Original Research Article

Awareness and perception regarding the e-waste management among a population in northern Kerala

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ABSTRACT

Background: Electronic waste, or e-waste, refers to all items of electrical and electronic equipment (EEE) and its parts that have been discarded by its owner as waste without the intent of re-use. Improper e-waste management can lead to adverse human health effects and environmental pollution. The aim of our study was to assess the knowledge, attitude and practice regarding e-waste management and the factors affecting it.
Methods: This cross-sectional study was conducted from December 2023 to February 2024 in three block panchayats of Malappuram district in Kerala with a sample size of 266 selected using multistage sampling. Data was entered in Microsoft Office and was analysed using statistical package for the social sciences (SPSS) software. Factors affecting the outcome variables was assessed using Chi-square test or Fisher exact test depending on the sample distribution.
Results: Study results showed that 28.9% of the participants had good awareness, 27.1% had average awareness and 44% of the population had poor awareness and on e-waste management. 89.5% of population had a very good perception towards e waste management. Age, gender, type of family they come from, educational factors, occupational factors and socioeconomic class were the factors affecting e-waste management.
Conclusions: Increasing public awareness and educating stakeholders about the hazards of e-waste is crucial. Promotion of campaigns and programs to inform individuals about the proper disposal methods, recycling options, and the importance of reducing e-waste generation through responsible consumption can significantly improve the management of e-waste.

Keywords: Awareness, Perception, E-waste management, Northern Kerala

INTRODUCTION

In recent times, there has been a significant increase in the usage of electronic devices, including computers, mobile phones other communication and household gadgets.[1] Electronic waste, or e-waste, refers to all items of electrical and electronic equipment (EEE) and its parts that have been discarded by its owner as waste without the intent of re-use.[2] Most of the consumers doesn't know how to properly dispose the outdated or malfunctioned electronic devices while upgrading to newer ones.

According to a report in 2012, e-waste generation will exceed 0.7 million metric tons annually by 2015 and 2.0 million metric tons by 2025.[3] The Kerala government had adopted the e waste management rules of 2016 for proper disposal of e-wastes.[4]

Improper handling of e-waste may contribute to environmental issues such as global warming. Several sustainable development goals (SDGs), including SDG 8 (decent work and economic growth), SDG 3 (health and well-being), SDG 6 (clean water and sanitation) and SDG 14 (life below water) are closely related to e-waste management.[5] Industrialized nations dump e-waste in developing nations like India and other Asian nations.[6]

Harmful heavy metals and material such as mercury, cadmium, lead, brominated flame-retardant plastics, and polychlorinated biphenyl's (PCB) can affect the flora and fauna. Elevated levels of lead have been found in the blood of those who burnt e-waste.[7] Human exposure to toxic chemicals can cause pulmonary and cardiovascular disease, hormonal imbalance, immune system suppression, birth defects, genitourinary diseases, old age dementia and learning disabilities.[8] Women exposed to heavy metals and PCB suffer from anemia, hormonal problems, menstrual irregularities, autoimmune disorders and malignancies. The burning of e-waste in open air pits are associated with infertility.[9] Although India created a specific e-waste management policy in 2016 to ensure proper e-waste treatment, many of the citizens lack knowledge regarding the proper disposal of e- waste and the potential hazards arising from it.[10] There are only a limited number of studies conducted in this topic. The main objective of our study was to find out the percentage of knowledge, attitude and practice regarding e-waste management and to find out the factors affecting the Knowledge, attitude and practice of e-waste management in northern population in Kerala.

Nisha et al conducted a study in northern Tamil Nadu during the year 2021 showed that 76% of the study participants had good knowledge of e-waste management.[11] Okoye et al conducted a study amongst the population in South-eastern Nigeria during the year 2013 and showed that 96% of households are concerned about their environment and showed positive perception towards e-waste management and only 22% households were aware of the hazardous nature of e-waste.[12] A study conducted by Kwatra in Delhi during 2014 showed that significant proportion of middle-class population were still unaware regarding the management of e-waste.[13] A study conducted in Uganda by Nuwematsiko et al showed that (79.1%) of the consumers had positive perceptions towards e waste management.[14] A study conducted by Athira in Kerala showed that 78.96 percent are unaware about the toxicity in EEE and 41.82% of the population believes improper disposal of e-waste results in environmental hazards.[15] A study conducted by Kumar and Madhusudan among dental students in Kerala showed only 3.2% had good knowledge while 52.9% had a good attitude towards e-waste disposal and management.[16] The aim of our study was to assess the knowledge, attitude and practice regarding e-waste management and the factors affecting it.

METHODS

This community based cross-sectional study was conducted from December 2023 to February 2024 in Perinthalmanna, Mankada and Ponnani block panchayats of Malappuram district in Kerala. Study participants were the people living in these Blocks who were more than 18 years of age and using electronic devices or electronic gadgets in their home were included in the study. Participants who refused to give consent and multiple

participants from the same household were excluded from the study. Sample size was estimated using the Cochran's formula given below at 95% confidence interval.

$$n = \frac{Z^2 P(1-P)}{d^2}$$

From the previous study, 76% of the study participants had good knowledge of e-waste management. The estimated sample size in our study was 202. The Study was conducted among 266 participants. Multistage sampling method was for collecting data. Malappuram district was divided into 15 blocks. From all the blocks, 3 blocks panchayats (Perinthalmanna, Ponnani and Mankada) were selected randomly. Perinthalmanna block have 17 panchayats, where as Mankada and Ponnani blocks have 13 blocks. Among 43 panchayats 9 panchayats were selected randomly. (Angadipuram, Elamkulam and Vettathur, Mankada, Moorkkanad, Puzhakkattiri, Edappal, Tavanur and Vattamkulam panchayats). Three wards from each panchayat were chosen at random, and the voter lists from these wards were collected from the state electoral commission website and sorted alphabetically. The data obtained was used to construct the sampling frame. The study participants were selected by means of systematic random sampling with a sampling interval of 210. A semi-structured interview schedule along with a formal informed consent form in Malayalam (the local language) was used for data collection.

For assessing the awareness, a set of 10 questions were asked. 1 mark was granted to the correct responses. A score 7 and above were assigned as good awareness, scores of 5 and 6 were given average awareness and score less than 5 denotes poor awareness. A set of 10 questions were asked for assessing the perception using a 5-point Likert scale. Participants who responded with "strongly agree" earned 5 points, "agree" assigned with 4 points, 3 points for "neutral", "disagree" received 2 points, and patients who responded with "strongly disagree" received 1 point. Maximum score was 50 and minimum point of 10. A score of 35 and above was considered to have good perception, average perception assigned to scores between 20 to 34 and a score below 20 had poor perception on e-waste management. No scoring system was assigned for assessing practice. E-waste disposal habbit was explained descriptively. Data was entered in Microsoft Office and was analysed using statistical package for the social sciences (SPSS) version 21. Qualitative variables were expressed in percentage or proportion. Factors affecting the outcome variables was assessed using chi-square test or Fisher exact test depending on the sample distribution. Permission for conducting the study was obtained from MES institutional ethics and scientific committee (IEC/MES/84/2023).

RESULTS

A total of 266 people participated in the study with a response rate of 95 %. The base line data of the study

participants is given in Table 1. Among the study population, 78.9% of the participants were males. Most of the study participants were married (69.5%), 27.4 % were single and 3.1% % were divorced. Most of the families belonged to nuclear family (66.5%), followed by three generation 27.8 % and joint family. (5.6%). Most of the study participants educated up to higher secondary education. (33.8%). Most of the participants were home makers (55.3%) and belonged to middle class family. 64.3% of the study population were using electronic gadgets for more than 10 years. Most of the study participants purchased new electronic equipment once every three years or more (65.8%). Majority of the study participants (88.7%) were familiar with the 4 R's of e waste management. (re-use, recycle, reduce, recovery). 97% of the study participants were unaware of the legal regulations in their area regarding e waste management. Only 40.6% were aware of the health hazards associated with toxic substances found in e-waste, and 68% were unaware of how to manage electronic waste. 96% of people believed that e waste can't be mixed with other house hold waste. Only 4.9% of the participants had ever participated in any e-waste recycling programs.

Regarding the awareness and perception on e-waste management, 28.9% had good awareness, while 27.1% had average awareness and 44% had poor awareness and on e-waste management. Majority of the study participants (89.5%) had very good perception towards e waste management. They are willing to attend awareness workshops and even contribute financially to the appropriate management of e-waste segregation in their community.

The association between the independent variables and degrees of awareness and perception was determined using the Chi-square and Fisher exact tests, depending on the sample distribution (Table 2). P value ≤0.05 (95% confidence interval) was taken as statistically significant. Those who were less than 40 years of age had more knowledge to e-waste management when compared to those who were aged more than 40 (p=0.001). Gender, educational status of the participants, occupational status and socio-economic class were the factors found to be statistically significant with awareness on e-waste management (p≤0.05).

Table 1: Baseline characteristics of study population.

Variables	N (%)
Age group (years)	
<40	201 (75.6)
≥40	65 (24.4)
Sex	
Male	56 (21.1)
Female	210 (78.9)
Marital status	
Single	73 (27.4)
Married	185 (69.5)
Divorced	8 (3)
Type of family	
Nuclear	177 (66.5)
Three generation family	74 (27.8)
Joint family	15 (5.6)
Educational status	
No formal education	2 (0.8)
Lower primary	18 (6.8)
Upper primary	25 (9.4)
High school	45 (16.9)
Higher secondary	90 (33.8)
Graduate	69 (25.9)
Post graduate	17 (6.4)
Occupational status	
Unemployed	3 (1.1)
Home maker	148 (55.6)
Unskilled	9 (3.4)
Semi-skilled	26 (9.8)
Skilled	16 (6)
Semi professional	11 (4.1)
Professional	49 (18.4)

Variables	N (%)
Retired	4 (1.5)
Duration of electronic device use (years)	
5 to 10	54 (20.3)
Less than 5	41 (15.4)
More than 10	171 (64.3)
Frequency of buying electronic gadgets	
Less than 6 months	6 (2.3)
6 months to 11 months	31 (11.7)
1 year to 3 years	54 (20.3)
More than 3 years	175 (65.8)
Number of waste collection points nearby	
Single	78 (29.3)
Multiple	21 (7.9)
Don't know	167 (62.8)
Frequency of environment sanitation conducted by local authorities	
Weekly	5 (1.9)
Monthly	134 (50.4)
Bi annually	56 (21.1)
Yearly	71 (26.7)
E waste collection facilities nearby	
Yes	39 (14.7)
No	103 (38.7)
Don't know	124 (46.6)
Any habbit of antique electronic collection inside house	
Yes	24 (9)
No	242 (91)
Is e-waste a threat to the environment?	
Yes	77 (29)
No	157 (59)
Don't know	32 (12)
Knowledge on 4 R of waste manage	
Yes	236(88.7)
No	30 (11.3)
Awareness regarding legal regulations on e-waste disposal	
Yes	6 (2.3)
No	260 (97.7)
Awareness on health hazards from e waste	
Yes	108 (40.6)
No	158 (59.4)
Prior information about e-waste management	
Yes	84 (31.6)
No	182 (68.4)
Mixing of e-waste with household waste	
Yes	12 (4.5)
No	254 (95.5)
Ever sold or donated old/unused electronic products	
Yes	216 (81.2)
No	50 (18.8)
Mode of disposal of old/unused electronic devices exchanged with new purchase	
Donation	71 (26.7)
Sold to scrap dealers	4 (1.5)
Stored inside home	143 (53.8)
Disposed with house hold waste	45 (16.9)
Burning	2 (0.8)

Continued.

Variables	N (%)
Others	1 (0.4)
Mode of disposal of communications devices (laptops, personal computers, and mobile phones)	
Exchanged with new purchase	85 (32)
Donation	5 (1.9)
Sold to scrape dealer	68 (25.6)
Stored in home	104 (39.1)
Dumping	4 (1.5)
Mode of disposal of communications devices (television, refrigerator, air conditioners, mixer grinder, induction cookers, radio, and CFL)	
Exchanged with new purchase	133 (50)
Donation	8 (3)
Sold to scrape dealer	96 (36.1)
Stored in home	20 (7.5)
Dumping	7 (2.6)
Others	2 (0.8)
How often the electronic devices been replaced to a new one	
Every year	25 (9.4)
Every 2 to 3 year	3 (1.1)
Every 3 to 4 year	45 (16.9)
Rarely	193 (72.6)
Ever participated in e-waste recycling programmes	
Yes	13 (4.9)
No	253 (95.1)

Table 2: Association between Awareness and perception on e-waste management with different variables.

Variables	Good awareness	Average awareness	Poor awareness	P value	Good perception	Average perception	P value
Age group (years)							
<40	63	62	76	0.001	184	17	0.05
≥40	14	10	41		54	11	
Gender							
Male	24	6	26	0.003	53	3	0.15
Female	53	66	91		185	25	
Type of family							
Nuclear	59	44	74		161	16	0.34
Three generation family	13	25	36	0.13	63	11	
Joint family	5	3	7		14	1	
Educational status							
No formal education	0	0	2		1	1	
Lower primary	3	3	12		13	5	
Upper primary	2	3	20		20	5	
High school	8	13	24	0.0001	38	7	0.004
Higher secondary	32	22	36		82	8	
Graduate	29	17	23		67	2	
Post graduate	3	14	0		17	0	
Occupational status							
Home maker	0	1	2		3	0	
Home maker	34	39	75		123	25	
Unskilled	2	0	7		9	0	
Semi-skilled	14	5	7	0.003	25	1	0.03
Skilled	4	3	9		16	0	
Semi professional	4	2	5		11	0	
Professional	17	22	10		47	2	
Retired	2	0	2		4	0	

Variables	Good awareness	Average awareness	Poor awareness	P value	Good perception	Average perception	P value
Socio-economic class							
Class I	8	2	2		12	0	
Class II	18	25	24		63	4	
Class III	29	18	3	0.01	76	10	0.27
Class IV	10	17	27		48	6	
Class V	12	10	25		39	8	
Duration of electronic device use							
5 to 10 years	17	11	26		52	2	
Less than 5 years	9	10	22	0.41	30	11	0.001
More than 10 years	51	51	69		156	15	
Ever participated in e-waste recycling programmes							
Yes	4	2	7	0.67	10	3	0.13
No	73	70	110		228	25	
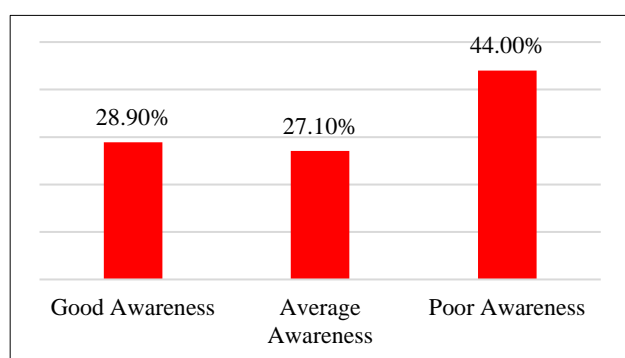
Figure 1: Level of awareness on e-waste management.

The participants' perception were classified as good or average, as no one had poor attitude towards e-waste management (Table 2). Age, educational status of the participants, occupational status, duration of electronic use, were the factors identified to be associated with good attitude towards e-waste management (p≤0.05). The confounding factors identified in this study were age group, gender and occupational status of the study participants.
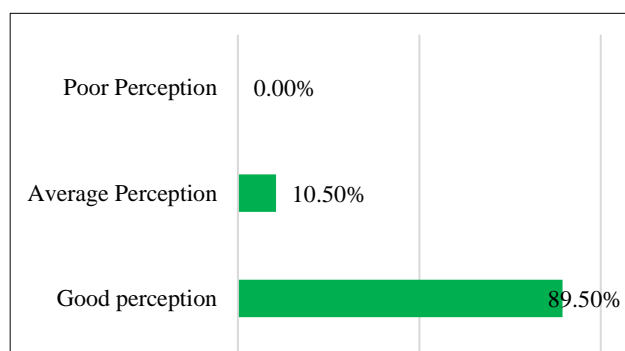

Figure 2: Level of perception on e-waste management.

DISCUSSION

Our study focused to find out the level of awareness, perception and practices of e-waste in Malappuram district of Kerala. Regarding the awareness and perception on e-waste management, 28.9% of the participants had good awareness, 27.1% had average awareness and 44% had poor awareness and on e-waste management. Majority of the study participants (89.5%) had a very good perception towards e waste management. The majority of the study participants in our study were females but according to the study conducted by Nisha et al and Okoye showed that majority of study participants were men.[11,12] In our study most of the study participants were married, consistent with the findings from previous studies.[10-12] In our study the most of the household belonged to nuclear family, consistent with the results from previous studies.[10,12] According to the study conducted by Arya et al in Trivandrum, the majority of the study participants were studied up to graduate level.[10] In our study most of the participants had higher secondary level of education. But another study in Uganda showed that 43% of the study population were post graduates.[16] Considering the occupational status, most of the study participants were home makers, this may be due to the head of the families were not there at the time of data collection as they went for their jobs. According to the study conducted by Nisha et al, 87% of the study population were semi-skilled workers but a previous study conducted in Trivandrum, Kerala showed that majority of the participants were engaged in private sector.[10,11] In our study 29% believed that e-waste was a threat to the environment, but according to a study conducted by Nuwematsiko et al showed that 64% of participants had good knowledge regarding the environmental hazards arising from the e-waste and study conducted in Tamil Nadu, India showed 81% of people were aware of the environmental issues arising from e-waste.[11,14] Only 2.3% of the study population were aware of the legal regulations of e-waste management. This may be due to lack of conducting awareness campaigns and gaps in program implementation by the authorities on e-waste management. According to Shah's study on public awareness of e-waste in Gujarat, only 11% of respondents are aware of the relevant regulations and study conducted in Kerala showed that 30% were aware about the legal regulations existing on e-waste management.[15,17]

In our study 16.9% of people store e-waste in their home in consistent 17% from a previous study conducted in Tamil Nadu.[11] Another study conducted in Trivandrum, Kerala showed that 32% of the population stored e-waste in their home, where 37% was seen in a study conducted in Malaysia.[10,18] In this study 53.8% of the people sell their electronic waste to the scrap dealers consistent with the previous studies.[19-21]

Our study shows that 28.9% of the population had good awareness, 27.1% had average awareness and 44% had poor awareness and on e-waste management. 89.5% participants had very good perception towards e waste management. Study done by Nisha et al showed that 76% of the study population have good knowledge while 70% had a good attitude towards e-waste management.[11] Study conducted in Jordan showed only 31% had good knowledge on e-waste management.[21] In our study, age, gender, type of family they come from, educational factors, occupational factors and socioeconomic class were the factors affecting the awareness on e-waste management, while age, educational status, occupational status and duration of electronic use affects the perception of the population on e-waste management. According to a previous study participant engaged in informal work were 0.96 times less likely to have good perception on e-waste management than those in regular employment.[14] Study conducted by Kumar et al in Kerala showed that improving educational qualifications enhances knowledge of e-waste management.[15]

Not many researches have been conducted on e-waste management in the northern part of Kerala. Multistage cluster sampling technique was adopted to get maximum representation of the district. This study involved engaging with local stakeholders such as residents, businesses, and government authorities. This engagement fostered community participation and ownership in addressing e-waste challenges.

Our study does have some limitations. Confounding factors like age, gender and socio-economic factors can affect the awareness and perception on e-waste management. The study was conducted over a short period; it may not capture long-term trends or changes in e-waste management practices. Longitudinal data collection may yield a more detailed knowledge of changing difficulties and solutions across time. This study's findings have significant implications for medical education, service, public health, and research. More research should be done to find out the trends and patterns of e-waste management.

CONCLUSION

In our study people were less aware of e-waste management, however they have very good perception towards management of e-waste. Effective management of electronic waste (e-waste) is essential to mitigate environmental pollution and health hazards associated with improper disposal practices. Increasing public awareness and educating stakeholders about the hazards of e-waste is crucial. Promotion of campaigns and programs to inform individuals about the proper disposal methods, recycling options, and the importance of reducing e-waste generation through responsible consumption can significantly improve the management of e-waste.

ACKNOWLEDGEMENTS

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