

## **Survey on the Industry and Public Awareness on the Effects of Harmful Chemicals in Personal Care Products (PCPs) on Human and Environment**

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**Abstract:** People usually use personal care products (PCPs) daily for various purposes. It can be categorized into fragrances, deodorant, lotion, sunscreen, face wash, makeup, hair products, soaps, hand sanitizers and toothpaste. In Malaysia, the increasing growth rate of personal care products is because of the high awareness of the young generation towards hygiene, beauty, and self-images. However, some people do not know the destructive effect of using personal care products because of the harmful chemicals in the product. Therefore, this research investigates the perceptions of the public and industry about the danger of certain chemical substances in personal care products (PCPs) and reviews the chemical substances commonly present in PCPs based on the previous study that affect humans and the environment in Malaysia. The questionnaire was designed based on the information and ideas gathered through the literature review to achieve the research objectives. Selected lecturers and knowledgeable persons have reviewed the questionnaire to ensure the questionnaire is practical and easy for the public and industry to answer. A total of 62 and 50 respondents from the public and industry have responded to this questionnaire. Section B and Section C on the questionnaire will be where the knowledge and perceptions of public and industry people will be asked about the PCPs' effect on them and the environment. The survey will be analyzed using the statistical function in Microsoft Excel, and it will be associated with Section A in a demographic profile questionnaire. The results showed that only a tiny percentage of the public (15%) and industry (4%) still lack knowledge on the issue. Between both sample populations, there is only a slight difference (0.3%) towards the perception regarding the issue. The study is aimed to make the public more aware of checking the ingredients of chemical substances and get some research before purchasing and using the products as a precautionary measure for themselves and the environment.

**Keywords:** Personal Care Products (PCPs), Human, Environment

## 1. Introduction

Personal care products, known as PCPs also commonly referred to as cosmetics under the Food and Drug Administration (FDA) because the PCPs have similar uses in cosmetics [1]. A wide range of PCPs such as deodorants, sunscreen, skincare, facewash, facial moisturizers, shampoo, conditioner, shower gel, makeup and other PCPs are used daily for various purposes [2]. Personal care products and cosmetics sales increase yearly in Malaysia and gain more attention among industry players [3]. The dramatic growth in this industry is because of the change of self-images among the generation and because they want to maintain their images to look attractive to others.

However, some of them are not concerned about the health risks and negative impact that may happen to them because of the hidden substances in the products they buy and use [4] and only focus on the short-term result skin appearance rather than the long-term impact on their bodies as they will experience a dangerous and awful effect to them [5]. PCPs also categorized as micropollutants called emerging contaminants that enter the natural environment and are usually found in water systems and water streams [6]. The widespread use and continuous discharge of PCPs through sewer systems cause about 200 substances to be categorized as harmful to aquatic life and the environment [7] and threaten the ecosystem and human health.

The previous research found phthalates and parabens used in PCPs as a preservative chemical in the urine samples collected between men and women [8]. For phthalates, its effect could be endocrine disruptors and in the male reproductive system, and PCPs chemicals substances like paraben are harmful as they give a high chance and risk for women to get breast cancer [9]. Because of PCPs that act as emerging contaminants, the chemicals substances impact the environment persistent, human health and aquatic organisms [10]. PCPs are the most common micro-pollutants found in water streams because their widespread and daily use is everywhere [6]. According to Paulsen [9], chemical substances like parabens can be found in wastewater treatment as a pollutant, enter domestic water supplies, and risk humans during daily activity.

Sadly, some of them did not know the negative and positive effects and the environment after using the products [5]. According to Hadi, et al. [11], in Malaysia, consumers generally update themselves through magazines, newspaper, the internet due to the cosmetic products that contain harmful ingredients or their cancellation. However, some of them are not well-informed on the issues due to some regulations. Other than that, it is found that consumers in Malaysia understand the benefit of natural and organic products, but they do not purchase them. Cosmetics markets in Malaysia have a severe problem, where the dumping of chemical cosmetics such as mercury, paraben, phthalates, tretinoin and petroleum increase and cause adverse effects to consumer [12]. Thus, the objective of this study is to review the common chemicals substances present in PCPs based on the previous study that affect humans and the environment in Malaysia and to determine the perceptions of the public and industry regarding the issue of effects of harmful chemicals in PCPs on human and the environment.

## 2. Literature Review

### 2.1 Common chemical substances in PCPs

Parabens have been used since the 1920s as an artificial preservative, active use in cosmetics, and personal care products (PCPs). Adding paraben as in the PCPs can prevent and reduce harmful bacteria in the products [13]. Paulsen [9] stated that paraben could easily be found in PCPs such as lotions, sunscreens, deodorants, toothpaste, powders, eye shadows, shampoos, and other hair care products. Next, triclosan was widely used in PCPs or cosmetics as a chemical substance that prevents bacterial contamination [14]. In addition, this substance is also used as aromatic antimicrobials [15], especially in hand soaps, shampoos, sunscreen, and deodorants [16].

Phthalates can be found in PCPs, especially fragrances, soaps, shampoos, and deodorants. In cosmetic industries, phthalates are used as a plasticizer for nail polishes to reduce the cracking and make them less brittle [17] and as solvent and fixative in perfumes [18]. Other than that, microplastic or plastic microbead, common chemical substance in PCPs, act as scrubber for exfoliating dead skin on the body in PCPs such as hand cleansers, face scrubs, toothpaste, and soaps. Lastly, mercury is one of the

ingredients in skin brightening products, creams, and soaps. Due to the availability and price of this chemical, it is can easily found in many countries [19].

## 2.2 Effect on humans

Not only does it give an effective result to body, but some of the chemicals in PCPs also harm to the bodies as they will absorbed into the skin and blood and can cause endocrine disruptors. The study by Paulsen [9] mentioned that chemical products such as paraben could potentially change the brain development and immune system and alter people's behaviours such as emotion as it penetrates the skin based on the repeated usage of users. Other than that, parabens' content in the body can lower the testosterone level and produce abnormal sperm in shape and slow-moving sperm [20]. Furthermore, PCPs containing paraben frequently for pregnant women can affect the babies and develop obese and diabetes child as it has been detected in the placenta linked to the fetus [9].

In Malaysia, one of the female consumers becomes the victim of mercury in PCPs in year 2021. The brightening cream containing mercury and hydroquinone makes the consumer's skin scabious, and the green veins appear around her leg [21]. A high mercury concentration can cause pregnancy complications and developmental problems in infants [22]. Phthalates can affect both males and females as they can create phthalate syndrome in men where it can decrease the production of sperm [9] and increase the risk of breast cancer for women [23].

## 2.3 Effect on the environment

People of all ages widely consume PCPs, and they will be released into rivers, lakes, sewerage plants, and other water bodies. The World Health Organization (WHO) states that PCPs are sources of an emerging pollutant that pollutes aquatic ecosystems with hazardous chemicals [24]. Ewadh, et al. [6] reported that the usage of PCPs everywhere become the factor of micropollutants is found in many wastewaters such as municipal and rural wastewater, septic tank, water treatment plants (WWTPs) and primarily found in the water stream. It will affect the water body as it has a low degradation rate and high mobility. Harmful chemicals such as methyl-triclosan cannot be treated 100 percent in WWTPs and will cause problems during the treatment process [9]. The remaining suspended compounds of UV filters in WWTPs will directly release surface water and become water pollution [25].

Not only affect the water body, but PCPs also negatively impact marine and aquatic life, such as coral reefs, fish, and other aquatic invertebrates, in growth, development, and reproduction [26]. UV filters, the main ingredient in sunscreen, tend to float and lead to oily film at the water surface[25]. Microplastic, including microbeads, was found at surface water in Bangi with various shapes, leading to water pollution and affecting marine life[27]. Other than that, at Sembrong River, a few phthalates esters (PAEs) compounds were in sediment that will affect aquatic life, human health and interrupt the river habitat [28].

## 3. Methods

### 3.1 Sampling study

A study population comprises public and industrial consumers of PCPs with different gender, age range, education levels or backgrounds and scope of employment. By choosing the public and industry consumers in both genders and not focusing on the specific population group, the survey results will not be biased as there are correlations between both populations. In addition, the sample size for public and industry respondents meets the minimum sample size of 30 respondents as the survey is considered a heterogeneous population [29]. Therefore, in this study, 62 respondents for the public and 50 respondents for the industry have used this study as every respondent has different values and characteristics of the demographics.

### 3.2 Questionnaire design

Based on the literature study, the information and ideas are used as a reference in designing questionnaires. The questionnaire consists of three sections for Section A: the demographic profile, Section B is general perspectives on the PCPs and Section C is the perception of respondents towards the effect of PCPs on humans and the environment. The questionnaire was conducted using quantitative data (Likert scale question). Respondents were given choices to rate their answers based on their preferences on a scale of 1 to 5. Lastly, the open question is provided in the last part of the questionnaire survey.

### 3.3 Data collection

The data was collected through questionnaires distributed to active PCPs consumers, public industry people via Google Forms through any media platform such as email, WhatsApp, Telegram, Instagram, and Facebook.

### 3.4 Data analysis

After collecting the data, the study continued by analyzing the data obtained. Descriptive statistics analysis was used to analyse the data. Graphical information was generated using percentages, bar charts, and pie charts for Section A and Section B. Data Analysis ToolPak in Excel was used to analyse the Likert scale questions in Section C. For open questions, theme-based by answers was used to analyse the question.

## 4. Results and Discussion

### 4.1 Descriptive analysis

Table 1 shows the results for the demographic profile for both populations of the respondent. In this section, five questions were asked to the respondents regarding their gender, state, age, education level and employment status. The table shows that the majority of the respondents were female in both populations (87.10%; n=54) public and (78%; n=39). The respondents were almost half from the state in Malaysia. Respondents from Johor dominated the number of respondents as given respectively for public and industry respondents, 41.94% (n=26) and 36% (n=18). With an age range from 21 to 25 years old, 44 respondents (70.97%) from the public and 26 respondents (52%) were the majority age range for both populations.

However, industry respondents got more age range from 21 to 60 years old than public respondents. Next, for the education level question, the degree holder was the most answered question between both populations, with 70.97% (n=44) for public, and 56% (n=28) for industry. Most public respondents were students (41.94%; n=26), and 72% (n=36) from industry respondents were private employers. For the detailed results, refer to Table 1.

Table 2 shows the detailed result for Section B of the survey. According to the results, most of the respondents for both populations have heard or known that the using of PCPs can affects humans and the environment. 85% (n=53) for public and 96% (n=48) answered 'Yes' to the question. Social media become the most picked source of information, with 83.87% (n=52) for public and 90%(n=45) for industry and followed by the internet. Public respondents gave the most an answer 'No' (85%; n=53) for question "Have you ever checked the ingredients list before purchasing the PCPs?". Most industry respondent answered 'Yes' (90%; n=45). Both populations (79%; n=49) public and (80%; n=40) industry are aware of the ingredients that they use. Next, both target respondents show that most of them understand that some of the ingredients in PCPs will lead to cancer (84%; n=52) public and (86%; n=43) industry. The results from both populations showed that most of them knew that some of the ingredients in PCPs could cause the environmental pollution (77%; n=48) public and (80%; n=40) industry. Almost all the respondents from both populations picked mercury as ingredients they had heard before with (96.77; n=60) for the public and (94%; n=47) for the industry. The last question in

Section B was regarding the factor of purchasing PCPs. Natural and organic ingredients were the top factors for both populations (77.42%; n=48) for the public and (72%; n=36) for the industry. For the detailed results, refer to Table 2.

**Table 1: Demographic profile results for public and industry respondents**

Item	<u>Public</u>		<u>Industry</u>	
	Frequency(n)	Percentage(%)	Frequency(n)	Percentage(%)
<b>Gender</b>				
Male	8	12.90	11	22
Female	54	87.10	39	78
<b>State</b>				
Johor	26	41.94	18	36
Kuala Lumpur	2	3.23	6	12
Melaka	2	3.23	2	4
Negeri Sembilan	1	1.61	3	6
Pahang	3	4.84	-	-
Perlis	1	1.61	-	-
Putrajaya	1	1.61	2	4
Selangor	13	20.97	10	20
Terengganu	4	6.45	-	-
Perak	3	4.84	-	-
Kelantan	3	4.84	2	4
Kedah	1	1.61	1	2
Penang	2	3.23	1	2
Sarawak	-	-	4	8
Sabah	-	-	1	2
<b>Age</b>				
16 to 20 years old	3	4.84	-	-
21 to 25 years old	44	70.97	26	52
26 to 30 years old	12	19.35	10	20
31 to 35 years old	3	4.84	5	10
36 to 40 years old	-	-	4	8
41 to 45 years old	-	-	3	6
46 to 50 years old	-	-	-	-
51 to 55 years old	-	-	1	2
56 to 60 years old	-	-	1	2
<b>Education Level</b>				
PT3/PMR/SRP	-	-	2	4
SPM	-	-	1	2
STPM	1	1.61	2	4
Diploma	14	22.58	8	16
Degree	44	70.97	28	56
Master	1	1.61	8	16
Ph.D.	1	1.61	1	2
Others	1	1.61	-	-
<b>Employment Status</b>				
Student	26	41.94	-	-
Self-employed	8	12.90	9	18
Government	4	6.45	5	10
Private	18	29.03	36	72
Housewife/Unemployed	6	9.68	-	-

**Table 2: General perspectives results for public and industry respondents**

Item	Public		Industry	
	Frequency(n)	Percentage(%)	Frequency(n)	Percentage(%)
<b>Have you ever heard from any sources about the effect of using personal care products on humans and the environment?</b>				
Yes	53	85	48	96
No	9	15	2	4
<b>If 'Yes' where did you get the sources?</b>				
Social Media	52	83.87	45	90
Internet	50	80.65	44	88
Magazines	9	14.52	10	20
Newspaper	12	19.35	17	34
Radio	11	17.74	19	38
Television	21	33.87	25	50
Books	8	12.90	14	28
Others	1	1.61	3	6
<b>Have you ever checked the ingredients list before buying personal care products?</b>				
Yes	9	15	45	90
No	53	85	5	10
<b>Do you aware of the ingredients of the products that you use?</b>				
Yes	49	79	40	80
No	13	21	10	20
<b>Did you know that some of the ingredients in personal care products (PCPs) can lead to cancer?</b>				
Yes	52	84	43	86
No	10	16	7	14
<b>Did you know that some ingredients in personal care products (PCPs) can cause environmental pollution?</b>				
Yes	48	77	40	80
No	14	23	10	20
<b>Have you ever heard any ingredients below before?</b>				
Paraben	53	85.48	42	84
Microplastic	19	30.65	18	36
Triclosan	8	12.90	11	22
Phthalates	6	9.68	13	26
Mercury	60	96.77	47	94
<b>Which of these following factors are important to you when purchasing personal care products (PCPs)?</b>				
Brand	37	59.68	30	60
Viral	6	9.68	2	4
Price	32	51.61	26	52

Packaging	17	27.42	8	16
Natural and Organic Ingredients	48	77.42	36	72
Environmental Safety	28	45.16	22	44
Affordability	39	62.90	35	70
Others	2	3.23	2	4

#### 4.2 Perceptions of respondents towards the issue

In this part, the Likert scale questions were analyzed, and the interpretation of the data is using mean score interpretation as shown in Table 3.

**Table 3: Mean score interpretation [30]**

Score	Interpretation
1 to 1.81	Strongly disagree
1.81 to 2.60	Do not agree
2.61 to 3.40	True to some extent
3.41 to 4.20	Agree
4.21 to 5.00	Strongly Agree

Table 4 shows the results for the perceptions of respondents regarding the issue. Based on the results, public respondents strongly agree that knowing the ingredients of PCPs is important before using (M=4.74) and buying (M=4.73) them. Again, with (M=4.69) the respondents strongly agree that information on the issue needs to disseminate. The highest mean (M=4.82) was that PCPs that containing harmful chemicals should not be sold. The respondents strongly agreed (M=4.61) that they will immediately stop using a product containing toxic chemicals but effective on their skin and gave (M=1.71) which interpret strongly disagree that they will keep using the products even if it has harmful chemicals but effective to them. With mean (M=2.62), respondents disagree that they will keep using the consequences if they negatively affect the environment.

**Table 4: Descriptive statistic data for public respondent**

Statements	n	Median	Mode	Mean	S.Dev	Variance
Knowing the ingredients of personal care products (PCPs) before using them is important.	62	5	5	4.74	4.24	0.26
Knowing the ingredients of personal care products (PCPs) before buying them is important.	62	5	5	4.73	4.22	0.24
Knowledge about the effect of certain ingredients in personal care products (PCPs) on humans and the environment needs to be disseminated.	62	5	5	4.69	4.20	0.31
Personal care products (PCPs) containing harmful chemical substances should not be sold at any premises or individually.	62	5	5	4.82	4.31	0.18
Personal care products that you use have a good effect on your skin but have a harmful chemical substance. You will immediately stop using it.	62	5	5	4.61	4.15	0.54
Personal care products that you use have a good effect on your skin but have a harmful chemical substance. Nevertheless, you will keep using it.	62	1	1	1.71	1.61	1.39

Personal care products that you use have a good effect on your skin and negatively impact the environment. Therefore, you will keep using it.	62	2	1	2.26	2.12	1.67
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Table 5 shows the summary results for descriptive statistic data of industry respondents. The respondent gives mean (M=4.62) and (M=4.66), respectively, as they strongly agree that knowing the ingredients of PCPs is important before purchasing and using them. The respondents once again strongly agree on statement 3: the knowledge about the effects of certain ingredients in products needs to be disseminated with (M=4.54). Other than that, 4.64 (M=4.64) is the mean for the statement that products containing harmful chemicals should not be sold at any premises or individually. The respondents strongly agree (M=4.40) that they will immediately stop using a PCPs with harmful chemicals but positively affect them. However, they disagree (M=2.12) that they will keep using the products even if they have harmful chemicals but are effective. Lastly, most of the respondents do not agree (M=2.6) that they will keep using the PCPs even if is effective to them but negatively impacts to the environment.

**Table 5: Descriptive statistic data for industry respondent**

Statements	n	Median	Mode	Mean	S.Dev	Variance
Knowing the ingredients of personal care products (PCPs) before using them is important.	50	5	5	4.62	4.13	0.32
Knowing the ingredients of personal care products (PCPs) before buying them is important.	50	5	5	4.66	4.17	0.31
Knowledge about the effect of certain ingredients in personal care products (PCPs) on humans and the environment needs to be disseminated.	50	5	5	4.54	4.06	0.46
Personal care products (PCPs) containing harmful chemical substances should not be sold at any premises or individually.	50	5	5	4.64	4.18	0.56
Personal care products that you use have a good effect on your skin but have a harmful chemical substance. You will immediately stop using it.	50	5	5	4.40	4.01	1.14
Personal care products that you use have a good effect on your skin but have a harmful chemical substance. Nevertheless, you will keep using it.	50	1	1	2.12	2.19	2.48
Personal care products that you use have a good effect on your skin and negatively impact the environment. Therefore, you will keep using it.	50	2	1	2.6	2.46	1.92

Table 6 shows the summary results from the open question at the end of the survey. Most of the respondents from both populations believe that the public still has low awareness, with 61.30% (n=38) for public and 52% (n=26) for industry, which is half of the total of public respondents. However, some of them also mentioned that the public has high awareness regarding to the issue (6.4%; n=4) for the public and (8%; n=4) for the industry. Other than that, they also answered that the public was aware of it but kept emphasizing the beauty and not the environment. Some also mentioned that certain people do not even care about the issue.



**Table 6: Open question results for public and industry respondents**

Theme of answer	Frequency (n, public)	Percentage (%, public)	Frequency (n, industry)	Percentage (%, industry)
Low awareness	38	61.30	26	52
High awareness	4	6.40	4	8
Aware but emphasizing the beauty	5	8.06	8	16
Aware but not to the environment	3	4.84	6	12
Not even care	0	0	1	2
No opinion	12	19.35	5	10

#### 4.2 Correlation between public and industry respondent

There is a correlation between the public and industry analysis results that interpret the data. The correlation between public and industry respondents was obtained using a t-test. First, the t-test was performed by using Analysis ToolPak in Microsoft Excel. Then, the t-test of two samples assuming unequal variances is performed, and the hypothesis is made. The first hypothesis, the null hypothesis, is if the difference means between both population is zero, the perceptions level between industry and public is the same. The alternative hypothesis is, that if the difference means between both populations is not zero, the implementation level between industry and the public is different. After running the t-test, the result of the p-value is 0.997, and it is more significant to  $\alpha$  value, which is 0.05.

From the data analysis, most respondents from the public population were female, lives in Johor, age range from 21 to 25 years old, a degree holder and a student. For the industry population, females who lives in Johor, age range from 21 to 25 years old, a degree holder and a private employer were the majority of the respondent. Most public respondents were only aware of the harmful chemicals in the ingredients of PCPs but did not take it as a precaution to check the ingredients list before buying and using it. This shows that the implementation of the public respondent is still low. They already have the knowledge and information regarding the issue but choose not to use it.

Industry respondents show that the majority of them know about the effects of harmful chemicals in PCPs on humans and the environment and implement it in good way. Therefore, the correlation analysis between both populations accepts the alternative hypothesis, which is the implementation level between industry and the public is different. However, because the p-value (0.997) is close to 1, it suggests no difference between the two study samples. Therefore, the null and alternative hypotheses cannot be rejected as there is only a slight difference (0.003, 0.3%) between the perception of industry and the public regarding the issue. This means, industry respondents only have 0.3% higher knowledge than the public respondents towards implementing harmful chemicals in PCPs on humans and the environment. The correlation between both samples is too strong, and there is no difference between both populations, which makes the result insignificant.

#### 5. Conclusion

Overall, the study shows that the public is ware that the common chemicals substances used in personal care products (PCPs) in Malaysia are mercury, paraben, microplastic, and triclosan. The result from the questionnaire survey showed that most people only knew the basic and common understanding about the impact on humans and the environment. Other than that, most of them only knew effects on human only, but not to the environment. This study will benefit society as they will be more aware of the impact on humans and the environment. In addition, several aspects that need to be highlighted to improve future studies and research by increasing the number of respondents to improve the accuracy of the data. If the targeted respondents are people who works in personal care products (PCPs) or related industries, use a smaller scope for the occupation in that industry, such as choosing a specific position in the company or industry for a better result.

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