

INFLUENCE OF THE WORK ENVIRONMENT ON THE HEALTH STATUS OF WOMEN WASTE PICKERS AT THE DANDORA DUMP SITE, NAIROBI KENYA

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Abstract

The main aim of this paper is to assess the effect of work environment on the health status of women waste pickers at the Dandora Dump site, Nairobi. Solid waste management is a key aim that every developing country strives to achieve. The sources of solid waste are diverse and range from domestic activities to industrial processes. Solid waste is a potential source of pollutants that are commonly associated with adverse health effects in human beings. As the urban population increases in Nairobi and its environs, and so is the waste from the normal operations of the population. This poses a threat to the health of the communities and particularly those majoring on waste picking as the source of their livelihoods. In such conditions, there is poor solid waste management which is characterized by open dumping due to lack of proper waste disposal system. Open dumping sites are often chosen without any environmental, health and safety considerations and pose a threat to the health of people living in adjacent areas. This paper assesses how the work environment has affected the health of status of the women waste pickers in Dandora dumpsite. The findings revealed that the waste management at the dumpsite has been not effectively undertaken and this has seen the work environment in the area become toxic and with negative health effects on women waste pickers. This has been evidenced by increased health-related concerns, most of which have affected the livelihoods of the women waste pickers.

Keywords: Waste Management, Work environment, Women waste Pickers, Dandora Dumpsite

I.0 INTRODUCTION

1.1 Background

In Africa and in particular Kenya, most dumpsites are not fenced and allow unauthorized waste scavenging which exposes waste pickers to health risks. Communities that reside in areas close to dumpsites are likely to be exposed to health risks when they come into contact with contaminated soil, air and water (Lutter *et al.*, 2011). Just like other cities of Africa, Nairobi City County generates approximately 4000 tonnes of waste daily most of which comprises organic wastes, plastic, paper, glass and metals among others (Kasozi & Blottnitz, 2010). According to (JICA, 2010) report, the collection rate of waste is as low as 33% leaving 2690 tonnes uncollected. Only 3.7% of the total daily solid waste is reused and recycled by the generators whereas the rest is dumped indiscriminately in the open dumpsites such as the Dandora dumpsite (Kasozi & Blottnitz, 2010).

The Dandora dumpsite is a 30-acre open quarry that serves as the main open waste dumping site in Nairobi. The localities surrounding the dumpsite include Dandora, Kariobangi, Lucky Summer Estates, Korogocho, Gitare-Mariguini, Kinyago, Kibagare and Muoroto informal settlements. This designated dumpsite does not conform to set regulations for solid waste management as this was not the intended purpose (Kenya National Audit, 2008). The

Nairobi River, which traverses the dumpsite, collects pollutants from the dumpsite, posing a health risk to communities living beyond the dumpsite (UNEP, 2007). Access to the site is constrained by piles of waste that obstruct access roads. During rainy seasons the situation is compounded by pools of water. This forces waste transporters to dump the waste outside the dumpsite area. The Nairobi City County government through the Department of Environment exercises only limited control over the dumpsite as unauthorized groups run the dumpsite sometimes charging fees and restricting access to only those who pay up (Kenya National Audit, 2008). The dumpsite is viewed as a resource by communities living in adjacent areas. Some of the community members scavenge at the dumpsite often looking for valuables for reuse and recycling.

1.2 Research Problem

The Dandora dumpsite is an informal workplace to about 10,000 women, children and a few middlemen who scavenge through the piles of rubbish from dawn to dusk (Concern Worldwide, 2012). The Dandora dumpsite has a number of co-operatives of youth and women which have come up to sort and recycle some of this waste. Due to hard economic times which has spawned a culture of survival, these people earn between Ksh 500-1500 (USD 5-15) a day (Ogolla and Moschetti 2007). They work under harsh conditions without any protective clothing and when they fall sick, their employers do not cover them. At the Dandora dumpsite, women play a key role in collecting and sorting wastes for sale to small buyers who later sell them to recycling factories for an average of Ksh 200 (\$ 20) per day (Kamala, 2011). A study on health risk reduction behavior model for scavengers of solid waste in Municipal dumpsites in Nakhon Province, Thailand showed that women were the majority scavengers in dumpsites at 52% (Thirarattanasu et al, 2012). Dandora dumpsite is a real human rights issue. Approximately a million poor and impoverished people's lives are put at risk hence a great injustice and social-economic apartheid to let the poor live in the rubbish pit while the wealthier suburbs continue to fill the dumpsite with their garbage (Concern Worldwide, 2012).

The waste pickers collect recyclable waste for sale to nearby weigh stations where small buyers purchase them and later supply these wastes to recycling companies. In carrying out their daily activities, the waste pickers expose themselves to environmental and occupational hazards that could be detrimental to their health. In 2007, a study commissioned by the UNEP at the dumpsite revealed severe environmental and public health impact on the immediate population. The study examined 328 children who were aged between 2-18 years that were living around the dumpsite and found that half of the children had blood lead levels that exceeded internationally accepted levels (UNEP, 2007).

2.0 LITERATURE REVIEW

2.1 Health effects of Heavy metals on women Scavenging at Dandora dumpsite

Heavy metal pollutants can cause harmful effects in plants, animals and humans as a result of long-term or frequent exposure to high concentrations in air, water or soil. Heavy metals are a group of elements with a specific density of more than 5gm/cm^3 and include lead, cadmium, manganese, mercury and zinc among others (European Commission, 2010, p. 47). Generally, heavy metals are required in low amounts by living organisms for optimal health. However, exposure to higher concentrations of heavy metals can be toxic to animal and plant life. Although heavy metals are naturally occurring elements that exist in the earth's crust, anthropogenic activities have altered their geochemical cycles and biochemical balance in the environment. Anthropogenic activities such as industrialization and poor waste management have led to release of heavy metals in various forms to the environment and the subsequent contamination of air, water and soil. The persistent use of heavy metals in industrial processes and manufacture of products has increased the exposure of people to these elements. The levels of heavy metal contaminants in dumpsites and surrounding environment can be extremely high. Several studies have reported a high concentration of heavy metals in soils surrounding dumpsites in Africa (Tsumaet al, 2013 ; Odhiambo et al, 2015 ; Mohammed & Mohammed, 2012).

According to a study commissioned by (UNEP, 2007), lead, cadmium and mercury are highly concentrated in Dandora dumpsite waste beyond the internationally acceptable standards. Soil samples adjacent to and within the

dumpsite revealed high lead concentrations of 264ppm and 13500ppm respectively, all beyond 50ppm reference value of Taiwan and Netherlands lead soil concentrations. Adjacent soil samples for mercury measured up to 18.6ppm while the soil within the dumpsite measured up to 46.7ppm, all above the 2ppm WHO standard. Cadmium levels were as high as 40ppm in adjacent soil and 1058ppm in the soil within the dumpsite which supersede 5ppm reference value of Taiwan and Netherlands soil standards. When the mean concentration levels were compared with a control sample from unpolluted Waithaka soil, the difference was significant with a ($p=0.0002$). Lead concentration was as low as 34.5ppm and Mercury concentration was below the detection limit of 15ppm in Waithaka soil. Mean concentrations of lead in Dandora soil samples were over seven times more than those found in Waithaka while Zinc concentrations were four times greater and these values exceeded the recommended standard levels as well.

The high-level of lead in the soil samples analyzed negatively impacted on the communities living near the dumpsite. In Africa, women form a high proportion of waste pickers in dumpsites whereas men buy and sell recyclable waste to middle men. This separation of tasks at dumpsite increases women exposure to solid waste problems as they rummage through heaps of garbage in search of recyclable waste. In addition, there exist gender differences that increase women's susceptibility to retention of metals such as cadmium and lead which can also be passed on to a developing foetus.

2.2 Impact of Environmental Hazard Metals on women waste pickers

2.2.1 Cadmium metal

Cadmium is a soft and silver-white, naturally occurring metal that is used in the manufacture of batteries, coatings, stabilizers for plastics, pigments, photovoltaic devices, non-ferrous alloys and other uses (Musa et al, 2013). At waste disposal sites female workers may be exposed to cadmium by heating cadmium containing materials during waste burning or when eating foods at the dumpsite. About 5% to 50% of inhaled cadmium and about 1% to 10% of ingested cadmium enters the body through the lungs and digestive system respectively (ATSDR, 2007). Cadmium is considered to be a metalloestrogen, is a risk factor for oestrogen-dependent diseases such as endometrial, and breast cancers. In addition, high levels of cadmium in maternal blood can lead to spontaneous abortions (Rzymiski et al, 2015).

Cadmium is an anti-metabolite of zinc and increased cadmium intake in the body could lead to zinc deficiency. Maternal deficiency of zinc is associated with delivery of low birth weight babies. A case-control study carried out in Ibadan, Nigeria among 160 subjects (125 pregnant women and 35 non-pregnant women) reported that maternal serum cadmium was negatively correlated with birth weight ($r=-0.708$, $p=0.000$) whereas maternal zinc concentration ($r=0.306$, $p=0.023$) was correlated positively with birth weight. Another epidemiological study in India also reported a negative correlation between maternal blood cadmium levels with the birth weight (Dwivedi et al, 2013). Cadmium exposure is associated with decreased birth weight, cancer, delayed ossification, kidney damage, skeletal malformations, bone fracture, low bone mineral density and impaired early life development (Dwivedi et al 2013).

A cross-sectional study in Northern Argentina among 202 women where biomarkers of cadmium exposure were measured, reported that low cadmium levels in blood and urine were inversely correlated with DNA methylation in peripheral blood ($\beta = -0.50$, $p = 0.0070$; $\beta = -0.44$, $p = 0.026$) (Hossain et al, 2012, p. 883). DNA methylation is essential for embryogenesis and for maintaining cell line embryogenesis whereas dysregulation of epigenetic process such as DNA methylation could lead to impaired childhood development or chronic diseases later in life including cancer (Hossain et al., 2012). Different studies have also shown that low environmental exposure to cadmium among children and adults is associated with bone reabsorption, decreased bone mineral density and osteoporosis (Engstrom et al, 2011).

2.2.2 Lead metal

Lead is a naturally occurring heavy metal that exists in small amounts in the earth crust. At waste disposal sites female workers may be exposed to Lead by inhaling or by absorption through skin mucous lead containing materials such as cathode ray tubes, solder, pipes, ceramic products and paints during waste burning process. ATSDR (2015) argues that women exposed to lead during pregnancy are more likely to encounter miscarriage, premature birth, high blood pressure and cancer. Lead poses health risks for everyone, but unborn babies are more prone to lead toxicity that contributes to brain development retardation of growing children hence poor learning ability.

A study carried out by The National Institute of Occupational Safety and Health, Nagao, Tama-ku, Kawasaki Japan on effects of prenatal lead levels on early childhood development found that maternal lead blood levels were inversely associated with childhood development. Mohsen et al, (2014) showed that Maternal whole blood lead levels in the first trimester were significantly higher in children with developmental scores <20% than in those with normal scores. Maternal blood lead levels in the first trimester were also inversely associated with the development scores ($r = -0.155$, $P = 0.041$). Logistic regression analysis showed a significant relationship between increasing maternal blood lead levels in the first trimester with low development scores (odds ratio 1.74). The WHO maximum exposure limits for lead are $10\mu\text{g}/\text{dl}$. However, a study by (Dwivedi, 2013) found out that 44% of babies studied had over $10\mu\text{g}/\text{dl}$ in their blood. There was a significant association between maternal lead level and baby birth weight after adjusting for confounding factors.

A study conducted in the UK reported that exposure to lead among pregnant mothers significantly increased the risk for preterm birth and reduction in birth weight (Taylor *et al* 2015). High levels of lead exposure $>40\text{ ug}/\text{dl}$ for a long period appear to reduce fertility and increase the risk of spontaneous abortion and reduced foetal growth. Maternal blood lead levels above $10\text{ug}/\text{dl}$ have been linked to increased risks of reduced offspring neurobehavioral development (Bellinger, 2005).

2.3 Environmental Health at Dadora Dumpsite

Usually, environments that surround dumpsites and landfills are known to have high concentrations of pollutants such as heavy metals and persistent organic pollutants (POPs) (Chifamba, 2007). A study carried out in Dandora Kenya reported that 42% of soil samples had ten times higher lead levels than normal (Oyaro, 2003). A waste audit revealed that household, industrial, agricultural and hospital wastes such as sharps and pharmaceuticals were among the wastes dumped at the dumpsite. Leachate from the dumpsites eventually finds its way into water bodies through underground seepage or during rains hence transporting the pollutants to other areas. In another study by UNEP (2007), the analysis of soil samples established the presence of heavy metal contamination and found lead contamination of over 400 parts per million (Kimani *et al*, 2007). Based on this research study it is clear that waste pickers at the dumpsite are exposed to pollutants such as heavy metals and POPs among others with implications for dermatological, gastrointestinal, respiratory and other chronic diseases. Whereas everyone at the dumpsite is likely to be affected by these pollutants, women are at a higher risk of developing reproductive challenges.

2.4 Impact of Environmental Hazards on Women waste pickers at Dadora Dumpsite

According to the 2012 report by Concern Worldwide titled Trash and Tragedy, suggested a high prevalence of health complications among women such as Anaemia, decreased fertility, frequent miscarriages, low birth weight and premature deliveries. The female reproductive system is susceptible to environmental pollutants which can produce a variety of adverse effects leading to congenital anomalies. Several research studies have reported an association between congenital anomalies and exposure to heavy metals such as lead, mercury and cadmium and POPs such as PCBs, HCBs and DDT (Athanasidou *et al.*, 2008). A study conducted by (Envilead, 2012) on contamination of free-range chicken eggs near the Dandora dumpsite by dioxins PCBs and HCB reported that PCBs and dioxins were four times and six times higher than European Union's limits respectively. The effect of environmental pollutants on the women's reproductive system is greatly influenced by the extent of exposure and

the level of dosage. Environmental pollutants can cause adverse effects during the development of ova, on implantation in the uterus and growth and development of the foetus. Women working and living near the Dandora dumpsite are likely to have been exposed to high levels of heavy metals and POPs making them vulnerable to reproductive problems and congenital anomalies.

2.5 Impact of Disposed Toxic Waste on the Environment

Indiscriminate dumping of solid waste can lead to air, water and soil pollution. Further, activities at dumpsites such as improper incineration and burning of solid waste often lead to air pollution. Unfortunately, dumpsites in Africa are mostly located next to residential dwellings and agricultural areas. In areas where waste management does not exist at all, the health damage costs are 20 times higher than the gross microeconomic costs of a fully established and compliant waste management system (European Commission, 2011, p. 76). Recycling of waste even in a closed facility such as a material recycling facility (MRF) can result to health hazards such as exposure to Radon, particulate matter and volatile organic compounds (Megrahi, 2009). MRFs are usually closed environments whereby sorting of waste and packaging is done and sent to recycling firms. Waste pickers in open dumpsites are also involved in sorting and packaging of waste but this increases environmental health risks.

Waste pickers in open dumpsites sometimes burn waste in order to recover plastics and metals. For example, in Ghana, (Amankwaa, 2014) reports that waste pickers openly burn e-waste with the aim of recovering precious metals such as gold, copper and platinum for sale. In developed countries recovery of precious metals in waste is done using sophisticated technology which is unavailable in most African countries. Open burning of waste can lead to release of neurotoxins and carcinogens to the atmosphere and could further contribute to smog (Olaifisoye *et al.*, 2013). Burning of solid waste leads to the release of polychlorinated dibenzofurans, polychlorinated dibenzodioxins, polyaromatic hydrocarbons, nitrogen oxides, Sulphur oxides, heavy metals and volatile organic compounds among other pollutants. Volatile organic compounds such as benzene, toluene, ethylbenzene, xylene (BTEX) are produced through the decomposition of organic waste and microbial action (Megrahi, 2009). Some of the pollutants that are released in dumpsites are bio accumulated in plants and animals and may pose a health risk along the food chain (Awokunmi *et al.*, 2010). In addition, uncontrolled decomposition of solid waste leads to the generation of greenhouse gases which are known to deplete the ozone layer and the release of untreated leachate which contaminates soil and water bodies. (Adegoke *et al.*, 2009) contend that metallurgical and chemical industries are the largest sources of heavy metal waste in the environment. However, electric and electronic wastes which are sometimes disposed of in dumpsites are also an important source of heavy metals. For example, fluorescent tubes contain mercury whereas resistors and rechargeable batteries contain cadmium and cathode-ray tubes contain lead. On the other hand, dismantling and burning computer monitors usually releases zinc into the immediate environment (Adaramodu *et al.*, 2012). Heavy metals are usually not affected during the breakdown of organic waste and remain toxic to living organisms. Substantial levels of heavy metals above background concentrations measured in mg/kg are given as : Zn 58.3±37.0, Cd 1.3±1.0, Cr(VI) 13.2±5.5, Cu 28.3±31.5, Pb 895.1±423.9, Ni 42.7±20.3, Mn 201.8±77.5 and Fe 1303.5±2028.6. Pb, Ni, Zn, Cd, Cr(VI). The mobility of heavy metals in soil is dependent on the redox potential, pH and the presence of inorganic and organic complexing agents (Toth *et al.*, 2016). An acidic soil increases the solubility, bioavailability and mobility of heavy metals such as lead and cadmium. Methylated mercury and elemental mercury are not affected by the pH of the soil but are volatile and easily evaporate resulting in air pollution (Toth *et al.*, 2016). A study at the Narok main dumpsite in Kenya reported an alkaline pH (mean= 8.14± 0.25) and a high concentration of heavy metals in soils within the area surrounding the dumpsite due to immobilization of heavy metals. The gradual build-up of heavy metals in alkaline soils due to immobilization overtime results in pollution of ground and surface water (Odhiambo *et al.*, 2015). A study in Kaduna Metropolis, Nigeria reported a decrease in bioavailability of metals in soils with increasing pH. A different study at the Dandora in Kenya reported a considerably high level of lead, cadmium, zinc, chromium in leachate and methane gas in the general dumpsite environment (Tsuma *et al.*, 2016). Pollutants in dumpsite soils and leachate usually find their way into surface and ground water even in regions that are far away from the dumpsite. For instance, (Adenkule *et al.*, 2017) reported that portable water obtained from hand-dug wells had concentrations of heavy metals that were above the WHO permissible levels. This study also reported that the concentrations of pollutants in portable water and the atmosphere increased with increased proximity to the dumpsite.

Free-range animals including livestock that feed on dumpsite food remains are likely to bio-accumulate toxic substances which may pose a health risk to consumers. A study on contamination of chicken eggs near the Dandora dumpsite found the levels of PCBs and dioxins to have exceeded background levels by 18-fold and about six times higher than the European Union limit in eggs (Envilead, 2012).

3.0 METHODOLOGY

3.1 Study Design

A cross sectional study design was used to determine the effect of work environment on health status of women waste pickers. A mixed methods approach was used for data collection. This was warranted by the nature of the study population. Dandora dumpsite is difficult to access since there local authorities have limited access to the site. The identification and access to the study respondents was on the behest the dumpsite's informal management. Therefore there was need to triangulate the data collected.

3.2 Target Population and Sampling

The study population were all women waste pickers at the Dandora dumpsite. The target population were all women waste pickers working at the Dandora dumpsite who are estimated to be about 6,000 out of a possible number of 10,000 dumpsite workers. The sample size was determined by using the (Fischer et al, 19986) formula

$$n = \frac{z^2 pq}{d^2}$$

$$n = 384 / (1 + (384/6667))$$

$$= 362.959$$

A sample size of 363 was selected for the study.

3.3 Data Collection

A questionnaire was used for quantitative data collection. The questionnaire was based on the literature review and was guided by the research questions, the items in the questionnaire were refined through piloting the questionnaire and rewording the question to ensure that they were capable of measuring the construct. Qualitative focus group questions guide was developed using similar parameters bearing in mind that which will not easily come out in the interview schedule can be captured in the focus group discussion.

3.4 Data Analysis

The study used the mixed method approach of both quantitative and qualitative. Qualitative approach enables us to gather information from women waste pickers in a structured way. This assisted us in getting maximum information that you would not necessarily gather in an informal setting. It involved a structured interviewer schedule with multiple questions which the women waste pickers were to respond to as the research assistant inputs the data. Data that was collected from focus group discussions was transcribed in to NVIVO version12. The data was organised as per the study objectives. Pattern coding was used to identify patterns in the data. Quantitative analysis for lead, cadmium and mercury in soil samples was done through Atomic Absorption spectrometry. Analysis of POPs was done using gas chromatography – Electron Capture Detector and Liquid chromatography–mass spectrometry.

4.0 FINDINGS

4.1 Overview of Work Environment at the Dumpsite

Majority of dumpsite workers (68.9%, n= 250) believed that the dumpsite causes pollution to the environment. Slightly more than half (53%, n= 192) believed that vegetables that are grown close to the dumpsite are harmful. 62% (n = 225) believed that working at the dumpsite can expose one to diseases, Figure 41. 77% (n= 280) of the respondents believed that use of PPEs at the dumpsite was necessary whereas slightly more than half (57%, n= 207) believed that the harmful effects of dumpsite to one's health can take a long time before they manifest themselves. Approximately 30% of dumpsite workers did not perceive the dumpsite as an unhealthy environment.

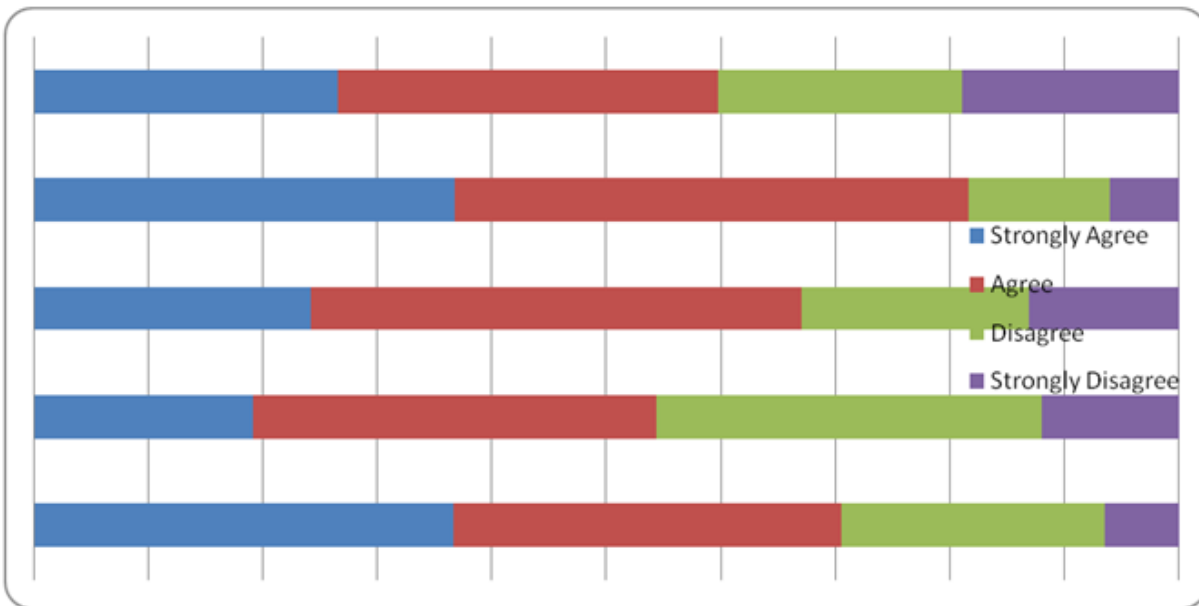


Figure 1: Women waste pickers perception on health and safety

Women waste pickers at the dumpsite explained that they were not aware of any national laws, regulations or policies that governed operations at the dumpsite. However, despite the existence of a coordinating office at the dumpsite there were no regulations or guidelines on workers' health and safety and there were no interventions from the County government

4.2 Health Risks Associated with working environment at the Dumpsite

4.2.1 Visual problems

Working in the dumpsite environment where there is waste that contains volatile and obnoxious substances as well as dumpsite fires may affect the workers' visual ability. The high temperatures at the dumpsite environment often lead to ignition of flammable wastes hence releasing chemicals into the atmosphere. These chemicals may affect the eyes leading to reduced visibility. In some cases, the exposure of the eyes to harmful chemicals may exacerbate underlying conditions resulting to blindness. Common visual problems that were reported by women waste pickers included 'burning' eyes 31%, poor eyesight 26%, and uncontrolled twitching 20%, figure 29. These visual problems can be attributed to long hours of exposure to burning waste and smoke in the dump site as well injuries caused by sharps that hit the eyes when breaking glass or other breakable recyclable materials. Physical injuries to the eye are likely to lead to partial blindness and or total blindness. Good visual acuity is important while working in the

dumpsite environment because it enables the worker to detect potential problems in advance. Workers who lack good visual ability are likely to experience injuries during their day to day work.

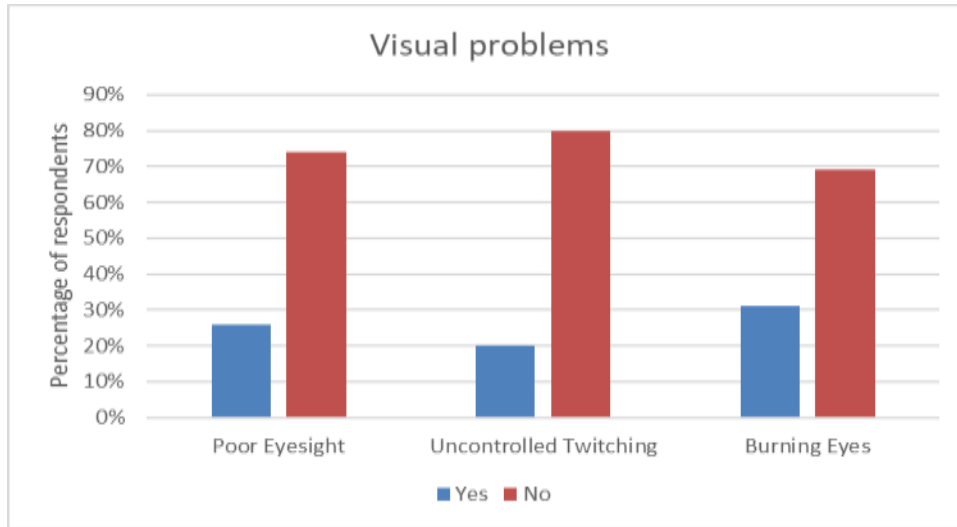


Figure 2: Visual problems among women waste pickers

4.2.2 Gastrointestinal Illness

The inhalation of obnoxious substances by women waste pickers at the dumpsite coupled with the consumption of contaminated food is likely to result to gastrointestinal problems. Women waste pickers reported having experienced the following illnesses within the six months preceding the study; stomach ache 34% , loss of appetite 36%, diarrhoea 33% and vomiting 25% were reported by more than 25% of the respondents. Food that is scavenged from the dumpsite environment is likely to contain chemical and biological contaminants because it is not hygienically packaged. This is because the substances are mixed together with other wastes which results in contamination with foreign substances. These substances when introduced to the body may have a local or systemic effect on various body organs. Some of the contaminants in the foods eaten are likely to cause harm after a long duration of time.

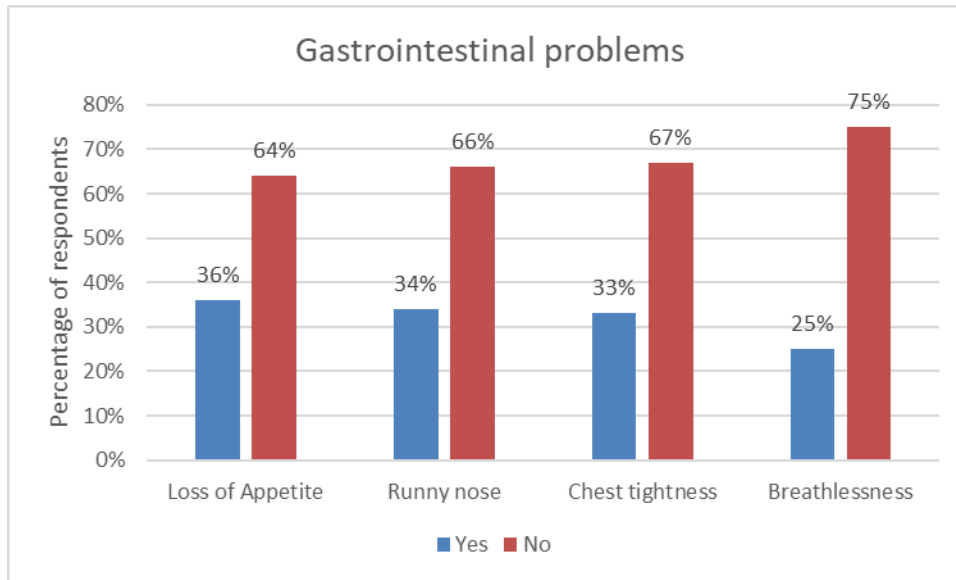


Figure 3: Gastrointestinal illnesses among women waste pickers

4.2.3 Respiratory Problems

The inhalation of harmful gases at the dumpsite is likely to affect the worker’s respiratory system. The burning of waste and the sublimation of volatile compounds at the dumpsite may lead to respiratory illnesses. However, some of the inhaled substances may also have systemic effects and may be transported to other organs where they may cause damage. The common respiratory problems that were reported in the study included sneezing 31%, runny nose 26%, chest tightness 18% and breathlessness 14%, figure 30. Women waste pickers interviewed during this study did not use respirators which would assist in reducing the amount of harmful substances that are inhaled. Women who experienced respiratory problems continued to work at the dumpsite despite the difficulty of working in such an environment whilst having respiratory challenges. If the respiratory illness was serious, the female waste pickers preferred to take a home rest and if very serious seek specialized care at health facilities near the dumpsite.

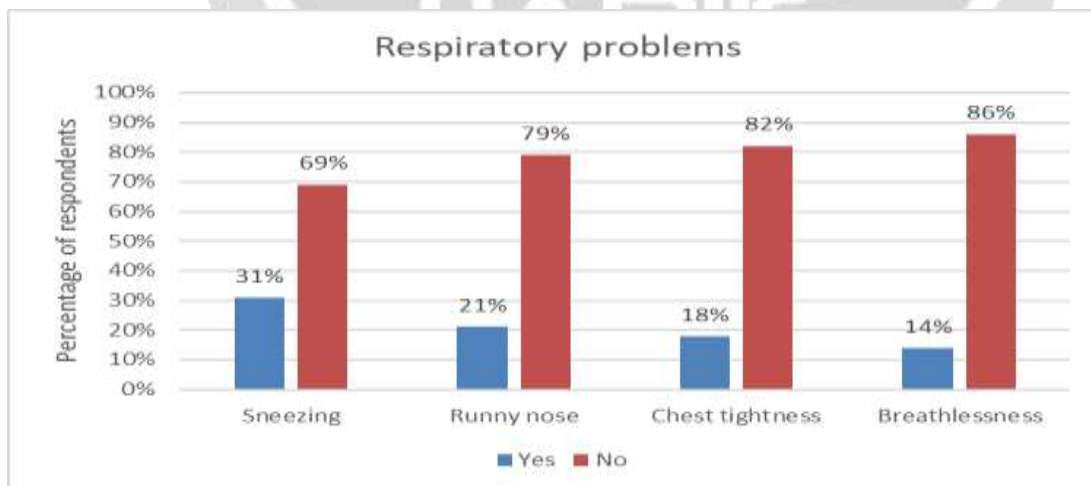


Figure 4: Respiratory problems among women waste pickers

4.3 Qualitative Results

People living adjacent to dumpsites are likely to be affected by local pollution as well as odours emanating from the dumpsites. As a result, communities living next to dumpsite are likely to hold negative opinions of the dumpsite. De Feo *et al* (2013, p. 980) argues that there is need to obtain the support of the community prior to setting up a dumpsite. However, the selection of the Dandora dumpsite as a regional dumpsite that serves the Nairobi county was done haphazardly with little involvement of the public when selecting the location. However, the community also benefits from purchase of recovered items from the Dandora dumpsite. Women at the dumpsite reported selling some of the items to the immediate community at a cheaper price.

A study conducted among community members living adjacent to the Kadhodeki dumpsite in Nairobi Kenya, showed that there was a low knowledge of the health risks that they were exposed to (Njagi, 2013, p. 428). However at the Dandora dumpsite women waste pickers reported that the community understood some of the health risks associated to living in areas that are close to the dumpsite. When probed further the women waste pickers claimed that the community complains mostly about miscarriages, pungent smell and respiratory illnesses.

Biohazards

The sorting of wastes within a dumpsite can expose workers to biological hazards that are present in the waste. These can pose significant health risks especially where the waste that is deposited at the dumpsite has not been well segregated. Waste from hospitals, if not well segregated may contain bio-hazards which may lead to serious infections among waste pickers. Women waste pickers at the dumpsite reported having come across dead babies, foetuses or mutilated organs while sorting through the waste. Exposure to biohazard among dumpsite workers can lead to acquisition of diseases such as HIV/AIDS and hepatitis B among others. Highly infectious waste from hospitals should be segregated from the other types of wastes before incineration. This will prevent disposal of such waste in dumpsites along general wastes

Chemicals

Wastes that are deposited in dumpsites may contain dangerous chemicals which may cause harm to waste pickers. Industrial wastes, in particular may contain chemical wastes that can affect waste pickers as they sort through the wastes. This may expose waste pickers to dangerous chemicals through inhalation, contact and ingestion. Chemical waste can be of diverse types and their composition varies with the type of industry where they originate. Exposure to chemicals through contact may have a local or systemic effect on the body depending on the type of chemical one is exposed to. However, some of the health effects that may result from exposure to these chemical may take a long duration before they can manifest. Dumpsite workers have a low capacity of understanding the composition of waste and may not differentiate waste containing hazardous chemicals from general waste. Therefore the dumpsite waste picker may lack the capacity to differentiate these waste during normal tasks

Consumption of food at the Dumpsite

Consumption of food within the dumpsite environment increase worker exposure to dumpsite contaminants through ingestion of contaminated foods. Some of the harmful substances that have a low likelihood of penetrating the body could be introduced into the body through consumption of contaminated food. The situation is compounded when food consumed is scavenged from wastes. Food that is sourced from the dumpsite may have been contaminated by harmful substances during waste collection at the source as well as during transportation and disposal at the dumpsite. This is besides the fact that foods that are poorly stored are ideal for microbial growth and food spoilage. Further, preparation and consumption of food that is scavenged from the dumpsite at household level is likely to lead to food poisoning at household level even among persons that do not work at the dumpsite. A few different studies have reported that waste pickers usually scavenge food from the dumpsite and store it within the dumpsite environment for future consumption (Nyathi *et al*, 2018, p. 28). Women waste pickers consume foods within the dumpsite environment for convenience as well as to lower their daily expenses.

Injuries within the Dumpsite

Sorting and collecting wastes at the dumpsite environment especially without using appropriate PPE increases the risk of getting injured. Dumpsite workers come across a variety of sharp objects which can break the skin or penetrate the body. Workers are likely to be injured while sorting waste that contains broken glass, pieces of metal, wood and ceramics among others. Women waste pickers reported that wastes originating from industries and hospitals had a high proportion of sharp objects which could also be contaminated with chemicals or hazardous fluids. In addition, the dumpsite floor comprises of compressed waste and is therefore inconsistent and may lead to trips and falls which can cause injuries to the dumpsite workers. Further, the workers reported that working at the dumpsite exposed them to accidents such as being hit by compactors, tippers and earthmovers that are present at the dumpsite.

Pregnancies

Most women waste pickers at the Dandora dumpsite are of reproductive age. After getting pregnant, most women at the Dandora dumpsite continue working till the full term of the pregnancy. Being pregnant does not pose a challenge to female waste workers at the dumpsite. Women waste pickers also reported not to have experienced any challenges while performing their duties at the dumpsite.

4.4 Discussion

In the dumpsite, there were no laws or regulations in force at the time of the study aimed at protecting the dumpsite workers from injuries and emissions arising from the dumpsite. Although there are Kenyan laws such as the Environmental Management and Co-ordination Act of 2009 and regulations such as the Waste Management Regulations of 2006 as well as Public Health Act Cap 242 which seek to improve the management of waste in urban areas such as the Nairobi county, they are poorly enforced and implemented even in other parts of the city which has effectively lowered their intended impact in management of waste in areas such as the Dandora dumpsite. In addition, poor enforcement of laws and lack of appropriate policies and strategies has further failed to reduce pollution in adjacent environment leaving the inhabitants of the environment around the dumpsite exposed to environmental contaminants which expose them to various environmental diseases.

The Nairobi informal waste disposal system that has been adopted at the Dandora dumpsite reflects the situation in other Kenyan cities and towns. Informal workers and communities living close to dumpsites are exposed to various environmental and occupational hazards which have put their health at risk (Muindi et al, 2016). The National and County governments are aware of the menace brought about by poor waste management but face various challenges in implementing proposed interventions. For instance, the UNEP Kenya country programme has worked closely with the ministry of environment, the Nairobi City County and other stakeholders to develop an integrated strategy for management of solid wastes (ISSW) (Njoroge et al, 2014). However, this strategy has not yet been implemented. On its part, the Nairobi City County in 2011 had announced plans to decommission the Dandora dumpsite the following year and simultaneously open a landfill site at Ruai which lies approximately 27 km east of the capital city though it never took root due to political affiliated reasons.

5.0 CONCLUSION AND RECOMMENDATIONS

5.1 Conclusion

In Kenya like many developing countries, the existing solid waste management system is affected by economic, institutional, legislative, technical and operational challenges. Developing countries are faced with a serious challenge when it comes to waste management especially in urban areas. The growing population as well as increase in industrialization has lead to increased generation of solid waste in many cities especially in developing countries

who are usually unprepared on how to handle them. There is minimal allocation of resources in this area that ends up with poor waste management practices. This has given rise to the proliferation of ineffective informal waste management system where women play a key role in recovering recyclable waste.

Women waste pickers in dumpsites such as the Dandora dumpsite live close to the area and spend most of their working hours at the dumpsite scavenging for valuable waste as the main source of their household income an environment that has affected their health due to presence of toxic metals such as lead and mercury released during waste combustion.

5.2 Recommendations

There is need to establish intermediate treatment facilities at the ward level to reduce health hazards at the Dandora dumpsite. These will be small scale waste composting plants that can provide employment, enable communities to generate income and alleviate poverty among women and the youth.

There is need to employ security officers to provide security to the dumpsite population that will also enable health intervention on the site for both mothers and their children. There is need for provision of personal protective equipment for use by waste pickers at the Dandora dumpsite. This will minimize the negative health effects arising from cuts and pricks as well as inhalation of obnoxious substances. There is need to establish a comprehensive environmental management plan that seeks to reduce the amount of hazardous infectious waste that end up in the dumpsite. There is need to establish easily achievable legal and institutional framework for reforms of the waste management sector There is need to establish cooperation among City communities, the informal sector, formal waste collectors and the County authorities to assist in waste minimization

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