FACTORS ASSOCIATED WITH SELF-REPORTED HEALTH OUTCOMES BY RESIDENTS RESIDING NEAR OSHAKATI MUNICIPAL DISPOSAL SITE IN OSHANA REGION, NAMIBIA

By:

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A dissertation submitted to the University of Zambia in partial fulfilment of the requirements towards the awarding of Master of Public Health in Environmental Health

The University of Zambia

Lusaka

2019

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MARIA MAGANO TUYAKULA ELAGO

2019

DECLARATION

I hereby declare that this dissertation is for the award of Master of Public Health degree in Environmental Health and it has not been presented or submitted wholly or in part for an award of any other qualification or course. This dissertation is wholly as a result of independent investigation. The various sources of information have been acknowledged in text through citations in the document and in the references.

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APPROVAL

This dissertation of Maria Magano Tuyakula Elago has been approved as fulfilling the requirements or partial fulfilment of the requirements for the award of the Master of Public Health Degree in Environmental Health by the University of Zambia.

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ABSTRACT

Environmental pollution is the introduction of contaminants into the natural environment that have the potential to cause adverse health outcomes. Open waste disposal sites are among the main causes of environmental pollution and public health hazards. In Namibia, majority of the towns, including Oshakati town, use waste disposal sites for waste disposal, a method that is known to cause environmental and public health hazards. Residents near Oshakati Municipal Disposal site raised health concerns which they link to the presence of the disposal site in their neighbourhood. In addition, medical records from Oshakati State Hospital revealed that diarrhoea diseases, respiratory and eye diseases were among the top ten morbidities reported at the hospital from 2014 to 2017. This study sought to assess association between the number self-reported health outcomes cases by residents and living near Oshakati Municipal Disposal site. Health outcomes in this study were acute respiratory symptoms, eye infections and diarrhoea cases.

This was a cross sectional study which targeted households in two villages located 10 km apart, of which one is where the waste disposal site is located. The study used cluster sampling method and utilized a closed-ended researcher administered questionnaire in all 103 households within the study area. For each household, the number of reported cases of each health outcome of interest and the characteristics of the household were recorded.

Collectively, this study revealed that nearly all households contracted at least one case of acute respiratory symptom, about half of the households contracted at least one case of eye infections and a few households contracted at least one case of diarrhoea. Nearby household members, however contracted double the number of cases contracted by household members far from the disposal site. Results from Poisson regression analysis revealed that residing near Oshakati Municipal Disposal site increased the risk ratio of contracting Acute Respiratory Symptoms in a household, as compared to residing far from the disposal site (IRR 1.562, 95% CI=1.142, 2.136, p value = 0.005). The use of firewood for cooking did not show any significant association with the reported cases of Acute Respiratory Symptoms. For eye infections, longer duration and the use of electricity for cooking significantly increased the risk ratio of contracting eye infections. There was however no significant association between any of the predictor variables and contracting of diarrhoea.

In this study, Oshakati Municipal Disposal site was found to be a potential health hazard and a significant risk factor for contracting Acute Respiratory Symptoms among surrounding residents. It is therefore recommended that the council strictly enforce waste management laws and regulations, encourage community participation in waste management. In the long run, the council should consider relocating the disposal site far away from the residential area and finding a suitable site to construct an engineered landfill.

Keywords: waste disposal site, health outcomes, resident

DEDICATION

I dedicate this humble work to my daughter, Iyaloo, and the rest of my dear family, for they have been my source of motivation and support throughout my studies.

ACKNOWLEDGEMENTS

I could not have accomplished my studies all by myself, therefore I would like acknowledge those that have contributed. I would like to express my heart felt gratitude to my dear family for their patience, support and encouragement during my studies.

My sincere appreciation goes to my supervisors, Mr. A. Mbewe, Mr. L. J. Banda and Mr. G. Moonga for their valuable guidance and support, and to the staff in the School of Public Health (University of Zambia) who valuably contributed to the success of my studies. I also acknowledge the Namibian Ministry of health and social services, Oshakati Town Council, the regional councillors and the two headmen for their cooperation. Special thanks go to my class mates, the 2016 - 2018 MPH class.

Above all, I thank the almighty God for the study opportunity, by preparing everything before me and placing the right people in this endeavour. I will forever be grateful.

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ACRONYMS

CEO	Chief Executive officer
EHIA	Environmental Health Impact Assessment
EIA	Environmental Impact Assessment
GRN	Government of the Republic of Namibia
LFG	Land Fill Gas
MSWM	Municipal Solid Waste Management
$PM_{2.5}$	Particulate Matter of 2.5 µm
PPE	Personal Protective Equipment
SWM	Solid Waste Management
UNZABREC	University of Zambia Biological Research Ethics Committee
VOCs	Volatile organic compounds
WHO	World Health Organization

WORKING DEFINITIONS

Waste - means any substance or matter whether solid, liquid or any combination thereof, irrespective of whether it or any constituents thereof may have value or other use.

Waste disposal site- means any facility or site which receives waste for treatment or final disposal, and which is authorised to accept such waste as per set provisions and other applicable law.

Waste disposal - the discharge, depositing, dumping, spilling, leaking, placing of waste on or at any premises or place set aside by the Council for such purposes, and "dispose" shall have a similar meaning.

Municipal waste - solid waste collected from households, which does not include hazardous or medical waste.

Health outcomes- adverse health conditions experienced after being exposed to a contaminant/health hazard

Diarrhoea - any type of watery stool (non-bloody) experienced atleast for two consecutive days by any household member in the last one month (September 2017).

Eye infection - short term effect such as teary eyes, itchy eyes, eye irritations/burning, persistent reddish eyes experienced by any household member in the last one month (September 2017).

Acute Respiratory Symptom - any acute (upper or lower) respiratory symptom such as nose/nostril irritation, sour throat, shortness of breath, cough, and chest pains that a household member has experienced for more than a day, within the last one month (September 2017).

Environmental Factors - identifiable conditions in the human surrounding that affect the normal functioning and health status of people, for this study these include household location, scavenging, smoking, biomass use, water source and sanitation.

CHAPTER 1

INTRODUCTION

1.1. Background Information

Environmental pollution is the introduction of contaminants into the natural environment that have the potential to cause adverse health outcomes. Pollution is the largest environmental cause of disease and premature deaths, in 2015, about 16 percent (nine million) of all premature deaths globally, were attributed to pollution (WHO, 2017). Waste disposal sites are one of the main sources of environmental pollution and public health hazards (Talyan & Sreekrishanan, 2008 Mavoropoulus & Newman, 2015), as they are characterised by poor management, exposed waste and lack of leachate and landfill gas collection systems (Bennet and Doyle, 1997, p288). The health effects of waste disposal are mostly felt in developing countries whereby about 70 percent of urban waste remains a public and environmental health threat because of inappropriate means of waste disposal (Moghadam, et al, 2009; Ziraba et al, 2016). Municipal Solid Waste (MSW) is classified as non-hazardous waste (Schubeler et al, 1996), however, health risks associated with improper Municipal Solid Waste Management (MSWM) have a great environmental and public health impact (Sankoh, 2013). The intensity of the impact is dependent on factors such as waste stream, individuals exposed, duration of exposure and availability of interventions for those exposed (Ziraba, et al, 2016).

1.1.1. The use of open waste disposal site approach to MSWM in developing countries

Despite the existing knowledge about public health impacts of open waste disposal sites, local authorities still make use of such sites for reasons such as rapid urbanization, lack of financial resources, skilled manpower and technological capacity (Ogunrinola & Adepegba, 2012 Ali, et al 2014, Hazra and Doel, 2009 Sharholy, et al., 2007; and Talyan, et al 2008).

Low income countries face solid waste hazards because of poor management as pollution control is costly and adherence to safe design standards requires a commitment to construction and operation supervision. Poor countries would rather opt for other urban infrastructure improvements over solid waste projects, because of no apparent profit returns and the much more time required to prepare, implement and maintain such projects. The complexity of the waste composition which is not organised and the ever-increasing waste generation percapita creates challenges for waste managers, particularly in poor countries (Hamid & Khidzir, 2009; Hazra & Goel, 2009). The developing world in general and Africa in particular has experienced

rapid urbanisation in recent years which has brought with it increased urban population and consequently increased solid waste generation per capita which has not been matched with equal financial resource allocation (Achankeng, 2003). As a result, haphazardly dumped refuse accumulates in undesignated or poorly designated sites (Onibokun, 1999). Toxic metal pollution has reached unprecedented levels over the past years in Africa, and subsequently, human exposure to such levels of toxic metals has become a major health risk and subject of increasing attention from national and international environmentalists (Yabe, et al, 2010).

1.1.2. State of solid waste management in Namibia

In Namibia, there is no national solid waste policy, individual local authorities formulate own by-laws regarding MSWM (GRN, 2014). The formulation of by-laws is however informed by the Public and Environmental Health Act 1 of 2015, The Environmental Management Act, No. 7 of 2007 and the Waste Management Regulations: Local Authorities Act, 1992. Public and Environmental Health Act 1 of 2015 compels local authorities within their areas of demarcation and jurisdiction to manage all sorts of waste sustainably, from the point of generation to the point of disposal and also control conditions which could endanger the health of the public. Local authorities should take all practical and reasonable measures to prevent diseases and public health nuisance from waste disposal sites (GRN, 2015). Local Authorities Act 23 of 1992 prohibits unauthorised scavenging to ensure occupational health and safety (GRN, 2011). Environmental Management Act, No. 7 of 2007 requires carrying out environmental impact assessment (EIA) before siting a waste disposal site to ensure ecological equilibrium and quality of life. Factors such as land, water and air; landscape, the natural, cultural, historical, aesthetic, economic and social heritage and values should be considered (GRN, 2007). Most of these laws and regulations put in place are however not fully implemented.

Mere dumps which were sited inappropriately, are a common method of solid waste disposal in most urban centres (Mwiya and Giles, 2004). Waste generation in Namibia and Oshakati town in particular, with a population of 37 000 residents, is approximated to be at 717,800 kg per month (Mughal, 2014). The waste generated in Oshakati town is dumped on a poorly sited and unengineered waste disposal site where no environmental impact assessment was done (The Namibian newspaper, 2016). Given the background, little is known about the public health effects of waste disposal sites in Namibia, and Oshakati in particular. The study therefore sought to assess association between the environmental factors and self-reported cases of acute respiratory symptoms, eye infections and diarrhoea by residents residing near Oshakati Municipal Disposal site in Oshana Region, Namibia.

1.2. Research Focus

This section presents the focus area for this study. It includes the statement of the problem, the research question and objectives that guided the study. This section also presents the justification for carrying out this study.

1.2.1. Statement of the Problem

In most developing countries, people living in the vicinity of waste dumps, suffer from environmental and public health hazards due to poor and ineffective management of such dumps (Sankoh, 2013). The recommended separating distance between disposal sites and rural residential areas is 3000 m, to minimize public exposure to health hazards associated with solid waste (Lunkapis, et al, 2002). In Swaziland, a study by Abul (2010) found that residents who resided within 200 meters from Mangwaneni waste disposal site in Manzini city were victims of Malaria, chest pains, Cholera, and diarrhoea, then those who resided beyond the 200 meters radius of the waste disposal site. Respiratory infections and lung cancer are also associated with living in the vicinity of waste disposal sites (Porta, et al, 2009).

In Namibia, waste disposal sites are widely used, as there are only two towns with properly engineered landfill sites. As a result, solid waste management is a serious concern in Namibia because of the public and environment health threats posed, (Ruppel & Ruppel-Schlichting, 2013). Oshakati is one of the towns which use a waste disposal site for municipal waste disposal and its current operating disposal site is situated in Othingo village, a rural residential neighbourhood (5 km away from town). At the time of data collection, the closest homestead to this disposal site was about 76 meters away (Google Earth). The disposal site was established in 2001. Residents near Oshakati disposal site expressed health concerns and claimed that the adverse health outcomes they have been experiencing are attributed to pollution from the disposal site (The Namibian, 2016). Residents have also claimed that the waste disposal site is to be blamed for the human and animal deaths and the subsequent poor harvests since 2003 (New Era, 2014a). "Residents have consulted the town council on several occasions to relocate the waste disposal site because it is a health hazard, but to no avail" (New Era, 2014b). In addition, Oshakati State Hospital records were reviewed and revealed that respiratory system disease, diarrhoeal diseases and eye diseases have been among the top 10 causes of morbidity presented at the hospital, for the past four years (2014 to 2017). This study therefore aimed to asses associations between the distribution of the health outcomes reported by residents near Oshakati Municipal Disposal site and the environmental factors.

1.2.2. Study Justification

This study was timely, as it was in response to the health concerns raised by Othingo village residents, which they claim are attributed to pollution from Oshakati disposal site. Studies have shown that prolonged exposure to chemicals and toxins results in the bioaccumulation of such substances to threshold levels, causing fatalities and chronic diseases such as respiratory diseases, cancers, birth defects and damage to major filtering organs (Felix et al, 2015). This study could inform Othingo village residents and other surrounding villages, of the association between reported health outcomes and the siting of Oshakati disposal site.

Furthermore, results from this study could be useful to Oshakati Town Council (OTC) as it is primarily responsible for the management of the waste disposal site. Results could inform the council to improve waste management by involving other stakeholders and coming up with appropriate interventions. Currently, there is no national solid waste policy in Namibia (GRN, 2014), the study findings could influence policy formulation to ensure uniform laws that govern local authorities with regards to solid waste management in a sustainable way.

Last but not least, the study results can add on to the existing body of knowledge concerning waste management and public health, which could further be used as a basis for further research in Namibia and Oshakati in particular. It was therefore against this background that there was need, hence this study, to assess associations between the reported health outcomes of residents and residing near Oshakati Municipal Disposal site, in Oshana region, Namibia.

1.2.3. Research Question

What are the factors associated with self-reported health outcomes by residents near Oshakati Municipal Disposal site, Oshana region, Namibia?

1.2.4. Research Objective

The study objective was to assess factors associated with self-reported health outcomes by residents near Oshakati Municipal Disposal site, Oshana region, Namibia.

1.2.5. Specific Objectives

1. To describe the health hazards observed at the disposal site.
2. To determine the distribution of health outcomes by residents in relation to the location of the waste disposal site.

3. To assess associations between environmental factors and self-reported health outcomes, among residents near Oshakati Municipal Disposal site in Oshana region, Namibia.

1.2.6. Conceptual Framework

Establishing direct causal relationships between exposures and health outcomes is challenging as some contaminants are implicated in more than one health outcome and one health outcome can be attributed to more than one contaminant. There are three routes of exposure to health hazards from disposal sites. The manifestation of the health outcomes is further dependent on the dose and duration of exposure and human factors such as age, sex, life phase and physiological state of the body. There are a number of health outcomes that could be attributed to waste disposal site pollution and new health conditions continue to emerge due to industrialization. Short term health effects include eye infections, irritations of skin, nose & eyes, allergies, psychological disorders, headache, fatigue, and gastrointestinal problems (Maheshwari et al, 2015, Gouveia and Prado, 2009, Rushton, 2003). People who remain exposed for a long time develop severe health outcomes such as different types of cancers, birth anomalies (Magaji, 2012), damage to kidneys, spleen, liver and lungs (Mataloni, et al, 2016). This study however focused on diarrhoea, eye infections and Acute Respiratory Symptoms as short term self-reported health outcomes among residents near Oshakati Municipal Disposal site. The conceptual framework in Figure 1 was constructed based on literature, as cited.

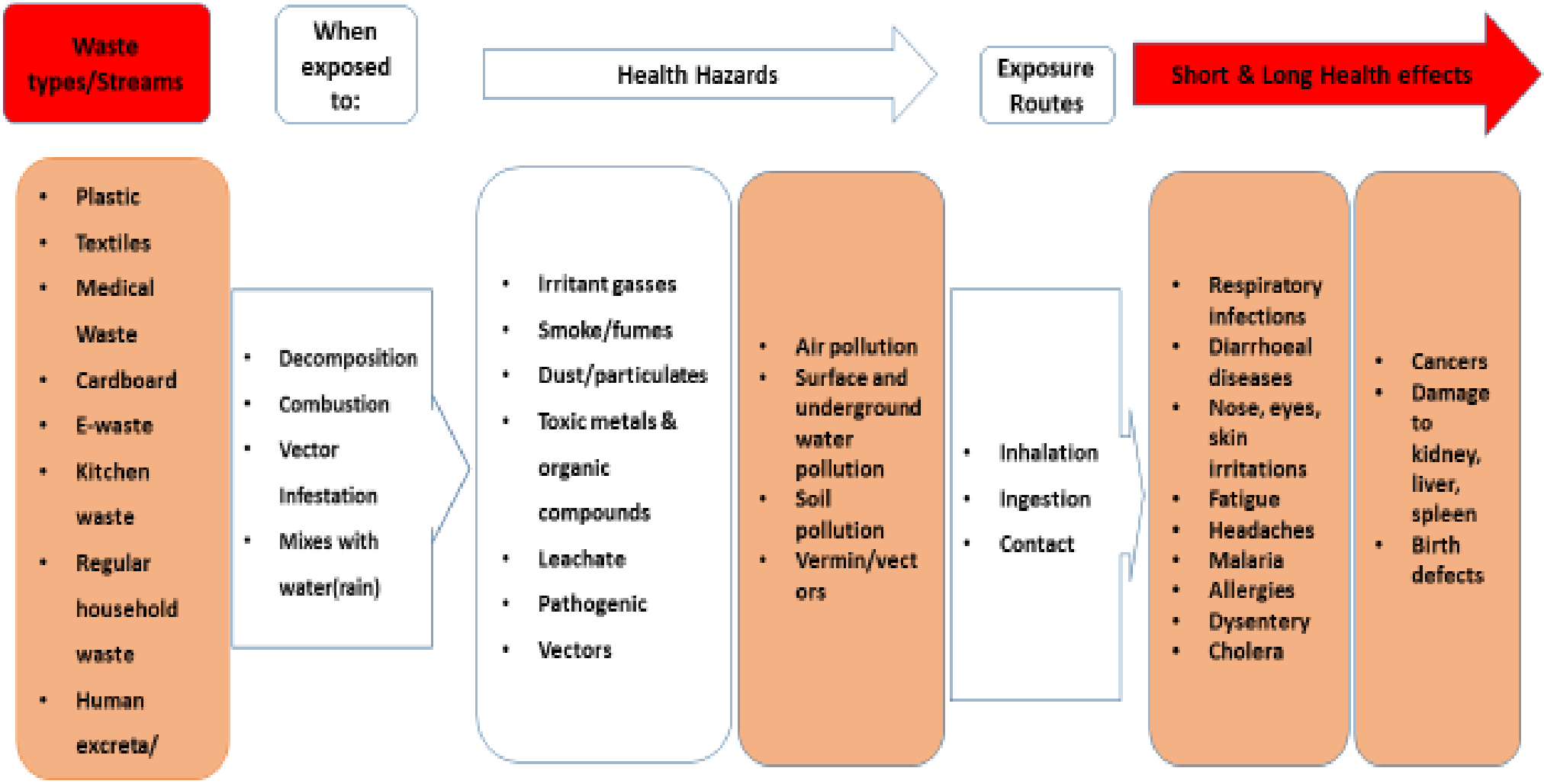

Figure 1. Conceptual Framework: The process/link between waste disposal and public health outcomes

CHAPTER 2

LITERATURE REVIEW

This chapter presents a review of similar and relevant literature done on pollution and health hazards related to waste disposal.

2.1. Types of waste disposal sites

There are three major types waste disposal sites, the sanitary landfill, controlled dump and open dump (Mavoropoulus & Newman, 2015). A sanitary landfill is a scientifically located and engineered waste disposal site where there is full control of leachate and landfill gas, land filling is done daily. There is complete record and control of waste volumes, types, sources and site activities/events. There is basic record keeping, poorly controlled waste picking, low or no control over leachate and landfill gas, with only basic hydrogeological conditions considered. Whereas on a waste dump, there is no waste segregation, thus all waste burns together, releasing "rich smoke" which is a major potential health threat to the environment and nearby residents (Sankoh et al, 2013).

2.2. Waste disposal health hazards with associated health outcomes

Communities who are directly or indirectly in contact with waste disposal sites are exposed to health hazards such as air pollution, waste pollution, water pollution, physical injuries and vermin through inhalation, ingestion and direct contact with waste or animals that roam around waste dumpsite (Taiwo, 2009).

Volatile organic compounds (VOCs), particulates, dust and dioxins

Some of the air based pollutants from waste disposal sites include Volatile organic compounds (VOCs), dust and dioxins. Their main short term health effects include Acute Respiratory Symptoms. VOCs have low boiling points, such that they are vaporized at room temperature making these compounds respirable (Kampa, 2008). Benzene and ethylbenzene are VOCs that can lead to eye, nose, and throat irritation, headache, loss of coordination, and damage to liver, kidney, and central nervous system, when inhaled (Mavoropoulus and Newman, 2015). Dioxin, which is a toxic substance is released by burning material containing polyvinyl chloride (PVC)

and causes cancer, growth defects, and immune diseases (eTobb, Health Blog, 2014). Dust, smoke and microorganisms which are found in high concentrations on open disposal sites are also associated with respiratory problems among waste pickers and nearby residents (Cointreau, 2006). Type of waste and site activities determine the type particles released. Respirable particulates ($PM_{2.5}$) can be deposited in the lungs and cause lung diseases, including lung cancer (Kampa, 2008). There is an association between particulate matter and cardiovascular mortality, and cardiopulmonary hospital admissions. The effects are more severe in children and the elderly as they are more susceptible (Hunt, 1996, Mavoropoulus & Newman, 2015). Corrêa, et al. (2011) found that children in the neighbourhood where a waste disposal site had been closed were at risk of acute respiratory symptoms. They were 1.3 times more at risk than the control group. This finding shows that even disposal site which have been closed for operations continue to be a health hazard to near residents.

Hydrogen sulphide (H_2S) is one of the land fill gases, which is produced when highly sulphate concentrated bearing materials are mixed with biodegradable waste. Exposure to H_2S may result in irritation to the mucous membranes of the eye and respiratory tract, depression of the central nervous system, loss of consciousness and respiratory paralysis (Agency for toxic substances & Disease Registry, 2014). Underground migration and accumulation of the landfill gases in sufficient amounts in buildings can be set off by a spark and explode (Lee and Jones-Lee, 1994, Bennett and Doyle, 1997, p292).

Odours are frequently a key issue for waste disposal sites, especially those receiving biodegradable waste. Sulphured compounds of intense odour are generated, whereas the incomplete processes of aerobic degradation produce emissions of alcohol, organic ketones, esters and acids (Domingo and Nadal, 2009). Apart from smell nuisance, odorous emissions and exposures are often accompanied by reports of a wide range of non-specific health symptoms such as nausea, headaches, drowsiness, fatigue and respiratory problems. Individual responses to odours are highly variable and are influenced by many factors including sensitivity, age and prior exposure to odour (Dalton, 2003).

Vector breeding grounds

The accumulation of uncovered or uncompacted waste such as cans, tyres, containers and plastics on waste disposal sites close to residential areas establishes a pathway to Malaria burden (Nasir, et al, 2015) as such sites serve as breeding grounds for mosquitos and other vermin. Cases of

environmental Malaria experienced by populations near waste dumps, especially among children, are a function of exposure and distance from a waste disposal site, through bites from infected female *Anopheles'* mosquitoes (Nkwocha, 2011).

Odour from waste dumps attracts flies (Toyama, 1988) which harbour the highest diversity of bacteria, including pathogenic bacteria (*Klebsiella*, *Aeromonas*, *Shigella*, *Morganella*, *Providencia*, and *Staphylococcus*) that are responsible for gastro intestinal infections (Gupta et al., 2012). *Salmonella* and *Shigella* species are highly harboured by flies (*Musca domestica*) from waste dumps, than from other various sampling sites (shopping mall, hospital, restaurant, waste disposal site), with an isolation rate at 61.7 percent and 100 percent respectively (Ugbogu et al, 2006). Waste picking and garbage handling is associated with high level exposure to a variety of pathogenic micro-organisms that could lead to an increased risk of gastrointestinal symptoms, frequent nausea and diarrhoea, irritations of the eye, skin, mucous membranes of the of the upper airways (Ray et al. 2005., Cointreau, 2006). Rats and rodents which may be on a disposal site spread typhus, *Salmonella, leptospirosis,* plague and other diseases (Raman and Narayanan, 2008; Hunt, 1996; Taiwo, 2009).

Heavy metals

There are 23 heavy metals which can be found in leachate, air and soil which are released from burning plastic or smelting scrap metals and e-waste. Lead, mercury, cadmium and arsenic are the main heavy metals which cause chronic conditions such as neurological impairments, anaemia, kidney failure, immunosuppression, gastrointestinal and respiratory irritation, abnormalities of skeletal system, malfunctioning of the mental and central nervous system function, inflammation of liver, cancer of liver, cardiovascular diseases (Holmes, 2009). In a study which was done in Nairobi, Kenya, half of the 328 children who lived near Dandora waste disposal site had high concentrations of lead in their blood and were disproportionately affected by anaemia, skin infections, asthma and other respiratory infections, health conditions which are associated with high levels of toxins at the waste disposal site (Oyaro, 2003). Lead in particular is known to cause damage to central and peripheral nervous systems, blood systems, kidney and brain development in children. Beryllium from computer parts has carcinogenic properties for lung cancer and skin diseases such as warts (Ramachandra & Saira, 2004). Other studies have shown that living close to a waste disposal site is associated with low birth weight, preterm and intrauterine growth retardation (Porta et al, 2009; Gilbreath and Kass, 2006). The relative risk of adverse health outcomes increases with the number of years lived close to the site and the distance from the site (Porta et al, 2009). A study using rats revealed that long-term habitation in

the vicinity of refuse dump sites results in damage to major filtering organs like the kidney, lungs and spleen (Felix et al., 2015; Holmes, 2009).

Leachate is an organically charged liquor which is formed after the biological decomposition of organic matter (Talyan et al, 2008). Organic wastes produce leachate which is rich in elements and ions such as calcium, magnesium, iron, sodium and ammonia. Depending on the waste composition, microbial organisms and trace elements such as lead, cadmium and nickel may also be present in leachate, as these elements get washed along. Leachate which is not contained or that has leaked from the collection system contaminates soil and water. Consuming polluted water by trace elements/heavy metals from leachate results in the bioaccumulation of such substances in the human body, causing long term health effects (Bennett and Doyle, 1997, p292). Landfill leachate is highly concentrated such that small amounts of leachate can pollute large underground water bodies, rendering it unsuitable for use for domestic water supply (Lee and Jones-Lee, 1994). Household wastes in waste disposal sites may contain faecal matter from baby nappies, which get washed away into surface water when it rains, causing diseases such as Typhoid, Cholera and other diarrhoeal diseases to those consuming such contaminated water (Hunt, 1996).

It can be concluded that a good number of studies have looked at health outcomes following exposure to waste disposal sites. Most studies have, however acknowledged that it is difficult to establish direct causal pathways, as a single pollutant can be implicated in so many health outcomes or a particular health outcome can be linked to so many pollutants.

CHAPTER 3

METHODOLOGY

3.1. Study Design

This was a cross-sectional analytical study to establish association between environmental factors and self-reported health outcomes by residents near Oshakati Municipal Disposal site. There were three dependant variables, which were the number of reported cases of Acute Respiratory Symptoms, Eye infections and diarrhoea diseases in a household, which were collected as count outcomes. The priori independent variable was the location of the household, in relation to Oshakati Municipal Disposal site. Other independent variables were included as they are also possible determining factors of the health outcomes of interest. The variables, their indicators and scale of measurement are presented in Table 1.

Table 1. Type of variable, indicators and scale of measurement

Type of Variable	Variable	Indicator	Scale of Measurement
Dependent	Diarrhoea	Any type of non-bloody diarrhoea case(s) reported by a household member which had persisted for more than a day/24hours, within the last one month (September 2017).	• Count/number of people
	Respiratory infections	Any of the following symptom (s) reported by a household member which had persisted for more than a day/24hours, within the last one month(September 2017) : • Acute cough • Nose/nostril irritation • Sour throat • Shortness of breath	• Count/number of people
	Eye infections	Household member having experienced eye infection in the last one month(September 2017): • Teary eyes • Eye irritation/burning	• Count/number of people
Independent	Household Location	• Othingo village • Ekamba village	• Near • Far
	Scavenging	• Any household member involved in scavenging	• Yes • No
	Duration of household	• A residential structure within the defined study site. The duration is dependent on the longest residing resident, in relation to the inception of Oshakati Municipal Disposal site.	• Before the inception – longer exposure • After the inception – Shorter exposure

	Smoking status	• Tobacco smoking by any household member	• Yes • No
	Biomass use	• The use of biomass for cooking or heating.	• Yes • No
	Water source	Water sources • Tap water - Treated • Bore hole - Untreated • Well	• Treated water • Untreated water
	Household Sanitation	Household Toilet	• Yes • No
		Hand washing facility	• Yes • No
	Knowledge level	• Number of questions answered correctly by an eligible member.	On a scale of 1 -10 • Unsatisfactory: ≤ 5 • Satisfactory: ≥ 6
	Education level of the household head	• Highest education level attained by the head of the household.	• No education • Primary education • Secondary education • Tertiary education
	Marital status	• The marital status of the household head.	• Single • Married • Widow • Widower
	Household income	Total household income in N$	• Low < N$1300 • Medium N$1,300 –5 000 • High N$5,000
Other variables: Health hazards present at the waste disposal site	Medical waste	Presence of medical waste at the waste disposal site	• Present • Absent
	Electronic/electrical waste	Presence of e-waste	• Present • Absent
	Smoke	Smoke, number of days waste is burnt in a week	• 1 – 4: low level • 5 – 7: high level
	Dust	Moving trucks, offloading waste. The average number of trucks that off load waste on site, in a day.	• Low level: <10 trucks • High level: ≥ 10 trucks

3.2. Study Setting

Oshakati town is in Oshana region in Namibia. Oshakati being the capital town of Oshana region, it is characterised by busy business activities and a relatively high residential density. The town is surrounded by rural villages and Othingo village is 5 km to the west, where the waste disposal site for the town is located. The waste disposal site caters for an estimated amount of 717800 tons of waste per month (Mughal, 2014). The site is located at 17˚46′ 31.24" S longitude and 15˚402.27' E altitude (Google Earth). Oshakati lays on a flood plain, which makes it prone to flash flood. Over a period of five years (2012 - 2016), Oshakati climatological records show that rainfall starts around October to May with rainfall records ranging from 150 mm to 300 mm and

temperature dropping to as low as 10 ˚C around June/July and rising to as high as 40 ˚C around October. The records show characteristics of a semi-arid to an arid environment. Over the same period, the highest wind speed recorded was 14.1 mph around July and the lowest was 5.8 mph around February (World Weather Online, 2017). Figure 2 and 3 show the geographical location of Oshakati.

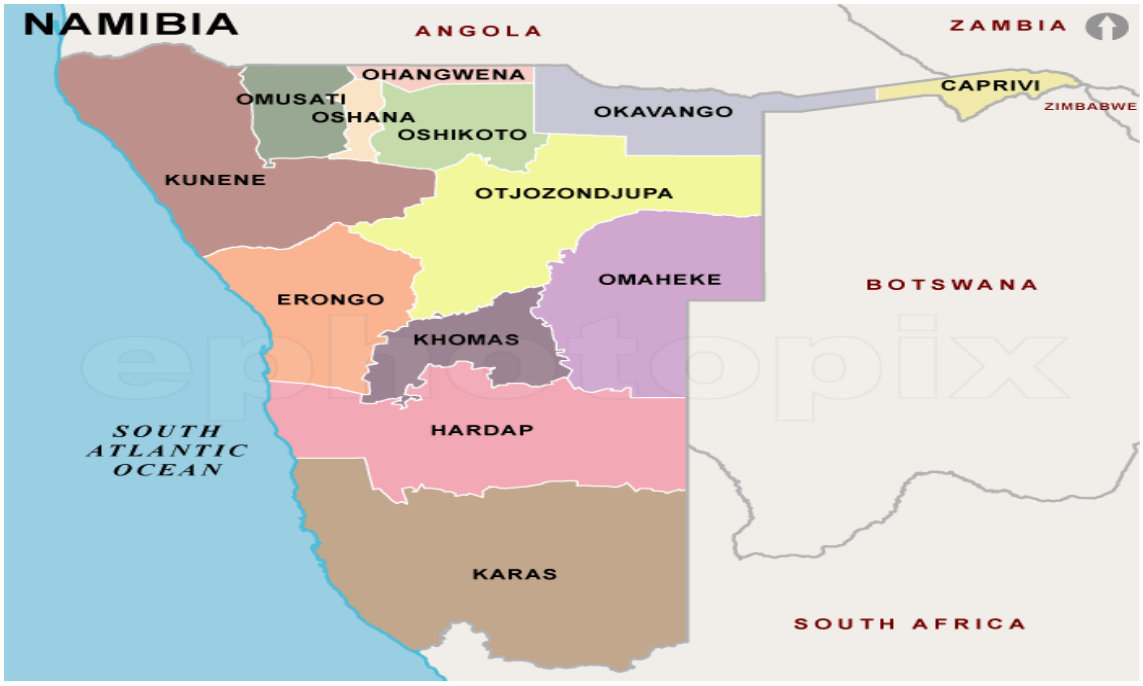

Figure 2: Map of Namibia, showing geographical regions (Oshana region)

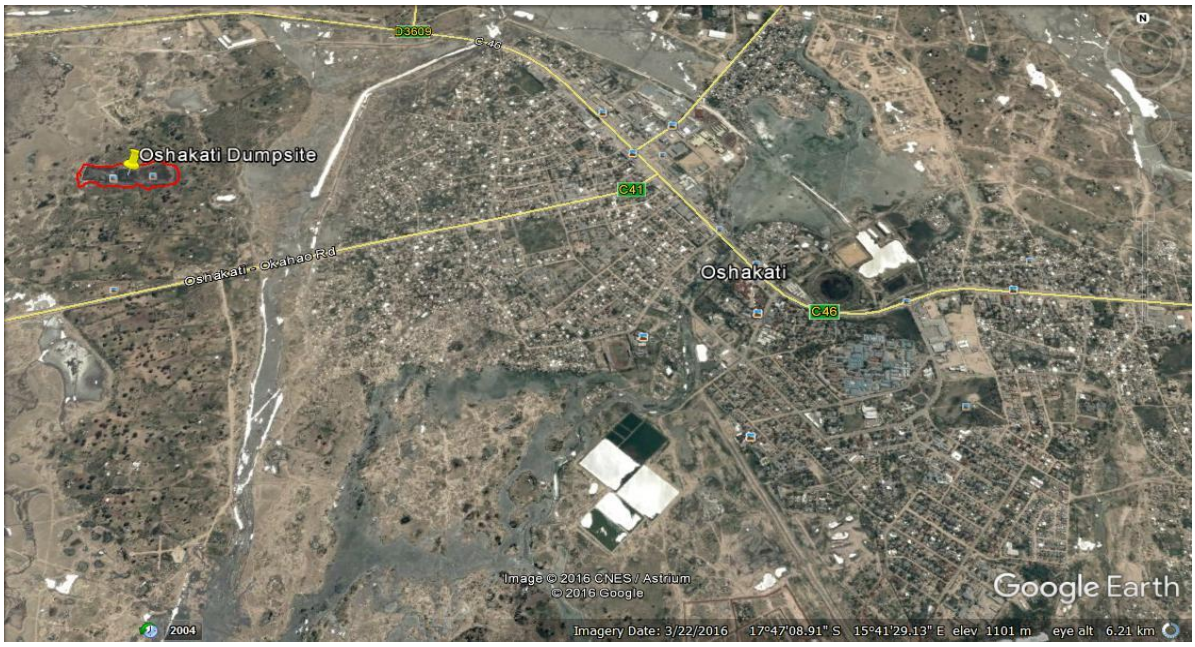

Figure 3: Aerial Map of Oshakati and Oshakati Municipal Disposal site (Google Earth, Accessed on the 09th May 2017)

3.3. Study Population

The study population were households from Othingo and Ekamba villages. Othingo village was purposively selected because of the health concerns raised by residents near Oshakati Municipal Disposal site, whereas Ekamba village was selected to serve as a comparative group.

3.4. Sampling Methodology

The two villages of the target population were purposively selected. The study used total enumeration and included all 103 households from Othingo and Ekamba villages.

3.5. Inclusion and Exclusion Criteria

Household members who had resided in the study area for the past three months at the time of data collection were included in the study. Household members who resided in the study area but spent more than two days per week, away from the study area were excluded. Only household members who were 18 years old and above were eligible for an interview to provide the household's information.

3.6. Data Collection Tools and Techniques

The study used a closed-ended researcher administered questionnaire to collect household data. For each household, there was one interview with an eligible household member. A total of 103 questionnaires were administered in 103 households, with a response rate of 100%. Data on the number of self-reported cases of each health outcome of interest, demographic, environmental and socio-economic health determining factors were collected. A checklist was used to observe the waste disposal site, to determine the health hazards present on the disposal site and to determine the average number of waste loads that are delivered for a period of three months.

3.7. Data Management and Storage

All materials used to collect data were kept by the principal investigator, to ensure confidentiality. Raw data was not shared with anyone else outside the research team.

3.8. Data Analysis

Collected data was coded and entered into Microsoft excel for data management, which was imported into a statistical software, STATA version 14 (College Station, Texas, USA) for analysis. Except for the outcome variables which were collected as count variables, all independent variables were collected as categorical variables. Categorical variables were summarized into frequencies and percentages, then presented in Tables and graphs. Chi square test was used to examine differences in the characteristics of the two groups of households, with a cut-off point of $p \leq 0.05$ for significance.

Poisson regression was used to determine the association between health outcomes and predictor variables, with the location of the household being the priori exposure variable. Bivariable Poisson model was used to assess unadjusted association between each of the outcome variables and all predictor variables. At bivariate level, there were few predictor variables which were +significantly associated with the outcomes variables, hence all known possible predictor variables were included in the multivariable Poisson models, using the backward stepwise method. The Bayesian Information System (BIC) and the Akaike Information Criteria (AIC) were compared and used to select the model that best fit the data. Each of the three outcome variables was analysed separately. Poisson regression was suitable for analysis because the outcome variables were count, with a Poisson distribution. The mean and variance of each health outcome were in close range and the study used the same exposure time for all households. Statistical significance level was set at less than 0.05 and Confidence Interval at 95 percent.

3.9. Pretesting of Tools

The household questionnaire and the waste disposal site observation checklist were pre-tested before being administered to the study site and population. Pre -testing was done on residents around Ondangwa waste disposal site, about 34 km from the study site.

3.10. Ethical Considerations

Confidentiality issues were dealt with by assuring participants that the data would be deidentified, not shared within anyone outside the study team and will only be used for this study. There were no other known risk to participants for taking part in the study. There were also no

monetary or material benefits to participants, however the study results could be used in informing policy, improve service delivery and public and environmental health. The study was carried out with the approval/permission from:

- ✓ University of Zambia Biomedical and Research Ethics Committee (UNZABREC)
- ✓ Namibian Ministry of Health and Social Services
- ✓ Permission from the regional councillor of Oshakati West Constituency
- ✓ Permission from the regional councillor of Okatana Constituency
- ✓ Oshakati Town Council
- ✓ The headmen of Othingo and Ekamba villages.
- ✓ The purpose and nature of the study was explained to all participants before they gave their Informed consent respondents

3.11. Limitations of the Study

The study had a sample size of 103 households because of low households' density, however the study managed to enumerate all the households in the defined population. The results in this study are an exact representation of the defined study population. The study was subject reporting bias, as cases were self-reported by residents who thought that they were exposed to health hazards, however researchers used follow up questions to probe the truthfulness of the responses.

CHAPTER 4

RESULTS

This study looked at the number of self-reported cases of acute respiratory symptoms, eye infections and diarrhoea as health outcomes of interest among residents near Oshakati Municipal Disposal site, in Oshana region. The study included all 103 households from Othingo and Ekamba villages, which were the target population. Details of the results from data analysis have been presented in subsequent sections of this chapter.

4.1. Baseline Characteristics

4.1.1. Stratified Households' Characteristics

The baseline characteristics of the households have been described in Table 2(a) and 2(b). Table 2(a) presents the demographic characteristics of households, stratified by households' location, whereas Table 2(b) presents the environmental characteristics of the households.

Table 2(a). Baseline demographic characteristics of households in the two locations

Variable	Near N=58 n (%)	Far N=45 n (%)	Overall N=103 (100)	P value (Chi2)
Marital status				
Single headed	22 (21.4)	8 (7.8)	30 (29.1)	0.453
Married	36 (34.9)	37 (35.9)	73 (70.9)	
Respondent's sex				
Male	13 (12.6)	5 (4.9)	18 (17.5)	0.124
Female	45 (43.7)	40 (38.8)	85 (82.5)	
Respondents' age category				
18 – 30 yrs	14 (13.6)	5 (11.1)	19 (18.5)	0.158
31 - 40 yrs	8 (7.8)	13 (28.9)	21 (20.4)	
41 - 50 yrs	8 (7.8)	6 (13.3)	14 (13.6)	
≥ 51 yrs	28 (27.2)	21 (46.7)	49 (47.6)	
Education level				
No education	10 (9.7)	4 (3.9)	14 (13.6)	0.143
Primary	34 (33.0)	31 (30.1)	65 (63.1)	
Secondary	6 (5.8)	8 (7.8)	14 (13.6)	
Tertiary	8 (7.8)	2(1.9)	10 (9.7)	
Residence				
After waste disposal site	14 (13.6)	6 (5.8)	20 (19.4)	0.307

Before waste disposal site	44 (42.7)	39 (37.9)	83 (80.6)	
Knowledge level				
Satisfactory	45 (43.7)	40 (38.8)	85 (82.5)	0.181
Unsatisfactory	13 (12.6)	5 (4.9)	18 (17.5)	

As shown in Table 2(a), about 70.9 percent (73/103) of the households were double headed and only 29.1 percent (30/103) were single headed. The majority of the respondents were female, making up 82.5 percent (85/103) and males making up 17. 5 percent (1/103). The respondents who were ≥ 51 years were the majority 47.6 percent (49/103) as compared to any other age group. From the Chi square test of differences, there were no significant differences in the distribution of the demographic characteristics between the two groups of households.

Table 2(b). Baseline environmental factors of households in the two locations

Variable	Near N=58 n (%)	Far N=45 n (%)	Overall N=103 (100)	P value
Level of income				
Low (below 1300)	27 (26.2)	32 (31.1)	59 (57.3)	
Middle (1301 - 8000)	12 (11.7)	2 (1.9)	14 (13.6)	0.604
High (above 8000)	19 (18.5)	11 (10.7)	30 (29.1)	
Scavenging				
Involved	14 (13.6)	0 (0.0)	14 (13.6)	<0.0001
Not involved	44 (42.7)	45 (43.7)	89 (86.4)	
Water quality				
Treated water	52 (50.5)	45 (43.7)	97 (94.2)	0.065*
Untreated water	6 (5.82)	0 (0.0)	6 (5.8)	
Type of toilet				
Pit latrine	37 (35.9)	36 (34.9)	73 (70.8)	0.073
No Toilet	21 (20.4)	9 (8.7)	30 (29.1)	
Hand washing practices				
Practised	10 (9.8)	5 (4.9)	15 (14.6)	0.362
Not Practised	48 (46.6)	40 (38.8)	88 (85.4)	
Smoking status				
Smoking	11 (10.7)	4 (3.88)	15 (14.6)	0.141
No smoking	47 (45.6)	41 (10.7)	88 (85.4)	
Energy source				
Fire wood	54 (52.4)	44 (42.7)	98 (95.2)	0.380*
Electricity	4 (3.9)	1 (0.97)	5 (4.9)	

P value - using Chi^2 test P value * - using Fischer's exact test

Table 2(b) presents the environmental factors of the two groups of households. Residents from far households were not involved in scavenging, while 14 households near the disposal site reported being involved in scavenging activities. The majority 94.2 percent (97/103) of the households used tap water (treated water) and only 5.8 percent (6/103) of the households used water from the borehole. Except for water sources (p value <0.0001) that showed a significant difference, all other characteristics did not show any significant differences between the two groups of households (all p values were > 0.005).

4.1.2. The distribution of the reported health outcomes

In total, about 81.5 percent (84/103) of the households have reported atleast one acute respiratory symptom, 49.5 percent (51/103) households have reported eye infections and 18.5 percent (19/103) households reported cases of diarrhoea. The minimum number of reported cases per household was zero and the maximum was seven for acute respiratory symptoms, three for eye infections and four for diarrhoeal cases. The highest number of cases for all the health outcomes were reported near the disposal site, and this was almost double the number cases reported far from the disposal site. Acute respiratory symptoms had the highest number of cases, which recorded a total of 184 cases, 66.3 percent (122/184) near the disposal site and 33.7 percent (62/184) far from the disposal site. For eye infections, 69.0 percent (40/58) cases were reported near and 31.0 percent (18/58) cases were reported far from the disposal site, which came to a total of 58 cases of eye infections. Diarrhoea had the least number of 25 cases in total. Refer to Table 3.

Table 3. The distribution of reported cases of the health outcomes, by location of household

	Near households (n=58)		Far households (n=45)	
Health Outcomes	No. of households with a case(s)	Cumulative cases reported	No. of households with a case(s)	Cumulative cases reported
ARS	50	122	34	62
Eye Infections cases	34	40	17	18
Diarrhoeal cases	12	17	7	8

Note: ARS - Acute Respiratory Symptoms cases

4.1.2. Socio-demographic distribution of the reported cases

Sex

Female dominance was observed in both the households' respondents and the individual household members who reported having suffered the health outcomes as shown in Figure 4. The majority of the respondents were female 82.5 percent (85/103) and only 17.0 percent (18/103) were male., out of the 184 reported cases of Acute Respiratory Symptoms, about 60.3 percent (111/184) of these cases were reported by females, while the 39.7 percent (73/184) by males. Out of 58 reported cases of eye infections, 75.9 percent (44/58) were female reported cases and 24.1 percent (14/58) were male reported cases. The lowest number of cases was observed for diarrhoea, with females reporting 68 percent (17/25) of the cases and males only reported 32 percent (8/25).

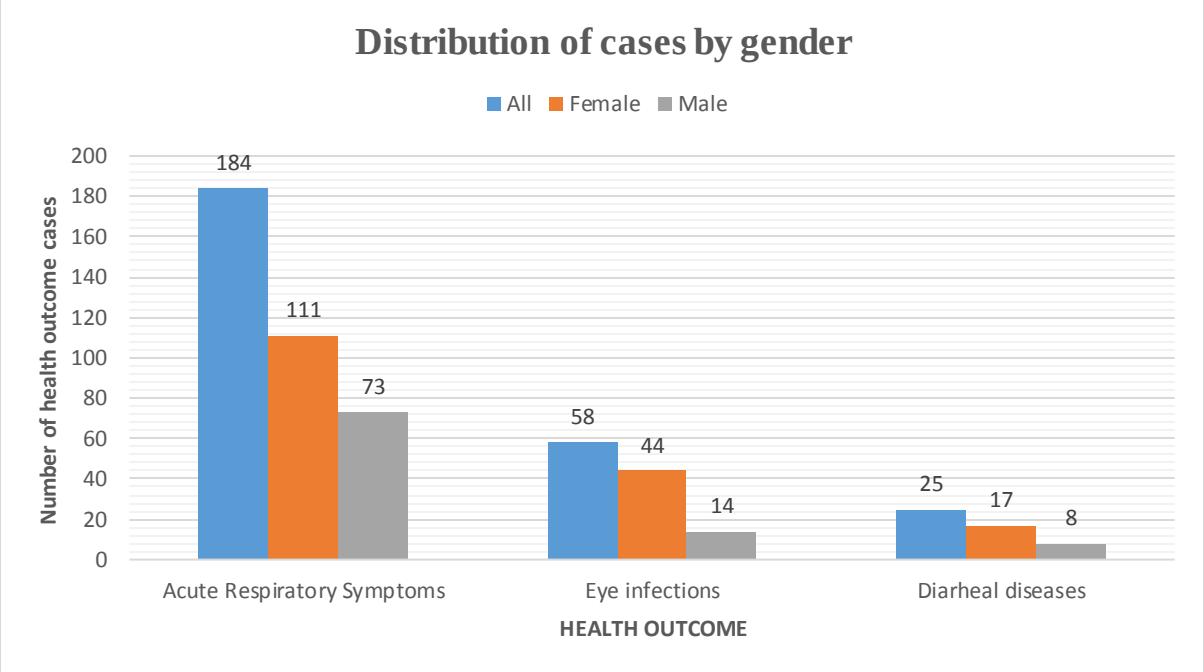

Figure 4: The distribution of the reported cases of the health outcomes by gender, in percentages

4.1.3. Age

Respondents' age distribution

The average age range of the respondents was between 41 – 50 years, whereas the modal age range was the ≥ 51 years group which also reported the most counts. The most number of cases for all the health outcomes were reported by respondents who were 51 years and above.

The age distribution of the individual cases

In this study, households were the study units, hence the individual ages for the cases were not recorded in the main data set, however efforts were made to note the ages of the individual cases, as shown in Table 4.

Table 4. The age categories of the individual cases of acute respiratory symptoms, eye infections and diarrhoea

Age group (years)	Acute Respiratory Symptoms % (n)	Eye infections % (n)	Diarrhoeal Diseases % (n)
0 – 5	25.0 (46)	5.2 (3)	28.0 (7)
6 – 10	18.5 (34)	12.1 (7)	20.0 (5)
11 - 20	14.1 (26)	15.5 (9)	0.0 (0.0)
21 – 35	7.6 (14)	15.5 (9)	20.0 (5)
36 – 50	12.0 (22)	15.5 (9)	12.0 (3)
51 – 70	15.2 (28)	20.7 (12)	20.0 (5)
≥71	7.6 (14)	15.5 (9)	0.0 (0.0)
Total	184 (100)	58 (100)	25 (100)

Table 4 presents the age groups with corresponding aggregated cases reported thereof. Of all age groups, the under five children reported the highest number acute respiratory symptoms 25 percent (46/184), followed by those who were between the age of six to 10 years, with 18.5 percent (34/184). Generally, younger children suffered more of the Acute Respiratory Symptoms, as compared to adults. For eye infections, the general trend showed that eye infections were more common among adults than children and young adults. Diarrhoea cases were mostly reported by the under-fives, by 25 percent (7/25), whereas the 11 – 20 and ≥71 age groups did not report any diarrhoea case.

4.1.4. Source and Level of income

The main source of households' income in this study was social grands 36.9 percent (38/103), followed by formal employment 29.1 percent (30/103). Farming 7.8 percent (8/103) and scavenging 1.0 percent (1/103) were also indicated to be the source of income for some families. Other sources of income made up 25.2 percent (26/103), these figures are shown in Figure 5. On average, there was a total monthly household income of N$ 3001 to 5000 for households near and N$ 1300 to N$ 3000 for households far from Oshakati Municipal Disposal site.

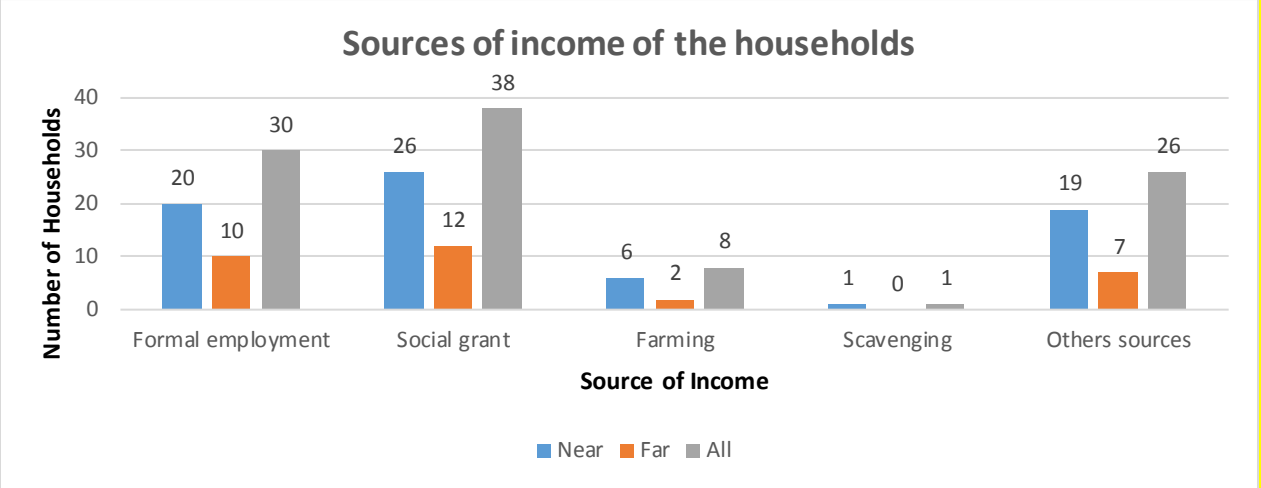

Figure 5: Sources of households' income in Othingo and Ekamba villages

4.1.5. Education

There was no significant difference in education attainment of the households' heads between the two groups, see Table 5. Overall there was low educational attainment, with only 9.7 percent (10/103) of the household heads have attended tertiary education. About 13.6 percent (14/103) have gone up to secondary education. The majority 63.1 percent (65/103) of the household heads have received only up to primary education. Those with no education at all were 13.6 percent (14/103).

Table 5. Educational attainment of household heads in Othingo and Ekamba village

Educational level	Othingo (near) %(n)	Ekamba (far) %(n)	Total %(n)
No schooling	17.2 (10)	8.9 (4)	13.6 (14)
Primary education	58.6 (34)	68.9 (31)	63.1 (65)
Secondary education	10.3 (6)	17.8 (8)	13.6 (14)
Tertiary Education	13.8 (8)	4.4 (2)	9.7 (10)
Total	100 (58)	100 (45)	100 (103)

4.1.6. Sanitation status

Sanitation was measured on two parameters, the presence of a household toilet and hand washing practices. Over all, about 70.9 percent (73/103) of the households had a toilet and 30 percent (30/103) had no household toilet. There was a low level of hand washing practices, as only 14.6 percent (15/103) of the households practiced hand washing after toilet use. See Figure 6.

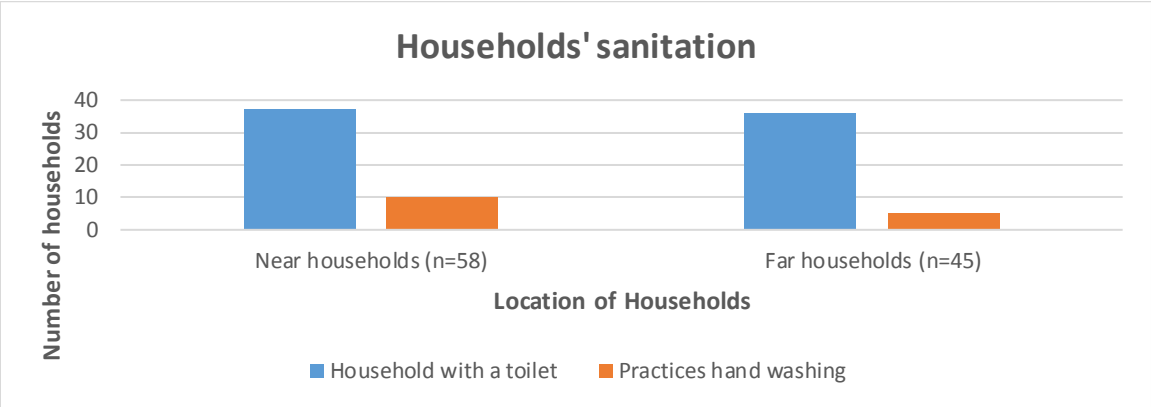

Figure 6: Household's sanitation, measured on toilet use and hand washing practices.

4.2. Associations of predictor variables with each outcome variable

The subsequent section presents the associations between each health outcome and the possible predictor variables. Bivariable and multivariable Poisson regression was ran for the count outcome of acute respiratory symptoms, eye infections and diarrhoea cases.

4.2.1. Acute respiratory symptoms

Table 6(a) presents bivariate associations between the number of Acute Respiratory Symptoms cases in a household and the predictor variables. An unadjusted estimate show that residing near the disposal site increased the risk of contracting Acute Respiratory Infections (cIRR=1.490, CI=1.098, 2.020, p value=0.010) as compared to residing far from the disposal site. Households where firewood was the main source of energy for cooking had a reduced risk ratio of contracting Acute Respiratory Symptoms, by 57 percent (CI=0.339, 0.974 p value=0.040), as compared to those who used electricity. Other households' characteristics did not show any significant associations with the reported acute respiratory symptoms.

Table 6(a). Crude estimates of the associations between Acute Respiratory Symptoms and predictor variables from Poisson regression

Household characteristics	cIRR (95 % CI)	P- value
Location		
Near	1.490 (1.098, 2.020)	0.010
Far		
Respondent's sex		
Male		
Female	1.346 (0 .883, 2.053)	0.166
Respondents' age category		
18 – 30 yrs	1.00	
31 – 40 yrs	1.029 (0 .625, 1.695)	0.909
41 – 50 yrs	1.123 (0.653, 1.928)	0.674
≥ 51 yrs	1.310 (0.865, 1.983)	0.201
Education level		
No education	1.00	
Primary	0.957 (0.630, 1.453)	0.838
Secondary	0.592 (0.319, 1.099)	0.097
Tertiary	1.088 (0 .615, 1.925)	0.770
Duration		
After	1.116 (0.783, 1.589)	0.542
Before		
level of income		
Low (below 1300)	1.00	
Middle (1301 - 8000)	0.967 (0.677, 1.382)	0.858
High (above 8000)	1.245 (0.873, 1.776)	0.225
Scavengers		
Present	1.1894 (0.800, 1.768)	0.391
Absent		
Smoking status		
Smoking	1.1428 (0.772, 1.689)	0.503
No smoking		
Fire place vent.		
Open kitchen	1.208 (0.733, 1.990)	0.456
Enclosed		
Knowledge level		
Satisfactory	1.231 (0.818, 1.852)	0.318
Unsatisfactory		
Energy source		
Fire wood	0.5748 (0.339, 0.974)	0.040
Electricity		

Note: cIRR – Crude Incidence Risk Ratio

From Table 6(a), unadjusted estimates show that only two variables, namely energy source and location of the household in relation to the disposal site were significantly associated with contracting Acute Respiratory Symptoms. Using the stepwise backward method, the best fit model included location, knowledge level, energy source and respondent's sex, as predictor variables. Adjusted estimates of the risk of contracting Acute Respiratory Symptoms with predictor variables are presented in Table 6(b). Adjusted for the type of energy used, knowledge level and respondent's sex, residents near the disposal site were likely to contract Acute Respiratory Symptoms by 56 percent (p value=0.005), as compared to far residents. Taking into account the households' location, knowledge level and respondent's sex, there was borderline evidence (p value=0.055) suggesting that residents who used fire wood were 42 percent less likely to contract Acute respiratory Symptoms, than those who used electricity as a source of energy. This estimate is however not reliable as the confidence interval was inclusive of the null value. There was no evidence of association between the sex of the respondent and the reported cases of acute respiratory symptoms, taking into account all other variables in the final model (p value=0.087). Households who demonstrated satisfactory knowledge level of SWM and safety had an increased risk ratio of the number of acute respiratory symptoms cases, having taken into account all other predictor variables in the final model.

Table 6(b). Crude and adjusted estimates of the association between acute respiratory symptoms and predictor variables from Poisson regression

Predictors	cIRR(95% CI)	P value	aIRR(95% CI)	P value
Location				
Far	1.00		1.00	
Near	1.490 (1.098, 2.020)	0.010	1.562 (1.142, 2.136)	0.005
Knowledge level				
Unsatisfactory	1.00		1.00	
Satisfactory	1.231 (0.818, 1.852)	0.318	1.516 (0.989, 2.323)	0.056
Type of energy				
Fire wood	0.5748 (0.339, 0.974)	0.040	0.580 (0.332, 1.011)	0.055
Electricity	1.00		1.00	
Respondent's sex				
Male	1.00		1.00	
Female	1.346 (0 .883, 2.053)	0.166	1.455 (0.946, 2.238)	0.087

cIRR – Crude Incidence Risk Ratio, aIRR - Adjusted Incidence Risk Ratio, CI – Confidence Interval

4.2.2. Eye infections

At bivariable analysis level, none of the considered predictor variables was significantly associated with the number of eye infections reported in a household, as shown in Table 7(a). All the p values were greater than the significance level of p value ≤ 0.005 and all confidence intervals included to null value of 1, suggesting lack of precision and association. Location of the household which was the priori variable also showed not no significant association with the number of eye infections cases reported in a household.

Table 7(a). **Associations of eye infections with predictor variables from Poisson regression.**

Household characteristics	cIRR (95 % CI)	P value
Location		
Near	1.592 (0.920, 2.755)	0.096
Far		
Respondent's sex		
Male		
Female	1.323 (0.627, 2.791)	0.462
Respondents' age catg		
18 – 30 yrs	1.00	-
31 – 40 yrs	0.995 (0.422, 2.343)	0.991
41 – 50 yrs	1.221 (0.496, 3.005)	0.663
≥ 51 yrs	1.085 (0.527, 2.235)	0.823
Education level		
No education	1.00	
Primary	1.261 (0.565, 2.811)	0.570
Secondary	0.571 (0.167, 1.952)	0.372
Tertiary	1.200 (0.403, 3.570)	0.743
Level of income		
Low (below 1300)	1.00	
Middle (1301 - 8000)	1.228 (0.666, 2.262)	0.510
High (above 8000)	1.037 (0.528, 2.033)	0.916
Fire place ventilation		
Open kitchen	1.370 (0.588, 3.189)	0.465
Enclosed		
Knowledge level		
Satisfactory	0.733 (0.395, 1.358)	0.324
Unsatisfactory		
Energy source		
Fire wood	0.540 (0.216, 1.352)	0.189
Electricity		

It is shown that after controlling for duration, scavenging and the type of energy used by the household, there was no significant association between the numbers of reported eye infections and location of the household (p-value = 0.260). The study however showed a reduced risk ratio (p value = 0.037) of the number of eye infections reported in a household, by 61 percent for residents who had resided in the study area after the inception the disposal site, having adjusting for the location of the household, scavenging and source of energy. Households which used firewood as a source of energy had a significant (p value = 0.020) reduced risk ratio of the number of reported eye infections cases in a household, by 72 percent, as compared to those that used electricity, after controlling for location, scavenging and duration. See Table 7(b).

Table 7(b). Crude and adjusted estimates of the relationship between eye infections and predictor variables from Poisson regression

Predictors	Crude IRR(95% CI)	P value	Adjusted IRR(95% CI)	P value
Location				
Far	1.00		1.00	
Near	1.592 (0.920, 2.755)	0.096	1.411(0.775, 2.569)	0.260
Duration				
Before/disposal site	1.00			
After/disposal site	0.664 (0.314, 1.400)	0.282	0.393(0.163, 0.946)	0.037
Scavengers in a household				
No	1.00		1.00	
Yes	1.836 (0.990, 3.404)	0.054	1.943(0.983, 3.839)	0.056
Energy used				
Electricity	1.00		1.00	
Firewood	0.540 (0.2161, 1.352)	0.189	0.278(0.094, 0.820)	0.020

cIRR – Crude Incidence Risk Ratio aIRR - Adjusted Incidence Risk Ratio

4.2.3. Diarrhoea diseases

Table 8(a) shows unadjusted estimates of the association between contracting diarrhoea, in a household and possible predictor variables. Without controlling for other predictor variables, households that used borehole water were 3 times more likely to contract diarrhoea, as compared to households who used treated water (p value = 0.039). Although the confidence interval does not include the null value, the interval is wide, suggesting lack of precision. All other variables did not show any significant unadjusted associations with the number of reported cases of diarrhoea in a household.

Table 8(a). Associations of diarrhoea cases with predictor variables from Poisson regression.

Household Characteristics	cIRR (95 % CI)	P value
Location		
Near	1.648 (0 .711, 3.820)	0.244
Far		
Respondent's sex		
Male		
Female	0.670 (0.267, 1.679)	0.393
Respondents' age catg		
18 – 30 yrs	1.00	
31 - 40 yrs	2.412 (0.640, 9.094)	0.193
41 - 50 yrs	1.357 (0.273, 6.724)	0.708
≥ 51 yrs	1.421 (0.396, 5.096)	0.589
Education level		
No education	1.00	ref
Primary	1.435 (0.426, 4.832)	0.559
Secondary	0.333 (0.034, 3.204)	0.341
Tertiary	0.466 (0.048, 4.486)	0.509
level of income		
Low (below 1300)	1.00	ref
Middle (1301 - 8000)	0.425 (0.161, 1.118)	0.083
High (above 8000)	0.538 (0.204, 1.416)	0.210
Scavengers		
Present	1.210 (0.415, 3.527)	0.726
Absent		
Water quality		
Treated		
Untreated	3.079 (1.057, 8.976)	0.039
Household toilet facility		
Toilet present	0.873 (0.376, 2.023)	0.752
Toilet absent		
Hand washing facility		
Present	0.244 (0.033, 1.806)	0.167
Absent		
Knowledge level		
Satisfactory	2.435 (0.574, 10.329)	0.227
Unsatisfactory		

Note: H. Water source – Household Water Source cIRR - Crude Incidence Risk Ratio

At bivariable analysis, only the household water quality was significantly associated with the outcome variable, as shown in Table 8(a), however at multivariable analysis, location, toilet use, hand washing practices were also included in the final model as they are known predictors of diarrhoeal cases. These adjusted estimates are shown in Table 8(b). Overall, taking account of

water quality, hand washing practices and toilet use, we see that there was an increased (59 percent increase) risk ratios of the number of diarrhoea cases reported in households near the disposal site compared to far households. There was no evidence to rule out chance finding as the p value was not significant (p-value=0.304) and the confidence interval included the null value. Taking into account other predictor variables in the final model, hand washing practices did not significantly (p value = 0.103) predict the number of reported diarrhoea cases in households. There was boarder line evidence (p value=0.051, IRR=3.838, 95% CI = 0.996, 14.789), suggesting an increased risk ratio of the number of diarrhoeal cases in households that used untreated water, as compared to treated water. Taking account of hand washing practices, water quality, and location of household, toilet use was not significantly associated with the number of diarrhoeal cases reported in households (p value = 0.298, IRR=1.758, 95% CI=0.607, 5.091) as compared to those who did not have a household toilet.

Table 8(b). Crude and adjusted estimates of the association between diarrhoea and predictor variables from Poisson regression

Predictors	Crude IRR(95% CI)	P value	Adjusted IRR(95% CI)	P value
Location				
Near	1.648 (0.711, 3.820)	0.244	1.594 (0.655, 3.88)	0.304
Far	1.00		1.00	
Hand washing				
Present	0.244 (0.033, 1.806)	0.167	0.181 (0.023, 1.411)	0.103
Not Present	1.00		1.00	
Sanitation facility				
No toilet	1.00		1.00	
Toilet present	0.873 (0376, 2.023)	0.752	1.758 (0.607, 5.091)	0.298
Water quality				
Treated water	1.00		1.00	
Untreated water	1.884 (1.050, 3.383)	0.034	3.838 (0.996, 14.789)	0.051

Note: cIRR – Crude Incidence Risk Ratio aIRR - Adjusted Incidence Risk Ratio CI – Confidence Interval

4.3. Disposal site observation

The disposal site was observed to determine the presence of potential health hazards. Oshakati Municipal Disposal site is fenced off and has a functional gate and a guard, although animals such as goats and cattle were also spotted on site, in addition to scavengers. There were rodent burrows, which suggested the presence of rodents on site. Figure 7 shows pictures which were taken from Oshakati Municipal Disposal site, depicting the presence of possible health hazards.

Some of the medical waste was seen scattered on the ground, unsegregated nor incinerated, thus posing a health hazard to scavengers and waste workers (see Figure 7(a)), whereas only a small portion of the medical waste was seen piled up in a pit, awaiting to be burnt. Medical waste comprised of moist bandages, cotton products, small packaging plastic, syringes etc., which will then release a heavy smoke when burnt. Animals were also spotted on site, freely roaming and feeding on waste (see Figure 7(d)). There are different types of waste being dumped that include electronic and electrical waste, regular household waste, industrial and medical waste. Different types of batteries and fluorescent bulbs were also observed. Commercial waste mainly included cardboards, plastics and residuals from alcohol brewing plants which were poured on site. All the waste on the disposal site was not covered nor compacted, thus it open to the environmental conditions such as rain, warm temperatures as shown in Figure 7. There was observed to be an uncontrolled burning of waste, as fire was never put off, for a week long during data collection.

(a) Used needles not incinerated nor buried.

(b) Medical waste piled in a pit.

(c) Unsegregated waste on site

(d) Unsegregated e-waste

Figure 7. Pictures taken from Oshakati Municipal Waste Disposal Site, depicting the presence of health hazards

Dust was another parameter to observe and it was determined by the number of trucks that off loaded waste on the disposal site in a day. Over a period of three months (July – September 2017), the average number of waste vehicles that off loaded waste on site was 15 trucks, with the minimum number of 14 trucks and the maximum number at 17 trucks, per day.

CHAPTER 5

DISCUSSION

The objective of this study was to determine if there was an association between contracting Acute Respiratory Symptoms, eye infections and diarrhoea cases in a household by residents and residing near Oshakati disposal site. This chapter attempts to discuss and interpret the distribution of the health outcomes, the association between the reported health outcomes and residing near the disposal site and the possible health hazards present on the disposal site.

5.1. The distribution of health outcomes among residents

Location of residence

Both groups of residents reported having contracted acute respiratory symptoms, eye infections and diarrhoea. For all the health outcomes in this study, the households near the disposal site had the higher frequency of cases contracted in a household, as compared to households far from the disposal site. This observed trend could have been attributed to many factors, some of which could not be controlled for in this study, such as climate change. Climate change is a huge threat to respiratory health, which directly aggravates respiratory diseases and increases exposure to risk factors for respiratory diseases, such as pollen grains and moulds (D'Amato, et al, 2014), populations in hot regions are more likely to report climatic induced respiratory diseases. Namibia is generally an arid country, which is experiencing the effects of climate change. This distribution pattern can also be attributed to the high concentration of air pollutants near the source of exposure, which is the disposal site. Other scholars have also discovered a similar trend, with specific reference to Mangwaneni disposal site in Swaziland (now e-swatini) were the most victims of malaria, chest pains, diarrhoea, cholera and irritation of the skin, nose and eyes were those who resided within 200 metres of the disposal site (Abul, 2010). Weather

Gender/sex

The study revealed greater variations between males and females who reported having contracted the health outcomes of interest in this study. The majority of the cases were reported by females, as compared to their male counterparts, a finding consistent with a study by Oliveira and others (2011). There are several factors that may explain this pattern.

One of the explanations could be cultural norms. Women are more likely to be aware of the health status of household members, especially for children and the elderly. Although women bear higher exposures to traditional environmental risks to health, men are however slightly affected more by the environment than women (Pruss-Ustun et al, 2016). Males however, have poor health-seeking behaviours (Women's Health Council, 2007), due to culture, society and gender roles. This makes some of the male's acute health outcomes, such as the ones considered in this study to go unnoticed. In this study, the majority of the respondents were females, hence this norm might have affected how male cases were reported.

Furthermore, women are generally responsible for cooking, making women more exposed to smoke as firewood burns. The burning of firewood increases kitchen $PM_{2.5}$ concentrations, resulting in women suffering from elevated respiratory symptoms (Clougherty, 2009). For this study, the main source of energy for cooking was firewood, which might have exposed women to particulates which trigger respiratory infections. In addition to kitchen smoke exposure, women may also be exposed to dumpsite smoke and other health hazards as they are more likely to be involved in scavenging, than men as established in literature (Nyathi, et al, 2018). This places women at risk of exposure to respiratory symptoms causing pollutants. This study however, did not analyse gender and sex which speaks to the distinction between susceptibility and exposure, as some exposures are due to patterns of behaviour, roles and place, as opposed to predisposition due to biological construct or chromosomal complements (Clougherty, 2009).

Age

This study revealed that children under the age of 10, regardless of gender, contracted the most acute respiratory symptoms, accounting for about half of all cases as compared to any other age group. This observation is similar to a study that was conducted in Brazil, that targeted children under the age of 13, whereby children who were two years and younger, were the most affected by respiratory symptoms (Corrêa et al, 2011). Apart from the adults of 50 to 75 years, the health of children under 5 years, and to a lesser extend up to the age of 10 years is the most affected by environmental risks. Children in communities near waste dumps are victims of health effects, as compared to children in control groups (Pruss-Ustun, et al, 2016) because children are vulnerable to environmental pollution (especially respirable) owing to their greater lung surface area, increased minute volumes and their under developed immune system (Agency for toxic substances & Disease Registry, 2014). This finding was expected based on the observations made on the disposal site. Waste on site laid uncovered nor segregated and burning is

uncontrolled, whereby smoke, most likely containing toxic substances is released onto the atmosphere, polluting the air.

This study did not reveal any greater variation of eye infections among the different age groups, however when the age groups were aggregated, it showed that adults (21 years and older) accounted for about 67.2 percent (39/58) of all contracted eye infection cases. On the contrary, it was however expected the majority of the cases to be reported by children as they are more susceptible to pollution than adults (Correa et al, 2011). This observation could suggest that the reported cases of eye infections were random or were due other determining factors which were not considered in this study.

5.2. Predictors of the health outcomes

Location of residence (near or far) was a priori variable in predicting all the health outcomes of interest in this study, whether it showed a high p value, it was maintained until the final model. The study units in this study were households in the defined area. One of the limitations in this study was the inability to account for the presence of other chronic diseases which may affect the occurrence of the acute symptoms that this study looked at.

5.2.1 Eye infections

The significant predictors of the number of eye infections contracted in a household in this study were found to be the use of electricity, as a source of energy and residence in the study area from the inception of the disposal site. The use of electricity as a source of energy for cooking increased the risk ratio of contracting eye infections by 28 percent (p value = 0.020), as compared to the use of firewood. This finding is in contradiction with earlier researchers who established that exposure to high concentrations (> 0.8 ppm) of formaldehyde which is released when wood is burnt is known to produce a transient irritation of the eyes and mucous membranes of the upper respiratory tract (Pierson et al. 1989). This contradicting finding in the current study could have been affected by the minority of households that use electricity for cooking, hence this association needs to be interpreted with caution. This study however revealed that residence in the study area before the establishment of the disposal site statistically increased the risk ratio of contracting eye infections in a household by 39 percent (p value=0.037), as compared to residence after its establishment. Within the parameters of this study, this finding suggests that people from households that have existed since the inception of the disposal site have been exposed longer, hence an increased risk ratio of eye infections. Eye infections are one of the short term health outcomes of waste dumps exposure (Rushton, 2003), however this finding can

also imply that those that have been exposed longer to pollution have increased chances of presenting with eye infections than those with lesser exposure time. It was however expected that residents near Oshakati Municipal Disposal site would have an increased risk ratio of contracting eye infections, than the control group, as documented in the literature that residing near waste disposal sites is a risk factor for eye infections such as allergic conjunctivitis and bacterial eye infection (UNEP, 2007, Sindama, 2017), however this study found no significant association.

5.2.2. Diarrhoeal cases

In this study, the possible risk factors of diarrhoea which were considered, did not show significant association with the reported cases. As literature states, the link between diarrhoea incidences and living close to waste dumps is mainly through the use of contaminated water by leachate or run-offs, scavenging activities and through carriers such as flies and domestic animals that visit the waste dumps (Raman and Narayanan, 2008., Oyeyemi et al, 2016., Gupta et al., 2012). This study showed boarder line evidence (p value = 0.051) to suggest increased chances of contracting diarrhoea for residents who used untreated water, this finding however could not be relied on because of the wide confidence interval, which is a sign of lack of precision. Nearly all residents used treated water from the main water supply, suggesting less use of untreated water that may be contaminated, unfortunately for this study, water samples could not be drawn for testing because of the limited budget.

Waste workers and scavengers are exposed to a variety of health hazards at high concentrations, when handling waste. Literature indicates that landfill workers and scavengers, compared with matched controls, had significantly higher prevalence of health conditions, including diarrhoea (Ray et al., 2005). For this study, there was no evidence to suggest an association between scavenging and contracting diarrhoea. Scavenging had a high p value (0.726) at bivariable and multivariable analysis, hence it was not included in the final model. Only about 14 percent22 of the households interviewed, were involved in scavenging.

In general, there was poor level of sanitation among the study population, in terms of toilet use and hand washing practices, which are known predictors of diarrhoea incidences (Prüss-Üstün and Corvalan, 2006). Although there was poor level of sanitation, this could not significantly predict the reported diarrhoea incidences in this study.

Living near Oshakati disposal site was not a significant predictor of the reported diarrhoea cases, as opposed to a study conducted in Sierra Lionne, at Granville Brook Dumpsite that found an

increased risk of diarrhoea incidences among residents near the disposal site (Sankoh et al, 2013). This study findings suggest that the presence of the waste disposal site was not associated with the reported diarrhoea incidences of the residents, a finding that could suggest randomness of the reported cases.

5.2.3. Acute respiratory symptoms

This study found a significant increased risk ratio of contracting Acute Respiratory Symptoms among residents living near Oshakati Municipal Disposal site, as opposed to the control group. People with pre-existing lung and heart disease, the elderly and children are particularly sensitive to particulate air pollution, admittedly, this study could not determine pre-existing health conditions of residents. The current study also revealed that children under the age of 10 years, were most likely to be affected as they accounted for nearly half of all cases reported. This finding was expected, as earlier established by other researches that populations living near waste disposal facilities are potentially exposed to a wide variety of pollutants, such that even very low concentrations which are almost negligible, result in health effects after longer duration of exposure (Spinazze et al, 2017). Furthermore, the physical inspection of the disposal site revealed the emission of smoke, as waste burnt every day, uncontrolled, and at low temperature, implying that toxic substances and particulates of different sizes are suspended in the air, rendering a health threat to respiratory health (Valavanidis et al. 2008).

This finding of an increased risk ratio of contracting Acute Respiratory Symptoms among residents in the vicinity of the disposal site could suggest the presence of other toxic substances that could result in health issues in the near future. The respiratory system is sensitive to environmental pollution whereby respiratory symptoms are one of the short term health effects associated with smoke, dust and pathogenic microorganisms from waste disposal sites (Maheshwari et al 2005). Respiratory symptoms are usually used as a proxy for other health outcomes associated with waste disposal pollution. Chronic exposure to pollutants is known to result in serious health outcomes such as birth defects, cancers and defective cognitive development in children (Felix et al, 2015. Gilbreath S. & Kass P., 2006.) The operations of Oshakati Municipal Disposal site do not comply with the Namibian Public and Environmental Health Act 1 of 2015 that compels all local authorities within their areas of demarcation and jurisdiction to manage all sorts of waste sustainably at all stages and also to control conditions which could be harmful or dangerous to public health within its area (GRN, 2015).

5.3. Oshakati Municipal Disposal site inspection

Oshakati Municipal Disposal site and the vicinity area were visited for physical inspection to determine possible environmental and public health hazards, which may be due to waste management operations.

Dust is one of the health hazards associated with waste disposal site. The level of dust from the disposal site was determined by the number of waste trucks/vehicles to the disposal site, on a day. The number of waste trucks/vehicles averaged at 16 vehicles per day, which according to the scale in this study, showed there was high level of dust generated by waste trucks/vehicles. There is ground and soil pollution on site by toxic substances from burnt and unburnt waste. As a result, the dust that is generated is likely to be highly concentrated with toxic metals, compounds and particulates that are associated with respiratory, skin and eye diseases. Households near the disposal site are the most affected by dust, when winds are still.

The waste delivered on site was mostly comprised of regular household waste such as plastic, kitchen, reusable and refillable packages, which is an indication that the community is not engaged in waste reduction activities. The resultant piles of uncompact waste serves as a possible breeding site for mosquitos and/or a food source for flies and rodents, which are known transmitters of diseases such Malaria, gastrointestinal diseases, plague and leptospirosis, respectively (Sebek et al, 1989, Mavoropoulus & Newman, 2015). Households around Oshakati Municipal Disposal site are in very close (76 m), placing residents at a greater risk of Malaria and gastrointestinal diseases.

The presence of human excreta, decaying food waste, flies and medical waste on site is a possible indication of the presence of pathogenic microorganisms that require such conditions to flourish well in disposal sites. Waste disposal sites are known to be populated by pathogenic microorganisms such as *Bacillus, Escherichia coli* and *Pseudomonas* species (Williams and Hakam, 2016). These pathogens contaminate surface and underground water sources, resulting in gastrointestinal infections to nearby residents and scavengers (Oyeyemi et al, 2016 and Gupta et al., 2012).

There is open burning of waste in Oshakati disposal site. Typically, open burning occurs at low temperatures (250 ˚C to 700 ˚C) and in oxygen-starved conditions, a practice that is known to release toxic gases to the public and the environment (Mavoropoulus & Newman, 2015). Since there is no containment and treatment of residuals, smoke and gases on site, the resultant products are rich in toxic substances, which are a potential public and environmental health hazard.

Electronic and electrical waste which was spotted on site are known to leak toxic metals and chemicals substances onto the soil, air and water, when burnt. As earlier established (Ali S. et al, 2013) in similar settings, the soil on site and in the vicinity of Oshakati disposal site is likely to be highly contaminated with Lead (Pb), Copper (Cu), Nickel (Ni), Chromium (Cr) and Zinc (Zn) because of the presence of e-waste on the disposal site. People get exposed to these toxins through inhalation and ingestion of contaminated crops and water (Igwe, at el, 2000, Magaji, 2012), resulting in health outcomes such as respiratory diseases and gastrointestinal infections.

The scavengers spotted on site were mostly females, who did not have proper personal protective equipment (PPE). These people are exposed to heavy metals, pathogens from organic waste and medical waste and gases from decomposing waste. The exposure of scavengers to hazards on the disposal site does not only end with them, women being the majority of the scavengers and their gender roles in the households, it's likely that some of these hazards are passed on to the rest of the family members.

The presence of goats, pigs, dogs and cattle on the disposal site, despite there being a guard, a functional gate and explicit rules on a board at the gate suggests weak enforcement of waste management regulations. The goats and cattle could feed on plastic during the dry season because of the scarcity of food. The swallowed plastic is dangerous to ruminant animals as it gets trapped in the intestines and gradually cause their death (Ramaswamy & Sharma, 2011, Tiruneh & Yesuwork 2010), hence this could explain the death of the livestock reported by residents. Human excreta, decaying food waste, flies, medical waste which were observed on site are sources of pathogenic microorganisms. Some bacteria and fungi populations are associated with waste disposal, as isolated from four waste disposal sites in Nigeria, in a study by Williams and Hakam (2016). These pathogens contaminate surface and underground water sources, resulting in gastrointestinal infections to residents who consume such water (Oyeyemi et al, 2016 and Gupta et al., 2012).

CHAPTER 6

CONCLUSSION AND RECOMMENDATIONS

6.1. Conclusion

This study examined the association between the health outcomes of residents near Oshakati Municipal Disposal site and environmental factors. This study revealed that both groups of residents contracted Acute Respiratory Symptoms, eye infections and diarrhoea, with high frequencies observed among nearby residents. The physical inspection of the disposal site revealed the presence of possible health hazards such as pathogenic micro-organisms, toxic dust and smoke, vectors' breeding ground and a water contamination possibility because of lack of leachate collection system. Females and children were more likely to be affected as they reported the majority of the cases. Statistically, only the number of Acute Respiratory Symptoms cases contracted in a household were significantly associated with residing near the disposal site, where as eye infections and diarrhoea did not show any significant associations with residing near the disposal site. It should however be noted that this study was observational and it is a primary step to determining the effects of the waste disposal site on the health of the residents in this study area. Further experimental studies need to be applied to this population residing near Oshakati Municipal Disposal site to gage more on direct human exposure measurements, biomarkers and susceptibility biomarkers, supported by data on corresponding health effects.

6.2. Recommendations

Based on the study findings, a number of recommendations were suggested to the council, residents and scavengers to reduce the public and environmental health hazards.

There is need for Oshakati Town Council to strictly control and reduce the burning of waste. This can be done if waste is piled up in pits, from which it is then burnt on specific days, to reduce the volume. With the supervision of the Public and Environmental Health Department Manager at Oshakati Town Council, the guard/keeper at Oshakati Municipal Disposal site needs to strictly enforce SWM regulations at the site by preventing animals from entering onto the site and restricting unauthorised scavenging. This would help to protect the health of unequipped scavengers and prevent animals that may enter the site and swallow plastic. The council and the contractors need to ensure that only waste vehicles that meet the requirements and fit for transporting waste are allowed to transport waste. All waste that is being transported should be covered with a reasonable sized net or mesh wire to secure the waste to prevent waste fall off

during transportation which results in ground pollution/littering. Through public engagement, outreach campaigns on public health from Oshakati Town Council and Oshakati State Hospital should incorporate information on waste management (such as the Reduce-Reuse-Recycle strategy), health and safety in order to reduce waste volumes and ensure the safety of the scavengers and residents.

Households who do not have access to piped water may be at risk of drinking water that has been contaminated by leachate, hence they are advised to boil untreated water, before drinking. This is to reduce diarrhoeal diseases that are spread by pathogens that may be present in contaminated water. Scavengers need to procure their own personal protective equipment, and only then they would be allowed onto the site for scavenging.

Due to rural-urban migration, there is an increasing trend of grabbing land in neighbourhoods close to towns, this is also a case in Othingo village. Therefore the Oshakati Town Council needs to demarcate off the area which is within 500 m of the disposal site and together with the headman, the council needs to restrict the construction of new houses within the demarcated area, as it is the recommended separating distance between waste disposal sites and households.

For a long term measure, Oshakati Town Council should look into closing and rehabilitating the current disposal site as it is a health hazard to the public and the environment. Instead, a suitable site needs to be identified and constructed to minimise environmental and public health hazards.

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APPENDICES

Appendix 1: Participant Information Sheet

Study Title

Factors associated with self-reported health outcomes by residents near Oshakati municipal disposal site, Oshana Region, Namibia.

Introduction: The researcher

Maria M. T. Elago, is a postgraduate student for Master of Public Health – Environmental Health at the University of Zambia, School of Public health. The researcher kindly invites your voluntary participation in the study. The study is scheduled to take place in August 2017.

Purpose of the research

To assess associations between reported health outcomes and residing near Oshakati Municipal Disposal site. The study results can be used by the local authority to improve waste management and thus reduce possible health hazards which might be on the disposal site and to ensure a safe and clean environment.

As a resident in the selected area, you have been identified to take part in this study as it is believed that you can provide the required information. Your participation in this study will be highly appreciated.

What you will be required asked to do

This study targets all households in Othingo and Ekamba villages. Should you agree to participate in the study, you will be interviewed to provide information regarding the occurrence, if any, of diarrhoea and acute respiratory symptoms and eye infections that any member of the household has experienced over the past one month. You will also be required to provide information on the demographic, social and environmental characteristics of your household.

The interview is expected to last for about thirty (30) minutes. You have the right to seek clarification before the interview begins and to withdraw your participation from the study at any time and without explanation, should you wish to. At the end of the interview you will be given an opportunity to review your remarks, and you can modify or remove those portions you are not comfortable with.

Benefits and Risks

There are no immediate benefits for participating in this study, however, the information that you will provide could be used to improve waste management and ultimately contribute to a clean and healthy environment. The information will be handled with confidentiality and only be used for this study purposes.

Confidentiality

The information obtained from this study will be only used for the purposes of this study and will not be availed to any other person not connected to the study.

Contacts

If there are any issues to be clarified, you are advised to contact
the Principal Investigator, University of Zambia or the Regional councillor from Oshakati West constituency on the numbers given below.

The Principal Investigator:
Maria M. T. Elago
Mobile: +264813226733
Email:emaganomt@gmail.com

The Chairman
University of Zambia Biomedical Research Ethics Committee (UNZABREC)
University of Zambia
Mobile: +260-1-256067
Email: unzabrec@zamtel.zm

Mr. H. Andreas
Regional councillor
Oshakati West Constituency
Tel: 065-220236

Appendix 2: Informed Consent Form

Study Title

FACTORS ASSOCIATED WITH SELF-REPORTED HEALTH OUTCOMES BY RESIDENTS NEAR OSHAKATI MUNICIPAL DISPOSAL SITE, OSHANA REGION, NAMIBIA.

Study Summary

This study is intended to determine the associations of the health outcomes (diarrhoea, acute respiratory symptoms and eye infections) with residing near Oshakati Municipal Disposal site. The results can be used by stakeholders in coming up with necessary measures to improve waste management.

When all your answers to the following questions are yes, and you have agreed to participate, please provide your signature below.

- Has the study been explained to you and have you been given a participant's Information sheet dated August/September 2017?
- Have you had an opportunity to ask questions and discuss this study?
- Have you received satisfactory answers to all of your questions?
- Do you understand that the study is not being carried out by the Oshakati Town Council.

Therefore, answering 'YES' to all the questions and providing your signature (or thumbprint) on this document is an indication that:

1. You have been informed of the purpose and procedures of the study.
2. You are taking part in this research voluntarily.
3. The results of the research may be published but you will not be identified.

In order to ensure some degree of anonymity, you may use your initials or thumb print on this sheet

I, _____ _____ _____

(Print name of Adult Participant) (Signature of Adult Participant) (Date)

have understood the aim of the study and have voluntarily agreed to take part in the study.

Thank you for your time.

Appendix 3: Households questionnaire

FACTORS ASSOCIATED WITH SELF-REPORTED HEALTH OUTCOMES BY RESIDENTS NEAR OSHAKATI MUNICIPAL DISPOSAL SITE, OSHANA REGION, NAMIBIA.

QUESTIONS FOR HOUSEHOLD INTERVIEWS

INSTRUCTIONS

1. This questionnaire will be administered by the interviewer
2. Eligible respondent should be a household member who is ≥ 18 years.
3. The interviewer shall introduce him/herself and the purpose of the visit.
4. Obtain verbal/written consent before proceeding with interview.

IDENTIFYING INFORMATION

1. Interviewer's name : _____

3. Questionnaire no. : _____

4. Date of interview : DD____ /MM ____ /YY ____

5. Name of Village_____

6. Name of respondent: _____

8. Sex

7. .Eligibility Status: Household head
Other household member (>18yrs)

F	M

9. GPS Coordinates

	Section A: Demographic data	
1	How old was the respondent at his/her last birthday? 1. 18 – 30 2. 31 – 40 3. 41 – 50 4. ≥ 51	☐
2.	What is the highest level of school have the household head attended? 1. No schooling 2. Primary 3. Secondary 4. Tertiary	☐
3.	When was your house built in this area? ☐	☐
4.	For how long have members of your household resided in this area? 1. ≤ 12 year 2. 13 – 30 months 3. 31 – 40 months 4. ≥ 40 months	☐
5.	What is the current marital status of the household head? 1. Single 2. Married 3. Widowed 4. Separated/divorced	☐
6.	What is the source of income for your household? 1. Formal employment 2. Farming 3. Unemployed 4. Scavenging 5. Pension Other, specify…….	☐
7.	"What is the income level in your household" *(This should include income for all household members both in formal and informal employment)* 1. < N$1300 2. N$1,300 – N$3,000 3. N$3,001 – N$5,000 4. N$5,001 – N$8,000 5. >N$8,000	☐
8.	Are there any members of your household that are involved in waste picking at the disposal site? 1. Yes 2. No	☐
9.	If the answer to question 8 is yes, state how many household members are involved? 1. Male ☐ 2. Female ☐	

	Section B: Environmental Factors	
10.	What is the main source of water for your family household? 1. Tap water (Private or communal) 2. Borehole water 3. Surface water (stream, river, pond or lake)	☐
11.	How can you describe the quality of your domestic water supply? 1. very good 2. Good 3. Fairly good 4. Poor	☐
12.	Where do you usually go to answer the call of nature? 1. Toilet 2. Bush/open defecation 3. Other	☐
14.	Is there any hand washing facility your toilet? 1. Yes 2. No	☐
15.	Is there anyone who smokes tobacco in the household? 1. Yes 2. No	☐
16.	What is the main source of energy in your household? 1. Wood 2. Charcoal 3. Gas 4. Electricity	☐
17	Where does your household prepare food? 1. In the open 2.Enclosed room/hut with windows 3. Enclosed room/hut without windows	☐
	Section C - Knowledge levels	
18.	Are there any benefits that you get from the disposal site? 1. Yes 2. No	☐
19.	If your answer at for question 17 is yes, what are the main benefits that you get from the disposal site? 1. Sale of recovered material 2. Get some food items for human consumption 3. Other benefits, specify	☐
20.	What do you think are the dangers associated with waste collection at disposal site?	

21	Between the household and the disposal site, who was the first to come to this area? 1. Household 2. Disposal site	☐
22.	If you had a choice, would you move your household out from the disposal site area? 1. Yes 2. No	☐
23.	If no, state why. ……	☐
24.	If yes, state why. ……	☐
25	If you were asked, would you have allowed the disposal site to be located where it is now? 1. Yes 2. No If Yes or No give reasons ……	☐
26.	What do you think is the safest distance between a disposal site and a residential site? 1. < 500 m 2. 600 m – 1 km 3. 2 – 5 km 4. ≥ 6 km	☐
27.	What type of diseases do people in this area suffer from that you think are associated with living close to the disposal site? 1. Diarrhoea 2. Tuberculosis 3. Respiratory tract infections	☐ ☐ ☐ ☐

	4. Eye infection 5. Injury 6. Other specify	☐ ☐

Section D – Health Effects

28. Has any member of the household experienced any of the following diseases/conditions in the last two months? For each member, indicate who has experienced any of the diseases/conditions according to their age and sex distribution.

	1		2		3		4		5	
	Age/sex		Age/sex		Age/sex		Age/sex		Age/sex	
▪ Coughing										
▪ Wheezing										
▪ Shortness of breath										
▪ Throat irritation										
▪ Nose/nostril irritation										
▪ Chest pains										
▪ Fatigue										
▪ Nasal/lung congestion										
▪ Runny nose										

29. Has anyone in the household suffered/suffering from asthma?

1. Yes
2. No

30. Has any member of the household experienced any of the following in the last two months? For each member, indicate who has experienced any of the diseases/conditions according to their age and sex distribution and frequency.

	1		2		3		4		5	
	Age/sex		Age/sex		Age/sex		Age/sex		Age/sex	
▪ Eye infection										
▪ Eye irritation										
▪ Itching eyes										
▪ Watery eyes										

☐

31. Has any of the household members experienced any type of diarrhoea over the past two months? Indicate the age and sex of each member who has suffered.

	1		2		3		4		5	
	Age/sex		Age/sex		Age/sex		Age/sex		Age/sex	
1. Yes										
2. No										

☐

Thank you for your valuable time

Appendix 4: Checklist for the disposal site observation

HEALTH OUTCOMES OF WASTE DISPOSAL AMONG RESIDENTS RESIDING AROUND OSHAKATI DISPOSAL SITE, OSHANA REGION, NAMIBIA.

Introduction

The aim of this research is to establish the health outcomes on the residents who reside around the disposal site at Othingo village near Oshakati. One way. This checklist is a tool to identify the health hazards present at the disposal site as one way to meet the research's objective.

1. Smoke

Days when waste is burnt.

Day	Tick if waste is burnt
Monday	
Tuesday	
Wednesday	
Thursday	
Friday	
Saturday	
Sunday	

2. Dust

How many trucks offload waste at the disposal site on each day?

Day	July				August				September			
Monday												
Tuesday												
Wednesday												
Thursday												
Friday												
Saturday												
Sunday												

3. The presence of electronic/electrical waste

Are the electronics and electrical gadgets present

TV set ☐

Radio, stereos ☐

Refrigerator ☐

Microwave ☐

Computer ☐

Electric cables ☐

Copiers, ☐

Fax machines ☐

Electric lamps ☐

Cell phones ☐

Batteries ☐

4. Waste on the open (not covered)

…..……

5. Presence of medical waste

Human organs/tissues ☐

Needles/syringes ☐

Pharmaceuticals ☐

Appendix 5: Ethical clearance letter from the University of Zambia Biomedical Research Ethics Committee (UNZABREC)

THE UNIVERSITY OF ZAMBIA

BIOMEDICAL RESEARCH ETHICS COMMITTEE

Telephone: 260-1-256067
Telegrams: UNZA, LUSAKA
Telex: UNZALU ZA 44370
Fax: + 260-1-250753
E-mail: unzarec@unza.zm
Assurance No. FWA00000338
IRB00001131 of IORG0000774

Ridgeway Campus
P.O. Box 50110
Lusaka, Zambia

13th September, 2017.

Your Ref: 036-06-17.

Ms. Maria M.T Elago,
University of Zambia,
School of Public Health,
P.O Box 50110,
Lusaka.

Dear Ms. Elago,

RE: RESUBMITTED RESEARCH PROPOSAL: "HEALTH OUTCOMES AMONG RESIDENTS RESIDING AROUND OSHAKATI DUMPSITE IN OSHANA REGION, NAMIBIA" (REF. NO. 036-06-17)

The above-mentioned research proposal was presented to the Biomedical Research Ethics Committee on 7th September, 2017. The proposal is approved.

CONDITIONS:

- This approval is based strictly on your submitted proposal. Should there be need for you to modify or change the study design or methodology, you will need to seek clearance from the Research Ethics Committee.
- If you have need for further clarification please consult this office. Please note that it is mandatory that you submit a detailed progress report of your study to this Committee every six months and a final copy of your report at the end of the study.
- Any serious adverse events must be reported at once to this Committee.
- Please note that when your approval expires you may need to request for renewal. The request should be accompanied by a Progress Report (Progress Report Forms can be obtained from the Secretariat).
- Apply in writing to National Health Research Authority for permission before you embark on the study.
- **Ensure that a final copy of the results is submitted to this Committee.**

Yours sincerely,

Dr. S. H Nzala PhD
VICE-CHAIRPERSON

Date of approval: 13th September, 2017. **Date of expiry:** 12th September, 2018.

Appendix 6: Permission letter from the Namibian Ministry of Health and Social Services

REPUBLIC OF NAMIBIA

Ministry of Health and Social Services

Private Bag 13198	Ministerial Building	Tel: 061 – 2032150
Windhoek	Harvey Street	Fax: 061 – 222558
Namibia	Windhoek	Email: shimenghipangelwa71@gmail.com

OFFICE OF THE PERMANENT SECRETARY

Ref: 17/3/3 **ME**
Enquiries: Mr. J. Nghipangelwa

Date: 19 October 2017

Ms. Maria T. Elago
University of Zambia: School of Public Health
P.O. Box 50110
Lusaka
Zambia

Dear Mr. Mugweni

Re: Health outcomes among residents around Oshakati dumpsite in Oshana Region, Namibia.

1. Reference is made to your application to conduct the above-mentioned study.

2. The proposal has been evaluated and found to have merit.

3. **Kindly be informed that permission to conduct the study has been granted under the following conditions:**

3.1 The data to be collected must only be used for academic purposes;
3.2 No other data should be collected other than the data stated in the proposal;
3.3 Stipulated ethical considerations in the protocol related to the protection of Human Subjects' should be observed and adhered to, any violation thereof will lead to termination of the study at any stage;
3.4 A quarterly report to be submitted to the Ministry's Research Unit;
3.5 Preliminary findings to be submitted upon completion of the study;

3.6 Final report to be submitted upon completion of the study;

3.7 Separate permission should be sought from the Ministry of Health and Social Services for the publication of the findings.

Yours sincerely,

Andreas Mwoombola (Dr.)
Permanent Secretary

MINISTRY OF HEALTH & SOCIAL SERVICES PERMANENT SECRETARY

"Your Health Our Concern"

Appendix 7: Permission letter from Oshakati Town Council

OSHAKATI TOWN COUNCIL

Tel: +264 65 229500
Fax: +264 65 220435

906 Sam Nuyoma Road
Private Bag 5530
OSHAKATI
Namibia

Enquiries: Mr. K.K. Kapolo

21st November 2017

Ms. Maria Elago
University of Zambia
School of Public Health

Dear. Ms Elago

SUBJECT: PERMISSION TO CONDUCT RESEARCH AT THE OSHAKATI MUNICIPAL DISPOSAL SITE

With reference to your request to conduct research on municipal disposal site your request is hereby acknowledge with the following condition:

1. The research information is strictly for your educational purpose of Master of Public Health
2. The research to be conducted during the normal working hours
3. No waste (any type of waste) shall be removed from the disposal site

Hope you will find the above in order

Yours sincerely,

Mr. W. Iita
Chief Executive Officer

Public Health & Env Management
Head of Department
21 NOV 2017
Oshakati Town Council
Private Bag 5530 • Oshakati

All official correspondence must be addressed to the Chief Executive Officer

Appendix 8: .Permition letter from Okatana Constituency

REPUBLIC OF NAMIBIA

OSHANA REGION

OKATANA CONSTITUENCY

Private Bag 5543
Oshakati,
Namibia

Tel: 065-225447
Fax: 065-224431

05th October 2017

TO WHOM IT MAY CONCERN

This note serves to inform you that **Ms. Maria M. T Elago,** is a student at the University of Zambia, School of Public Health. She is granted a permission to conduct a research study titled "**HEALTH OUTCOMES AMONG RESIDENTS RESIDING AROUND OSHAKATI DUMPSITE IN OSHANA REGION, NAMIBIA.**

In order for her to achieve that, she need information from the residents that will assist her with writing research.

Against this background this office is therefore kindly requesting the residents of Ekamba village to render her your cordial assistance.

Your cooperation will be highly appreciated.

Yours faithfully

OKATANA CONSTITUENCY OFFICE
05 OCT 2017
OSHAKATI

Pp M. Ma-Shimbi
Hon. Rosalia Shilenga (MP)
Regional Councillor: Okatana Constituency