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Public Awareness of the Exposure and Effects of Microplastics on Humans: A Descriptive Cross-Sectional Study in the Colombo District, Sri Lanka

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ABSTRACT

Plastic particles less than 5mm in size are a growing global concern, making the environment more vulnerable. Raising public awareness of their harmful effects might help to reduce plastics entering the environment. The study aimed to assess public knowledge and attitudes towards microplastics and their adverse health effects in the Colombo District, Sri Lanka. A descriptive, cross-sectional study design was used, and data were collected from the general public using an online Google Form. The online questionnaire included questions on knowledge and attitudes towards microplastics. A total of 510 responses were received; after excluding 21 incomplete responses, 489 (95.8%) were included in the analysis. The responses were analysed for descriptive statistics: frequencies and percentages with SPSS version 26. Out of 489, 405(82.8%) had a university degree, and 313(64%) were females. Regarding knowledge, 473(96.7%) and 446(91.2%) recognized that microplastics harm human and marine life, respectively. Only 228 (46.6%) identified improper disposal as a primary cause. Even though 363 (74.2%) knew about the toxicity of microplastics, only 179(36.6%) and 212(43.4%) knew about its crossing into gastric epithelium and food chain integrations, respectively. Regarding attitudes, while 370(75.7%) considered living with fewer microplastics, only 37(7.6%) believed they could completely live without them. All individuals (n=489[100.0%]) advocated for biodegradable alternatives. However, 6(1.2%) individuals firmly expressed their unwillingness to reduce the use of microplastics. The study identified knowledge gaps and uncertain behavior to reduce pollution, highlighting the need for effective public education and stronger waste management policies.

KEYWORDS: *Microplastics pollution, Knowledge and Attitudes, Health effects, Sri Lanka*

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1 INTRODUCTION

Plastic pollution is a growing global concern, particularly affecting marine environments and posing risks to wildlife and humans (Ziani et al., 2023). Among plastic waste, microplastics—defined as plastic particles less than five millimeters in size—are found in the air, water, food, and even personal care products (Gasperi et al., 2018; Cox et al., 2019). Human activities, such as improper disposal and large-scale plastic imports, exacerbate this problem. Between 2012 and 2018, Sri Lanka imported approximately 3,353.9 million kilograms of plastic, with 140,000 metric tons processed annually (Center for Environmental Justice, 2020). The country ranks fifth globally in mismanaged plastic waste, contributing 5% to global plastic pollution, following China, Indonesia, the Philippines, and Vietnam (Ranatunga et al., 2023).

Microplastics, being non-biodegradable, adversely affect marine life by disrupting survival mechanisms including respiration and ingestion (Indrayanti et al., 2023). Despite the prevalence of microplastic pollution, public awareness of its impact remains inadequate (Henderson and Green, 2020). Moreover, microplastics pose significant health risks, as they release estrogenic-like chemicals upon exposure to ultraviolet radiation, potentially leading to metabolic disorders such as obesity and diabetes (Yang et al., 2011). Research links microplastics to breast cancer, low sperm counts, and early puberty in humans (Ma et al., 2020). Additionally, microplastics can translocate through the bloodstream and lymphatic system, affecting the cardiovascular and respiratory systems (Browne et al., 2008). Studies on animal models suggest that inhaled nanoplastics may cross the placenta, accumulating in fetal tissues (Lawan et al., 2024).

Despite these health risks, public knowledge of microplastics is limited, particularly in low-income countries like Sri Lanka, where regulatory measures are insufficient (Premarathna et al., 2023). Given the increasing evidence of environmental and health risks, this study aimed to assess public knowledge and attitudes towards microplastics in the Colombo District, Sri Lanka.

2 MATERIALS, METHODS AND TECHNIQUES

This study employed a descriptive, cross-sectional design to assess public knowledge and attitudes regarding microplastics. An online self-administered questionnaire was used, available in Sinhala, Tamil, and English. The survey consisted of two parts: Part A assessed knowledge and attitudes, while Part B displayed an educational video on microplastics (*Microplastics explained (explainity® explainer video)*, 2019).

The questionnaire was disseminated through online platforms using a voluntary response sampling method. Ethical approval was obtained from the Ethics Review Committee, Faculty of Medical Sciences, University of Sri Jayewardenepura (Approval No. 18/21). Participants provided informed consent before proceeding. Only the responses from

individuals residing in the Colombo District were included in the analysis.

Participants had the opportunity to read a consent form at the start of the questionnaire, which also included contact details of the researchers so that any queries and concerns could be forwarded to the research team. The participants were directed to the questions only after providing consent to proceed with the study and to utilize data maintaining anonymity.

A total of 510 responses were collected, of which 21 were excluded due to being incomplete. Thus, 489 responses (95.8% response rate) were analyzed. Descriptive statistics were used to evaluate knowledge and attitudes, with results presented in tables.

3 RESULTS AND DISCUSSION

Altogether, 489 out of 510 individuals participated in the study conducted in the Colombo district. The majority of participants (n=405, 82.8%) had a university degree, while a smaller percentage (n=62, 12.7%) the GCE Advanced Level examination. Employment status varied, with 255 (52.1%) employed full-time and 15 (3.0%) retired. The gender distribution showed a higher proportion of females (n=313, 64.0%) compared to males (n=176, 36.0%), which aligns with the gender distribution in Sri Lanka (Table 1).

Table 1. Socio-demographic characteristics of the general public in the Colombo District, Sri Lanka.

		Frequency	Percentage
Education	Passed Grade 5	14	2.9
	Passed O/L	8	1.6
	Passed A/L	62	12.7
	University degree	405	82.8
Employment	Unemployed	192	39.3
	Employed - Part-time	27	5.5
	Employed - Full time	255	52.1
	Retired	14	2.9
Gender	Female	313	64.0
	Male	176	36.0

Regarding knowledge of microplastics and their health effects, most individuals (n=228, 46.6%) viewed microplastic pollution as a problem caused by improper disposal, while 140 (28.6%) saw it as a manmade disaster. A vast majority (n=473, 96.7%) acknowledged that microplastics harm human life, and 446 (91.2%) recognized the harm to marine life. About 363 (74.2%) understood that microplastics are toxic, while 179 (36.6%) were aware that microplastic particles can cross the placenta or intestinal epithelium, and 212 (43.4%) knew that they absorb toxic chemicals and integrate into food chains. Awareness of the plastic identification coding system stood at 74.6% (n=365). Regarding the recycling rate of plastic waste, 328 (67.1%) correctly identified it as being less than 10%. Knowledge of microplastics' presence in various products was also notable, with 289 (59.1%) recognizing their presence in food, 260 (53.2%) in bottled

water, and 192 (39.2%) in the air. Social media (n=415, 84.9%), newspapers (n=191, 39.1%), the internet (n=191, 39.1%), and movies/short videos (n=137, 28.0%) were the primary sources of information on microplastics (Table 2).

Table 2. Knowledge of microplastics and their health effects among the general public in the Colombo district, Sri Lanka

		Frequency	Percentage
Identify microplastic pollution as a	Huge concern about waste management	25	5.1
	Manmade disaster destroys the environment	140	28.6
	A problem caused by improper disposal	228	46.6
	A problem that needs immediate control	15	3.1
Microplastics harm human life		473	96.7
Microplastics harm marine life		446	91.2
Microplastics are toxic		363	74.2
Microplastic particles cross the placenta or intestinal epithelium		179	36.6
Microplastics absorb toxic chemicals and integrate into food chains		212	43.4
Awareness of the plastic identification coding system		365	74.6
Knowledge of the recycling rate of plastic waste	<10%	328	67.1
	Around 25%	111	22.7
	Around 50%	19	3.9
	Majority	31	6.3
Microplastics are present in	Facewash	233	47.6
	Bottled water	260	53.2
	Cosmetics	389	79.6
	Toothpaste	211	43.1
Sources of microplastic knowledge	Internet	415	84.9
	Social media	191	39.1
	Movies/Short videos	137	28.0
	Newspapers	191	39.1
	Television	312	63.8

Microplastic pollution is a global environmental and public health threat, affecting water systems, coastal regions, and oceans (Indrayanti et al., 2023). These non-biodegradable materials disrupt marine species' feeding, breathing, and reproduction (Browne et al., 2008; Jin et al., 2018; Ma et al., 2020). More than 90% of study participants identified microplastics as harmful to marine and human life. However, more than 50% of Sri Lankans did not recognize microplastics as a manmade disaster, indicating a lack of general knowledge compared to other studies (Henderson and Green, 2020; Premarathna et al., 2023). Similar findings were observed in the UK, where only environmentally conscious individuals were aware of microplastics, and in Tamil Nadu, India, where only 5.4% of university students had poor knowledge (Srinivasan et al., 2019). A study by Premarathna et al., (2023) also found that while the public had heard of microplastics, their impacts on plant and human health were

less understood. Furthermore, although many recognized the plastic recycling coding system, few knew its details (Amarteifio, 2020; Tachwali, 2005). Research has shown that microplastics absorb toxic chemicals and pollutants (Yu et al., 2021), yet over 50% of our study population was unaware of this fact. It has also been demonstrated that indoor microplastic concentrations exceed outdoor levels (Perera et al., 2022), yet over 50% of respondents were unaware that microplastics exist in the air. These findings highlight crucial points for future awareness campaigns.

Regarding attitudes, 370 (75.7%) of individuals believed they could live with less microplastic, while 37 (7.6%) thought they could live completely without it. However, 26 (5.3%) did not want to live without microplastics, and 55 (11.2%) were unsure. Usage of 'shopping bags' was a significant concern, with 442 (90.4%) preferring disposable bags over reusable ones. Overwhelming support existed for limiting polythene bag availability, with 487 (99.5%) advocating for a limit per person, 485 (99.1%) supporting charging per bag, and 97.9% favoring biodegradable alternatives. Opinions on plastic bottle collection chambers were generally positive, with 386 (78.9%) considering them beneficial. Willingness to reduce microplastic usage was evident, with 306 (62.6%) expressing strong willingness and 141 (28.8%) being somewhat willing. Additionally, 324 (66.3%) were ready to change their behavior to mitigate the generation of microplastics.

The study identified that only seven (1.4%) individuals had used the 'Beat the Micro Bead' application. Awareness of the Great Pacific Garbage Patch was limited to only 199 (40.7%) participants. Regarding its size, 120 (24.5%) estimated it to be over 20 times the size of Sri Lanka, while 69 (14.1%) believed it to be smaller. Furthermore, 336 (68.7%) correctly identified the purpose of the numbering system for plastic products as recycling-related. The University of Newcastle reported that an average human consumes 5g of plastic weekly (Cox et al., 2019), yet less than 60% of our study population was aware of this. Given the presence of microplastics in food and water (Kapukotuwa et al., 2022), these findings emphasize the need for increased public awareness.

Microplastics have been linked to serious health risks, including metabolic disorders, reproductive issues, and respiratory diseases (Yang et al., 2011; Ma et al., 2020). Research indicates that microplastics can translocate through the blood, lymph, and respiratory systems, causing cardiovascular and pulmonary issues (Cox et al., 2019; Browne et al., 2008). Yet, less than 50% of our study population recognized their toxic nature. Studies on zebrafish and mussels have demonstrated microplastic ingestion and its adverse effects (Jin et al., 2018; Browne et al., 2008). Similarly, shrimp in the Negombo lagoon were found to have microplastics in their gastrointestinal tracts (Lawan et al., 2024). Despite this, public knowledge of microplastic contamination in food remains limited.

Personal care products also contribute to microplastic pollution (Anderson et al., 2016), but only 38-48% of respondents were aware of this issue.There are varying levels of attitudes toward microplastic mitigation worldwide (Al Masud et al., 2024; Omoyajowo et al., 2022). In Tamil Nadu, India, only 20% followed good practices (Srinivasan et al., 2019), while a previous Sri Lankan study indicated moderate attitudes toward microplastics (Premarathna et al., 2023). Our study aligns with these findings, with around 60% of respondents ready to change their behavior. Such positive attitudes should be highlighted and encouraged through awareness campaigns. The findings pertaining to attitudes in our study have been summarized in Table 3.

Table 3. Attitudes on microplastics among the general public in the Colombo district, Sri Lanka

		Frequency	Percentage
Life	Can live without any microplastics	37	7.6
	Can live with distinctly less microplastics	370	75.7
	Do not want to live without microplastics	26	5.3
	Do not know	55	11.2
The bag of choice to use regularly	Reusable plastic bag	90	18.4
	Disposable bag	442	90.4
Thoughts about the availability of unlimited polythene bags at stores	Should limit the bags per person	487	99.5
	Should charge per number of bags	485	99.1
	Should be changed with biodegradable bags	489	100.0
Opinion on plastic bottle collection chambers	Good	386	78.9
	Somewhat good	79	16.2
	Not sure	11	2.2
	Not good	13	2.7
Willing to reduce microplastic usage	Very much	306	62.6
	Somewhat	141	28.8
	Little	36	7.4
	Not at all	6	1.2
Willing to change personal behavior to overcome microplastic generation	Yes	324	66.3
	No	20	4.0
	May be	145	29.7

Plastic pollution is associated with the Great Pacific Garbage Patch and striking media imagery (Henderson and Green, 2020). However, less than 50% of our study population had heard of this issue. Awareness campaigns should emphasize that a floating plastic island exists in the Pacific Ocean, several times the size of Sri Lanka (Ranatunga et al., 2023). Social media (84.9%) was the most cited source of microplastic information, underscoring its potential for effective

awareness campaigns (Rapada et al., 2021; Fortunov, 2024).—Traditional print media (31.4%) was less preferred, suggesting that awareness efforts should shift towards digital platforms (Reed, 2018).

4 CONCLUSION AND RECOMMENDATIONS

It is important that Sri Lanka address the issue of microplastics pollution through scientific policies and operational management strategies. The public is aware of the term, microplastics, but core basic knowledge was lacking with the majority which reflects badly on the willingness and positive attitudes to reduce microplastic pollution. The public attitudes toward waste management are generally careless as we have found in our study, further complicating efforts to tackle the problem. Comprehensive policies and education are needed to mitigate the impact of microplastics on health and the environment. The necessity of introducing effective strategies to enhance the awareness of regulatory measures to control plastic usage and safe disposal mechanisms among the general public to manage microplastic pollution in Sri Lanka should be implemented appropriately and accurately with the help of social media platforms. It is noted that this article was able to bridge a knowledge gap by describing the knowledge and attitudes of the general population in the most urbanized district of Sri Lanka, with more depth than previous researches, but the knowledge and attitudes of people living in more rural settings needs to be studied as well.

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