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Assessment of Knowledge, Awareness, Attitude, and Practice of Plastic Waste Management Among the Digitally Active Public in India

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ABSTRACT

Plastic pollution has become a significant challenge that seriously threatens the environment and biota. Studying people's knowledge, awareness, attitudes, and practices regarding plastic pollution and plastic waste management can help inform policymaking, source segregation, and mitigation measures. The present study was conducted using an online Google Forms-based survey to assess the knowledge, awareness, attitudes, and practices of the general public towards plastic pollution and plastic waste management. A total of 540 respondents participated across 27 different states of India. Descriptive statistical measures, frequency analysis, chi-square goodness-of-fit tests, and Pearson correlation analysis were performed to analyse the results of sociodemographic information, sources of plastics, and different domains of KAP scores. The results show that plastic bags were the most regularly used single-use plastic items, mainly from grocery stores. The overall KAP scores revealed that 16.7% of respondents had poor knowledge, 30% had poor awareness, 19.3% had poor attitude, and 61.5% had poor practice related to plastic waste management and pollution. Sociodemographic variables such as residential area, education level, and occupation were significantly associated with KAP towards plastic pollution and waste management ($P<0.05$). The study recommends conducting environmental awareness campaigns, integrating topics related to plastic pollution and its impacts on the environment and human health into formal and informal education, and ensuring access to recycling facilities within local communities.

1. INTRODUCTION

Plastic pollution has emerged as one of the most serious threats to land and aquatic ecosystems (Kumar et al. 2021). Due to its mass-scale production, extensive usage, persistence, water resistance, durability, and low degradability, it poses a serious environmental challenge for effective waste management (Lakhiar et al. 2024). The global production of plastic has increased significantly in the last few decades because of its high demand, lightweight nature, low cost, and durability, and it is used in different sectors like packaging, construction, textiles, and consumer packaged goods (Pilapitiya & Ratnayake2024). Globally, till now, 8300 million metric tonnes of virgin plastic has been produced, and as of 2015, 6300 metric tonnes of plastic waste had been generated, of which approximately 79% of the discarded plastic waste was disposed of in landfills, and only 9% of the plastics were recycled, and 12% were incinerated (Gaffney et al. 2024, Geyer et al. 2017). However, their extensive use can lead to the accumulation of plastic in the natural environment, where plastics persist for hundreds of years and eventually disintegrate into small particles and form microplastics and nanoplastics.

India alone generated 4.12 million tonnes of plastic waste in 2020-21 (CPCB 2021, Rakib et al. 2023). Managing plastic waste is a significant challenge in India due to its burgeoning population, urbanization, and rapid economic growth (Rafey & Siddiqui 2023). To protect humans and the environment from the increasing threats of plastic pollution, the government of India, along with international agencies like UNEP, is enforcing restrictions on plastic waste management, including the ban on single-use plastic (Hossain et al. 2022, Nøklebye et al. 2023). Raising public awareness is considered as important as other strategies to reduce plastic pollution (Bashir et al. 2020, Coco Chin et al. 2023). However, the pro-environmental behaviour of the public can be predicted by individual attitudes and knowledge about plastic pollution (Felipe-Rodriguez et al. 2022, Mistry & Joshi 2025). It is pivotal to explore public opinion and knowledge for the successful implementation of targeted policies. It is essential to understand public behaviour and what people know about plastic waste and its associated environmental and health risks (Heidbreder et al. 2019, Henderson & Green 2020). To understand the behaviour of the general public towards plastic waste management, this study is informed by the Theory of Planned Behaviour (TPB). According to this theory, the behaviour of an individual is influenced by their attitude, subjective norms, and perceived behavioural control. In the context of environmental behaviour of the people, the level of knowledge and awareness of individuals shapes their attitude, which decides their behaviour (Wu et al. 2022). If the people are well aware and have good knowledge of plastic waste and environmental pollution, then their mindset and attitude will change, which governs their behaviour towards plastic waste management. Therefore, the KAP framework used in the current study is conceptually fit with the theory of planned behaviour (Hasan et al. 2022). Based on the theoretical perspective, the current study also assumes a sequential relationship between knowledge, attitude, practice, and behaviour. This study aims to assess the knowledge, attitude, practice, and behaviour of digitally active members of the general public in India towards plastic waste management. Especially, it examines how aware people are of plastic waste, their willingness to adopt sustainable practices, and their actual behaviour regarding plastic waste management. To achieve this, we have conducted an online survey using a structured questionnaire through Google Forms. The questionnaire included questions on sociodemographic details, knowledge, awareness, attitude, and practice (KAP) of plastic waste management. Respondents' answers were collected and analysed using a 3-point Likert scale. All the results were statistically analyzed to evaluate the overall level of behaviour patterns and the awareness among participants.

2. MATERIALS AND METHODS

2.1. Data Collection

A structured questionnaire was prepared based on previously published research articles. The responses were collected from the participants through a survey using Google Forms. The questionnaire comprised five sections, including socio-demographic details, knowledge, awareness, attitude, and practice. Each section consisted of 5–10 items: knowledge (8 items), awareness (5 items), attitude (10 items), and practice (6 items). The responses were collected using multiple-choice closed-ended questions, checkboxes, short answers, and a 3-point Likert scale, such as responses such as yes, no, and maybe. In the sociodemographic section, participants were asked about their age group, gender, the highest level of education, occupation, state, and residential area (urban or rural). The questionnaire also included questions on the type and source of single-use plastics in day-to-day life. The knowledge domain included items on plastic pollution, where plastic comes from, whether plastic pollution affects human life, open burning and incineration of plastic, how long plastic takes to degrade, etc. The awareness section included questions on whether the respondents and people around them were aware of plastic pollution. In the attitude section, the respondents were asked about their attitude towards plastic pollution, whether the government or the public is more responsible for reducing plastic pollution, whether they think it is increasing, etc. The practice section included questions such as whether they segregate plastic or not, whether they reuse plastic products, whether they bring a carry bag to buy groceries, etc.

The questionnaire was prepared in English, and the study was conducted with educated, digitally active members of the public in India. The draft questionnaire was vetted by two research faculty members and five respondents in a pilot survey before data collection to identify potential weaknesses in the questionnaire, and based on their feedback, the questionnaire was revised. The generated Google Form link was disseminated by email and social media applications. Snowball sampling was also used, and the respondents were asked to circulate and share the Google Form link with their friends and family members. The form was available online for data collection from March to October 2024. Since the study only assessed the knowledge, awareness, attitude, and practice of plastic pollution among the respondents, a consent form was obtained from all the participants. A total of 543 individuals responded to the survey; three responses were excluded, and data from 540 respondents were included in the statistical analysis.

Table 1: Reliability analysis using Cronbach's alpha.

Domain	No. of items	Cronbach's alpha
Knowledge	8	0.670
Awareness	5	0.690
Attitude	10	0.690
Practice	6	0.644
All domains	29	0.779

2.2. Data Analysis

The questionnaire's reliability and internal consistency were analysed using Cronbach's alpha test. The Cronbach's alpha values of 0.60 or higher are generally considered acceptable for survey research (Hair 2011). The Cronbach's alpha reliability coefficients for the knowledge (8 items), awareness (5 items), attitude (10 items), and practice (6 items) scales were 0.670, 0.690, 0.690, and 0.644, respectively, indicating moderate internal consistency within each domain. The overall reliability for the combined 29 items based on Cronbach's alpha was 0.779, as shown in Table 1, confirming the questionnaire's robustness in measuring KAP constructs. These findings demonstrate that the instrument is a reliable tool, supporting its use in research and practical applications involving knowledge, awareness, attitudes, and practices. Descriptive frequency analysis was performed to summarize the characteristics of sociodemographic variables. The Chi-Square goodness-of-fit test was performed to study the categorical distribution of the respondent population. Further, KAP (knowledge, attitude, and practice) scores were calculated. For the estimation of KAP, 1 mark was assigned for a correct answer, 0.5 marks for a partially correct answer, and 0 marks for an incorrect answer (Coco Chin et al. 2023). The percentage score of KAP was used for further statistical analysis. Respondents who scored $\geq$70% were categorised as good, while those who scored <70% were categorised as poor (Chimisso 2021, Coco Chin et al. 2023). The mean KAP score was compared with the sociodemographic variables by performing a one-way analysis of variance (ANOVA) and an independent t-test. A chi-square test of association was performed to study the association between KAP domain levels and the sociodemographic variables containing two levels. Pearson correlation analysis was performed to study the relationship between each KAP domain score. Sociodemographic variables like age, education, gender, occupation, residential place, and environmental science education influence the dependent variables like attitude and practice for plastic use and recycling, respectively. Multiple linear regression analysis was conducted to determine whether knowledge and awareness influence the attitudes and practices of respondents toward plastic pollution and plastic waste management. All the statistical analyses were performed using SPSS software version 25.0. A p-value of <0.05 was considered statistically significant.

3. RESULTS

3.1. Socio-Demographic Characteristics of Respondents

A total of 540 respondents participated in the study, of whom

Table 2: Socio-demographic details of the respondents.

Socio-Demographic Variables	Categories	Frequency (N=540)	%	Chi-Square Value	p-value
Gender	Male	316	58.5%	15.674	<0.001
	Female	224	41.5%		
Age	18-30 years	408	75.6%	457.744	<0.001
	31-50 years	113	20.9%		
	> 50 years	19	3.5%		
Residential place	Rural	242	44.8%	5.807	<0.05
	Urban	298	55.2%		
Education	No formal School Education	4	0.7%	512.267	<0.001
	Upto secondary	30	5.6%		
	UG	172	31.9%		
	PG	334	61.9%		
Have you ever studied Environmental Science subject?	No	39	7.2%	395.267	<0.001
	Yes	501	92.8%		
Occupation	Govt Sector	77	14.3%	963.393	<0.001
	Private Sector	97	18.0%		
	Business	15	2.8%		
	Homemaker	10	1.9%		
	Retired	4	0.7%		
	Student	316	58.5%		
	Unemployed	21	3.9%		

58.5% were male (P<0.001). A total of 55.2% of respondents were from urban areas (P<0.001). The participants were categorized into three age groups (18-30 years, 31-50 years, and more than 50 years) with the largest proportion of respondents (75.6%) in the 18–30-year age group, followed by the 31–50-year and >50-year age groups (P<0.001) (Table. 2). About 60% of the respondents had postgraduate-level education (P<0.001). The study also revealed that 58.5 % are students, followed by 18.0 % working in the private sector and 14.3% working in the government sector (P<0.001). A majority of respondents (92.8 %) reported that they had studied Environmental Science in their education (P<0.001). However, 39 respondents (7.2%) mentioned never studying Environmental Science. Among the total respondents, 55.2% were from urban areas and 44.8% from rural areas. Respondents from 27 states across India participated in this survey, and among them, the maximum were from Bihar (19.3%), followed by Tamil Nadu (16.7%) and Assam (13.9%).

Fig. 1 reveals the regularly used single-use plastics. Around 66.7% of the respondents reported that the most commonly used plastic items were plastic bags, followed by

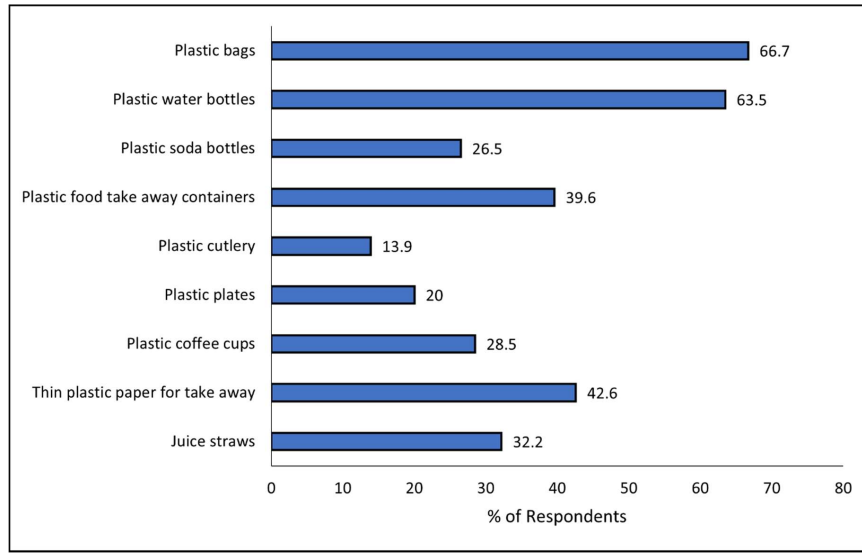

Fig. 1: Regularly used single-use plastics.

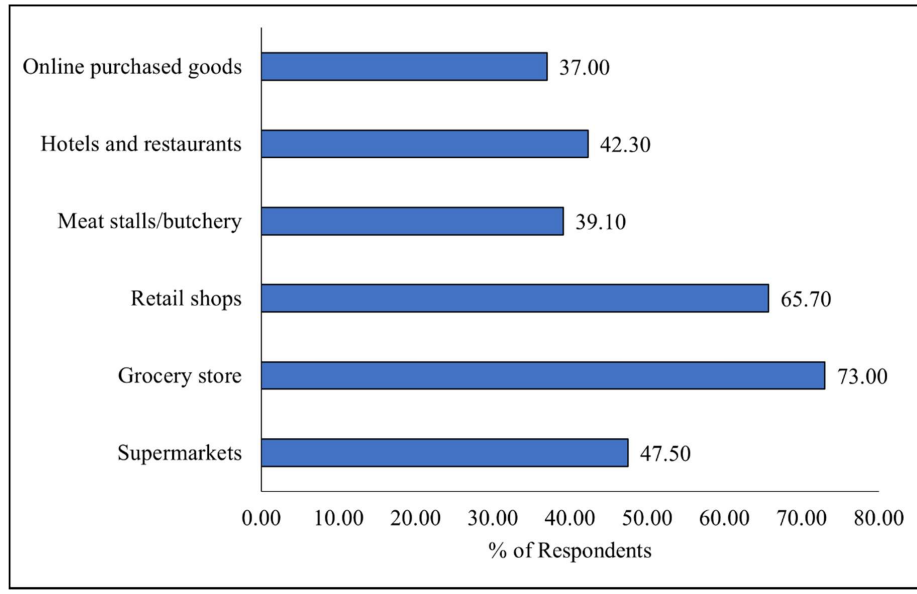

Fig. 2: Source of single-use plastics.

plastic water bottles (63.5%). Other frequently used items include thin plastic paper for takeaway purposes (42.6%) and plastic food takeaway containers (39.6%). In contrast, disposable items such as plastic soda bottles (26.5%), plastic coffee cups (28.5%), juice straws (32.2%), plastic plates (20.0%), and plastic cutlery (13.9%) were reported less frequently. A statistically significant difference was observed in the distribution of single-use plastic materials ($\chi^2 = 34.62$, $p < 0.001$), with plastic bags and water bottles predominating, while items such as plastic cutlery and plates were reported less frequently. These findings demonstrate that single-use plastic products associated with packaging and convenience, such as bags, bottles, and takeaway containers, are more commonly used than disposable items, including plates and cutlery.

The sources of single-use plastics used by the participants during daily life are given in Fig. 2. The results show that 73.0% of the respondents stated that the most common source of single-use plastics was grocery stores, followed by 65.7% from retail shops, 47.5% from supermarkets, 42.3% from hotels and restaurants, 39.1% from meat stalls or butcheries, and 37.0% from online purchases. A significant variation was observed in the sources of single-use plastics ($\chi^2 = 22.17$, $p < 0.001$), with grocery stores and retail shops being the leading sources. These results suggest that routine consumer activities, particularly food and retail purchases, primarily contribute to daily single-use plastic use among the surveyed population.

3.2. Assessment of Knowledge, Awareness, Attitude, and Practice with Sociodemographic Variables

The mean scores of knowledge, awareness, attitude, and practice across the respondents' sociodemographic variables are presented in Table 3. The overall mean score for knowledge was 88.66 ±12.57%, indicating a high level of knowledge among respondents. The mean awareness score was 80.50±16.24%, while the attitude score was 86.14±11.78%, reflecting a generally positive view. Participants' overall mean practice score was relatively lower, 69.78 ±22.21%. The mean knowledge score was significantly higher among males (89.62 ± 11.91%) compared to females (87.30 ± 13.36%) ($t = 2.112$, $p < 0.05$), indicating a statistically significant difference between male and female respondents. No significant difference was observed between males and females regarding awareness (Male: 81.49 ± 16.37%, Female: 79.11 ± 15.99%; $t = 1.681$, $p > 0.05$) and attitude (Male: 85.63 ± 12.22%, Female: 86.85 ± 11.11%; $t = -1.186$, $p > 0.05$). Similarly, no significant difference was observed between the male and female respondents for practice (Male: 70.52 ± 22.85%, Female: 68.75 ± 21.28%; $t=0.911$, $p > 0.05$). There were no statistically significant differences in knowledge, awareness, attitude, or practice scores across three different age groups ($p > 0.05$). The knowledge scores were 87.83 ± 19.15% in the >50 age group and 89.49 ± 11.18% in the 31–50 years age group ($F = 0.337$, $p > 0.05$). The awareness scores were observed at 79.68 ± 16.96% in the 18–30 years and 83.27 ± 12.57% in the 31–50 age group ($F = 2.219$, $p > 0.05$). The attitude scores of participants ranged from 84.74 ± 13.49% in the > 50 years age group to 86.19 ± 11.91% in the 18-30 years age group ($F = 0.139$, $p > 0.05$). The practice scores ranged from 63.60 ± 19.09% among respondents above 50 years to 69.91 ±22.97% in the 18-30 years age group ($F = 0.781$, $p > 0.05$). The urban and rural populations have similar knowledge, attitude, and practice scores ($p > 0.05$).

Education level significantly influenced the knowledge score ($F = 9.684$; $p < 0.001$). Participants with no formal education had the lowest knowledge score (75.00 ± 37.85), while those with postgraduate education had the highest (90.42 ± 9.66). Awareness scores, attitudes, and practices did not differ significantly across education groups ($p > 0.05$). Overall, awareness scores ranged from 75.00 ± 31.09 to 81.23 ± 15.11, attitude scores from 82.17 ± 19.28 to 86.60 ± 10.54, and practice scores from 69.19 ± 21.86 to 81.25 ± 27.53. These results indicate that higher education is significantly associated with greater knowledge but does not appear to influence awareness, attitudes, or practices.

Participants who had studied environmental science earlier scored significantly higher in knowledge ($t = -4.301$; $p < 0.001$), awareness ($t = -2.255$; $p = 0.025$), and attitude ($t = -2.044$; $p = 0.041$) than those who had not. However, the two groups had no significant difference in practice scores ($t = -1.536$; $p = 0.125$). This suggests that education in environmental science is positively associated with greater knowledge, awareness, and attitudes toward plastic waste management and pollution; however, practice scores did not differ between the groups ($P>0.05$).

Across the different occupational groups, the knowledge score was significantly influenced by occupation ($F = 2.932$; $p = 0.008$), with government sector employees demonstrating the highest knowledge (90.34 ± 8.93) and homemakers scoring the lowest (75.63 ± 28.48). However, there were no significant differences in awareness ($F = 1.059$; $p = 0.386$), attitude ($F = 1.408$; $p = 0.209$), or practice ($F = 1.195$; $p = 0.307$) scores across the occupational groups. These results suggest that occupation may be a key factor affecting knowledge, but it does not appear to influence awareness, attitudes, or practices.

3.3. The Overall KAP Status of the Respondents Towards Plastic Pollution

Table 4 shows the respondents' knowledge, awareness, attitude, and practice (KAP) related to plastic waste

Table 3: Mean KAP scores with the socio-demographic variables of the respondents.

Variable		Knowledge Score (%) (Mean ± sd)	F/t value	p-value	Awareness Score (%) (Mean ± sd)	F/t value	p-value	Attitude Score (%) (Mean ± sd)	F/t value	p-value	Practice Score (%) (Mean ± sd)	F/t value	p-value
Overall mean score		88.66±12.57			80.50±16.24			86.14±11.78			69.78±22.21		
Gender	Male	89.62±11.91	2.112	0.035	81.49±16.37	1.681	0.093	85.63±12.22	-1.186	0.236	70.52±22.85	0.911	0.363
	Female	87.30±13.36			79.11±15.99			86.85±11.11			68.75±21.28		
Age	18-30 years	88.47±12.59	0.337	0.714	79.68±16.96	2.219	0.110	86.19±11.91	0.139	0.870	69.91±22.97	0.781	0.458
	31-50 years	89.49±11.18			83.27±12.57			86.19±11.07			70.35±19.76		
	Above 50 years	87.83±19.15			81.58±18.64			84.74±13.49			63.60±19.09		
Residential place	Rural	88.15±14.36	-0.852	0.395	80.50±17.80	-0.005	0.996	86.55±13.38	0.730	0.466	70.97±24.27	1.120	0.263
	Urban	89.07±10.92			80.50±14.89			85.81±10.31			68.82±20.37		
Education	No formal School Education	75.00±37.85	9.684	<0.001	75.00±31.09	0.696	0.554	82.50±28.72	1.446	0.228	81.25±27.53	0.530	0.662
	Upto secondary	80.21±24.84			80.00±21.50			82.17±19.28			69.72±23.42		
	UG	87.03±12.70			79.30±16.98			86.02±11.83			70.69±22.67		
	PG	90.42±9.66			81.23±15.11			86.60±10.54			69.19±21.86		
Have you ever studied Environmental Science subject?	No	80.45±23.13	-4.301	<0.001	74.87±22.58	-2.255	0.025	82.44±17.47	-2.044	0.041	64.53±22.92	-1.536	0.125
	Yes	89.30±11.14			80.94±15.59			86.43±11.19			70.19±22.12		
Occupation	Govt Sector	90.34±8.93	2.932	0.008	83.64±11.69	1.059	0.386	87.53±9.85	1.408	0.209	71.32±19.33	1.195	0.307
	Private Sector	87.76±14.57			79.59±15.87			84.28±15.00			67.35±23.62		
	Business	82.50±18.02			77.33±22.19			82.67±14.13			58.89±22.15		
	Homemaker	75.63±28.48			73.00±18.89			81.50±19.16			65.00±26.29		
	Retired	85.94±16.44			80.00±16.33			82.50±6.45			66.67±11.79		
	Student	89.16±10.90			80.57±16.82			86.85±10.49			71.07±22.21		
	Unemployed	90.18±17.29			78.10±17.21			84.29±13.63			66.67±24.01		

Table 4: Overall KAP status of respondents.

KAP domain	Status	Frequency	%	Chi-Square	p-value
Knowledge	Poor	90	16.7	240	<0.001
	Good	450	83.3		
Awareness	Poor	162	30.0	86.4	<0.001
	Good	378	70.0		
Attitude	Poor	104	19.3	204.119	<0.001
	Good	436	80.7		
Practice	Poor	332	61.5	28.474	<0.001
	Good	208	38.5		

management and pollution. The majority of respondents demonstrated good knowledge (83.3%), good awareness (70.0%), and positive attitudes (80.7%) towards plastic waste management ($p < 0.001$). However, a significant portion of the respondents (61.5%) showed poor practice, with only 38.5% demonstrating good practices ($p < 0.001$).

3.4. The Level of KAP Associated with Socio-Demographic Variables

The Chi-square test of association was performed to study the association between different sociodemographic variables and the level of KAP, and the results are presented in Table 5. No significant association was observed between gender and respondents' knowledge ($\chi^2 = 0.738$, $p = 0.39$) or awareness ($\chi^2 = 1.222$, $p = 0.27$). However, attitude was significantly associated with gender ($\chi^2 = 7.231$, $p = 0.007$). Practice was not significantly associated with gender ($\chi^2 = 3.405$, $p = 0.065$). The male and female respondents who participated in the study demonstrated similar knowledge, awareness, and practice levels, except for attitudes. No significant association was observed between different age groups and the level of knowledge ($\chi^2 = 0.681$, $p = 0.711$), awareness ($\chi^2 = 5.374$, $p = 0.068$), attitude ($\chi^2 = 0.048$, $p = 0.976$), and practice ($\chi^2 = 1.238$, $p = 0.538$).

No significant association was observed between residential place and the level of knowledge ($\chi^2 = 0.38$, $p = 0.54$), awareness ($\chi^2 = 0.69$, $p = 0.41$), and attitude ($\chi^2 = 0.28$, $p = 0.60$). However, practice was significantly associated with residential place ($\chi^2 = 7.88$, $p = 0.005$), with a higher proportion of good practices in handling plastic waste and plastic pollution observed among rural respondents (52.4%) as compared to urban respondents (47.6%). The results show a significant association between the respondents' educational background and knowledge level ($\chi^2 = 13.89$, $p = 0.003$). However, there was no significant association with awareness level ($\chi^2 = 5.93$, $p = 0.12$), attitude ($\chi^2 = 3.767$, $p = 0.29$), or practice ($\chi^2 = 2.32$, $p = 0.51$). Higher education was significantly related to better knowledge, while awareness, attitude, and practice did not vary significantly among the participants with different educational levels. Having studied environmental science was significantly associated with knowledge ($\chi^2 = 6.02$, $p = 0.014$), indicating that individuals who had studied environmental science demonstrated significantly better knowledge levels. However, no significant association was observed between awareness ($\chi^2 = 2.43$, $p = 0.12$), attitude ($\chi^2 = 3.58$, $p = 0.06$), or practice ($\chi^2 = 1.07$, $p = 0.30$). A significant association was observed between the respondents' occupation and knowledge level ($\chi^2 = 14.627$, $p = 0.023$). However, there was no significant association with awareness ($\chi^2 = 10.86$, $p = 0.09$), attitude ($\chi^2 = 7.09$, $p = 0.31$), or practice ($\chi^2 = 3.50$, $p = 0.74$). Overall, occupation significantly influenced knowledge level, while awareness, attitude, and practice remained broadly similar across groups.

3.5. Relationship Between KAP Domain Scores of Respondents

The Pearson correlation analysis was performed to study the relationship between the KAP domain scores. The results show a positive and significant correlation among knowledge, awareness, attitude, and practice scores related to the KAP domain (Table 6). The knowledge of respondents was positively correlated with awareness ($r = 0.424$, $p < 0.001$), attitude ($r = 0.413$, $p < 0.001$), and practice ($r = 0.266$, $p < 0.001$). This indicates that higher knowledge scores are significantly associated with increased awareness, positive attitudes, and improved practices on plastic waste management and pollution. Awareness was also significantly and positively related to both attitude ($r = 0.397$, $p < 0.001$) and practice ($r = 0.333$, $p < 0.001$). Additionally, attitude demonstrated a positive and significant correlation with practice ($r = 0.422$, $p < 0.001$). These results suggest that enhancing knowledge may increase awareness, attitudes, and practices related to plastic waste management and pollution.

Multiple linear regression analysis was conducted to determine whether knowledge and awareness influence the attitudes and practices of respondents toward plastic

Table 5: Association of sociodemographic variables with KAP status.

Sociodemographic Variables	Levels	Knowledge				Awareness				Attitude				Practice			
		Poor	Good	χ^2 Value	p-value	Poor	Good	χ^2 Value	p-value	Poor	Good	χ^2 Value	p-value	Poor	Good	χ^2 Value	p-value
Gender	Male	49 (54.4)	267 (59.3)	0.738	0.390	89 (54.9)	227 (60.1)	1.222	0.269	73 (70.2)	243 (55.7)	7.231	0.007	184 (55.4)	132 (63.5)	3.405	0.065
	Female	41 (45.6)	183 (40.7)			73 (45.1)	151 (39.9)			31 (29.8)	193 (44.3)			148 (44.6)	76 (36.5)		
Age	18-30	71 (78.9)	337(74.9)	0.681	0.711	133 (82.1)	275 (72.8)	5.374	0.068	78 (75.0)	330 (75.7)	0.048	0.976	249 (75.0)	159 (76.4)	1.238	0.538
	31-50	16 (17.8)	97 (21.6)			25 (15.4)	88 (23.3)			22 (21.2)	91 (20.9)			69 (20.8)	44 (21.2)		
	> 50	3 (3.3)	16 (3.6)			4 (2.5)	15 (4.0)			4 (3.8)	15 (3.4)			14 (4.2)	5 (2.4)		
Residential place	Rural	43 (47.8)	199 (44.2)	0.383	0.536	77 (47.5)	165 (43.7)	0.690	0.406	49 (47.1)	193 (44.3)	0.276	0.600	133 (40.1)	109 (52.4)	7.879	0.005
	Urban	47 (52.2)	251 (55.8)			85 (52.5)	213 (56.3)			55 (52.9)	243 (55.7)			199 (59.9)	99 (47.6)		
Education	No formal School Education	1 (1.1)	3 (0.7)	13.893	0.003	1 (0.6)	3 (0.8)	5.926	0.115	1 (1.0)	3 (0.7)	3.768	0.288	1 (0.3)	3 (1.4)	2.320	0.509
	Upto secondary	7 (7.8)	23 (5.1)			10 (6.2)	20 (5.3)			8 (7.7)	22 (5.0)			18 (5.4)	12 (5.8)		
	UG	42 (46.7)	130 (28.9)			63 (38.9)	109 (28.8)			39 (37.5)	133 (30.5)			107 (32.2)	65 (31.3)		
	PG	40 (44.4)	294 (65.3)			88 (54.3)	246 (65.1)			56 (53.8)	278 (63.8)			206 (62.0)	128 (61.5)		
Have you ever studied Environmental Science subject?	No	12 (13.3)	27 (6.0)	6.019	0.014	16 (9.9)	23 (6.1)	2.433	0.119	12 (11.5)	27 (6.2)	3.581	0.058	27 (8.1)	12 (5.8)	1.066	0.302
	Yes	78 (86.7)	423 (94.0)			146 (90.1)	355 (93.9)			92 (88.5)	409 (93.8)			305 (91.9)	196 (94.2)		
Occupation	Govt Sector	7 (7.8)	70 (15.6)	14.626	0.023	15 (9.3)	62 (16.4)	10.856	0.093	14 (13.5)	63 (14.4)	7.086	0.313	46 (13.9)	31 (14.9)	3.503	0.744
	Private Sector	20 (22.2)	77 (17.1)			35 (21.6)	62 (16.4)			22 (21.2)	75 (17.2)			62 (18.7)	35 (16.8)		
	Business	4 (4.4)	11 (2.4)			3 (1.9)	12 (3.2)			5 (4.8)	10 (2.3)			12 (3.6)	3 (1.4)		
	Homemaker	4 (4.4)	6 (1.3)			6 (3.7)	4 (1.1)			4 (3.8)	6 (1.4)			7 (2.1)	3 (1.4)		
	Retired	2 (2.2)	2 (0.4)			1 (0.6)	3 (0.8)			1 (1.0)	3 (0.7)			3 (0.9)	1 (0.5)		
	Student	52 (57.8)	264 (58.7)			96 (59.3)	220 (58.2)			53 (51.0)	263 (60.3)			189 (56.9)	127 (61.1)		
	Unemployed	1 (1.1)	20 (4.4)			6 (3.7)	15 (4.0)			5 (4.8)	16 (3.7)			13 (3.9)	8 (3.8)		

Table 6: Relationship between KAP domain scores.

KAP Domain	Correlation	Awareness Score %	Attitude Score %	Practice Score %
Knowledge	Pearson Correlation	.424**	.413**	.266**
	p-value	<0.001	<0.001	<0.001
Awareness	Pearson Correlation		.397**	.333**
	p-value		<0.001	<0.001
Attitude	Pearson Correlation			.422**
	p-value			<0.001

**. Correlation is significant at the 0.01 level (2-tailed).

Table 7: Multiple linear relationship of knowledge and awareness with attitude and practice domains.

Dependent variable	Intercept & Independent variable	B	Model F-Value	Model p-value	R^2	Beta	t-Value	p-value	Tolerance	VIF
Attitude	Intercept	45.537	80.540	<0.001	0.231		13.718	<0.001		
	Knowledge	0.280				0.299	7.160	<0.001	0.821	1.219
	Awareness	0.196				0.270	6.459	<0.001	0.821	1.219
Practice	Intercept	16.388	40.087	<0.001	0.130		2.462	0.014		
	Knowledge	0.269				0.152	3.425	0.001	0.821	1.219
	Awareness	0.367				0.269	6.043	<0.001	0.821	1.219

pollution and plastic waste management (Table 7). The regression model was statistically significant, F =80.540, $p < .001$, explaining 23.1% of the variance ($R^2 = .231$) in attitude. Both knowledge ($\beta = .299$, $p < .001$) and awareness ($\beta = .270$, $p < .001$) were significant positive predictors of attitude. Multicollinearity diagnostics indicated no significant collinearity among predictors, with tolerance values of 0.821 and VIF values of 1.219 for both knowledge and awareness scores, suggesting that the independent variables were not highly correlated. For predicting practice, the regression model was also significant, F = 40.087, $p < .001$, , explaining 13.0% of the variance in respondents' practice ($R^2 = .130$). Knowledge ($\beta = .152$, $p = .001$) and awareness ($\beta = .269$, $p < .001$) both significantly predicted practice scores. No multicollinearity was detected (VIF = 1.219). These findings suggest that increasing knowledge and awareness may positively influence respondents' attitudes and practices regarding plastic waste management.

4. DISCUSSION

Most respondents showed a high level of awareness about plastic pollution and its impacts on the environment and human health, but there is a significant gap in translating this awareness into sustainable practice. The level of knowledge about plastic pollution varied, with many misconceptions about plastic degradation and recycling. The attitude of respondents towards plastic reduction was largely positive, but when it comes to changing their behaviour to avoid single-use plastic or participating in recycling programmes, they become inconsistent. A similar finding was reported by Dowarah et al. (2022), indicating that awareness alone is not sufficient to bring changes in public behaviour for environmental conservation. Studies from other regions also align with the current study, showing that despite a high level of awareness and education, practical implications towards replacement or recycling of plastic products are low due to convenience, lack of alternatives to plastic materials, and lack of strict policy enforcement (Arulnayagam 2020, Coco Chin et al. 2023, Tang 2023).

Respondents in this study reported a lack of infrastructure and management for plastic waste collection, recycling, and the use of alternative sources. The study highlighted the need for targeted actions or interventions that bridge the gap between awareness and practice. Environmental education and campaigns should focus on awareness and facilitating behaviour change through incentives and community engagement. Furthermore, collaboration among governments, NGOs, businesses, and the private sector can provide better solutions or alternatives to plastic products, making it easier for people to adopt pro-environmental behaviour. The key barriers to behaviour change identified in this study are economic factors, convenience, and limited access to alternative options. Apart from that, many shopkeepers and grocery stores provide plastic bags free of cost to their customers. Applications of single-use plastic are widespread, and the usage of plastic products has become a

regular part of our day-to-day life. These habits may be one of the reasons that hinder people from changing their regular behaviour and practices. Also, due to this habit, the plastic bag is the most used single-use plastic by the respondents, followed by plastic bottles. People mainly use plastic bottles for drinking water, especially when they are outside their houses. This could be related to the affordability of water bottles and concerns about the quality of alternative water sources. Overcoming these challenges requires a multifaceted approach. The analysis of age-wise differences in knowledge, awareness, attitude, and practice toward plastic pollution revealed no statistically significant differences across age groups for all KAP domains. However, interesting trends were observed in the mean scores that offer valuable insights. Individuals in the 31–50 age group demonstrated the highest mean knowledge score (89.49%), followed closely by the 18 –30 years age group. This trend could reflect increased exposure to environmental issues through educational curricula, digital media, or workplace policies among younger and middle-aged adults. Interestingly, individuals above 50 years, despite their life experience, showed slightly lower scores across all KAP domains, particularly in practice (63.60%), which may be due to generational habits or reduced access to recent environmental awareness campaigns. Attitude scores were relatively high across all age groups, but the efforts should focus on encouraging real behavior change. Awareness campaigns should not only provide information but also work on shaping people's attitudes through community involvement and social influence. Correlation analysis among knowledge, awareness, attitude, and practice shows a significant and positive association. Especially, attitude was strongly correlated with practice. These findings are compatible with the theory of planned behaviour. The TPB also proposes that behaviour is primarily influenced by attitudes. Knowledge and awareness appear as precursors that shape attitudes and may influence behaviour. However, the present study does not incorporate the key concepts of TPB, which are subjective norms and perceived behavioral control. Therefore, this study partially follows the theory rather than a full theoretical application. The limitations of this study are that it relies on an online survey in which 58.5% of respondents are students. This may introduce sampling bias and limit representativeness due to the availability of the internet and mobile devices. Second, this study does not include a regional comparison of KAP across different parts of India. Third, the scope of this study does not include interventions or simulations of existing policies to evaluate the effectiveness of existing policies. Future studies should incorporate region-based comparative analysis and intervention approaches to evaluate the impacts of existing policies of plastic waste management.

5. CONCLUSIONS

This study provides a basic understanding of people's knowledge, attitudes, awareness, and practices towards plastic pollution and its management. The results of this study can inform future policy design and targeted interventions. The respondents have good knowledge, awareness, and attitudes towards plastic pollution, but lack of practice. It may be due to misconceptions, cultural barriers, or the lack of alternatives to plastic products. To change practice, the government should incorporate waste management and recycling training and educational awareness programs in private and government sector offices and educational institutions, highlight the environmental impacts of plastic pollution, and establish waste and recycling units in every city and residential area. Stringent measures should be taken to implement the regulations in the manufacturing, supply, distribution, and disposal of plastics by the manufacturing companies, retailers, and consumers. Additionally, school and college curricula should incorporate elements of plastic pollution, its ecological impacts, and possible recycling options to raise awareness among students to a larger extent.

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