Future Nurses as Stewards of Health and Environment: Awareness and Actions Toward Plastic Pollution Prevention and Environmental Sustainability

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Abstract:

Introduction: Human exposure to plastics through air, water, and soil causes a variety of significant and complex health hazards. The aim of the present study was to explore the level of awareness regarding plastic pollution and the level of engagement in actions towards plastic pollution prevention and environmental sustainability promotion among nursing students.

Methods: This quantitative, cross-sectional survey was conducted at two selected health sciences universities in India. Convenience sampling was used to enrol 511 undergraduate nursing students. A structured questionnaire was used to collect information regarding awareness of plastic pollution, its impact on human health and the environment, sustainable alternatives to plastics, levels of engagement in preventing plastic pollution and promoting environmental sustainability, and opinions towards strategies for mitigating plastic pollution.

Results: The ages of the participants ranged from 18 to 28 years, with a mean age of 21 ± 2.22 years. While 41.5% of the participants had adequate awareness of plastic pollution, only 14.1% demonstrated adequate levels of engagement in plastic pollution prevention and actions promoting environmental sustainability. A positive correlation was found between awareness of plastic pollution and engagement in plastic pollution prevention and environmental sustainability promotion ($r = 0.19$, $p < 0.001$).

Discussion: A substantial discrepancy exists between nursing students' awareness of plastic pollution and their actual engagement in pro-environmental behaviours. Additionally, the results indicate that enhancing awareness can lead to improved pro-environmental behaviors, underscoring the importance of preparing future nurses adequately as agents and advocates for environmental health and sustainability.

Conclusion: This study highlights the need to integrate environmental sustainability education into nursing curricula to bridge the gap between awareness and action.

Keywords: Awareness, Behaviors, Nursing students, Plastic pollution, Universities.

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1. INTRODUCTION

Plastic pollution has emerged as one of the foremost environmental crises both globally and in India, capturing widespread attention from the public, governments, environmental organizations, and business sectors. Studies have shown that millions of tons of plastic waste originating from both land-based and marine sources enter the oceans annually (Thushari and Senevirathna, 2020). Nevertheless, this pollution is not evenly distributed across the globe, with significant accumulation in the gyres of the world's oceans and on the shores of many developing countries. The COVID-19 pandemic has led to a significant increase in medical plastic waste, exacerbating plastic pollution (Prata *et al.*, 2020). Despite being densely populated, India currently holds the 12th position among nations with mismanaged plastics. However, projections suggest that it will ascend to the 5th position by 2025 (Neo *et al.*, 2021). The figure of 8-12 million metric tons (Mt) of plastic waste entering the oceans annually highlights the immense scale of marine pollution, which poses a serious threat to marine biodiversity, ecosystems, and human health (Chowdhury, Chowdhury, and Sait, 2021). The pervasive nature and durability of plastics mean that they can persist in the environment for hundreds to thousands of years, leading to significant ecological, economic, and health impacts (Bank *et al.*, 2021; Ravi, Baby, Elias, *et al.*, 2024).

The healthcare sector also relies heavily on plastics because of their cost-effectiveness and sterile, single-use properties. The medical equipment used in procedures such as dialysis, blood transfusion, and Extracorporeal Membrane Oxygenation (ECMO) often contains phthalates. These chemicals can also leach into food from plastic packaging. While phthalates are quickly metabolized, they raise health concerns such as endocrine disruption and male reproductive system malformations in animals (Daltry, Merone, and Tait, 2021). The abrupt increase in medical plastic waste due to the COVID-19 pandemic has indisputably resulted in a notable surge in plastic pollution.

The widespread issue of plastic pollution has a detrimental impact on the environment and the overall ecosystem (Kibria *et al.*, 2023). Additionally, plastic pollution can affect climate change by releasing greenhouse gases that contribute to global warming (Ford *et al.*, 2022; Ratnasari *et al.*, 2024). When present in the environment, plastics break down into small particles called microplastics (particles smaller than 5 mm) and nanoplastics (even smaller particles, less than 100 nm). Recent evidence indicates that these plastic particles are present everywhere in the ecosystem, including the air, drinking water, and food. Microplastics and nanoplastics suspended in the air can enter the human respiratory system through inhalation (Gregory, 2009; Yee *et al.*, 2021; Ramsperger *et al.*, 2023; Liu *et al.*, 2024). Furthermore, the consumption of food and water facilitates the transfer of these particles into the human digestive system (Mao *et al.*, 2022). Microplastics have been identified in a range of biological samples, including feces, sputum, saliva, blood, and placenta. These tiny particles have been associated with the onset or worsening of many conditions, including gastrointestinal disorders, respiratory problems, cardiovascular diseases, infections, and inflammatory diseases (Osman *et al.*, 2023).

The significant accumulation of plastic waste stems from various factors, including a shortage of technical expertise in hazardous waste management, inadequate infrastructure for recycling and recovery, and a general lack of awareness regarding applicable regulations. Decreasing plastic usage, reusing and recycling plastic products, altering behavior, and utilizing biodegradable plastics are some of the many initiatives that help curb plastic pollution. Over the past decade, efforts have been made to combat plastic pollution by either reducing its generation at the source or eliminating it post-generation. Several technologies, including adsorption, photocatalytic degradation, coagulation, and microbial decomposition, have been developed and studied to mitigate plastic accumulation. The implementation of a circular economy can effectively reduce the amount of plastic waste by transforming it into valuable products. This approach has the potential to enhance a nation's economy and offer alternative income sources (Pandey *et al.*, 2023). Nurses, as the largest healthcare workforce, can promote pro-environmental behaviors within healthcare facilities by advocating for and reducing the use of single-use plastics and encouraging the use of sustainable alternatives.

In recent times, media platforms such as television programs, publications, and social media have begun to enhance public understanding and awareness of microplastics (Osman *et al.*, 2023). In particular, nurses can have a direct influence on waste management practices in patient care, ensuring proper disposal and recycling protocols to minimize environmental impact (Ravi, Edwin, *et al.*, 2024). They play an exceptionally huge role in promoting environmental sustainability in healthy environments by promoting green products, reducing the usage of toxic materials, advocating sustainable policies, and promoting sustainable practices, such as green transportation and digitalization (Choukou, 2021; Baby and Ravi, 2023; Ravi, Baby, Pareek, *et al.*, 2024). In addition, they can be stewards of planetary health by educating patients and communities to prevent planetary pollution, biodiversity loss, and climate-related health crises (Al-Shidi, Ambusaidi, and Sulaiman, 2021; Soares *et al.*, 2021; Omoyajowo *et al.*, 2022; R. K. Ravi *et al.*, 2025; R. Ravi *et al.*, 2025). They can engage individuals and communities in environmental health initiatives by educating them about the effects of plastic pollution and its impact on health and the environment, by promoting awareness, and encouraging them to make sustainable choices. They can lead by example as agents of change, partnering with organizations to advocate for sustainable policies and promoting systemic changes within healthcare institutions to adopt pro-environmental practices.

While there is a growing recognition of the importance

of integrating planetary health into nursing education, significant gaps remain in the literature regarding nursing students' awareness of plastic pollution and their actions towards preventing plastic pollution and promoting environmental sustainability (Luque-Alcaraz *et al.,* 2022). Although many studies have focused on general environmental issues, very few have addressed the unique intersection of nursing practice and plastic waste. Further studies are needed to determine whether nursing education effectively prepares students to act as agents of change in mitigating plastic pollution. Lastly, there is an insufficient exploration of how nursing students translate their awareness into concrete actions, both in their personal lives and in future professional practice, highlighting the need for studies that bridge awareness with behavior change in the context of sustainability (Luque-Alcaraz *et al.,* 2022). Relevant studies can significantly contribute to understanding and mitigating plastic pollution within the healthcare sector, particularly through the lens of future healthcare professionals. This can help devise strategies and interventions to equip the future workforce with skills and motivation to actively promote sustainable practices within healthcare settings and communities. Hence, this study aimed to assess the level of awareness and engagement in plastic pollution prevention among nursing students in India.

2. METHODS

2.1. Design and Setting

The study employed a quantitative approach and an exploratory cross-sectional design to gather data from two selected nursing institutes in India. Based on geographic location, one institute from the northern (Punjab) and southern (Karnataka) regions of India was conveniently selected. Both institutes offer undergraduate and graduate nursing programmes. The undergraduate Bachelor of Nursing program in these selected institutes consisted of four years of integrated clinical and community postings.

2.2. Population and Sample

Convenience sampling was used to recruit participants. The inclusion criteria for the sample were as follows: aged 18 years or above and enrolled as a student in undergraduate nursing programs at the selected institutes. Those who were unavailable during the study period were excluded. The sample size was calculated by considering a 95% confidence level, a 5% margin of error, and a population proportion of 50%, as the estimate of the population proportion was not accurately available. The sample size calculated for the cross-sectional survey was 385, considering the possibility of a 10% non-response rate, using an online calculator software (https://www.calculator.net/sample-size-calculator.html). However, all students willing to participate were included in the study to improve the confidence and generalizability of the findings.

2.3. Measurement and Data Collection

A self-administered questionnaire was used to collect information from the students. The questionnaire was developed through a thorough review of the relevant literature and consultation with experts, following the standard process for the development of instruments (Srinivasan *et al.,* 2019; Alzubaidi, Slade and Dwivedi, 2021; Ravi and Mohamed, 2022; Miguel *et al.,* 2024; Rani *et al.,* 2025). The final version of the survey was structured into four parts.

Part one included four items to assess the characteristics of the students, including age, gender, marital status, and year of study. Part two included 15 multiple-choice questions with three options (Yes, No, and I do not know) to examine students' awareness of plastic pollution. This included three subcategories: 1) general awareness about plastic pollution (eight items), 2) impact of plastics on health and environment (five items), and 3) sustainable alternatives (two items). Correct responses were coded as 1, and incorrect responses were coded as 0. The total score was calculated by adding the scores of the individual items, which ranged from 0 to 15. The total score was categorized as adequate (80-100%, score ≥ 12), moderately adequate (60-79%, -score 6-11.9), and inadequate (less than 60%, score less than 6). Part three contained ten items related to plastic pollution prevention and environmental sustainability promotion actions: engagement in sustainable consumption (7 items) and environmental activism (3 items). All ten items were rated on a five-point Likert scale ranging from "never" (coded as 1) to "often" (coded as 5). The total score on the Likert scale ranged from 10 to 50 and was categorized as adequate (80-100%, score ≥40), moderately adequate (60-79%, - score 30-39), and inadequate (less than 60%, score less than 30). Part four was an opinionnaire to explore the outlook of students regarding strategies to mitigate the effects of plastic pollution. These included ten items on a three-point Likert scale ranging from disagree to agree. All items on this scale were analyzed and interpreted individually.

The questionnaire was pre-tested with ten students for appropriateness, readability, and understanding. As it was found appropriate for use, no modification was made to the tool prior to the main study. Two experts from the field of nursing, two experts from the field of medicine, and one expert from public health were asked to assess the survey instrument in accordance with predetermined criteria in order to test its content validity. The Content Validity Index (CVI) for the instrument was 0.92. Reliability of the study instrument was ensured using the split-half method. The total reliability score is 0.89.

Upon obtaining the necessary approval from the administrators and scientific and ethical Review Boards, data were collected from January to April 2023. All undergraduate nursing students enrolled in the selected institutes during the academic year 2022-2023 were invited to participate in the study. The survey was conducted online between June and July 2022. The study utilized Google Forms to create and administer the survey online. The investigators distributed the survey to the students' classrooms after explaining the study

procedures. The data collection was completed without interrupting academic activities. The students took approximately 20–30 minutes to complete the survey questionnaire. No problems were encountered during the data collection. The study adhered to the STROBE (Strengthening the Reporting of Observational Studies in Epidemiology) guidelines for reporting cross-sectional surveys.

A pilot study was conducted with 20 students to assess feasibility, identify any potential challenges, including confounding variables, and finalize the methods for statistical analyses. No further changes were made to the study protocol after the completion of the pilot study.

2.4. Ethical Considerations

The research and ethics committees of both institutes reviewed and approved The Internal Ethics and Scientific Review Committee of National Institute of Mental Health and Neurosciences College of Nursing, Bangalore City, with the approval number NIMH/CON/SEC/12-23 and the Ethics Committee of Saraswathi Professional and Higher Educational, College of Nursing, Ludhiana City, with the approval number IEC/SPHE/N/2023/131, Date 21/08/2023. Additionally, permission was obtained from the college authorities. All potential participants received a participant information sheet and consent form after being informed of the study's goals, nature, and duration. The survey was completed only by those who signed a written informed consent form. Participants' confidentiality and anonymity were ensured throughout the study. No identifiers, including the name, University ID number, address, and email address, were collected during the survey. Unique identifiers were allocated to participants to maintain their privacy. Only investigators had access to the data.

2.5. Analysis

Data collected using Google Forms was exported to Microsoft Excel, cleaned, coded, and later analyzed. Statistical processing was performed using the SPSS software package version 26. Responses with missing data were excluded from the analysis. Categorical and continuous variables are presented as numbers (%) or arithmetic means (SD) using descriptive statistics. The Chi-square test was used to determine the association between awareness, level of engagement in plastic pollution prevention, and environmental sustainability actions, and selected variables of interest. The bivariate relationship between awareness scores, as well as behavior scores and their subscales, was assessed using Pearson's correlation coefficient. The correlation coefficient >0.70 is interpreted as high, 0.3 to 0.7 as moderate, and <0.3 as negligible correlation (Schober, Boer, and Schwarte, 2018). Two-sided significance tests were used, and the significance level was set at $p < 0.05$.

3. RESULTS

3.1. Section 1: Characteristics of the Participants

The age of the study participants ranged from 18 to 28 years, with a mean of 21 ± 2.22 years. The majority of the participants were females (75.1%) and unmarried (97.7%). While 219 participants (42.9%) were first-year students, 116 (22.7%) were second-year students, 103(20.2%) were third-year students, and 73 (14.3%) were fourth-year students.

3.2. Section 2: Awareness Regarding Plastic Pollution and Actions Towards Plastic Pollution Prevention and Environmental Sustainability Promotion

The statements in each domain, the frequency of correct responses to these statements, and the mean score for each domain are presented in Table **1**. The mean score of awareness among participants was found to be 10.10 ± 3.3. The items with the highest positive responses were 'Plastic will cause health problems to animals and humans' and 'Storing and using food items in plastics are injurious to health.' Most incorrect responses were for the statements 'Throwing plastic in the trash ensures that it will not harm the environment' and 'A piece of plastic 5 mm or less is called a "microplastic."'

The domains of pro-environmental behaviors and the frequency of participants engaged in these practices are mentioned in Table **2**.

Table 1. Awareness about plastic pollution among participants (N = 511).

Domains	Statements	Correct Responses F (%)	Rank Order of Items based on Awareness
General understanding of plastic	All plastics are recyclable	318 (62.2)	10
	All plastics are biodegradable	353 (69.1)	6
	A majority of plastics are recycled	251 (49.1)	13
	Plastics require years to degrade in the environment	358 (70.1)	5
	Some cosmetic products have plastic in their constitution	349 (68.3)	7
	Plastics can break down into small pieces called "microplastics"	328 (64.2)	9
	A piece of plastic 5 mm or less is called a "microplastic"	270 (52.8)	14
	Throwing plastic in the trash ensures that it will not harm the environment	242 (47.4)	15
Sustainable alternative	Biodegradable plastics are friendly to the environment	309 (60.5)	11
	Biodegradable plastics are a good option to conventional (micro) plastics.	283 (55.4)	12

(Table 1) contd.....

Domains	Statements	Correct Responses F (%)	Rank Order of Items based on Awareness
Impact of plastic on health and the environment	The number of species affected by plastic ingestion has been increasing	383 (75.0)	3
	Storing and using food items in plastic is injurious to health	403 (78.9)	2
	Plastic will cause health problems to animals and humans	415 (81.2)	1
	The majority of plastic waste eventually ends up in the ocean	369 (72.2)	4
	Microplastics enter the food chain and can reach humans	340 (66.5)	8

Table 2. Engagement in Plastic pollution prevention and environmental sustainability promotion actions among participants (N = 511).

Domains	Statements	f (%)				
		Never	Rarely	Sometimes	often	Always
Sustainable consumption	Bringing your own bag to the supermarket	86(16.8)	134 (26.2)	152 (29.7)	111 (21.7)	28 (5.5)
	Buying products with less or no packaging	84(16.4)	163 (31.9)	182 (35.6)	62 (12.1)	20 (3.9)
	Refusing plastic straws at restaurants and bars	117 (22.9)	151 (29.5)	144 (28.2)	76 (14.9)	23 (4.5)
	Using low-damage objects such as paper and glass whenever possible	67 (13.1)	148 (29.0)	153 (29.9)	106 (20.7)	37 (7.2)
	Using water purifiers (avoiding plastic bottles)	68 (13.3)	150 (29.4)	122 (23.9)	142 (27.8)	29 (5.7)
	Deposit garbage in the appropriate garbage containers in public places	74 (14.5)	111 (21.7)	111 921.7)	167 (32.7)	48 (9.4)
	Adopting environmentally friendly alternatives (*e.g.,* use biodegradable plastic)	79 (15.5)	129 (25.2)	137 (26.8)	133 (26.0)	33 (6.5)
Environmental activism	Alert my family and friends to environmental issues	69 (13.5)	131 (25.6)	138 (27.0)	143 (28.0)	30 (5.9)
	Participate in voluntary environmental actions (*e.g.,* beach clean-up)	126 (24.7)	139 (27.2)	140 (27.4)	80 (15.7)	26 (5.1)
	Read more about plastic pollution	74 (14.5)	145 (28.4)	151 (29.5)	115 (22.5)	26 (5.1)

SD-Standard Deviation, f-Number of Respondents.

The percentage of individuals with a specific degree of pro-environmental behaviors and awareness of plastic pollution is presented in the doughnut chart (Fig. **1**).
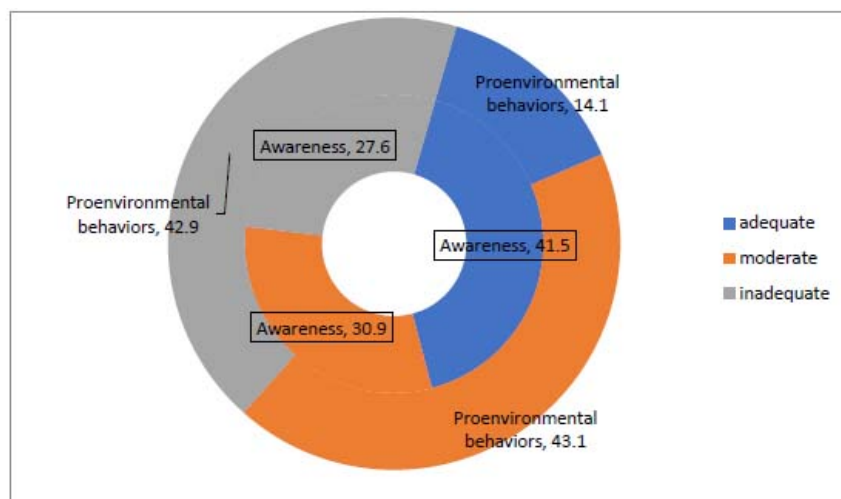

Fig. (1). Level of awareness and engagement in plastic pollution prevention and environmental sustainability promotion actions (in percentages).

Table 3. Association between awareness about plastic pollution, engagement in plastic pollution prevention and environmental sustainability promotion actions, and selected variables.

Variable		Awareness About Plastic Pollution (Mean ± SD)	F value *	P-value	Pro-environmental Behaviours (Mean ± SD)	F value *	P-value
Gender	Male	9.9 (3.4)	0.08	0.76	30.6(7.4)	0.09	0.75
	Female	10.1 (3.2)			31.0(7.2)		
Marital status	No	10.07(3.3)	1.65	0.19	26.3(7.6)	0.03*	0.95
	Yes	11.4 (2.4)			31.0(7.2)		
Age (years)	18-20	10.04(3.5)	0.07	0.92	31.3 (7.5)	0.70	0.49
	21-24	10.16(2.9)			30.7(6.9)		
	24 and above	10.10(3.5)			30.05(7.5)		
Year of study	First	10.1(3.1)	1.9	0.23	31.1(7.81)	0.07	0.94
	Second	9.9(3.6)			30.8(7.08)		
	Third	9.7(3.7)			30.9(7.1)		
	Fourth	10.8(2.3)			30.7(6.02)		

*ANOVA test has been performed.

Table 4. Correlation between awareness about plastic pollution and pro-environmental behaviors.

S.No.	Variable	R values					
		1	2	3	4	5	6
1.	**Awareness about plastic pollution**						
2.	General aspects	0.92**					
3.	Impact on health	0.83**	0.61**				
4.	Sustainable alternatives	0.66**	0.49**	0.45**			
5.	**Pro-environmental behaviors**	0.19**	0.19**	0.15**	0.06		
6.	Environmental activism	0.18**	0.19**	0.14**	0.05	0.87**	
7.	Sustainable consumption	0.17**	0.18**	0.15**	0.05	0.98**	0.76**

** significant at $p<0.001$ levels.

While 41.5% of the participants had adequate awareness of plastic pollution, only 14.1% had adequate levels of engagement in actions promoting plastic pollution prevention and environmental sustainability. This finding highlights the disparity between knowledge and practice.

The association between awareness, engagement in plastic pollution prevention, environmental sustainability promotion actions, and selected socio-demographic variables is presented in Table **3**.

None of the selected sociodemographic variables was found to be significantly associated with awareness of plastic pollution or the actions taken.

The correlations between awareness of plastic pollution, its subscales, and engagement in actions promoting plastic pollution prevention and environmental sustainability, along with their subscales, are presented in Table **4**. A positive correlation was found between awareness of plastic pollution and engagement in plastic

pollution prevention and environmental sustainability promotion (r = 0.19). Except for knowledge about sustainable alternatives, every other subscale was positively correlated with the others, indicating that increasing awareness of plastic pollution can improve engagement in plastic pollution prevention and environmental sustainability promotion actions.

3.3. Strategies for Mitigation

Fig. (**2**) shows the participants' opinions regarding various strategies for mitigating plastic pollution. The strategy agreed upon by the maximum number of participants (n = 451) was to raise awareness about plastic pollution. The majority of participants also approved of "laws to phase out use of plastic," "bans on plastic at mass events," and "supplying bins in convenient locations" as measures for mitigating plastic pollution. 'Including content in the course curriculum' was the least agreed-upon strategy among the nursing student participants.
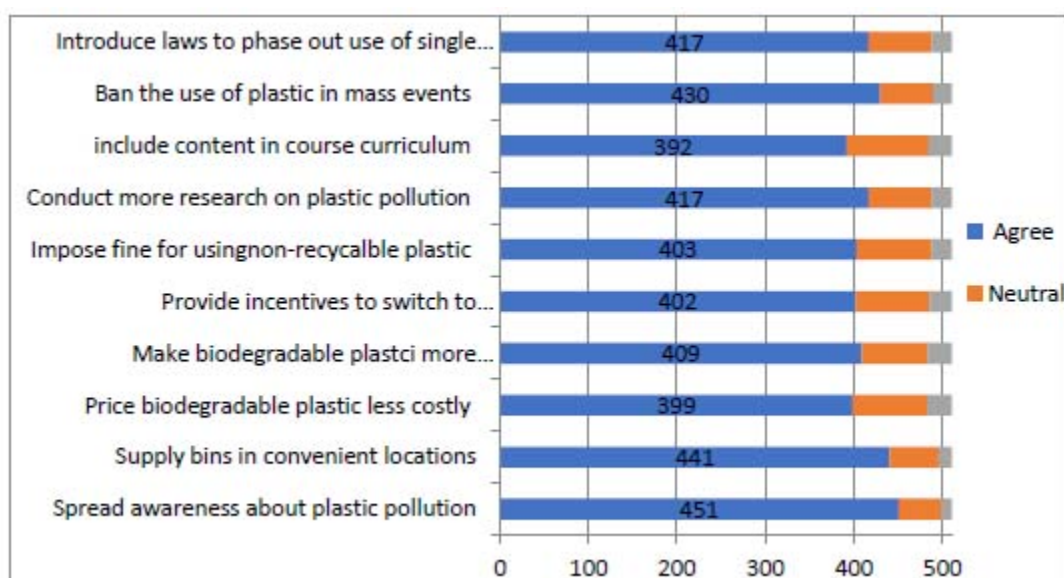
Fig. (2). Opinion on strategies to mitigate plastic pollution.

4. DISCUSSION

This study aimed to assess nursing students' awareness of and pro-environmental behaviors regarding plastic pollution. In the current study, a considerable proportion of nursing student participants showed a good understanding of plastic pollution, but only a small fraction demonstrated sufficient pro-environmental behaviors. This discrepancy underscores the disparity between awareness levels and actual pro-environmental behaviors. In addition, the statements garnering the most positive responses were related to the perceived health risks associated with plastics, particularly concerns about their impact on both animals and humans. Additionally, the participants expressed apprehension regarding the health implications of storing and using food items in plastic containers. Most incorrect responses in the research study were associated with two statements. First, there was a prevalent misconception regarding the belief that the disposal of plastic in trash guarantees its harmlessness to the environment. Second, participants commonly erred in identifying a piece of plastic measuring 5 mm or less as a "microplastic."

Nursing students who were more aware of plastic pollution tended to have a comprehensive understanding of environmental issues beyond plastic pollution. This indicates broader environmental awareness among students who are knowledgeable about plastic pollution. Similarly, individuals who are aware of plastic pollution also recognize the potential health risks associated with it. Studies conducted in several medical specialties and work settings worldwide have highlighted this concerted effort (Shah *et al.*, 2024). Additionally, a significant relationship was found between pro-environmental behaviors and environmental activism, suggesting that individuals who engage in pro-environmental actions are also likely to participate in environmental activism. This highlights the interconnectedness and importance of understanding plastic pollution, its health implications, and the promotion of pro-environmental behaviors and activism in addressing environmental challenges.

The proposed strategies encompass a range of approaches to mitigating plastic pollution, including legislative actions, educational initiatives, economic incentives, and awareness campaigns. The predominance of 'Agree' responses for most strategies indicates a widespread consensus among respondents regarding the significance and potential efficacy of these measures in addressing plastic pollution. Introducing laws to phase out single-use plastics signifies a regulatory approach to reducing plastic waste and encouraging sustainable alternatives. Including the topic of plastic pollution in course curricula highlights the importance of education in raising awareness and fostering responsible behavior towards plastic use. Imposing fines for using non-recyclable plastics serves as a deterrent to discourage environmentally harmful practices. Additionally, conducting more research on plastic pollution underscores the need for a deeper understanding of this issue to inform evidence-based interventions and policies (Rana and Newby, 2024; Shah *et al.*, 2024). The study also notes that providing incentives to switch to biodegradable products and to make them more accessible and affordable incentivizes the adoption of eco-friendly alternatives, promoting sustainable consumption patterns.

Our findings are supported by an earlier study conducted among nursing students. They reported inadequate knowledge, poor practices, and unfavorable attitudes towards plastic pollution (Srinivasan *et al.*, 2019). In the current study, a significant proportion of nursing students recognized the potential health risks

associated with plastic pollution, both for animals and humans. Another study on the understanding and awareness of microplastics also showed that a notable portion of the students in healthcare university programs were unfamiliar with the harm imposed by microplastic pollution and its impact on the environment and ecosystem (Cammalleri *et al.*, 2020). Microplastics have been present in seawater for decades and are expected to significantly increase in the future; thus, there is a need to improve awareness and implement student-led initiatives to minimize plastic pollution in the environment (Dey *et al.*, 2022). They not only harm the environment and marine life but also contaminate food intended for human consumption, posing a risk to food safety (Usman *et al.*, 2020; Osman *et al.*, 2023). Chemicals produced as by-products, such as phthalates, bisphenol A, flame retardants, and perfluorinated chemicals, are frequently discharged into the ocean through plastic waste, leading to potential disruptions in endocrine signalling, decreased male fertility, nervous system impairment, and increased cancer risks (Landrigan *et al.*, 2020).

Due to the cross-sectional nature of the study, it did not establish a robust link between participants' awareness of plastic pollution and their pro-environmental behaviors. An earlier study discovered that attitudes towards plastic problems are influenced by age and educational background. Older individuals and those with lower educational levels tended to view recycling as a less important solution (Miguel *et al.*, 2024). A study conducted among health professionals indicated that individuals with higher health consciousness were more likely to participate in recycling activities, indicating a positive association between health awareness and recycling behavior (Shimoda *et al.*, 2020; R. K. Ravi *et al.*, 2025). In addition, the association between visual depictions of images showing floating plastic waste and animals affected by plastics with plastic pollution has been reported among individuals. Furthermore, there was limited awareness of the presence of microplastics in everyday consumer products, such as personal care items, highlighting knowledge gaps concerning the adverse effects of plastic degradation and its increasing risks. More individuals can be encouraged to adopt pro-environmental behaviors through financial incentives, which are viewed as primary motivators for engaging in eco-friendly practices.(Ravi, Edwin, *et al.*, 2024; R. Ravi *et al.*, 2025)

Nursing students who participated in this study favored raising awareness of plastic pollution as the most effective strategy. They also endorsed implementing laws to phase out plastic use, banning plastic at mass events, and providing convenient bins for proper disposal as effective methods to holistically address plastic pollution. By contrast, incorporating plastic pollution content into the academic curriculum was the least favored strategy among the participants. Bank *et al.* (2021) suggested the establishment of a Global Plastic Pollution Observation System (GPOS), detailing its functions and benefits in addressing the worldwide issue of plastic pollution (Bank *et al.*, 2021).

4.1. Implications for Practice

This study addresses an important environmental issue and contributes to understanding how awareness translates into pro-environmental actions. The findings of this study may have practical implications for educational programs, policy development, and interventions aimed at promoting pro-environmental behavior among nursing students. Specific targeted interventions among students through workshops, environmental sustainability projects, and healthcare-related sustainability projects can boost their actions and bridge the gap between knowledge and action. This study explores the impacts of awareness of plastic pollution on pro-environmental behaviors, highlighting the crucial role of healthcare professionals, particularly future nurses, in addressing environmental challenges specifically related to plastic pollution.

4.2. Strengths and Limitations

One of the major strengths of this study is that it was conducted at multiple sites involving students from all regions, thereby providing a representative sample. The sample size also improves the generalizability of the findings.

This study's cross-sectional design may limit the ability to establish causality between awareness levels and pro-environmental behaviors. However, this design was selected to improve the feasibility of this study. Moreover, there could have been bias in participant responses, such as social desirability bias, where participants provide answers that they think are socially acceptable rather than their true beliefs. The convenience sampling technique can also account for selection bias; hence, the generalizability of the findings should be approached cautiously. Indeed, the lack of analysis regarding geographical variation represents a missed opportunity to gain insights into the potential differences in awareness and behaviors across regions. This study focused solely on nursing students, possibly limiting the generalizability of the findings to other populations or professions.

CONCLUSION

The current study highlights a significant gap between nursing students' awareness of plastic pollution and their actual engagement in pro-environmental behaviors. Although causality is not established in this study, and generalizability should be considered cautiously, the need for comprehensive environmental education that translates into community action can be underscored. Although certain students possess a solid grasp of plastic pollution, this awareness often fails to translate into proactive measures. Future studies should focus on methods for closing this gap by addressing it through interventions to promote pro-environmental behaviors. Addressing these challenges is imperative to effectively combat plastic pollution and foster a sustainable future.

AUTHORS' CONTRIBUTIONS

It is hereby acknowledged that all authors have accepted responsibility for the manuscript's content and

consented to its submission. They have meticulously reviewed all results and unanimously approved the final version of the manuscript.

NOVELTY OF THE STUDY

- The first study specifically assesses nursing students' awareness of and actions towards plastic pollution in India.
- It highlights the gap between awareness and actual pro-environmental behaviors among future healthcare professionals.
- Integrates the concept of nursing as a key player in environmental sustainability within healthcare settings.
- Emphasizes the role of nursing students as potential agents of change in mitigating plastic pollution in the healthcare sector.
- This highlights the need to implement targeted educational programs and workshops to bridge the gap between awareness and pro-environmental actions among nursing students.
- Recommends the incorporation of environmental sustainability and plastic pollution prevention topics into nursing education to ensure long-term behavioral change.
- Follow-up studies are recommended to assess the long-term impact of awareness on behavioral changes among nursing students.
- Collaboration with healthcare institutions and policymakers is required to implement sustainable waste management practices in nursing education and hospital settings.

LIST OF ABBREVATIONS

ECMO	=	Extracorporeal Membrane Oxygenation
Mt	=	Metric Tons
nm	=	Nanometer
mm	=	Millimeter
IEC	=	Institutional Ethics Committee
STROBE	=	Strengthening the Reporting of Observational Studies in Epidemiology
CVI	=	Content Validity Index
SD	=	Standard Deviation
ANOVA	=	Analysis of Variance
SPSS	=	Statistical Package for the Social Sciences
GPOS	=	Global Plastic Pollution Observation System
UAE	=	United Arab Emirates

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

The research and ethics committees of both institutes reviewed and approved by The Internal Ethics and Scientific Review Committee of National Institute of Mental Health and Neurosciences College of Nursing, Bangalore City, with the approval number NIMH/CON/SEC/12-23 and the Ethics Committee of

Saraswathi Professional and Higher Educational, College of Nursing, Ludhiana City, with the approval number IEC/SPHE/N/2023/131, Date 21/08/2023.

HUMAN AND ANIMAL RIGHTS

All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or research committee and with the 1975 Declaration of Helsinki, as revised in 2013.

CONSENT FOR PUBLICATION

Written informed consent was obtained from all participants of this study.

STANDARDS OF REPORTING

STROBE guidelines were followed.

AVAILABILITY OF DATA AND MATERIALS

The data and supportive information are available within the article.

CONFLICT OF INTEREST

The authors declare no conflict of interest, financial or otherwise.

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