



Urban Africa Risk Knowledge

Working Paper

Impact of Solid Waste Management on Health: A Biomedical Study of Solid Waste Workers at Dandora Dumpsite, Nairobi, Kenya

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Abbreviations

APHRC:	African Population and Health Research Centre
CBO:	Community Based Organization
HBM:	Health Belief Model
IDI:	In-depth Interviews
KII:	Key Informant Interviews
NEMA:	National Environment Management Authority
SW:	Solid Waste
SWM:	Solid Waste Management
UNEP:	United Nations Environment Programme

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Abstract

Urbanization is a major feature of global population redistribution, and Sub-Saharan Africa (SSA), though currently ranked as the least urbanized region of the world, is the most rapidly urbanizing globally. It is projected that in the next few decades the continent will have more than half of its population living in urban settings and this increase comes with several challenges, among which is the high production of solid waste. The management of this waste and associated health risks constitutes a major problem confronting many cities in SSA. This study builds on the need for research to objectively identify the specific health issues associated with vulnerability to poor solid waste management, especially among workers directly exposed to these wastes. The objectives of the study were to: (a) Assess the prevalence of infections associated with exposure to wastes among waste workers; (b) Identify and estimate the prevalence of injuries and accidents associated with exposure to solid waste; (c) Explore knowledge and perceptions of stakeholders and general public on the health risks associated with poor solid waste management. This was a cross-sectional study conducted over a period of approximately twelve months. The study employed a complimentary mixed methods approach (quantitative and qualitative) in the data collection process. Findings show that: there are more female than male solid waste workers and this is linked to many work options men have beyond the dumping site than women; some waste workers own protective clothing, yet it is fully established that none owns a full set of protective gears and very few uses the protective clothing they own consistently; there is a high prevalence of infections associated with solid waste work activities and environment within the dumpsite; injuries and accidents reported to be common among solid waste workers include: cuts and injuries, diarrhea, and high susceptibility to Hepatitis B infections (up to 70%). In conclusion, impact of solid waste management on health of solid waste workers need to be a priority in development planning of Nairobi County stakeholders and residents. We identify the need for sensitization and mobilization of solid waste workers on their health and for the Nairobi County government to make the SWM and health of SW workers a priority. Further studies are needed to expand the scope of health risks assessment associated with solid waste exposure. This might include air quality assessment and ground water quality assessment. Such a study would benefit by including more people living in the vicinity of the dumpsite, those with secondary exposure to the dumpsite and sub-populations in non-slum settlements not exposed to the dumpsite.

CHAPTER ONE: INTRODUCTION

1.1 Background Information

Solid waste, which includes household refuse, non-hazardous solid waste from industrial and commercial institutions, market waste, yard waste and street sweepings have been identified among others as an indication of societal lifestyles and production technology (Schubeler et al., 1996). However, improper solid waste management is linked to a wide range of risks including the stagnation of economic development, the incidence of diseases, environmental degradation and impact on livelihoods. This is especially true in urban settlements where huge amounts of waste are generated within a very small area. The impacts of poor solid waste management within cities and big municipalities on public health and the environment and ultimately quality of life of all citizens have been highlighted (National Environment Management Authority, 2014).

The estimated quantity of Municipal Solid Waste (MSW) generated worldwide annually is 1.7 – 1.9 billion metric tons (UNEP, 2010). In many cases, municipal wastes are not well managed in developing countries, as cities and municipalities cannot cope with the accelerated pace of waste production. Waste collection rates are often lower than 70 per cent in low-income countries, and more than 50 per cent of the collected waste is often disposed of through uncontrolled landfilling and about 15 per cent is processed through unsafe and informal recycling (Chalmin & Gaillochet, 2009). In cities throughout Africa, as in other developing regions, rapid population growth as well as an expansion of service and manufacturing sectors have led to an increase in the amount of solid waste produced, while its management has remained highly deficient (UN-HABITAT, 2013). This is especially the case in poor areas where limited or no waste collection takes place and where waste is collected, it is improperly disposed of, typically in open dump sites or landfills, which are frequently situated in close proximity to the city, particularly informal settlements.

The lack of formal systems to sort waste at source, and to control leakages and gas from dump sites, exposes surrounding communities to a spectrum of health risks and threatens the environment. By the same token, materials that are recovered for recycling – mainly by informal and small-scale operations, are likely contaminated, thus impacting their safety for re-use (CalRecovery Inc. & UNEP International Environmental Technology Centre (IETC), 2005; Hoornweg & Bhada-Tata, 2012). Existing evidence points to disproportionate expenditure on collection versus disposal, poor municipal administrative abilities and a lack of public funding, staff and equipment as key institutional constraints to appropriate solid waste management (SWM) (UN-Habitat, 2010). The SWM phenomenon in Kenya is not different. Municipalities all over Kenya are faced with a huge challenge in managing the increasing production of municipal wastes, and recycling which is one of the key methods of reducing MSW is not effectively used by municipalities and individuals who are into SWM. The Dandora dump site, which is an official dump site of the city of Nairobi is overflowing with waste. This is compounded by the activities of scavengers who dig through the waste for valuable items. The consequential effect of the poor management of the Dandora dump site on the environment and health of the surrounding communities and the people working at the site cannot be underestimated but is yet to be quantified and documented. Consequently, the African Population and Health Research Centre (APHRC) launched this study to empirically examine the impact of exposure to the Dandora dumpsite on specific human health outcomes among the most vulnerable waste workers in the City.

1.2 Problem Statement

The problem of solid waste generation and the inability to manage it is of a great concern to many countries in SSA. This is particularly the case because of the risks poor solid waste management (SWM) practices pose to population health. Besides, poor SWM leads to the occurrence of man-made hazards (Hambati & Gaston, 2015; Lamond et al., 2012), which have a direct implication for the health of the population (Kimani, G.N. & UNEP, 2007). Consequently, increased attention is being paid to the growing urban environmental risks that threaten the well-being and prospects especially of poor city dwellers. Kenya typifies these challenges, key among them being the often mutually exacerbating health hazards of SWM. Nairobi, the largest city in the country, has only one official dump site at Dandora, which is poorly designed and managed. This situation creates a conducive environment for disease transmission agents. Available evidence shows that poorly managed and designed landfills attract all kinds of insects and rodents that transmit disease to humans (Elliott et al., 1996), especially to people who are directly exposed to the waste.

Recycling of solid waste carries with it health risks if proper precautions are not in place. People working with solid waste containing chemicals and metallic elements may experience toxic exposure (Lavoie & Guertin, 2001). Disposal of medical wastes requires more attention as it can cause major health hazards, such as Hepatitis B and C, through wounds from discarded syringes (Anagaw et al., 2012). Waste pickers and others who are involved in scavenging in the waste dumps for items that can be recycled, may sustain injuries and come into direct contact with these infectious items. This is the case for the Dandora dump site where not only municipal waste is disposed, but also medical waste from health facilities, thereby exposing the people working on the dump site to the risks of infections. It is important to note that the Kenyan Ministry of Health in collaboration with its partners (MOH, 2016) have come out with a five year (2016-2021) health care waste management (HCWM) plan to address the issue of HCW in the country. This plan has elaborate HCWM strategies, which include but not limited to clear delineation of responsibilities, occupational health and safety programmes, waste minimization and segregation, protocols on HCW disposal, and documentation of best practices/innovations. It is envisaged that the implementation of this plan over the next five years will result in improvement and sustainability of HCWM in health care facilities, prevent and reduce risks and mitigate hazards associated with poor HCWM in humans and the environment.

Overall, occupational hazards associated with waste handling include infections (skin and blood, eye and respiratory, and those transmitted by flies); chronic diseases (respiratory diseases, cancers); accidents and injuries (bone and muscle disorders, poisonous and chemical burns, burns and other injuries); and psychological disorders (stress, depression) (United Nations Environmental Programme., 1996).

Although, the problem of solid waste management has been clearly described in the African context, its impact on health of the different exposed population groups has not been explored in a systematic manner. Indeed, making evidence on health impacts of solid waste management available could inform the planning and delivery of health care services to the exposed and affected population groups as well as the design of protective measures. In addition, knowledge of health impacts of poor SWM could inform the formulation of policies that protect the health and well-being of the most at risk populations. The present study seeks to establish the health risks associated with SWM at the Dandora dump site, so as to provide policy makers with local

evidence to design interventions to address the health needs of people who are directly exposed to solid wastes.

1.3 Overview of Impact of SWM on Health Implications

Poor solid waste management can have impacts on human health in many different ways. The population segments that are at high risk from poor solid waste management usually include – those living in areas where there is *no proper solid waste disposal method*, especially children; waste workers (collectors, transporters, and pickers); and people working in facilities that produce toxic and infectious waste. Other groups at high risk include people living near dump sites. Population groups whose water source has become polluted by leakages from solid waste dumping or landfill sites are also at special risk. Uncollected solid waste and solid wastes dumped at public sites could also increase the risk of injury, and infection. More importantly, organic solid waste poses a serious risk, as they ferment, creating conditions suitable to the growth and proliferation of *microbial pathogens*. Moreover, handling of solid waste without proper protection can result in various types of infectious and chronic diseases with the waste workers and the pickers being the most vulnerable (Pervez Alam & Ahmade, 2013).

In addition, exposure to hazardous solid waste, wastes that directly impact human health and well-being, also poses greater risk. Children are more vulnerable than any other population groups to hazardous solid wastes. Direct exposure to hazardous wastes could directly lead to diseases through chemical exposure. This is due to the fact that the release of chemical waste into the environment leads to *chemical poisoning*. Many studies have been carried out in various parts of the world to establish a connection between health and hazardous waste with some showing some grave impacts (Carter et al. 1996; De Rosa et al. 1996; Rushton, 2003).

Furthermore, solid waste from industries and agricultural establishments can also pose serious health threats. Disposal of industrial hazardous waste together with municipal waste could expose people to chemical and *radioactive hazards* (Giusti, 2009). Uncollected solid waste can also block storm water drainage systems, resulting in flooding and the formation of stagnant water bodies that serve as the breeding sites for disease causing organisms. Waste dumped near or into a water source could also cause pollution of the source of drinking water (Zurbrügg, 2002). Dumping of solid waste into rivers, seas, and lakes would result in the buildup of toxic substances in the food chain through organisms that feed on it.

Equally important is that disposal of medical waste from health facilities, also requires exceptional attention since this type of waste can create major health hazards. This waste is generated from the health facilities -hospitals, health care centers, medical laboratories, and research centers – and includes discarded syringe needles, bandages, swabs, plasters, and other types of infectious waste are often disposed with the regular non-infectious waste (Chaves et al., 2013; Puri et al., 2008). This type of waste places people who are in contact with it at an elevated risk to hepatitis B, C and other related infections. The preceding literature highlights the health risks associated with solid waste and informs this study using objective measures of health risks and outcomes related to exposure to SWM in Nairobi.

1.4 Research Objectives

The general objective of the study was to investigate the different health risks arising from exposure to poor SWM practices and people’s knowledge and perception about these risks.

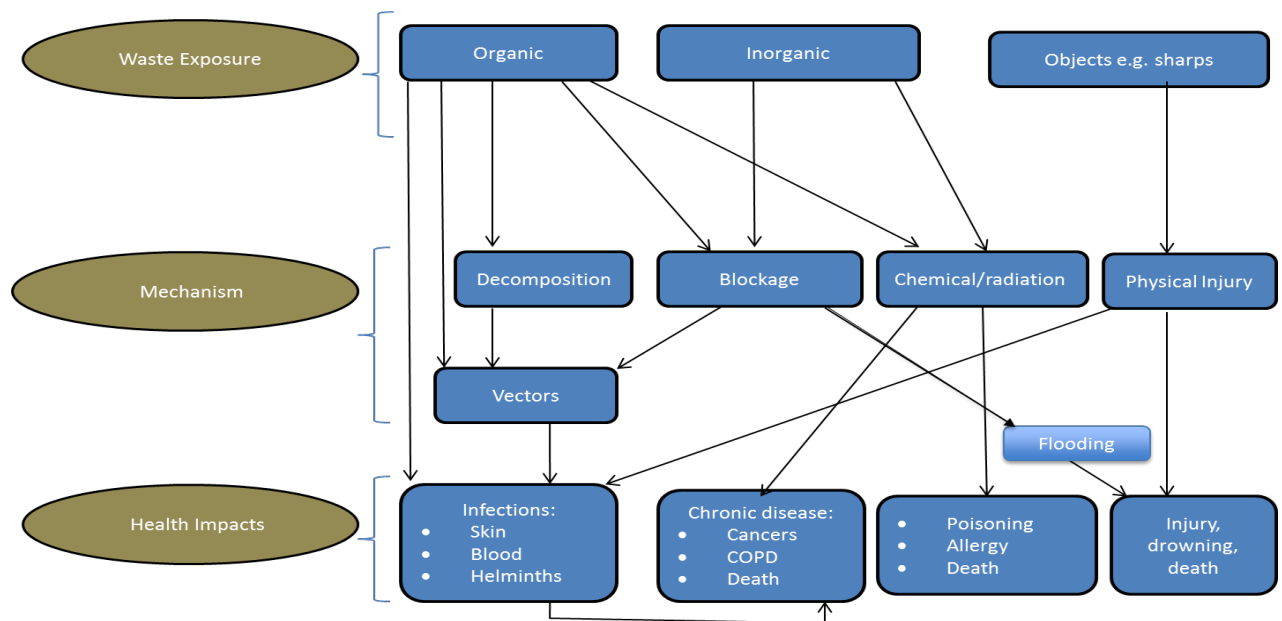
The specific objectives of the study were to:

1. Assess the prevalence of infections (e.g hepatitis B, skin infections, intestinal infestations) associated with exposure to wastes among waste workers at the Dandora dump site
2. Identify and estimate the prevalences of injuries and accidents associated with exposure to wastes among waste workers at the dump site
3. Explore knowledge and perceptions of stakeholders and general public on the health risks associated with poor solid waste management

1.5 Conceptual Framework and Operationalization

The empirical literature reviewed informs a multi-level conceptual framework to guide this study. The resulting framework illustrates the various mechanisms through which exposure to solid waste can lead to different health outcomes, both through direct pathways and through mediating/intermediate outcomes. The framework, presented below, recognizes three dimensions/sources of exposure to solid waste, which in the context of poor SWM, may include organic waste, inorganic waste, objects and sharps, which could lead to adverse health outcomes including infections, chronic diseases, poisoning, allergy and physical injuries. The accumulation of solid waste can cause blockages that increase the likelihood of flooding and also provides breeding sites for disease vectors. Organic waste could undergo decomposition and create favourable conditions for vectors, micro-organisms and parasites. Exposure to inorganic waste can cause acute poisoning, allergies and respiratory complications. On the other hand, direct exposure to sharp objects could result in physical injuries and infections. For example, exposure to sharp objects from medical waste can result in blood transmitted infections such as hepatitis B and tetanus. Even though, waste dump sites are a nuisance to many, they are also economic hubs to those with economic interest, including garbage collection cartels and pickers. As a result of competing interests, dumpsites are often associated with violent crimes, resulting in bodily injuries to those involved. Pollution of air from burning inorganic waste and decomposing organic waste also exposes residents to the risk of chronic respiratory diseases.

Figure 1: Conceptual Framework showing the pathways between exposure to solid waste and adverse health outcomes



Source: Ziraba et al., 2016

1.6 Research questions

The following specific questions guided the study:

1. What infections are associated with exposure to solid wastes?
2. What are the prevalence of injuries and accidents associated with exposure to solid waste?
3. What knowledge do stakeholders and the general public have about the health risks associated with poor SWM at individual, household and community levels?

1.7 Study Design and Sampling Strategy

1.7.1 Study design

The study was a cross-sectional study conducted for a period of twelve months. The study employed mixed methods approach (quantitative and qualitative) for data collection. The qualitative component was aimed at deepening insights on the findings from the quantitative survey.

1.7.2 Study site

The proposed study was conducted at the Dandora dump site; the only official dump site in Nairobi. The dump site is located on the outskirts of Nairobi city, about 12 kilometers from the city center. The dump site is an open sprawling area where the city county of Nairobi and private garbage collectors dispose of solid waste brought in by trucks. The site shares a boundary with the informal settlements of Korogocho and Dandora. The dump site is frequented by waste pickers who retrieve re-usable articles from the waste.

1.7.3 Population

The study population included solid waste pickers who work at the dump site and garbage collectors who bring in waste using trucks. On average, every truck has two operators who help

with the loading and offloading of solid waste. They also at times double as pickers sifting through garbage on their trucks for any valuable articles.

Inclusion criteria

Study participants were males and females, aged 6 years and above who were found working at the dump site as either collectors or pickers during the time of study. Stakeholders and members of communities bordering the dump site also formed part of the study population.

Exclusion criteria:

Individuals who, either due to physical or mental illness are unable to respond to the interview or provide a specimen sample were excluded.

1.7.4 Measurements

The following measures were used to assess the primary outcomes:

- i) Blood infections, where the test for hepatitis B was a marker infection;
- ii) Urinary infections, where we did test for urinary tract infections;
- iii) Haemoglobin level, where the level of haemoglobin of study participants was measured. The Hb measurement was done at the field level using a portable Hb meter by a finger prick;
- iv) Intestinal infestations: We did test for *Ascaris lumbricoides*; tapeworms (*Taenia* spp.), *Schistosoma mansoni* or *S. haematobium* ova and hookworm (*Ancylostoma duodenale* and *Necator americanus*). Presence of any of these constituted a positive result for intestinal infestation;
- v) Body lesions: physical examination was carried out by clinical officers to identify any clinically significant infections/lesions;
- vi) Injuries and accidents: Physical examination and/or self-reported cases were recorded;
- vii) Reported morbidity in the past two weeks: Other outcomes of interest included reported episodes of diarrhea, skin diseases and respiratory complications.

1.7.5 Sampling strategy for the quantitative survey

Sample size estimation was based on the design and occurrence of outcome of interest and level of sample stratification desired. We had three strata by age: less than 18 years; 18 to 24 years and 25 years and above. The age stratification hinges on the fact that the spectrum of individuals involved in solid waste management in terms of age is wide. We decided to use the three broad categories each of which has adequate numbers to enable us compute indicators for characterizing the population. The under 18 represent minors who are engaged in this hazardous labor activity. The 18-24 represent young adults starting out life in employment while the 25 and above represent older individuals. We were not seeking for equal age groups partly because we do not have a ready sampling frame but also it would possibly add little value. Having no strata at all would possibly misrepresent the study population structure, while having too many would require a large sample size to be able to compute indicators for each group. We very much thought that having the three categories might give us a variety of exposure risks, which are partly correlated with length of exposure (and one's age) and associated health outcomes.

We used the following sample size estimation formula to estimate sample size using the outcome that gives a higher sample size:

$$N = (Z^2_{\alpha/2} * P * Q) / d^2 \quad (\text{Kadam \& Bhalerao 2010})$$

Where N is the required minimum sample size; Z is the normal distribution value corresponding to two tailed test (1.96); P is the proportion of outcome of interest (intestinal infestation-20% ref); Q=1-P and; d is the desired level of precision (5%).

The ideal sample size was 246, and therefore for the three age strata, the overall sample size was intended to be 246*3=738. At the time of study, tension related to post election were still high and therefore data collection and specimen collection was completed by 381 waste workers which is 51.6% of the intended sample size. Due to challenges with finding minors respondents as they are nowadays encouraged to go school, the respondents constituted 6.6%. 18-24 young adults starting out life in employment had not settled back to work as a result of post-election tension and they constituted 22.6%. Therefore, majority of waste workers who were in the dumpsite and work mostly during the day were aged 25 and above and constituted 70.8% of the respondents.

Given that there was no sampling frame for this population, we recruited participants using systematic sampling. For those working with the waste delivery vehicles, we selected participants at intervals of two trucks spread throughout the day and week. For waste pickers (scavengers and collectors), we randomly selected the first participant and subsequently selected at intervals of two individuals along a chosen path through the day and week until the required sample size was reached. Details of each participant such as age, sex, place of residence, and for those working on trucks, the truck registration number, was collected and searched in the database each time a new participant is being recruited to ensure that no single person was interviewed more than once.

1.7.6 Sampling strategy for the qualitative investigation

We used a purposive sampling technique to select study participants for the qualitative arm of the study. This helped us focus on people we thought were better able to assist us understand the health risks associated with SWM. The strata for qualitative interviews is summarized below.

Type of Interview	Cadre of Respondent	Number
Key Informant Interviews (KII)	Women Leaders in the dumpsite	4
	Youth Leaders in the dumpsite	4
	Recyclers/ Entrepreneurs of solid waste	4
	Religious based organization/CBOs	2
	Community Members around the dumpsite	4
In-depth Interviews (IDI)	Scavengers/ Waste collectors	6
	Waste pickers	6
	Waste transporters	4
Total		34

1.8 Data Collection

1.8.1 Quantitative data collection

The quantitative survey data collected was aimed at generating robust representative data on the scope of socio-demographic patterns and correlates (age, sex, education, occupation, ethnicity, religion, place of residence, and marital status) of the various health risks associated with SWM as captured in study's conceptual framework shown above. The survey data was collected using a structured questionnaire, (annex 2), administered to selected waste workers at the Dandora dump site. The quantitative survey tool was programmed into tablets.

1.8.2 Collection of specimen

Blood samples

The collection of the blood samples and physical examination was conducted by trained health professionals. We hired a space in the outskirts of the dumping site, with audio and visual privacy to allow for a general examination and drawing of specimen. We used auto-disable syringes to draw 3-5mls of venous blood. Using aseptic technique, blood was drawn from the arm of the study participants by venipuncture using an evacuated tube collection system and kept in an EDTA vacutainer. Blood in the EDTA tubes was kept in a cool box with frozen ice packs and transferred to the laboratory daily. This made it possible for the specimen to be processed on the same day. The procedure of drawing the blood was guided by the WHO guidelines on drawing human blood (best practices in phlebotomy) (WHO 2010).

Collection of stool and urine samples

To facilitate taking of stool samples, a mobile waterborne toilet was hired and kept at the site for the period of the study. Participants who were not able to provide a specimen sample were encouraged to either wait on site or return whenever they were ready and were given an appointment card to ensure matching of the specimen and survey data. Participants were asked to pass the stool sample directly into a plastic poly-pot cup with a tightly fitting lid. About 20 – 40 grams of well-formed stool or 5 - 6 tablespoonful of watery stool sufficed for the routine examination. Stool samples were also kept in a cool box with frozen ice packs awaiting transfer to the laboratory for analysis on the same day. A midstream sample of urine was also collected. The urine sample collection was done by the study participants themselves based on the following instructions: They were required to first cleanse the urethral area with a castile soap towelette, which were provided by the study team. Additionally, study participants were advised to void the first portion of the urine stream into the toilet. These first steps were aimed at reducing the opportunities for contaminants to enter into the urine stream. The urine midstream was then collected into a clean container (any excess urine should be voided into the toilet). After obtaining the urine specimen the lid was screwed on tightly again being careful to avoid touching inside the container or lid. We used standard microscopy to identify either ova or parasites. This is because, standard microscopy is the gold standard for diagnosis of intestinal parasite and helminthes as it focuses on identification of either ova, cyst trophozoites or segments of the worm. The method for stool processing is the one that make the difference. In this respect the processing method is the most important, thus stool was processed using Kato Katz method.

1.8.2 Qualitative data collection

The qualitative component complemented the quantitative data and involved key informant interviews (KII) with local leaders, and individuals living in the neighborhood of the dump site. This provided an indepth understanding of the underlying disparities in perceived health risks associated with SWM and interventions put in place to reduce these risks. Study participants' diversity was critical to our goal of generating robust and grounded knowledge on health risks associated with SWM in informal settlements including community leaders, private sector actors (community based organizations, private waste management companies and youth groups who are into waste collection) and waste workers and pickers. The interviews were conducted at the most convenient locations for the participants.

1.8.3 Training of field staff and piloting

The project recruited research assistants and professional transcribers for the quantitative and qualitative data collection processes, who were taken through an intensive fieldwork training using African Population and Health Research Center's (APHRC) training protocol. The training was facilitated by researchers from APHRC, including the principal investigator, project manager, research officer, programmer, field coordinator and qualitative experts. The objective of the training was to provide the field staff with a thorough knowledge of their role in the data collection process. It entailed a combination of theoretical training (on the study protocol) and practical exercises. Specifically, the training involved: Facilitated sessions on the overall aims of the study, the study tools, research ethics; mock interviews; a field-based pilot and a debrief session was conducted after the pilot to learn from their experience with the pilot. In addition, training on the study protocol was provided for phlebotomists' nurses, and medical officers who collected the samples and conducted physical examination of study participants respectively. This enabled them get a clear picture as to what the study is intended to achieve.

1.8.4 Ensuring data quality during fieldwork

The field staff were closely monitored by field supervisors to ensure that the data being collected were of high quality. We had a dedicated office editor responsible for reviewing the data on daily basis and providing the supervisors with frequent feedbacks on identified data related issues. Data quality checks such as skips, and ranges was built into the program / software. The office editor reviewed 100% of the completed interviews, to: a) check for completeness of the data; b) ensure that all questions have been answered; c) checking for data inconsistency. We implemented a continuous process of data quality checks in the field using spot checks, sit-in interviews, and editing of completed surveys. For the spot checks, team leaders randomly select 10% of the people interviewed for revisits. The health professionals engaged were closely supervised by the project manager to ensure that they strictly adhere to the study protocol.

1.8.5 Ethical considerations

All study participants were informed about the study before any consent to participate was sought. Participants were adequately informed about the: purpose of the study and methods to be used; institutional affiliation of the researchers; the right to abstain from participating in the study, or to withdraw from it at any time, without reprisal; and measures to ensure confidentiality of information provided. All participants provided a written informed consent and were informed that participation is voluntary and no victimization of any sort was meted if they refused to participate. For those who could not read, the consent form was read to them by person they themselves identify. Also, before any medical procedures were carried out, informed consent was obtained. For minors, we obtained consent from their guardians and assent from the minor before they participated. Participants were given 500 Kenya shillings

(approximately USD 5) for lunch and lost earning opportunity. No other material benefits were provided. Individuals who were found to have intestinal worm infestation were provided with deworming treatment at one of our collaborating health facilities near the study site. Those found with other serious health conditions were referred to the nearest public health care facility for further assessment and management. The study programme facilitated their transport to the referral facility. Participants were encouraged to get their test results. Those who wish to, were encouraged to return to designated health facility to receive their results. The blood samples were taken by trained health professionals, using sterile equipment, thereby minimizing any harm or risks to the study participants. A study participant who refused for their samples to be taken were assumed not to have consented to participate in the study. All data collected was stripped of identifiers and kept in password protected database only accessible by the data manager and project principal and co-investigators.

To ensure the safety of researchers in the field, especially when working in areas on or close to the dump sites, protective clothing was provided. These included a pair of sturdy gumboots, face masks and protective coats. Protective gloves were provided to those taking the blood samples.

Blood samples were stored for analysis in the future when more resources become available. We therefore sought broad consent from all participants to cover any future analyses.

1.9 Data Processing and Analysis

Data coding, entry, and editing; transcription and coding of qualitative data generated

Quantitative data was collected using tablet computers programmed using Open Data Kit (ODK). After data collection, data was uploaded on a safe APHRC server from where it was extracted into analytical software. Further data management was conducted using Stata software. Qualitative data was captured in digital recorders and transferred to computers. The audio data were transcribed by a professional transcriber.

Analysis of quantitative and qualitative data

The quantitative data analysis were performed using STATA version 14.0. The analysis involved descriptive analysis to provide general information on the characteristics of the sample. The qualitative data was analyzed using NVivo. The data was synthesized using thematic, content and narrative analyses and was triangulated with quantitative analysis results to provide a robust picture of people's perspectives on solid waste management and health related risks arising from poor solid waste management practices.

Laboratory analysis

Laboratory analysis for blood and stool samples was conducted at the Kenya National Public Health Laboratories Services (NPHLS). Upon reception of the specimen, the samples were accessioned into the laboratory information system (LIMS). The sample was then taken to respective section for analysis. Blood in EDTA tube was separated for plasma at the laboratory by centrifugation and aliquoted into 2mls cryovials for storage at -80o C awaiting testing. Plasma was analyzed for three biomarkers for hepatitis B; hepatitis B surface antigen (HBsAg), hepatitis B surface antibodies (anti- HBs) and hepatitis B core antibody (anti-HBc) by the enzyme linked immunosorbent assays (ELISA). The testing was done using bioelisa (BIOKIT, S.A. - Ma s/n - 08186 Lliçà d'Amunt - Barcelona - Spain. Additionally, hemoglobin level of study participants was measured using blood collected in the EDTA tube at the makeshift tent

in the field using portable Hb meter. Stool samples was processed and examined by direct smear method for the presence of protozoa using Kato- Katz quantitative technique for the presence and count of parasites. For urinalysis, mid-stream urine sample was examined using standard microscopy for pus cells and parasites.

1.10 Communicating Findings of the Study

The evidence generated was already being used to influence policy and action, specifically promoting better waste management practices to reduce health risks associated with poor SWM. We facilitated dialogue amongst SWM practitioners, community members, policy makers and the general public on the need for better SWM to reduce the incidence of SWM related diseases.

The project team worked with the key actors in the city to develop a strategic policy engagement and communications plan, to guide the design and execution of actions that are more likely to result in policy and programmatic decisions. Briefly outlined below are outreach activities:

1. **Communities at risk:** These included key opinion leaders at the community level including community health workers, administrative leaders, community elders, health care providers, teachers, religious leaders and representatives of community-based organizations.
2. **Policy makers:** These include Heads of Divisions and Programme Officers/managers in the divisions of Environment, Health and Finance and Community Health Services, and District/County Health Management Teams (DHMTs) for the Nairobi County using policy briefs and face to face meetings. We shall also engaged the parliamentary committees on health and environment in the county. At the regional level, we sought to engage the Eastern Central Southern African- Health Committee (ECSA-HC) and the Network for parliamentary committees of health, all of which have annual forums.
3. **Practitioners, civil society and the research community:** These include urban planners, humanitarian agencies and research scientists both at the local and international levels. Building on the fact that SWM is a devolved function under the 2010 Kenya constitution, we are part of a countrywide Kenya Alliance of Residents Associations-led stakeholders' forum that have drafted model bills and policies on proper solid waste management across the counties of Kenya. At the international level, we targeted participations at the World Health Summit, United Nations Environmental Programme (UNEP) conferences and made presentations to a global audience.
4. **Public:** We used a variety of channels to reach the general public including fact sheets, and infographics. We also sought opportunities for interviews, news and opinion articles in the national media, as well as social media. We specifically conducted a community feedback meeting to share key results with community where most participants came from.

1.11. Study Limitations and Risks

Intense political activities around SWM in Nairobi is a key risk that hindered our study. To address this risk, we collaborated with local groups to navigate the anticipated political hindrances.

Mounting of mobile health post was misinterpreted by those working on the dump site and this led to violent opposition and attacks and on field staff. To address this, we engaged the services of community security guards throughout the data collection processes and called off further

data collection when the situation became very dangerous following the political violence of the disputed Kenya's general election in October 2017.

Beyond sampling solid waste workers using a systematic approach, the study was constrained by resources and time. Otherwise it would have been necessary to sample simultaneously non-waste workers as a comparative group to be able to establish that findings among waste workers were peculiar to the group and wholly attributable to exposure to poor solid waste management.

Our inclusion and exclusion criteria allowed only waste workers actively working in the dumpsite during the period of the study. Those who were already sick, those down and out and not able to work were not part of the study. Consequently, we may be underestimating the implications of exposure to solid waste on loss to health.

In the context of lack of separation of wastes at source, waste workers are generally exposed to hazardous chemicals, with well-known negative health outcomes such as cancer, COPD, allergies and death. However, due to financial constraints, we were unable to test for these outcomes as well as other infections like Hepatitis C and the presence of heavy metals in the blood.

Notwithstanding, our work covered significant grounds that adequately contributes to our understanding of the health risks associated with primary exposure to solid waste in the city of Nairobi, which provides a veritable basis for local discourses and engagement with policy makers in identifying health priorities and addressing related risks and outcomes among the most vulnerable urban poor. The evidence contributes to addressing the lack of data at local levels across African cities, which have been identified as a major hindrance to answering questions critical to the health needs of the urban poor; in addressing the great health inequities in urban areas; pinpointing priorities; and improving urban health programming on the nature and distribution of urban risks.

1.12 Operational definitions

1. *Waste workers*: refers to waste collectors/pickers, scavengers, and all those who offload waste trucks at the Dandora dump site
2. *Stakeholders*: refer to waste management companies, community based organizations, youth and women groups and community leaders

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CHAPTER TWO: CHARACTERISTICS OF SOLID WASTE WORKERS

2.0 Background Information

The chapter presents overview of demographic and household characteristics of waste workers in the Dandora dumpsite of Nairobi. In relation to Demographic characteristics the chapter covers information of waste workers relating to sex, age group, marital status, residential area, school attendance and highest level of school attained. In relation to household characteristics the chapter covers ownership of household items and source of drinking water.

2.1 Demographic Characteristics

Demographic information covers data on sex, age group, marital status, residential area, school attendance and highest level of school attained as shown in table 2.1 below.

Table 2.1: Demographic characteristics

Demographic characteristics (N=381)	
Sex of the Respondent	Percentage (%)
Male	35.7
Female	64.3
Age group of the participants	
Below 18	6.6
18-24 years	22.6
25+ years	70.8
Ever attended school	
Yes	95.5
No	4.5
Current marital status	
Single/Never married	34.1
Married	26.0
Cohabiting/Living together	2.6
Separated/widowed/divorced	37.3
Residential area	
Slum	33.1
Non-slum	59.1
Dumpsite	7.8
Highest Level of education attained (N=364)	
Primary	73.1
Secondary	25.0
College/university	1.9

Findings showed that there are more female than male workers in the dumping site with 64.3% and 35.7% respectively. This is attributed to more responsibility of child care to women than

men, as well as more varied work options available to male than female residents in urban slums and non-slum areas. According to a community leader:

“Women are majority working in the dumpsite and it is not their wish. It’s because of poverty thus they work at the dumpsite. Women are the majority because they do not want their kids to sleep without food so they go collecting plastics, wires and other things and go sell to get money; they don’t like doing the job but circumstances force them to do, as they have family responsibilities to manage.... It’s because men have many other options of getting money compared to women.” (IDI, Community Leader)

For this study, age of participants was categorized into three. Below 18 year olds is shown to have a low percentage constituting 6.6%, those aged 18 -24 years constitute 22.6%, and those 25years and above constituting the highest percentage of 70.8%. This is attributed to high financial demands and less work options for urban residents 25 years and above relative to the other age groups.

In terms of current marital status, the data shows that a higher percentage of waste workers are separated/divorced/widowed (37.3%). The corresponding proportions for the single/never married is 34.1%, and the cohabiting group constitute only 2.6%. .

On educational participation, a higher percentage (95.5%) of the waste workers have ever attended school, with majority (73.1%) of them having attained only primary education. The attainment of professional education is wanting among the waste workers in the dumping site with few (1.9%) respondents having attained the college/university level. The level of education attained by the waste workers was generally attributed to lack of school fees.

Education status of waste workers differs by sex. The majority (82.4%) of female compared to 17.7% of male have never attended school. The highest level of education attained by many female participants was primary and secondary constituting 68.1% and 53.9% respectively versus 31.9% and 46.2% for the male in the dumping site. For the professional education, majority (85.7%) of male participants have attended university/college level compared to female low percentage (14.3%) having attended the same level.

Educational attainment vary by marital status and residence. None (0.0%) of the participants residing in the dumpsite have ever attended college/university for professional studies while majority (85.2%) who attended college/university for professional studies resides in non-slum areas. A higher percentage of workers who resides in the non-slum have attended primary and secondary with (59.0%) and (62.6%) respectively. However participants who resides in the dumpsite have low percentage of primary and secondary school attendance with (6.4%) and (12.1%) respectively.

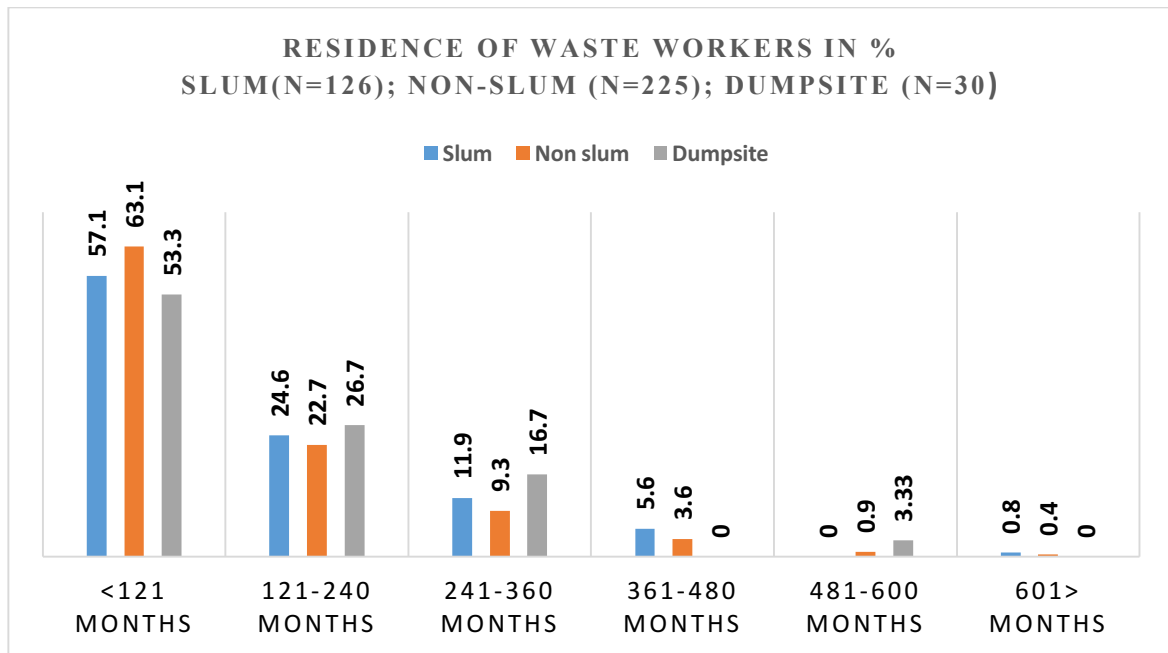


Figure 2.1 Residence and period of time in months

Previous work estimated that 20% of the waste pickers at Dandora reside at the dumpsite itself (Karanja, 2005), however the current finding shows that 7.9% of waste workers interviewed reside in the dump site. Other workers reside at the slum and non-slum areas. Majority (over 50.0%) of waste workers have resided in their current place for less than 120 months and very few (less than 10.0%) of them have resided in their current place for over 360 months as shown in figure 2.1 above.

2.2 Household Characteristics

Household characteristics entail ownership of items and the source of drinking water as shown in Table 2.3

The data shows that the main source of drinking water in the Dandora dump site is piped water into the compound (58.7%), low percentage (0.5%) described the public well as their main source of drinking water.

In terms of ownership of items, an important outcome is the over 91% of residents working in the dumping site who owns a functioning mobile phone, with 90% owning a kerosene stove and 88% owning a table. The wealth index suggests a more even distribution of residents across all wealth index categories. The extent to which these demographic and household characteristics combine with exposure to wastes in the dumpsite and linked to health outcomes of waste workers were ultimately examined in subsequent sections of this report.

Table 2.3: Household characteristics

Main source of drinking water Total (N=381)	Percentage (%)
Water sellers/vendors	11.0
Piped into dwelling	4.4
Piped into compound/plot	58.3
Public tap/standpipe	22.6
Well on residence/plot	0.8
Public well	0.5
Other	2.4
Ownership of Item (in working condition) * Total (N=381)	Percentage (%)
Clock	13.1
Radio cassette	62.2
Television	45.4
Mobile phone	91.3
Refrigerator	1.8
Electric/gas stove	17.9
Car	1.3
Motorcycle	1.6
Bicycle	4.20
Sofa set	49.3
Table	87.9
Flashlight	20.2
Kerosene lamp with glass/lantern	31.2
Kerosene stove	89.8
Electric iron	10.5
Charcoal iron	8.1
Wealth Index	
Very Low	21.0
Low	19.2
Moderate	20.7
High	19.4
Very High	19.7

*: Multiple responses

CHAPTER THREE: PARTICIPATION IN SOLID WASTE WORK AND JOB SATISFACTION AMONG SOLID WASTE WORKERS

3.0 Introduction

Managing solid waste is one of the most costly urban services, typically absorbing up to 1 per cent of GNP and 20 to 40 per cent of municipal revenues in developing countries. Solid waste management provides employment for up to 6 workers per 1,000 population – a figure that could represent up to 2 per cent of the national workforce. Even so, the service is frequently inadequate, with more than half the refuse generated in urban areas remaining uncollected, and large areas of cities receiving no regular attention, UN DESA (2014)

In Kenya, Solid Waste Management is a real challenge to the public sector (Gakungu, 2011) and addressing the challenge efficiently requires a dedicated work force. According to available evidence, deficiencies in management of solid waste are most visible in cities and towns of developing countries, with many areas within these urban centres receiving little or no attention at all (UN DESA 2014). Accordingly, the demand for solid waste collection has steadily increased in the Kenyan urban sector as urban population increase with the accompanying expansion of settlements mostly occupied by the peri-urban poor (in informal settlements) that receive little or no waste services at all.

This chapter highlights participation in solid waste work which entails income generating activity and work arrangement among waste workers. The chapter further describes the nature and the use of retrieved commodities.

3.1 Participation in Solid Waste Work

Solid waste work is the core economic activity at the dumping site. Table 3.1 shows that majority (97.4%) of the participants were involved in income generating activity in the past one year while all participants are currently involved in income generating activity. The current income generating activity with over three-thirds of the workers at the dumping site is scavenging (72.2%); this is followed by solid waste collection (24.5%) with security work being the least (0.3%) in the economic activity categories. The engagement of waste workers in solid waste work is due to lack of another job alternative as stated below:

“I did not find any other place to work. So I met some other guys who worked at the dumping site and at that time I was going through a hard time. So I decided to join them so that I can at least get something to eat” (IDI Waste Worker)

“My parents were discouraged also my marks were very little. I got 199 and my parents saw I can't go to form 1. They felt no one will accept me in school, I saw who would accept me? So I had to get alternative of surviving...I cannot refuse to do another job if I got it and it paid better, it's just that I don't have the ability to get a better job” (IDI, Waste Worker)

“The income we get from dumpsite can't be enough for saving, it's just for daily consumption, sometimes you can get you have no one who buys after collecting and you find that you have sold nothing...while I'm still doing this I'm still looking for an alternative job but can't get one” (IDI, Waste Worker)

Waste work like any other work has associations/organizations. Some waste workers are registered and once registered the members are entitled to privileges. This is what the respondents had to say about the existence of associations:

“As a group we have some money we contribute then take a group member who is sick to hospital so that they are treated. However there is no medical cover. When we contribute the money we take the person to the hospital and pay the bill.” (IDI Community Leader-Youth Leader)

“At first we formed a group... You must have a group registered with MOU registered so that the group may function. You must come with names of the group members. The process enables the group to identify themselves, therefore the community members will trust us and will know we are not thieves in their plots” (IDI Community Leader-Youth Leader)

Despite the existence of associations in the dumping site, the common work arrangement with over three-thirds (83.5%) is at individual levels. This is an indication that associations are not empowered with only 6.1% belonging to groups. This is associated to low economic status of waste workers as described below:

“There are groups but they are composed of poor people... it’s a group headed nowhere because even the contributions are meagre... everybody is complaining.” (IDI Community Leader-Youth Leader)

Table 3.1: Income generating activities of solid waste workers

Income generating activities of solid waste workers (N=381)	
Income generating activities of solid waste workers	Percentage (%)
Involvement in income generating activities in the past one year *	97.4
Current involvement in income generating activities *	100
Income generating activity*	
Solid waste collection	24.5
Scavenging at the disposal site	79.5
Waste transportation	4.2
Security officer at the dumpsite	0.3
Loader/off loader of vehicles	8.1
Buy and sell things at the dump site	2.4
Others	2.6
Main income generating activity engaged	
Solid waste collection	18.9
Scavenging at disposal site	72.2
Waste transportation	2.4
Security officer at dumpsite	0.3
Loader of waste on vehicles	2.8
Buying and selling at the dumping site	2.1

Other	1.3
Type of work arrangement	
Individual	83.5
Family	1.3
Casual employment	9.2
Organized group	6.0
Membership of waste workers' association/organization	
Yes	25.2
No	74.8

3.2 Nature of Retrieved Commodities

Current total waste collection levels in Nairobi are estimated at 50% (UNEP/CCN 2009 ISWM Framework Report). JICA study (1998) determined the Nairobi Municipal Solid Waste stream to comprise of: 51% food waste, 17% paper (15% recyclable), 12% plastics (5% containers), 7% grass and wood, 3% metal, 3% textile, 2% glass, and others (5%) and ITDG (now called Practical Action) in 2004 gave a slightly different municipal solid waste composition with organics comprising 61%, 21% plastics and 12% paper (Bahri, 2005).

Findings from this study (see Table 3.2) show that plastic was the most commonly retrieved item (83.7%) whereas papers with 53.0% was the second most retrieved item. Medicines 0.8% was the least retrieved items.

“Mostly we collect plastic things like bottles, basins and plastic paper bags and then sort them” (IDI Waste Worker)

Some hospitals do not separate syringes from other waste and we collect them. (IDI Community Leader-Youth Leader)

The benefits of the retrieved items was seen to be for sale and the least benefit is using them as with 92.1% and 23.9% respectively. Recycling was depicted to be 0%. This is confirmed by the fact that inorganic waste recycling in Nairobi is restricted to licensed waste dealers who buy from large groups of unregistered individual waste pickers and neighbourhood based itinerant waste traders, and sell in bulk to large scale waste recyclers (Baud et al, 2004).

There are those people we sell to them in quantity like kilograms, they pay per kilogram ... In that garbage we get privilege of collecting some usable materials like plastic materials, metals which we find from the garbage. So you go measure and get other money. (IDI Waste Worker)

Almost 50% reported that human fetus is the most distressing retrieved item while hospital waste is the least retrieved distressing item

Table 3.2: Retrieved commodities in the dumpsite

Retrieved commodities (N=381)	
Commonest item retrieved from the dumpsite *	Percentage (%)
Metal	43.3
Plastic	83.7
Glass	21.3
Paper	53.0
Clothing Item	17.3
Food remains	40.9
Medicines	0.8
Electronics	7.9
Bones	15.0
Carton Boxes	16.8
Do not collect/retrieve	2.1
Others	20.0
Benefits of retrieved items *	
Use them	23.9
Sell them	92.1
Recycle them	0.0
Others	7.1
Distressing item retrieved from the dumpsite *	
Human Foetus	48.8
Human body parts	23.6
Fecal waste	25.5
Animal carcasses	26.8
Hospital waste	18.9
Others	22.8

***: Multiple responses**

3.3 Income generating activity of solid waste workers

Income is a motivating factor for solid waste workers and previous studies show that waste dealer's incomes average US\$163/month (US\$5.4/day), and range from US\$31 – US\$500/month (Karanja, 2005).

In the current study, the average monthly income from main income generating activity shows that majority (84.25%) of the respondents earns less than 10,000 Kshs. The average monthly income from other income generating activity shows that a higher percentage (75.6%) earns less than 5,000 Kshs. This is shown in Figure 3.1a and 3.1b below.

“At the dumpsite all is luck you may not earn anything.... It depends on your brain may be per day they make 300KSH, so in a month it could be 9,000KSH” (IDI, Community Leader-Youth Leader).

The amount of money earned at the dumpsite for different groups differ:

“Around six thousand in a month... In a day sometimes you earn 200... 300 sometimes 250 it depends. There are some who own vehicles, those may make ten to fifteen thousand a month, because of their levels...we are not all equal just because

we are at the dumping site, there are car owners and some car owners who work in their own vehicles, now those ones earn more than us, then there are lower ranks... us... we also earn little” (IDI Waste Worker).

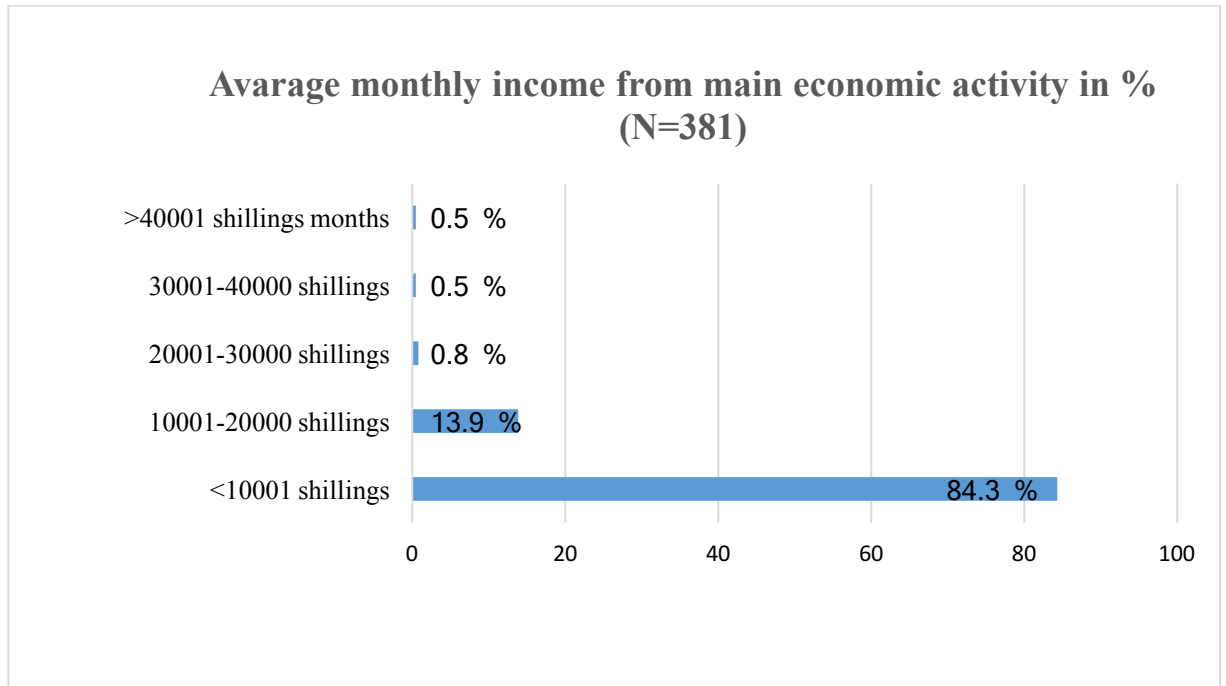


Figure 3.3a: Average monthly income from the main income generating activity

The figure 3.3a shows that the higher the salary, the lower the percentage of people who are earning. Almost all (%) of waste workers earn below 20,000Ksh in the main income generating activity (shown in figure 3.3a) with majority (85.3%) earning less than 10,000Ksh from the other income generating activity (shown in figure 3.3b).

Previous studies reported that most waste dealers also earn from supplementary activities; 60% of the dealers reported secondary activity in 2nd hand clothes and 48% in charcoal. Some do this to diversify, others as an exit strategy should business decline (Baud et al, 2004). For this study, 22.6% of waste workers are engaged in another income generating activity (Figure 3.3b).

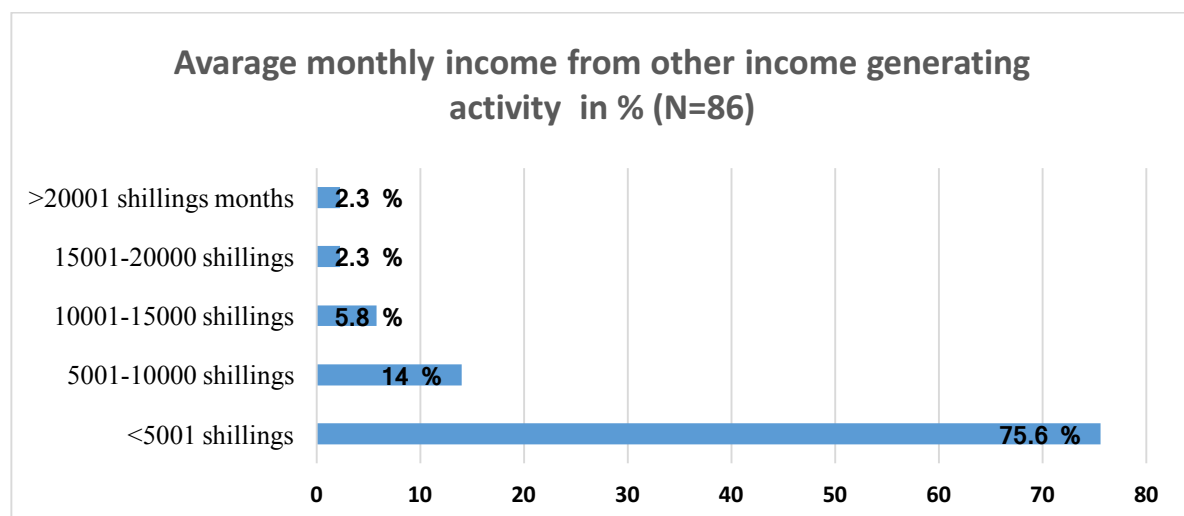


Figure 3.3b: Average monthly income from other income generating activity

Waste workers also earn some income from retrieved items. Income from retrieved items is less than 1500 Kshs for 97.6% of the workers as shown in figure 3.3c below.

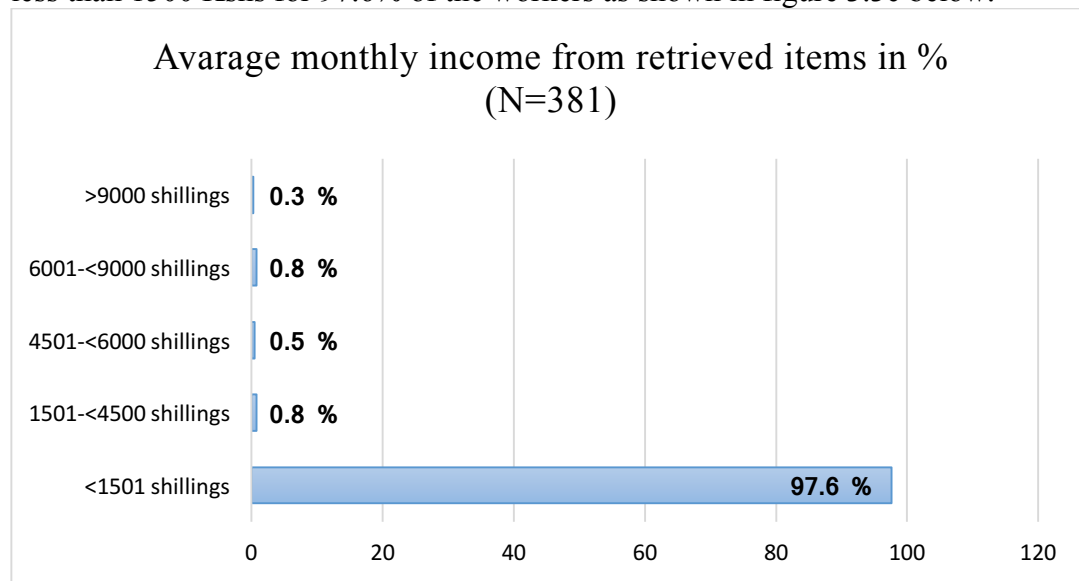


Figure 3.3c: Monthly income from retrieved items

3.4 Job satisfaction of solid waste workers

Job satisfaction is the collection of feeling and beliefs that people have about their current job. People's levels of degrees of job satisfaction can range from extreme satisfaction to extreme dissatisfaction. In addition to having attitudes about their jobs as a whole, people also can have attitudes about various aspects of their jobs such as the kind of work they do, their coworkers, supervisors or subordinates and their pay (George et al., 2008).

Job satisfaction of solid waste workers is related to earnings from main income generating activity, duration of stay working in the dumping site, working hours in a typical day among other characteristics.

3.4.1 Job Satisfaction and Earnings from Main Income Generating Activity

The status of satisfaction with the main economic activity show that close to half (46%) of individuals working in the dumping site are not satisfied; 30% are dissatisfied and 16% were very dissatisfied as shown in figure 4.2 below. All (100%) of very dissatisfied group earn below 20,000 Kshs per month from main income generating activity whereas almost all (97.4%) of dissatisfied group earn below 20,000 Kshs. This is an indication that there is a relationship between earnings per month from main economic activity and job satisfaction. Chi-square test for job satisfaction and earnings per month from main economic activity confirms the existence of a relationship with a P-value of 0.05 (Tabulations not shown).

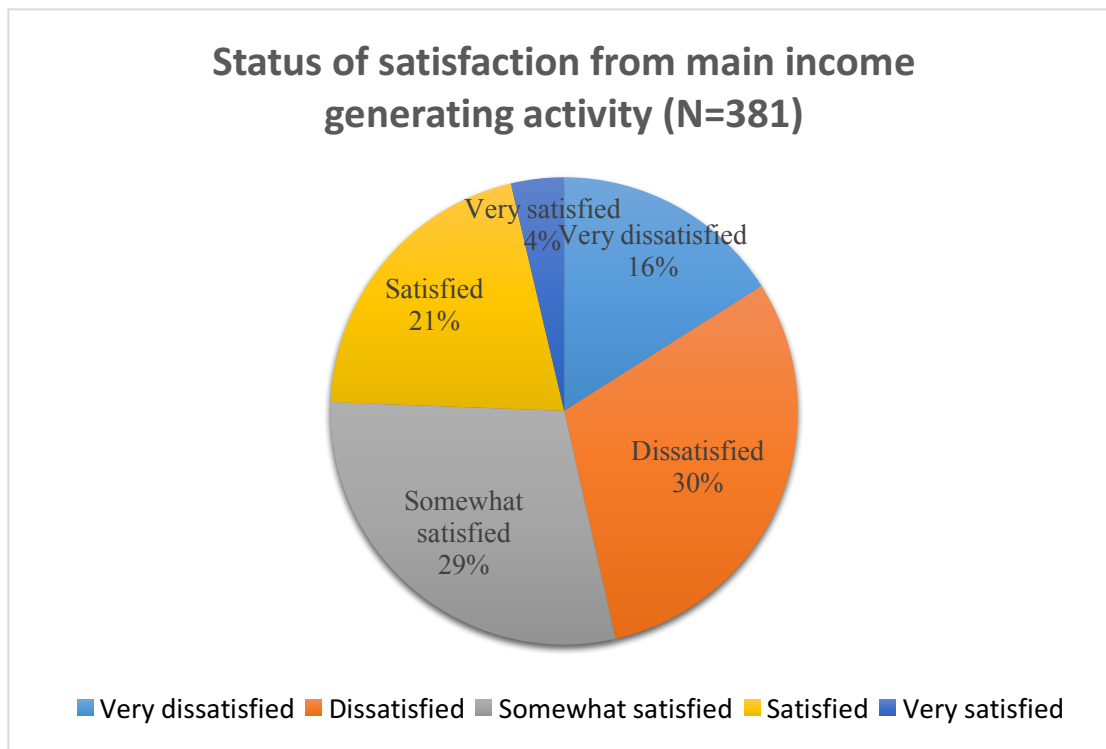


Figure 3.4; Status of satisfaction from main economic activity

3.4.2 Duration working in the dumping site and Job satisfaction

There is no stipulated period one has to work in the dumping site. Some have worked for many years (40 years) while others just started working (1 month).

“There is no stipulated time that one must work there... some have worked for ten Years. six years...” (IDI, Waste Worker)

“You find people who joined while they were children, now they are old they are still there... they age while still there.” (IDI, Entrepreneur)

Findings show that majority (67.2%) of the waste workers who participated in the study have been in the waste work for less than 121 months (10 years) with a very low percentage(0.5%) having worked for a duration of over 480 months (40 years). The inability to stay long in the waste work is attributed to health reasons:

“Most don’t last for long working in the dumping site because their health becomes worse as they are affected by diseases and gets injuries like wounds. Like myself I slipped and got a cut on my finger and fall in the garbage working place. You see I have stayed for long without going there. Therefore, many people do not stay long there without being hurt and those who have options leave the job.” (IDI, Community Leader-Women Leader)

Employees who have stayed long in the dumping site appreciate their work and feel satisfied

“I find my work good because I have done it for a long time... around fifteen years... It helps me feed my family of three children and I don’t have a husband...I think my job is good because my children eat and school... I don’t see anything bad about my job...there’s no other job, it’s the only thing I rely on.” (IDI, Waste Worker)

Table 3.1: Duration of work at the dump site

Duration of work at the dump site (in months)	Percent
< 121 months	67.2
121-240 months	25.5
241-360 months	3.7
361-480 months	3.1
>480	0.5
Total (N)	381

3.4.3 Working Hours in a typical day and job satisfaction

Labour laws of Kenya recommend a standard 8 working hours for effective work-life balance of an individual. Majority of waste workers (68.5%) work for 6-10 hours per day.

Table 3.2: Waste workers working hours

Working hours in a typical day	Percent
<6 hours	15.2
6-10 hours	68.5
11-15 hours	16.0
>15 hours	0.3
Total (N)	381

Individuals who work for relatively longer hours inclusive of nights are less satisfied.

“it is not satisfactory. So you are forced to work at night, or if it’s during the day, from morning to 2PM” (IDI, Community Leader-Youth Leader)

3.4 Summary

At the time of the study, majority of the participants were involved in income generating activity in the past one year, while all participants were currently involved in income generating activity. Some waste workers are registered and once registered the members are entitled to privileges. Many others are unregistered, which makes them vulnerable to competition and exploitation. Despite the existence of associations in the dumping site, the common work arrangement among over three-third of the workers is at individual level. Plastic was the most commonly retrieved item, second in order of magnitude was papers, with medicines being the least retrieved item. The benefits of the retrieved items was seen to be mostly for sale, with using them reported as the least of the benefits. The amount of money earned at the dumpsite for different groups differ based on levels of activities, with those having multiple activities in the dumpsite, such as those offloading lorries (which tend to be men than women) and those owning their own vehicles for waste collection earning more than others. Most waste dealers also earn from supplementary activities beyond the dumpsite.

Job satisfaction of solid waste workers is related to earnings from main income generating activity, duration of stay working in the dumping site, working hours in a typical day among other characteristics.

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CHAPTER 4: PROTECTION AND SAFETY

4.0 Introduction

This chapter examines the safety and protective resources available to solid waste workers to protect them against the hazards associated with daily exposure to solid waste. These work related hazards have health implications for the workers and hence need to be addressed. The Kenyan labour law emphasizes the right of every individual or citizen to work in an environment that is safe. Provision of safe environment as envisioned in the law is the responsibility of the employer. However, this bit may not be applicable to solid waste workers, majority (85%) of whom are self-employed. The framers of the labour law anticipated this arrangements and therefore made provisions in the law to take care of the self-employed. The relevant part of the law asserts that every self-employed person shall— (a) take all necessary precautions to ensure his/her own safety and health and that of any other person in his/her workplace or within the environs of his workplace; (b) at all times use appropriate safe systems of work, preventive and control measures (Government of Kenya, 2010). In the context of solid waste workers at the Dandora dumpsite in Nairobi, this is quite a problem probably due to lack of knowledge on safety issues, inability to acquire safety gears due to poverty among others.

In this study, we investigated a number of safety related resources and practices: possessing protective gears, consistent use of protective gears at the work place, being knowledgeable about safety and infection control related to work, vaccination against Hepatitis B and Tetanus, hand washing between work and meals and deworming. The details of the findings are presented below.

4.1 Protective Gears

Based on the referenced law above, it is expected that people engaged in solid waste management would use protective gears to prevent them from being exposed to hazards of the waste. However, that is not the case among some solid waste workers at the Dandora dump site, as greater number do not own protective gears.

“There are those who have (Protective clothing) and some who don’t, the bigger number are those who do not have” (IDI, Entrepreneur). “We do not wear protective gears such as gumboots, we just use old shoes” (IDI, Waste Worker). These views were also supported by some community leaders. “Waste workers do not have protective gears, in fact most of them don’t have” (IDI, Community Leader)

Some of the entrepreneurs in the solid waste management space feel that the most important protective gear that is needed by waste workers are gumboots. Other gears such as clothing and gloves are not so important. Below is what one of them had to say.

“We don’t insist on gloves but rather gumboots because of the water beneath the waste, so as to prevent pneumonia. We believe, gumboots are the only articles we feel may be of assistance, but with regards to clothes, we just use worn out clothes” (IDI, Entrepreneur).

An analysis of those who indicated they had protective gears showed that having a protective gear did not guarantee a consistent use. For example, the results showed that half (51%) of the waste workers owned gumboots. However, only 66% (Table 4.1) indicated they used them consistently. Thus, owning a protective gear is one thing and using it is another. This finding is consistent with previous studies, whereby the knowledge about protective gears did not correlate with consistent use (Diwe et al., 2016). The inconsistent use could be attributed to

lack of knowledge on the risks associated with exposure to solid waste. The findings in the quantitative analysis were supported by those of the qualitative study. The qualitative respondents indicated that they wear gumboots when it is not sunny and wear something else when it is sunny to avoid being burnt by heat from the sun. Furthermore, 59% of those who indicated they owned gloves used them consistently. The dominant narrative among waste workers largely point to the lack of basic facilities, tools, protective gears or suited places where waste workers can work under safe and sanitary conditions. The lack of these things as the literature suggests make the informal waste workers vulnerable to health risks and hazards due to their prolonged exposure at open dump sites and by working with toxic, hazardous and infectious materials from the waste stream (Paul, 2012).

Table 4.1; Protective Gears

Protective Clothing possession * (N=381)	Yes (%)
Footwear (gumboots)	50.7
Gloves	16.0
Goggles	1.3
Face masks	2.4
Total (%)	26.3
Protective Clothing consistently used* (N=368)	Yes (%)
Footwear (gumboots)	66.3
Gloves	59.0
Goggles	20.0
Face masks	44.4
Total (%)	

* Multiple responses

4.2 Reasons for Inadequate Safety and protection

Previous studies show that inadequate safety and protection of solid waste workers is as a result of poverty since attributed to meagre wages from the solid waste work (Ochwoto et al. 2017). Our results revealed a number of reasons why waste workers do not use protective gears, ranging from ignorance to poverty. Some of the participants in the qualitative interviews did not see the importance in the use of protective gears in their work, and others did not just like wearing protective gears as they are used to working without them. Some participants also had the view that wearing protective gears interferes with their work. The quotes below illuminate the various reasons outlined above

“I don’t see the importance of protective clothing.” (IDI, Waste Worker)

“We don’t like wearing them. Our Boss gave us but just wearing them every time is what we don’t like.” (IDI, Waste Worker)

“Sometimes, you can’t wear them since it’s difficult to carry loads while overdressed.” (IDI, Waste Worker)

“I don’t use anything at all because, for instance, if I use gloves on my hands, I would not be able to work properly.” (IDI, Waste Worker)

“Most people don’t use them because they are used to work without them, and secondly the gears are not available” (Entrepreneur)

“Some may want to but some don’t care. There are people who don’t even care about their own lives.” (IDI, Waste Worker)

The views of the community leaders were in conformity with that of the solid waste workers. This is what one of them had to say.

“Sometimes when you wear a protective gear, it makes you uncomfortable... We may say things like gloves reduces efficiency of work” (IDI, Community Youth Leader)

The issue of poverty as it relates to non-use of protective gears also came out in the qualitative interviews, as the quotes below illustrate.

“What makes them not have protective clothing is because of financial constraints. The money goes to the group and others for their own day to day use. There is no way someone working in the dumpsite can budget for money to go and buy protective clothing when there is need to contribute to their group...yes if provided with protective clothing they will use.” (IDI, Community Youth Leader)

“We don’t wear protective gears because we don’t have. I have gumboots but I don’t have gloves... unless I get them from the garbage I don’t have money to buy them.” (IDI, Waste Worker)

Protection and safety are important in the health and wellbeing of waste workers yet there are shortcomings as stated in the excerpts above, which calls for policies to support health and safety as stated early by Ferry et al. (2015) who proposed the need to use a comprehensive Workplace Safety and Health Management framework consisting of a policy, management commitment, effective planning, reliable implementation and operations, performance measurements and an audit review program. The paradox in our study could be attributed to negligence by government and stakeholders to act on the shortcomings.

4.2 Vaccination, hygiene practices and deworming

Vaccination as a preventive measure against Hepatitis and Tetanus infection due to exposure to solid waste was also explored in the study. The results showed that as high as 76% (Figure 4.1) of solid waste workers were vaccinated against Tetanus, while a paltry 2% vaccinated against Hepatitis B. The low vaccination rate for Hepatitis B is worrying as these workers are exposed to all kinds of hazardous waste including medical waste and hence makes them more prone to Hepatitis B infection (Moi et al., 2015). This highlights gap in efforts to promote Hepatitis B vaccination among persons working at the dump sites in Nairobi. The challenge however is that Hepatitis B is a major public health challenge across the country and there are gaps generally in the availability of vaccination nationwide (Ochwoto et al. 2017).

Another important preventive measure is good hygiene practices such as hand washing with soap. The results from Figure 4.2 below show that hand washing is not a common practice among solid waste workers. Only 20% of those interviewed indicated that they always wash their hands with soap between work and meals, while 44% indicated they never wash their hands. This has the potential of exposing them to elevated risks of infectious diseases morbidity, as the literature shows a strong link between poor hygiene practices and disease infections (Black et al., 1981).

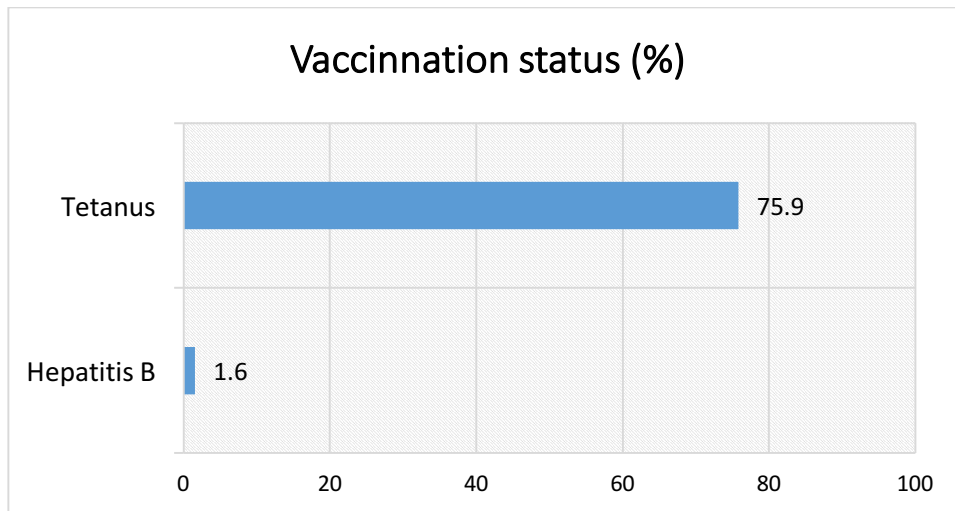


Figure 4.1: Vaccination stats of solid waste workers

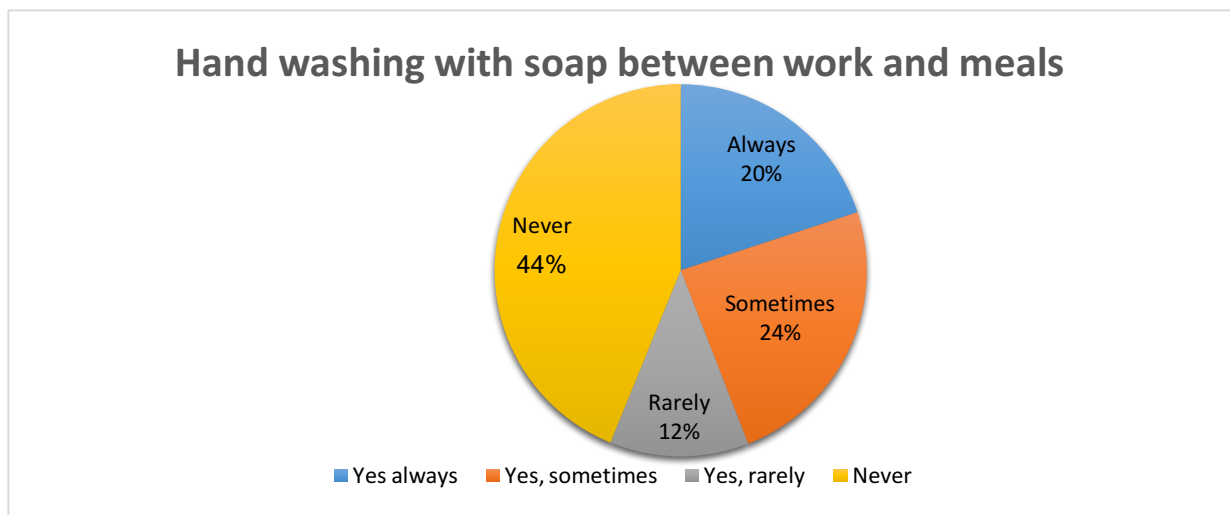


Figure 4.2: Handwashing status of solid waste workers

4.3 Summary

The chapter investigated the safety and protective measures employed by waste workers to protect themselves against the hazards of daily exposure to solid waste. Based on Kenyan labour laws, it is expected that people engaged in solid waste management would use protective gears to prevent them from being exposed to hazards of the waste. The results showed that the use of protective gears is not a common practice among solid waste workers at the Dandora dump site. There are number of reasons for non-use of protective gears and these included, ignorance on the importance of using protective gears, inability to purchase items due to poverty and difficulty in performing their work effectively when wearing protective gears. Solid waste workers feel that the most important protective gear that is needed for their work are gumboots. Other gears such as clothing and gloves are seen as not so important. Notwithstanding, protective gear ownership did not guarantee consistent use. Waste workers wear gumboots when it is not sunny and wear normal shoes when it is sunny to avoid being burnt by heat from the sun. The findings highlight the gaps in efforts to educate solid waste workers on the need to use protective gears during their work.

The results on vaccination against Tetanus and Hepatitis B showed that majority of solid waste workers were vaccinated against tetanus, while the number vaccinated against Hepatitis B was extremely low (2%). Thus, making Hepatitis B vaccines accessible to this group of people is a warranted priority. Good hygiene practices such as handwashing with soap was also found to be lacking among solid waste workers. These gaps highlight opportunities for community mobilization and education-related interventions among waste workers on health implications of their exposure to solid waste and protective behaviors. Evidence from Asia and Africa consistently support that Hepatitis B virus (HBV) is likely to be more prevalent in certain populations and occupational groups, such as municipal solid waste workers, especially waste scavengers (Alireza et al., 2016; Sawyerr et al. 2016). With pathways to virus transmission including use of bare hands and the lack of hygiene and occupational safety during waste management activities (Sawyerr et al. 2016), our findings reiterate the importance of prioritizing HBV vaccination, promotion of personal hygiene practices and regular training on occupational safety among waste workers.

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CHAPTER 5: SUPPORT FOR SOLID WASTE WORKERS

5.0 Introduction

The section focuses on the support solid waste workers need to be able to perform their work effectively. Several sources of support were identified in our study. These included government, community, individuals and the private sector. The need for support by solid waste workers is a global concern. A study done in Thailand reported the need for facilities to support waste separation, waste containers, waste collection points and more or modified waste collection vehicles. Technical solutions also included increasing the frequency of waste collection days, and changes to collection routes. Second tier solutions of waste reduction through recycling and composting were also mentioned (Taiwo, 2011).

It is believed that if government gives the necessary support to these informal waste workers, it will have a positive impact on their day to day activities. However, this is often not the case, because the local governments have limited resources and often there is a lack of prioritization in SWM as well as the lack of political will to effectively implement SWM programmes. Consequently, as UN-Habitat observed, the service provided in a majority of developing country cities and towns can, at best, be described as unreliable, irregular and inefficient (UN-Habitat, 2014). The detail discussion on the sources of support is presented in the subsequent sub-sections.

5.1 Support from the government

Previous report identified the main challenge among Nairobi solid waste picker groups in 2009 as the lack of support by the Municipal Council in relation to the transportation of waste and the non-recognition of CBOs and other informal waste organizations (Kuria and Muasya, 2010). The results from our current analysis showed that not much have changed in the last ten years. Consequently, solid waste workers continue to face similar challenges for which they need various forms of support from either the county or central governments. For instance, as low as 8% of respondents indicated they got support from the county government (Figure 5.1). This low response to the needs of solid waste workers by the government was attributed to unfulfilled promises from politicians and government. This is echoed in the quotes below.

“Many of them (politicians) keep promising, but nothing has been done. It’s just God who helps us; the government should try and save its people from problems.” (IDI, Waste Worker)

“The issue is about the government... either their solutions do not work or they never fulfilled their promises. We have been informed JICA is coming, then that project just vanishes and funds embezzled, then we are informed of another organization that wants to produce gas from excreta among others but they never initiated the projects.” (IDI, waste worker/Middle man)

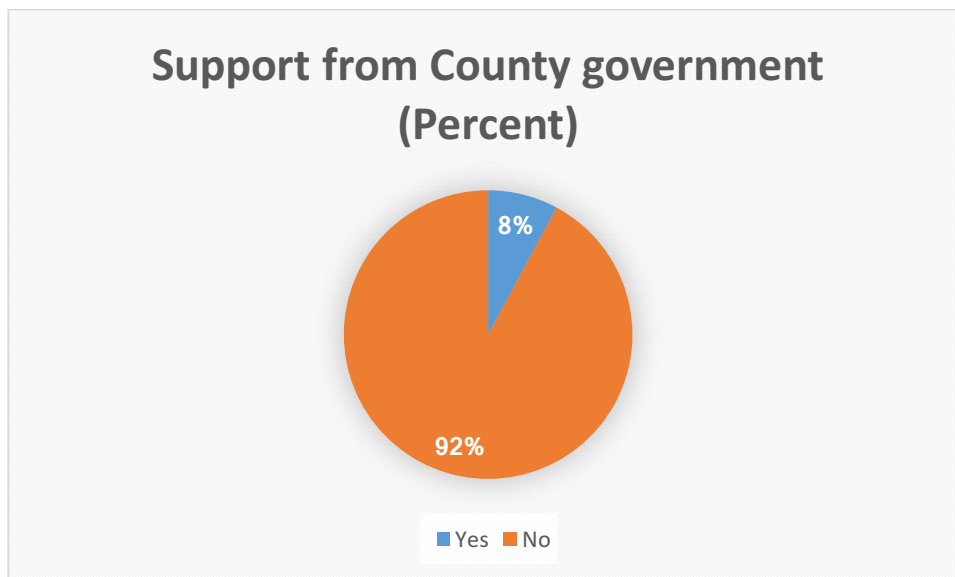


Figure 5.1: Support of solid waste workers by the government

Waste workers felt that government could support them in the following ways: provision of working tools and machines, better alternative jobs, protective gears and clean water to facilitate their work.

5.1.1 Working tools

The provision of machines such as tractors and trucks will increase their work output and also create more job opportunities for waste workers.

“Nairobi City county should get serious and provide good machines such as tractors and trucks, which will increase our work and job opportunities for others who are not working” (IDI, Waste Worker).

Community leaders felt that the provision of these facilities will make it possible for residence to assemble the waste at one area for collection. This is quite a justifiable request, but may not be addressed immediately as the county indicated several challenges with regards to SWM machinery. However, bringing the private sector onboard may help.

5.1.2 Alternative Jobs

Study participants also indicated the need for the government to provide them with alternative jobs. This suggests that solid waste workers are not content with the job they are currently doing. Nevertheless, providing alternative for them may be a challenge to the government as getting an alternative job requires some skills, and since majority of the solid waste workers are non-skilled labourers.

“Yeah they normally say if the government can assist them to get other jobs and leave the one of solid waste management, they will be happy.” (IDI, Waste Worker)

“My opinion is that the government should provide us with alternative jobs. That will really make us happy... we don't like working here” (IDI, Waste Worker)

5.1.3 Protective Clothing

With regards to protective clothing, the results showed that solid waste workers need support from government in relation to the provision of protective gears for their work. Though, there has been an effort from the government in this regard, the approach has been piece meal.

“We should be helped with things like gloves” (IDI, Waste Worker).

“We should be given protective gears like apron, and gumboots.” (IDI, waste Worker)

“Only the government can intervene because if it’s on matters to do with gumboots, gloves... we have tried to talk to those in government to provide this things but they only provide piece by piece.” (IDI, Entrepreneur)

5.1.4 Management of the dumping site

The management of the dump site was placed on the shoulders of the government. Respondents were of the view that it is the responsibility of the government to provide safe place for waste disposal and also ensure that dump sites are properly managed. This is what a community leader had to say;

“It’s their responsibility (government) to have a designated place where people can dump their garbage...you can’t just create a place where people live for garbage to be dumped there and it’s not being managed. Our health is in their (government) hands because it’s them who are allowing the garbage to be dumped here.” (IDI, Community Leader)

5.1.5 Support for medical care

Solid waste workers indicated they will need government to support them in the payment of their medical bills. This is because they are unable to afford health insurance (only 5% were on health insurance) due to low incomes and therefore have to pay from their pocket anytime they fell ill. And in most cases, they were not able to go for treatment due to lack of money to pay for the same.

“If I could get a place to be treated, I would be happy and it would help me because sometimes I don’t have money for medication” (IDI, Waste Worker)

“The government could provide us with medication to prevent diseases such as Hepatitis B, even if there is one for preventing TB” (Community Women Leader)

“Government should intervene and provide where this people should go to hospital and provide this clinic with medicines so that they can get medicine when they go there. If they get medication then they could go back to work. So the challenge is mostly health, the hospital here, especially has no medicine... they prescribe you medicine to go and buy for yourself.” (IDI, Entrepreneur).

5.1.6 Issues associated to nature of solid waste work

Figure 5.2 presents the factors affecting the work of the solid waste workers. Prominent among them is the issue of lack respect for solid waste workers by the community. The results showed that over two thirds (79%) of waste workers reported that they were not valued in the community because of the nature of their work. The qualitative data also supported this finding; *“We help them and they call us people for garbage”* This may have been influenced by the perception that solid waste workers are thieves or bad people, as 68% of the respondents reported that they were viewed as such in the community. Consequently, people tend to shy away from them. A little over half (53%) of the respondents indicated that this as an issue affecting their work. Related to the above findings is the issue of emotional and physical harassment, where 38% (results not shown) indicated they were either physically or emotionally harassed in the course of their work.

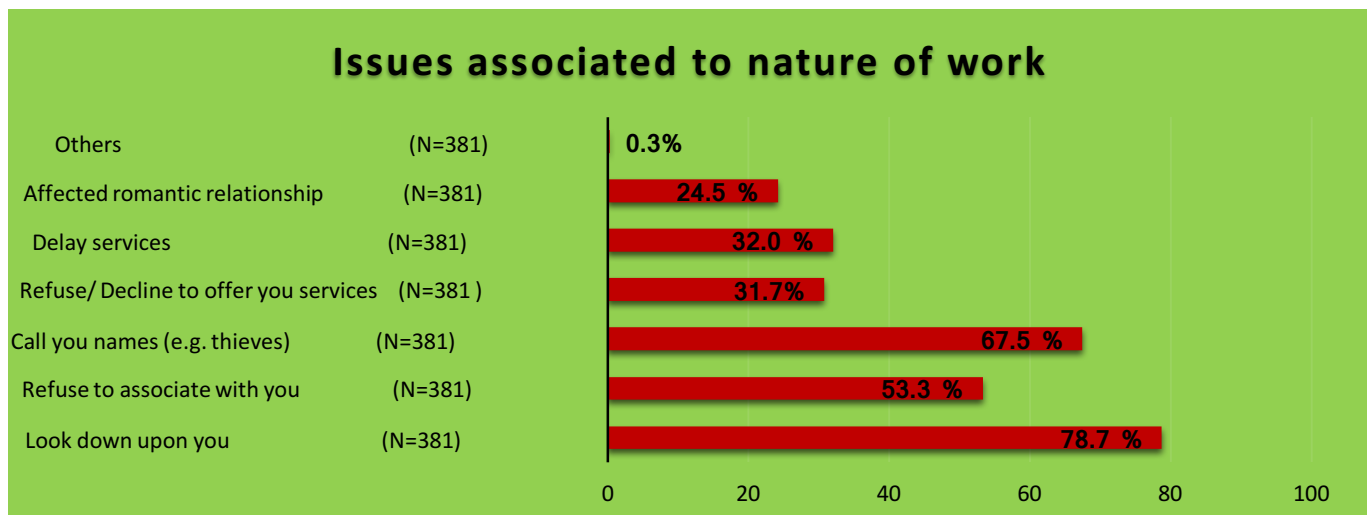


Figure 5.2: Issues associated to solid waste work

5.2 Summary

This chapter discusses the sources of support to enhance the working environment of solid waste workers, which included government, community, individuals and the private sector. The evidence shows insufficient support from government in relation to the provision of protective gears and infrastructure investments especially as it relates to the management of the dump site. The lack of access to medical care is identified as another important area **for** government support, particularly in relation to lack of access to health insurance. With only 5% of waste workers having access to health insurance cover, social investments for health among this group, will be consistent with the overall vision of universal health coverage and will begin to address the enormous intra-urban inequity in access to health care services in the city,

Beyond areas for support from Government, waste workers identified social issues that hinder their effectiveness, among which are lack of respect, negative perceptions about their characters, social exclusion and stigmatization by the community members, security agencies and government officials. Related to these are emotional and physical harassment in the course of their work. These highlight the need for social mobilizations, sensitization, empowerment and capacity building among waste workers, government officials and communities to collectively address the hostile social environment, and practical challenges and indignities waste workers face in the course of their work. There may also be need for specific focus on knowledge creation and education campaigns among waste workers as it relates to the management of hazardous and medical waste, which poses specific risks to their health and personal safety.

Further, weak leadership and limited capacity within the waste picking groups to understand the broader challenges of managing solid waste have specifically been identified by a previous report, with recommendations for their training in waste training, leadership training, capacity building and exchange visits with other groups (Kuria and Muasya, 2010).

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CHAPTER 6: HEALTH STATUS OF SOLID WASTE WORKERS

6.0 Introduction

In Kenya, the challenge of Solid Waste Management, particularly the collection systems are characterized as inefficient and disposal systems as not environmentally friendly (Gakungu, 2011). Handling solid waste at any stage in the solid waste management cycle poses an occupation health risk (Shibamoto et al. 2007). While household generated solid waste is not expected to be as hazardous as other types of waste, such as industrial and medical waste which have more strict code for its management, in Kenya the reality is different as, sorting of waste at household level is non-existent and therefore all waste generated at household level finds its way in the same pool and gets disposed of together (Ikiara et al. 2004) The final stage of waste management is also at open dump sites, which burns continually releasing toxic fumes into the atmosphere. In addition to the solid waste from households containing hazardous articles (not sorted), the dumpsite also receives waste from industries as well as medical facilities. The health risks involved in managing such waste have been severally identified in literature to range from physical injuries, infections, chemical injuries, respiratory problems due to inhalation of toxic fumes as well as long terms effects associated with use of ground water contaminated by chemicals especially the heavy metals. (Roht et al., 1985; Mallin, 1990; Pradyumna, 2013. and Dalton 2003).

Understanding the health risks and their seriousness is important and it influences decisions of putting in place measures to protect those involved in waste management. At individual level risk perception is also key in the formation of behaviors that ensures consistent protection against health risks. For workers in contractual work arrangements to manage waste, it is expected that their employer takes steps to ensure that the workers are sensitized on the health risks, vaccinated and are given appropriate protective gear. Even those working independently, need information on health risks as well as encouragement to use protection. At national policy level, there should be a system to ensure compliance with worker protection (Haregu et al., 2016; Persson, 2004; Barczak, 2017). For all this to work, solid waste workers need to know that they are at risk and that the consequences are significant hence the need for protection (Barczak, 2017; Ziraba, et al., 2016). However, the reality is far from this. While the health status of persons involved in waste management in Kenya has not been fully understood, the available literature from elsewhere suggests that the situation is likely to be dire (Gakungu, 2011; Rushton & Elliott, 2003).

We aim to fill the knowledge gap as well as make practical recommendations for reducing exposure risk and for managing those already exposed. This chapter sheds light on the health risk perceptions and practices of individuals involved in solid waste management and as well their health status with regard to known health risks. Data used is from interviewer administered interviews that collected data on risk perceptions, behaviors, exposure to waste and risk mitigation practices. Infection status (hepatitis B virus) and helminthes infestation was established through standard laboratory investigations as outlined in the methodology chapter.

6.1: Health risk perceptions related to solid waste handling

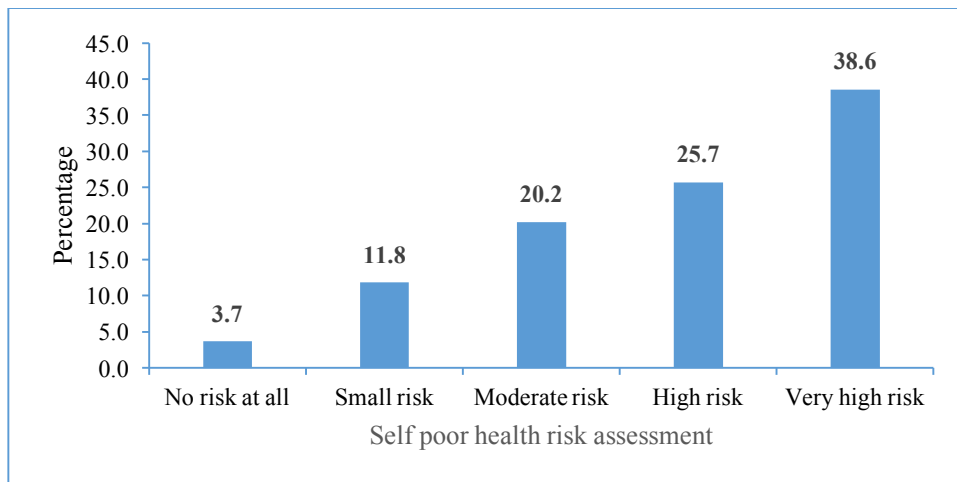
As per Health Belief Model, risk perception is integral in health behavior change and its sustenance. While most exposure to health risks among those in solid waste management is systemic- beyond individual workers actions, at personal level a lot more can be done to prevent exposure to solid waste and its consequences. We present results on health risk knowledge and perceptions which are critical in forming behaviors that are protective.

We asked participants to rate their own health risks associated with their work in the solid waste sector. Figure 6.1 shows that 39% indicated that they were at very high health risk, while about 4% indicated that they were not at risk at all. Overall, about 85% reported that their work in solid waste exposes them to a moderate to very high health risk.

The risk perception is echoed by a waste worker who stated the existence of health risks associated with cuts in their work as described below:

“...you just work but expose yourself to risks... because those shreds of glass may cut you. Being cut or pricked. You cannot stay for long before being pricked when you are here it is a guarantee that, you will go through that.” (IDI, Waste Worker).

Figure 6.1: Self-assessed risk of poor health emanating from their work on solid waste



Health risk perception may vary by important social, economic and demographic characteristics. Understanding these variation is important not just for profiling but also for identifying potential entry points and targeting for interventions. Table 6.1 shows the proportion of participants who self-assessed themselves as being at a high or very high risk of poor health emanating from their work on solid waste by the e main activity they are involved in and their socio-demographic characteristics.

Overall, 64% of respondents indicated that they were either at a high or very high risk of poor health as a result of their work involving handling solid waste. Similar proportion of waste collectors and pickers-65% and 64% respectively rate their risk as high or very high compared to 53% among those involved in the transportation.

Table 6.1: Proportion of participants who self-assess themselves as being at a high or very high risk of poor health by main activity and socio-demographic characteristics

Characteristics	Collectors		Pickers		Transporters/loaders		Overall	
	%	N	%	N	%	N	%	N
Age group								
<18 yrs	60.0	5	52.4	21	100.0	2	56.0	25
18-24 yrs	56.0	25	50.0	64	44.5	18	53.5	86
25-34 yrs	64.5	31	66.7	93	46.2	13	63.6	121
35-44 yrs	56.3	16	60.7	56	62.5	8	60.3	63
45+ yrs	85.0	20	79.7	69	75.0	4	81.4	86
Sex								
Male	52.4	42	60.6	94	57.9	38	56.6	136
Female	74.5	55	65.6	209	28.6	7	68.6	245
Education								
No formal education	100.0	6	78.6	14	--	--	82.4	17
Primary	62.7	67	60.9	212	51.9	27	62.4	266
Secondary/higher	62.5	24	70.1	77	55.6	18	66.3	98
Marital status								
Never married	60.7	28	55.4	101	50.0	26	57.7	130
Married	51.7	29	62.2	82	45.5	82	60.6	109
Divorced/widowed	77.5	40	72.5	120	75.0	120	73.2	142
Residence								
Slum	61.9	42	62.4	93	66.7	12	64.3	126
Non-slum	65.1	43	62.5	184	45.2	31	62.2	225
Dumpsite	75.0	12	80.8	26	100.0	2	80.0	30
Total	65.0	97	64.0	303	53.3	45	64.3	381

It is, however, worthy noting that often the roles/activities overlap. For example out of those involved in transport, some also pick usable materials from the waste. Generally, higher proportions of those who indicated that they live at the dump site, females and those aged 45 years and above expressed a concern that they are at a high or very high risk of poor health related to their work. This is what a community leader had to say about this:

“Old people around the age of 50 and above are the most affected...My views, the aged have many challenges you know as you grow old, many diseases attack you easily. So it’s them who suffer most in the dumpsite.” (KII, Community Leader).

One waste worker also mentioned how women are mostly affected as stated:

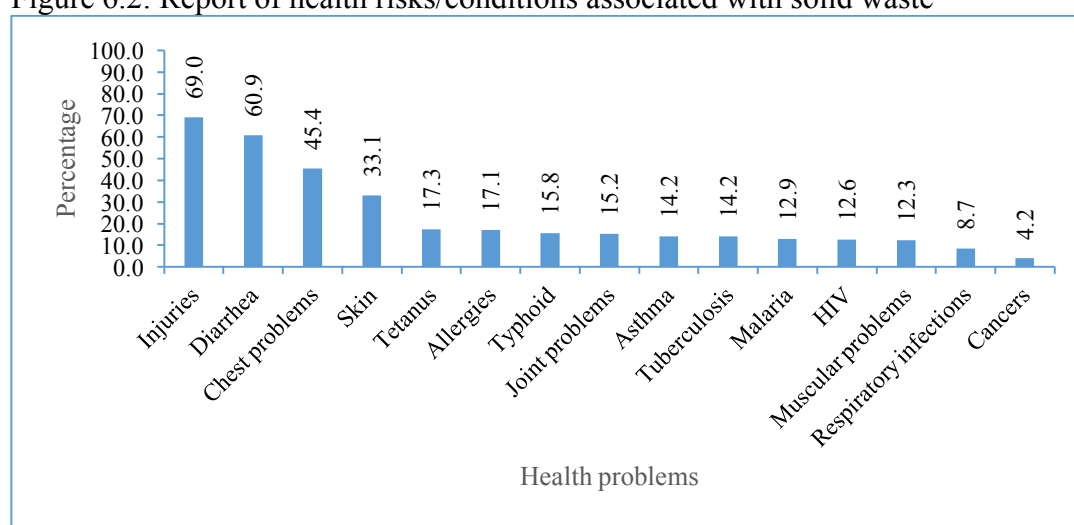
“Let’s say women in general are the most affected. You will get a woman has been ill, she is admitted, she comes from hospital back to work but boys are not many” (Waste Worker).

We further explored knowledge of specific health risks or conditions individuals thought could arise out of handling solid waste. Figure 6.2 summarizes the various health conditions mentioned by participants. Overall, 69% of participants mentioned injuries as a health risk. This could be related to the fact that most solid waste in Kenya is not sorted meaning that sharp broken objects like bottles end up in the same containers or waste hips. This is what one community leader had to say about lack of waste separation:

“If we could have separation of garbage at the plot before being transported i.e separating plastics, foods and bottles among others. It will be easier even for those who pick waste materials in the dumping site. They will work effectively and this dumpsite might have even ended.” (IDI, Community Leader).

Secondly, use of protective gear is also limited and hence those who handle waste know that they are exposed to a risk of injury or have indeed experienced it. Diarrhea was considered a health risk by over 60% of the respondents. Normally people associate poor hygiene with diarrhea so it is not surprising that such a high percentage reported diarrhea as a risk since often solid waste is always in a state of decomposition and represent filth. Of special note is the category that reported “chest problems”-45%; asthma- 14%; tuberculosis 14%; and respiratory infections 9%. These perceptions could be based on the fact that the dump site is always burning often releasing fumes that a noxious but also the knowledge that some of the waste is from medical facilities.

Figure 6.2: Report of health risks/conditions associated with solid waste



Skin lesions were mentioned by 33% while 17% indicated that there is a risk of allergies. This is in agreement regarding diarrhea from what one waste worker described:

“There is the problem with diarrhea... the same hands they use while collecting waste, they then use to eat without washing hands...so, these issues of diarrhea and the sort... is almost inseparable with them (KII, Community Leader).

6.2: Exposure to solid waste and uptake of protective interventions

Like many other jobs involvement in solid waste management potentially exposes one to occupation hazards. As such, it is recommended that protective gear is used to limit the risk of physical and chemical injuries as well as prevention of infection transmission. The dump site has extremely high levels of sharp objects ranging from broken glass, medical needles, scrap metal and others.

Table 6.2 summarizes use of three key protective wears: footwear (gum boots); gloves and overalls by individual characteristics. Overall, about 51% of respondents reported using protective footwear (gumboots), 16% and 26% reported wearing gloves and overalls respectively. Few women (43%); older people (45 years and above) (42%); those with secondary or higher education (43%); and the widowed (42%) used protective footwear compared to their counterparts. With regard to use of gloves, a lower proportions of older

people; women; and those who lived in slums or dumpsite used them. Only 16% of females use overall garments compared to 45% among men. This could be due to being unable to afford or not knowing the value as described:

“They do not have clothes to protect them such as gloves and gumboots. People just work the “jua kali” way we do not insist on gloves but gumboots because of the water beneath thus prevents pneumonia... we believe gumboots are the only articles we feel may be of assistance... but with regard to clothes... we just use worn out clothes.” (KII, Waste Worker Leader). *“It’s either they don’t know the importance and others do not have because they are not available. And even if they are made to be available, they can’t afford to buy them.”* (KII, Community Leader)

Table 6.2: Use of protective wear

Characteristic	Boots	Gloves	Overalls	Number
	%	%	%	
Age group				
<18 yrs	56.0	20.0	20.0	25
18-24 yrs	60.5	19.8	31.4	86
25-34 yrs	50.4	16.5	24.8	121
35-44 yrs	47.6	7.9	22.2	63
45+ yrs	41.9	16.3	27.9	86
Sex				
Male	64.0	21.3	44.9	136
Female	43.3	13.1	15.9	245
Education				
No formal education	58.8	17.7	29.4	17
Primary	53.0	14.3	23.7	266
Secondary/higher	42.9	20.4	32.7	98
Marital status				
Never married	55.4	18.5	26.9	130
Married	56.9	19.3	29.4	109
Divorced/widowed	41.6	11.3	23.2	142
Residence				
Slum	49.2	7.9	26.2	126
Non-slum	50.7	20.4	25.8	225
Dumpsite	56.7	16.7	30.0	30
Total	50.7	16.0	26.3	381

Table 6.3 shows the proportions of reported use of protective by type of activity one is primarily involved in (waste collector, picker or transporter). While 51% reported use of protective footwear, a lower proportion among waste collectors (46%) reported used of protective footwear. For all the three protective gears examined, waste pickers reported the lowest usage of each of those.

Table 6.3: Type of work and use of protective gear

Main activity	Boots		Gloves		Overalls	
	%	Number	%	Number	%	Number
Solid waste collection	46.0	74	23.0	74	33.8	74
Waste picking	49.8	275	14.6	275	22.9	275
Waste transportation	65.0	20	20.0	20	35.0	20
Other	75.0	12	0.0	12	41.7	12
Total	50.7	381	16.0	381	26.3	381

Among those who reported use of any of the protective gears, we asked about their consistence in use of the gears. Table 6.4 summarizes consistent use of footwear, gloves and overall garments by main type of solid waste management activity and duration in that activity. Overall, about 34% of respondents reported that they consistently used protective footwear compared to 51% who reported use of the same. On the other hand, about 10% reported consistent use of gloves compared to 16% who reported generally using gloves while 19% reported consistent use of overall garments compared with 26% who reported users of overall garments. Consistent use of protective gear is also lowest among waste pickers. While there seem to be no consistent pattern of use of footwears and overall garments, for gloves, it seems that usage decrease with duration in the job. This could be attributed to not appreciating the value of using protective gear consistently as stated by one participant:

“But sometimes some NGOs come and support them, like giving them wheelbarrows, overalls and gumboot, but after some two weeks they sell them and remain without anything. But few remain with them not all are that bad.” (KII, Community Leader).

Table 6.4: Main type of work and duration and consistent use of protective wear

Main activity	Boots		Gloves		Overalls	
	%	Number	%	Number	%	Number
Solid waste collection	39.2	74	13.5	74	28.4	74
Waste picking	30.5	275	8.7	275	16.7	275
Waste transportation	35.0	20	10.0	20	15.0	20
Other	66.7	12		12	25.0	12
Years dealings in solid waste						
Up to 1yr	26.1	23	17.4	23	13.0	23
1-5yrs	33.6	125	15.2	125	20.8	125
5-9yrs	38.0	108	3.7	108	15.7	108
>10yrs	31.2	125	7.2	125	21.6	125
Total	33.6	381	9.5	381	19.2	381

Having assessed individual risk perceptions and actual exposure to potential risk of poor health associated with solid waste management and the physical protection they might have used, we went further to seek understanding of whether participants had received some of the key public health interventions that would be of great use to such a group, Table 6.5.

Overall, less than 2% of respondents had ever been vaccinated against hepatitis B virus but a much high proportion had received vaccination against tetanus. About 16% had never dewormed while majority (52%) had dewormed for a period more than one year ago. With regard to hand washing, a key public health intervention, while 31% reported having access to water for hand washing, 20% carried out hand washing consistently. Access to toilet while managing solid waste was very low with only 7% reporting access to one. Training in safety at work and training on infection prevention was reported by 11% and 17% of respondents respectively. In terms of accessing health care, 95% of the respondents indicated that they pay-out-of-pocket to receive treatment and only 5% had health insurance. Because few waste workers have NHIF insurance, majority are unable to go to a nearby government hospital that offers service delivery using NHIF cards as captured here:

“Yah, all do not have medical cover, even if I call one of them to ask if they have a medical cover or if you move around here asking you will not find any with a health cover. Those with cuts there is no way they have a medical cover then have a cut and not afford Mama Lucy hospital bill “(KII, Community Leader). “No medical cover. We just use our own means for medication. (IDI, Waste worker).

Table 6. 5: Proportion of respondents who had received key interventions before

Prevention interventions	Number	Percentage
Hepatitis B vaccination		
Yes	6	1.6
No	375	98.4
Tetanus vaccination		
Yes	289	75.9
No	92	24.2
Deworming		
Never dewormed	60	15.8
< 6 months	123	32.3
6-12 months	56	14.7
More than 12 months	142	37.3
Access to water for hand washing		
Yes	119	31.2
No	262	68.8
Hand washing		
Yes always	76	20.0
Yes, sometimes	92	24.2
Yes, rarely	46	12.1
Never	167	43.8
Have toilet		
Yes	25	6.6
No	356	93.4
Training on safety		
Yes	43	11.3
No	338	88.7
Training on infection prevention		
Yes	63	16.5
No	318	83.5
Payment for health care		
Out of pocket	362	95.0
Health insurance	19	5.0
Total	381	100.0

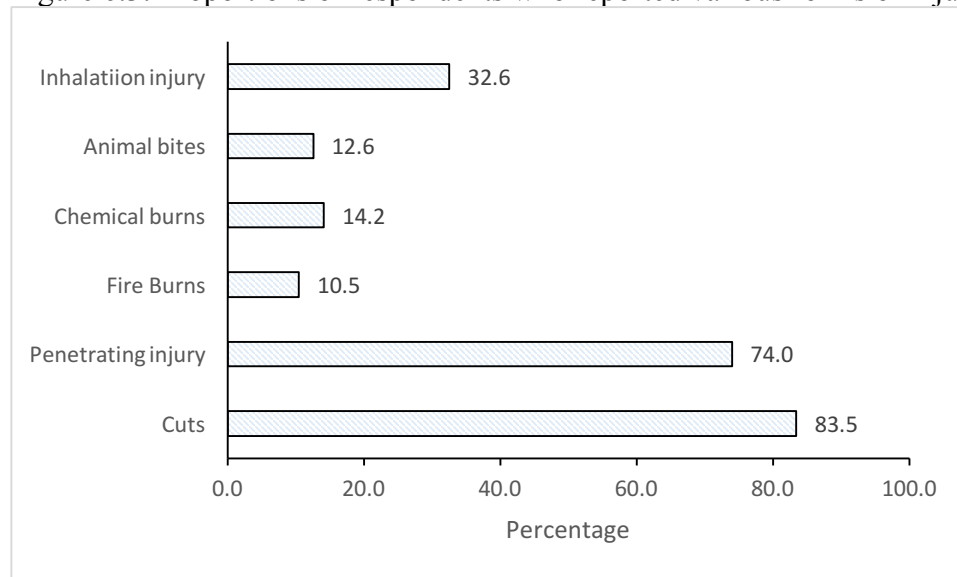
6.3: Injuries and infections among individuals involved in solid waste management

In this subsection, we present results on self-reported injuries in the line of work on solid waste as well as infections (hepatitis B virus) and infestations (helminthes) that could be related to solid waste management as well as other important clinical outcomes (anemia) that can be directly associated with helminthes infestation.

Figure 6.3 show percentages of self-reported injuries suffered by respondents in the line of work on solid waste. Close to 84% reported to having had a cut into their skin in process of

managing or picking solid waste. Penetrating injuries were reported by 74% while another 33% reported having suffered inhalation injuries from the fumes of the burning materials at the dump site. Animal bites were surprisingly common and reported by 13% of respondents.

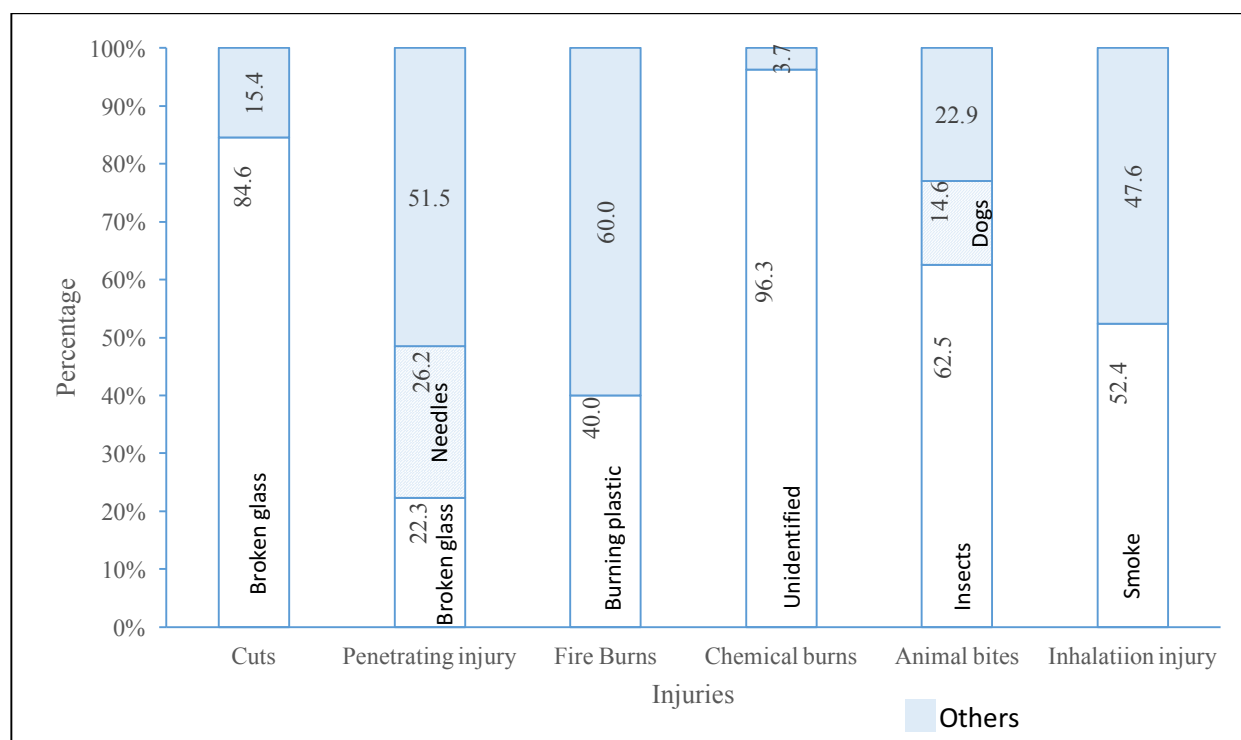
Figure 6.3: Proportions of respondents who reported various forms of injuries



For the various types or forms of injuries, we explored further the causes of those injuries. This is important because clinical effects might be different and as well potential long term consequences. Out of all reported cases of cuts, 85% of them were attributable to broken glass-which are often from broken bottles and window panes. Among the deep penetrating injuries, 22% were attributed to glass, and 26% were attributed to medical needles. Most of the burns came from burning plastic materials (40%). The cause of burns from chemicals was majorly unidentifiable with 86% not knowing the type of chemical that burnt them. Of all the animal bites, 63% were insect bites while 15% were from dogs that frequently scavenge at the same dump site. Inhalation injuries were majorly attributed to smoke from burning dump site materials which often range from usual household waste materials to medical waste including pharmaceutical products. Some of the injuries are life changing as described in this instance:

“This one (hand) broke on 13th May 2000...I was trying to escape the lorry which offloads the waste, so I fall in a hole and broke... After the accident, first my hands were cut, I was told to go to South Africa after 8 surgeries in Kenyatta. I stayed with plaster for 15 years. Now when I go to Kenyatta, they keep saying there is no bones or muscles growing for the affected area to be intact, so they suggest I go to South Africa so that I get a machine that can have the bones and muscles be intact.” (IDI, Waste Worker).

Figure 6.4: Types of injuries reported by cause of injury

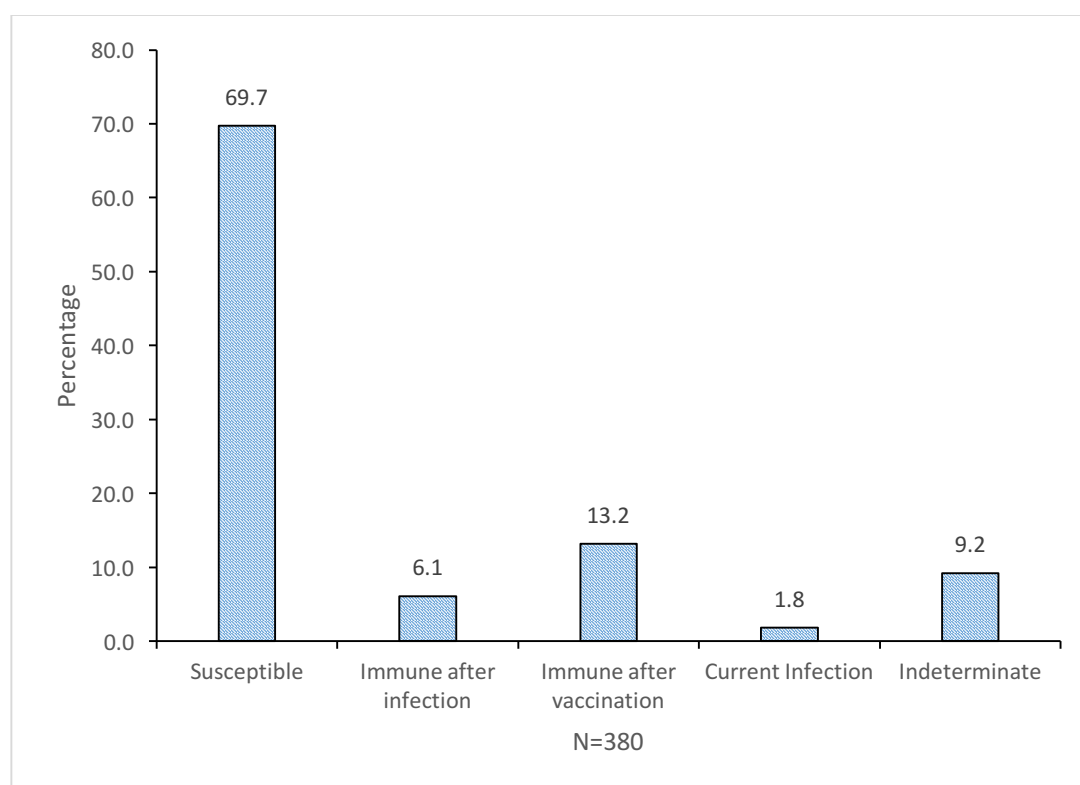


Hepatitis B virus is one of the pathogens that survive for long after exposure to ambient temperatures. It is also known to be transmitted easily when exposed to broken skin or mucosa. Therefore, unlike other virus, the risk of transmission from contaminated articles is higher with hepatitis B and this is the reason we chose it as a marker for probable infection from solid waste which is often mixed with medical waste in this setting.

Interpretation of hepatitis B serology is not straight forward and for this purpose we provide a brief overview before delving into the findings. Any sample that tested positive for hepatitis B surface antigen (HbsAg) was considered to be having a current hepatitis B infection. Samples that were positive for both hepatitis B surface antibody (Anti-Hbs) and hepatitis B Core antibody (Anti-Hbc) were classed as immune having had a natural infection in the past that resolved. Those that were positive for hepatitis B surface antibody (Anti-Hbs) but negative for hepatitis B Core antibody (Anti-Hbc) were classed as being immune from vaccination. Samples with positive anti-Hbc but negative for HbsAg and anti-Hbs were classed as indeterminate while those negative for all tests were grouped as susceptible to hepatitis B infection.

Overall, 1.8% of respondent were positive for hepatitis B infection, 6% were immune after natural infection, and 13% were immune after vaccination while 9% had indeterminate results. Close to 70 % of respondents were susceptible to hepatitis B infection.

Figure 6.5: Hepatitis B infection



We assessed life-time exposure to hepatitis B infection by socio-demographic characteristics, Table 6.6, as well as occupation-related characteristics, Table 6.6, life-time exposure to hepatitis B is composed of those with current infection, those who are immune after a natural infection and the indeterminate case (positive for anti-Hbc).

Life-time exposure to hepatitis B infection increased with age from as low as 4% among those aged less than 18 years to 24% among those aged 45 years and above. By gender, a higher proportion of females (19%) had had exposure to hepatitis B infection compared to 13% among men. The results also reveal a surprisingly low exposure to hepatitis B infection among those with no formal education (6%) compared to 19% among those with secondary or higher education. Among those exposed to hepatitis B infection, 25% of those were widowed or divorced which was more than twice that of respondents who reported that they had never been married before (12%).

Table 6.6: Life-time exposure to hepatitis B infection by individual socio-demographic characteristics

Characteristic	Percentage	Number
Age group		
<18 yrs	4.0	25
18-24 yrs	14.0	86
25-34 yrs	15.8	120
35-44 yrs	19.1	63
45+ yrs	24.4	86
Sex		

Male	13.2	136
Female	19.3	244
Education		
No formal education	5.9	17
Primary	17.0	265
Secondary/higher	19.4	98
Marital status		
Never married	12.3	130
Married	13.0	108
Divorced/widowed	24.7	142
Residence		
Slum	15.9	126
Non-slum	17.9	224
Dumpsite	16.7	30
Total	17.1	380

Table 6.7 summarizes life-time exposure to hepatitis B infection by occupation-related characteristics. Overall, 17% of respondents had ever been exposed to hepatitis B infection at the time of the survey. Compared to those in waste picking and transporters, a slightly higher proportion of those involved in waste collection were previously exposed to hepatitis B infection. Similarly, a higher proportion of those who reported to have been involved with solid waste for longer were exposed to hepatitis B infection. A higher proportion of those who reported that they were at a very high risk of poor health related to solid waste handling had been exposed to hepatitis B (21%) compared to those who indicated that their risk was small or moderate (15%). The proportion exposed to hepatitis B infection among those who reported consistent use of gloves was 8% compared to 18% who reported no or inconsistent use of gloves. Among those who reported having experienced penetrating injuries, 19% had been exposed to hepatitis B before compared to 13% who had no history of penetrating injuries from work.

Table 6.7: Life-time exposure to hepatitis B infection by occupation-related characteristics

Characteristic	Percentage	Number
Main activity in SWM		
Solid waste collection	18.9	74
Scavenging at disposal site	16.1	274
Waste transportation	15.0	20
Other	33.3	12
Duration in SWM		
Up to 1yr	9.1	22
1-5yrs	15.2	125
5-9yrs	19.4	108
>10yrs	18.4	125
Health risk perception		
No risk at all	0.0	14
Small risk	15.6	45
Moderate risk	15.6	77
High risk	15.5	97
Very high risk	21.1	147
Hepatitis B vaccination		
Yes	33.3	6
No	16.8	374
Trained on safety in work place		
Yes	14.0	43
No	17.5	337
Trained on infection prevention		
Yes	15.9	63

No	17.4	317
Consistent use of boots		
Yes	16.5	127
No	17.4	253
Consistent use of Gloves		
Yes	8.3	36
No	18.0	344
Consistent use of overalls		
Yes	15.1	73
No	17.6	307
Ever had blood transfusion		
Yes	20.0	25
No	16.9	355
Penetrating injuries		
Yes	18.5	281
No	13.1	99
Total	17.1	380

We tested for anaemia and helminthes infestation. Anaemia can be caused by so many factors among them helminthes infestation. Overall, in Table 6.8 about 17% of respondents had mild to severe anaemia while 4% had evidence helminthes infestation. There were some important differences in prevalence by socio-demographic characteristics. Prevalence of anaemia among those less than 18 years of age was 12% while that of those aged 45 years and above was 21%. Paradoxically, helminthes infestation was highest among those aged less than 18 years. As expected, prevalence of anaemia among women (22%) was higher than that among men (7%). Prevalence of helminthes among those who reported to be residents at the dump site was 10% compared to 5% among those who lived in slums but away from dump site and 2% among those who lived in non-slum area. The paradox in helminthes infestation being higher among aged less than 18 could be attributed to their lack of knowledge, exposure and playful nature of children as described by one waste worker,

“They are small, they (children) are not used to some waste... young ones don’t know what not to touch and where you are not supposed to go...Children also like playing with garbage are mostly affected.” (IDI, Waste Worker).

Table 6.8: Prevalence of moderate and severe anaemia and helminthes infestation by individual socio-demographic characteristics

Characteristic	Anaemia (mild-severe)		Helminthes	
	Percentage	Number	Percentage	Number
Age group				
<18 yrs	12.0	25	13.0	23
18-24 yrs	11.6	86	5.7	70
25-34 yrs	18.3	120	0.0	109
35-44 yrs	16.1	62	5.1	59
45+ yrs	20.9	86	2.4	83
Sex				
Male	7.4	136	2.6	115
Female	21.8	243	3.9	229
Education				
No formal education	17.6	17	0.0	17
Primary	16.7	264	4.2	240
Secondary/higher	16.3	98	2.3	87
Marital status				
Never married	15.5	129	5.3	114
Married	16.7	108	2.1	94
Divorced/widowed	17.6	142	2.9	136
Residence				
Slum	15.1	126	4.5	112
Non-slum	18.4	223	2.0	203
Dumpsite	10.0	30	10.3	29
Total	16.6	379	3.5	344

Table 6.9 shows the prevalence of anaemia and helminthes infestation by occupation-related characteristics including use of personal protective gear and individual behaviors while handling solid waste. Prevalence of anaemia among respondents who had worked in solid waste for 10 or more years was 22% compared to 9% among those who had worked for a year of less. By occupation, those involved in waste transportation had the least prevalence of anaemia (5%) while on the other hand waste pickers had the highest prevalence of helminthes compared to the other job categories. This could be attributed to contaminated food consumed by waste workers who are usually scavenging for their food and consuming without washing their hands. This is what one of the waste workers had to say about this,

“Sometimes at boma (dumping site), there is no water so sometimes you may get food and take it without washing your hands” (IDI, Waste Worker).

Table 6.9: Prevalence of moderate and severe anaemia and helminthes by occupation-related characteristics

Work related characteristics/factors	Anaemia			Helminthes		
	No anaemia	Mild-severe anaemia	Number	Negative	Positive	Number
Duration in SWM						
Up to 1yr	90.9	9.1	22	95.2	4.8	21
1-5yrs	84.0	16.0	125	98.2	1.8	112
5-9yrs	87.0	13.0	108	95.9	4.1	97
>10yrs	78.2	21.8	124	95.6	4.4	114
Main activity in SWM						
Solid waste collection	83.8	16.2	74	98.5	1.5	68
Scavenging at disposal site	82.4	17.6	273	95.6	4.4	249
Waste transportation	95.0	5.0	20	100.0	0.0	16
Other	83.3	16.7	12	100.0	0.0	11
Consistent use of boots						
Yes	82.7	17.3	127	97.3	2.7	110
No	83.7	16.3	252	96.2	3.9	234
Consistent use of Gloves						
Yes	80.6	19.4	36	93.3	6.7	30
No	83.7	16.3	343	96.8	3.2	314
Consistent use of overalls						
Yes	87.7	12.3	73	93.3	6.7	60
No	82.4	17.7	306	97.2	2.8	284
Trained on safety in work place						
Yes	86.1	14.0	43	97.6	2.4	41
No	83.0	17.0	336	96.4	3.6	303
Trained on infection prevention						
Yes	84.1	15.9	63	98.2	1.9	54
No	83.2	16.8	316	96.2	3.8	290
Health risk perception						
No risk at all	71.4	28.6	14	100.0	0.0	12
Small risk	81.8	18.2	44	90.5	9.5	42
Moderate risk	81.8	18.2	77	97.0	3.0	67
High risk	84.5	15.5	97	98.9	1.1	90
Very high risk	85.0	15.0	147	96.2	3.8	133
Deworming						
Never dewormed	90.0	10.0	60	96.3	3.7	54
< 6 months	75.4	24.6	122	98.2	1.8	112
6-12 months	90.9	9.1	55	96.2	3.9	52
> than 12 months	84.5	15.5	142	95.2	4.8	126
Access to water for handwashing						
Yes	80.7	19.3	119	94.4	5.6	107
No	84.6	15.4	260	97.5	2.5	237
Access to toilet at work place						
Yes	84.0	16.0	25	92.0	8.0	25
No	83.3	16.7	354	96.9	3.1	319
Total	83.4	16.6	379	96.5	3.5	344

6.4 Discussion

This chapter discusses findings on risk perceptions, practices, exposure history and health status of individuals working in the solid waste sub-sector in Nairobi City. The results showed that overall, a large proportion of respondents know the linkage between working on solid waste and ill-health. Nearly 70% of the respondents reported that working on solid waste exposes one to injuries while over 60% indicated that such workers are exposed to diarrheal

diseases. Several other ailments were mentioned including tetanus, respiratory complications, and typhoid fever and skin ailments among others. Knowledge of how diseases are transmitted or caused is critical in all prevention efforts including behavioral changes (Abd El-Wahab 2014)

In assessing their own health risk a large proportion of respondents (85%) indicated that their risk of getting ill-health from waste work was moderate to very high. As envisaged in the health belief model, risk perception is a good first step in behavior change, other factors allowing. (Rosenstock, 1974) This result means that there is a good opportunity for intervening for individuals working on solid waste to protect them against ill-health if interventions were available. Unfortunately, there are other key barriers including cost for sustained interventions. Indeed only 51% indicated consistent use of protective footwear, and only 16% used heavy duty gloves. Vaccination against hepatitis B virus was very low (less than 2%) while a relatively higher proportion (76%) reported having received vaccination against tetanus- most received after injuries that are common. In Kenya, vaccination outside of the childhood schedule and antenatal care clinics during pregnancy is opportunistic. There is no deliberate plan to protect individuals whose work puts them at an increased health risk. Basic and yet proven interventions such as clean water for hand-washing and or drinking are not always available (Barczak, 2017). About 7% reported that they had access to a toilet while at work and 31% consistently wash their hands. Less than 20% of the participants reported having ever received training on safety and infection. In terms of access to healthcare an overwhelming 95% reported paying out of pocket for healthcare services.

Occurrence of injuries in the study population was very high. About 85% reported having had a cut in the course of their work while 74% reported having a penetrating injury 26% of which were from medical needles. This is in line with the observation that hazardous waste is mixed with household waste at the disposal site which unfortunately is scavenged for valuable items for use or recycling (Ikiara et al., 2004).

Hepatitis B virus infection is a known occupation risk for medical personnel as well ancillary workers who handle medical waste (Rachiotis, 2012). We found that over 17% had evidence of current or past hepatitis B infection. That hepatitis B infection is common speaks to the fact that only a few of the participants had received hepatitis B virus vaccination and yet many reported having had an injury from medical needles presumably from medical facilities. While anaemia among adults can be attributed to various factors, helminthes infestation is an important risk factor (Porta, 2009). Estimates showed that about 17% had mild to severe anaemia and 4% had helminthes infestation.

Limitations:

We only attained about 60% of the originally intended sample size. This has potential to cause a measurement error with wide confidence intervals for the estimates. We also only surveyed individuals working at or delivering solid waste to one dumpsite. As such the findings from this population might not be generalizable to all solid waste workers in Kenya. However, this being the largest of all such dumping sites in Kenya, we are confident that the study population is fairly reflective of the study population.

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CHAPTER 7: SUMMARY, CONCLUSION & RECOMMENDATION

7.1 Summary

Majority of solid waste worker who participated in the study were female, with about three thirds being aged 25years and above. Almost all waste workers who participated in the study have ever attended school. A higher percentage (95.5%) of the waste workers have ever attended school, majority (73.1%) of them having highest level of education attained as primary school. The attainment of professional education is wanting among the residents in the dumping site with few (1.9%) respondents having attained the college/university level. Majority of waste workers reside in slum and non-slum areas outside the dumpsite, with 7.9% residing in the dump site.

Solid waste work is a core economic activity at the dumping site. The current income generating activity with over three-thirds of the workers is scavenging at the dumping site followed by solid waste collection (24.5%) with security work being the least (0.3%). The engagement of waste workers in solid waste work is due to lack of another job alternative. Plastic was the most commonly retrieved item (83.7%) whereas papers with 53.0% was the second most retrieved item. Medicines 0.8% was the least retrieved item. There is existence of associations in the dumping site yet the common work arrangement with over three-thirds (83.5%) is work arrangement as individuals. The average monthly income from main income generating activity shows that majority (84.25%) of the respondents earns less than 10,000 Kshs. The average monthly income from other income generating activity shows that a higher percentage (75.6%) earns less than 5,000. Employees who have stayed long in the dumping site appreciate their work and feel satisfied.

Good hygiene practice such as handwashing with soap was found to be lacking among solid waste workers. Basic and yet proven interventions such as clean water for hand-washing and or drinking are not always available. About 7% of waste workers reported that they had access to a toilet while at work and 31% consistently wash their hands. Less than 20% of the participants reported having ever received training on safety and infection.

The ownership of protective gears among participants was low while consistency in the use of protective clothing was equally very low. There are number of reasons for non-use of protective gears and these included, ignorance on the importance of using protective gears, inability to purchase items due to poverty and difficulty in performing their work effectively when wearing protective gears. The results on vaccination against Tetanus and Hepatitis B showed that majority of solid waste workers were vaccinated against tetanus, while the number vaccinated against Hepatitis B was extremely low (2%). There is insufficient support from the government as regards to the provision of protective gears and other infrastructure services for solid waste workers.

Occurrence of injuries in the study population was very high. About 85% reported having had a cut in the course of their work while 74% reported having a penetrating injury 26% of which were from medical needles. 17% had evidence of current or past hepatitis B infection. That hepatitis B infection is common speaks to the fact that only a few of the participants had received hepatitis B virus vaccination and yet many reported having had an injury from medical needles presumably from medical facilities.

7.2 Conclusion

Solid waste is an outcome of economic productivity and consumption and includes waste from households, commercial establishments, institutions, markets, and industries. Health of solid waste workers is a growing public-health concern. As population growth and economic development has brought increase in waste generation and therefore there is a need to improve the health status of solid waste workers. Waste management is one of the most visible urban services whose effectiveness and sustainability serves as an indicator for good local governance, sound municipal management and successful urban reforms.

Good understanding of solid waste sector is only possible if there is data. Therefore, it is important to include the economic and technical performance of this sector together with their socio-economic profile in annual reports, reviews, and as the baseline for planning. Solid waste data will provide basis for policy and programme interventions on the safety of solid waste workers. Solid waste work related injuries and unsafe procedures have health implications for the workers that need to be addressed. It is therefore justifiable that the Kenyan labour law emphasizes the right of every individual or citizen to work in an environment that is safe.

Solid waste management practices causes environment pollution within the localities. Solid waste disposal is done in an open space at the Dandora dumping site. The waste is then left to decompose and/or burnt which affect the environment. Decomposing waste makes a good breeding place for vectors such as flies and rats. There is also the danger of water pollution when leachate from the dump sites enters surface water or groundwater resources. Uncontrolled burning which is also the most favoured method of disposing of the waste causes air pollution. All these affect the health of solid waste workers.

Solid waste management is a decentralised function of urban councils but its funding is predominantly external and the urban councils do not prioritize SWM in their plans. These have combined to cause poor allocation of resources and ineffective solid waste management by urban councils. The predominantly conventional waste management methods by the communities have failed because they do not effectively address local conditions such as financing system, institutional framework, technical and human capacities, socio- political situation and waste characteristics. There is therefore a need for urban councils to explore opportunities for innovative integrated approach for sustainable waste management such as the 3Rs, composting, anaerobic biogas production that involve all stakeholders including the community and the informal sector. The process from planning to implementation should be all inclusive to ensure consensus building for success.

Knowledge of health risks associated with solid waste work was high and many of respondents think that they are at a high risk of poor health related to their work. The practice, however, does not match the risk perception. This gap needs to be narrowed in order to improve the health of waste workers and minimize loss to health due to exposure to solid waste among solid waste workers.

7.3 Recommendations

There is a limited focus on control mechanisms on SWM which is adversely affecting on safety, health and the environment. Therefore, efforts should be made by solid waste management stakeholders to empower solid waste workers on the need to own and consistently use protective gears at work because some of them own gears yet they do not always utilize the same. Often, it requires facilitation, leadership, empowerment, capacity building, sensitization and mobilization, advocacy, inter-agency co-operation and an interdisciplinary team to find solutions but moreso solid waste workers should be the key actors in the process.

County government may need to allocate adequate resources for the provision of solid waste management services within the county, which should be reviewed periodically to ensure that the funds are put to proper use in terms of efficient and effective waste management. Furthermore, there is need to develop waste management policies that will address all types of wastes ranging from household to medical to industrial wastes. This calls for a speeding up of the process of developing and finalizing regulations, guidelines and standards on solid waste management at the devolved levels of government, as set out by the environmental legislature.

National and county government should put in place an ideal waste management system that embraces a technical approach including collection, transportation, waste reduction, recycling and disposal plans. It should have improved management and regulatory systems that embrace an institutional and financial approach including legal, private sector and public education and awareness plans.

Government should establish waste transfer stations where intense settlements do not allow for landfills that are close. These reduce overall community truck traffic, offer flexibility in waste handling and disposal options, reduce air pollution, fuel consumption and road wear, allow for screening of waste, reduce traffic at the disposal facility and offer citizens facilities for convenient drop-off of waste and recyclables.

Specific policies and regulations to solid waste management that address all types of waste and with clarity of the roles and responsibility of each citizen should be developed. This will catalyze SWM monitoring system in ensuring adherence to SWM regulations/laws.

There are several ways to reduce the waste load at the dumping site: prevention of the production of waste; sorting waste at production stage; development of new clean processing methods; and treatment of waste effectively. Individuals and community groups should spearhead the waste reduction process. Therefore, the role of the private sector, NGOs, CBOs and the informal sector should be strengthened to minimize solid waste in the environment while at the same time providing social and economic benefits to communities especially the urban poor. This requires long-term planning by the urban councils that involve all the stakeholders.

There is a need for health of waste workers to be regarded important and prioritized by individuals, communities and the government. This may be done through provision of affordable and accessible medical vaccination services and medical camps within the dumping site. Particularly, there is a need to increase vaccination against hepatitis B among waste workers as a large proportion are still susceptible to hepatitis B virus infection, including promotion of personal hygiene practices and regular training on occupational safety.

There is a need for a portfolio of low-threshold formalization measures by the government regulation agencies. This will combine regulation with facilitation of improvements, and documentation of results. Regulation can provide the city with key data and points of influence in waste management without requiring things that peri-urban areas may not have like a street address or a bank account.

Solid waste workers like any other worker is affected by different decisions. Therefore, county government leaders and community leaders should encourage them to be actively involved in decision making affecting their wellbeing at work so as to strengthen the waste work procedures and increase ownership of solid waste management work. Previous work in the sector have identified leadership weaknesses among waste worker groups and have called for their training in leadership, capacity building and exchange visits with other groups.

Future research need to expand the scope of health risks assessment associated with exposure to solid waste. This might include air quality assessment to ascertain the extent to which the continuous burning from the dumpsite contributes to this as well as potential negative respiratory health outcomes measured through lung function tests. Ground water quality assessment might be another consideration to ascertain the extent of contamination by heavy metals as well as by biological contaminants. Such a study would benefit by including more people living in the vicinity of the dumpsite and beyond the dumpsite, including non-slum settlements.

Appendices

Appendix 1: Quantitative tool

AFRICAN POPULATION AND HEALTH RESEARCH CENTER	
URBAN RISK AFRICA PROJECT	
SURVEY ON HEALTH EFFECTS OF EXPOSURE TO SOLID WASTE	
1.0	BACKGROUND
1.1	INDIVIDUAL BARCODE [PRE-LOADED] <input type="text"/> <input type="text"/>
1.2	INDIVIDUAL'S NAME _____
1.3	START TIME <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/>
1.4	FIELD WORKER'S CODE <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/>
1.5	DATE OF INTERVIEW <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/>
INTRODUCTION AND CONSENT	
Hello, my name is _____ and I work with the African Population and Health Research Centre.	
We are conducting a survey in the city of Nairobi to assess the health effects of exposure to solid waste among individuals who closely live and/or work with solid waste. We shall collect information on where you live, the work you do and the health issues you have experienced in the recent past. After the questions, we shall also request for urine and blood samples which will be collected by a qualified medical person. These shall then be taken to a laboratory for testing to see if you have a risk to negative effects to your health due to your exposure to solid waste. Individuals who will be found to be at high risk of health damage will be referred to a hospital for follow up assessment and management.	
Your participation in this study is voluntary and if at any point you decide to discontinue your participation, you are free to do so. You or members of your household will not be penalized in any way if you choose not to participate. The information you give will be kept secret and none of your names shall be used in any reports. There are no direct financial benefits to you or members of your household, however we shall provide you with the results of your tests and information will be given to you depending on what your tests say about the risk to your health. The information you provide will be useful in informing policy and practice on solid waste management. This interview is not expected to cause you any harm and if you feel uncomfortable with certain questions, you can choose not to answer. However, we hope that you will participate in this survey since your views are important. This interview will take one hour of your time.	
1.6	Do you accept to participate in the study? [1=YES; 2=NO; IF YES SKIP TO 1.8] <input type="checkbox"/>
1.7	IF THE RESPONDENT DOES NOT ACCEPT TO BE INTERVIEWED Thank you for your time. [GO TO Q5.4]
1.8	IF THE RESPONDENT ACCEPTS TO BE INTERVIEWED: Thank you for agreeing to participate in this study.

2.0 BACKGROUND CHARACTERISTICS AND INCOME GENERATION			
		In this section we shall briefly discuss about your household's duration of stay in the place you live, the source of drinking water and household possessions. We shall also talk about your level of education and nature of work that you have been engaged in during the past 12 months.	
QUESTIONS & FILTERS		CODING CATEGORIES	
SKIP			
2.1	INDICATE SEX OF RESPONDENT	Male	1
		Female	2
2.2	On what day, month and year were you born? [IF DATE AND MONTH NOT KNOWN INDICATE 98] [YEAR MUST BE KNOWN]	DATE	<input type="text"/>
		MONTH	<input type="text"/>
		YEAR	<input type="text"/>
2.3	Have you ever attended school?	Yes	1
		No	2 → 2.5
2.4	What is the highest education level that you attained and what class did you complete at that level? [INDICATE CLASS =00 IF INDIVIDUAL DID NOT COMPLETE FIRST CLASS IN LEVEL ATTAINED] LEVEL: [None=0; Primary=1; Secondary=2; College/university=3]	LEVEL	<input type="text"/>
		CLASS	<input type="text"/>
2.5	[CHECK Q2.2, IF AGED 12+ YEARS, ASK: What is your current marital status? [OTHERWISE GO TO Q2.6]	Single/Never married	1
		Married	2
		Cohabiting/Living together	3
		Separated/widowed/divorced	4
2.6	Where does your household usually live? [PROBE TO FIND OUT IF SLUM OR NOT]	Slum	1
		Non-slum	2
		Dumpsite	3
2.7	How many people usually live in your household?	ADULTS AGED 18+	<input type="text"/>
		CHILDREN (BELOW 18)	<input type="text"/>
2.8	For how long has your household lived in this [PLACE IN 2.6]? (ask about the duration for the household member who has lived there the longest) [CIRLCE 98 IF LESS THAN A MONTH]	MONTHS	<input type="text"/>
		LESS THAN A MONTH	98
2.9	What is the main source of your household's drinking water?	Water sellers/vendors	10
		PIPED WATER	
		Piped into dwelling	11
		Piped into compound/plot	12
		Public tap/standpipe	13
		WELL WATER	
		Well on residence/plot	21
		Public well	22
		SURFACE WATER	
		River/stream	31
		Pond/lake	32
		Rain water	41
		Bottled water	51
		Other _____	96
		(Specify)	

2.10	[CIRCLE THE APPROPRIATE RESPONSES]	Does your household own any of the following items?			
			Yes	No	DK
	A clock?	Clock	1	2	8
	A radio/cassette player (in working condition)?	Radio/cassette player	1	2	8
	A television (in working condition)?	Television	1	2	8
	A mobile telephone?	Mobile phone	1	2	8
	A refrigerator (in working condition)?	Fridge	1	2	8
	An electric/gas stove?	Electric /gas stove	1	2	8
	A car?	Car	1	2	8
	A motorcycle?	Motorcycle	1	2	8
	A bicycle?	Bicycle	1	2	8
	Sofa set?	Sofa set	1	2	8
	Table?	Table	1	2	8
	A flash light (with working batteries)?	Flash light	1	2	8
	Kerosene lamp with glass/lantern?	Lantern	1	2	8
	Kerosene stove?	Kerosene stove	1	2	8
	An electric iron	Electric iron	1	2	8
	A charcoal iron	Charcoal iron	1	2	8
	INCOME GENERATING ACTIVITIES				
2.11	In the past one month, have you been involved in any income generating activity?	Yes			1
		No			2
2.12	Are you currently involved in any income generating activity?	Yes			1
		No			2
2.13	What income generating activities are you currently /have you been involved in?		Yes	No	
		1 Solid waste collection	1	2	
		2 Scavenging at disposal site	1	2	
		3 Waste transportation	1	2	
		4 Security officer at dumpsite	1	2	
		5 Loader of waste on vehicles	1	2	
		96 Other	1	2	
		[SPECIFY]			
2.14	Which of these is the main income generating activity that you are engaged in?	Solid waste collection			
		Scavenging at disposal site			
		Waste transportation			
		Security officer at dumpsite			
		Loader of waste on vehicles			
		Other			
2.15	For how long have you worked in the solid waste sector? [RECORD RESPONSE IN MONTHS. IF LESS THAN A MONTH, CIRCLE GIVEN CODE]	MONTHS			
		LESS THAN A MONTH			98
2.16	For how many hours do you work in a typical day?	HOURS			
2.17	What type of work arrangement do you have i.e are you employed, working alone or as a group? [PROBE FOR NATURE OF EMPLOYMENT AND GROUP]	Individual			01
		Family			02
		Casual employment			03
		Formal Employment			04
		Organized group			05
		Other			96
		(Specify)			

2.18	On average, how much do you earn in a month from the waste management work that you do?	AMOUNT						
2.19	Are you currently involved in any other income generating activity?	Yes	1					
		No	2				2.22	
2.20	What is the nature of this other income generating activity?							
		Own established business	1	2				
		Unestablished own business	1	2				
		Casual employee	1	2				
		Formal employee	1	2				
		Agriculture	1	2				
		Other						
		(Specify)						
2.21	On average, how much do you earn in a month from this other income generating activity?	AMOUNT						
2.22	How satisfied are you with the main income generating activity that you are engaged in? Would you say you are very dissatisfied, dissatisfied, somewhat satisfied, satisfied or very satisfied?	Very dissatisfied	1					
		Dissatisfied	2					
		Somewhat satisfied	3					
		Satisfied	4					
		Very satisfied	5					
2.23	Are you a member of any waste workers' association/ organization?	Yes	1					
		No	2					
2.24	How many people from your household are involved in waste management work?	NUMBER						
2.25	What are the commonest items that you collect/retrieve from waste?							
		Metal	1	2				
		Plastic	1	2				
		Glass	1	2				
		Paper	1	2				
		Clothing items	1	2				
		Food remains	1	2				
		Medicines	1	2				
		Electronics	1	2				
		Don't collect/retrieve	1	2			2.28	
		Other	1	2				
		(Specify)						
2.26	What do you do with the items you retrieve/collect from waste?							
		Use them	1	2				
		Sell	1	2				
		Recycle	1	2				
		Don't collect/retrieve	1	2				
		Other						
		(Specify)						
2.27	What is the value of items that you retrieve in a typical day?	AMOUNT						
2.28	What unsightly/unusual type of waste have you ever seen?	Human fetus	1					
		Human body parts	2					
		Fecal waste	3					
		Animal carcasses	4					
		Other	6					
		(Specify)						

2.29	Do you have any of the following protective gear to use at work? [IF 2 FOR ALL SKIP TO Q2.31]		Yes	No				
		Foot ware (gumboots)	1	2				
		Gloves (heavy duty)	1	2				
		Goggles	1	2				
		Face masks	1	2				
		Overalls	1	2				
2.30	In your work, do you consistently use any of the following protective gear?		Yes	No				
		Foot ware (gumboots)	1	2				
		Gloves (heavy duty)	1	2				
		Goggles	1	2				
		Face masks	1	2				
		Overalls	1	2				
2.31	What tools (if any) do you use in your line of work?		Yes	No				
		Rake	1	2				
		Wheelbarrows	1	2				
		Magnets	1	2				
		Other _____ (SPECIFY)	1	2				
2.32	Have you ever received any training on safety related to your work?	Yes		1				
		No		2				
2.33	Have you ever been trained on infection control in the line of your work?	Yes		1				
		No		2				
2.34	Do you get support from the county government for example in getting training or in organizing your work?	Yes		1				
		No		2				
2.35	Do you wash hands with soap between work and meals including when taking just a drink?	Yes always		1				
		Yes, sometimes		2				
		Yes, rarely		3				
		Never		4				
2.36	Do you have regular access to sanitary services to the following services while at the dumpsite?		Yes	No				
		Water for handwashing	1	2				
		Toilet	1	2				
2.37	What social/recreational substances (if any) do you take?		Yes	No				
		Cigarette smoking	1	2				
		Drinking alcohol	1	2				
		Marijuana	1	2				
		Sniffing glue/petrol	1	2				
		Chewing tobacco	1	2				
		Chewing miraa/khat	1	2				
		Other _____ (Specify)						

3.0 HEALTH CONCERNS RELATED TO WORKING WITH WASTE																																																																							
We are now going to talk about the health risks arising from exposure to solid waste, given the nature of your work. We shall discuss about your experiences in the past 12 months.																																																																							
3.1	<p>What health issues do you think arise due to one's exposure to solid waste?</p> <p>CIRCLE ALL THAT APPLY</p> <p>ALLOW READING OF OPTIONS</p> <table border="1"> <thead> <tr> <th></th> <th>Yes</th> <th>NOT MENTIONED</th> </tr> </thead> <tbody> <tr><td>01 Cholera/Diarrhea</td><td>1</td><td>2</td></tr> <tr><td>02 Chest problems</td><td>1</td><td>2</td></tr> <tr><td>03 Allergies</td><td>1</td><td>2</td></tr> <tr><td>04 Skin problems</td><td>1</td><td>2</td></tr> <tr><td>05 Asthma</td><td>1</td><td>2</td></tr> <tr><td>06 Heart problems</td><td>1</td><td>2</td></tr> <tr><td>07 Injuries (e.g.cuts, burns)</td><td>1</td><td>2</td></tr> <tr><td>08 Blood disorders</td><td>1</td><td>2</td></tr> <tr><td>09 Cancers</td><td>1</td><td>2</td></tr> <tr><td>10 Muscle pains</td><td>1</td><td>2</td></tr> <tr><td>11 Joint pain</td><td>1</td><td>2</td></tr> <tr><td>12 Swollen joints</td><td>1</td><td>2</td></tr> <tr><td>13 Joint deformities</td><td>1</td><td>2</td></tr> <tr><td>14 Tetanus</td><td>1</td><td>2</td></tr> <tr><td>96 Other _____</td><td>1</td><td>2</td></tr> <tr><td colspan="3" style="text-align: center;">(Specify)</td></tr> </tbody> </table>		Yes	NOT MENTIONED	01 Cholera/Diarrhea	1	2	02 Chest problems	1	2	03 Allergies	1	2	04 Skin problems	1	2	05 Asthma	1	2	06 Heart problems	1	2	07 Injuries (e.g.cuts, burns)	1	2	08 Blood disorders	1	2	09 Cancers	1	2	10 Muscle pains	1	2	11 Joint pain	1	2	12 Swollen joints	1	2	13 Joint deformities	1	2	14 Tetanus	1	2	96 Other _____	1	2	(Specify)																					
	Yes	NOT MENTIONED																																																																					
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02 Chest problems	1	2																																																																					
03 Allergies	1	2																																																																					
04 Skin problems	1	2																																																																					
05 Asthma	1	2																																																																					
06 Heart problems	1	2																																																																					
07 Injuries (e.g.cuts, burns)	1	2																																																																					
08 Blood disorders	1	2																																																																					
09 Cancers	1	2																																																																					
10 Muscle pains	1	2																																																																					
11 Joint pain	1	2																																																																					
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96 Other _____	1	2																																																																					
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3.3		3.3a	3.3b	3.3c	3.3d	3.3e
	Since starting your work with solid waste, have you had any of the following symptoms/conditions?	Has had (.)?	How many times have you had (.)?	Where did you get treatment for (.)? ASK ABOUT MOST RECENT EPISODE IF HAD MORE THAN ONE	[IF 3.3a=YES] ASK: Are you currently suffering from (.)	How long have you had (.)?
			[INDICATE 88 IF >20 TIMES; 99 IF HAD IT THROUGHOUT]			
		Yes No		Yes No	Yes No	
	a Skin infection/reaction	1 2		1 2	1 2	
	b Eye irritation	1 2		1 2	1 2	
	c Diarrhea	1 2		1 2	1 2	
	d Cough	1 2		1 2	1 2	
	e Wheezing	1 2		1 2	1 2	
	f Chest pain	1 2		1 2	1 2	
	g Difficulty in breathing	1 2		1 2	1 2	
	h Asthma	1 2		1 2	1 2	
	i Abdominal pain	1 2		1 2	1 2	
	j Common colds	1 2		1 2	1 2	
	k Emotional distress	1 2		1 2	1 2	
	l Muscle pains	1 2		1 2	1 2	
	m Joint pain	1 2		1 2	1 2	
	n Swollen joints	1 2		1 2	1 2	
	o Joint deformities	1 2		1 2	1 2	
	p Tetanus	1 2		1 2	1 2	
	q Other (specify) _____	1 2		1 2	1 2	
	[IF 3.3d FOR ALL IS 2, SKIP TO Q3.6] CODES FOR 3.3e: DAYS; WEEKS; MONTHS; YEARS					
	CODES FOR 3.3c: 00=Did not seek treatment; 01=Public Hospital; 02=Public health center/dispensary; 03=Private health facility in slum; 04=Private health facility elsewhere; 05=Mission/Islamic hospital; 06=Pharmacy/drug shop; 07=Traditional healer/herbalist; 08=Community health worker; 09=Self; 96=Other _____					
3.4	Has having this condition(s) affected your work in any way?			Yes 1 No 2	3.6	
3.5	In what way has this affected your work?			Yes No		
				Work fewer days 1 2		
				Work for short duration per day 1 2		
				Changed work station 1 2		
				Stopped work altogether 1 2		
				Changed nature of work 1 2		
				Lower ability/energy to work 1 2		
				Other _____ 1 2		
				(Specify)		
3.6	Have you ever been vaccinated against the following:			Yes No		
				Hepatitis B 1 2		
				Tetanus 1 2		

3.7	When was the last time you took dewormers? [RECORD IN WEEKS IF LESS THAN A MONTH; IN MONTHS IF LESS THAN A YEAR; CIRCLE 99 IF NEVER TAKEN]	WEEKS AGO					
		MONTHS AGO					
		YEARS AGO					
		NEVER TAKEN		9	9		
3.8	Have you ever received blood transfusion?	Yes				1	
		No				2	
3.9	On a scale of 1 meaning no risk at all to 5 meaning very high risk of poor health from your work, how would you rate your risk? Would you say you have no risk at all, have a small risk, moderate risk, high risk or very high risk of poor health?	No risk at all				1	
		Small risk				2	
		Moderate risk				3	
		High risk				4	
		Very high risk				5	
3.10	When you fall sick and go to hospital, do you pay out of pocket or do you have health insurance such as NHIF?			Yes	No		
		Yes NHIF		1	2		
		Yes other insurance		1	2		
		Out of pocket		1	2		
		Other		1	2		
		(Specify)					
3.11	Do you get any form of harrasment either emotional or physical from your competitors or employers?	Yes				1	
		No				2	
3.12	Due to the nature of your work, do other people do any of the following?			Yes	No		
		Look down on you		1	2		
		Refuse to associate with you		1	2		
		Call you names (e.g. thieves)		1	2		
		Deny you services		1	2		
		Decline/refuse your services		1	2		
		Delay services		1	2		
		Affected romantic relationships		1	2		
		Other					
		(Specify)					
4.0	OFFICE/FIELD CHECKER'S DETAILS						
4.1	FIELD SUPERVISOR/TEAM LEADER'S CODE						
5.0	END OF INTERVIEW						
5.1	I would like to thank you for taking your time to answer the questions that I asked you. As I said at the beginning, the information you have given me will help a lot in understanding the health effects of solid waste among those working in the sector. Now we have come to the end of our discussions. Do you have any questions for me? 1=YES; 2= NO; [IF 2 SKIP TO Q5.3]						
5.2	FW: RECORD QUESTIONS AND COMMENTS RAISED BY RESPONDENT						
5.3	FW: RECORD COMMENTS ABOUT THE INTERVIEW						
5.4	RESULT OF INTERVIEW 1=Complete; 4=Refused; 8=Other (Specify)						
5.5	END TIME (24 HRS)						

Appendix 2: Clinical Assessment tool

AFRICAN POPULATION AND HEALTH RESEARCH CENTER	
BIOMEDICAL STUDY AMONG WASTE PICKERS	
INDIVIDUAL BARCODE	
INDIVIDUAL'S NAME	
INDIVIDUAL'S AGE	[][]
SEX	[]
NURSE'S CODE	[][][][]
DATE OF EXAMINATION	[][][][][][][]
Weight	[][][] . [] KG
Temperature	[][] . []
	SYST [][][] DIAST [][][]
Blood pressure (adults only)	
DOCTOR'S CODE	[][][][]
Clinical findings:	
Parlor	YES [] NO []
Jaundice	YES [] NO []
Skin lesions and likely diagnosis	YES [] NO [] DIAGNOSIS _____
Location of skin lesions	Upper limbs [] Lower limbs [] Trunk [] Face []
Hepatomegaly	YES [] NO []
Splenomegaly	YES [] NO []
Respiratory abnormalities	YES [] NO []
Cardiac abnormalities	YES [] NO []
Enlarged lymph nodes	YES [] NO []
Musculoskeletal deformities (joint swellings,tenderness)	YES [] NO []
	Duration [][] Days/Weeks/Months/Years
Other observations	



The contents of this Working Paper reflect the views of the authors only and not those of the UK Department for International Development or the Economic and Social Research Council.