ASSESSMENT OF AWARENESS AND PERCEPTION ON MICROPLASTIC POLLUTANTS IN DRINKING WATER

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ABSTRACT

Microplastic mostly come from everyday items that we used and then throw away such as water bottles, plastic packaging, container, straw, and others. These microplastic might end up in our source of drinking water. The microplastic become bigger threat to us in terms of health and environment but there are still people who are not aware of this problem. Therefore, an online survey has been conducted on university's students from one of the public higher institutions in Malaysia towards awareness and perception on microplastics pollutants in drinking water to raise awareness about microplastic pollution. On top of that, in this study, the awareness of the respondents was measured based on the knowledges, concern, and behavior towards microplastic pollutants in drinking water and the respondents' current perception were measured by looking into towards awareness on microplastic pollutants in drinking water The questionnaires have been conducted through online platform. About 320 respondents from were involved in this survey. The data was determined and analyzed using descriptive analysis, Mann- Whitney, Kruskal Wallis and Spearman Rho. The spearman rho test show correlation shows very weak correlation between perception with other variables. This study indicates that more efforts are needed to enhance the awareness and perception on microplastic pollutants in drinking water among university's students.

Keyword: microplastic, drinking water, awareness, perception, knowledge, concern, behavior

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1.0 INTRODUCTION

Plastic usage around the world have become more worrisome and increasing about 10 tonnes of plastic are created every second and plastic manufacture consumes 8% of worldwide oil production (Aljaradin, 2020). In 1950, plastics production has exploded in popularity about two million tonnes and increasingly nearly 400 million tonnes in 2015. Plastic is now used to replace several materials, including glass in beverage and mineral water bottling, as well as food packaging (Halden, 2010). This plastic production leads to microplastic pollutants. Microplastic is defined as a plastic particle with < 5mm in length with a different type of size, shape, and polymer composition (Smith et al., 2018). Microplastic pollutants have become a serious issue and threat to the environment, humans, and especially to the marine environment. Physical, chemical properties and microbial disturbances correlated with microplastic exposure can pose health risks. These issues have recently grown to include the potential effects of plastics in drinking water and treated water supplies.

Primary microplastics are made directly used in cosmetic products such as facial scrubs and toothpastes, either as resin pellets. Secondary microplastic is created as bigger plastic garbage disintegrates, as opposed to its planned use (Klein et al., 2018). Plastics are divided into three categories: thermosets, elastomers, and thermoplastics. Thermosets do not soften once they have been formed such as polyester resins, Bakelite, and polyurethane (PU). Thermoplastics soften when on heating and stiffening when cooled such as polyethylene terephthalate (PET), polyvinyl chloride (PVC), polypropylene (PP), polyethylene (PE), polyamide (PA). Besides that, elastomers are polymers that are flexible such as neoprene and rubber (Lusher et al., 2017).

Microplastic has its physical characteristic. They are practically found in different shapes, colors, densities, and sizes. Common forms of microplastic particles are fragments, pellets, and fibres of different geometries, from irregular to spherical ones. According to Naji (2017), stated that fiber has become the

most familiar type of microplastic found in various studies about 83%, come after by plastic films (about 11%) and fragments (average 6%). In terms of size, plastic particles are currently classified according to their diameter, with plastics being classified as macro, micro, or nano depending on their size. Based on the size, plastics are classified as nano plastics (1 to <1000 nm), microplastics (1 to <1000 mm), mesoplastics (1 to < 10mm), and macroplastics (1 cm and larger) (Hartmann et al., 2019). Microplastics are defined by the number of research as polymers with a diameter of smaller than 5 mm. However, the lower limit is less well defined because it entirely depends on the sampling and processing technique (Hidalgo-Ruz et al., 2012). In the end, the microplastic size ranged smaller than 5mm is obtained by many researchers.

All polymers have their uses, especially for human consumption. Polyethylene (PE) and Polypropylene (PP) are by far the most extensively used plastics, with much of it utilised to manufacture malleable films and materials for production, as well as pipelines, automobile parts, and houseware. Other chemicals ingredients may be used in order to increase stability, processability, durability, appearance, or function that are added during the production process and also exposed to other chemicals from the environment. In addition, previous studies stated that microplastics can contain two different kinds of chemicals which are polymeric raw materials and additives derived from the plastics during production, such as monomers or oligomers, and chemicals absorbed from the environment (Campanale et al., 2020). The ability of plastic polymers like polyethylene (PE) and polyurethane (PUR) to accumulate chemical action such as persistent organic pollutants (POPs) from the environment is important characteristics in their use as passive samplers in environmental monitoring (Lohmann et al., 2012). These toxic chemicals bind preferentially to the surface of the microplastic, and the amount adsorbed per gram of plastic may be significant due to the particle's high surface-to-volume ratio.

The other chemicals that can interact with microplastic are heavy metals. Heavy metals are usually known as metals and metalloids with greater atomic weight. Heavy metals including Cr, Cd, Pb, and Hg have an impact on the environment and humans. Many of these pollutants can bind to microplastics and sorb from the environment like POPs. Microplastics are thus viewed as vectors of causing irreversible damage due to their capacity to sorb xenobiotic substances (Duan et al., 2020).

Next, the other type of chemicals that absorbed into microplastic's surface is additives chemicals. Additives are chemicals that are applied to plastic during the manufacturing process to give it characteristics like color and clarity, as well as to increase its resistance to light radiation, mould, temperature, ozone, light radiation, humidity, and bacteria, as well as its electrical potential and mechanical thermal (Campanale et al., 2020). Plasticizers are one of the additives that are added to plastic to change its strength, durability, and flexibility. There are approximately 50 plasticizers in commercial usage. Only certain flame retardants are polymerized with plastic molecules and become part of the polymeric chain; in almost all situations, the additives are not chemically attached to the plastic polymer. Because of their greater surface area to volume ratio, microplastics leach more chemical additives than larger plastic objects. As larger pieces of plastic degrade into microplastic, chemicals may be leached (Bergmann et al., 2015).

The widespread presence of microplastics of all sizes in wastewater, surface water, and groundwater has prompted the issue of whether or not bottled water is contaminated (SAPEA, 2019). Only a few studies have been published to date that solves this problem, and they have all found microplastics in both bottled and tap water (Kosuth et al., 2018; Mason et al., 2018). General polymer types (PS, nylon, PET, PP), as well as shapes (foam, fiber, pellet, fragments), have been discovering similar to those found in surface waters. The most common particle forms in drinking water were fragments and fibers with polyethylene terephthalate and polypropylene being the most commonly detected polymers (WHO, 2019).

Microplastic can give a negative effect on the environment, especially on humans in drinks and food. Drinking water has been suggested as a possible path for microplastics to invade the human body. According to Wright and Kelly (2017), recently the effects of microplastic on human health have been evaluated. Microplastic can be exposed to the human body through skin contact, ingestion, and inhalation (Prata et al., 2020). The essence of the toxic chemical, exposure properties, human sensitivity, and hazard controls and all influence the severity of adverse effects caused by exposures of microplastic to humans and the environment. According to limited evidence from animal studies, when the human body or animal is exposed through ingestion or inhalation, the microplastics can ultimately cause particle toxicity by bringing out an immune response in the body. Microplastics could potentially cause a range of tissue damage due to their different physicochemical properties (solubility, surface, shape, size, surface reactivity, surface change, and energy band structure). Microplastics' large surface area can lead to the

release of hazardous chemicals, increasing oxidative stress and cytotoxicity in individual cells, and may enable microplastic translocation into human and animal tissues (Galloway, 2015).

There seems to be little doubt that in recent years, a strong collective awareness of environmental challenges has emerged. There is a lack of research on society's awareness related to microplastic, and there are gaps in particular regarding the perception of different types, sources, and final destinations of microplastic (for example in food, from plastic container/packaging and fabrics, atmospheric, and primary versus secondary microplastic) (SAPEA, 2019). Plastic particles in food and drinking water have been found to be significantly (39%) or moderately (23%) contaminated by the majority of the people in Germany based on representative survey (SAPEA, 2019). This show that the people are still not aware about the presence of microplastic pollution. Environmental attitudes and behavior related to minimizing plastic pollution are influenced by a variety of social, personal, and situational factors. Concern perceived behavioral control, identity, values, attitudes, emotions, personal and social norms, as well as knowledge and awareness, have all been found to be determinants of intentions and behavior (S. Pahl & Wyles, 2017). Although knowledge is linked to awareness and concern about environmental issues caused by human behavior, these links are not always strong (Ünal et al., 2018). However, a lack of knowledge also may make it difficult to take action to remedy the environmental issues.

In the early twenty-first century, the research about microplastic has begun and the attention on microplastics has exploded in recent years (Klingelhöfer et al., 2020). The public is becoming increasingly worried about microplastics as a growing environmental problem, one whose immediacy has risen as a result of new scientific data. Several natural sciences researches have looked into microplastics from various angles (SAPEA, 2019), including i) a baseline understanding of microplastics and polymer properties (Andrady, 2011) ii) the source of microplastics and the route of their migration (Boucher & Friot, 2017) iii) microplastic distribution features in various habitats, such as oceans, lakes, and rivers (Klingelhöfer et al., 2020) iv) microplastic biological toxicity and concerns (Remy et al., 2015). Microplastics research in the social and behavioral sciences, on the other hand, is still in its early stage. Overall, this study mainly aims to determine the respondents' level awareness based on knowledge, concern and behavior and also to analyses the perception towards awareness to the microplastic in drinking water by using online questionnaires survey.

2.0 DATA COLLECTION AND METHOD

2.1 Design of the questionnaire

The questionnaires were assigned to targeted students in one of the local higher institutions in Kelantan. The sample size was determined using Krejcie and Morgan Formula 1970. There were 320 respondents that involved in this study.

The structured of the questionnaire was designed in 5 different sections and assigned to the respondents through online google form through Whatsapp, Instagram and Telegram to collect the data. Section A was about respondents sociodemographic (age, gender, year, education level, faculty), section B was about knowledge of the respondents towards the microplastic pollutions, section C was about concern on microplastic pollutants in drinking water, section D was about respondents' behaviour on managing to reduce the microplastic pollutants in drinking water and the last section (Section E) was about respondents' perception towards microplastic in drinking water.

2.2 Statistical Analysis Descriptive Analysis

The data obtained from the questionnaire was analysed using statistical analysis software (SPSS). The statistical analysis that has been used are such as descriptive analysis, Mann- Whitney U test, Kruskal Wallis test and Spearman Rho test.

3.0 RESULT AND DISCUSSION

3.1 Pilot test

The sample size for the pilot study should be 10% of the sample size. Therefore, the questionnaire was distributed to 32 respondents before being analysed using Cronbach Alpha (Johanson & Brooks, 2010). Cronbach's alpha analysis was used for all parts of the questionnaires to confirm the reliability.

This approach was used to assess size efficiency. As a result, questions with α-value of less than 0.70 should be excluded (Taber, 2018). In this study the result was greater than 0.70 and was regarded as 'good' for reliability test based on Table 1.

Table 1. Reliability test

Cronbach's Alpha	Internal Consistency
.826	good

3.2 Normality test

The normality test used were Shapiro–Wilk test and Kolmogorov–Smirnov test. Kolmogorov–Smirnov test is used for (n ≥50 samples) meanwhile Shapiro–Wilk test is more appropriate method for small sample sizes (n<50 samples), although it can also be handling on larger sample size (Mishra et al., 2019). The null hypothesis for both of the above tests asserts that the data are drawn from a normally distributed population. The null hypothesis is accepted when P >0.05 and the data is said to be normally distributed (Mishra et al., 2019). But in this study, the data are not normal distribution.

3.3 Sociodemographic Information

Table 2 showed that respondents' demographic data distribution. Most of the respondents were 19-21 years old (51.2%). Furthermore, the respondents were mostly year 1 student, where it presented 86 respondents (26.9%) from the total number of 320 respondents in total. Most of the respondents were diploma students from their previous education 124 more than students with previous education with matriculation and foundation.

Table 2. Distribution of respondent

Factor		N	Percentages (%)	Total (%)
Age	19-21	164	51.2	
	22-24	139	43.4	320(100)
	25-26	17	5.3	
Gender	Female	199	62.2	
	Male	121	37.8	320(100)
Previous Education	Matriculation	84	26.3	
	Foundation	112	35.0	320(100)
	Diploma	124	38.8	
Year	Year 1	86	26.9	
	Year 2	74	23.1	320(100)
	Year 3	77	24.1	
	Year 4	83	25.9	

3.4 Knowledge

Mostly 190 respondents (59.40%) strongly agreed that they know that "microplastic is hazardous to humans and animals" (Questions No. 5). Almost half of the respondents are known and aware of the microplastic pollution effect on human and animals. Besides that, 145 respondents (45.3%) out of 320 also realize that "microplastics exist in daily drinking water and food". This shows that either the respondents came from different faculties, they were aware that microplastics pollutants would affect their daily drinking water and food. The respondents indicate their level of awareness of microplastic pollution, which has become a serious challenge. On social media channels, respondents could acquire or find information and have better understanding about microplastics pollutants in drinking water easily (Deng et al., 2020).

However, some respondents were not aware of these microplastics issues in drinking water as 52 respondents (16.3%) were the least number of respondents who strongly agree with the statement "don't know what's in their drinking water". They strongly agree regarding that "they don't know what's in their drinking water". The other questions about they not sure "whether their drinking water is safe or not from any microplastic pollutants". The results show that many respondents with "whether their drinking water is safe or not" choose the answer of agree 128 respondents and strongly agree with the statement were 89 respondents. This show that many people just drink or used the drinking water without knowing the quality

of water whether it safe or not. The majority of the respondents believed in microplastics' presence in drinking water.

To analyses the level of awareness based on knowledge between male and female was analyses using Mann- Whitney U Test. Based on table 3, the test revealed were not significantly different in the preference of female were higher compared to male. The significance level for this study was set at 0.05.

Table 3. Respondents' knowledge based on gender

	Gender	N	Mean Rank	Sum of Ranks	Mann-Whitney U	Asymp. Sig.
Knowledge	**Female**	199	163.18	32472.50	11506.500	.506
	Male	121	156.10	18887.50		
	Total	320				

3.5 Concern

The result show that about 142 respondents (44.40%) showed their concern about microplastics pollution, where they strongly agreed that "drinking water has become a pathway for microplastics to enter the human body". About 4 respondents (1.30%) had chosen strongly disagree about the drinking water has become a pathway for microplastics to enter the human body. Furthermore, about 6 respondents (1.9%) chose the scale, not a concern with the statement "pays special attention to reports of microplastic pollution on media social". The more information and knowledge the respondents have about plastic pollution, the more they worry about the environmental effects due to plastics (Deng et al., 2020). 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.

Based on table 5, the test revealed were not significantly different in the preference of female respondents were higher compared to male respondents. In this result female respondents show a great concern on microplastic pollutants in drinking water. Based on previous study, women regularly expressed pro-environmental views and expressed greater concern about various environmental issues than men (Ramstetter & Habersack, 2020).

Table 5. Respondents' concern between gender

	Gender	N	Mean Rank	Sum of Ranks	Mann-Whitney U	Asmyp. Sig.
Concern	**Female**	199	156.84	31211.50	11311.500	.363
	Male	121	166.52	20148.50		
	Total	320				

3.6 Behaviour

The result show that only 1 respondent (0.3%) strongly disagreed to "reduce the use of plastic products". In question no. 7 presented those 120 respondents (31.9%) were strongly agreed "willing to refuse straws with café or takeaway drinks". This result show that, the respondents were interested in using greener way to reduce the plastic pollutants but need some motivation. A statement in the questionnaire "I am sure that recycling is the best way to reduce plastic pollution" has highest mean. From this question, we see that 174 respondents choose strongly agree with the recycling method to reduce the plastic pollution. Next, it was proven that most respondents have high behavioural in reducing microplastics pollutants in drinking water as 162 respondents (50.60%) strongly agreed "willing to participate in the clean-up efforts of microplastics pollution". Motivation can lead to the behavioural change based on behavioural and social scientists, but they lack information to explain the behaviour that should apply or be taken (Deng et al., 2020).

According to table 7, a Mann- Whitney test was used to evaluate the level of awareness based on behaviour between male and female was tested. The test revealed were not significantly different in the preference of female respondents were higher compared to male respondents. This show that female respondents were willing to participate and show some effort to reduce the microplastic issues. In 39 previous study show that females are more environmentally aware than males and have a stronger instinct to preserve the environment (Mainieri et al., 1997).

Table 7. Respondents' behaviour between gender

	Gender	N	Mean Rank	Sum of Ranks	Mann-Whitney U	Asmyp. Sig.
Behaviour	**Female**	199	163.22	32480.00	11499.000	.500
	Male	121	156.03	18880.00		
	Total	320				

3.7 Perception

About 137 respondents (42.8%) strongly agreed that "they still need to learn more about microplastic pollutants in drinking water" because of this we can conclude that the respondents are still eager to learn about the microplastic pollutants in drinking water. Besides that, 46 respondents (14.4%) out of 320 choose to strongly disagree about "don't know that microplastic pollutant in drinking water is a very serious issue". This shows that either the perception of the respondents was aware that microplastics pollutants in drinking water are a very serious issue. The respondents indicate their level of perception and awareness of this issue. Moreover, some respondents were not aware of these microplastics issues in drinking water as 9 respondents (2.80%) were the least number of respondents who strongly agree with the statement "don't think that the microplastic will harm the environment". This show that they know about microplastics can harm the environment. Besides, about 31 respondents (9.7%) also choose to strongly agree on "microplastic is too complicated to understand". This concept of microplastic is quite hard to understand.

3.8 Perception Towards Knowledge, Concern, and Behavior

Referring to table 9, the variable of perception and knowledge presented as very weak link negative correlation: r = -.313, N = 320, p = 0.000 by using spearman rho test. This show that, the relationship is not significant as shown by the low correlation coefficient. It is also show that both variables have weak relationship to each other, and this can be said that the respondent's current perception are not influences on their knowledge. Furthermore, there is strong enough to reject H_0 null hypothesis since p – value is smaller than 0.05. Based on the result, the improvement of respondent's knowledge is still needed to be improve in order to influences the perception.

Next, there is also very weak negative correlation: r = - .363, N =320, p = 0.000 between perception and concern (table 9). The relationship between these two variables is not significant because of low correlation coefficient and shows that the respondent's perception are not influences the concern. In this case, the H_0 null is strong enough to be rejected because p -value is smaller than 0.05. Based on result, it still need improvement in order to increases the respondent's concern with perception towards microplastic pollutants in drinking water.

Meanwhile, the variable of perception and behaviour presented a very weak negative correlation: r = -.163, N = 320, p = 0.004 (table 9). Therefore, the relationship is not significant as shown by the low correlation coefficient. In this study, the results show a weak relationship between both variables, and it can be said that the respondents' perception are not influences their behaviour enough to reduce the microplastics pollutants in drinking water. This is because of, they are lack both in perception and behaviour to engage with the microplastic issues. It is the same with the other two variables that there is strong enough to reject H_0 null hypothesis since p – value is smaller than 0.05. There is also strong evidence to suggest relationship between these two variables does exists even though it is weak or strong.

Table 9. Spearman Rho correlation current perception toward knowledge, concern, and behavior

			Knowledge	Concern	Behaviour
Spearman's rho	**Perception**	**Correlation Coefficient**	-.313**	-.363**	-.163**
		Sig. (2-tailed)	.000	.000	.004
		N	320	320	320

4.0 CONCLUSION

Based on the overall result, in terms of awareness, there is an increase of knowledge, concern, and behavior among the students in one of the higher institution. However, in terms of perception, knowledge, concern, and behavior have a low relationship with perception. It can conclude that awareness and perception have an effect and different result on those three variables. This research did not only talk about health impacts to the environment and humans but also improved waste management to reduce plastic pollution. Increasing public health knowledge and awareness about microplastic pollution would greatly help to increase perception and thus, encourage everyone to be more active in each role for reducing microplastics pollution.

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