

A survey and statistical analysis of the awareness, practice, attitude, and the satisfaction of the public towards household solid waste management across major cities in India

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ABSTRACT

The paper focuses on the awareness and the attitudes of the respondents across various demographic, and socioeconomic variables in the major cities of India. The data were collected using a descriptive survey questionnaire. The survey was conducted by undergraduate students under supervision to give a first-hand understanding of the subject, enabling them to put their learnings into practice and gain new research skills in the field of environment. The findings aim at simplifying the awareness of the public on solid household waste management, and in addressing the grievances related to open dumping grounds in their vicinity. The collected data were inferred using frequency, percentage, chi-square, descriptive statistical analysis and correlations tests. The study shows a significant relationship between awareness, practice, and attitudes (APA) to age, gender, occupation and the source of information to the respondents. The study aims to investigate and comprehend the factors that facilitate the knowledge and participation of the respondents. Moreover, their satisfaction level and willingness to participate in paying for their services towards waste management. The findings of the paper validate the importance of awareness through education, campaigns and media in people's awareness of waste segregation and recycling, and in leading their behaviour towards waste disposal, and willingness to participate in various solid-household waste (SHW) awareness programs.

Keywords: Awareness, Solid-household waste, Waste segregation, Pearson test, Spearman test.

1. Introduction

In the rapidly urbanized cities in developing countries, it is important to address the problem of solid-household waste management (SHWM) (Song, Wang et al. 2016). The management of solid-household waste remains to be a challenge and needs improvements. In the study conducted by the Centre for Science and Environment (CSE), in India, an urban population of 377 million people generate 62 million tonnes (mt) of solid waste annually. Only 43 mt of solid waste is collected, out of which 12 mt is treated and the rest stays in the dumping sites (Lahiry, 2017). With the rapid growth in the population and urbanization, this is likely to be upshot by 3.4 billion tonnes in 2050 (Singh 2020). Improper management of the waste has sent the public health and the environment of the cities to peril. In addition, open dumping and landfills are common in India. This has negatively affected the health of the residents and their surrounding environment living close to these regions. The generation of solid-household waste

depends on various factors, including population, incomes, and changing consumption patterns (Singh 2020), which is reflected in the awareness, attitude and willingness of the people in segregating the waste at the source and recycling it. Segregation of the waste at the source and ensuring that it goes through different streams of recycling, recovering and reprocessing, is the key to efficient solid waste management (Lahiry, 2017).

Several works of literature have reported people's attitudes, awareness and practice toward waste management through surveys. Sarbassov et al., 2019, have surveyed household-solid waste and investigated the behavioural attitudes of the citizens of Nur-Sultan city of Kazakhstan towards its management. The result showed that 24 % of the respondents were involved in waste sorting (Sarbassov et al., 2019). In another survey-based study, Song et al., 2016 (Song et al., 2016) discussed and analyzed residents' attitudes and willingness to pay for solid waste recycling in Macau, China. Results showed

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that 96 % of the respondents were willing to sort the solid waste at home. The results were important in understanding the attitudes of the residents for the policymakers and managers in promoting the recycling of the waste. Yet in another study, *Warunasinghe et al., 2016 (Warunasinghe and Yapa 2016)* examined the willingness of the people's participation in the upgraded program and the level of awareness of household solid waste management in peri-urban areas in Colombo, Sri Lanka. The survey showed that 26% of the respondents were not aware of the recycling practices, while 96 % agreed to cooperate by participating in the waste awareness programs. Similarly, *Indira et al., 2015 (Indhira, Senthil et al. 2015)* study the attitude and awareness of the people in understanding the behavioural pattern of the people toward household solid waste management (*Madrigal and Oracion 2017*).

The present study dissects the findings similar to the previously reported literature on the relevance, importance and impacts of people's awareness, practice, and attitude in the selected cities in India in response to the demographic variables age, sex, education and occupation. The cities were selected randomly from where the students belonged namely Delhi, Kolkata, Ghaziabad, Noida, Bhopal, Indore, and Patna. The study aims at giving first-hand experience to the students in conducting surveys by collecting data on environmental awareness. Second, it aims at simplifying an understanding of the demographic impacts on the attitudes, and practice. It explains the public awareness and willingness toward waste management. It also offers understanding and recommendations that will help the policymakers and managers in improvising the sorting, segregation and recycling of the solid-household waste management (*Madrigal and Oracion 2017*).

2. Methodology

Two hundred eighty-eight (288) respondents from major cities across India participated in the survey. The sampling method was 'random'. Based on the previously reported surveys (*Asuamah, Kumi et al. 2012, Babaei, Alavi et al. 2015*) and research papers, the questionnaires were prepared by the undergraduate students under supervision. The questionnaire contained 48 variables, which are divided into 13 sections (questionnaire attached). It contained questions about their knowledge, practice and attitude towards waste management. These questions were broadly categorized into demographic information which included age, gender, occupation and source of information, and the second part included information on SHW separation, recycling, and collection, of solid waste (Tables 1 and 2). The data were assessed and analyzed using descriptive statistics, frequency and percentage, correlation, and non-parametric statistical tests. The survey data were coded and

transferred into SPSS (IBM SPSS data analyzer) and were analyzed. The sample size was collected at a 95 % confidence level. The mean (M), standard deviation (SD), frequency and percentage were used to analyse the degree and extent of the 1) awareness, 2) practice and 3) attitude (APA) in the respondents based on their i) age, ii) gender, iii) occupation, and iv) source of information. The Chi-square value (χ^2) test was used to compare the categorical variables. Moreover, Karl Pearson correlation (r) and Spearman correlation coefficient (ρ) were used to evaluating the strength of the linear relationship between continuous variables and the relationship between the variables taken on the ordinal scales, respectively. However, the existence of a correlation value between two variables may not explain the causation between them. Thus, the correlation coefficient measured the strength of the relationship between two variables, which may/may not have a cause-effect. While comparing most of the variables it was not clear whether their scatter plot was linear or monotonic. Hence, to validate the relationship between two variables both Pearson and Spearman tests were conducted.

3. Results and Discussions

In the current study, age has been taken as an independent factor in analysing the APA of the respondents. The demographic distribution of the age, gender, occupation, and source of the information is given in table 1 and figure 1. The survey contained 105 (~36 %) males and 184 (64%) females in 289 respondents. The respondents were divided into different age groups, and occupations (Table 1, Figure 1). ~60% of the respondents are students/researchers (~71%) belonging to the age group of 19-28 yrs, which is followed by 58% of respondents as job holders (~20%) in the same age group (Figure 2). 97% of the respondents were homemakers (~8 %), followed by ~47% as job holders the age >28 yrs. Moreover, in the age group of 13-18 yrs, all the respondents were students (~36%) (Figure 2). The source of information on waste management for ~50% of respondents comes from the educational institute, ~30% from the media (traditional, social, mass media), ~9% from drives, campaigns, and awareness programs, and the remaining ~4% have obtained information from other sources which include NGOs, friends, peers etc. (Table 1, Figure 1).

Table 4 shows the variation in correlation coefficients, and chi-square values in the respondent's answers to awareness, practice and attitude (APA) based on their demographic characteristics i.e. age, gender, occupation and source of information. ~72% and ~70% of the respondents indicated their practice and awareness of using separate bins, and recycling and reusing waste, respectively. It is noteworthy that women have been more effective as compared to men in the separation, recycling and reusing (women, ~61%; men, 49%; $\chi^2=1.267$), as well

Table 1: Frequency and percentage of the characteristic variables of the respondents

Demographic characteristics		Frequency	Per cent	Total
i. Gender	Male	105	36.3	289 (100%)
	Female	184	63.7	
ii. Age	13-18	63	21.8	288 (99.7%)
	19-28	172	59.5	
	>28	53	18.3	
iii. Occupation	Student/Researcher	205	70.9	289 (100%)
	Job	59	20.4	
	Home-maker	23	8.0	
iv. Source of Information	Educational Institute (School/College/Research)	145	50.2	265 (91.7%)
	Drives and Campaigns	26	9.0	
	Media (Social, Traditional, Mass Media)	83	28.7	
	Others	11	3.8	

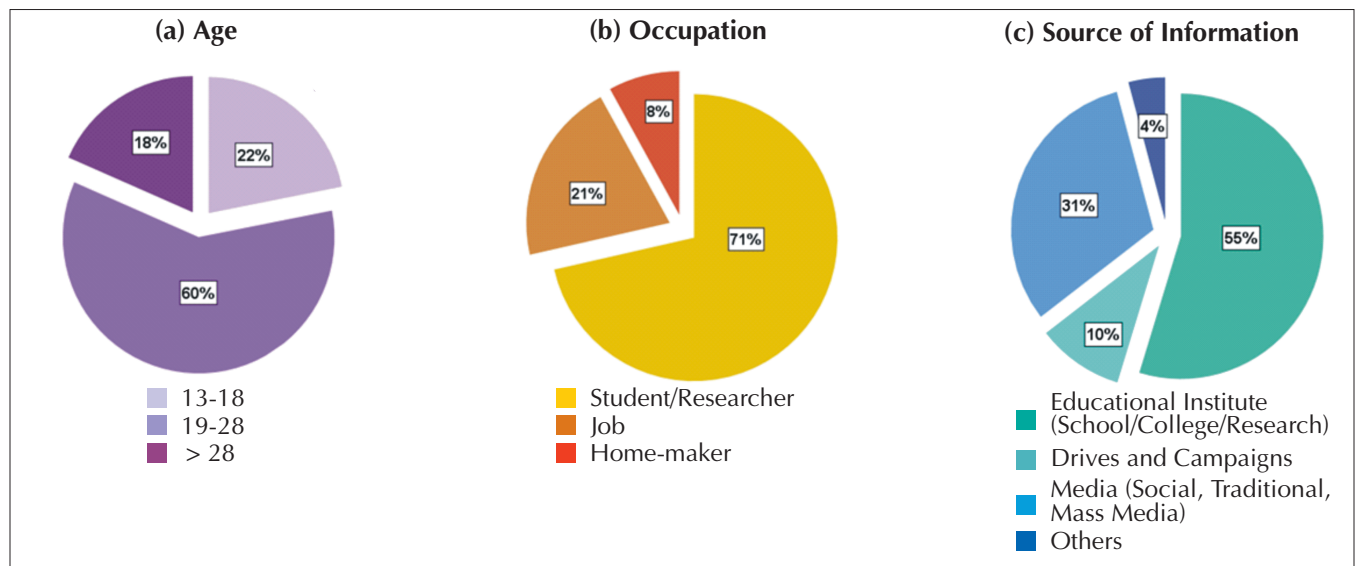


Figure 1: Pie-chart percentage distribution of the respondents in the following demographic variables: a) age, b) Occupation and c) Source of Information

as their willingness (women, ~59%; men, 52%, $\chi^2=4.535$) in participating in SHW management programs (Figure 4). Moreover, the r (recycle-reuse: 0.052, $p<0.044$; willingness: 0.199, $p<0.025$) and ρ correlation coefficient (recycle-reuse: 0.124, $p<0.035$; willingness: 0.052, $p<0.022$) values show the existence of the relationship between these two variables (Table 4). This observation is consistent with the previously reported works (Nixon and

Saphores 2009, Babaei, Alavi et al. 2015). This is reasonable as the women take responsibility for the domestic household. Thus, educating women can be suggested as the potential area for enhancing their awareness and practice on recycling, reduction and managing SHW. In terms of giving away the waste, men gave it to the municipal corporation disposals (MCD) (men, ~64%; women, 46%) and women preferred giving it

Table 2: Structure of the Questions

Components	Questions	Question Nos.
Awareness	Types of waste generated	Q ₅
	Do you recycle and reuse	Q ₁₀
	Are you aware of any open landfill/dumping site in / close to the vicinity	Q ₁₁
Practise	Do you have a separate bin for the dry- and wet-waste	Q ₆
	The type of container used for collecting waste	Q ₇
	How often do you empty your bins	Q ₈
	Where do you dump your waste	Q ₉
Attitude	Problems faced by open dumping sites	Q ₁₂
	Satisfaction level with the MCD services	Q ₁₃
	Willingness to participate in the awareness campaigning	Q ₁₄

away to the dedicated waste collectors (women, 39%; men, 20%).

This affirms the pivotal role of educational institutes in environmental education and sustainability. Thus, through

Table 3: Descriptive statistical values for the variables
a) frequency (N), b) mean (M) and c) standard deviation (SD)

Variables	a) N	b) M	c) SD
Age	288	1.9653	.63480
Gender	289	1.6367	.48179
Occupation	287	1.3659	.62742
Source of information	265	1.8491	1.00371
Q ₅	287	2.9582	2.13160
Q ₆	289	1.2941	.48591
Q ₇	289	2.1107	.63590
Q ₈	289	1.5017	.92092
Q ₉	289	1.6713	.82868
Q ₁₀	289	1.5329	.67169
Q ₁₁	289	1.6920	.64976
Q ₁₂	143	2.6573	1.23394
Q ₁₃	276	1.4312	.59602
Q ₁₄	289	1.7024	.95817
Valid N (listwise)	132		

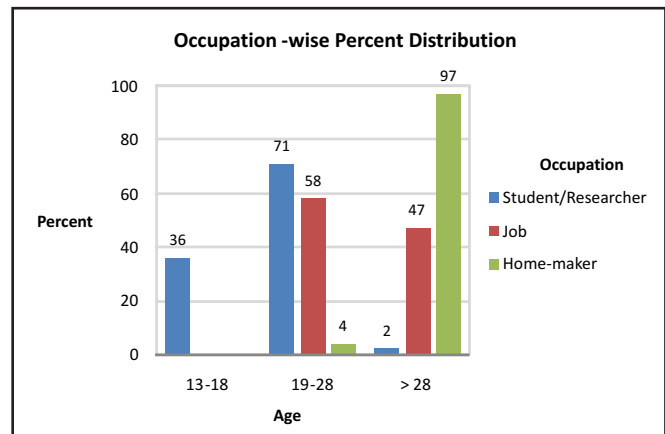


Figure 2: Bar-graph showing occupation-wise per cent distribution of the different age groups of the respondents.

non-academic courses, academic institutes can raise awareness in the students, teaching, and non-teaching staff. Moreover, they can transcend boundaries from college learning to creating public awareness and citizens' encouragement and help them mitigate the problem of household waste management. The drives, campaigns, and waste management programs are the potential areas that can raise awareness of people's attitudes and willingness in managing their waste.

In the current study, occupation also showed imperative prediction on the knowledge and attitude towards SHW. Amongst occupations, students were more aware (64%) than jobholders (~39%) and homemakers (~39%). Moreover, students (~75%) showed a significant percentage towards practising source separation as compared to jobholders (~65%) and home-makers (~61%) (Table 4, Figure 5). This again validates the

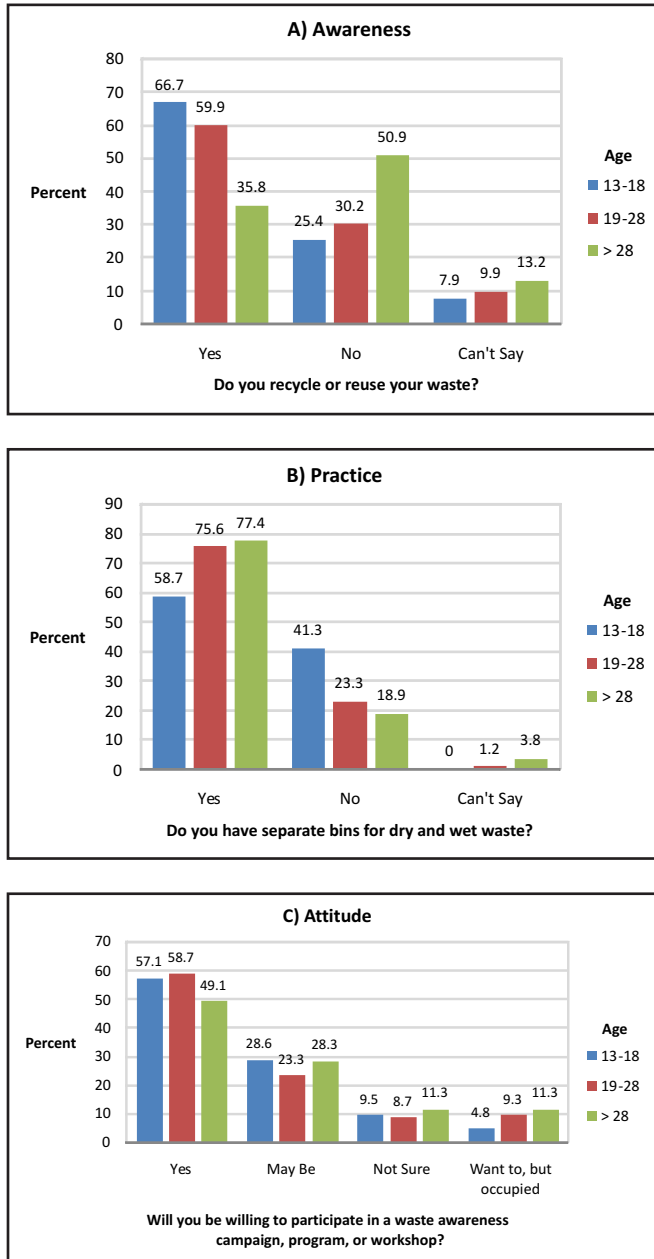


Figure 3: Percent relationship of **age** of respondents in A) awareness, B) practice and C) attitude towards solid-household waste management

importance and efficiency of the role of educational institutes in creating awareness and motivating respondents towards solid waste management.

Several studies have been conducted to find the impact of demographic characteristics on APA. While conducting investigations, most of the demographic variables found a poor correlation to APA. However, some of the variables that reported a high correlation coefficient do not necessarily mean that a meaningful conclusion or cause-effect can be drawn. For instance, sources of information derived from educational institutes provided a significant

correlation ($r, 0.172, p < 0.005$) and set of the cluster ($\chi^2, 17.687$) towards practising the frequency of emptying the dustbins (Table 4). However, the exact impact of education here remains unclear. Also, sources of information derived from an educational institute with a poor correlation coefficient ($r, 0.061, p < 0.322$) on the contrary reported a significant percentage (~64%) (Figure 6) of respondents towards practising source separation (using separate bins). This can be attributed to the education enabling the development of the knowledge that enhances the responsibility towards SHW management. However, the

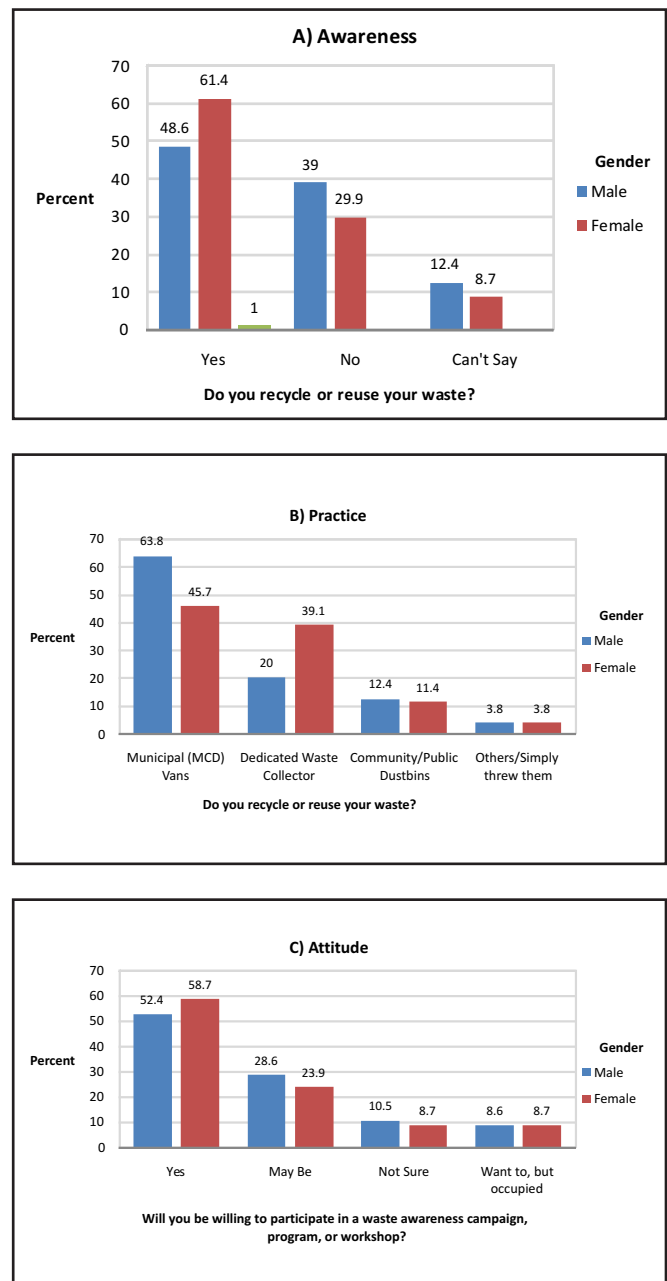


Figure 4: Percent relationship of the **gender** of respondents in, A) awareness, B) practice, and C) attitude towards solid-household waste management

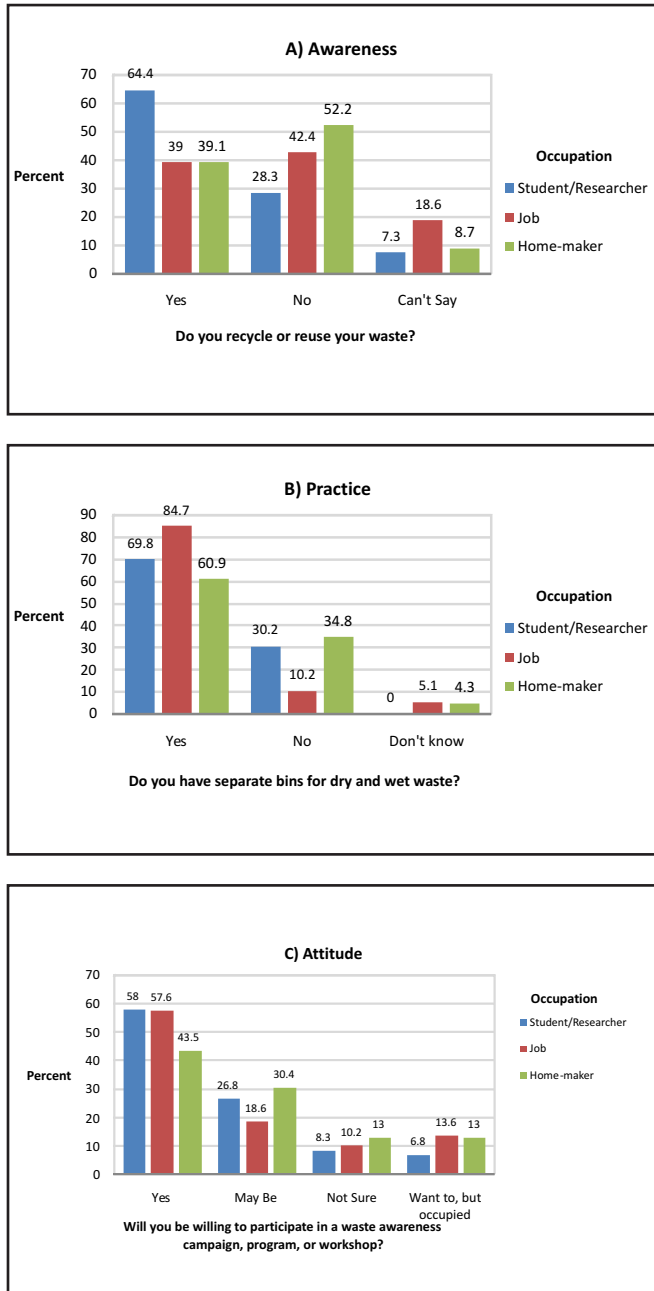


Figure 5: Per cent relationship of the **occupation** of respondents in A) awareness, B) practice, and C) attitude towards solid-household waste management

source of information had little or no impact on the significance of the respondents to their willingness in participating in awareness programs on SHW.

On the percentage satisfaction levels of the respondents towards MCD (Municipal Corporation Development) services, the majority of respondents (~62%) showed that they were satisfied.

4. Conclusion

The survey has successfully assessed the respondent's awareness in terms of knowledge and information,

practice in terms of the extent of sorting, segregation and recycling waste at source, and attitude in terms of extent and degree of willingness to properly dispose of and to take part in the recycling programmes. Respondent's knowledge and attitude toward solid-household waste management are positive and good. The studies also validate the importance of education and the source of information in dissipating the awareness and information on waste management. Moreover, the role of women and students is apparent in solid-household waste management and shows a positive impact on the

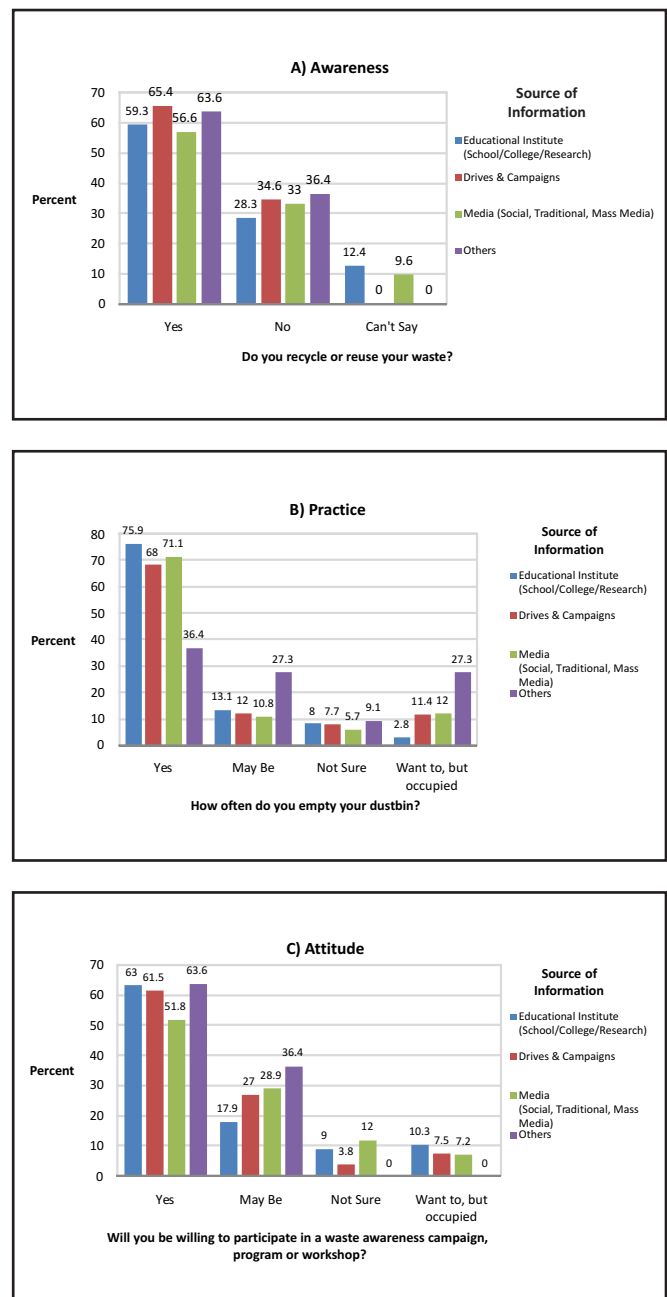


Figure 6: Per cent relationship of the **source of information** of respondents in A) awareness, B) practice, and C) attitude towards solid-household waste management

Table 4: Correlation and variation in the respondent's answers to awareness, practice and attitude based on their age, gender, occupation and source of information

Question	Demographic Characteristics	Groups	Variables (%)				Chi-square value χ^2	Pearson Correlation coefficient r	Significance (2 tailed) p-value	Spearman Correlation coefficient ρ	Significance (2 tailed) p-value
Awareness											
			Yes (%)	No (%)	Can't say (%)						
Do you recycle and, or reuse?	Age	13-18	67	25	8		12.934	0.166	0.005	0.18	0.002
		19-28	60	30	10						
		>28	35	51	13						
	Gender	Male	49	39	12		4.535	0.199	0.044	0.124	0.035
		Female	61	30	9						
	Occupation	Student/Researcher	64	28	7		18.141	0.198	<0.001	0.230	<0.001
		Job	39	42	19						
		Homemaker	39	52	9						
	Source of Info.	Educational institute	59	28	12		5.691	-	-	-	-
		Drives/Campaigns	65	35	0						
Media		57	34.5	10							
Others (friends, peers, NGOs.)		64	36.4	0							
Practice											
			Yes (%)	No (%)	Don't know (%)						
Do you have separate bins?	Age	13-18	67	25	8		12.221	-	-	0.129	0.028
		19-28	60	30	10						
		> 28	36	51	13						
			MCD (%)	Dedicated waste collector (%)	Communi- nity bins (%)	Just throw them away (%)					
Where do you dump your waste?	Gender	Male	64	20	12	4	11.874	-	-	-	-
		Female	46	39	11	4					
			Yes (%)	No (%)	Don't know (%)						
Do you have separate bins?	Occupation	Student/Researcher	70	30	0		19.554	-	-	-	-
		Job	65	10	5						
		Homemaker	61	35	4						
			Daily (%)	Alternately (%)	Random (%)	Never (%)					
How often do you empty your dustbins?	Source of Info.	Educational institute	76	13	10	3	17.687	0.172	0.005	0.134	0.030
		Drives/Campaigns	69	12	8	12					
		Media	71	11	7	12					
		Others (friends, peers, NGOs.)	36	27	9	27					
Attitude											
			Yes (%)	No (%)	Maybe (%)	Want to but busy (%)					
Willingness to participate in the awareness program on solid-household waste management.	Age	13-18	57	9	29	5	3.321	-	-	-	-
		19-28	59	9	23	9					
		>28	49	11	28	11					
	Gender	Male	52	10.5	29	9	1.267	-0.052	0.025	-0.056	0.022
		Female	59	9	24	9					
	Occupation	Student/Researcher	58	8	27	7	5.772	-	-	-	-
		Job	58	13	19	14					
		Homemaker	43.5	13	30	13					
	Source of Info.	Educational institute	62	18	9	10	9.289	-	-	-	-
		Drives/Campaigns	61.5	28	4	10					
Media		52	29	12	7						
Others (friends, peers, NGOs)		64	36	0	0						

opportunity score. Thus, empowering activities that utilize access to education, dedicated awareness drives and programs, convenient accessibility to waste disposal bins, and involvement of women and students in waste management training programs will help at building more sustainable household waste management activities. This will help in bringing the change for a good living environment.

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