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Informal Technicians' Awareness of E-Waste Health Risks and Effects at Kinondoni Municipal, Dar Es Salaam

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ABSTRACT

This study explored the informal technicians' awareness of e-wastes health risks and effects using a cross-sectional study design at Kinondoni municipal, Dar es Salaam. Informal technicians from the selected wards of Kinondoni municipal were involved in interviews. These wards were Mwananyamala, Bunju, Hananasif, Kawe, Kigogo, Kijitonyama, Kinondoni, Magomeni, Makongo, and Makumbusho. The interviewed officials were from the department of environments from Kinondoni municipal. The survival of the informal technicians in urban areas depends much on dismantling electronic wastes (e-wastes) as part of their primary livelihood activities. Such dismantling discharges harmful compounds that expose them to health risks and effects. The results from this study have established that most of the informal technicians are unaware of the e-waste-derived toxic substances, which have higher hazardous health-related risks and effects. Our study suggests a need to improve working environments for informal technicians through the "Indoor Technicians Health and Safety Precautions Initiatives." Therefore, informal technicians need to be educated about their engagement in dismantling various technological devices and materials that can have health risks and adverse effects.

Key Words: Informal technicians, e-wastes, health risks, health effects, Kinondoni municipal

Background Information

Electronic waste (also known as *'e-waste'*) is products that are dumped as waste materials without putting them into reusable objects (Tanskanen, 2013). The Organization for Economic Cooperation and Development (OECD) defines e-waste as "any appliances utilising the electrical supply that has reached end-of-life over its product lifespan." E-waste entails a mixture of materials containing various harmful compounds from multiple household and office items, including cell phones, computers, televisions, music recorders, washing machines, and air conditioners (Bachér et al., 2020). Globally, all these consumer goods are heavily used regularly in developed and developing countries.

The leading global producers of e-waste are the USA, China, Western Europe, Japan, Canada, India, and Australia (Chen et al. 2011), while the vital recipient countries are those found in Asia and Sub-Saharan Africa. E-waste recycling activities are practised in several countries like China (Guiyu and Taizhou); India (Delhi and Bengaluru); Pakistan (e.g., Karachi and Gujranwala); in Vietnam (e.g., Dong Mai and Trang Minh); Nigeria (Lagos) and Ghana (Agbogbloshie and Accra) (Awasthi et al. 2016; Iqbal et al. 2015; Tue et al. 2010, 2016; Caravanos et al. 2011; Asante et al. 2012). Some countries, like Brazil, Colombia, Morocco, Mexico, Kenya, South Africa, Peru, Senegal, Uganda, etc., have small recycling facilities for e-waste (Chen et al. 2011). In contrast, recycling operations in some other nations are still unmapped.

A minimal amount of e-waste goes to the formal sector, whereas a more significant part of it goes to the informal sector, where it is dismantled by informal technicians using primitive methods (Awasthi et al., 2016; Chi et al., 2011; Luo et al., 2011). Consequently, careless handling of discarded e-waste gets into air, soil and water bodies (Grant et al., 2013), posing severe health risks to humans and other living organisms. Furthermore, informal technicians sometimes are tempted to extract precious metals such as gold using improper and unauthorised methods (Awasthi & Li, 2017). As a result, they often suffer physical injuries caused when dismantling/dismantling electronic waste (WEEE).

The proliferation of technological innovations such as computers and mobile phones has attracted most young people to engage in technological-based self-employment in the informal sector, hence, "informal technicians." Economically, urbanisation, accompanied by the fast-growing demand for consumer goods in various nations, has increased the demand and supply of electronic goods (Babu et al., 2007). This study explored the informal technicians' awareness of e-wastes health risks and effects at Kinondoni municipal, Dar es Salaam.

Attention is, therefore, increasingly being devoted to the e-waste risks and effects among the dismantlers in urban areas, particularly informal technicians in developing countries. The e-waste health risks and effects among the people engaging in dismantling and collecting the "end-of-life" technological devices and materials have been reported extensively by researchers. In the past two decades, technology and society theorists (Awasthi et al., 2018;

Ramesh Babu et al., 2007; Reichel, 2011; Xiao & Su, 2022) have continued to re-examine the impact of technological innovations on people and their environments. The concern has been the fast-growing and emerging global challenge of e-waste caused by releasing toxic chemicals during dismantling, burning, and recycling processes. These chemicals are dangerous to the health of informal technicians and the environment. Forti et al. (2020) that in 2017, Tanzania generated e-waste, whereas electronic equipment waste took the lead, followed by small equipment (Figure 1).

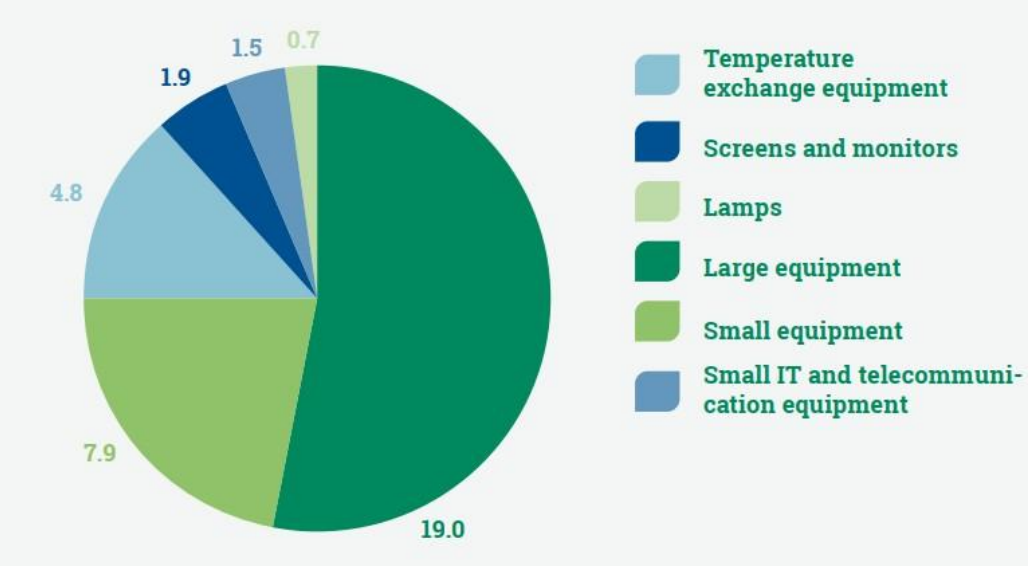

Figure 1: ***Tanzania's E-waste (in kt) generated per category in 2017***

(source: The Global E-waste Monitor 2020)

Many developing countries continuously receive massive technologies that create employment for informal technicians and, on the one hand, generate colossal e-waste chunks. Major leading countries importing technological innovations include European countries, the United States, and China. These nations have engineered higher production of e-waste in developing countries, particularly in urban areas. For example, through its digital expansion in the global south, China alone contributes to a significant production of e-waste toxic compounds, including polycyclic aromatic hydrocarbons (PAHs) and polybrominated diphenyl ethers (PBDEs) (Pascale et al., 2018; Iqbal et al. 2015). These are evident through human samples such as blood, hair, and urine.

The disassembling of electronic equipment has become a problem and survival strategy among informal technicians in developing countries. However, such technicians have low awareness of the health-related impacts of hazardous substances contained in electronic materials (Afroz et al., 2012). For example, McKenzie (2019) contends that in Tanzania, e-waste is being generated in volumes, and technicians' knowledge in terms of toxicity is still inadequate.

Nevertheless, most informal technicians do not consider the risks to their health or the adverse effects of deconstructing e-waste materials; instead, they only perceive economic benefits (Borthakur and Govind, 2018). The literature shows that the initiative to create awareness among the technicians and the public on the hazardous nature of chemical elements contained in e-waste and the effect on human health is very important (Otieno and Omwenga, 2016). Among others, researchers such as Prakash et al. (2020) recommend having appropriate interventions for e-waste handling practices among informal technicians to reduce health-related risks associated with e-wastes dismantling. Building informal technicians' capacity to properly handle e-wastes using safe technology to avoid impacts on health and the environment is one way developing countries promote sustainable e-waste management.

Adanu et al. (2020) contend that most health risks people working in e-waste environments face include paralysis and, in some cases, even death. According to them, ingesting too much chromium can also cause health effects, such as skin rashes, stomach upset and ulcers, weakened immune systems, respiratory problems, kidney and liver damage, genetic changes, lung cancer, and even death. Additionally, other health-related issues are faced by people working in the informal sector, such as diarrhoea, stomach pains, severe vomiting, damage to the central nervous system, and damage to the immune system (Adanu et al., ibid).

E-waste workers are not concerned about not wearing protective clothing such as overalls, eyeglasses, and gloves, though it adversely affects their health (Asante et al., 2012). The literature further indicates that some informal e-waste workers reported being sick. Yet, they were unaware of their health status until a health group came to the site to take their blood samples to test for infections and upper respiratory diseases before they became aware of the conditions they contracted. Scholars (Asante et al., 2012; Ledwaba & Sosibo, 2016) affirm that e-waste is among the fastest universal growing pollution problems, particularly in Africa, due to the presence of a variety of toxic elements that threaten informal technicians' health due to primitive and poorly management of e-electronic wastes.

Informal Technicians

Informal technicians are individuals who repair and refurbish electronic items. They extend the lifetime of new and used electronic materials, which they sell for re-use, but they also produce e-waste from such equipment that cannot be repaired. Informal technicians are among the actors in the *e-waste value chain*, regularly concentrating their activities on refurbishing specific types of electronic facilities.

In our study, we conceptualise the "e-waste value chain" as an entire chain of a business's activities in creating a product or service -- from the initial reception of materials to its delivery to market. Formal e-waste recycling is a significant and growing industry in many countries. In many contexts, downstream vendors purchase the e-waste components that recyclers have separated, dismantled, and recovered. Collecting and treating e-waste formally usually includes the following steps (ILO, 2019: 8-9).

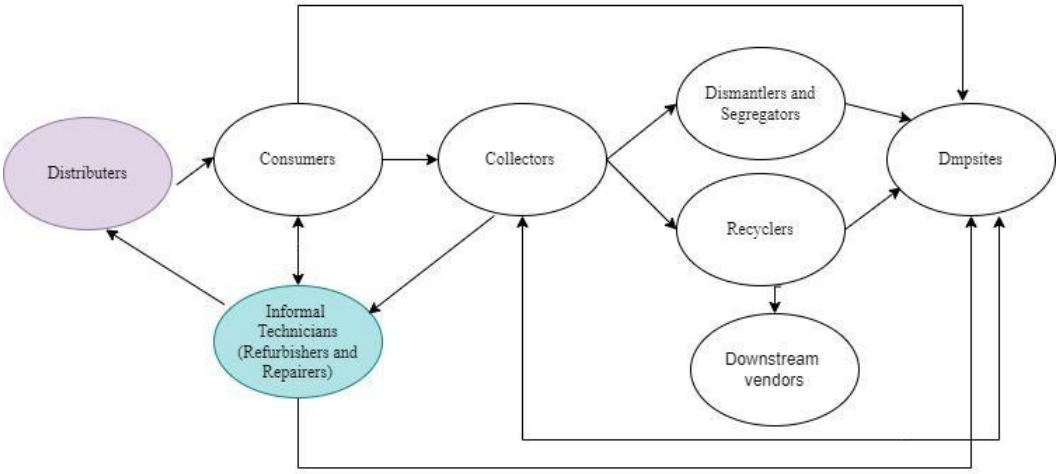

Figure 2: ***Electronic waste flows (Source: ILO, 2019).***

Figure 1 shows that when e-waste is handled in the informal economy, the value chain is more intricate, with multi-directional flows and multiple actors. While informal e-waste value chains vary from country to country, mapping carried out by the ILO in India, Argentina, and Nigeria suggests that there are some resemblances (ILO, 2019: 9-10):

a) **Distributors** purchase new and used electronic gear from numerous sources locally or globally and sell them to consumers directly.

b) **Consumers** of new and used electronic gear can be divided into individual, public, and corporate consumers.

c) **Collectors** walk door to door to collect, buy, or scavenge dumps for e-waste materials. The collectors are also referred to as waste pickers or scavengers. Most operate in unsafe conditions in the informal economy, and many belong to disadvantaged groups or minorities.

d) **Informal technicians (repairers and refurbishers)** extend the lifetime of both new and UEEE, which they sell for re-use, but they also generate e-waste from the equipment that cannot be repaired. They are among the better-organised actors in the value chain, often specialising in the refurbishment of specific types of equipment.

e) **Dismantlers** or **segregators** manually break down the used electronic gears that cannot be repaired into usable and marketable components and materials.

f) **Recyclers** burn, leach, and melt e-waste gears to convert them into secondary raw materials, which are sold to suppliers of manufacturing industries.

g) **Downstream vendors** purchase the e-waste components that recyclers have separated, dismantled, and recovered.

All e-waste gear is disposed of in landfills. Collectors scour the landfills for e-waste and components that are eventually discarded by the above actors that eventually end up in the landfills. Some of the e-waste components are taken by informal technicians for re-use purposes. Nevertheless, these technicians do not understand the health risks associated with such components (Maphosa & Maphosa, 2020). We can generally contend that the awareness of health risks associated with e-waste among informal handlers has not yet received the attention it deserves in research and public health agendas (Davis, 2021), especially in Africa.

A generic literature review portrayed several key themes and sub-themes related to e-waste disposal and management. Key aspects being discussed in these articles are many and relevant to our study, as indicated in the MAXQDA word cloud (Figure 3). However, this study narrowed the focus to informal technicians' awareness of e-waste health risks and effects.

Figure 3: ***Emerging issues from the literature on e-waste disposal and management***

Tanzania's e-waste policy context

Policies concerning e-Waste as per the e-Waste Assessment Report presented in January 2011 by Magashi, Anne, and Schluep, Mathias under the United Nations Industrial Development Organization (UNIDO) to Tanzania established that currently there is no specific policy targeting issues related to the e-waste management; however, there are several policies in place that aim to protect the environment and human health. Among the identified policies relevant to e-waste management include:

a) National Environment Policy (1997).

b) the Sustainable Industrial Development Policy (SIDP) 1996-2020.

c) the National Water Policy (2002).

d) the National Energy Policy (2003).

e) the Small and Medium Enterprises (SMEs) Development Policy (1996), and

f) the present National Information and Communications Technologies (ICT) Policy (2003).

Methods

Study settings

The study examines the informal technicians' awareness of e-waste health risks and effects at Kinondoni municipal, Dar es Salaam. Kinondoni is one of five municipalities in Dar es Salaam, the others being Ilala, Temeke, Ubungo, and Kigamboni. The Municipal Council funds, plans, and provides waste collection and disposal services under the Local Government (Urban Authorities) Act of 1982. Waste management is part of the structure of the Municipal Council's Waste Management (SWM) Department. Still, other departments such as Works, Health, and Urban Planning carry out some of its operations. The municipality collects solid waste in collaboration with private companies, community-based organisations, and other informal sector stakeholders. Kinondoni Municipal Council was chosen on purpose because it entails many informal technicians who were easily accessible by researchers. Moreover, Kinondoni was selected due to its proximity to the researchers. Kinondoni is both the administrative and commercial municipal with a population of approx. 1,245,861 people as projected by the 2012 population and housing census; among those, 847,185 are manpower, while the remainders are elders and children (URT, 2012). Of the workforce population, 61% are engaged in the private sector, 35% are self-employed, including informal technicians, and 4% are employed in the public sector. The activities involved are technical, private companies, institutions, businesses, petty traders, fishing, livestock keeping, and agricultural activities (KMC, 2018).

Study design

The descriptive case study qualitative design was used in the study (Hancock & Algozzine, 2006; Yin, 2018). This design was chosen because it was appropriate for investigating informal technicians' real-world working environments and their understanding of the health risks associated with handling electronic waste, which was the case for this study.

Sampling procedure

The study employed purposive sampling whereby informal technicians were selected based on researchers' judgment rather than randomisation. Purposive sampling was chosen as a "representative" of the population of informal technicians in Dar es Salaam city based on the ground that there were small numbers of informal technicians' working sites. The selected sites were determined based on judgment, although, within each area included, the selection of technicians was randomised. On the other hand, the research budget was limited, and thus, Kinondoni was selected for that reason. Purposive sampling was deliberately selected (Maxwell, 2013) to provide important information regarding electronic informal technicians' awareness of health risks associated with handling electronic waste.

Study sample

This study targeted 56 informal technicians, 1 Municipal Environmental Health Officer (MEHO), and 3 Occupational Health Stakeholders (OHS) at Kinondoni municipal council (*see Table 1*) to understand the informal technicians' awareness of electronic waste health risks and effects associated with the handling of such e-wastes.

Table 1: Study sample profile

	Male	**Female**	**Total**
Informal Technicians	48	8	56
Municipal Environmental Health Officer	1	0	1
Occupational Health Stakeholders	1	2	3
	50	**10**	**60**

Data collection techniques

The study used two types of data collection techniques. These included key informant in-depth interviews and documents review. Interviews were conducted with informal technicians, the target group of this research. All informal technicians were interviewed at their workplaces or workshops. Interviews lasted 10 to 15 minutes and were conducted until the saturation point was reached. The saturation point approach was adopted since researchers could not obtain new information from subsequent interviews. Documents were primarily used to cross-check information reported during interviews. Table 2 summarises the types of respondents and their distribution within the ward.

Ethical consideration

Our study was part of the mini research that aimed to understand the level of awareness towards the health risks associated with e-waste handling among informal technicians at Kinondoni municipal. The study was granted permission by the Mwalimu Nyerere Memorial Academy, and then it was submitted to the Dar es Salaam Regional Administrative Secretary (RAS). Ultimately, the RAS office permitted the study to be conducted at Kinondoni Municipal Council. The Kinondoni Municipal Executive Director (MED) granted permission to visit the informal technicians in the selected wards and the Municipal Environmental health office. Before conducting the interviews and data collection, verbal informed consent was obtained from the respective participants.

Data analysis

We employed a thematic data analysis approach (Braun & Clarke, 2006) to analyse interview data and documents. Several stages were undertaken, whereby interviews were transcribed and reviewed based on the identified themes. Researchers became acquainted with the data by reading and re-reading the transcripts and listening to the recorded interviews. The preliminary codes were generated using MAXQDA computer-based software, and all emerging issues were visualised using word cloud (see Figure 3). All regulations were reviewed and categorised into the main themes. The responses were compared across participants involved in the study by considering the coded extracts. The findings were synthesised and summarised while keeping key phrases and respondents' expressions (authentic voices) to support the findings. Finally, interview results were triangulated with those from document analysis (regulations, guidelines, policies).

Results

In this section, we report and highlight key findings of the study related to the informal technicians' awareness of e-waste health risks and effects. We employed qualitative methods to explain the emerging themes from the collected data using MAXQDA qualitative data analysis.

Knowledge of toxic e-waste materials

Informal technicians' knowledge of some components of electronic devices that contain toxic or hazardous materials. This aspect was explored as the first step of assessment to gauge their understanding of the risks associated with their daily interaction with electronic waste. It entails knowledge of identifying hazardous materials (such as specific materials found in e-waste, e.g., teratogenic and mutagenic potentials) (Machete, 2017; Thabethe et al., 2014) and the response thereof (i.e., whether they take precautions on not). This study employed interviews to identify informal technicians' awareness of the potential health risks of handling e-waste and their response. The results are presented in Figure 2.

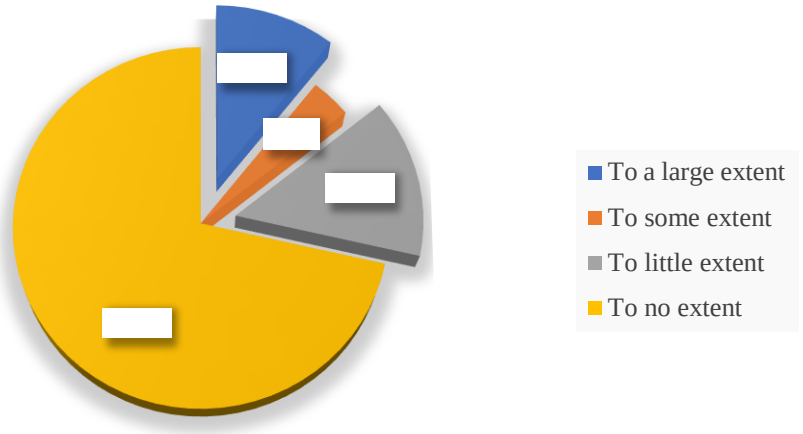

Figure 4: ***Informal technicians' knowledge of toxic e-waste materials***

The findings in Figure 2 show that the majority (71%) of informal technicians were to no extent knowledgeable regarding the hazardous chemicals in e-waste that could impair their health. Only 11% of the informal technicians, to a large extent, were knowledgeable about e-waste toxic materials, while the remaining 4% said to some extent, and 14% to a little extent. These findings imply that most informal technicians in the visited workshops are unaware of the toxic constituents available in e-wastes.

Knowledge of e-waste health-related risks

The informal technicians' knowledge of the e-waste health-related risks was assessed to establish their understanding of the precautions to be taken and their response (i.e., whether they take precautions or not). Figure xxx indicates the informal technicians' reactions on this subject.

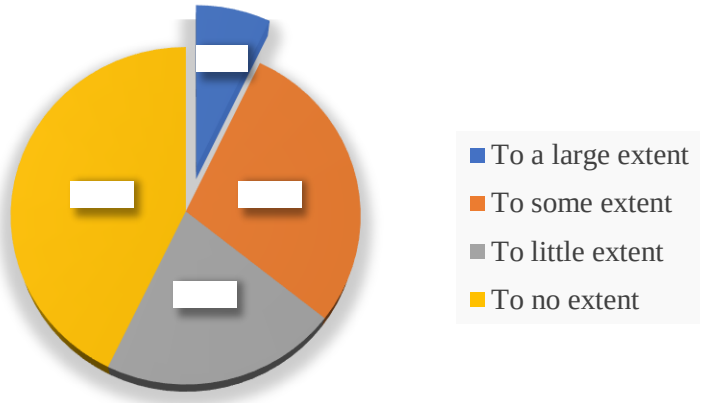

Figure 5: ***Informal technicians' knowledge of e-waste health-related risks***

Only 43% of informal technicians handling the e-wastes (i.e., as dismantlers and repairers) had no idea about e-waste health-related risks. A small percentage (7%) of the informal technicians stated that, to a large extent, they understand likely risks or illnesses emanating from their daily interaction with the e-wastes. On the other hand, 29% of the informal technicians said to some extent and 21%, to a little extent, knowledge of the likely risks of e-wastes handling. Furthermore, the informal technicians did not think they could get sick from their interaction with e-wastes but from other sources unrelated to their work or work environment.

Overall, the informal technicians were classified as having poor knowledge of their work-related health risks, even if some of them complained to have prolonged suffering from headaches, as stated by one of the technicians:

Sometimes I feel a prolonged headache, and I use anti-pains. However, I cannot say that these e-waste materials cause it because I have no idea …Mmmh I have no protection gear (*InfoTech-03*).

During interviews, it was established that the majority of the informal technicians understood that e-waste materials contain toxic substances but could not tell what kind of the toxin. One technician said:

… I have heard that these materials contain toxic substances… I don't know the types of such toxins and their effects on human health. No one has visited nor helped us understand their effects (*InfoTech-08*).

Further inquiry was made to understand the informal technicians' knowledge of the required gears to protect their health while handling the e-waste materials. The findings suggest that the variation in knowledge emanates from the lack of training, as echoed by some respondents:

I have never attended training regarding the risks of handling electronic waste… Of course, I understand some components contain materials that are not good for my health, but this is the way I have chosen, and I have no other option for getting income.

There were more disparities among the informal technicians regarding their knowledge of the protection gears than the stakeholders' views. The Municipal Environmental Health Officer thought that most informal technicians knew the required workplace protection gear. Nevertheless, informal technicians tend to ignore the use of such equipment. Such sentiment was also supported by the Occupational Health Stakeholders (OHS-01, OHS02, and OHS-03)) who emphasised that the informal technicians have elementary knowledge of the protection gears required to protect themselves in their daily activities.

Knowledge of health effects of e-wastes

The informal technicians' knowledge of the health effects of e-waste was examined using the questions presented in Table 2.

Table 2: The informal technicians' awareness level of health effects of e-wastes (n = 56).

CHARACTERISTICS	FREQUENCY (PERCENTAGE)		
	YES	**NOT SURE**	**NO**
Do you consider old electronics and electrical equipment as waste?	38(68)	6(11)	12(21)
Do you know the amount of e-waste you generate at least per month?	2(3)	25(45)	29(52)
Do you know the places where old and dis-functioning e-wastes are disposed of?	12(21)	34(61)	10(18)
Do you know that e-waste contains both toxic and precious substances?	50(89)	5(9)	1(2)
Do you know that the mishandling of e-waste has a risk to technicians?	44(79)	9(16)	3(5)
Do you know that e-waste may cause serious health problems for technicians?	15(27)	5(9)	36(64)
Do you know at least one e-waste health-related effect?	18(32)	32(57)	6(11)

Only 68% of the informal technicians considered old electronics and electrical equipment as waste; 11% were unsure, and the remaining 21% did not consider these products as waste. The study established that only 3% of the informal technicians knew the amount of e-waste they generate at least per month. Most of them were unsure (45%) and did not know (52%) the amount of e-waste they generate at least monthly at their workplaces. Further, only 21% of the informal technicians knew where old and dis-functioning e-wastes are disposed of, while 61% were unsure and 10% did not know. As to whether informal technicians know that e-waste contains toxic and precious substances, the study established that 89% of the informal technicians know, 9% are unsure, and 2% have no idea. On the other hand, 79% of the informal technicians understand the risks of mishandling e-waste, while 16% were unsure, and 5% had no idea. Moreover, while 27% of the informal technicians believe that e-waste may cause serious health problems to technicians, 9% were unsure, and 64% said that they had no idea.

Some of the informal technicians were even able to mention such adverse effects as explained by one of the informal technicians:

… the harmful materials found in electronic waste, such as lithium, barium, lead, and mercury, may cause damage to the liver and kidney... but also, I have heard that such waste has a significant impact on our nervous and reproductive systems which may later result in illness and birth problems *(InfoTech-22).*

The low awareness among the informal technicians indicates that e-waste will continue to pose severe health risks among them and to the environments where such waste is disposed of. This result is consistent with the work of Bhaskar and Turaga, which also noted that high generation of e-waste erupting because of technological growth would continue posing challenges to e-waste handlers and environments through re-use and repair remanufacturing (Bhaskar & Turaga, 2017). This is of grave concern and demands clear government policy, regulations and guidelines to protect e-waste handlers and the environment.

Initiatives by the government and stakeholders

The Municipal Environmental Health Officer and Occupational Health Stakeholders in our sample reported being aware of the government's and other stakeholders' current initiatives regarding the generic e-waste issues in Dar es Salaam city. All of them admitted that the informal technicians' current practice of e-waste handling is home-based, and its management is still challenging. In further clarification, the Municipal Environmental Health Officer said:

We understand that most informal technicians have established workshops and are not registered in their home areas. Because of that, it becomes challenging to reach all of them for educational awareness. However, as a municipal, we plan to ensure that they are educated on the risks of e-waste on their health and its environmental effects (MEHO-KN).

Regarding e-waste disposal initiatives, the Municipal Environmental Health Officer recognised the current collaboration between the municipal and other stakeholders in ensuring that e-waste is appropriately managed and the handlers, including the informal technicians, are well informed regarding the risks associated with e-waste. So far, the government has all the required regulations and guidelines for managing e-waste in different contexts. Nevertheless, the operationalisation and implementation of such instruments are still at a minimal level. The interviewed informal technicians failed to ascertain that instruments are in place that guide all businesses related to e-wastes. Limited knowledge of the available guidelines and regulations on handling e-wastes may also contribute to this observation (Wang et al., 2020).

What does this indicate about e-waste management in Kinondoni municipal council? Evidently, despite being aware of the health risks associated with the handling of e-waste among the informal technicians, some of them, nevertheless, are yet to understand the available guidelines on the re-use and disposal of e-waste as explained by one of them:

I usually take out all valuable materials and re-use them; then I dispose of all burgage here, as you can see. Most of these are useless and cannot be converted into valuable materials. …. Of course, in other countries, these would be recycled into other products, but here in Tanzania, I have not seen or heard of such industries that recycle e-waste. This is possibly the biggest challenge in our country *(InfoTech-32).*

Remarkably, the informal technicians working indoors show that their access to health-related education is minimal compared to those working in formalised areas where they than an opportunity to interact with their counterparts and share knowledge. It was commented that this might be one of the inhibiting factors for accessing awareness programmes of e-waste health-related impacts among informal technicians.

Discussion

This study sought to assess the informal technicians' awareness of e-waste health risks and effects at Kinondoni municipal in Dar es Salaam. The results revealed that most informal technicians lack knowledge of the health risk and e-waste effects. Moreover, most informal technicians fail to use protection gears when interacting with the e-wastes, increasing their risks of health-related diseases. The informal technicians working in household-based environments are not easily accessible by the authorities and e-waste stakeholders, unlike those working in formalised areas or spaces. This observation demands the formalisation of household-based technicians at the ward level to cope with the growing pace of technological innovations. Through that, it may become a positive push towards educating the informal technicians regarding Dar es Salaam city's health-related risks and effects. Studies conducted in other areas (Ankit et al., 2021; Chen et al., 2010) have revealed that disassembling electronic waste can harm the health of the dismantlers and users.

Generally, the findings of this study may be due to a lack of guidance from the government and other relevant authorities. Even though the government has implemented a few regulations and initiatives on e-waste management, there are no significant efforts to educate and guide the informal technicians on the health risks associated with e-waste handling. This implies that the government should intensify its efforts in providing informal technicians with guidelines and training on safely handling e-waste. The government should also develop regulations or laws to ensure the informal technicians comply with given standards. This could be done by providing protective gear and other safety equipment and creating opportunities for them to access information on health risks associated with e-waste handling.

Conclusion

Informal technicians often underestimate the health risks associated with their jobs and the safety measures they should take to protect themselves. The health risks of informal settings, such as e-waste technicians, are often overlooked, despite the potential dangers. To address this issue, formal institutions and informal associations must work together to communicate the health risks and occupational safety and health (OS&H) associated with such jobs. Recent research has revealed that the health risk awareness level of e-waste technicians is significantly lower than that of their counterparts in the same informal sector. It is a cause for concern, as the level of knowledge directly correlates with practices, meaning that by increasing the technicians' health risk knowledge, their risky work practices may decrease. This suggests that a bottom-up approach to reducing health risk practices in the informal sector may be more effective. To effectively implement health risk awareness programs in the informal sector, it is essential to remember that the approach may differ depending on the type of job performed, location, and technicians' position in the business. However, by considering the needs of informal technicians and engaging with associations at the grassroots level, it is possible to ensure that the health risks of such jobs are adequately addressed. Both formal and informal institutions must work together to ensure that technicians in the informal sector know the e-wastes health risks and effects of their

jobs and the safety measures they should take to protect themselves. Only by doing so can we ensure that the health and safety of informal technicians are adequately addressed.

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