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Community Engagement and Readiness for E-waste Initiatives: Attitudes, Barriers and Opportunities

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Abstract

Introduction: *The research "Community Engagement and Readiness for E-waste Initiatives: Attitudes, Barriers, and Opportunities" investigates the attitudes, barriers, and opportunities regarding e-waste management among community members in four divisional cities of Bangladesh.* ***Materials and Methods:*** *A cross-sectional design was employed over six months from January to June 2024, focusing on community members in Dhaka, Chittagong, Rajshahi, and Khulna. A stratified random sampling technique selected 408 participants based on their involvement with e-waste and willingness to participate. Data were collected using a semi-structured questionnaire.* ***Results:*** *Participants included 58.8% males and 41.2% females, with the majority aged between 20-30 years. Education levels varied, with 14.5% holding a Bachelor's degree, while 23.5% were classified as illiterate or with minimal education. Most participants lived in urban areas (69.4%). Mobile phones were the most commonly used devices (99.3%), followed by televisions (73.8%), refrigerators (56.9%), and laptops/computers/tablets (17.2%). Recycling was the most common e-waste disposal method (47.3%), with 63% selling old devices. Environmental concern motivated 28% to recycle, while personal values motivated 40.4%. Social media was the most common source of information regarding e-waste disposal (33.8%). The government was perceived as primarily responsible for e-waste recycling (68.4%). A lack of convenient recycling facilities was identified as the most significant barrier (13.5%) hindering participation in e-waste initiatives. Regarding information on e-waste recycling options, 57.8% agreed, with 29.2% strongly agreeing. In believing that e-waste recycling reduces environmental impact, 75.7% agreed, with 25.5% strongly agreeing. Cancer was identified as the most prevalent health concern (28.9%), followed by respiratory problems (25.7%) and skin problems (22.5%).* ***Conclusion:*** *While there is a general awareness of the importance of e-waste recycling, significant barriers such as a lack of facilities and information hinder effective participation. To improve community engagement, efforts should focus on enhancing public awareness, improving infrastructure, and incorporating schools and digital platforms into the solution.*

Keywords: *E-waste, community engagement and readiness, attitudes, barriers and opportunities.*

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Introduction:

The 21st century has seen a rapid proliferation of electronic devices, from smartphones and laptops to household appliances and industrial equipment, electronic devices have become integral to modern life, leading to substantial environmental challenges, especially regarding the management of electronic waste (e-waste). E-waste refers to discarded electrical and electronic equipment, and it has become one of the fastest-growing waste streams globally, posing serious

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environmental and health risks[1,3,24-26]. During the 1970s and 1980s, hazardous e- waste that was transferred from industrialized to developing countries seriously contaminated the environment[29]. In 2019 alone, the world generated 53.6 million metric tons of e-waste, presenting complex environmental, health, and socio-economic issues[1-4]. Managing e-waste effectively is a complex challenge that extends beyond the capabilities of technological solutions alone. It necessitates a multifaceted approach that includes policy frameworks, technological advancements, and, critically, community engagement because communities play a vital role in the success of e-waste management initiatives, as their participation and cooperation are essential for the proper collection, segregation, and recycling of e-waste[27,28]. Despite the critical importance of community involvement, there remains a significant gap in understanding the factors that influence community engagement and readiness for e-waste initiatives[5-8]. Attitudinal factors play a significant role in shaping behaviors towards e-waste. Positive attitudes towards recycling and proper disposal can drive community participation, while negative perceptions or lack of awareness can impede efforts[11-13]. Barriers to community engagement in e-waste initiatives can be diverse and multifaceted. They may include lack of awareness, inadequate infrastructure, financial constraints, and socio-cultural factors. Understanding these barriers is crucial for designing targeted interventions that can overcome obstacles and promote active participation[14-18]. Conversely, opportunities for enhancing community engagement in e-waste management are abundant and varied. These opportunities can arise from educational campaigns, community-based recycling programs, policy incentives, and the integration of local knowledge and practices[19-23]. This research investigates community engagement and readiness for e-waste management initiatives in four major divisional cities of Bangladesh: Dhaka, Chittagong, Rajshahi, and Khulna. The study aims to assess attitudes, identify barriers, and explore opportunities for better community participation in e-waste management. Understanding the community's role is critical for fostering a sense of ownership and responsibility in e-waste initiatives[9-10].

Materials and Methods:

This study employed a cross-sectional design to investigate the attitudes, awareness, and behaviors of community members regarding e-waste management in four divisions of Bangladesh, Dhaka, Chittagong, Rajshahi, and Khulna. These cities were selected to ensure a representative sample of the community, encompassing diverse demographic and socio-economic backgrounds. The study was conducted over a period of six months, commencing from January 2024 to June 2024. The study included community members, both male and female, who were users and handlers of e-waste, aged 18 years and above, and willing to participate by providing informed written consent. Severely ill individuals were excluded from the study to avoid any bias in the data collection process. In a similar study, awareness about the meaning of e-waste revealed that the majority (60%) of respondents were familiar with the term “e-waste” Utilizing this reported prevalence as a baseline, with a 95% level of significance and a 5% degree of error. The estimated sample size for this study was 369 participants. To allow for potential non-responses, the sample size was increased by 10%, bringing it to 406 participants. Ultimately, interviews were conducted with 408 participants. stratified random sampling technique was used to select the divisional cities, ensuring that each city had a representative sample of the population. Within these cities, eligible study participants were selected purposively. A semi-structured questionnaire was developed and data were collected by Face-to-face interviews. Informed written consent was obtained from all participants prior to their inclusion in the study. Collected data underwent simultaneous checking, editing, coding, and recoding to ensure accuracy and reliability. IBM SPSS version 27 was used for data analysis, aligned with the study's aims and objectives. Descriptive statistics were used to summarize the data, and inferential statistics were employed to identify significant associations between variables.

Results:

The participants consisted of both male (58.8%) and female (41.2%) community members who were involved in the handling of e-waste and aged 18 years and above, with a majority falling within the 20-30 age range (33.1%). The majority of participants had attained a basic education level, with 23.50% being classified as Illiterate/Signature only, followed by 14.20% at the Primary level and 14.50% at the Secondary level. Furthermore, 11.30% held an SSC (Secondary School Certificate), while 11.00% possessed an HSC (Higher Secondary Certificate). Additionally, 14.50% of participants held a Bachelor's degree, and 11.00% had completed a Master's degree or higher. Regarding household type, 29.4% lived in Pucca houses, 21.8% in Semi Pucca houses, 36.3% in Tin Shade houses, and 12.5% in Apartments. In terms of residential area, 69.4% resided in urban areas, with 30.6% living in semi-urban areas. Employment status varied, with 34.6% being employed, 2.7% unemployed, 5.4% students, 1.5% retired, 25.0% housewives, 18.6% involved in business, and 12.3% categorized as 'Others'. Mobile phones were the most commonly used device, with 99.30% of participants reporting usage. Televisions followed, with 73.80% of participants using them. Refrigerators were used by 56.90% of participants, while Laptops/Computers/Tablets were used by 17.20%. Additionally, 77.00% of participants reported using other devices.

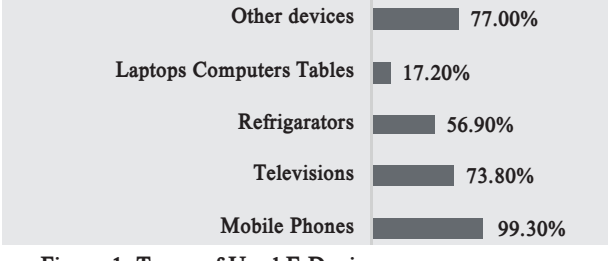


Figure 1: Types of Used E-Devices

Recycling was the most common method, with 47.30% of participants opting for this approach. Throwing in the trash was reported by 15.70% of participants, while Donating was chosen by 7.40%. Selling old e-devices was the most prevalent method, with 63.00% of participants opting to sell their devices.

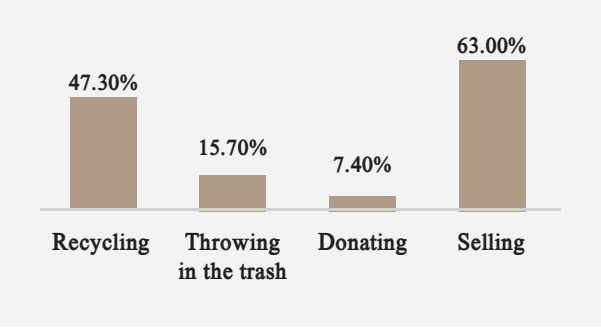


Figure 2: Ways of Disposal of Old E-Devices

Environmental concern was cited by 28.00% of participants, while Personal Values motivated 40.40% of participants to recycle e-waste. Convenience of Recycling Facilities was reported by 38.20% of participants as a motivating factor. Incentives/Rewards played a minor role, motivating only 1.90% of participants, while Government Regulations influenced 6.10% of participants to recycle e-waste. Participants reported various sources of relevant information regarding e-waste disposal, with social media being the most common source, cited by 33.80% of participants. The Internet was also a significant source, with 25.70% of participants reporting it as a source of information. Newspaper and Television were mentioned by 24.00% of participants, while other sources were cited by 15.00%. Additionally, 15.00% of participants reported never having heard about e-waste disposal from any source. Participants identified various entities responsible for e-waste recycling, with the Government being cited by the majority, with 68.40% of participants considering them responsible. Manufacturers were also seen as responsible by 28.40% of participants, while Consumers were mentioned by 26.00%. Additionally, 16.70% of participants cited Others as being responsible for e-waste recycling.

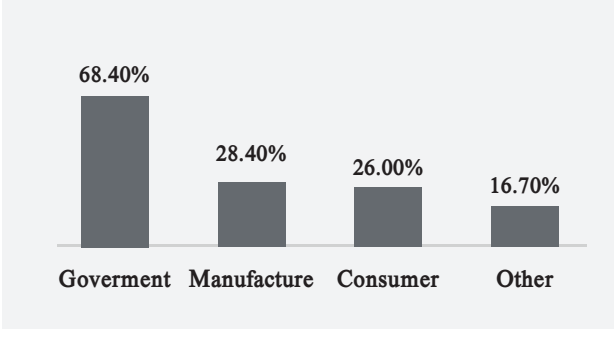


Figure 3: Who is Responsible for E-waste Recycling

Concern about the environmental impact varied among participants, with 44.6% reporting being slightly concerned, followed by 34.8% not concerned at all, 16.4% moderately concerned, and 4.2% extremely concerned. The majority (55.4%) agreed that it is important to dispose of e-waste properly to protect the environment, with 21.8% strongly agreeing. Regarding appropriate e-waste recycling methods, 75.0% of participants considered formal recycling to be appropriate, while 14.7% preferred informal recycling and 10.3% indicated both methods. Confidence in the community's ability to effectively manage and recycle e-waste was divided, with 43.1% feeling neutral, 33.3% confident and 23.5% not confident. A minority (14.7%) reported difficulties finding e-waste recycling facilities in the community, while 42.2% did not encounter any difficulties, and 43.1% were unsure. Lack of convenient recycling facilities was identified as the most prevalent barrier, with 13.50% of participants reporting this issue. Other barriers included Lack of Knowledge, cited by 7.40% of participants, Cost of Disposal, reported by 4.20% of participants, and Lack of Incentives, mentioned by 1.90%. Privacy Concern was cited as a barrier by 1.30% of participants, while 0.60% reported other reasons hindering their participation in e-waste initiatives. The accessibility of e-waste recycles facilities in the community varied among participants, with 4.20% reporting them as Very Accessible and 21.30% as Somewhat Accessible. Additionally, 24.30% of participants considered the facilities to be Neither Accessible nor Inaccessible. However, 35.50% found them to be Somewhat Inaccessible, while 14.70% deemed them Very Inaccessible. In total, 408 participants provided feedback on the accessibility of e-waste recycle facilities. Regarding the lack of information about e-waste recycling options, 57.80% of participants agreed, with 29.20% strongly agreeing, while only 0.70% disagreed or strongly disagreed. In terms of the belief that e-waste recycling helps reduce environmental impact, 75.70% of participants agreed, with 25.50% strongly agreeing, and 24.00% remaining neutral. Only a small proportion, 0.20%, disagreed with this statement. Health Risks associated with e-waste was considered the most important information, cited by 38.70% of participants, followed by Proper Disposal Method, deemed important by 28.40%. Additionally, 25.70% emphasized the importance of understanding the Environmental Effects of e-waste, while 24.30% valued knowledge about the Recycling Process. Only a negligible proportion of participants, 0.20%, mentioned other aspects as important information regarding e-waste recycling. Education emerged as the primary method, with 55.90% of participants acknowledging its importance. Incorporation with Curriculum was also highlighted significantly, with 50.00% of participants recognizing its role. Organizing Drives was mentioned by 3.90% of participants as a means for schools to promote e-waste recycling, while 2.20% suggested Partnership with Facilities. A small proportion, 0.20%, mentioned other methods for schools to contribute to e-waste recycling efforts. Cancer was identified as the most prevalent health concern, with 28.90% of participants citing it. Respiratory Problems and Skin Problems were also reported, with 25.70% and 22.50% of participants

mentioning them, respectively. Additionally, Neurological Problems were highlighted by 18.10% of participants. Furthermore, 18.40% mentioned other health issues resulting from e-waste contamination.

Table I: Demographic Status of Participants

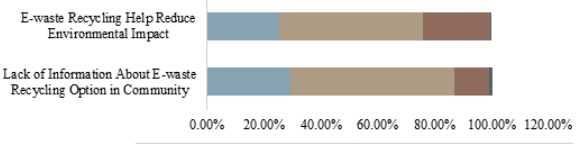
Traits	Response	N (%)
Resident Ownership	Yes	109 (26.7)
	No	299 (73.3)
Household Type	Pucca	120 (29.4)
	Semi Pucca	89 (21.8)
	Tin Shade	148 (36.3)
	Apartment	51 (12.5)
Residential Area	Urban	283 (69.4)
	Semi Urban	125 (30.6)
Employment Status	Employed	141 (34.6)
	Unemployed	11 (2.7)
	Student	22 (5.4)
	Retired	6 (1.5)
	Housewife	102 (25.0)
	Business	76 (18.6)
	Others	50 (12.3)

Table II: Community Attitudes Towards E-Waste Management and Recycling

Traits	Response	N (%)
How much concerned about environmental impact?	Not concerned at all	142 (34.8)
	Slightly Concerned	182 (44.6)
	Moderately Concerned	67 (16.4)
	Extremely Concerned	17 (4.2)
Is it important to dispose of e-waste properly to protect environment?	Strongly Agree	89 (21.8)
	Agree	226 (55.4)
	Neutral	92 (22.5)
	Disagree	1 (0.2)
What is an appropriate way of e-waste recycling?	Formal Recycling	306 (75.0)
	Informal Recycling	60 (14.7)
	Both	42 (10.3)
How much confident about community's ability to effectively manage and recycle e-waste?	Confident	136 (33.3)
	Neutral	176 (43.1)
	Not Confident	96 (23.5)
Any difficulties finding e-waste recycle facilities in community?	Yes	60 (14.7)
	No	172 (42.2)
	Not Sure	176 (43.1)

Table III: Barriers and Accessibility Towards E-Waste Management and Recycling

Traits	Response	N (%)
Barriers that hinder community participation in e-waste initiatives	Lack of convenient recycling facilities	34 (13.50)
	Lack of knowledge	18 (7.40)
	Privacy concern	10 (4.20)
	Cost of disposal	10 (4.20)
	Lack of incentives	5 (1.90)
	Others	03 (0.6)
Accessibility of e-waste recycle facility in community	Very inaccessible	36 (14.70)
	Somewhat inaccessible	87 (35.50)
	Neither accessible nor inaccessible	60 (24.30)
	Somewhat accessible	52 (21.30)
	Very accessible	10 (4.2)



	Lack of Information About E-waste Recycling Option in Community	E-waste Recycling Help Reduce Environmental Impact
Strongly Agree	29.20%	25.50%
Agree	57.80%	50.20%
Neutral	12.30%	24.00%
Disagree	0.50%	0.20%
Strogly Disagree	0.20%	0.00%

Figure 4: Lack of Information About E-waste Recycling Option in Community & E-waste Recycling Help Reduce Environmental Impact

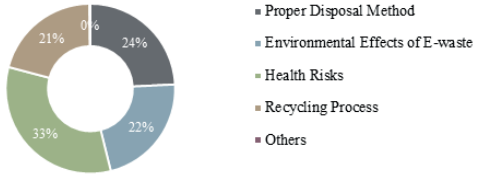


Figure 5: Important Information for Public to Know about E-waste Recycling

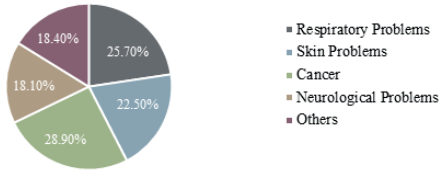


Figure 6: Health Issues Caused Following E-waste Contamination

Discussion:

Comparing the findings from the study titled "Community Engagement and Readiness for E-waste Initiatives: Attitudes, Barriers and Opportunities" with other relevant research provides a broader context and highlights both commonalities and unique insights. Several key areas for comparison include demographic influences, attitudes towards e-waste management, barriers to participation, and community engagement strategies. Similar to the findings from Bangladesh, studies conducted in other developing countries also reveal significant demographic influences on e-waste management practices. For instance, a study in India found that younger populations are more aware and engaged in e-waste management compared to older generations. This aligns with the Bangladesh study, where the majority of participants fell within the 20-30 age range, indicating a trend across similar socio-economic contexts[30,35]. Attitudes towards e-waste management vary significantly across different regions. In the Bangladesh study, while personal values and convenience were primary motivators for recycling, a study[36] in India highlighted environmental concern as a major motivator for e-waste recycling among urban populations. This suggests that cultural and contextual factors play a significant role in shaping attitudes. Additionally, a study[37] in Nigeria found that financial incentives were crucial in motivating e-waste recycling, contrasting with the Bangladesh findings where incentives were less significant (only 1.90%). The barriers to effective e-waste management identified in the Bangladesh study, such as lack of convenient recycling facilities and lack of knowledge, are echoed in various international studies. For example, a study[38] in China identified similar barriers, emphasizing the need for improved infrastructure and public education. Similarly, in a study conducted in Kenya[39], the lack of formal recycling facilities and public awareness were major obstacles. These consistent findings across different countries highlight the global nature of these challenges. The role of educational institutions in

promoting e-waste recycling, as identified in the Bangladesh study, is also supported by another research. For instance, a study[40] in Thailand emphasized the importance of integrating e-waste education into school curriculums to foster a culture of recycling from a young age. Moreover, the reliance on digital platforms for information dissemination, such as social media and the internet, is a common strategy observed globally. A study[41] in Botswana highlighted the effectiveness of digital campaigns in raising awareness and encouraging proper e-waste disposal practices. Awareness of the health implications of e-waste, such as cancer and respiratory problems, was a significant finding in the Bangladesh study. This is consistent with findings from other regions. For instance, a study[42] in Ghana also highlighted severe health risks associated with e-waste, including respiratory and dermatological problems, due to the informal recycling processes prevalent in developing countries. This underscores the universal need for public health campaigns to address the health risks of e-waste. In summary, the findings from the Bangladesh study align with those from other developing countries, highlighting common challenges such as lack of infrastructure, need for public education, and the role of cultural factors in shaping attitudes towards e-waste management. However, the emphasis on personal values and convenience as motivators in Bangladesh adds a unique perspective, suggesting that strategies to enhance community engagement must be tailored to local contexts. These comparisons underscore the importance of a multifaceted approach to e-waste management that includes improving infrastructure, enhancing public education, leveraging digital platforms, and addressing health risks associated with e-waste.

Conclusion:
This study highlights critical aspects of community engagement and readiness for e-waste initiatives in Bangladesh. While there is a general awareness and positive attitude towards recycling, significant barriers such as lack of facilities and information hinder effective participation. Addressing these barriers through targeted educational campaigns, improving infrastructure, and leveraging the role of schools and digital platforms can significantly enhance community engagement in e-waste management. The findings underscore the need for a comprehensive, multi-faceted approach to tackle the e-waste challenge, involving community participation, government support, and educational initiatives.

Conflict of Interest: None.

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