?

	GenPop	ChemSens	Asthmatic	FragSens
Total	306	139	150	306
	100.00%	100.00%	100.00%	100.00%
Yes	78	58	56	78
	25.50%	41.70%	37.30%	25.50%
No	195	64	78	195
	63.70%	46.00%	52.00%	63.70%
Don't know/not sure	33	17	16	33
	10.80%	12.20%	10.70%	10.80%
Decline to answer	-	-	-	-
	-	-	-	-

Table 16

Do you consider yourself allergic or unusually sensitive to everyday chemicals like those in household cleaning products, experience spray and things like

	GenPop	ChemSens	Asthmatic	FragSens
Total	1100	179	278	306
	100.00%	100.00%	100.00%	100.00%
Yes	179	179	102	139
	16.30%	100.00%	36.70%	45.40%
No	830	-	145	131
	75.50%	-	52.20%	42.80%
Don't know/not sure	88	-	30	35
	8.00%	-	10.80%	11.40%
Decline to answer	3	-	1	1
	0.30%	-	0.40%	0.30%

Table 17

Has a doctor or health care professional ever told you that you have multiple chemical sensitivities?

	GenPop	ChemSens	Asthmatic	FragSens
Total	1100	179	278	306
	100.00%	100.00%	100.00%	100.00%
Yes	73	54	54	65
	6.60%	30.20%	19.40%	21.20%
No	983	118	212	223
	89.40%	65.90%	76.30%	72.90%
Don't know/not sure	41	7	12	17
	3.70%	3.90%	4.30%	5.60%
Decline to answer	3	-	-	1
	0.30%	-	-	0.30%

Table 18

Has a doctor or health care professional ever told you that you have asthma or an asthma-like condition?

	GenPop	ChemSens	Asthmatic	FragSens
Total	1100	179	278	306
	100.00%	100.00%	100.00%	100.00%
Yes - asthma	188	71	188	99
	17.10%	39.70%	67.60%	32.40%
Yes - asthma-like condition	99	36	99	58
	9.00%	20.10%	35.60%	19.00%
Yes - asthma/asthma-like condition (asthmatic)	278	102	278	150
	25.30%	57.00%	100.00%	49.00%
No	791	70	-	145
	71.90%	39.10%	-	47.40%
Don't know/not sure	30	7	-	11
	2.70%	3.90%	-	3.60%
Decline to answer	1	-	-	-
	0.10%	-	-	-

Table 19

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?

	GenPop	ChemSens	Asthmatic	FragSens
Total	1100	179	278	306
	100.00%	100.00%	100.00%	100.00%
Yes	133	69	76	94
	12.10%	38.50%	27.30%	30.70%
No	891	93	177	178
	81.00%	52.00%	63.70%	58.20%
Neutral/not sure	72	17	24	32
	6.50%	9.50%	8.60%	10.50%
Decline to answer	4	-	1	2
	0.40%	-	0.40%	0.70%

Table 20

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

	GenPop	ChemSens	Asthmatic	FragSens
Total	1100	179	278	306
	100.00%	100.00%	100.00%	100.00%
Yes	144	76	74	108
	13.10%	42.50%	26.60%	35.30%
No	827	66	163	134
	75.20%	36.90%	58.60%	43.80%
Neutral/not sure	125	36	40	62
	11.40%	20.10%	14.40%	20.30%
Decline to answer	4	1	1	2
	0.40%	0.60%	0.40%	0.70%

Table 21

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?

	GenPop	ChemSens	Asthmatic	FragSens
Total	1100	179	278	306
	100.00%	100.00%	100.00%	100.00%
Yes	113	65	72	83
	10.30%	36.30%	25.90%	27.10%
No	899	96	184	192
	81.70%	53.60%	66.20%	62.70%
Neutral/not sure	82	17	21	29
	7.50%	9.50%	7.60%	9.50%
Decline to answer	6	1	1	2
	0.50%	0.60%	0.40%	0.70%

Table 22

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

	GenPop	ChemSens	Asthmatic	FragSens
Total	1100	179	278	306
	100.00%	100.00%	100.00%	100.00%
Yes	148	71	77	98
	13.50%	39.70%	27.70%	32.00%
No	873	97	183	182
	79.40%	54.20%	65.80%	59.50%
Don't know/not sure	76	11	17	24
	6.90%	6.10%	6.10%	7.80%
Decline to answer	3	-	1	2
	0.30%	-	0.40%	0.70%

Table 23

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

	GenPop	ChemSens	Asthmatic	FragSens
Total	1100	179	278	306
	100.00%	100.00%	100.00%	100.00%
Yes	69	38	39	50
	6.30%	21.20%	14.00%	16.30%
No	953	125	217	229
	86.60%	69.80%	78.10%	74.80%
Don't know/not sure	74	16	21	24
	6.70%	8.90%	7.60%	7.80%
Decline to answer	4	-	1	3
	0.40%	-	0.40%	1.00%

Table 24

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

	GenPop	ChemSens	Asthmatic	FragSens
Total	1100	179	278	306
	100.00%	100.00%	100.00%	100.00%
Yes	492	124	152	195
	44.70%	69.30%	54.70%	63.70%
No	256	27	50	47
	23.30%	15.10%	18.00%	15.40%
Neutral/not sure	344	28	74	62
	31.30%	15.60%	26.60%	20.30%
Decline to answer	8	-	2	2
	0.70%	-	0.70%	0.70%

Table 25

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

	GenPop	ChemSens	Asthmatic	FragSens
Total	1100	179	278	306
	100.00%	100.00%	100.00%	100.00%
Yes	476	122	153	196
	43.30%	68.20%	55.00%	64.10%
No	294	30	61	58
	26.70%	16.80%	21.90%	19.00%
Neutral/not sure	324	27	64	51
	29.50%	15.10%	23.00%	16.70%
Decline to answer	6	-	-	1
	0.50%	-	-	0.30%

Table 26

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

	GenPop	ChemSens	Asthmatic	FragSens
Total	1100	179	278	306
	100.00%	100.00%	100.00%	100.00%
Yes	306	139	150	306
	27.80%	77.70%	54.00%	100.00%

Table 27

People who answer "Yes" to each type of health problem under BA for each of these questions Q2/Q3/Q4/Q5/Q6.

	GenPop	ChemSens	Asthmatic	FragSens
Total	1100	179	278	306
	100.00%	100.00%	100.00%	100.00%
Migraine headaches	92	49	47	92
	8.40%	27.40%	16.90%	30.10%
Asthma attacks	75	46	71	75
	6.80%	25.70%	25.50%	24.50%
Neurological problems (e.g., dizziness, seizures, head pain, fainting, loss of coordination)	41	24	24	41
	3.70%	13.40%	8.60%	13.40%
Respiratory problems (e.g., difficulty breathing, coughing, shortness of breath)	128	74	83	128
	11.60%	41.30%	29.90%	41.80%
Skin problems (e.g., rashes, hives, red skin, tingling skin, dermatitis)	108	58	54	108
	9.80%	32.40%	19.40%	35.30%
Cognitive problems (e.g., difficulties thinking, concentrating, or remembering)	31	24	22	31
	2.80%	13.40%	7.90%	10.10%
Mucosal symptoms (e.g., watery or red eyes, nasal congestion, sneezing)	101	54	52	101
	9.20%	30.20%	18.70%	33.00%
Immune system problems (e.g., swollen lymph glands, fever, fatigue)	21	14	11	21
	1.90%	7.80%	4.00%	6.90%
Gastrointestinal problems (e.g., nausea, bloating, cramping, diarrhea)	33	19	22	33
	3.00%	10.60%	7.90%	10.80%
Cardiovascular problems (e.g., fast or irregular heartbeat, jitteriness, chest discomfort)	35	24	27	35
	3.20%	13.40%	9.70%	11.40%
Musculoskeletal problems (e.g., muscle or joint pain, cramps, weakness)	22	17	20	22
	2.00%	9.50%	7.20%	7.20%
Other	23	9	5	23
	2.10%	5.00%	1.80%	7.50%

Table 28

Demographics

	GenPop	ChemSens	Asthmatic	FragSens
Total	1100	179	278	306
	100.00%	100.00%	100.00%	100.00%
Male/Female				
All Males	550	85	131	141
	50.00%	47.50%	47.10%	46.10%
All Females	550	94	147	165
	50.00%	52.50%	52.90%	53.90%
Gender vs Age				
Male 18-24	83	16	22	20
	7.50%	8.90%	7.90%	6.50%
Male 25-34	102	21	33	39
	9.30%	11.70%	11.90%	12.70%
Male 35-44	107	20	28	30
	9.70%	11.20%	10.10%	9.80%
Male 45-54	135	16	29	27
	12.30%	8.90%	10.40%	8.80%
Male 55-65	123	12	19	25
	11.20%	6.70%	6.80%	8.20%
Female 18-24	81	17	27	22
	7.40%	9.50%	9.70%	7.20%
Female 25-34	129	24	38	41
	11.70%	13.40%	13.70%	13.40%
Female 35-44	135	23	27	43
	12.30%	12.80%	9.70%	14.10%
Female 45-54	108	14	28	33
	9.80%	7.80%	10.10%	10.80%
Female 55-65	97	16	27	26
	8.80%	8.90%	9.70%	8.50%

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.

Checklist for Reporting Results of Internet E-Surveys (CHERRIES)		
Item Category	***Checklist Item***	***Explanation***
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		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.
	Open survey versus closed survey	Closed survey (only SSI participants), general population, random sample nationally representative of demographics.
	Contact mode	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 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		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.
	Unique site visitor	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	not used
	IP check	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	not used
	Registration	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	Only completed questionnaires were included in the final dataset for analysis.
	Questionnaires submitted with an atypical timestamp	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.