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# Knowledge and Practice of E-waste Management Among Workers of Waste Recycling Centres in Puducherry – A Mixed Method Study

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## Abstract

**Background:** India is the second largest e-waste generator in Asia. Electronic and electrical wastes contain more hazardous materials than any other municipal waste and have a negative impact on health and the environment if not properly managed.

**Objective:** to assess the knowledge of e-waste and practice of e-waste management among waste recycling workers in Puducherry.

**Methodology:** A community-based mixed methods study was conducted in two municipalities of Puducherry. Qualitative key informant interviews were conducted among subject experts to form the study tool. Quantitative surveys were conducted among 150 workers in waste recycling centres.

**Results**: The majority (95%) of workers involved in the informal sector and 80% were handling e-waste exclusively. The majority were involved in the repairing process (80%) and less than half (20%) were involved in dismantling activities. Half of the workers (48%) were not aware of what constitutes e-waste. Two-thirds (66%) were aware of the health hazards of e-waste and among them, half mentioned respiratory effects. Nearly 49% were unaware of the environmental effects of e-waste and the majority of the responses were pollution or ozone depletion. Only 25% were aware of the existing government regulation on e-waste. Two-thirds (68%) did not use any kind of personal protective equipment and a mask (44%) was the most common method. 40% had experienced workplace injuries while 9% had respiratory illness.

**Conclusion:** This study has highlighted the need for better awareness of the effects of e-waste among waste recyclers. Awareness should be created regarding harmful substances in e-waste, and safe disposal methods to maintain good health and clean environment.

**Keywords**: E-waste, waste recycling workers

## Introduction

Electrical or electronic devices discarded loosely, obsolete, surplus, or broken are called E-waste[1]. Worldwide, India is ranked third position in generating e-waste[2]. 57.4 million tons were generated, globally[3]. In India, 95% of e-waste recycling has been done in unorganized sectors, and involved in dismantling activities, these practices may affect human health as well as the environment[1]

Indian government released E-waste (management) rules in 2016 which give directions for the production to recycling of e-waste. Through the Extended Producer Responsibility (EPR), the e-waste rule

guides the manufacturers to collect e-waste during manufacture and channel it for proper recycling and disposal through authorization from State Pollution Control Board (SPCB)[4].

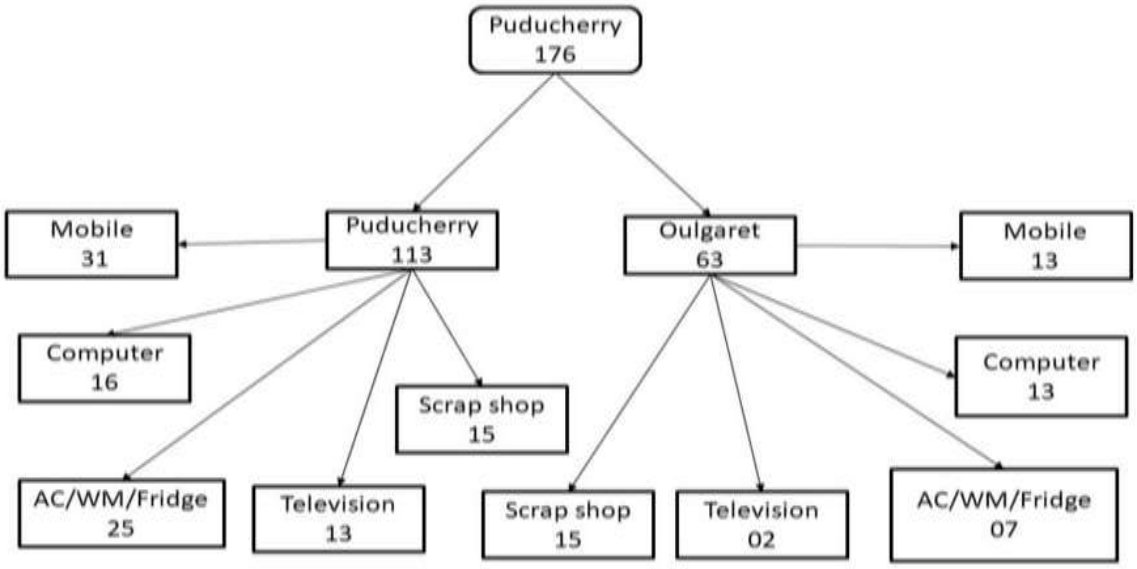
The lack of knowledge lead to ill health and environmental damage. A recent article showed that public awareness of e-waste is very low due to less or no media coverage of this e-waste[5]. Hence this study was undertaken to assess the existing scenario concerning e-waste and its management among waste recyclers in Puducherry.

## Materials And Methods

**Study location:** The study was conducted in waste recycling centers and mobile and computer service Centers in two municipalities (Oulgaret and Puducherry) of the Puducherry Union territory.

**Sample size and sampling:** In the qualitative phase, purposively chosen, 6 Key informant interviews were conducted among stakeholders from SPCB, subject experts, dealers from authorized recycling centers, and academicians. As this is an exploratory study, 150 participants were selected for the quantitative survey after the approach of all waste recycling centers in two municipalities of Puducherry (Fig 1).

**Fig 1: Sampling frame of available recycling centres in selected municipalities of Puducherry**




**Methods:**

A study tool was developed by Key informant interviews (KII) to understand the local terms and common practices. Based on this, a structured questionnaire was developed. It has 4 Parts; A- Recycling center and participant's details, B- e-waste knowledge, and C & D - handling and disposal practices (using picture cards). Additionally, Health education material was prepared to educate the workers.

Then, a pilot study was conducted among six workers, and based on this, the questionnaire was modified. In a quantitative survey, interviews were conducted among 150 workers. At the end of the interview, a health education session was conducted with the help of flash cards.

**Data Analysis**

The Qualitative interviews were transcribed and translated into English. The compiled data were coded and themes were created after content analysis. This was supplemented with quotes from the interviews. Quantitative data was entered in Epidata (v- 4.2). Analysis was done using SPSS software (V 20). Data are presented as frequency and proportions.

**Results**

In our qualitative study based on the repetition and similarities, we prepared various codes and then divided them into five main themes: (Fig2)



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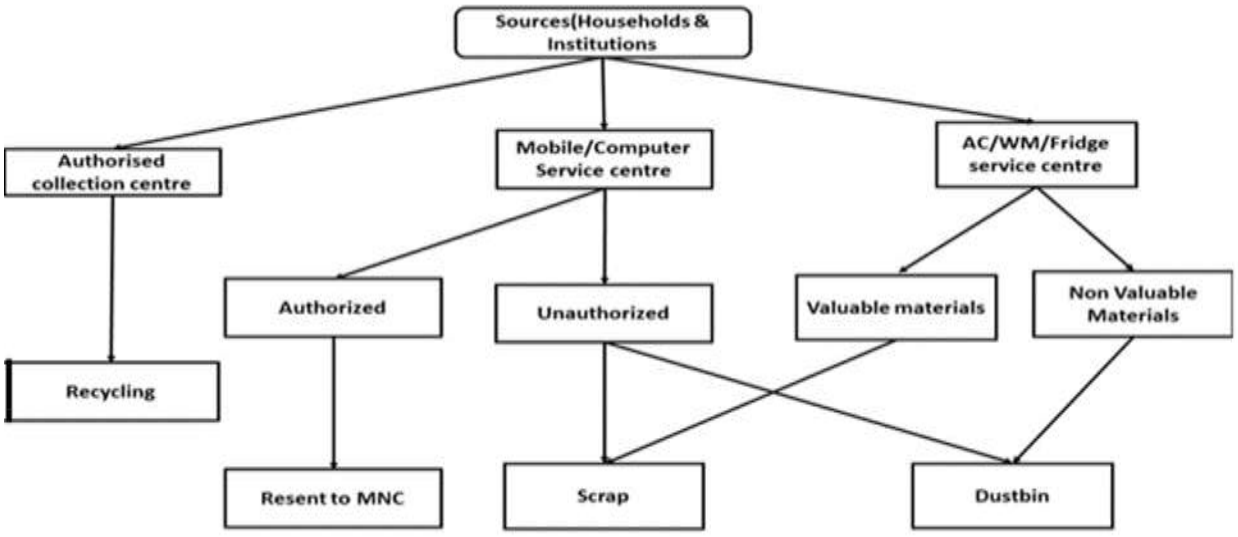
**Fig 2: Result of the Key informant interview in this study**

| Themes | Statement |
|---|---|
| Understanding the knowledge of e-waste and its components | "In mobile phones, various parts like display, keypad, battery, and motherboard are present. In refrigerator compressor, coil, inner and outdoor parts are present". |
| Perception of e-waste effects on health and environment | "It can affect the brain, nervous system, and respiratory illness (asthma): workplace injuries like small cuts, abrasion, and other wounds may happen" |
| | "When the chemicals and metals present in e-item come in contact with water and humidity in the atmosphere, it reacts through oxidation and contaminates the groundwater and causes air pollution" |
| The practice of e-waste management | "Yes, there are some protective devices for these like hand gloves, boots for their legs, goggles for eyes, mask, face shield, etc" |
| Government regulations regarding e-waste | "If you conduct such workshops, workers are ready to participate as it is done for their welfare". |
| Suggestions to improve e-waste management | Strict enforcement of e-waste law, awareness creation, Provide more e-waste collecting Centres |

**Fig 3: Flow of E-waste in recycling Centres in Puducherry**




**Quantitative results:**

Among the recycling centers, 95% were in the informal sector. The majority were in Pondicherry municipality (66.7%). Almost 80% of the centers were handling e-waste exclusively. 27% of centers were handling 2-5kg/month, and home is the main source (85.3%). The worker's mean (SD) age was



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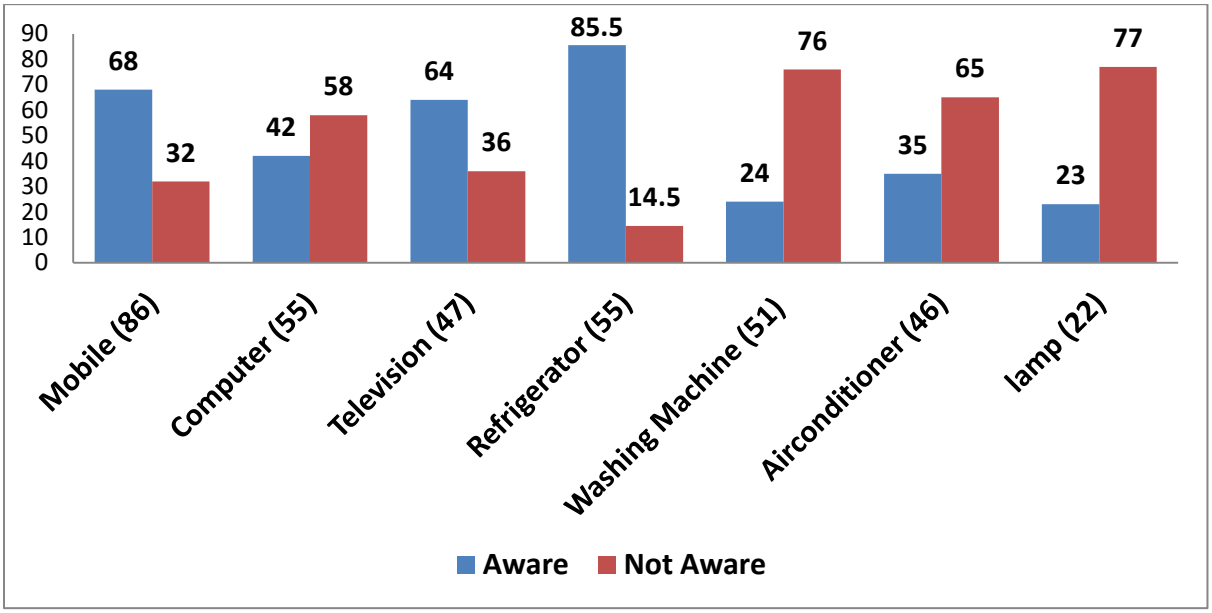
34.1(10) years. 42.6% were between 18-30 years and 99% were male. 80% were involved in repairing work and the remaining were in dismantling. 52 % had formal training [Table 1]

The majority 48% of workers don't know about the e-waste components. 66% believed it affects health; among them, 50% stated, it affects the respiratory system. While 48.7% believed, e-waste doesn't affect the environment, 52% were unaware of the government regulations [Table 2]. In this study, the majority of the workers were unaware of harmful chemicals in e-items (fig.4).

**Fig.4 Awareness of the presence of harmful materials in E-items among waste recycling Centres in Puducherry. (n-150)**




In our study, 42 % stored e-waste for 1-2 months, and 70% stored in a separate storage area. Only 1% were using vacuum cleaners for dust control, and none of the workers followed noise control measures. Among 68% of PPE users, 43% used masks, and 38% hand gloves.

Only 10% were involved in recycling and reuse. Workers (TV- 66%, Fridge-58%, Washing machines- 63%, and AC-63%) were involved in dismantling activity while 64% sold the end products to other Centres. 94% did not maintain any records for e-waste. 43% suffered from skin problems, dust allergies, respiratory illnesses, and workplace-related injuries (trauma or burns). [Table 3]

**Table 1: Characteristics of recycling Centres and Socio-demographic details of the workers in e-waste recycling Centres in Puducherry, 2017(n=150)**

| *Sl. No* | *Variables* | *Frequency*<br>*N* | *Percentage*<br>*%* |
|---|---|---|---|
| 1 | **Location** | | |
| | Puducherry | 100 | 66.7 |
| | Oulgaret | 50 | 33.3 |
| 2 | **Type of Recycling Centre** | | |
| | Authorized service Centre | 7 | 5 |
| | Informal sector | 143 | 95 |



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| | | | |
|---|---|---|---|
| 3 | **Registration Status** | | |
| | Registered | 79 | 52.6 |
| | Not registered | 71 | 47.3 |
| **Socio-demographic and work-related characteristics** | | | |
| 4 | **Age** | | |
| | 18-30 years | 64 | 42.6 |
| | 31-40 years | 48 | 32.1 |
| | >40 years | 38 | 25.3 |
| 5 | **Education** | | |
| | Primary & Secondary | 52 | 34.6 |
| | Hr.sec /Diploma | 52 | 34.7 |
| | Graduation | 46 | 30.7 |
| 6 | **Type of equipment handled** | | |
| | Electrical waste[#] | 73 | 47.6 |
| | Electronic waste[$] | 47 | 31.3 |
| | Mixed | 30 | 20.0 |
| 7 | **Type of work** | | |
| | Dismantling | 30 | 20 |
| | Repair | 120 | 80 |

[#]-TV/AC/washing machine/ Refrigerator

$-mobile/computer/ laptop

**Table 2: Awareness of e-waste among the workers in e-waste recycling Centres in Puducherry, 2017 (n=150)**

| Sl. No | Knowledge characteristics | Frequency | Percentage |
|---|---|---|---|
| 1 | **Components of E-waste** | | |
| | Electronic items[*] | 11 | 07.3 |
| | Electric items[#] | 26 | 17.3 |
| | Both | 41 | 27.3 |
| | Don't know | 72 | 48.0 |
| 2 | **E-waste affects health** | | |
| | Yes | 99 | 66.0 |
| | No | 46 | 30.7 |
| | Don't know | 05 | 03.3 |



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| | | | |
|---|---|---|---|
| | **Type of health effects (n=99)** | | |
| | Respiratory effects | 50 | 50.5 |
| | Allergies (Dust & Skin) | 23 | 23.1 |
| | Vision problems | 10 | 10.1 |
| | Injury | 10 | 10.1 |
| | All of the above | 06 | 06.1 |
| 3 | **E-waste affects environment** | | |
| | Yes | 66 | 44.0 |
| | No | 73 | 48.7 |
| | Don't know | 11 | 07.3 |
| | **Type of environmental effects (n=66)** | | |
| | Pollution | 37 | 56.1 |
| | Ozone depletion | 13 | 19.7 |
| | Others[+] | 16 | 24.2 |
| 4 | **Govt. regulation on e-waste** | | |
| | Exist | 37 | 24.7 |
| | Does not exist | 78 | 52.0 |
| | Don't know | 35 | 23.3 |

*Mobile and computer

# TV, AC, Washing Machine, Fridge

+ Mosquito breeding/ soil erosion

**Table 3: Practice of e-waste management and Health effects among the workers in e-waste recycling Centres in Puducherry, 2017 (n=150)**

| S No | Variable | Frequency N | Percentage % |
|---|---|---|---|
| 1 | **Duration of storage of E-waste** | | |
| | 0-2 months | 64 | 42.7 |
| | >3 months | 24 | 16.0 |
| | No specific time | 42 | 30.0 |
| | Not stored | 17 | 11.3 |
| 2 | **Place of storing E-waste** | | |
| | Separate storage area | 93 | 69.4 |
| | Mixed with general waste | 41 | 30.6 |



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| | | | |
|---|---|---|---|
| 3 | **Dust control measures** | | |
| | Yes | 02 | 1.3 |
| | No | 148 | 98.7 |
| | **Noise control measures** | | |
| | No | 150 | 100 |
| 4 | **Type of Protective equipment (n=48)** | | |
| | Gloves | 18 | 37.6 |
| | Masks | 21 | 43.7 |
| | Electrostatic devices | 07 | 14.5 |
| | Goggles | 02 | 4.2 |
| 5 | **Disposal of waste generated** | | |
| | Sold to other Centres | 96 | 64.0 |
| | Municipal waste | 26 | 17.4 |
| | Recycled | 14 | 9.3 |
| | Returned to customer | 14 | 9.3 |
| **Health effects due to occupation** | | | |
| 6 | **Health effects** | | |
| | No | 85 | 56.7 |
| | Injuries | 26 | 17.3 |
| | Respiratory illness | 12 | 8 |
| | Others[#] | 27 | 18 |

[#] - Allergies/Skin problems

## Discussion

In this study, 95% of the recycling centers were informal sectors. Similarly, in Kapoor et al where 95% were informal centers[6]. Half (53%) of the centers were not registered. Indian e-waste (management) Rules 2016 recommends that all e-waste recycling centers should be registered with the state pollution control board (SPCB)[4]. There is a need to encourage recycling centers to be registered in SPCB. All centers received e-wastes from households. while 15% are from institutions and companies.

In this study, the mean age of the participants was 34 years and one-third were graduates, and 25% were from ITI backgrounds. This is similar to a study by Chimera et al, where the mean age was 30 years[7]. In Anthony et al study, where 90% completed high schooling[8]. and 66% stated that that e-waste affects their health, many studies reported e-waste cause respiratory infection, skin problems, and, etc[9], Therefore, more research is to be carried out with biomarkers and environmental samples. And awareness would be created among all waste recyclers and the public regarding e-waste effects

In our study, 16% of the workers stored e-items for more than three months and 99% do not use any kind of dust control or noise control measures. Workers felt that using PPEs can cause discomfort while handling small parts. The e-waste (management) rules in India 2016 state that the e-waste storage should not exceed >180 days, the center should use



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some form of dust and noise control systems, and also the workers should use adequate PPEs like goggles, gloves, etc[4]

In this study, 17% of workers dumped e-waste along with general waste in the municipality dust bins. And 20% were involved in the dismantling activity. Indian e-waste rules do not permit dismantling activities. Through dismantling, harmful chemicals and metals cause environmental degradation and affect human health by ingestion and inhalation. Hence the education of customers and waste recycling workers on proper e-waste disposal is needed[4].

In this study, 63% were unaware of the government e-waste policy. Similarly, in the Korin Franklin study, where 61% of the workers were unaware[10]. In India, the e-waste guidelines 2016 gives clear directions and responsibilities to all stakeholders for sustainable e-waste management. The PCB enforces that the recycling centers should maintain the record to monitor the flow of e-waste[4], while, only 6% of workers maintained the records in this study.

This study had several strengths, including the exploratory design and inclusion of workers dealing with a range of e-items. It sensitized workers about the danger of e-waste and its harmful effects through health education sessions. However, there is a possibility of social desirability bias. Further, this being an exploratory study, the sample size may be inadequate for the generalizability of results. Health effects related to specific e-waste handling may be studied in future research.

**Conclusion:**

This study has highlighted the need for better awareness of e-waste, its management, and its policies & regulations among all waste recyclers and the community so that they handle e-waste properly and safely. Further, this can reduce harmful effects on their health and the environment.

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