

ORIGINAL ARTICLE

Exploring Socio-Demographic Factors Associated with Microplastic Knowledge and Risk Perception in Kuala Langat, Selangor

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ABSTRACT

Introduction: Microplastics (MPs), plastic particles under 5 mm, are emerging as pervasive pollutants with potential environmental and human health impacts. However, public understanding of their risks remains limited, especially in Malaysia. **Methods:** A cross-sectional study involving 150 adult residents from 11 neighbourhoods in Kuala Langat, Selangor, was conducted using snowball sampling. Respondents completed a validated questionnaire assessing socio-demographics, knowledge, and risk perception related to MPs. Data were analysed using SPSS Version 29.0. Chi-Square tests were applied to determine associations ($p < 0.05$). **Results:** Respondents demonstrated higher risk perception than knowledge regarding MPs. Age was significantly associated with knowledge of environmental impacts ($\chi^2 = 16.65$, $p = 0.034$) and health risks ($\chi^2 = 18.17$, $p = 0.011$). Education level was significantly associated with knowledge of MPs, with respondents who had tertiary education demonstrating greater awareness than those with lower educational attainment ($\chi^2 = 21.83$, $p = 0.001$). Gender was significantly associated with risk perception of respiratory health effects ($\chi^2 = 3.96$, $p = 0.046$), while race was associated with perceptions of MP characteristics ($\chi^2 = 9.94$, $p = 0.002$). Respondents with higher educational attainment also exhibited greater awareness of the environmental and health risks of MPs and stronger support for preventive practices. **Conclusion:** Sociodemographic factors significantly influence knowledge and risk perception of MPs. The gap between high-risk perception and low detailed knowledge highlights the need for targeted public education strategies to enhance environmental health literacy in affected communities.

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INTRODUCTION

Microplastics (MPs), defined as plastic particles less than 5 mm in diameter, have emerged as a ubiquitous contaminant of concern in both environmental and public health domains [1]. The morphology and physicochemical properties of MPs, particularly when combined with environmental pollutants, may influence their environmental fate and potential toxicity [2]. MPs have been detected in various environmental matrices, including river water, soil, air, and food packaging [3]. Studies have demonstrated that MPs are present across a wide range of urban aquatic systems, particularly in sewage sludge and river sediments [1,2].

In Malaysia, the Langat River, one of Selangor's major river systems, has been reported to contain a substantial concentration of MPs, attributed largely to surrounding industrial activities such as waste recovery, metal processing, and plastic manufacturing [4]. Kuala Langat is a rapidly developing district in Selangor known for its heavy industrial zones and proximity to the Langat River. The area has been flagged for environmental degradation, including high levels of microplastic pollution in its waterways due to plastic waste mismanagement [5].

Kuala Langat, which lies downstream of several MP-emitting industrial zones, is uniquely positioned as a district facing heightened environmental exposure. Its combination of rural, semi-urban, coastal, and industrial-adjacent communities creates socio-demographic diversity that may influence residents' awareness, exposure pathways, and perceived vulnerability to MPs [6]. This geographical and socio-economic heterogeneity

provides a strong rationale for selecting Kuala Langat as the study location, as variations in community knowledge and risk perception are expected.

Despite the growing body of evidence on environmental and health-related implications of MPs, public knowledge and awareness remain insufficient. Prior studies suggest that while the general population may be familiar with conventional plastic products, their understanding of MPs, particularly about chemical composition, environmental fate, and biological impact is limited [7,8]. Education appears to be a critical factor influencing environmental consciousness and risk perception [9]. In addition, a local study found that 51% of Malaysian respondents exhibited high knowledge levels such as they have heard of MPs and could identify at least one environmental or health impact. However, only 39.8% demonstrated positive risk perception such as they acknowledged MPs as a serious threat requiring behavioural change or policy action [10].

This study seeks to address this gap by examining the relationship between socio-demographic factors and levels of knowledge and risk perception concerning MPs among residents of Kuala Langat, Selangor. Given the district's proximity to high-impact industrial zones and documented environmental contamination, this research offers valuable insights for environmental health policymakers and risk communication strategists in Malaysia.

MATERIALS AND METHODS

Study Design

This study employed a cross-sectional quantitative design among residents of Kuala Langat, Selangor. The district was selected due to its proximity to industrial activities known to contribute to environmental microplastic contamination.

Sampling Method

Data collection was conducted using a snowball sampling technique, which is particularly useful for accessing populations where a comprehensive sampling frame is unavailable. This approach allowed the recruitment of participants through community networks, particularly during local public events, thereby enhancing participation efficiency under time and resource constraints. However, because recruitment occurs through social networks, it may disproportionately capture individuals who are more socially connected, more educated, or more engaged in community activities. This introduces the possibility of selection bias and limits the representativeness of the sample. These limitations are acknowledged when interpreting the findings.

Participants were recruited from 11 residential areas within Kuala Langat. Recruitment was facilitated through

attendance at community events held at a community hall. Data collection took place over a three-month period from August to October 2024.

Sample size estimation was performed using the OpenEpi sample size calculator, incorporating a 10% non-response rate, an expected frequency of 20%, and a confidence interval of 80%, resulting in a minimum required sample of 116 participants. A final sample of 150 respondents was achieved.

Data Collection and Instrumentation

Data were collected using a structured, validated questionnaire distributed both online (via Facebook and WhatsApp) and through face-to-face administration during public events. This mixed-mode distribution increased reach but may introduce differences in response patterns due to convenience, access to technology, or perceived anonymity. Potential biases were considered, including self-selection bias, whereby individuals more interested in environmental issues may be more likely to participate. To reduce these biases, investigators used anonymous self-administered questionnaires, provided neutral instructions, and ensured inclusion of both online and in-person respondents to enhance representativeness.

Prior to participation, all respondents received an explanation of the study's objectives, and assurances of confidentiality, and were asked to complete an informed consent form. Inclusion criteria required participants to be Malaysian citizens aged 20 to 69 years and to have lived or worked in Kuala Langat for at least five years. This criterion ensured that respondents possessed contextual familiarity with the local environment, including potential exposure to MPs.

The questionnaire was adapted from established instruments used in previous studies [11,12]. Items were culturally and contextually refined for the target population and translated from English into Malay to accommodate varying levels of language proficiency. The final questionnaire comprised three sections, which captured section A on socio-demographic characteristics (14 items), section B on knowledge of MPs (20 items) and section C on risk perception of MPs (10 items). For knowledge items in Section B, responses were coded as "Yes", "No" or "Not sure". No composite knowledge score was calculated. Instead, descriptive statistics were reported for each item, and associations with socio-demographic variables were analysed using Chi-square tests. This approach allowed for item-level interpretation rather than relying on aggregate scoring. Meanwhile, risk perception items in Section C used a 5-point Likert scale ranging from 1 (Very not agree) to 5 (Very agree). Overall scores were classified based on cumulative agreement as high for $\geq 80\%$ agreement, moderate for 50%–79% agreement and low for $< 50\%$ agreement.

Quality Assurance and Control

A pilot test was conducted with 10% of the estimated sample size ($n=15$) to assess the clarity, feasibility, and cultural relevance of the questionnaire. Feedback from this pre-test informed further refinements. To ensure reliability, internal consistency of the questionnaire was evaluated using Cronbach's alpha, which yielded a value of 0.81, indicating good reliability. Additionally, content validity was reviewed by two academic assessors with expertise in environmental health and survey methodology to ensure consistency, accuracy, and construct relevance.

Data Analysis

Data were analysed using IBM SPSS Statistics for Windows, Version 29.0. Descriptive statistics were employed to summarise socio-demographic characteristics. The Shapiro-Wilk test was used to assess normality of continuous variables, revealing non-normal distribution. Therefore, categorical analyses were performed. Chi-square tests were used to examine associations between socio-demographic variables and both knowledge and risk perception levels related to MPs. A significance level of $p<0.05$ was used throughout.

Ethical Consideration

This study was approved by the Ethics Committee for Research Involving Human Subjects of Universiti Putra Malaysia (JKEUPM-2024-403). Informed consent was obtained from all participants, and their anonymity and confidentiality were rigorously maintained throughout the study. Approval to conduct the study and distribute the questionnaire was also granted by the relevant local authority.

RESULTS

Socio-Demographic Characteristics of Respondents

A total of 150 respondents participated in this study. As presented in **Figure 1**, the majority were females (64.7%), Malay ethnicity (84.7%), and had attained tertiary education (66.7%). The age group with the highest representation was 40–49 years (28.7%).

Knowledge of Microplastics

Respondents demonstrated a moderate level of knowledge regarding MPs. To categorise knowledge levels, responses were scored based on the percentage of correct answers. Following the classification method adapted from a previous study [12], knowledge scores were grouped as high for $\geq 80\%$ correct answers, moderate for 50%–79% correct answers and low for $<50\%$ correct answers. As shown in **Figure 2**, a high proportion responded “Yes” to general questions about MPs, suggesting some exposure to the topic. However, responses such as “Not Sure” exceeded 35% across several items, particularly those assessing knowledge about the formation, sources, and health impacts of MPs.

Risk Perception of Microplastics

The majority of respondents expressed concern about the potential environmental and health impacts of MPs. Following the classification method adapted from a previous study [11], risk perception was assessed using a 5-point Likert scale, and overall scores were classified based on cumulative agreement as high for $\geq 80\%$ agreement, moderate for 50%–79% agreement and low for $<50\%$ agreement. As illustrated in **Figure 3**, most agreed or strongly agreed with statements describing the hazards of MPs, suggesting a heightened perception of risk. Despite this, uncertainty persisted among some participants, especially concerning specific exposure pathways and long-term health outcomes.

Association between Socio-Demographic Factors and Knowledge of Microplastics

Statistical analyses revealed significant associations between age and knowledge for selected items. As shown in **Table I**, participants aged 50–59 years exhibited the highest percentage of “Yes” responses compared to other respondents, particularly those aged 20–29, who had the highest levels of “Not Sure” responses.

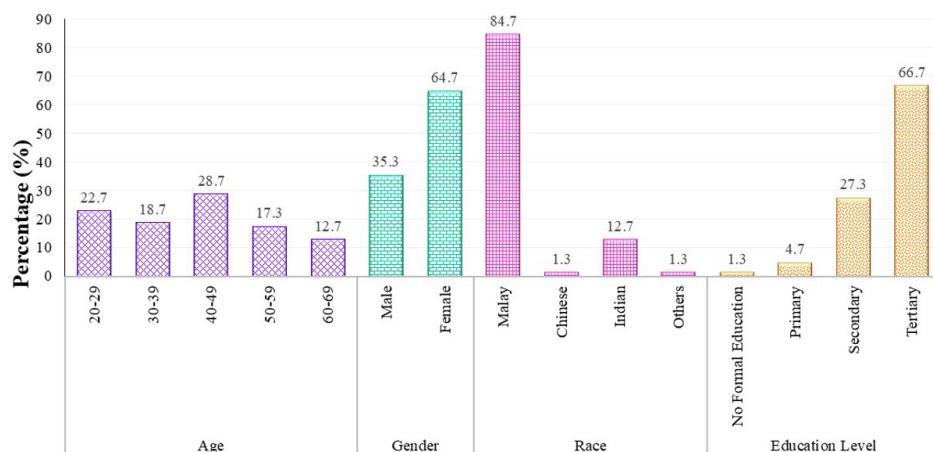
In addition, education level demonstrated a strong association with knowledge of MPs. As detailed in **Table I**, five knowledge items were significantly associated with education level. Respondents with tertiary education had the highest percentage of “Yes” responses, whereas those with no formal education reported the lowest.

Associations between knowledge of MPs and race were statistically significant ($p=0.039$), with Malays and Indians exhibiting higher knowledge of MPs than Chinese and other groups. On the contrary, no significant association between knowledge of MPs and gender ($p=0.111$) although females demonstrated a higher knowledge level than males (93.8% vs. 81.1%).

Associations between Socio-Demographic Factors and Risk Perception of Microplastics

As presented in **Table II**, gender was significantly associated with risk perception. For example, a higher percentage of females perceived that MPs could cause respiratory problems ($\chi^2=3.96$, $p=0.046$) and reduce exposure through seafood consumption ($\chi^2=4.20$, $p=0.040$), compared to their male counterparts. Moreover, race exhibited a statistically significant association with risk perception. Malays were more likely to agree that MPs are small in size and can be found in small organisms ($\chi^2=9.94$, $p=0.002$), and that dietary modifications such as reducing seafood consumption can lessen exposure ($\chi^2=8.29$, $p=0.040$).

Furthermore, education level showed associations with risk perception across several statements. Respondents with higher education levels were significantly more likely to agree that MPs disrupt ecosystems ($\chi^2=11.34$, $p=0.010$), are small and inhalable ($\chi^2=20.12$, $p<0.001$;



Socio-demographic Factors

Fig. 1: Socio-demographic factors of the respondents (n=150)

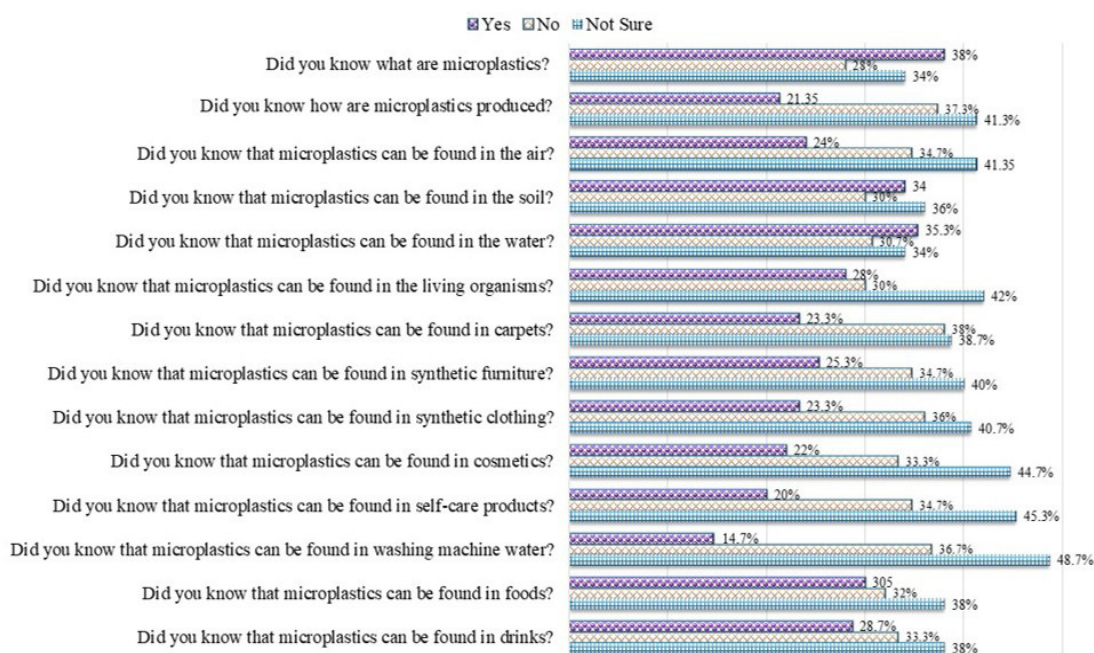


Fig. 2: Level of Knowledge (%)

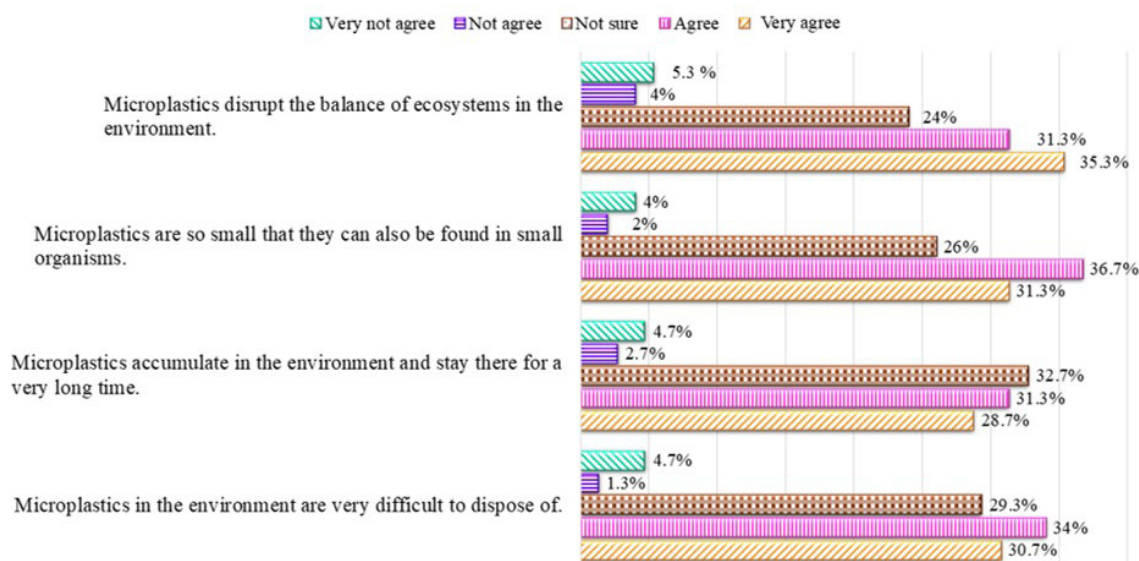


Fig. 3: Level of Risk Perception (%)

Table 1: Associations between socio-demographic factors and knowledge of microplastics among the respondents

Statement	Category	Yes	No	Not Sure	χ^2	p
N (%)						
Age						
Did you know that plastic pollution is one of the biggest environmental problems today? ^δ	20-29	25 (73.5)	4 (11.85)	5 (14.7)	16.65	0.034*
	30-39	23 (82.1)	2 (7.1)	3 (10.7)		
	40-49	41 (95.3)	1 (2.3)	1 (2.3)		
	50-59	25 (96.2)	1 (3.8)	0 (0.0)		
	60-69	16 (84.2)	3 (15.8)	0 (0.0)		
Did you know that plastics that end up in the ocean are a threat to human health? ^δ	20-29	24 (70.6)	2 (5.9)	8 (23.5)	18.17	0.020*
	30-39	18 (64.3)	5 (17.9)	5 (17.9)		
	40-49	38 (88.4)	2 (4.7)	3 (7.0)		
	50-59	24 (92.3)	2 (7.7)	0 (0.0)		
	60-69	15 (78.9)	3 (15.8)	1 (5.3)		
Did you know that microplastics can be found in the air? ^δ	20-29	25 (73.5)	4 (11.85)	5 (14.7)	16.65	0.034*
	30-39	23 (82.1)	2 (7.1)	3 (10.7)		
	40-49	41 (95.3)	1 (2.3)	1 (2.3)		
	50-59	25 (96.2)	1 (3.8)	0 (0.0)		
	60-69	16 (84.2)	3 (15.8)	0 (0.0)		
Education Level						
Do you know what microplastics are? ^δ	None	0 (0.0)	0 (0.0)	0 (0.0)	21.83	0.001*
	Primary	1 (14.3)	5 (71.4)	1 (14.3)		
	Secondary	11 (26.8)	19 (46.3)	11 (26.8)		
	Tertiary	45 (45.0)	18 (18.0)	4 (4.0)		
Do you know how microplastics are produced? ^δ	None	0 (0.0)	0 (0.0)	2 (100.0)	19.94	0.003*
	Primary	0 (0.0)	6 (85.7)	1 (14.3)		
	Secondary	6 (14.6)	22 (53.7)	13 (31.7)		
	Tertiary	26 (26.0)	28 (28.0)	46 (46.0)		
Did you know that microplastics can be found in the soil? ^δ	None	0 (0.0)	0 (0.0)	2 (100.0)	15.44	0.017*
	Primary	1 (14.3)	4 (57.1)	2 (28.6)		
	Secondary	8 (19.5)	18 (43.9)	15 (36.6)		
	Tertiary	42 (42.0)	23 (23.0)	35 (35.0)		
Did you know that microplastics can be found in synthetic clothing? ^δ	None	0 (0.0)	0 (0.0)	2 (100.0)	15.30	0.018*
	Primary	2 (28.6)	4 (57.1)	1 (14.3)		
	Secondary	4 (9.4)	21 (51.2)	16 (39.0)		
	Tertiary	29 (29.0)	29 (29.0)	42 (42.0)		
Microplastics can be contributed by the following activities: Agriculture ^δ	None	0 (0.0)	0 (0.0)	2 (100.0)	14.07	0.029*
	Primary	2 (28.6)	2 (28.6)	3 (42.9)		
	Secondary	7 (17.1)	15 (36.6)	19 (46.3)		
	Tertiary	44 (44.0)	24 (24.0)	32 (32.0)		

N=150, *Significant at $p < 0.05$; ^δBy χ test with Yates' correction for expected value < 5

$\chi^2=17.29$, $p<0.001$), are persistent and difficult to dispose of ($\chi^2=15.63$, $p<0.001$), are harmful to human health, including links to cancer and food poisoning ($\chi^2=15.09$, $p=0.002$; $\chi^2=8.81$, $p=0.032$). They also demonstrated greater agreement with preventive practices, such as using filtered tap water, avoiding microwaving in plastic containers, and choosing plastic-free products ($p<0.001$). Notably, age was not significantly associated with risk perception in this study.

DISCUSSION

The socio-demographic profile of respondents in this study reflects a predominance of females, Malay ethnicity, and individuals with tertiary education, with most aged between 40 and 59 years. This demographic trend suggests that middle-aged, educated adults were more inclined to engage in a study addressing

environmental health concerns, which aligns with previous research highlighting greater environmental consciousness among these groups [13].

Respondents exhibited a moderate understanding of MPs, with high affirmative responses to general questions indicating baseline knowledge. However, the consistently high proportion of "Not Sure" responses, particularly on questions addressing the formation, exposure sources, and health implications of MPs signals an incomplete understanding. This pattern underscores the presence of fragmented knowledge, possibly linked to limited public outreach or the technical nature of the topic, which remains underrepresented in mainstream education and media [14,15].

Despite these knowledge gaps, the study found a high level of risk perception among respondents. Most

Table II: Associations between socio-demographic factors and risk perceptions of microplastics

Statement	Category	High	Low	x ²	p
		N (%)			
Gender					
Microplastics are associated with the following health problems: Respiratory problems? ^δ	Male	48 (90.6)	5 (9.4)	3.96	0.046*
	Female	95 (97.9)	2 (2.1)		
Exposure to microplastics can be reduced in the following ways: Eat less seafood.	Male	23 (43.4)	30 (56.6)	4.20	0.040*
	Female	59 (60.8)	38 (39.2)		
Race					
Microplastics are so small that they can also be found in small organisms? ^δ	Malay	93 (73.2)	34 (26.8)	9.94	0.002*
	Chinese	1 (50.0)	1 (50.0)		
	Indian	7 (36.8)	12 (63.2)		
	Others	1 (50.0)	1 (50.0)		
Exposure to microplastics can be reduced in the following ways: Eat less seafood.	Malay	75 (59.1)	52 (40.9)	8.29	0.040*
	Chinese	0 (0.0)	2 (100.0)		
	Indian	6 (31.6)	13 (68.4)		
	Others	1 (50.0)	1 (50.0)		
Education Level					
Microplastics disrupt the balance of ecosystems in the environment ^δ	None	2 (100.0)	0 (0.0)	11.34	0.010*
	Primary	2 (28.6)	5 (71.4)		
	Secondary	22 (53.7)	19 (46.3)		
	Tertiary	74 (74.0)	26(26.0)		
Microplastics are so small that they can also be found in small organisms ^δ	None	2 (100.0)	0 (0.0)	20.12	<0.001*
	Primary	1 (14.3)	6 (85.7)		
	Secondary	21 (51.2)	20 (48.8)		
	Tertiary	78 (78.0)	22 (22.0)		
The small size of microplastics allows microplastics to be inhaled by humans ^δ	None	1 (50.0)	1 (50.0)	17.29	<0.001*
	Primary	0 (0.0)	7 (100.0)		
	Secondary	18 (43.9)	23 (56.1)		
	Tertiary	65 (65.0)	35 (35.0)		
Microplastics in the environment are very difficult to dispose of ^δ	None	2 (100.0)	0 (0.0)	15.63	<0.001*
	Primary	1 (14.3)	6 (85.7)		
	Secondary	21 (51.2)	20 (48.8)		
	Tertiary	73 (73.0)	27 (27.0)		
Microplastics are associated with the following health problems:					
Cancer ^δ	None	0 (0.0)	2 (100.0)	15.09	0.002*
	Primary	0 (0.0)	7 (100.0)		
	Secondary	21 (51.2)	20 (48.8)		
	Tertiary	59 (59.0)	41 (41.0)		
Food poisoning ^δ	None	0 (0.0)	2 (100.0)	8.81	0.032*
	Primary	1 (14.3)	6 (85.7)		
	Secondary	19 (46.3)	22 (53.7)		
	Tertiary	57 (57.0)	43 (43.0)		
Exposure to microplastics can be reduced in the following ways:					
Drink filtered tap water ^δ	None	0 (0.0)	2 (100.0)	14.00	0.003*
	Primary	2 (28.6)	5 (71.4)		
	Secondary	22 (53.7)	19 (46.3)		
	Tertiary	74 (74.0)	26 (26.0)		
Do not heat food in a microwave oven in plastic containers ^δ	None	0 (0.0)	2 (100.0)	13.43	0.004*
	Primary	1 (14.3)	6 (85.7)		
	Secondary	23 (56.1)	18 (43.9)		
	Tertiary	69 (69.0)	31 (31.0)		
Use plastic-free personal care products ^δ	None	0 (0.0)	2 (100.0)	16.19	<0.001*
	Primary	1 (14.3)	6 (85.7)		
	Secondary	22 (53.7)	19 (46.3)		
	Tertiary	72 (72.0)	28 (28.0)		

N=150; *Significant at $p<0.05$; ^δ By χ^2 test with Yates' correction for expected value <5

participants recognised MPs as harmful to both human health and the environment. This suggests that even without comprehensive knowledge, general awareness and concern about MPs are growing, likely driven by media coverage or increasing public discourse [16]. However, persistent uncertainty around specific exposure routes and long-term health effects highlights a need for clearer communication and targeted public education.

The analysis revealed that socio-demographic characteristics, particularly age and education level, were significantly associated with respondents' knowledge of MPs. Older participants, particularly those aged 40-59 years, exhibited a higher proportion of correct responses compared to younger age groups, especially those aged 20-29, who demonstrated greater uncertainty. This finding is consistent with existing literature suggesting that older individuals may have more life experience, heightened environmental awareness, and greater exposure to information sources related to environmental health [13].

Furthermore, education attainment emerged as a particularly strong determinant of knowledge. Respondents with tertiary education consistently demonstrated a higher understanding of MPs, while those without formal education showed markedly lower understanding of MPs. This reinforces previous findings that environmental literacy is positively correlated with education background [14]. Individuals with higher education are more likely to encounter environmental issues through formal instruction, media, and peer networks, contributing to improved comprehension of complex topics such as microplastic pollution.

While airborne MPs were more readily acknowledged likely due to their visible sources such as dust from industrial areas, many respondents were unaware of MPs released from washing machines or present in personal care products. This suggests a public knowledge gap concerning less visible or indirect sources of MP exposure. Notably, even among highly educated respondents, unfamiliarity with specific MP exposure routes suggests that general education does not necessarily translate to specialised environmental health literacy [12].

Despite limited detailed knowledge, risk perception of MPs was remarkably high. Most respondents recognised that MPs pose a threat to both environmental and human health, which suggests an intuitive or generalised environmental concern. However, the "Not Sure" responses to questions related to specific health risks such as cancer or respiratory issues illustrate a lack of confidence in understanding the mechanisms through which MPs affect human health. This is consistent with earlier findings, which reported that while environmental consequences of MPs are widely acknowledged, their

health implications remain poorly understood by the general public [10].

The study also observed that perceived risk was positively associated with proposed mitigation behaviours. Respondents largely agreed that certain lifestyle changes, such as reducing seafood consumption or using alternatives to plastic could reduce MP exposure. This supports the Health Belief Model suggesting that individuals are more likely to adopt preventive measures when they perceive a high level of risk and possess sufficient knowledge to guide their actions [17].

In terms of gender, females exhibited higher risk perception of MPs compared to males, consistent with prior research highlighting women's greater environmental awareness and protective behaviours [10]. However, care must be taken not to overgeneralise this finding. The observed pattern may also reflect sample-specific dynamics rather than broad cultural norms. [18].

Ethnic differences were also observed, with Malays and Indians showing relatively higher knowledge levels compared to Chinese respondents. Nevertheless, caution is warranted in interpreting these results, as the Chinese and "Other" ethnic groups were underrepresented in the sample. The observed differences may be partly due to small subsample sizes, and broader inferences should not be drawn without further study [19]. Additionally, structural factors such as language barriers or unequal access to information sources could have influenced the responses.

In addition, the association between education level and risk perception of MPs was particularly evident. Respondents with tertiary education demonstrated both greater knowledge and higher concern about MPs. This group also tended to report behavioural adaptations aimed at reducing MP exposure, including using filtered water and avoiding plastic containers. These findings align with previous research suggesting that education enhances environmental consciousness and facilitates more sustainable lifestyle choices [20].

Interestingly, age was not significantly associated with risk perception, contrasting with its strong association with knowledge. This finding may suggest that while older individuals have greater exposure to environmental information, perceived vulnerability or behavioural change is not necessarily age-dependent. Additionally, structural factors such as language barriers or unequal access to information sources could have influenced the responses. [21].

CONCLUSION

This study highlights a critical gap between knowledge and risk perception of MPs among residents in Kuala

Langat. While general awareness exists, detailed understanding remains limited, particularly regarding exposure routes and long-term health effects. Socio-demographic factors such as age, gender, education, and race significantly influence both knowledge and perception.

To address these gaps, targeted education interventions and public communication strategies are essential. Integrating MP topics into school curricula and leveraging media for effective science communication can enhance environmental literacy. Future research should explore more diverse populations and use mixed methods to better understand public behaviour and barriers to change. Ultimately, improving MP literacy is vital for encouraging sustainable practices and reducing plastic-related health and environmental risks.

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