

ORIGINAL ARTICLE

Awareness and Attitudes towards Fragrance Products And Its Associated Health Symptoms Among Malaysian Adults - A Cross-Sectional Study

Michelle Mah Hui Lin¹, Chee Kin Weng¹, Sasmitaasree Sugumaran¹, Saila Dharishinee a/p Alagu¹, Avinaash Vijayarao¹, Soe Moe², Muhammad Zulfiqah Sadikan^{3,4}, Mila Nu Nu Htay^{2,5}

¹ Faculty of Medicine, Manipal University College Malaysia, Bukit Baru, 75150 Melaka, Malaysia.

² Department of Community Medicine, Faculty of Medicine, Manipal University College Malaysia, Bukit Baru, 75150 Melaka, Malaysia.

³ Faculty of Pharmacy and Health Sciences, Universiti Kuala Lumpur Royal College of Medicine Perak, Jalan Greentown, 30450 Ipoh, Perak.

⁴ Department of Pharmacology, Faculty of Medicine, Manipal University College Malaysia, Bukit Baru, 75150 Melaka, Malaysia.

⁵ Centre for Population Health (CePH), Department of Social and Preventive Medicine, Faculty of Medicine, Universiti Malaya, Kuala Lumpur, Malaysia

ABSTRACT

Introduction: Fragranced products, prevalent in personal care and household items, can enhance sensory experiences but pose health risks such as respiratory problems, skin irritation, and migraines. This study aimed to investigate the awareness, and attitudes towards fragrance products, utilization patterns of various fragrance products and their association with health symptoms among the general adult population. **Methods:** This cross-sectional study was conducted by recruiting the general adult population in Malaysia by convenience sampling method. Data was collected via an online questionnaire, covering demographics, health conditions, fragrance exposure, awareness, attitudes, and health symptoms. Data was analysed by SPSS version 28. **Results:** A total of 403 respondents participated in this study. 46.9% were more frequently exposed and utilized to fragrance products. Being female (OR:2.21, 95%CI:1.36, 3.58), Chinese ethnicity (OR:0.22, 95%CI:0.07, 0.68), and attitudes (OR:2.91, 95%CI:1.80, 4.69) were significantly associated with frequent utilization of fragrance products. Meanwhile, the occurrence of health symptoms after exposure to fragrance products was significantly associated with existing dermatological conditions (OR:2.90, 95%CI:1.51, 5.57). **Conclusion:** Frequent exposure to fragrance products is common among Malaysian adults, with nearly half (47%) of the respondents regularly using them. Awareness of the potential health risks of fragrance products is high, but usage patterns are influenced by gender, ethnicity, and personal attitudes. Women and those with more positive attitudes towards fragrances are more likely to use them, while utilization is lower among the Chinese ethnic group. This highlights the need for targeted public health strategies to address health concerns and promote informed decision-making about fragrance use.

Malaysian Journal of Medicine and Health Sciences (2025) 21(6): 1-11. doi:10.47836/mjmh.v21.i6.1383

Keywords: Fragrance, Fragrance products, Health symptoms, Awareness, Malaysia

Corresponding Author:

Muhammad Zulfiqah Sadikan, PhD

Email: mzsadikan@yahoo.com

Tel: +6018-2240885

Introduction

The widespread use of fragrance products has become a notable aspect of modern lifestyle, with these products being embedded in various consumer goods, ranging from personal care items to household cleaning agents. Designed to enhance sensory experiences, fragrance products include perfumes, lotions, shampoos, air fresheners, and scented candles. However, alongside their popularity, there is growing concern regarding their potential health implications (1).

There are many reasons why people choose fragrance

products, such as perfumes or colognes, or even products with fragrances like air fresheners or scented essential oils. The human mind is a complex organ, and attempting to quantify all these reasons would be irrational. Some potential motivations include the fact that fragrances enhance product appeal, making them more attractive and desirable. Previous studies have shown that the limbic system, a key part of the human brain, functions as the central hub for emotion, mood regulation, motivation, and sexual behaviour. It is directly stimulated through the sense of smell and plays a crucial role in the selection and transmission of information between our short-term and long-term memories via the corresponding associative regions of the limbic system. This information is received through various sensory regions, such as the olfactory region, which is also known as the 'rhinencephalon' or the

'smell brain' (2). Recent studies have highlighted the association between fragrance products and a range of adverse health symptoms. Steinemann (2019) conducted a study which indicated that a significant portion of the population experiences health issues due to fragrance exposure, including respiratory problems, skin irritation, and migraine headaches (3). Scented personal care products, such as perfumes and lotions, have been linked to immediate allergic reactions and long-term respiratory issues. Al Khathlan et al emphasized that frequent use of fragrance products such as scented candles could lead to increasing the prevalence of respiratory symptoms among users (4). The most common adverse health effects associated with fragrance product exposure include respiratory issues, mucosal symptoms, migraine headaches, dermatological issues, asthma attacks, and neurological problems. Across four countries, 9.5% of the general population—representing 29.1% of fragrance-sensitive individuals (49.5% in the US, 17.1% in Australia, 25.5% in the UK, and 24.2% in Sweden) reported health effects that can be considered disabling (3).

Heisterberg et al. found out that frequently identified sources of allergic contact dermatitis included deodorants (25.3%), scented lotions (24.4%), fine fragrances (16.0%), shampoos (13.0%), liquid soaps (10.8%), aftershaves (2.7%), and lipsticks (1.9%). The remaining categories had frequencies of 1% or less (5). In Malaysia, few studies are exploring this topic in depth. One example is a five-year retrospective study of patients who developed positive reactions to fragrance allergens at the Department of Dermatology in Hospital Kuala Lumpur. The study revealed that about 15% of patients who underwent patch testing had contact sensitization to fragrance allergens. Among the 854 patients, the most common initial presentations included allergic contact dermatitis, hand eczema, contact dermatitis, discoid eczema, atopic eczema, cheilitis, hand and foot eczema, and lichen planus/lichenoid reaction of the oral mucosa (6).

In Malaysia, the existing studies focus primarily on contact sensitization associated with fragrance allergies. To our knowledge, there are limited studies that explored the association between fragranced products and other health-related symptoms, including respiratory, neurological (migraines, dizziness, etc.), mucosal (watery or red eyes, nasal congestion, sneezing, etc.), gastrointestinal (nausea, vomiting, etc.), cardiovascular (palpitation, chest discomfort, etc.), and musculoskeletal symptoms (muscle or joint pain, cramps, etc.). Studies examining a broader range of health-related symptoms have only been conducted outside of Malaysia, such as in Germany (7), United Kingdom, Australia, United States, and Sweden (3). Therefore, it is important to conduct this study among the adult population in Malaysia to investigate how many adults are affected by health-related symptoms caused by fragranced products

in the general population. This study aimed to bridge this gap by examining the awareness, attitudes towards fragrance products, utilization patterns of various fragrance products and their association with health symptoms among the general adult population.

Methods

Study design and study population

This cross-sectional analytical study was conducted from June to August 2024 by recruiting the general adult population in Malaysia.

Sample size and sampling

The sample size was determined using OpenEpi (OpenEpi Version 3.01) statistical calculator. The estimated prevalence of health-related symptoms in correlation to fragranced product usage is 34.7% (1). The sample size was calculated with a 95% confidence level and 5% precision. Considering a non-response rate of 10%, the final required sample size was 388. The participants were recruited by convenience sampling method. Study participants were recruited by distributing online survey links via Whatsapp, Telegram, Instagram, and email. Adults aged 18 and above, residing in Malaysia, regardless of their nationality and socio-demographic background were recruited in this study.

Data collection

The data was collected through an online questionnaire form that we created, and the content was validated with expert opinions. This questionnaire was designed and developed based on insights from previous studies (8-10). The questionnaires were prepared in dual languages: English and Bahasa Malaysia. There were seven sections in this questionnaire, with a total of 61 questions.

Section 1: Demographic Information

This section collected demographic information of the participants. Information collected included gender, age, nationality, ethnicity, relationship status, highest completed education level, occupation, total household income per month and residing area.

Section 2: Pre-existing health conditions among the general adult population in Malaysia

This section collected information on pre-existing health conditions and habits. The data collected were, if the participant is a smoker (whether active or reformed, using traditional cigarettes or e-cigarettes), has any pre-existing lung disorders (such as chronic obstructive pulmonary disease, lung cancer, bronchial asthma or chronic bronchitis) and has any pre-existing dermatological disorders (such as atopic dermatitis/eczema, or psoriasis).

Section 3: Exposure of products with fragrance among adults in Malaysia

This section started with a brief introduction to products with fragrance and their examples. Pictures illustrating commonly used products with fragrances were shown for participants' better understanding. There was a total of 13 questions in this section. Participants were asked questions to measure their exposure to products with fragrance in one week. Examples of products with fragrance include air fresheners and deodorizers (e.g., sprays, solids, oils), Personal care products (e.g., lotion, skin care products, shampoo, soap, make-up, hand sanitiser, sanitary pads, essential oils), Cleaning supplies (e.g., all-purpose cleaners, disinfectants, dishwashing soap), Laundry products (e.g., detergents, fabric softeners), Household products (e.g., scented candles, toilet paper, trash bags, baby products), Fragrance (e.g., perfume, cologne, after-shave, skin musk) and Religious products (e.g., incense, joss sticks). Data on their exposure was collected based on their usage of these products and their exposure to other people's use of these products. The data was collected with a score range of 0-4 points per question, using a Likert scale, from "0 = never, 1 = rarely, 2 = sometimes, 3 = often, 4 = very often".

Section 4: Awareness of adults in Malaysia on the presence of fragrance in consumer products

This section measured the awareness of the presence of fragrance in consumer products and contains 9 questions. Each question is a "Yes or No" question, where participants were asked a series of questions to determine if they were aware of the given scenario or if they were already practising certain habits out of their pre-existing awareness of fragrance in products.

Section 5: Awareness of adults in Malaysia the association of fragrance with health symptoms

This section focuses on the awareness of the association of fragrance with health symptoms and contains 7 questions.

Section 6: Attitude of adults in Malaysia towards products with fragrance

This section which contains 9 questions focuses on a series of statement-based questions where participants were asked if they agree or disagree with each statement. These statements are formed in a 1st person's perspective and decision to carry out certain activities and decisions which revolve around their liking or attitude towards fragrance products despite potential health risks. Data on their attitude was collected via a score range of 1-5 points per question, using a Likert scale, from "1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, 5 = strongly agree".

Section 7: Prevalence of potential health risks according to exposure level of fragrance in products

This section consisted of 9 questions. Participants are then asked if they experience a series of symptoms

such as migraine, asthma attacks, neurological problems, respiratory problems, mucosal symptoms, gastrointestinal problems, cardiovascular problems, musculoskeletal problems and if they have ever sought medical advice for symptoms believed to be caused by fragrances.

Overview of methodology on investigating awareness, attitudes, and health impacts of fragranced products in the Malaysian adult population is presented in Figure 1.

Data analysis

Our data was processed and analyzed using the SPSS (Version 28) software. Results were presented through frequency counts and other descriptive statistics. Inferential statistical analysis of multivariate logistic regression analysis was conducted to identify the association between the demography, awareness, attitudes, and exposure level. Furthermore, the factors associated with the occurrence of health symptoms are assessed by multivariate logistic regression analysis. The significant level (p-value) was set up at 0.05 with a 95% confidence interval.

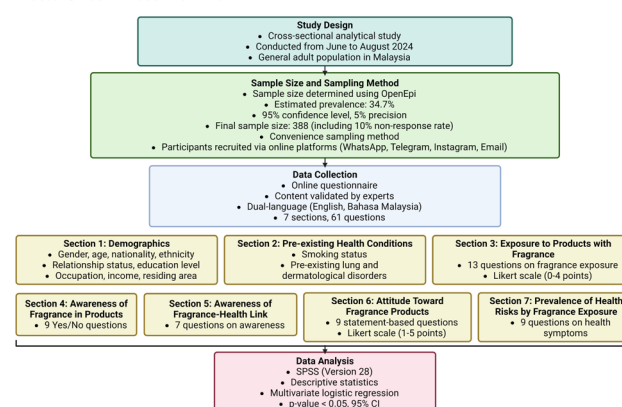


Figure 1: Overview of methodology on investigating awareness, attitudes, and health impacts of fragranced products in the Malaysian adult population.

Ethical consideration

The background information of the study and outline contents of the survey form were provided to the participants. Participation is voluntary and informed consent was obtained from the participants. Ethical approval to conduct the study is granted by the Research Ethics Committee (MUCM) (MUCM/ Research Ethics Committee – 005A/05/2024).

Results

Table 1 presents the survey population's demographic characteristics, which consisted of 403 respondents. Among the participants, 57.6% were female, more than half were young adults aged 18-25 years old (59.8%), and mainly Malaysians (97.3%). Approximately half of the respondents were middle 40 income range (45.9%), and the majority were residing in urban areas (82.9%). Among the respondents, 53.1% (n=214) reported of less frequent own usage, and 46.9% (n=189) reported to have more frequent own usage. (Table 1).

Table I: Demographic Characteristics of our respondents (n = 403)

Demographic Characteristics	n(%)
Gender	
Male	171 (42.4%)
Female	232 (57.6%)
Age (Completed Years)	
Young Adult (18-25 years)	241 (59.8%)
Adult (26-44 years)	88 (21.8%)
Middle Age (45-59 years)	63 (15.6%)
Old Age (>60 years)	11 (2.7%)
Nationality	
Malaysian	392 (97.3%)
Non-Malaysian	11 (2.7%)
Ethnicity	
Malay	58 (14.4%)
Chinese	223 (55.3%)
Indian	102 (25.3%)
Others	20 (5.0%)
Relationship Status	
Single	278 (69.0%)
Married	116 (28.8%)
Divorced	4 (1.0%)
Widowed	5 (1.2%)
Highest Completed Education Level	
Primary Education	4 (1.0%)
Secondary Education	134 (33.3%)
Tertiary Education	264 (65.5%)
No Schooling	1 (0.2%)
Occupation	
Student	210 (52.1%)
Employed	164 (40.7%)
Unemployed	29 (7.2%)
Total Household Income per month	
B40 (<RM4,850)	122 (30.3%)
M40 (RM4,850-RM10,959)	185 (45.9%)
T20 (RM10,959)	96 (23.8%)
Residing Area	
Rural	73 (18.1%)
Urban	330 (81.9%)
Smoking	
Yes	36 (8.9)
No	367 (91.1)
Lungs disorder	
Yes	16 (4.0)
No	387 (96.0)
Dermatological Disorders	
Yes	50 (12.4)
No	353 (87.6)

CONTINUE

Demographic Characteristics	n(%)
Own Usage of fragrance products	
Less Frequent ¹	214 (53.1)
More Frequent ²	189 (46.9)

Note: Smoking includes active/reformed smokers, & traditional cigarettes/e-cigarettes. Lung disorders include Chronic Obstructive Pulmonary Disease (COPD), Lung cancer, Bronchial asthma, and Chronic bronchitis. Dermatological Disorders include atopic dermatitis (eczema), psoriasis

¹ Score: Total scoring <12, based on Median value (12.00)

² Score: Total scoring >12, based on Median value (12.00)

The majority of the respondents were aware of the presence of fragrances in products and they are mainly chemical compounds (>90%). However, only 43.2% reported that they were aware to check the labels for the fragrances (Table 2).

Table II: Awareness of adults in Malaysia towards the presence of fragrance in consumer products (n=403)

Question	Yes n (%)	No n (%)
Awareness on the fact that fragrances are added for the purpose of improving the appeal of the product	383 (95.0%)	20 (5.0%)
Awareness on the fact that fragrances added are often chemical compounds	381 (94.5%)	22 (5.5%)
Awareness to check the product labels to identify if the fragrance is listed	174 (43.2%)	229 (56.8%)
Awareness on the fact that fragrances are commonly added to air fresheners and deodorizers (e.g. sprays, solids, oils, disks)	381 (94.5%)	22 (5.5%)
Awareness on the fact that fragrances are commonly added to personal care products (e.g. soaps, hand sanitizer, lotions, deodorant, sunscreen, shampoos, essential oils)	389 (96.5%)	14 (3.5%)
Awareness on the fact that fragrances are commonly added to cleaning supplies (e.g. all-purpose cleaners, disinfectants, dishwashing soap)	385 (95.5%)	18 (4.5%)

CONTINUE

Question	Yes n (%)	No n (%)	Items	n (%)
Awareness on the fact that fragrances are commonly added to laundry products (e.g. detergents, fabric softeners, dryer sheets)	393 (97.5%)	10 (2.5%)	Yes	310 (76.9%)
			No	52 (12.9%)
			Not Sure	41 (10.2%)
Awareness on the fact that fragrances are commonly added to household products (e.g. scented candles, toilet paper, trash bags, baby products)	366 (90.8%)	37 (9.2%)	Red eyes, nasal congestion, sneezing	
			Yes	276 (68.5%)
			No	67 (16.6%)
			Not Sure	60 (14.9%)
Awareness on the fact that fragrances are commonly added to personal fragrances (e.g. perfume, cologne, after-shave, skin musk)	391 (97.0%)	12 (3.0%)	Gastrointestinal symptoms ²	
			Yes	89 (22.1%)
			No	168 (41.7%)
			Not Sure	146 (36.2%)
			Cardiovascular symptoms ³	
			Yes	89 (22.1%)
			No	154 (38.2%)
			Not Sure	160 (39.7%)
			Cancer	
			Yes	129 (32.0%)
			No	120 (29.8%)
			Not Sure	154 (38.2%)
			Have had experienced any of the above-mentioned symptoms after using or being exposed to fragranced products	
			Yes	162 (40.2%)
			No	200 (49.6%)
			Not Sure	41 (10.2%)
			Concerned about the ingredients used in fragranced products	
			Very Concerned	50 (12.4%)
			Slightly Concerned	79 (19.6%)
			Neutral	151 (37.5%)
			Not Very Concerned	87 (21.6%)
			Not Concerned at All	36 (8.9%)
			Information sources about the health effects of fragranced products ⁴	
			Healthcare Professionals	126 (31.3%)
			News and Media	197 (48.9%)
			Internet (websites, social media)	330 (81.9%)
			Family & Friends	155 (38.5%)
			Awareness on correlation between fragranced products and health symptoms	
			Yes	269 (66.7%)
			No	41 (10.2%)
			Not Sure	93 (23.1%)
			Do you think there is enough awareness in Malaysia about the potential health risks associated with fragranced products?	
			Yes	32 (7.9%)
			No	318 (78.9%)
			Not Sure	53 (13.2%)

¹ Respiratory problems include asthma, difficulty in breathing and coughing² Gastrointestinal symptoms include nausea, diarrhea and vomiting³ Cardiovascular symptoms include fast or irregular heartbeat, jitteriness and chest discomfort⁴ Multiple answers allowed

CONTINUE

Among the attitude fragrance, “fragrance is an important factor in my choice of personal care products (mean: 3.35)” has the highest score, which is followed by “I would invest in humidifiers and essential oils to make my living environment smell good (mean: 3.08)” and

“It is important for me to use deodorant or perfumes on a regular basis to boost my confidence (mean: 3.07)” (Table 4).

Table IV: The attitude of adults in Malaysia towards products with fragrance (n= 403)

Items	Mean (SD)
Fragrance is an important factor in my choice of personal care products.	3.35
I prefer products with a strong fragrance over those with no fragrance.	2.67
I would invest in humidifiers and essential oils to make my living environment smell good.	3.08
I am not willing to pay more for fragrance-free alternatives.	2.92
I use fragrant incense sticks for religious practices even if people around me experience health symptoms due to this.	2.08
I still use products with fragrance to smell good even if the people around me experience health symptoms due to the fragrance.	2.30
It is important for me to use deodorant or perfumes on a regular basis to boost my confidence.	3.07
I disregard warnings or news about the potential health effects of fragranced products.	2.30
I assume that fragrance in household products signifies cleanliness and effectiveness.	2.91

The factors associated with the utilization of fragrance products are reported in Table 5. Gender is found to be significantly associated with the more frequent exposure and utilization of fragrance products (OR: 2.21, 95%CI: 1.36, 3.58). Chinese ethnicity were less likely to utilize fragrance products compared to other ethnicity (OR:

0.22, 95% CI: 0.07, 0.68). Furthermore, good attitudes towards fragrances were significantly associated with more frequent exposure and utilization (OR: 2.91, 95%CI: 1.80, 4.69) (Table 5).

Table V: Multivariate logistic regression analysis on association between demographic factors, awareness, attitudes on presence of fragrances and own utilization to fragrance products

Demographic Factors	Own Usage		aOR (95%CI)	P-Value
	Less Frequent Exposure n (%)	More Frequent Exposure n (%)		
Gender				
Female	105 (45.3)	127 (54.7)	2.21 (1.36, 3.58)	0.001
Male	109 (63.7)	62 (36.3)	Ref	
Age (Completed Years)				
Young Adult (18-25 years)	114 (47.3)	127 (52.7)	4.23 (0.65, 27.49)	0.131
Adult (26-44 years)	51 (58.0)	37 (42.0)	2.04 (0.33, 12.63)	0.443
Middle Age (45-59 years)	40 (63.5)	23 (36.5)	1.42 (0.23, 8.75)	0.707
Old Age (>60 years)	9 (81.8)	2 (18.2)	Ref	
Ethnicity				
Malay	18 (31.0)	40 (69.0)	0.84 (0.24, 2.91)	0.785
Chinese	163 (73.1)	60 (26.9)	0.22 (0.07, 0.68)	0.008
Indian	27 (26.5)	75 (73.5)	0.82 (0.25, 2.66)	0.744
Others ¹	6 (30.0)	14 (70.0)	Ref	
Highest Completed Education Level				
Secondary Education	74 (55.2)	60 (44.8)	0.88 (0.07, 10.80)	0.919
Tertiary Education	138 (52.3)	126 (47.7)	0.63 (0.05, 7.73)	0.716
Primary Education	2 (50.0)	2 (50.0)	Ref	

CONTINUE

Demographic Factors	Own Usage		aOR (95%CI)	P-Value
	Less Frequent Exposure n (%)	More Frequent Exposure n (%)		
Occupation				
Student	98 (46.7)	112 (53.3)	0.52 (0.17, 1.65)	0.270
Employed	99 (60.4)	65 (39.6)	0.75 (0.27, 2.07)	0.580
Unemployed	17 (58.6)	12 (41.4)	Ref	
Total Household Income per month				
M40 (RM4,850-RM10,959)	99 (53.5)	86 (46.5)	1.15 (0.67, 1.96)	0.611
T20 (RM10,959)	44 (45.8)	52 (54.2)	1.87 (0.97, 3.59)	0.061
B40 (<RM4,850)	71 (58.2)	51 (41.8)	Ref	
Residence area				
Rural	37 (50.7)	36 (49.3)	0.64 (0.35, 1.19)	0.161
Urban	177 (53.6)	153 (46.4)	Ref	
Awareness on presence of fragrances in products				
Good awareness	182 (52.3)	166 (47.7)	0.92 (0.47, 1.78)	0.799
Poor awareness	32 (58.2)	23 (41.8)	Ref	
Attitudes towards the fragrance products				
Good attitudes	83 (38.2)	134 (61.8)	2.91 (1.80, 4.69)	<0.001
Poor attitudes	131 (70.4)	55 (29.6)	Ref	

¹ Includes Kadazan, Bidayuh, Indian Muslim, Dusun, Bumiputera Sarawak, Punjabi, Eurasian, Bangladesh, Chinese Thai, Australian, Filipino, Canadian, Chindian

In multivariate logistic regression analysis, having experience with health-related symptoms after using fragrance products was significantly associated with having dermatological conditions (OR: 2.90, 95%

CI:1.51, 5.57) after adjusting the demographic variables (Table 6).

Table VI: Multivariate logistic regression analysis on the association between utilization of fragrance products and having experienced health symptoms

Demographic Factors	Having experience with health symptoms n (%)	No experience with health symptoms n (%)	aOR (95%CI)	P-Value
Gender				
Female	106 (45.7)	126 (54.3)	2.13 (1.33, 3.42)	0.002
Male	56 (32.7)	115 (67.3)	Ref	
Age (Completed Years)				
Young Adult (18-25 years)	111 (46.1)	130 (53.9)	5.02 (0.67, 37.64)	0.117
Adult (26-44 years)	31 (35.2)	57 (64.8)	2.26 (0.31, 16.47)	0.422
Middle Age (45-59 years)	18 (28.6)	45 (71.4)	1.45 (0.20, 10.58)	0.713
Old Age (>60 years)	1 (18.2)	9 (81.8)	Ref	
Ethnicity				
Malay	20 (34.5)	38 (65.5)	0.74 (0.24, 2.32)	0.610
Chinese	90 (40.4)	133 (59.6)	0.89 (0.32, 2.51)	0.830
Indian	42 (41.2)	60 (58.8)	0.67 (0.23, 1.90)	0.448
Others ¹	10 (50.0)	10 (50.0)	Ref	
Highest Completed Education Level				
Secondary Education	47 (35.1)	87 (64.9)	0.08 (0.01, 0.90)	0.041
Tertiary Education	112 (42.4)	152 (57.6)	0.11 (0.01, 1.20)	0.070
Primary Education	3 (75.0)	1 (25.0)	Ref	

CONTINUE

Demographic Factors	Having experience with health symptoms n (%)	No experience with health symptoms n (%)	aOR (95%CI)	P-Value
Occupation				
Student	96 (45.7)	114 (54.3)	1.15 (0.39, 3.38)	0.801
Employed	58 (35.4)	106 (64.6)	1.35 (0.49, 3.69)	0.560
Unemployed	8 (27.6)	21 (72.4)	Ref	
Total Household Income per month				
M40 (RM4,850-RM10,959)	70 (37.8)	115 (62.2)	0.92 (0.56, 1.53)	0.753
T20 (RM10,959)	43 (44.8)	53 (55.2)	1.43 (0.78, 2.63)	0.250
B40 (<RM4,850)	49 (40.2)	73 (59.8)	Ref	
Residence area				
Rural	26 (35.6)	47 (64.4)	0.90 (0.50, 1.61)	0.717
Urban	136 (41.2)	194 (58.8)	Ref	
Smoking ²				
Yes	14 (38.9)	22 (61.1)	1.70 (0.78, 3.70)	0.183
No	148 (40.3)	219 (59.7)	Ref	
Lung Disorders ³				
Yes	7 (43.8)	9 (56.3)	0.93 (0.31, 2.80)	0.894
No	155 (40.1)	232 (59.9)	Ref	
Dermatological Disorders ⁴				
Yes	32 (64.0)	18 (36.0)	2.90 (1.51, 5.57)	0.001
No	130 (36.8)	223 (63.2)	Ref	
Exposure to fragrance products				
More frequent	76 (39.2)	118 (60.8)	0.76 (0.47, 1.21)	0.240
Less frequent	86 (41.1)	123 (58.9)	Ref	

¹ Includes Kadazan, Bidayuh, Indian Muslim, Dusun, Bumiputera Sarawak, Punjabi, Eurasian, Bangladesh, Chinese Thai, Australian, Filipino, Canadian, Chindian

² Includes active/reformed smokers, & traditional cigarettes/e-cigarettes.

³ Includes Chronic Obstructive Pulmonary Disease (COPD), Lung cancer, Bronchial asthma, Chronic bronchitis.

⁴ Includes atopic dermatitis (eczema), psoriasis

Discussion

This study investigated the awareness, attitudes towards fragrance products, utilization patterns of various fragrance products and their association with health symptoms among the general adult population. Most of the respondents were aware of the presence of fragrances in products, and they are mainly chemical compounds (>90%), however, only a limited number of respondents checked the labels. Thus, there is a gap between awareness and active measures such as label-checking to mitigate potential health risks, suggesting a need for targeted education or clearer labeling.

Furthermore, a high level of awareness was reported on the health risks of fragrance products among the respondents. Our findings were similar to the previously conducted study in India, where 10% of study respondents were not aware of chemical substances in daily products which have harmful impacts on human health (11).

Among the respondents, 40.2% of respondents reported having experienced health symptoms such as migraine, headache, skin irritation, respiratory, nasal congestion, red eye, sneezing, etc after using or being exposed to fragranced products. The findings of our study higher prevalence compared with existing literature that suggests exposure to fragranced products to various health issues. A study by Caress and Steinemann (2009) found that 30.5% of the general population reported adverse health effects from exposure to fragranced products, with symptoms ranging from respiratory problems to migraines and mucosal symptoms (12). This might be attributed to the different utilization and exposure rates among different study populations and coverage of health issues asked in different studies.

In our study being female was found to be frequent users compared to male respondents. This trend is consistent with other studies which have found that women are generally more likely to use personal care products, including fragrances, due to societal norms

and marketing strategies that target women more aggressively. Similar trends have been observed in various studies. For instance, a study by Van Amerongen reported that females had significantly higher exposure to scented products than men (13).

Ethnic differences in fragrance product exposure are notable among our study participants. Chinese individuals show significantly lower frequent exposure compared to other ethnic groups. This finding could be related to previous studies in which the findings highlighted ethnic variations in personal care product usage, with significant differences observed among different ethnic groups due to cultural practices (14, 15). Having a positive attitude towards fragrance products was significantly associated with own utilization. It might be related to the influence of ethnic differences and attitudes towards fragranced products. This aligns with studies indicating that cultural and health perceptions vary widely among ethnic groups (16). Having a positive attitude towards fragrance products will enhance their desire to purchase, utilize and have more exposure in the living environment (17).

Having experience with health-related symptoms after being exposed to fragrance products was reported in 40% of the study respondents. Women were more likely to have health-related issues after exposing to fragrance products. Previous studies have reported similar findings that females are more likely than males to suffer from the effects of using fragrance products (1, 18). Furthermore, having pre-existing dermatological conditions was significantly associated with having health symptoms. Similarly, a study conducted among the general population in European countries revealed that people with sensitive skin were associated with fragrance allergy upon exposure to scented products (13). Individuals with sensitive skin or dermatological issues are more vulnerable to fragranced product exposure, emphasizing the need for alternatives or awareness campaigns tailored to such groups.

The study effectively captures awareness of a wide range of health issues associated with exposure to fragranced products, including migraines, neurological and respiratory problems, mucosal symptoms, gastrointestinal and cardiovascular problems, and musculoskeletal issues. This comprehensive approach provides a detailed overview of the potential health risks awareness.

Our study has some limitations. The study responses were based on self-reported data, which may be subject to response bias and inaccurate reporting, as participants may not accurately recall or may underreport their symptoms and exposure levels. The survey did not cover all possible product types and health effects, nor did it include long-term health outcomes or non-conscious health effects of scent exposure.

Conclusion

In conclusion, approximately 47% of the respondents had frequent exposure to fragrance products and awareness of its adverse effects on human health was high. Utilization of products including fragrance was associated with being female, less utilization among Chinese ethnicity and high utilization is highly influenced by the respondents' attitudes.

Study highlights

High awareness but low label checking: The survey revealed that the majority of the participants knew that fragrances exist in products, with more than 90% identifying them as chemicals. Nevertheless, few of them made it a practice to read product labels to look for these chemicals.

Health symptoms linked to fragrance exposure: About 40.2% of the respondents claimed to have developed health symptoms like headaches, skin rashes, breathing difficulties and others after being exposed to fragranced products, a percentage higher than in other identical studies.

Gender and ethnic differences in usage: The research also showed that women were more likely to use fragranced products than men as observed in society and endorsed by marketers. Also, Chinese participants had significantly lower exposure compared to other participants from another ethnic group, this may be attributed to cultural beliefs.

Attitudes influence usage and exposure: There was a positive attitude towards fragrance products and this was related to their use and exposure. This trend was thus informed by ethnic variations as well as cultural perception towards fragranced products.

Recommendations

For future research, it is recommended to include a broader age range to assess the impact on children and adolescents, as their developing systems might be more vulnerable to the effects of fragranced products. Longitudinal studies should be conducted to better understand the long-term health effects of exposure to fragranced products, as these types of studies can track changes over time and provide a more comprehensive view of causality. Additionally, incorporating objective measures of exposure and health outcomes can enhance the reliability of the findings. This could include using environmental monitoring devices to measure actual exposure levels and medical examinations to confirm health outcomes.

Furthermore, future research could benefit from a more diverse geographic and cultural sample to generalize the findings across different populations. This could involve conducting similar studies in different countries and regions to compare the prevalence and types of health effects associated with fragranced products.

Community education towards health issues related to fragrance products should be tailored according to the ethics culture and focus towards the women population. Finally, collaboration with regulatory bodies to develop standardized guidelines for the safe use of fragranced products based on empirical evidence could help mitigate the health risks identified in this and future studies.

ACKNOWLEDGEMENT

We would also like to express our gratitude to our Professor Dr. Jayakumar Gurusamy (Vice Chancellor and Dean of the Faculty of Medicine, MUCM) and Professor Dr. Adinegara Lutfi Abas (Pro Vice Chancellor, MUCM) for their support of our research endeavors. Additionally, we would like to express our sincere gratitude to the Research Ethics Committee, Manipal University College Malaysia, for approving our research proposal, as well as all the participants who generously contributed their time and expertise to us.

REFERENCES

- Steinemann A. Fragranced consumer products: exposures and effects from emissions. *Air Qual Atmos Health*. 2016;9(8):861-6. doi:10.1007/s11869-016-0442-z.
- Mensing J, Beck C. The psychology of fragrance selection. In: Van Toller S, Dodd GH, editors. *Perfumery: The psychology and biology of fragrance*. Dordrecht: Springer Netherlands; 1988. p. 185-204. Available from: https://doi.org/10.1007/978-94-017-2558-3_10
- Steinemann A. International prevalence of fragrance sensitivity. *Air Quality, Atmosphere & Health*. 2019;12(8):891-7. Available from: <https://doi.org/10.1007/s11869-019-00699-4>
- Al Khathlan N, Basuwaidan M, Al Yami S, Al-Saif F, Al-Fareed S, Ansari K. Extent of exposure to scented candles and prevalence of respiratory and non-respiratory symptoms amongst young university students. *BMC Public Health*. 2023;23(1):80. Available from: <https://doi.org/10.1186/s12889-023-15001-6>
- Heisterberg MV, Menn  T, Andersen KE, Avn storp C, Kristensen B, Kristensen O, et al. Deodorants are the leading cause of allergic contact dermatitis to fragrance ingredients. *Contact Dermatitis*. 2011;64(5):258-64. doi:10.1111/j.1600-0536.2011.01889.x.
- Tai V, Sharifah Rosniza SNC, Tang MM. Contact sensitization to fragrance allergen: a 5-year review in the Department of Dermatology, Hospital Kuala Lumpur. *Med J Malaysia*. 2023 [2024 Aug 16];78(5):583-8. Available from: <https://www.e-mjm.org/2023/v78n5/fragrance-allergen.pdf>
- Steinemann A, Klaschka U. Exposures and effects from fragranced consumer products in Germany. *Air Quality, Atmosphere & Health*. 2019;12(12):1399-404. doi:10.1007/s11869-019-00770-0
- Klaschka U. "This perfume makes me sick, but I like it." Representative survey on health effects associated with fragrances. *Environmental Sciences Europe*. 2020;32(1):30. Available from: <https://doi.org/10.1186/s12302-020-00311-y>
- Steinemann A. Fragranced consumer products: exposures and effects from emissions. *Air Quality, Atmosphere & Health*. 2016;9(8):861-866. doi:10.1007/s11869-016-0442-z.
- Steinemann A. Health and societal effects from exposure to fragranced consumer products. *Prev Med Rep*. 2017;5:45-7. Available from: <https://doi.org/10.1016/j.pmedr.2016.11.011>
- Hartmann S, Klaschka U. Interested consumers' awareness of harmful chemicals in everyday products. *Environmental Sciences Europe*. 2017;29(1):29. Available from: <https://doi.org/10.1186/s12302-017-0127-8>
- Steinemann AC. Fragranced consumer products and undisclosed ingredients. *Environmental Impact Assessment Review*. 2009;29(1):32-8. Available from: <https://doi.org/10.1016/j.eiar.2008.05.002>
- van Amerongen CCA, Ofenloch RF, Cazzaniga S, Elsner P, Gonzalo M, Naldi L, et al. Skin exposure to scented products used in daily life and fragrance contact allergy in the European general population - The EDEN Fragrance Study. *Contact Dermatitis*. 2021;84(6):385-94. doi: 10.1111/cod.13807.
- Madan S, Basu S, Ng S, Ching Lim EA. Impact of Culture on the Pursuit of Beauty: Evidence from Five Countries. *Journal of International Marketing*. 2018;26(4):54-68. Available from: <https://doi.org/10.1177/1069031X18805493>
- Collins HN, Johnson PI, Calderon NM, Clark PY,

- Gillis AD, Le AM, et al. Differences in personal care product use by race/ethnicity among women in California: implications for chemical exposures. *J Expo Sci Environ Epidemiol*. 2023;33(2):292-300. doi: 10.1038/s41370-021-00404-7.
16. Hendriks AM, Gubbels JS, Jansen MW, Kremers SP. Health Beliefs regarding Dietary Behavior and Physical Activity of Surinamese Immigrants of Indian Descent in The Netherlands: A Qualitative Study. *ISRN Obes*. 2012;2012:903868. doi:10.5402/2012/903868.
 17. Herz RS, Larsson M, Trujillo R, Casola MC, Ahmed FK, Lipe S, et al. A three-factor benefits framework for understanding consumer preference for scented household products: psychological interactions and implications for future development. *Cognitive Research: Principles and Implications*. 2022;7(1):28. Available from: <https://doi.org/10.1186/s41235-022-00378-6>
 18. Steinemann A. Fragranced consumer products: effects on asthmatics. *Air Qual Atmos Health*. 2018;11(1):3-9. doi:10.1007/s11869-017-0536-2.