Journal of Environmental Health and Sustainable Development

Knowledge, Attitude and Performance (KAP) of People regarding Microplastics as a New Health Problem in Kerman, Iran

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ARTICLE INFO

ORIGINAL ARTICLE

Article History:
Received: 06 July 2024
Accepted: 27 August 2024

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Keywords:
Microplastics,
Environmental Pollution,
Public Health,
Kerman City.

ABSTRACT

Introduction: This study aims to evaluate knowledge, attitude, and practice (KAP) of people towards Microplastics (MPs).

Materials and Methods: Data were collected from 500 residences in Kerman city, southeast Iran, in 2023 through a questionnaire that was designed and validated by the authors.

Results: More respondents were female (65%), 18–30 years old (43%), undergraduate (48%), and students (35%), and 63% of respondents sorted garbage. Respondents had good knowledge towards general information, but not towards expert information. The highest percentage of respondents with correct answers to the knowledge questions (80%) had the knowledge about environmental pollution to MPs, causing diseases in humans. The maximum percentage of respondents agreed to the attitude questions (57%) agreed with the point that food sellers should recommend cloth bags to shoppers instead of plastic bag, and 60% of them would like to know more about MPs. In terms of practice, 41% of the respondents stated that they usually leave plastic waste in the environment.

Conclusion: The current study showed that there is limited information about MPs in books and among the public. Education and offering free reusable bags were considered as the effective policies to reduce MPs pollution. Also, less environmental awareness and poor management were considered as challenges to reduce emission of MPs.

Citation: Alizadeh I, Sabok Khiz Z, Faraji M. ***Knowledge, Attitude and Performance (KAP) of People regarding Microplastics as a New Health Problem in Kerman, Iran*.** J Environ Health Sustain Dev. 2024; 9(3): 2318-28.

Introduction

The production of plastics has recently increased, and the world has entered the "plastic age" [1]. Some global challenges, such as COVID-19, increase plastic production and environmental pollution [2]. In recent years, global plastic production has reached 8,300 million metric tons [3]. Release of 10,000 million metric tons of plastic in the environment will be predicted by 2050 [1]. The term microplastics (MPs) was first mentioned in the scientific literature by Thompson et al., who described them as very small plastic particles and fibers [4]. The released plastic into the environment can be converted to the smaller form such as MPs and nanoplastics (NPs) [5, 6]. The range of the size of MPs usually refers to 0.1 mm to 5 mm, and NPs are defined as having a size less than 0.1 mm [7]. MPs can be divided into primary and secondary in terms of source [8]. Primary MPs are plastics produced on a micro-sized scale for using in industrial and household products such as hand and face cleaners [9], cosmetics [10] and scrubbers in air

[DOI: 10.18502/jehsd.v9i3.16580]

blast [11]. Secondary MPs resulted from decomposition of MPs in the sea and on land [12]. MPs as ubiquitous pollutants are accumulating in different environments such as marine, freshwater, and terrestrial habitats [1, 13]. Their presence is verified in water bodies such as rivers, lakes, and oceans [7]. So far, current technologies for removing, recycling, or breaking down MP particles are not sufficient to be completely removed from the environment [14]. It is predicted that the mass of plastic accumulated in the oceans will increase to 250 million tons by 2025 [15]. The level of concern about MPs is such that governments around the world are establishing laws on plastic generation [16]. There is suspicion that MPs' pollution from the environment poses a potential risk to humans, freshwater ecosystems, marine systems, and organisms. Moreover, it is a major environmental concern in the world [7, 13]. However, this concern is related to the presence of MPs in food chain that can be transferred by aquatic organisms [13, 17]. Due to their small size, MPs may disrupt the activity of organisms and cause blockage, inflammation, and accumulation in tissues [18]. MPs have been shown to reduce photosynthesis and growth of microalgae [19], and also negatively affect feeding activity of zooplankton [20] and worms [21]. In addition, they probably cause adverse effects on gills, stomach, and hepatopancreas of crabs [22] and cause negative changes in tissues and organs of the fish [23]. In the study of Ilmaskal et al. on the negative impacts of MPs regarding coastal communities and the younger generation, a significant increase was observed in knowledge (9%) and attitude (10%) of community about the dangers of MPs [24]. The study conducted by Omoyajowo et al. in 2021 found that awareness about MPs' pollution among the surveyed population around Lagos Lagoon was relatively high, and over 50% of the respondents had adequate awareness. However, the level of knowledge about MPs was found to be fairly acceptable, indicating a need for further education and awareness. The study also revealed a poor perception of MPs' pollution among the respondents, highlighting the need for efforts to change attitudes towards sustainable waste management practices [25]. In the study by Guerranti et al. in 2020 on the freshwater environments in Mediterranean tributary rivers, a lack of information was observed on distribution patterns, abundance, and characteristics of MPs. This study emphasized the need for adequate and uniform measurement methods to collect data on MPs in freshwater environments [26]. In Karbalaei et al.'s study in 2018, MPs were detected in the food consumed by humans and air samples, indicating possible contact with MPs through ingestion or inhalation, which can lead to adverse effects on the human health. They stated that various terrestrial and marine processes contribute to MP pollution, including domestic and industrial drainage, marine activities, agricultural runoff, and effluent from wastewater treatment plants (WWTPs) [12]. Due to the limited studies conducted on knowledge, attitude, and practice (KAP) of the public regarding MPs, this issue remained largely a problem around the world. Given that increasing the level of awareness among the people who are in direct contact with MPs pollution is very important, this study aims to assess and compare the levels of KAP towards MPs among the public in Kerman, Iran. However, for designing a sustainable policy framework for the management of MPs pollution in the environment, information is needed from the whole country, and this study aims to fill a part of this knowledge gap. To the best of the authors' knowledge, the present survey is the first study investigating KAP towards MPs among the public in Kerman city, southeast of Iran.

Materials and Methods

Study area

This study was done in Kerman city (30º 28′ N, 57º 08′ E), located in the southeast of Iran (Figure 1) the capital of Kerman province, with a population of 738 000 people and an urban area over 240 km^2 [27]. In 2017, Kerman produced more than 10,000 tons of household garbage [28].

[DOI: 10.18502/jehsd.v9i3.16580]

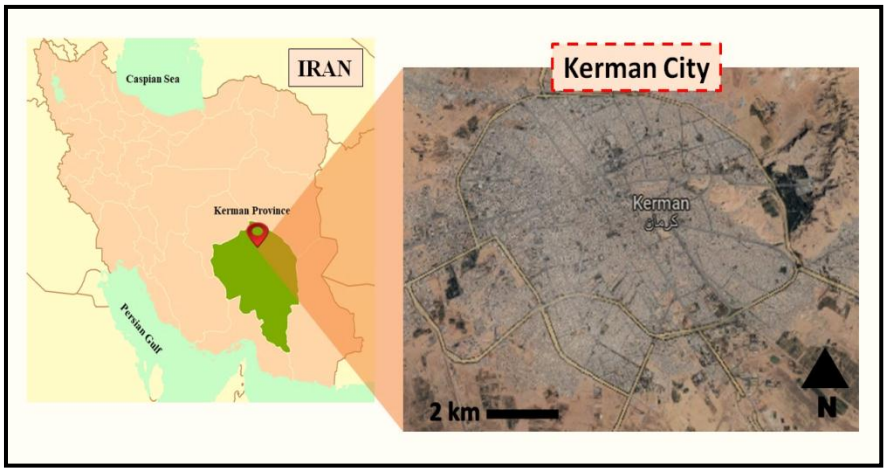

Figure 1: Study areas, (Images provided through Google Earth Professional (https://www.google.com/earth/versions/#download-pro).

Study design

The authors were conducted a cross-sectional study to assess knowledge, attitude, and practice of the public about MPs in Kerman city, from March to May 2023. The questionnaires were filled via face-to-face interviews by 500 randomly selected respondents in universities, parks, shopping malls, and other public places. Sample size (n) was calculated based on Equation 1:

$$n = \left(\frac{zs}{d}\right)^2 \quad (1)$$

Where variables are defined as:

Z = 1.6

S = Standard deviation of KAP in the similar study = 1.4 [25]

d = Error of estimation = 10%

n = Sample size = 500

Data collection

The data were collected through a questionnaire that was designed by the authors according to Deng´s study [29]. The initial questionnaire was completed in pilot form in groups of 20 individuals, and the final corrections were made. Experts confirmed the validity of this questionnaire. A Cronbach's alpha index of 0.87 from a preliminary study approved its reliability. The questionnaire consisted of six sections: the first section included the purpose of the investigation; the second section consisted of respondents' demographic characteristics (age, gender, education level, and occupation) and garbage sorting habits; the third section composed of the respondents' knowledge towards MPs through nine questions. For questions with 'yes' and correct answers, the questions' point was considered 1. 0 point was given to 'no' and wrong answers. Therefore, the minimum and maximum scores in this section were 0 and 9, respectively. The fourth section contained the respondents' attitudes regarding MPs with six questions and scores, including 'strongly agree = 5, agree = 4, neutral = 3, disagree = 2, and strongly disagree = 1'. The minimum and maximum scores in this section were 0 and 30, respectively. The fifth section aimed to identify the practice of residents regarding MPs. Four questions were answered with 'never, rarely, sometimes, usually', and always' from scores 1 to 5, and the minimum and maximum scores in this section were 0 and 20, respectively. The sixth section of the questionnaire included single and multiple-choice questions that determined the sources of information, attractiveness of the topics, personal desire of respondents to reduce MP emissions, and problems for reducing emissions that could be useful for policymakers.

Statistical analysis

The data were analyzed via R software, Version 4.3.1. The demographic characteristics of the

[DOI: 10.18502/jehsd.v9i3.16580]

respondents were reported as numbers and percentages. The descriptive statistics, including minimum, maximum, percentile, median, and mean ± standard deviation (SD) was used to report respondents' knowledge, attitude, and practice score. Then, the mean scores were compared according to demographic variables via ANOVA test. Correlation between respondents' knowledge, attitude and practice regarding MPs was assessed via Pearson correlation analysis. The significant level was defined as P- value < 0.05, and GraphPad Prism software, version 8.4.3, was used for graphing.

Results

Sociodemographic characteristics of the respondents

The sociodemographic characteristics of the respondents are shown in Table 1.

Respondents' knowledge

Nine questions were asked to assess the respondents' knowledge of MPs. Their knowledge is reported in Table 2.

Table 1: Sociodemographic characteristics of the subjects (n = 500).

Characteristics	Category	No.	Percentage (%)
Gender	Male	172	34.4
	Female	328	65.6
Age	18-30	215	43
	31- 40	123	24.6
	41-50	106	21.2
	> 50	56	11.2
Education level	Uneducated	15	3
	High school, diploma or lower	127	25.4
	Undergraduate	239	47.8
	Graduate and higher	119	23.8
Occupation	Employee	158	31.6
	Self-employed	63	12.6
	Student	173	34.6
	Housekeeper	68	13.6
	Others	38	7.6
Garbage sorting habits	Yes	315	63.0
	No	185	37.0

Table 2: Respondents' knowledge of MPs

Points	Responses	No.	Percentage (%)
Do you know MPs?	Yes	227	45.40
	No	273	54.60
What is the size of MPs?	True (less than 5 mm)	92	18.40
	False	408	81.60
Do you know the MPs mainly produced by releasing plastic into the environment?	True (Yes)	317	63.40
	False	183	36.60
Which way do MPs enter the human body?	True (Seafood)	134	26.80
	False	366	73.20
Does environmental pollution with MPs cause human disease?	True (Yes)	402	80.40
	False	98	19.60
Can MPs be excreted from the human body?	True (Most of them)	68	13.60
	False	432	86.40
Are MPs visible in the environment?	True (No)	304	60.80
	False	196	39.20
How many years does it take a plastic bottle to decompose in the environment?	True (400 - 500 years)	258	51.60
	False	242	48.40
Is MPs pollution a global problem?	True (Yes)	395	79.00
	False	105	21.00

[DOI: 10.18502/jehsd.v9i3.16580]

Respondents' attitude

The respondents' attitudes towards MPs were assessed through 6 points with answers including 'strongly agree, agree, neutral, disagree, and strongly disagree'. The responses are reported in Table 3.

Respondents' practice

Four questions assessed the respondents' practice about MPs. Respondents' practice with MPs is displayed in Figure 2.

Table 3: Respondents' attitude of MPs

Points		Strongly agree	Agree	Neutral	Disagree	Strongly disagree
A lot of plastic products' use in daily life produce MPs	No.	182	232	67	15	4
	Percentage (%)	36.40	46.40	13.40	3.00	0.80
In order to reduce MPs in the environment, plastic waste can be buried	No.	63	97	105	158	77
	Percentage (%)	12.60	19.40	21.00	31.60	15.40
People who deal with MPs in their work should use gloves and suitable protective clothing	No.	134	193	125	40	8
	Percentage (%)	26.80	38.60	25.00	8.00	1.60
Food sellers should recommend cloth bags to shoppers instead of plastics	No.	285	180	27	8	0
	Percentage (%)	57.00	36.00	5.40	1.60	0.00
MPs can enter the human body and cause various diseases	No.	168	233	81	18	0
	Percentage (%)	33.60	46.60	16.20	3.60	0.00
I would like to know more about MPs	No.	302	145	36	8	9
	Percentage (%)	60.40	29.00	7.20	1.60	1.80

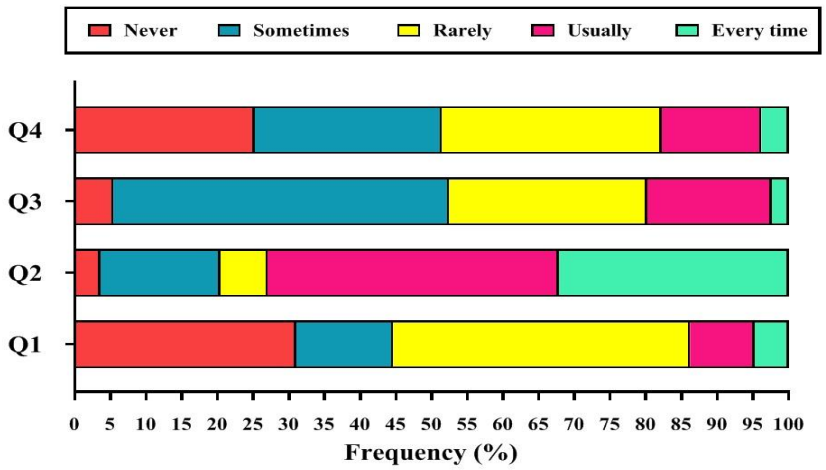

Figure 2: Respondents' practice of MPs; Q1: using plastic bags; Q2: leaving plastic waste in the environment; Q3: using non-plastic products; Q4: using plastic bags for garbage.

KAP towards MPs

The mean and SD of scores for the studied components, including knowledge, attitude, and practice in various categories in terms of sociodemographic characteristics are reported in Table 4. As seen in Table 4, the scores of knowledge and attitude were significantly different between males and females, and females had more knowledge and attitude towards MPs. Practice in both groups was found to be similar. In terms of age category, a significant difference was obtained in knowledge score, which was higher among 18 to 30 years old.

[DOI: 10.18502/jehsd.v9i3.16580]

Table 4: Mean and SD of scores for knowledge, attitude, and practice in several categories

Characteristics	Category	Mean ± SD		
		Knowledge	Attitude	Practice
Gender	Male	3.88 ± 2.12	22.90 ± 3.71	11.20 ± 2.21
	Female	4.66 ± 2.07	24.24 ± 3.13	11.36 ± 2.13
P-value		< 0.001	< 0.001	0.43
Age	18-30	4.81 ± 2.13	23.60 ± 3.37	11.68 ± 2.03
	31-40	4.16 ± 1.71	24.05 ± 3.56	11.11 ± 2.66
	41-50	4.19 ± 2.28	24.33 ± 3.26	11.01 ± 1.81
	> 50	3.70 ± 2.30	22.82 ± 3.20	10.82 ± 1.81
P-value		0.003	0.98	0.43
Education level	Uneducated	2.00 ± 1.73	23.80 ± 3.55	12.27 ± 2.43
	High school, diploma or lower	3.21 ± 1.92	22.36 ± 3.31	11.28 ± 2.02
	Undergraduate	4.59 ± 1.88	23.87 ± 3.28	11.09 ± 2.26
	Graduate and higher	5.56 ± 1.99	25.10 ± 3.15	11.64 ± 1.99
P-value		< 0.001	< 0.001	0.72
Occupation	Employee	4.77 ± 1.78	24.65 ± 3.19	10.82 ± 2.21
	Self-employed	3.41 ± 1.85	21.94 ± 3.84	11.44 ± 2.47
	Student	4.94 ± 2.26	23.84 ± 3.13	11.71 ± 1.93
	Housekeeper	3.32 ± 1.90	23.50 ± 3.54	11.41 ± 2.33
	Other	3.89 ± 2.29	23.47 ± 3.16	11.03 ± 1.68
P-value		0.005	0.038	0.034
Garbage sorting habits	Yes	4.82 ± 1.81	24.51 ± 3.13	11.37 ± 2.38
	No	3.67 ± 2.40	22.54 ± 3.47	11.19 ± 1.71
P-value		< 0.001	< 0.001	0.39

*Bold numbers are significant P-value.

Investigating the correlation between respondents' knowledge, attitude, and practice regarding MPs in Figure 3 revealed a weak and direct correlation between knowledge and practice (r = + 0.1) and knowledge and attitude (r = + 0.30).

Other information

Four questions in the final section of the questionnaire could be valuable for instructors and policymakers to arrange educational topics and set policies. The first question was about sources of information regarding MPs. Responses are shown in Figure 4.

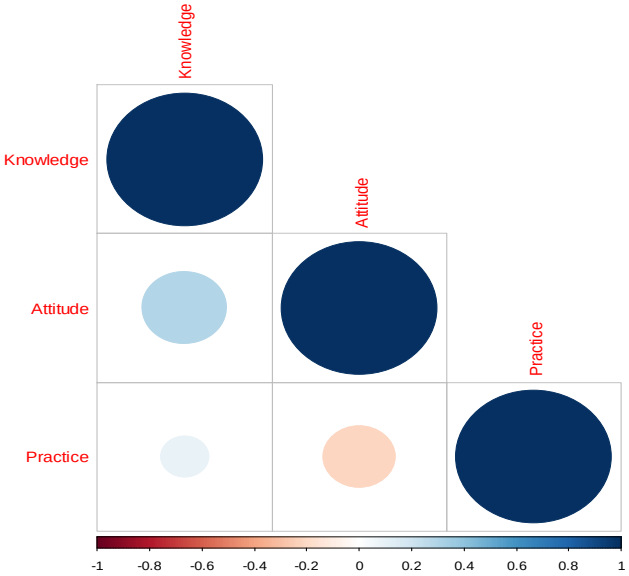

Figure 3: Correlation between respondents' knowledge, attitude, and practice regarding MPs

[DOI: 10.18502/jehsd.v9i3.16580]

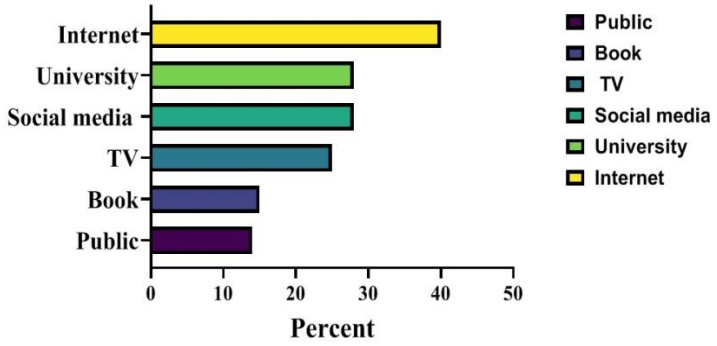

Figure 4: Sources of information regarding MPs

Regarding several impacts of MPs, people are more worried about the impacts on the human health. Approaches for reducing pollution and the release of MPs were asked in the third and fourth questions and results are shown in Figure 5. The subjects could select more than one response.

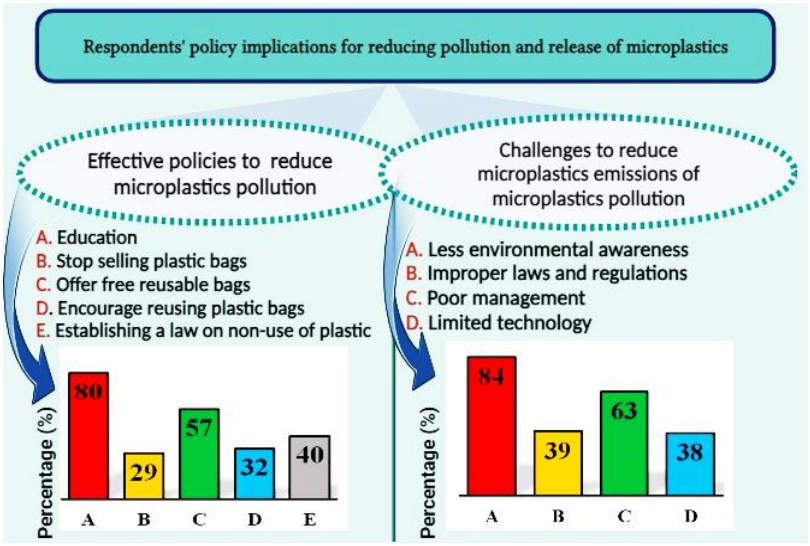

Figure 5: Approaches for reducing pollution and the release of microplastics; respondents could select more than one response

Discussion

Based on Table 1, in this study, there were more females (66%) than males (34%); this proportion was not similar to the proportion reported in the study by Deng in Shanghai, where males were more than females [29]. The participants ranged from 18 to more than 50, and their age was biased towards younger people, with 43% aged between 18 and 30, and only 11.20% over 50. More than 45% had an undergraduate education. In terms of the occupation types, including employees, self-employed, students, housekeepers, and others, 35% were students. Therefore, most respondents were female undergraduate students between 18 and 30, 315 of whom (63%) declared that they would have sorted garbage at home.

According to the results of the respondents' knowledge of MPs in Table 2, the first question asked the subjects to identify MPs. From statistical results, 45% (n = 227) knew MPs. From 500 respondents, only 18.40% (n = 92) had correct knowledge about the size of MPs, but 61% (n = 304) knew that MPs are not visible in the environment. Approximately, 63% of them (n =

[DOI: 10.18502/jehsd.v9i3.16580]

317) declared that MPs are mainly produced by releasing plastic into the environment. MPs may enter human body through seafood. In a marine environment with numerous MPs, animals may mistakenly eat MPs. Therefore, MPs can enter from marine organisms to the human body via food chain, which may cause potential damage to human health [30]. Only, about a quarter of the participants believed that seafood was the main way for entering MPs to the body. Although, more than half of the respondents did not have complete knowledge about MPs, 79% of them (n = 395) knew that environmental pollution from MPs is a worldwide problem, and 80% of people (n = 402) knew MPs can cause diseases in humans. According to the 2017 report from Food and Agriculture Organization of the United Nations, MPs may not be absorbed in body and not cause harm to humans [31]. Thus, most MPs can be excreted from human body. Only, 13.60% (n = 68) was aware that MPs can be excreted from human body. In the study by Deng in Shanghai, 14% of the subjects chose this option [29]. These results show that people in situations of exposure to unknown compounds are extremely worried about their negative effects on the health. Approximately, 52% chose the correct answer of 400–500 years as decomposition time of plastic bottles in nature. Thus, the majority had awareness about the impact of plastic on the ecological environment. In Deng's study in Shanghai, only 14% chose this option, and a lack of knowledge about plastics was observed [29]. In terms of the respondents' knowledge, they had good knowledge of general information. But, there was no proper knowledge about expert information, including the size of MPs, their entry into human body, and their excretion.

Results of the respondents' attitudes towards MPs in Table 3 showed that more than 45% agreed with the first point of the attitude assessment: “High use of plastic products in daily life produces MPs”. Approximately, 30% disagreed that the burning of plastics can reduce MPs in the environment, and 21% were neutral on this point. 38% of the respondents agreed that people who deal with MPs in their work should use gloves and suitable protective clothing. The point that food sellers should recommend cloth bags to shoppers instead of plastic bags was strongly agreed by 57% of the respondents. Therefore, suitable interventions can be proposed to encourage consumers to use environmentally-friendly products. In the survey of knowledge, 80% of people knew that MPs can cause diseases in humans. 46% agreed that MPs can enter human body and cause various diseases. Recommendations to use cloth bags instead of plastic had the most agreeable attitude among the respondents. Finally, more than half of the subjects liked to know more about MPs.

Regarding the participants' practice about MPs in Figure 2, as mentioned before, 60% declared that MPs are mainly produced by releasing plastic into the environment, and 80% knew that environmental pollution from MPs can impact human health. In practice, 40% rarely used plastic bags, and 41% stated that they usually left plastic waste in the environment. It might be due to the lack of a proper program for waste collection in Kerman city. Only, 2.4% tried to use non-plastic products every time, and 47% sometimes used them; this suggested more production of non-plastic products and their presentation to consumers. In a similar study in South Africa, researchers found the availability was the key reason why people use plastics. Therefore, reducing the convenience of people was suggested for reducing the use of plastics [32].

30% rarely used plastic bags as garbage bags, and only 3.8% tried to use plastic bags as garbage bags every time. These results suggest that consumers may be attracted to apply greener alternatives, but they require motivation and reminder.

As seen in Table 4, the scores of knowledge and attitude were significantly different between males and females, and females had more knowledge and attitude towards MPs. Practice in both groups was found to be similar. In terms of age category, a significant difference was obtained in knowledge score, which was higher among the participants of 18–30. The difference in knowledge and attitude scores among participants with different education

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levels was significant, and graduates had higher knowledge and attitude scores. It is interesting to note that the score of practice for undergraduate education level was higher than others. Therefore, it can be said that education may not affect environmental practice, which was consistent with the view in the literature that there was no significant relationship between environmental behavior and education [29].

Responses about sources of information on MPs are shown in Figure 4. The most frequent sources of information on MPs for the respondents were the "Internet" (40%), followed by "university" and "social media" (28%), and "TV" (25%), which shows that there is a lack of reports on MPs in books and between public, and the sources of information are limited. This result encourages us to strengthen the knowledge about MPs in subsequent policymaking. When respondents were asked a second question with the following headlines 'MPs exist in daily drinking water and food', 'MPs can have an impact on marine life', 'MPs can cause environmental pollution', and 'MPs can have an impact on human health'. This question was attractive and the most frequently selected ones were "MPs exist in daily drinking water and food" (55%), followed by "MPs can have an impact on human health" (48%). Similar results were reported in Deng's study [29]. According to Figure 5 about approaches for reducing pollution and the release of microplastics, 80% of the respondents declared that MP pollution could be effectively controlled through education. Providing free reusable bags was selected by 57% of the subjects, which can reduce the consumption of plastic bags and environmental pollution. The researchers discussed the challenges of reducing the emissions of MPs. Less environmental awareness was selected by 84% of the subjects, and 63% declared poor management as the main challenge in controlling emissions of MPs pollution (Figure 5). In a similar result in Deng's study, 90% chose a lack of environmental awareness as a problem they might cause to reduce microplastic pollution [29]. This result shows the importance and urgency of publicity, education, and modification of management as important interventions, as well as the people's tendency to learn more about MPs.

Conclusions

In the current study, knowledge, attitude, and practice of the public towards MPs were evaluated in Kerman city, southeast of Iran. Overall, the respondents have good knowledge towards general information but not for expert information. Half of them declared that they usually left plastic waste in the environment. Although the respondents have good general knowledge towards MPs, they do not show acceptable environmental performance in practice. Therefore, it is important to imply management programs to collect and recycle plastics and inform people about these programs. Moreover, education and offering free reusable bags can be suggested as effective policies to reduce MPs pollution in the environment.

Acknowledgments

This study is the result of a research project approved by the Student Research Committee of Kerman University of Medical Sciences under the number 401000390, which was carried out with the financial support of the Research and Technology Vice-Chancellor of this university. The authors would like to thank the Student Research Committee of Kerman University of Medical Sciences for their financial support.

Conflict of Interest

The authors declared no conflict of interests.

Funding

This article was the result of a research project approved by the Student Research Committee of Kerman University of Medical Sciences No. 401000390, which was carried out with the financial support of the Vice-Chancellor for Research and Technology of the University.

Ethical Considerations

Written informed consent was obtained from participants before the study.

Code of Ethics

This study received ethical approval from the Ethics Committee of Kerman University of

[DOI: 10.18502/jehsd.v9i3.16580]

Medical Sciences (IR.KMU.REC.1401.397).

Authors' Contributions

MF designed the study, analyzed, and interpreted the data. ZS collected data. IA designed the study and analyzed the data. All authors read and approved the final manuscript.

Data availability

The datasets during the current study are available from the corresponding author on reasonable request.

Consent to Participate

All the participants signed written informed consents for taking part in the study.

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[DOI: 10.18502/jehsd.v9i3.16580]

