

Original Research Article

Knowledge, Perception and Practice of Mercury-Containing Cosmetics among Malaysian Adults

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ABSTRACT

Locally, mercury-containing products are easily accessible due to a lack of regulations. Thus, this study aims to determine the prevalence of mercury-containing cosmetics usage among Malaysian adults, identify their knowledge of the negative effects of the products, and assess their perception of skin tone preferences, focusing on sociodemographic factors. The study was conducted cross-sectionally among Malaysian adults. The questionnaire was divided into four dimensions; i) sociodemographic factors, ii) knowledge of mercury-containing cosmetics, iii) perception of skin tone preferences, and iv) practice of usage of mercury-containing cosmetics. Descriptive analyses, t-tests, one-way ANOVA and Pearson's Chi-square test were performed by using SPSS. A 100% response rate was achieved, and they were predominantly female (82.0%) and Malay (94.3%). The participants' knowledge score and perception score were 25.81/30 (5.62) and 35.83/50 (8.44) respectively. The respondents were highly knowledgeable about mercury-containing cosmetics and had high positive perceptions regarding skin perception and preference. The selection of mercury-containing cosmetics is influenced by factors including the list of ingredients, affordability, and availability on online platforms. The practice of usage of mercury-containing cosmetics shows a low prevalence (7.25%). Significant differences were found in perception scores of skin preferences based on gender ($p=0.024$) and geographic region ($p=0.023$) but not in knowledge scores. Malaysian adults have a low prevalence of mercury-containing cosmetics usage, possibly due to knowledge of its adverse effects and positive skin tone preferences. Future studies are needed to establish the association between usage prevalence, knowledge, and perception. Gender and geographic factors significantly influence perceptions, necessitating targeted awareness campaigns.

Keywords: *mercury-containing cosmetics, knowledge, perception, practice, Malaysia*

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1.0 Introduction

Nowadays, cosmetics are synonymous with the world, regardless of gender, as both men and women use cosmetic products in their daily lives. Younger generations generally use cosmetics for aesthetic reasons to improve their appearance and self-confidence, while older generations generally use cosmetics to combat the effects of aging (1). A study conducted in the United States found that 88% of women over the age of 18 use cosmetics to look good (2). In Malaysia, skin whitening is a common technique and skin lighteners are widely available in the market (3). Data from a 2004 survey shows that 61% of women in Malaysia believe they look younger with a fair complexion (3). A recent study conducted in 2023 indicate that Malaysians favour light or fair complexion tones, particularly for women (4). Another study reported that Malaysians prefer lighter skin tones. The "X" platform reveals that the majority of the public are self-conscious about their darker skin tones and actively work to lighten them (5). The primary market for these products is women seeking quick and effective beauty solutions. Unfortunately, for many local cosmetic companies, profit often takes precedence over customer safety, leading to the continued use of harmful ingredients like mercury (2). The Malaysian Bureau of Statistics estimates that the total expenditure on cosmetics in Malaysia is approximately US\$407 million and that most of this demand is met by imports rather than locally manufactured products (6).

Mercury is one of the elements in the periodic table with the symbol Hg and belongs to group 12 (7) is widely used for its properties of being liquid at room temperature, having a uniform and rapid volume expansion, high density and low evaporation (7). Despite its benefits, mercury is highly toxic and has a long half-life in the atmosphere, and its widespread use in cosmetics could be extremely harmful to human health (7). Mercury is

often included in cosmetics as an excipient because it can cause skin whitening by inhibiting melanin production, which results in pigmentation and color in hair and skin (8). To achieve the skin-lightening result, mercury inhibits the production of melanin, which creates the pigmentation and color of hair and skin (9). These skin-lightening agents target melanin synthesis by inhibiting tyrosinase, the enzyme responsible for melanogenesis (7)". Mercury salts such as mercuric chloride, mercuric oxide, and ammoniacal mercury are used for their whitening effects (10). However, excessive use of mercury-containing cosmetics is highly toxic as it is easily absorbed through the skin, especially with repeated use and after the stratum corneum is hydrated (11).

Other nations' laws pertaining to cosmetics containing mercury comparatively demonstrate that it is forbidden. This claim is backed by research conducted in India, where the Drugs and Cosmetics Act 1940 and Rules 1945 forbid the use of cosmetics containing mercury due to the restrictions of rules 135A and 145 D (12). Furthermore, mercury is still frequently added to skin-lightening creams made in Cambodia, which is a prevalent concern in illicit skin-whitening products (13). Globally, there are differences in regulatory efforts; generally speaking, high-income countries have more strict regulations than low-income countries (14). Geographically, skin-lightening product concentrations varied; cosmetic products from South-East Asia, the Eastern Mediterranean, and the Western Pacific regions of the WHO had the highest median quantities of mercury (8).

In the local context, access to mercury-containing products is easily available due to the lack of specific regulations prohibiting their use. Cosmetic companies only need to notify the Ministry of Health (MOH) about their products without undergoing any safety assessment process. The National Pharmaceutical Control Bureau (NPCB) actively monitors these notified cosmetic products in the Malaysian market (15).

However, products with adulterated ingredients are typically identified only when consumers file complaints, prompting the NPCB to cancel the product notification for the involved company. This highlights a limited quality inspection process in Malaysia's cosmetics industry (2). The use of mercury-containing cosmetics is still common despite warnings about the negative health effects due to various factors (16). These persistent practices carry serious consequences for consumers' health. This study aims to determine the prevalence of mercury-containing cosmetics usage among Malaysian adults, identify their knowledge of the negative effects of these products, and assess their perception of skin tone preferences. By focusing on sociodemographic factors, this study could provide valuable insights into the extent of mercury-containing cosmetics use and highlight areas where targeted interventions can improve consumer safety and promote healthier alternatives.

2.0 Material and methods

2.1 Research design

A cross-sectional study was conducted which involved adults in Malaysia. Adults are defined as individuals aged 18 to 60 years. The data collection process was completed from 25 March 2023 until 6 April 2023. This study utilized the convenience sampling method

2.2 Research sample population

The sample is drawn from a population that meets the inclusion requirements, which includes persons between the ages of 18 and 60 who are Malaysian citizens and who are fluent in either written English or Bahasa Malaysia.

2.3 Research sample size

The study sample size is calculated based on the adult estimates by the Malaysian Statistics Research Department (17). The minimum sample size of the study was found at 385 with Raosoft computation, adjusted for a

margin error of 5%, confidence level of 95% and 50% response distribution.

2.4 Research instrument

A modified and validated survey-based questionnaire was utilised. Three experts consisting of lecturers from the Faculty of Pharmacy, Universiti Teknologi MARA (UiTM) validated the content using a validation form. The experts conducted their evaluations and judgements on the degree of relevance, clarity and appropriateness of each item in the questionnaire with scores ranging from 1 (not relevant/clarity/appropriate) to a full score of 4 (very relevant/clarity/appropriate). The validation score is determined by dividing the total number of experts participated by the number of experts who gave each question a perfect score of 4. In accordance with the computation, questions were excluded if the result was less than 70. The elements that scored higher than 90 stayed unchanged, while the scores between 70 and 90 were adjusted accordingly. The questionnaire was available in both English and Bahasa Malaysia and was conducted via the "Google Form" platform. The questionnaire comprised 31 items divided into four sections: Section A gathered sociodemographic data, Section B assessed knowledge regarding the harmful effects of mercury-containing cosmetics, Section C explored perceptions and preferences related to skin tone, and Section D examined the actual usage of mercury-containing cosmetics. Section A featured multiple-choice questions, while Sections B and C utilized Likert-type scale questions. Section D included a mix of multiple-choice and yes/no questions. Distribution of the questionnaire was facilitated through social media platforms such as Facebook, WhatsApp, and Instagram.

2.5 Data analysis

Data entry and analysis were conducted using IBM Statistical Package for the Social

Sciences (SPSS) Statistics version 28 software. Descriptive analysis was employed to present the sociodemographic characteristics of the respondents. Categorical data were summarized as frequencies (n) and percentages (%), while continuous data were expressed as mean (M) and standard deviation (SD). The relationship between independent and dependent categorical variables was assessed using Pearson's Chi-square test. To compare means in the analysis of respondents' knowledge, independent t-tests and one-way ANOVA were utilized. Both One-Way ANOVA and Pearson's Chi-square tests were conducted at a significance level of $p \leq 0.05$, with a 95% confidence interval considered statistically significant. Scores for knowledge and perception were calculated to assess each participant's level. The maximum total score for knowledge was 30, with a minimum of 1. Higher scores indicated higher levels of knowledge (High = 21-30, Moderate = 11-20, Poor = 1-10). For perception, the maximum total score was 50, with a minimum of 1. Higher scores reflected more

positive perceptions of preferred skin tone (High = 33-50, Moderate = 17-32, Poor = 1-16).

3.0 Results

3.1 Sociodemographic profile

Table 1 shows the result of frequency and percentage from section A which is the sociodemographic profile of the participants. A total of 400 individuals from varied backgrounds participated in this study. Based on the result, most of the respondents were female (n=328, 82%) and in the group Malay (n=377, 94.3%). The highest number of respondents was from age 18 to 28 years old (n=286, 71.5%). Around 305 respondents were single and their highest academic for most of them were undergraduate (46.0%). More than half of the respondents were from urban areas (59.5%) and many of them (209 participants) were unemployed with approximately 210 respondents having no income. Table 1 summarizes the sociodemographic characteristics of the participants.

Table 1: Results extracted from descriptive analysis using SPSS version 28 software regarding sociodemographic profile of participants.

Sociodemographic	Frequency (n)	Percentage (%)
Gender		
Male	72	18.0
Female	328	82.0
Race		
Malay	377	94.3
Chinese	5	1.3
Indian	8	2.0
Others	10	2.5
Age		
18-28	286	71.5
29-39	51	12.8
40-50	32	8.0
51-60	31	7.8

Marital status		
Single	305	76.3
Married	87	21.8
Divorced	3	0.8
Widowed	4	1.0
Separated	1	0.3
Highest academic qualification		
Secondary school	17	4.3
Foundation/Diploma	99	24.8
Undergraduate	184	46.0
Honours	74	18.5
Master	25	6.3
Doctorate	1	0.3
Geographic region		
Rural area	78	19.5
Urban area	238	59.5
Suburban	84	21.0
Employment		
Employment Full-time	107	26.8
Employed Part-time	10	2.5
Unemployment	209	52.3
Seeking opportunities	16	4.0
Retired	17	4.3
Prefer not to say	41	10.3
Incomes		
<RM2,500	80	20.0
RM2,500-RM4,849	44	11.0
RM4,850-RM10,959	58	14.5
RM10,960-RM15,039	7	1.8
>RM15,039 No income	1	0.3
	210	52.5

3.2 Knowledge about negative effects of mercury-containing cosmetics

The mean total score of respondents' knowledge was (M=25.81, SD=5.62). The six questions for knowledge regarding the negative effects of mercury-containing cosmetics were calculated as the total score to determine the knowledge level of the participants. By using an independent-sample t-test, there were no significant differences in knowledge scores for both

males (M= 25.46, SD= 5.45) and females (M=25.89, SD =5.66; p= 0.552). The magnitude of the differences in the mean of gender was very small (Cohen's d= 0.077). For another seven sociodemographic profiles, the test used was One-way ANOVA. The result for all seven sociodemographic groups shows there are no significant differences when compared within the groups for the knowledge score (p>0.552). The results are shown in Table 2.

Table 2: Result of association between sociodemographic with total knowledge score and perception score using independent t-test and one-way ANOVA.

Sociodemographic	Knowledge score Mean (SD)	P value	Perception score Mean (SD)	P value
Gender				
Male	25.46 (5.45)	0.552*	33.79 (8.48)	0.024*
Female	25.89 (5.66)		36.27 (8.38)	
Race				
Malay	25.90 (5.66)	0.329**	35.78 (8.38)	0.244**
Chinese	22.90 (6.22)		32.80 (10.9)	
Indian	23.63 (5.26)		41.25 (9.19)	
Others	26.30 (2.87)		34.60 (8.71)	
Age				
18-28	25.50 (5.81)	0.238**	35.55 (8.27)	0.522**
29-39	27.20 (4.72)		37.27 (9.08)	
40-50	26.22 (5.63)		36.59 (9.53)	
51-60	26.06 (4.99)		35.16 (7.81)	
Marital status				
Single	25.65 (5.69)	0.297**	35.82 (8.34)	0.485**
Married	26.64 (5.09)		36.21 (8.79)	
Divorced	24.67 (6.11)		27.67 (5.86)	
Widowed	23.50 (9.82)		35.50 (9.95)	
Separated	18.00 (--)		30.00 (--)	
Highest education				
Secondary school	27.65 (2.40)	0.598**	32.59 (10.22)	0.136**
Foundation/Diploma	25.40 (5.51)		35.81 (8.35)	
Undergraduate	25.65 (5.52)		36.03 (8.28)	
Honours	26.01 (6.55)		34.86 (8.22)	
Master	26.64 (5.39)		39.04 (8.80)	
Doctorate	30.00 (--)		45.00 (--)	
Geographic region				
Rural area	24.88 (6.27)	0.110**	33.50 (8.41)	0.023**
Urban area	25.79 (5.68)		36.29 (8.42)	
Suburban	26.74 (4.63)		36.67 (8.25)	
Employment				
Employment Full-time	26.60 (5.07)	0.142**	37.07 (9.12)	0.144**
Employed Part-time	27.10 (3.21)		36.60 (7.52)	
Unemployment	25.09 (6.13)		35.76 (8.22)	
Seeking opportunities	27.38 (3.65)		34.75 (8.68)	
Retired	27.06 (3.75)		36.76 (7.57)	
Prefer not to say	26.05 (5.65)		32.78 (7.75)	

Incomes				
<RM2,500	26.35 (5.67)		36.20	(8.44)
RM2,500-RM4,849	26.18 (5.36)	0.744**	35.11	(8.03) 0.930**
RM4,850-RM10,959	26.16 (5.53)		36.62	(9.30)
RM10,960-RM15,039	25.00 (4.00)		34.43	(8.90)
>RM15,039 No income	30.00 (--)		33	(--)
	25.45 (5.74)		35.67	(8.33)

*Independent sample t-test **One-Way ANOVA

3.3 Perceptions and preferences of skin tone

The mean total score perception regarding skin preferences was 35.83. The maximum total score is 50 and the minimum of 1. A higher score indicates a good perception of skin preference. The comparison of perception scores for males (M=33.79, SD=8.48) and females (M=36.27, SD=8.38) shows a significant difference with $p=0.024$. The magnitude of the differences in the means was very small (Cohen's $d = 0.310$). For comparison between the

geographic region with perception score, the $p=0.023$ indicates there was a significant difference between the rural, urban, and suburban areas because it is less than $p=0.05$. For 'race', 'age', 'marital status', 'highest education', 'employment' and 'incomes' show the result of no significant difference in the perception score. The complete result is shown in Table 2. Whereas Table 3 shows the frequencies and percentages of respondents answering each statement for perception of the skin preferred.

Table 3: Result of respondent's perception of skin preferred using descriptive analysis using SPSS analysis version 28 software.

Question	Participant's response (n, %)				
	Strongly agree	Agree	Neutral	Disagree	Strongly disagree
I am satisfied with my skin tone.	151 (37.8)	113 (28.2)	91 (22.8)	32 (8.0)	13 (3.3)
I want to change my skin tone	27 (6.8)	45 (11.3)	79 (19.8)	93 (23.3)	156 (39.0)
Fair or light complexion is my skin tone preference	62 (15.5)	92 (23.0)	138 (34.5)	61 (15.3)	47 (11.8)
Advertisement in social media influence me to get fair or light skin tone	42 (10.5)	85 (21.3)	86 (21.5)	83 (20.8)	104 (26.0)
Family and friends influence me to get lighter skin complexion	20 (5.0)	65 (16.3)	80 (20.0)	100 (25.0)	135 (33.8)
I want to get fair skin tone to be more successful in my career	16 (4.0)	59 (14.8)	91 (22.8)	88 (22.0)	146 (36.5)
I want to get a fairer skin tone to look fashionable and trendy	24 (6.0)	81 (20.3)	94 (23.5)	83 (20.8)	118 (29.5)

I want to get fairer skin tone to impress my partner	31 (7.8)	54 (13.5)	94 (23.5)	81 (20.3)	140 (35.0)
I think fairer skin tone looks more attractive	48 (12.0)	99 (24.8)	109 (27.3)	70 (17.5)	74 (18.5)
I did not consider the safety of the product but only the outcomes of the product to achieve fairer skin tone	19 (4.8)	10 (2.5)	22 (5.5)	56 (14.0)	293 (73.3)

3.4 Practice of usage of mercury-containing cosmetics

Out of 400 respondents, only 29 provided information for Section D, whereas the remaining 372 had no prior experience with mercury-containing cosmetics. Table 3 shows frequencies and percentages of the practice of usage of mercury-containing cosmetics by sociodemographic profile. Whereas, in Table 4, facial cleansers (n=14) are the most used types of mercury-containing cosmetics among the respondents. There were a few reasons the participant bought these products which were due to a list of ingredients (n=18) in the product and having a reasonable price (n=18). Friends or family recommendations and testimony (n=15) also have a huge impact on the

selection of cosmetic products. Online platforms (4.5%) with herbal and complementary (3.5%) were the preferred places to buy these products. In this study, the participants who experienced adverse effects with mercury-containing products were approximately 22 out of 29 respondents. Skin rashes (31.4%) were the most reported adverse effect followed by allergic reactions (15.7%) and skin discoloration (15.7%). The complete description is displayed in Table 4. According to statistical analysis in Table 5 by using the Chi-Square test, there was no significant correlation between all the sociodemographic such as gender, age, marital status, educational attainment, and occupation with the use of skin-lightening products ($p > 0.05$)

Table 4: Result of practice of usage of mercury-containing cosmetics using descriptive analysis by SPSS version 28 software.

Section D: Practice of usage of mercury-containing cosmetics		
	Frequencies (n)	Percent (%)
Types of products		
Facial Cleanser	14	25.0
Facial Mask	4	7.1
Facial Moisturizer	13	23.2
Toner	10	17.9
Sunblock	7	12.5
Serum	8	14.3

Factors bought mercury-containing cosmetics		
Advertisement	10	13.3
Friend/Family recommendation and testimony	15	20.0
List of ingredients	18	24.0
Reasonable price	18	24.0
Brand influence	14	18.7
Places bought mercury-containing cosmetics		
Department store	6	11.3
Pharmacy	8	15.1
Online platform	19	35.8
Convenience shop	5	9.4
Herbal and complementary	15	28.4
Adverse effects		
Kidney damage	2	3.9
Allergic reaction	8	15.7
Skin rashes	16	31.4
Skin discoloration	8	15.7
Skin scarring	6	11.8
Anxiety	3	5.9
Depression	4	7.8
Psychosis	1	1.9
Damage of systems	3	5.9

Table 5: Result extracted using chi-square test to determine sociodemographic factors associated with use of mercury-containing cosmetic

Sociodemographic	Usage of banned cosmetic containing mercury		P value
	Yes, n (%)	No, n (%)	
Gender			
Male	3 (0.8)	69 (9.8)	0.388
Female	26 (6.5)	302 (75.5)	
Race			
Malay	28 (7.0)	349 (87.3)	0.766
Chinese	0	5 (1.25)	
Indian	0	8 (2.0)	
Others	1 (0.3)	9 (2.3)	
Age			
18-28	20 (5)	266 (66.5)	0.680
29-39	3 (0.8)	48 (12.0)	
40-50	4 (1.0)	28 (7.0)	
51-60	2 (0.5)	29 (7.3)	

Marital status			
Single	21 (5.3)	284 (71.0)	0.882
Married	8 (2.0)	79 (19.8)	
Divorced	0	3 (0.8)	
Widowed	0	4 (1.0)	
Separated	0	1 (0.3)	
Highest education			
Secondary school	1 (0.3)	16 (4.0)	0.221
Foundation/Diploma	3 (0.8)	96 (24.0)	
Undergraduate	18 (4.5)	166 (41.5)	
Honours	7 (1.8)	67 (16.8)	
Master	0	25 (6.3)	
Doctorate	0	1 (0.3)	
Geographic region			
Rural area	4 (1.0)	74 (18.5)	0.548
Urban area	20 (5.0)	218 (54.5)	
Suburban	5 (1.3)	79 (19.8)	
Employment			
Employment Full-time	9 (2.3)	98 (24.5)	0.366
Employed Part-time	0	10 (2.5)	
Unemployment	16 (4.0)	193 (48.3)	
Seeking opportunities	2 (0.5)	14 (3.5)	
Retired	2 (0.5)	15 (3.8)	
Prefer not to say	0	41 (10.3)	
Incomes			
<RM2,500	6 (1.5)	74 (18.5)	0.407
RM2,500-RM4,849	3 (0.8)	41 (10.3)	
RM4,850-RM10,959	8 (2.0)	50 (12.5)	
RM10,960-RM15,039	0	7 (1.8)	
>RM15,039 No income	0	1 (0.25)	
	12 (3.0)	198 (49.5)	

4.0 Discussion

Our findings revealed that Malaysian adults have a high level of knowledge regarding mercury-containing cosmetics, which provided new insight into the knowledge aspect, as found not exclusively explored in the local context (1). The result corroborates two similar studies conducted among university students indicating undergraduate students possess high knowledge of skin-whitening products that contain mercury (18,19). From our results, a comparable mean score of knowledge for the negative effect of mercury-containing cosmetics was observed among gender groups. A study by Ndiritu *et al.* (2021) (20) found a contradicting finding whereby women were significantly practicing skin whitening products (20). Nonetheless, our study was found as similar to Rahiman *et al.* (2021) (5) where skin-lightening use was equally prevalent among both genders, indicating a growing acceptance of cosmetic practices among men (21). This finding explains some changes in gender ideologies, socio-economic landscapes, and popular cultural trends that shape masculinity notions nowadays (22).

The perception scores related to sociodemographic profiles indicate a high overall score, suggesting that respondents have a positive view of their skin preferences and a positive attitude toward their skin tone. In the questionnaire (Table 5), over half (62.3%) of the respondents agreed with the statement "I am satisfied with my skin tone." This finding shows that Malaysian citizens possess self-awareness and self-love, with increased self-esteem due to their satisfaction with their skin tone. However, this contrasts with a study by Rohimi *et al.* (2021) (23), which found participants to be only moderately satisfied with their skin tone (23). The perception of skin tone significantly impacts self-esteem and vulnerability, as social expectations shape these aspects in individuals worldwide (24). There are significant differences ($p=0.024$) between men and

women in perception scores, with women demonstrating a more positive attitude towards preferred skin tones. This suggests that Malaysian women are more accepting of a variety of skin colors, although their self-esteem was not comprehensively assessed. Our findings align with a study conducted in the Philippines, which also indicated that young women with higher levels of education have a positive perception of their skin preferences. (22). The geographic region also revealed that there were significant differences ($p=0.023$) between rural, urban, and suburban regions with perception of skin tone preference scores. Skin tone perception impacts self-esteem and vulnerability, as social expectations influence vulnerability and self-esteem in various individuals worldwide (25). Our findings indicated urban and sub-urban respondents have higher mean perception scores, aligning to with Mishra *et al.* (2020) (26) study reported that women in urban areas displayed higher levels of self-esteem than those in rural areas (26). Another finding among Jamaican children with darker skin colour had higher self-esteem than urban children due to the self-protective effect, and older children with identity concordance to cultural preference predicted high self-esteem regardless of skin color (27). This study highlights the unique dynamics that influence self-perception in different nationalities and social contexts. This includes factors such as identity concordance with cultural influences, as well as intrapersonal and interpersonal factors.

The practice of usage of mercury-containing cosmetics shows a low prevalence (7.25%) in this study. This finding is contradictory to Rusmadi *et al.* (2015) (3) which reported 60.6% of Malaysian female university students used skin-lightening products in their life (3). The conflicting result was mainly due to our study that only specifies mercury but no other skin whitening agents that are usually incorporated

into cosmetics, including hydroquinone, thus more prevalence was reported by the previous study (3). The high prevalence of use in the previous study was also linked to the perception findings that most respondents (60.6%) agreed lighter skin provides high self-esteem and makes them presentable as more attractive and healthier. The same belief is also related to better job securing opportunities, and higher chances of marriage proposal (28). Our findings reveal a positive perception towards skin tone among the Malaysian population, with a significant proportion of respondents expressing satisfaction with their natural skin tone. For instance, only 36.8% of our respondents agreed that a fairer skin tone is more attractive, although considerably higher than the 4.5%, reported in a previous study. Similarly, the belief that fairer skin contributes to career success was held by 18.8% of our participants, compared to only 2.7% in the same study (29). This contrasts with previous studies that have shown a preference for lighter skin tones and associated benefits (21,30). These differences highlight an evolving attitude towards skin tone, suggesting that Malaysians are increasingly embracing a wider range of skin tones. This positive shift could be attributed to stringent regulatory measures of skin-lightening products by the Malaysian National Pharmaceutical Regulatory Agency (NPR). NPR is responsible for overseeing the authorization of cosmetic items following the Control of Drugs and Cosmetics Regulation (1984). Starting from January 1, 2008, Malaysia has been regulating cosmetic products through a notification process under the ASEAN Cosmetic Directive. The Director of Pharmaceutical Services (DPS) must adhere to specified criteria and file a declaration to the NPR, guaranteeing that goods meet safety and efficacy requirements to prevent regulatory action

(31). Mercury-containing cosmetics purchasing factors were consistent with Rahiman *et al.* (2021) (21), that highlighted 24.0% of respondents prioritizing product ingredients and price. Interestingly, advertisements were deemed less influential. A majority (65.4%) purchased these cosmetics from physical stores, diverging from prior studies favoring online platforms (32,33). Despite Malaysia's legal prohibition on mercury in cosmetics, manufacturers often prioritize profit over consumer health, evident from incomplete ingredient disclosures (34). This practice facilitates the inclusion of harmful and illicit substances aimed at delivering rapid results, such as skin whitening, despite associated health risks (35). The widespread availability of these products in night markets and non-traditional retail outlets further complicates regulatory oversight and consumer protection efforts (33).

An overall total of 22 (75.86%) of the 29 responders who had used mercury-containing cosmetics had encountered a negative outcome, given that skin rashes (31.4%) were the most prevalent adverse effect. This finding is seen lower than 60% of respondents from Bamerdah *et al.* (2023) (36) who experienced serious effects with skin whitening products (36). The adverse effects may be attributed to the fact that only a minority (37.9%) of the respondents checked the registration number before purchasing the products, a practice likely intended to guarantee the product's safety, whereby many of the respondents were unsure about verifying the cosmetic notification number on the packaging of the cosmetic products (3). Despite that, those who experienced the unwanted adverse effects of mercury-containing cosmetics claimed immediate cease of usage, indicating a proactive approach to self-care. In contrast to the results of another study, which revealed that a significant portion of

participants persisted in using various brands while experiencing negative effects, which also supports Atari *et al.* (2017) (37) observed that users frequently attempt to mitigate unpleasant effects rather than completely cease usage (35,37). Our study has also identified a considerable number of respondents (15.6%) experienced psychological symptoms such as depression, anxiety and psychosis. Meanwhile, 5.9% of participants reported damage to the system, although the condition and duration of exposure were not specified. Excessive and chronic use of mercury-containing cosmetics is associated with specific and non-specific psychological symptoms and serious body system damage including cardiovascular, nervous and digestive systems. Future studies should involve experimental measurements of mercury levels to better reflect mercury poisoning from cosmetics, given the variability in symptom manifestation over time. Furthermore, it is important to note that mercury levels in the body may not always correlate with the presence of symptoms, as abnormal levels can sometimes develop without any noticeable effects (38).

This study is limited by its exclusion of various races throughout Malaysia due to significant disparities in participant numbers. Furthermore, there was an under-representation of individuals who had previously used mercury-containing cosmetics. Consequently, extrapolating our findings to the entire society would be challenging. Nonetheless, this study obtained a sample size greater than the minimum required.

5.0 Conclusion

This study reported a 7.25% prevalence of the use of mercury-containing cosmetics, as listed by the Malaysian NPRA. It is evident that while the prevalence of mercury-

containing cosmetics use in Malaysia is relatively low, there is a notable positive perception regarding natural skin tone preferences among Malaysian adults. The knowledge of mercury-containing cosmetics is relatively high, given that sociodemographic factors do not significantly affect the score. Alternately, gender and geographic region significantly affect the perception score underscoring the necessity for targeted public health interventions aimed at these groups. Future efforts should focus on enhancing awareness and changing perceptions among both genders, stressing of harmful use of mercury-containing cosmetics while promoting safer alternatives. High schools should be the starting point for raising public knowledge of the risks associated with mercury in cosmetics because even high schoolers have started to use cosmetic products. Continuous monitoring and stricter enforcement of regulations are also essential to prevent the distribution and use of these banned products. The government may potentially develop a mobile application that scans the barcodes of registered products to verify their absence of mercury or other heavy metals.

Authorship contribution statement

FAZ: Data analysis, Methodology, Formal analysis, Writing–original draft. **NSMH:** Visualization, Methodology, Writing – review & editing. **AAJ:** Visualization, Resources, Draft corrections. **NSMH:** Supervision, Funding acquisition, Writing – review & editing.

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Ethical Approval

This study was approved by the Research Ethics Committee of University Teknologi MARA (UiTM), Malaysia (REC (PH)/UG/040/2023).

Conflict of interest

The authors declare no conflict of interest in the present work.

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