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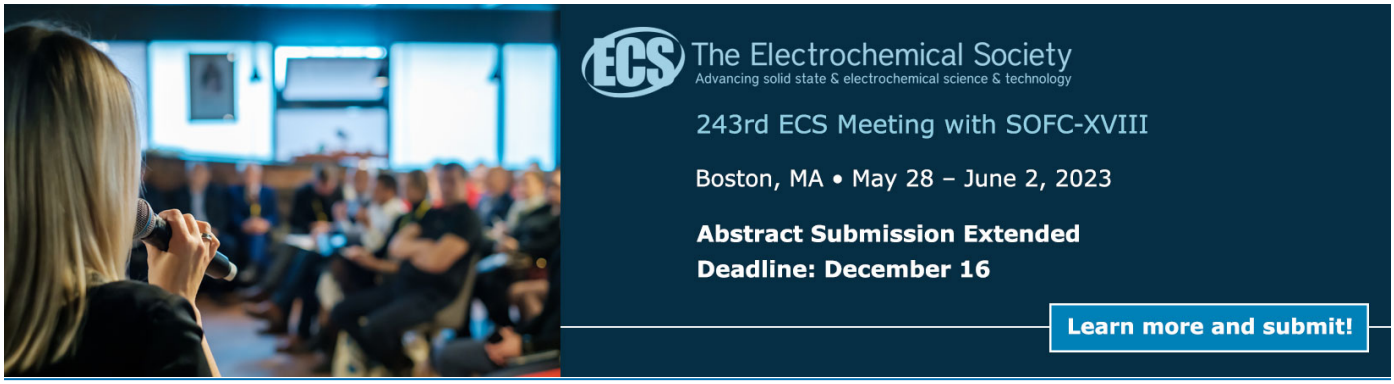

Assessment of Risk Perception on Microplastics Pollution in Drinking Water Sources

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Abstract: Degradation of plastic debris in the marine environment has become a global issue. Microplastics may affect the human health and aquatic life. Therefore, a survey has been conducted on higher institutional students towards the risk perception of microplastics pollution in drinking water sources to increase awareness regarding microplastic pollution. On top of that, this study aims to measure the level of risk perception and the relationship between risk perception, concern and behavioural intentions of the respondents towards microplastics pollution in drinking water sources. In this study, questionnaires are distributed through an online platform to conduct the survey involving 320 respondents. Analysis of independent t-test, ANOVA, correlation and multiple linear regression has been used to analyse the data. It shows that the factor gender does not influencing the risk perception, concern and behavioural intentions of the respondents on microplastics pollution in drinking water sources. The results show a positive correlation between each variable. However, multiple linear regression analysis shows that the behavioural intentions do not significantly affect the level of respondents' risk perceptions.

1. Introduction

Plastics have been found worldwide in the freshwater environment, with estimates showing more than 5 trillion plastic debris floating at a set. A significant amount of this plastic waste originates from coastal sources that mainly enter the water environment through rivers, industrial and urban effluents, and beach sediment runoff. The increasing of plastic debris and microplastics becomes a particular concern due to their small sizes. Moreover, insufficient technologies can be used to measure the existence of the smallest microplastics in the ecosystem and their potential to cause adverse effects on marine biota and humans [1].

Microplastics refers to a particle with a size of < 5 mm and consists of two forms, which are primary and secondary microplastics. The primary source came from the manufactured products produced in microscopic structure, while the secondary source was created after larger plastics had broken down from the larger plastic debris [2]. Microplastic production in our natural ecosystems relies on the biological or chemical cycle on the materials' density, form, and degradation phase [3].

Increasing of microplastics problems highlights the influential environmental factors, such as ecological behaviour, awareness and knowledge. It is hypothesized that if people become more

knowledgeable about the environment issues, they will become more aware and be more motivated to act towards it in responsible ways [4]. Thus, for this reason, the responsibility for behavioral change to reduce the issues lies within themselves. It can be proven that in previous studies in Dungun, Terengganu [5], the researchers concluded that anthropogenic activities such as fishing activities by humans contribute to microplastics pollution in drinking water sources. This shows that people are having behavioural problems regarding these microplastics issues and need to be changed.

On top of that, this study focused on the dimensions of risk perceptions which were cognitive dimension and perceptive dimension. The cognitive size relates to an individual's knowledge and understanding of the risk itself, including the personal need to acquire more information regarding the microplastic issues and magnitude of which its existence is denied based on knowledge [6]. The cognitive dimension consists of the perceived ability to control the risk, the person's concerns about the social surrounding, previous experiences facing, and the perceived benefits of industrial development [7]. In this study, concern and behavioural intentions are the components of the cognitive dimensions.

As for the conceptual framework in this study, risk perception is the dependent variable, while concern and behavioural intentions are the independent variables that will affect the respondents' risk perceptions towards the microplastic pollution in drinking water sources. Throughout this study, the level of risk perception, concern and behavioural intentions of the respondents on the microplastics pollution in drinking water sources were identified. Besides, the relationship between risk perception, concern, and behavioural intentions was analysed and the most significant independent variable that influences the respondents' risk perceptions were identified.

2. Materials and methods

2.1. Study design and sample size

In this study, the questionnaires were distributed to higher institutional students, consisting of 9042 students. However, the targeted respondents were the fourth year, where the total population was 1891 students. The sample size in this study was calculated using the equation (Equation 1 and 2) by researcher [8] and there were 320 respondents with a 95% of confidence level (Z), 5% of margin error (E) and 50% of sample proportion (p) in exact who had been involved in this study. The questionnaires were distributed to the targeted respondents via an online platform through WhatsApp, Telegram and Instagram.

$$n = \frac{s}{1 + \frac{(s - 1)}{N}} \quad (1) \qquad s = \frac{z^2 p\,(1 - p)}{E^2} \quad (2)$$

2.2. Questionnaires

The questionnaires were closed-ended questions to restrict the topics' answers [9]. The questionnaires were consisted total of four sections to measure the variables risk perception, concern and behavioural intentions, including the demographic part. The questionnaires' reliability test was conducted on a group of 320 students from Universiti Malaysia Kelantan before distributing to the targeted respondents. This data was then analysed using Cronbach's alpha [10] with an acceptable coefficient ≥ of 0.70 in the SPSS software.

The first section of the questionnaire was section A, where the respondent's demographic information. Section B consisted of 15 questions regarding the respondents' risk perception. Next, section C evaluated the concern variable which also consisted of 15 questions. The last section was section D, the respondents were assessed with the behavioural intention on reducing the microplastics pollution in drinking water sources were determined from this section. Section B to D was answered with 5-point Likert scales [11].

2.3. Statistical analysis

The Statistical Package for Social Science (SPSS) was the software used to analyse the collected data. In this study, the type of statistical analysis involved included the t-test [15, 16], Analysis of Variance (ANOVA) [17], Spearman Rho correlation test and linear regression analysis [18]. In this study, an independent t-test has been used to compare the risk perception, concern and behavioural intentions of male respondents and female respondents. Moreover, this t-test also was used to identify the significance of the factor gender towards the level of risk perception, concern and behavioural intention of the respondents. One-way ANOVA was used to compare the mean differences in risk perception, concern and behavioural intentions of the respondents from different stages of age. The relationship between risk perception, concern, and behavioural intentions on microplastics in drinking water sources was determined using Spearman Rho correlation test. Lastly, the independent variable concern and behavioural intentions relationship were analysed using linear regression analysis.

3. Results and discussion

3.1. Demographic information

The parameters used for demographic data were gender, age and race. The population of the higher institutional students were 1891 students in total. From the calculated sample size using the equation by Cochran [9], the total sample size needed to be involved in this study were 320 respondents. Table 1 showed respondents' distribution by gender, age and race. From the results, the female respondents were dominant in this study with 64.2 % and only 35.8% were male. Most of the respondents were 21-23 years old (90%). High number of respondents from those age may be due to common age of high institutional students. Moreover, the respondents were mostly Malay, where it presented 282 respondents (88.1%) from the total number of 320 respondents followed by Chinese, Indian and other races.

Table 1. Distribution of respondents.

Factor		N	Percentage (%)	Total (%)
Gender	Male	115	35.8	320 (100)
	Female	205	64.2	
Age	18-20 years old	19	5.9	320 (100)
	21-23 years old	288	90.0	
	24-26 years old	12	3.8	
	27-30 years old	1	0.3	
Race	Malay	282	88.1	320 (100)
	Indian	14	4.4	
	Chinese	21	6.6	
	Others	3	0.9	

3.2. Risk perspection

In this study, each question's frequency and percentage were analysed accordingly based on their respective scales. About 170 respondents (53.1%) strongly agreed that they know the microplastics can harm the aquatic lives and their food chain. Besides, 153 respondents (47.8%) out of 320 also realize that microplastics pollution will affect the ecosystems. This shows that regardless the courses of the respondents were taking, they understood microplastics would affect the aquatic lives and their food chains. Previous study has concluded the basic partial knowledge of the microplastics source and formation was well acquired by students with media as the vital source of information [17]. Respondents

might get information regarding the microplastics pollution in drinking water sources on the Internet and social media platforms [18].

However, some respondents were not aware of these microplastics issues as 79 respondents (24.7%) were the least number of respondents who strongly agree with the microplastics issues. Besides, the information on the understanding of the size of microplastics recorded the highest number of respondents that strongly disagree with the statement, which were 12 respondents (3.8%) and eight respondents (2.5%) were disagree. The results show that many respondents who were not aware of the size of microplastics as the number of respondents who portrayed their opinions by chose neither agree nor disagree were 85 respondents (26.6%) in total. Most of the respondents believed in microplastics' presence in drinking water sources and their environmental impacts. However, they were not aware of the size of the microplastics.

Most of the respondents have a good risk perception of microplastics pollution, where 298 respondents (93.13%) agreed with the statement in this section. However, about eleven respondents (3.435%) were categorized as neither agree nor disagree perception section. Means that, the respondents were not sure regarding this microplastics issues. About eleven respondents (3.435%) were categorized as disagree where the microplastics pollution will harm the environment. From the results, it shows that some of the respondents were lack of awareness regarding the microplastics pollution in drinking water sources.

The students came from engineering, science and humanities courses and were asked five questions regarding microplastics and the results shown that 80% of the respondents answered the questions correctly. However, 80% of the respondents who answered correctly came from the science courses, but few other programs correctly answered. It means that science students have more knowledge regarding microplastics pollution compared to non-science students. In this study, the study background of the respondents was remained unknown. Therefore, the number of respondents who likely to disagree with this section might came from non-science background or lack of awareness in this microplastics pollution in drinking water sources.

The variations in the overall risk perceptions were examined based on factor gender. An independent t-test was conducted to compare the students' risk perceptions in microplastics pollution in males and females of the higher institutional students. Next, one-way Analysis of Variance (ANOVA) was conducted to compare the respondents' risk perceptions towards the microplastics pollution from different stages of age. Results show $p = 0.000$ were significant to the age factor. However, the factor gender ($p = 0.633$) shows no significance regarding the respondents' risk perception towards the microplastics pollution in drinking water sources. The female respondents indicated higher risk perception than male respondents as the mean for females was M = 4.236, N = 205 and male respondents presented the standard of M = 4.208, N = 115. It was proven, the factor age of the respondents plays a crucial role in the perception of risk but not for gender. Age has become one factor that may influence the respondents' risk perception towards microplastics pollution in drinking water sources as the significant value for factor age was $p = 0.000$ [17].

3.3. Concern

About 152 respondents (47.5%) showed their concern about microplastics pollution, where they strongly agreed that plastics pollution would affect the freshwater ecosystem. About two respondents (0.6%) had chosen strongly not concern about the usage of stainless-steel straw and accept the use of a plastic straw. About six respondents (1.9%) chose the scale, not a concern with the statement bringing a reusable food container instead of polystyrene. Thus, higher knowledge the respondents have about plastics pollution, the more they concern about the environmental effects due to plastics [17]. Therefore, it can be said that some of the respondents were lack of knowledge regarding microplastics pollution. Hence, they were less concerned regarding the impact of microplastics pollution on the environment. Table 2 presented the mean percentage for the respondents' concern on microplastics pollution in drinking water sources. The mean percentage of respondents' concern about microplastics pollution in drinking water sources was 96.25% (308 respondents) and the mean percentage of for not concern was only 0.312% (1

respondent). It was proven that the respondents could estimate the potential harm [17] and shows their concern regarding the microplastics pollution in drinking water sources.

Table 2. Main percentage of respondents' concern.

Not Concern (%)	Neither Concern nor Not Concern (%)	Concern (%)
(0.312)	11 (3.438)	308 (96.25)

The variation of concern based on gender, campus and age were analysed. An independent t-test was conducted to analyse and compare the respondents' concern on microplastic pollution in males and females. The results shows that gender was not significant on the respondent's (p = 0.150). Female respondents' mean was slightly higher than male respondents, where the mean for female and male respondents was m = 4.249 and m = 4.176. A study conducted by Deng [17] proved that female respondents were more environmentally friendly and had the sense to protect the environment compared to male respondents.

A one-way ANOVA was conducted to compare the respondents' concern on microplastics pollution in drinking water sources for campus and age. The age factor was significant to the respondents' concern towards microplastics pollution in drinking water sources (p = 0.000). The respondents were expected to be aware of these microplastics issues regardless of their age as they became a global issue today. Even though some of the study backgrounds of the respondents were unknown, they still showed their concern as if they heard about the microplastics issue on mass media. Studies conducted by [18] has stated that knowledge is crucial, as it can trigger our concern and attention by providing the starting point for a willingness to act. The studies portrayed that knowledge about microplastics pollution managed to stimulate the respondents' concern and awareness and perception of the microplastic pollution in drinking water sources. It was not strange to find that if the respondents had a sense as they already had information from a specific source such as media as now has become one of the main platforms of knowledge nowadays [17].

3.4. Behavioural intentions

About 170 respondents (53.1%) strongly agreed to use reusable bottles with BPA free instead of plastic bottles. About 166 respondents (51.6%) were strongly agreed to use stainless steel straw instead of plastic straw when buy beverages. Next, it was proven that most customers have high behavioural intentions in reducing microplastics pollution in drinking water as 164 respondents (51.2%) strongly agreed to minimize plastic usage to decrease the pollution. In contrast, two respondents strongly disagreed where they could not say "No" when people offered them to use the plastic cutlery and were rather to use plastic bags instead of cloth bags when shopping. Behavioural and social scientists believed that motivation is the main factor that will drive behavioural change. However, they still lack information to explain what behaviour should be taken or how to apply it [17].

Besides, Table 3 shows that 94.06% of the respondents had shown behavioural intentions on reducing microplastics pollution in drinking water sources. About 301 respondents (94.06%) agreed on reducing microplastics pollution. It shows that all the respondents have intentions of reducing the microplastics pollution in drinking water sources.

Table 3. Mean percentages of respondents' behavioural intentions.

Not at All (%)	Somewhat (%)	Very Much (%)

0 (0)	19 (5.9375)	301 (94.0625)

In general, the respondents' behavioural intentions showed a positive intention towards these microplastics issues. However, they might offer harmful behavioural purposes when they had a personal belief which sacrifices were needed. Many social psychologists pointed out that a positive attitude is affected by primitive beliefs, including a wide range of beliefs and attitudes regarding specific environmental problems. On the other hand, positive behavioural intentions also could come from the shared media [4] regarding awareness about environmental issues. Therefore, it can be said that a respondent's behavioural intentions on reducing microplastics pollution depended on the level of knowledge and beliefs within themselves.

The variations in overall behavioural intentions were based on gender and age were examined. An independent t-test was conducted to compare between male and female respondents' behavioural intentions in reducing microplastics pollution (p = 0.630). Therefore, the factor of gender did not significantly influence the respondents' behavioural intentions towards reducing the microplastics pollution in drinking water sources. The mean of behavioural intentions for male was M = 4.308, SD = 0.592 while female was M = 4.340, SD = 0.541. It shows that female students were more concerned about reducing microplastics pollution compared to male students as the mean value for female respondents were slightly higher than the mean of the male respondents.

Meanwhile, one-way between-subject ANOVA was conducted to compare the respondents' behavioural intentions in reducing the microplastics pollution in drinking water sources for age. The factor age shows significant in respondents' behavioural intentions on reducing the microplastics pollution in drinking water sources as the significant value for this factor was p = 0.000. A study which has been conducted stated that people that aged between 17 to 35 years old were more concerned about the environment [18]. This finding clearly shows that the number of respondents aged between 21-23 years old recorded the highest number of respondents compared to those aged 24-26. However, the age difference should be negligible as this study was conducted on the respondents, where most of them were aged between 19 to 23 years old.

3.5. Relationship between risk perception, concern and behavioural intentions

Results of the overall correlation between risk perception, concern and behavioural intentions was moderately positively correlated with each other (r = 0.195 to r = 0.479).

The correlation between risk perception and concern shows positively moderate correlation (r = 0.479, N = 320, $p < 0.05$). This study shows that the respondents were aware of the microplastics pollution in drinking water sources. Therefore, the respondents realize that microplastics will pollute the drinking water sources. Hence affect their health. This study's results were acceptable, as a similar study has been conducted by the University of Twente, where they measured the risk perception, psychological distance, behavioural intentions, and concern towards the microplastics issue. From the study, they identified that the variable concern and risk perception were correlated significantly. Based on the findings, the researcher stated that concern was influenced due to the awareness of the microplastics' harmful consequences [7].

The variable of risk perception and behavioural intentions presented a very weak positive correlation: (r = 0.195, N = 320, $p < 0.05$). Behavioural intentions are the individual's readiness to perform a given behaviour [7]. In this study, the results show a weak relationship between both variables, and it can be said that the respondents are aware of the microplastics pollution in drinking water sources. However, they are lack behavioural intentions to engage with the issues. Also, similar findings have been identified by the researcher at the University of Twente, where they stated that the respondents in their study show a positive relationship between behavioural intention and risk perception [7].

The correlation between concern and behavioural intentions shows positively moderate correlation (r = 0.401, N = 320, $p < 0.05$). It showed that the variable of risk perception has a strong correlation with the concern variable. This result clearly showed that variable concern and behavioural intentions

were significantly correlated to risk perception, even though the behavioural intentions were not strongly correlated to risk perception. Based on a study in 2020, they stated that the more knowledge the respondents have, the more concerned the respondents are, and the greater role they are willing to play in environmental protection [7].

This study's results were acceptable, as similar research has been conducted by the University of Twente, where they measured the risk perception, psychological distance, behavioural intentions, and concern towards the microplastics issue. From the study, they identified that the variable concern and risk perception were correlated significantly. Based on the findings, the researcher stated that concern was influenced due to the awareness of the microplastics' harmful consequences [7].

3.6. Relationship Multiple linear regression

The model shows in Table 4 gives the value of R = 0.479[a], R^2 = 0.229 and the value of adjusted R^2 = 0.224. R-value represents the correlation between the independent and dependent variables. R's value in this study was approaching 1, which showed a moderately positive correlation between the variables. R^2 shows the variation for the dependent variable that could be explained by the independent variables. A value greater than 0.5 shows that the model is effective enough to determine the relationship between concern and behavioural intentions on the risk perception. However, in this study, the value of R^2 was 22.9% of the variance for the risk perception. It is possible to be explained by the respondents' concern and behavioural intentions toward microplastics pollution. Adjusted R^2 shows the generalization of the results and in this study, the difference between R^2 value (0.229) and adjusted R^2 was not far off from 0.224, which was good.

Table 4. Model summary of multiple linear regression.

Model	R	R^2	Adjusted R^2
1	0.479[a]	0.229	0.224

a. Predictors: (Constant), Concern, Behavioural Intentions
b. Dependent Variable: Risk Perception

ANOVA tables identified whether the model is significant enough to determine the outcome. Based on Table 5, the result was substantial as the significance value was 0.000 < 0.05. The F-ratio represents an improvement in predicting a variable by fitting the model after considering the model's inaccuracy. In this study, the F-ratio value was 47.139 and greater than 1. Hence the model was overall significant of the regression analysis.

Table 5. ANOVA of multiple linear regression.

Model		Sum of Square	df	Mean Square	F	Sig.
1	Regression	4.893	2	2.447		
	Residual	16.453	317	0.052	47.139	0.000[b]
	Total	21.347	319			

a. Dependent Variable: Risk Perception
b. Predictors: (Constant), Concern, Behavioural Intentions

The significance value of behavioural intentions was p = 0.950, more significant than 0.05. Hence, the variable behavioural intentions gave no significant impact on risk perception. The concern variable significantly influenced the risk perception (p < 0.05).

4. Conclusion

In this study, the level of risk perception of microplastics pollution in drinking water sources from the higher institutional students has been successfully analysed using statistical analysis. More than half of

the respondents were agreed with the questions in each section. The respondents show high level of risk perception, concern and behavioural intentions within themselves. Moreover, they were aware and concerned about microplastics pollution, hence have the behavioural intentions on reducing the microplastics pollution in drinking water sources. Different study backgrounds, such as science and non-science students, did not entirely affect the risk perception, concern and behavioural intentions of the respondents. All the results of Spearman's rho test show a positive relationship but not a strong relationship. Variable concern showed that it affects the respondents' risk perception, where the higher the level of respondents' knowledge, the more the concern the respondents. Thus, the higher the risk perception of the respondents. The results of regression analysis show that, variable behavioural intentions did not significantly influence the respondents' risk perception compared to variable concern in this study.

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