

# Knowledge, Attitude and Practices Regarding Electronic Waste Management Among Users of Electronic Equipments Living in Lucknow City

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## Abstract

**Background:** Contemporary society has led to the increasing use of electronic equipment that is very much responsible for the burden of electronic waste (e-waste). E-waste contains very hazardous substance that harms health and environmental conditions. There is no delicate mechanism for the management of e-waste in Lucknow city, Uttar Pradesh. This study assessed knowledge, practice, and awareness of e-waste management among residents of this city.

**Material and methods:** The study was conducted amongst users of electronic equipment living in the Lucknow City of Uttar Pradesh. The study was a cross-sectional descriptive study. Multi-stage random sampling was done for the selection of participants for the study. A predesigned and pretested questionnaire was administered in a single setting for all phases. The total optimum sample size is 700 individuals who participated in the study. Data were entered in MS Excel 2016 and descriptive statistics such as frequencies and percentages were calculated, applying the chi-square test for association using R-4.2.1 Statistical software.

**Aim and objectives:** To assess the knowledge, attitude and practices regarding the management of electronic waste among users of electronic equipment residing in Lucknow city.

**Results:** Only 37% of users are aware that e-waste adversely affects health. Only 34.3% of users knew that e-waste should be given to the seller or manufacturer for recycling while rest told that it should be stored at home, sold to a scrap dealer, or disposed with normal waste. 87.3% users are not aware about e-waste govt guidelines. In the current study electronic and print media like television, radio and news paper were not found to be source of information for e-waste disposal.

**Conclusion:** Education regarding the ill effects of e-waste is essential for people and awareness of proper disposal of e-waste is the need of the hour. Electronic and print media as well as companies producing electronic equipment should play a significant role to awaken the respondent about the disposal of e-waste.

**Keywords:** Humans, Electronic Waste, Cross-Sectional Studies, Hazardous Substances, Sample Size, Health Knowledge, Attitudes, Practice, Electronics, Surveys and Questionnaires, Software, Television

## INTRODUCTION

Time-worn electrical and electronic equipment (EEEs) are frequently known as electronic waste (e-waste). The past two decades show that e-waste is growing exponentially.

According to Organization for economic co-operation and development, e-waste is defined as “Any appliances using an electric power supply that has reached its end of life”.<sup>[1]</sup>

Including this definition, the e-wastes are small and large household appliances, information technology and telecommunications equipment; lighting equipment; electrical

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and electronic tools, toys, and leisure and sports equipment; medical devices; monitoring and control instruments; and automatic dispensers.<sup>[2]</sup>

Rapid changes in technology, falling prices and planned obsolescence have resulted a fast-growing surplus of electronic waste around the globe.<sup>[3,4]</sup>

Atiemo *et al.*, (2012) observed that yearly 20 to 50 million tonnes of EEE wastes are generated worldwide, which poses a potential threat to human health and the environment.<sup>[5]</sup> It is estimated that about 74 million tonnes of e-waste would be generated by 2030.<sup>[6]</sup> The US environmental protection agency (EPA) estimates that as much as three-quarters of the computers sold in the US are stockpiled in garages and closets.<sup>[7]</sup> Disposal of these e-wastes without appropriate measures can cause health and environmental hazards to humans, live stocks and the ecosystem.<sup>[8]</sup>

As per the global perspective, in Kuala Lumpur and Malaysia, only 2 to 3% of households are involved in recycling their e-waste.<sup>[9]</sup> There is no organized e-waste management program in Nigeria as in study by Alabi OA *et al.*<sup>[10]</sup> In Bangladesh, although 100% of people are involved in e-waste generation but a large proportion of these people (about 73.5%) have no proper knowledge about the management of electronic waste.<sup>[11]</sup>

In India, over 72.8% of users have disposed of their electronic waste, and nearly 92.2% are unaware that they produced it. Additionally, the majority of Indian users are unaware of the problems created by e-waste.<sup>[12]</sup> Studies indicate that the annual rate of e-waste production in India will reach 2.0 million metric tons by 2025.<sup>[13]</sup> This unawareness leads to contamination of the environment and poses a serious health threat to people engaged in this occupation.<sup>[14]</sup>

Numerous research have been done on the knowledge, attitude, and practices of managing e-waste in different parts of India,<sup>[1,11,15]</sup> but no such research was found to be conducted in Lucknow city, the capital of Uttar Pradesh. The knowledge, attitude, and practices (KAP) of users utilising electronic equipment in Lucknow, India, are examined using the KAP model and its associated factors in the current study.

The rest of the paper is organized as follows: Section 2 and section 2.1 discusses the material and methods and ethical consideration. In section 3, statistics and in section 3.1 results have been discussed. Section 4 and 5 comprises of discussion and comparison and conclusion, respectively.

## MATERIAL AND METHOD

The study was conducted amongst users of electronic equipment living in Lucknow city of Uttar Pradesh. As per Grant K *et al.*<sup>[2]</sup>, e-waste includes small and large household appliances, information technology and telecommunications equipment; lighting equipment; electrical and electronic tools, toys, and leisure and sports equipment; medical devices; monitoring and control instruments; and automatic dispensers.

The study was a cross-sectional descriptive study. Taking knowledge attitude and practice level at 50%,<sup>[16]</sup> an absolute allowable error of 5%, and design effect of 1.5 the required sample size was 576, and taking nonresponse at 20% around 700 sample size was required. Multi-stage random sampling was done for the selection of participants for the study. Urban Lucknow is divided into six zones. From these 6 zones, 1 zone was selected randomly. From the selected zone, 1 municipal ward was selected randomly. The household list of the selected municipal ward was taken from Lucknow Municipal Corporation. From the list, 700 households were randomly selected. From each household, one adult family member over 18 years old per inclusion and exclusion criteria was selected randomly using KISH selection Grid.<sup>[17]</sup> Inclusion criteria were users of electronic equipment defined in e-waste management and handling guideline 2016<sup>[18]</sup> and those who gave their consent to participate. Those electronic equipment users aged less than 18 years were excluded from the study. A predesigned and pretested questionnaire was used to assess the knowledge, attitude, and practice regarding e-waste as objective of study.

## Ethical Considerations

The Ethics Committee of the Medical Institute approved the study. Informed consent was obtained from all the study participants.

## Statistical Analysis

All the data gathered, are presented in tabular form to interpret the results and descriptive statistics such as proportion and frequency, were utilized to determine the level of knowledge, attitude, and practice. The chi-square test is used for test of association in the study. *p-value* of less than 0.05 was considered significant with 5% level of significance. MS excel and R software (version 4.1.3) were used for data analysis.

## RESULTS

### Sociodemographic Characteristics of Electronic Waste Users

Out of the total participants, 87.3% were male and 12.7% were female As per modified BG Prasad socioeconomic classification,<sup>[19]</sup> more than one-fourth (28.6%) of participants were from class I. Electronic products usages in the house, 99.3% of individuals are mobile phone users, near to three-fourths of users had a television (Table 1).

### Knowledge of Electronic Waste

Only 62.1, 56.1, 39.0, 31.4, 29.7, and 7.4% users were aware that car light bulbs, computers, fridges, T.V., batteries, and mobile, respectively, produce e-waste. 37.0% of participants were sure that e-waste affects their health. On adverse health effect of e-waste, 35.7 and 18.6% responded that psychological problems and effects on the nervous system, respectively, are the adverse effect of e-waste. 18.9% of participants correctly responded to the presence of heavy metals as arsenic, lead,

**Table 1:** Description of demographic characteristic

Demographic Characteristic	Frequency (n)	Percent (%)	
Gender	Female	89	12.7
	Male	611	87.3
Age	<=20	30	4.3
	21-30	154	22.00
	31-40	198	28.3
	41-50	172	24.6
	51-60	107	15.2
	>60	39	5.6
	Married	588	84
Marital Status	Single	107	15.3
	Other	5	0.7
	Illiterate	136	19.4
Educational Qualification	Upto Higher secondary	261	37.3
	Graduate and above	173	24.7
	Diploma and others	111	15.9
	Professional degree	19	2.7
	Joint Family	169	24.1
Type of family	Nuclear Family	531	75.9
	Nature of Residence	Rented	143
Employment Type	Own	557	79.6
	Business/self-employment	234	33.4
	Government employee	85	12.1
	Private Employee	173	24.7
Per Capita Income (BG Prasad Social Class)	Private Professional (doctor, engineer, etc.)	59	8.4
	Other	149	21.3
	I	200	28.6
	II	156	22.3
	III	142	20.3
Electronic Products in the house (Multiple responses)	IV	131	18.7
	V	71	10.1
	Personal Computer	79	11.3
	Laptop	210	30
	Mobile Phone	695	99.3
Electronic Products in the house (Multiple responses)	Television	505	72.1
	Washing Machine	283	40.4
	Air Conditioner	144	20.6
	Headphone	461	68.9

cadmium, and mercury in e-waste, while partially correct or incorrect responses were obtained from the remaining participants.

In this order, respondents were assessed for their awareness on various aspects of e-waste. 33.3% of participants were aware of the effect of discarding electronic equipment. The presence of lead, mercury, cadmium and arsenic in the electronic equipment was responded by 13, 2.7, 6.3 and 6.3% of participants respectively. They were also assessed regarding knowledge of any company that collect e-waste, only 9.6% of participants said yes. Only 12.7% of participants were aware of the government guidelines regarding e-waste (Table 2).

In this sequence we also assessed the attitude among the respondents. When inquired about their opinion that responsibility for e-waste disposal lies with whom, 29.1% of respondents believed that it is their own responsibility to dispose of their personal e-waste. 39% of participants opined that municipal corporations should play major role for disposal of e-waste. Upon asking their views on the disposal of old electronic equipments, 55.6% believed that it should be collected and recycled by the manufacturer (Table 2).

### Practices regarding E-waste

Purchase of mobile and computer was largely influenced by requirement and convenience as responded by 75.7% of participants. Most common option adopted for disposing of gadgets was selling it to sellers instead of a new product. Many users disposed e-waste along with household waste, such as battery 56.3%, cartridges 15.1%, floppy disc 14.6%, CD 22.9%, TV remotes 29.6% and electronic toys by 26.1% users. Television, newspaper, the internet and radio manual of products were not possible sources of information to discard the gadget (Table 3).

In Table 4, the chi-square test was applied for significant testing. If the *p-value* is less than 0.05 then it shows a significant difference. Test was applied to see whether users replaced the gadgets in less than 5 year or greater than 5 years and reason for the replacement. Individuals with higher educational qualifications were less likely to continue using computing devices like personal computers and laptops for more than 5 years compared to less educated individuals. This difference was found to be statistically significant ( $p < 0.001$ ). The reason for the early replacement of the computing device's availability of a newer model was significantly linked to higher educational qualifications ( $p < 0.001$ ). The younger individuals (<30 years of age) were more likely (78.3%) to continue using computing devices for longer duration (>5 years) compared to older (65.6%) individuals (>30 years of age), but this difference was not statistically significant ( $p = 0.135$ ). Similarly, individuals belonging to the lower socioeconomic classes are more likely to continue using the computing devices for >5 years compared to middle & upper SE classes, but this difference again was found to be non-significant ( $p = 0.242$ ).

**Table 2: Knowledge and attitude regarding e-waste**

Particulars	Responses	Frequency (n)	Percent (%)
<b>Knowledge regarding e-waste</b>			
Correctly recognized e-waste symbol	No	588	84.0
	Yes	112	16.0
<b>Products that produce e-waste</b>			
Battery	No	208	29.7
	Yes	492	70.3
Mobile	No	52	7.4
	Yes	648	92.6
Computer	No	393	56.1
	Yes	307	43.9
TV	No	220	31.4
	Yes	480	68.6
Car light bulb	No	435	62.1
	Yes	265	37.9
Fridge	No	273	39.0
	Yes	427	61.0
e-waste adversely affects the health	Definitely	259	37.0
	Don't know	69	9.9
	No	35	5.0
	Perhaps	107	15.3
Adverse health effect caused by e-waste	To some extent	230	32.9
	Effect on Nervous System	130	18.6
	Poisoning of heavy metal (poisoning)	260	37.1
	Psychological problems	250	35.7
Heavy metals are present in e-waste	Others	60	8.6
	Correct knowledge	132	18.85
	Incorrect knowledge	568	81.15
Disposal of e-waste	Should be stored at home	84	12.0
	Should sell to scrap dealer	210	30.0
	Disposed with normal waste	166	23.7
Are you aware of the effect of discarding the equipment	Should be given to the seller or manufacturer for recycling	240	34.3
	No	467	66.7
	Yes	233	33.3

Particulars	Responses	Frequency (n)	Percent (%)
Are you aware of the chemical present in electronic equipments	No	514	73.4
	Yes	186	26.6
Any company that collects discarded e-waste for recycling	No	633	90.4
	Yes	67	9.6
Aware of e-waste govt guidelines	No	611	87.3
	Yes	89	12.7
<b>Attitude regarding e-waste</b>			
As per your opinion responsibility for e-waste disposal lies with	User	204	29.1
	Manufacturer of products	200	28.6
	Municipal Corporation	273	39.0
	Seller	23	3.3
Your opinion for disposal of old electronic equipments	Stored in house	152	21.7
	Should be put with normal waste	159	22.7
	Should be collected and recycled by manufacturer	389	55.6

**Table 3: Practice regarding e-waste**

Particulars	Responses	Frequency (n)	Percent (%)
Purchase of the gadget influenced by	Advertisement	16	2.3
	New advanced facilities (features)	83	11.9
	Increase in income	40	5.7
	Requirement and convenience	530	75.7
Purchased electronic good	Status symbol	29	4.1
	Others	2	0.3
	New	528	75.4
How many years later did you replace the gadget	Second hand	172	24.6
	Personal Computer		
	Before 1 year	4	2.0
	In 1-2 years	7	3.5
	In 2-3 years	18	9.1
	In 3-5 years	38	19.2
	5 years or more	131	66.2
Laptop	Before 1 year	1	0.4
	In 1-2 years	5	2.1
	In 2-3 years	28	11.7
	In 3-5 years	44	18.4
	5 years or more	161	67.4

<i>Particulars</i>	<i>Responses</i>	<i>Frequency (n)</i>	<i>Percent (%)</i>	<i>Particulars</i>	<i>Responses</i>	<i>Frequency (n)</i>	<i>Percent (%)</i>	
Mobile Phone	Before 1 year	48	7.2	Other electronic equipments	Beyond repair	121	42.3	
	In 1–2 years	92	13.8		Stuck	68	23.8	
	In 2–3 years	128	19.2		Was working	66	23.1	
	In 3–5 years	178	26.6		Others	31	10.8	
	5 years or more	222	33.2	Options adopted in disposing the gadgets				
Other electronic equipments	Before 1 year	5	1.7	Personal Computer	Donated to friends, relatives, schools, charitable institutions	21	10.6	
	In 1–2 years	13	4.5		Gave it to the scrap dealer	20	10.1	
	In 2–3 years	35	12.2		Selling to sellers in lieu of a new product	120	60.6	
	In 3–5 years	37	12.9		Stored at home	10	5.1	
Reasons for replacement	5 years or more	196	68.5	Throw it into the dustbin with other waste	7	3.5		
	Personal Computer	Got older	74	37.4	Others	20	10.1	
		New facilities	40	20.2	Laptop	Donated to friends, relatives, schools, charitable institutions	32	13.4
		Repair was not possible	73	36.8		Gave it to the scrap dealer	39	16.3
Other reasons		11	5.5	Selling to sellers in lieu of a new product		129	54.0	
Laptop	Got older	82	34.3	Stored at home		10	4.2	
	New facilities	58	24.3	Throw it into the dustbin with other waste	4	1.7		
	Repair was not possible	90	37.6	Others	25	10.5		
	Other reasons	9	3.8	Mobile Phone	Donated to friends, relatives, schools, charitable institutions	66	9.9	
Mobile Phone	Got older	262	39.2		Gave it to the scrap dealer	70	10.5	
	New facilities	104	15.6		Selling to sellers in lieu of a new product	318	47.6	
	Repair was not possible	302	45.2		Stored at home	112	16.8	
Other electronic equipments	Got older	74	25.9	Throw it into the dustbin with other waste	68	10.2		
	New facilities	57	19.9	Others	34	5.1		
	Repair was not possible	149	52.1					
	Other reasons	6	2.1					
Condition of the equipment while discarding	Personal Computer	Beyond repair	73	36.9				
		Stuck	56	28.3				
		Was working	51	25.8				
		Others	18	9.1				
Laptop	Beyond repair	80	33.5					
	Stuck	64	26.8					
	Was working	74	31.0					
	Others	21	8.8					
Mobile Phone	Beyond repair	233	34.9					
	Stuck	197	29.5					
	Was working	232	34.7					
	Others	6	0.9					

Particulars	Responses	Frequency (n)	Percent (%)
Other electronic equipments	Donated to friends, relatives, schools, charitable institutions	15	5.2
	Gave it to the scrap dealer	80	28.0
	Selling to sellers in lieu of a new product	124	43.4
	Stored at home	21	7.3
	Throw it into the dustbin with other waste	18	6.3
	Others	28	9.8
Other e waste that you dispose along with household waste			
Battery	No	306	43.7
	Yes	394	56.3
Cartridge	No	594	84.9
	Yes	106	15.1
Floppy disk	No	598	85.4
	Yes	102	14.6
CD	No	540	77.1
	Yes	160	22.9
TV Remote	No	493	70.4
	Yes	207	29.6
Electronic Toy	No	517	73.9
	Yes	183	26.1
Source of information to discard the gadget			
Television	No	698	99.7
	Yes	2	0.3
Newspaper	No	698	99.7
	Yes	2	.3
Internet	No	700	100
	Yes	0	0
Radio	No	698	99.7
	Yes	2	0.3
User manuals of products	No	700	100
	Yes	0	0

For the mobile users, individuals with older age ( $\geq 30$  years) were more likely to continue using mobile devices for less than 5 years, and this difference was found to be statistically significant ( $p=0.006$ ). The reason for the early replacement of the computing device's availability of a newer model was significantly linked to professional degree qualifications ( $p<0.001$ ). Similarly, individuals belonging to the middle socioeconomic classes are more likely to continue using the

computing devices for  $<5$  years compared to lower & upper SE classes, but this difference was found to be significant ( $p=0.027$ ), and reason for replacement lower class were more likely to a non-functional and not repairable mobile device as compared to middle and upper SE classes, this difference is statistically significant ( $p < 0.001$ ).

## DISCUSSION

In Dhaka City, Bangladesh, Meem RA *et al.*<sup>11</sup> carried out a study that revealed that while 100% of the population is involved in the generation of e-waste, but only 73.5% are knowledgeable about its management. On the other hand, roughly 96.8% of residents think that the city doesn't manage e-waste well. Approximately 95.2% of respondents said they would be interested in helping to develop a responsible and secure recycling program in the city to eliminate the negative consequences of e-waste. For the benefit of future generations and to lessen the present socio-ecological hazard, about 79% of users were eager to get involved in proper e-waste management facilities by putting up a responsible and safe recycling system.

Arpitha V. S. *et al.*<sup>11</sup> conducted a cross-sectional study among medical students in March and April of 2019. Here, 81.18 and 95.82% of study participants were aware of the risks that e-waste poses to human health and the environment. Only 4.18% of people were aware of laws related to e-waste. 56.44% of participants routinely replaced their electronic equipment to keep up with technology. The willingness to learn more about e-waste was 97.91% among participants. More than half (53.60%) of the study participants believed that incorrect e-waste disposal results from a lack of awareness.

Another study on e-waste was conducted by Borthakur *et al.* (2022),<sup>[15]</sup> New Delhi, India. Over 49% of our respondents change their mobile phones between 1 and 3 years. Over 42% of the respondents said that they purchase or replace a mobile phone when the older one becomes non-functional. Complementing this, over 16% of the respondents replace their phones when the older one cannot be repaired. Only 1.3% of the respondents purchase new phones influenced by their peers. The problem with the mobile battery was found to be the foremost malfunctioning reason for mobile replacement, as stated by 43.7% of the respondents. The most common disposal behavior was to keep stored at home by 46.5% of participants, followed by handing over of their old mobile phones to siblings, relatives or others for free as responded by 20% of respondents. Also, 56.4% of the respondents showed their willingness to repair their mobile phones, while the rest did not wish to repair their phones.

Likewise, a study carried out in the city of Chandigarh mentioned that 37.1% of the respondents in the city store their e-waste without any reason and this storage of obsolete electronics has been established as a major setback in the quantification of the waste volume and its recycling (Singh *et al.* 2018).<sup>[20]</sup>

**Table 4:** Chi square test for association between sociodemographic profile and gadget replacement

Computing Device	How many years later did you replace the gadget			Reasons for replacement		
	>5 years	<5 years	p-value	Functional and New Model	Non-functional and not repairable	p-value
<b>Age</b>						
Older (>=30 years)	139 (65.56%)	73 (34.44%)	0.135	113 (58.25%)	81 (41.75%)	0.890
Younger (<=30 years)	36 (78.26%)	10 (21.74%)		33 (73.34%)	12 (26.67%)	
<b>Education</b>						
Diploma and others	32 (74.42%)	11 (25.58%)	<0.001	31 (79.48%)	8 (20.52%)	<0.001
Graduate and above	56 (53.85%)	48 (46.15%)		65 (65.00%)	35 (35.00%)	
Professional Degree	6 (46.15%)	7 (53.85%)		9 (75.00%)	3 (25.00%)	
Up to Higher Secondary	81 (82.65%)	17 (19.35%)		41 (46.59%)	47 (53.41%)	
<b>Socio-economic status (BG Prasad)</b>						
Lower Class (IV & V)	40 (75.48%)	13 (24.52%)	0.2415	15 (34.10%)	29 (65.90%)	<0.001
Middle Class (I, II, & III)	135 (65.85%)	70 (34.15%)		131 (67.17%)	64 (32.83%)	
<b>Mobile Phone</b>						
<b>Age</b>						
Older (>=30 years)	191 (35.83%)	342 (64.17%)	0.006	291 (53.70%)	251 (46.30%)	0.6433
Younger (<=30 years)	31 (22.96%)	104 (77.04%)		75 (56.40%)	58 (43.60%)	
<b>Education</b>						
Diploma and others	30 (29.42%)	72 (70.58%)	0.068	66 (61.68%)	41 (38.32%)	<0.001
Graduate and above	48 (28.57%)	120 (71.42%)		110 (64.32%)	61 (35.68%)	
Professional degree	3 (16.67%)	15 (83.34%)		14 (82.35%)	3 (17.64%)	
Up to Higher Secondary	141 (37.10%)	239 (62.90%)		176 (46.32%)	204 (53.68%)	
<b>Socio-economic status (BG Prasad)</b>						
Lower Class (IV & V)	74 (40.00%)	111 (60.00%)	0.027	79 (41.79%)	110 (58.20%)	<0.001
Middle Class (I, II, & III)	148 (30.64%)	335 (69.36%)		287 (59.06%)	199 (40.94%)	

## CONCLUSIONS

We conclude that the use of electronic equipment has increased exponentially in our society and has become an integral part of our life. After replacing electronic equipment, we observed that more than half of the participants dispose of the e-waste by selling to scrap dealers, putting with normal waste or storing at home. Most of them were unaware of the adverse effects of e-waste on health and the environment caused by improper disposal. We also observed that the participants had least knowledge of government guidelines on e-waste disposal. So, education regarding ill effects of e-waste is essential for people and awareness on proper disposal of e-waste is the need of the hour. Electronic and print media as well as companies producing electronic equipment, should play a significant role to awake the respondent about the disposal of e-waste.

## RECOMMENDATION

The current study mainly focused on the use of e-waste material. After extensive work has been done, it was found that the participants had less knowledge regarding e-waste disposal guidelines. It is the need of the hour to focus on proper

disposal of e-waste and this should be improved through participation by the government, electronic and print media and the people.

## Limitations of the study

This study was a single-centre study conducted in an urban area, so this may not be representative of a marginalized population in remote areas. For ease, the awareness has been assessed through closed ended questions in the form of yes and no.

## Relevance of the Study

This study gives the participant knowledge, attitude, and practice of e-waste material. This allows the opportunity to make relevant policies to improve the knowledge, attitude and practice of e-waste material among the general population.

## FINANCIAL SUPPORT AND SPONSORSHIP

Nil.

## CONFLICTS OF INTEREST

There are no conflicts of interest.

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