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SPATIAL ANALYSIS OF THE PERCEIVED HEALTH RISKS AT HOUSEHOLD LEVEL EMANATING FROM POOR SOLID WASTE DISPOSAL IN HIGHFIELD, HARARE.

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BACHELOR OF SCIENCE HONORS DEGREE IN DISASTER MANAGEMENT STUDIES (HBScDMS)

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THIS DISSERTATION IS SUBMITTED IN PATIAL FULFILMENT OF THE REQUIREMENTS OF THE BACHELOR OF SCIENCE HONORS DEGREE IN DISASTER MANAGEMENT STUDIES.

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APPROVAL FORM

The undersigned certify that they have read the dissertation and have approved its submission for marking after conformation that it confirms to the requirements of the Bachelor of Science Honours Degree in Disaster and Management Studies.

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DECLARATION FORM

I, Mandaza Itai P (B1542317) do hereby declare that this study has been the result of my own original efforts and investigations. It is being submitted for the Bachelor of Science Honours Degree in Disaster and Management Studies at Bindura University of Science Education. This work has not been submitted elsewhere for the purposes of degree assessment. All additional sources have been acknowledged by means of references**.**

Name…… Signature…… Date:

DEDICATION

To and for my parents Mr and Mrs Mandaza and my siblings, Angeline, Blessing and Mellisa Mandaza.

"……I can do all things through Him who strengthens me".

Phillippians 4 vs 13.

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ABSTRACT

Proper solid waste disposal constitutes one of the most pressing challenges facing urban authorities in Zimbabwe. In recent years there has been a considerable increase in illegal waste dumping, which indicates that throughout the country, urban solid waste disposal systems are inefficient, environmental unsafe and posing health risks to human beings. To date no study has attempted to quantify the perceived health risks at household level emanating from poor solid waste disposal. Against this backdrop the above study spatially analyses the perceived health risks at household level emanating from poor solid waste disposal in Highfield, Harare. The main objective of the study was to spatially analyze the perceived health risks at household level emanating from poor solid waste disposal in Highfield, Harare. To satisfy the above objectives, data was collected through the use of observations, key informant interviews, questionnaire surveys and maps showing spatial variations generated through GIS software QGIS. One hundred respondents were sampled using random sampling and purposive was applied to identify 7 key informants who were interviewed. Observations were applied in identifying dumpsites and noting the types of waste materials found at these dumpsites using a field matrix and lastly Maps showing spatial variations of risk generated. The study established that several health risks exist as a result of poor solid waste disposal and these include malaria, cholera, typhoid, tuberculosis, lung cancer and asthma. The study highlighted that malaria has the highest level of risk followed by cholera and then typhoid. Lung cancer and asthma present only low to medium level of risk. The study also noted that the spatially variations exist and they vary that risks some risks are more concentrated in other areas than others, while some are distributed across the area under study The study also established that the emergence of poor solid waste disposal which now pose health risks to the community is due to the erratic waste collection services offered by the Harare City Council. Therefore the study recommends that there be institutional capacitating of the municipality of Harare through provision of refuse collection trucks and containers to be installed at suitable points and local health clinics to be provided with adequate working equipment and drugs

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List of Acronyms

GIS	Geographic Information Systems
IDW	Inverse Distance Weighting
MSW	Municipal Solid Waste
NIMBY	Not In My Back Yard
PIC	Products of Incomplete Combusition
PPP	Polluter Pays Principle
SWM	Solid Waste Management
UPP	User Pays Principle

CHAPTER 1

1.1 Background of the study

In recent years, research on solid waste management has shifted to urban areas of developing, in particular sub-Saharan Africa, where a multiplicity of factors notably rapid urbanisation, declining economies, lack of expertise, insufficient funds, poor supervision, lack of adequate equipment, institutional weakness have made sanitary disposal of solid waste one of the most serious environmental and health challenges facing Africa, (Senkoro, 2003). Research shows that in most cities in sub-Saharan Africa such as Kampala, Nairobi, Lusaka and Dar es Salaam solid waste are inefficiently collected and poorly disposed of. Similarly in some cities such as Kinshasa, SWM services offered are erratic, unreliable and only cater for a small fraction of the urban population (UNEP, 2000b). It has been estimated by UNEP (2000b) that close to and in some cases, more than 33% of the urban population in developing countries does not receive any municipal refuse removal services hence open waste burning and illegal solid waste dumping are common. The growing piles of illegal dumped waste provide overwhelming evidence that solid waste disposal systems are failing to keep pace with the increasing volumes of solid wastes being generated.

Furthermore, over the past decade, many researchers, institutions and international organisations have expressed concern about the adverse environmental and health effects of solid waste mismanagement. A central theme that runs in most of these studies (for example Cheena and Rondimelli, 1988; UNEP, 1996; Sengedo, 1997) is that the capacity of the urban authorities in developing countries to provide adequate levels of solid waste collection and disposal have been outgrown by unprecedented urban growth rates. This waste emanates from both residential and industrial sources, and should be managed in ways that are environmentally friendly, ecologically sound, economically viable, and socially acceptable and without causing health hazards. Thus, the strategies employed in the management of household solid waste are of concern especially given the fact that quantities of household solid waste are on the rise and may increase fourfold by 2025 (World Resources, 1996).

The uncontrolled and un-scientific dumping of municipal solid wastes has brought about a rising number of incidents of hazards to human health; contamination of both surface and ground water which in turn causes serious human health risk. Public Health Service identified 22 human

diseases that are linked to improper solid waste management (Hanks, 1967. cited in Tchobanoglous *et al.*, 1993). Surprisingly, the indiscriminate dumping of solid waste materials in water bodies' sources and low lying areas without consideration of its effect on the environment is a common practice in many cities of the developing countries (Medina, 2010; Zurbrugg, 2003; Da Zhu *et al*., 2008).

A study by Tevera,(1996a) found that over 100 people die every year due to diseases caused by improper household solid waste management in Zimbabwe. It is estimated that up to 5.5 million people are at risk of death from diseases that result from poor household solid waste management globally. These diseases can be avoided if proper waste management strategies are put in place. Harare, capital city of Zimbabwe, is at risk to these ever-increasing household solid waste management problems. The Harare City Council is facing household solid waste management challenges

1.2 Statement of the problem

.In order to ensure that solid wastes are disposed of in a manner that does not threaten human health, urban authorities throughout the world have put in place measures which ensure that all solid wastes generated that are not recovered or recycled are treated and disposed of through sanitary landfilling. However in all urban centres of Zimbabwe, most solid wastes are crudely tipped, openly burnt and illegal dumped in undesignated areas such as road sides, open spaces and alleys, (Tevera, 1991a). These elementary disposal methods are a cause for concern because they threaten the health of over 30% of Zimbabweans living in urban areas. Urban centres are treated as open access resource where solid wastes are disposed of cheaply without due regard to the public health safety and environmental protection. Such indiscriminate disposal is an environmental hazard and can threaten human health and safety. Solid waste that is improperly disposed of can result in a number of problems. It can create a breeding ground for pathogenic microorganisms and vectors of disease, and cause a public nuisance due to unsightliness and bad smell. It can cause contamination of surrounding soil, groundwater and surface water, and it can also create fire hazards, physical hazards and have poisoning effects (from pesticides and insecticides).

A handful of literature on waste management does focus on the health risks associated with improper waste management at a large scale that is focusing on large Cities such as Harare however this study will look focus on the Highfields suburb and seek to spatial analyse the perceived health risks at household level emanating from poor solid waste disposal. It will focus mainly at the health risks that arise as a result of improper waste management.

1.3 Significance of the study

The management of solid waste in Zimbabwean cities has been a major problem for decades. Solid waste goes uncollected for long periods of time thereby littering the streets and open fields in residential areas. With the passage of time and lack of proper disposal these area form sites for waste disposal. Open solid waste dumpsites are found in minor streets across towns, suburbs and in open fields in middle and low income residential areas. Due to the inefficiency of the solid waste collection system in Highfields, most of the domestic and commercial waste from activities is dumped at these dumpsite areas resulting in health risks as the residents of the area come in contact with the waste through various means. Research has been conducted at city level on health risks, however this research will spatially analyze the perceived health risks associated with poor solid waste disposal at household level and insights from this study will highlight these health risks related to poor SWM practices. The beneficiaries of this project are the residents of Highfields and also stakeholders such as the local municipal council. Through this project residents will gain insight on the dangers they put themselves in through poor waste disposal, furthermore the local authority will be able to revise some of their strategies and also implement new ones in order to curb the risks that community people are faced with.

1.4 Aim of the study

The overall aim of this study is to spatially analyze the perceived health risks at household level emanating from poor solid waste disposal in Highfield, Harare.

1.5 Objectives of the study

1. To identify the key perceived health risks associated with poor solid waste disposal in Highfield.
2. To determine the levels of perceived household health risks in Highfield.
3. To examine the spatial variations of the perceived household health risks in Highfield.

1.6 Research questions

1. What are the perceived health risks as a result of poor waste disposal in Highfields?
2. What are the levels of perceived household health risks in Highfields?
3. How do the perceived household health risks vary spatially in Highfields?

1.7 Delimitation of the study

Highfields is a high density suburb located in the city of Harare. Harare was chosen because it is within this city that the high density area of Highfield is located and it is facing serious health risks due to poor solid waste disposal which is on the rise as a result of population increase and other related activities within the area. The study is expected to begin in the year 2018 until mid-2019. Its main focus is on perceived health risks arising from poor solid waste disposal practices that are being done in Highfield and the spatial variation of household risks in the vicinity of the various dumping sites. The perceived health risks that are to be studied affect the residents of the suburb.

1.8 Definition of terms

1.8.1 Solid waste

"Solid waste is the term used to describe non-liquid waste materials arising from domestic, trade, commercial, agricultural, industrial activities and from public services." (Palnitkar., 2002). "The 'Municipal Solid Waste' includes commercial and residential wastes generated in municipal or notified areas in either solid or semi-solid form excluding industrial hazardous wastes but including treated bio-medical wastes." (MoEF., 2000).

1.8.2 Solid waste management

Involves decisions and actions that are taken regarding the generation, storage, collection, transportation, processing and disposal of solid wastes with the intention to minimize environmental damage and protect public health (Tevera and Masocha, 2003).

1.8.3 Solid waste disposal

This involves the burning, dumping or placing of waste on land or into water bodies in such a way that the waste becomes a burden to the environment.

1.8.4 Health Risk

Medterm medical dictionary defines health risk as an adverse event or negative health consequence due to a specific event, disease or condition. A healthy risk may be related to genetic conditions, chronic diseases, certain occupations or sport, lifestyle factors or any number of events or situations.

1.9 Organisation of the study

This study consists of five chapters. Chapter 1 introduces the study by presenting the background information to the study, statement of the problem, significance of the study, study aim, objectives of the study, research questions, delimitation of the study, limitations to the study and definition of key terms. Furthermore, Chapter 2 is a presentation on relevant literature pertaining waste management and how it influences the type of waste disposal methods practiced in different homes. The review of literature further provides a view on the health risks associated with the different waste disposal practices practiced by various populations. Furthermore, chapter 3 demonstrates the study area, research design, research instruments, sampling procedure, data collection methods and procedures and data analysis methods and procedures used in this study. In addition, chapter 4 demonstrates the study's results and discussions as determined by the operational objectives. In conclusion, chapter 5 presents a summary, conclusion and recommendations of the study.

1.10 Chapter summary

This chapter takes into consideration the problem statement, significance of the study as well as the background information. Various health risks are arising as a result of poor waste management and if these risks are left unchecked they will do more harm to the people and the environment as well.

CHAPTER 2

LITERATURE REVIEW

2.0 Introduction

This chapter presents a collection of work on efforts aimed at putting forth to various populations the health risks associated with poor solid waste disposal. This chapter also gives an insight on the waste disposal practices across the globe and also in Zimbabwe and an understanding on the probable health risks that arise as a consequence of poor disposal of waste in different areas particularly in Zimbabwe. In conclusion the chapter outlines the knowledge gap that exists in literature which the study aims to fill.

2.1 Conceptual Framework

A schematic conceptual framework representation of the linkages between exposure to the various types of solid waste, the pathways to negative outcomes and final impact on health was adopted from a study previously done by Ziraba *et al*, (2016) on the need to understand the linkages between poor solid waste management and adverse health outcomes in developing countries. The representation here is only illustrative and not exhaustive. For ease of understanding, the framework categories the health impacts into four that is

1) Infection transmission: This could be bacterial, viral and other disease causing organisms

2) Physical bodily injury: These may include cuts, drowning, blunt trauma, and chemical or radiation injury. This may range from immediate skin or inhalation burns, to longer terms effects.

3) Non-communicable diseases- long term exposure may lead to cellular damage and development of cancer while other might result in bodily organ injury and damage.

4) Emotional/psychological effects (strong smells, unsightly waste as human body parts)

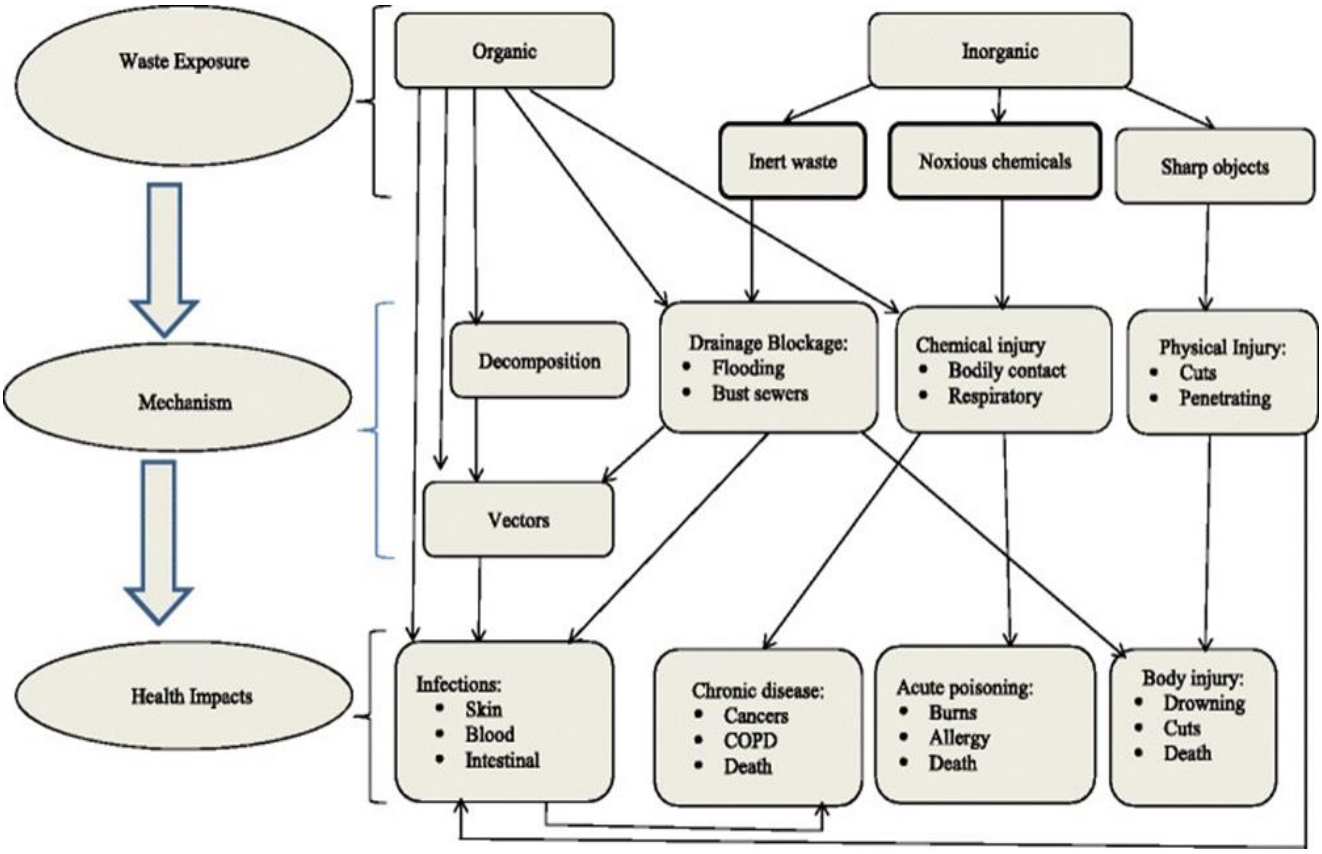


Figure 2.1 Framework for understanding the linkages between poor solid waste management and adverse health outcomes

Source: Adapted from Ziraba *et al*, (2016)

2.1 Urban solid waste management in the developed world

Solid waste management problems in the developed world largely differ from those of developing countries, reference can be made to solid waste management practices in cities of developed world to indicate the possible direction municipalities in developing countries such as Zimbabwe could follow in order to ensure that they minimize negative health, environmental and aesthetic impacts of solid waste.

Srinivas (2003), notes that although cities in the developed world generate large amounts of solid waste, industrialized countries have developed adequate facilities and competent institutions for managing their solid wastes. This is shown by the fact that solid wastes produced are efficiently removed and safely disposed. Cities in the developed world such as New York (USA), Tokyo (Japan) and last but not least London (United Kingdom), most solid wastes generated which are

not recovered and recycled are treated prior to disposal at carefully chosen, designed and secure landfills (UNEP, 2002). In contrast, cities in developing countries such as Harare (Zimbabwe) are still in the transition towards better solid waste management hence they currently have insufficient solid waste collection and improper disposal systems (Srinivas, 2003).

2.2 Urban solid waste management problems affecting the developing world

Although 62% of the total population still lives in rural areas in sub-Saharan in Africa, urban population growth rates averaging 4% per year are the highest in the world (UNDP, 2001). As a direct consequence of rapid urbanization, the amount of solid waste produced is increasing rapidly. This trend started during the 1970s when the scale of urbanization started to gather momentum. At present, there are notable signs that high rates of urban waste generation are starting to outweigh the capacities of local urban governments to collect, treat and dispose of solid wastes in an environmentally friendly manner that does not threaten human health. This is evidenced by the fact that waste collection rates are often lower than 70% in low-income countries. More than 50% of the collected waste is often disposed of through uncontrolled landfilling and about 15% is processed through unsafe and informal recycling. Given such low levels of waste collection, open waste dumping and burning are widespread (Modak, 2010).

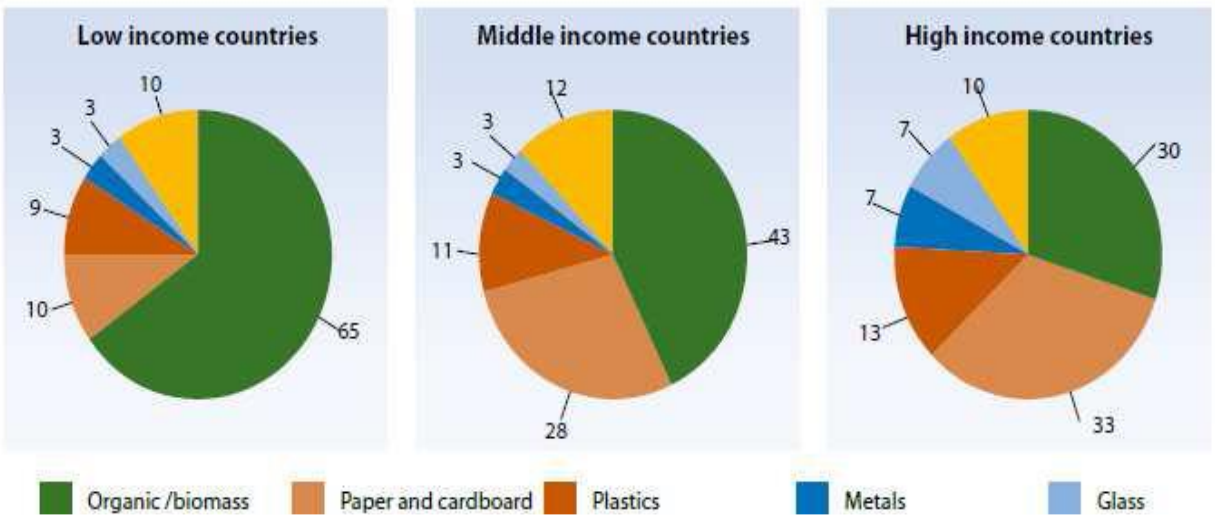


Figure 2.2 MSW compositions in Relation to the Relative Wealth of the Countries.

Source: Adapted from UNEP (2011)

2.3 Factors contributing to urban SWM problems in Sub-Saharan Africa

The nexus between rapid urban population growth and solid waste disposal problems is one that has been explored by several authors such as Salvato (1982), Cohen (1998), Harris (1990), Gourlay (1992) and Tevera (1993b), who noted that there seems to be a strong positive correlation between rapid urbanization and increases in quantities of solid waste generated. As has been mentioned before that presently Africa holds the fastest rates of urbanization in the world hence it is generating large quantities of solid waste. This has resulted in the costs of waste collection and disposal being pushed beyond the means of most municipalities in the sub-continent.

According to Senkoro, (2003) there is overwhelming evidence in the form of growing piles of uncollected solid wastes that local authorities in Sub-Saharan Africa are failing to keep pace with the scale of urbanization and environmental and health problems associated with it. As noted by Tevera (1996), there are visible signs in the form of overly littered streets and clogged drains that urban councils within the region are failing to operate efficient waste collection and disposal systems and the urban environment is already under stress from waste contaminants.

Hazra and Goel, (2009) also cite that major deficiencies were found in all elements of SWM. The collection process is deficient in terms of manpower and vehicle availability. Bin capacity provided is adequate but locations were found to be inappropriate, thus contributing to the inefficiency of the system. Lack of suitable facilities (equipment and infrastructure) and underestimates of waste generation rates, inadequate management and technical skills, improper bin collection, and route planning are responsible for poor collection and transportation of municipal solid wastes.

Local authorities lack the financial means to ensure waste collection adequately in Highfields leading to indiscriminate dumping of the waste. Cash is admittedly vital once it involves waste management because cash is required to purchase technology to clean up huge quantities of waste generated in the suburb. Financial shortage causes failure in giving proper hygienic facilities, maintenance cost and affects the standard and quantity in hygienic services.

Another factor to be taken into consideration is low public awareness and attitudes. Low public awareness and attitudes can affect the enthusiasm to get together or take the initiative to participate in programs that might improve waste management. Bad attitude will worsen the

waste management because the citizens do not have the awareness about how the waste affects their own health.

Tevera (1991a) contends that urban solid waste disposal problems are indicative of economic policy failures at either the local government or national government and this applies to a greater extent in Zimbabwe. Furthermore Tevera (1991a) attributed the presence of inefficient SWM systems to a poor revenue base which preludes meaningful investment in solid waste infrastructure hampers regular maintenance of equipment. In order to improve service delivery, he advocates for implementation of new initiatives such as commercialization, cost recovery measures and privatization of aspects of SWM.

Furthermore lack of national SWM policies and plans (Senkoro, 2003), the absence of stringent environmental planning and monitoring (Tevera, 1996), poor disposal site selection, inadequate supervision of waste dumps (Dohrman, *et al.,* 1991) and the general culture of littering make SWM a daunting task for urban local authorities in Sub-Saharan Africa. Although the influence of culture on waste handling has not been the subject of academic enquiry in Zimbabwe, however Kwakwe (1995), has shown that culture has a strong influence on the manner in which people dispose of solid waste.

2.4 Health problems associated with poor solid waste disposal in Sub-Saharan Africa.

Typically one to two thirds of the municipal solid waste generated is not collected in many cities of the developing countries and the most underdeveloped (Firdaus and Ahmad, 2010). Most wastes are disposed of in open dumps, deposited on vacant land or burned by residents in their backyards (Visvanathan and Glawe, 2006; Medina, 2010) this is due to the prevalence of the Not In My Backyard (NIMBY) attitude amongst communities. Insufficient collection and inadequate disposal generate significant pollution problems and risks to human health, (Medina, 2010).

Due to poor solid waste disposal communities are faced with various risks as they come into contact with the waste. The health risks associated with improper waste disposal affect both the young and the older. Some of the illnesses are slow onsets which are discovered in later stages of life while others are immediate especially for children who are found most of the time playing at these undesignated dumpsites and also waste pickers these encompass the mentally challenged and those who separate waste looking for reusable and recyclable materials.

Box 2.1 Health risks for waste pickers and communities

Risks to Waste Pickers

Informal waste pickers, who most often operate without any protective measures, are

exposed to a wide range of health risks such as:

- HIV (due to handling of hospital waste)
- Tetanus (due to handling of jagged metals)
- Respiratory problems (due to exposure to smoke)
- Neural damage (due to lead)
- Injuries
- Premature drinking
- Stress
- Skin and gastric problems

Risks to the Communities

- There is a significant increase in the incidence of sickness among children who live in households where garbage is dumped or burned in the yard.
- Uncollected solid waste clogs drains and causes flooding and subsequent water-borne diseases.
- People living downwind of a burning dumpsite will likely suffer from respiratory diseases.
- Contaminated liquids or leachate, leaking from dumpsite could pollute city's drinking water supplies.
- Waste dumps potentially serve as breeding ground for Malaria, thus having implications in achieving Millennium Development Goals (MDGs).

Source: Adapted from Gunn (2009), UN-HABITAT (2009).

Sharp objects such as syringes, scalpels and razor blades disposed at waste dumping sites can cause serious injuries to children visiting these sites either to defecate or play as it is very common in suburbs such as Highfield, Harare (Zimbabwe). Karshima (2016), states that, municipal waste management workers and waste pickers are also at risk of injuries caused by these sharp objects. These objects can also pose serious health risks to these groups of people if contaminated with infectious pathogens. For instance in the year 2000 alone the World Health Organization estimated that contaminated syringes caused 21 million hepatitis B virus, 2 million hepatitis C virus and 260,000 human immune-deficiency virus infections worldwide. These risks are particularly higher in developing countries where scavenging at waste disposal sites and manual sorting of hazardous waste from health-care establishments is common. Another direct effect may include environmental pollution associated with the decaying of the long standing waste.

Contamination of underground water, water is vital to life and the existence and quality of life of the people living in a region depends on access to good clean water. Ground water is a crucial link in the hydrologic cycle because it is the source of most of the water in rivers, lakes and wells which are usually municipal sources of water. Contamination of ground water often results from poor municipal waste management. A study by Karija *et al.,* (2013) conducted in Nigeria, showed that drinking water contaminated by municipal solid waste contained fecal coliform counts ranging between 15.25 MPN/100ml of water against the recommended 0 MPN/100ml of water. This may be a confirmation that human and animal excreta are components of municipal solid waste in developing countries.

Karshima, (2016) further attributes that, heavy metals including lead, cadmium, mercury and arsenic from municipal solid waste are also washed into surface and ground water posing serious public health threats. Common sources of these heavy metals in waste may include paint containers and other lead coated containers for lead, cadmium batteries and cigarette stumps for cadmium, broken mercury thermometers and barometers for mercury and containers of arsenic pesticides and wood preservatives for arsenics. These substances are not recycled in developing countries and are frequently dumped together with household waste ending in the contamination of drinking water sources for humans and animals. Generally, the health effects of heavy metals can be life threatening and may range from headache, irritability, memory deterioration, diminished intellectual capacity, kidney damage, liver disease and bioaccumulation that leads to cancer.

Furthermore there is the transmission of food and water borne endemic diseases**,** one of the public health implications of dumping solid waste within human settlements is the risk of transmission of food and water borne endemic diseases. These endemic disease pathogens which are usually associated with human and animal excreta on waste dumping sites are usually washed by rains into surface or ground water, contaminating these sources of water for humans and animals, resulting in illness (Karshima, 2016). In addition, food animals serving as vertebrate intermediate hosts can feed on human excreta, acquiring infections which are later transmitted to humans causing serious health problems.

Possible emergence, re-emergence and maintenance of diseases**,** the disposal of dead animals such as dogs, cats and chickens among others of unknown causes on illegal waste sites especially those within human settlements may pose serious public health threats considering the fact that 61% of infectious disease of humans are of animal origin. These dead animals can pose health risks to children, adult waste pickers and waste workers visiting these sites. There are possibilities of dead animals disposed at waste sites initiating outbreaks of anthrax in humans and other animals if death is due to this disease especially with the fact that anthrax spores can remain viable in the environment for more than a decade (Karshima, 2016). Human outbreaks arising from human contact with animals that died as a result of anthrax have been documented.

Breeding sites for disease vectors and rodents**,** poor municipal solid waste management can lead to the breeding of insect vectors and rodents that are capable of transmitting various diseases. The public health risk becomes higher if these sites are located within human settlements. For instance, municipal solid waste sites either holds water or block drainages resulting in water stagnancy and breeding of mosquitoes which are capable of transmitting malaria. It is estimated that approximately one million people in Africa die from malaria alone each year and most of these are children under five years. Other diseases transmitted by mosquitoes are the dengue virus and yellow fever. Rodents from solid waste sites can also enter neighboring houses posing residents of such houses to potential risks of diseases like Lassa hemorrhagic fever. House flies from waste sites can find their ways into neighboring houses and in the process transmit several diseases including cholera mechanically from excreta of infected persons when they come into contact with human food. Schirnding, (1992) attributed that high prevalence of malaria and cholera in several African cities to unsanitary disposal of solid wastes.

A report by the Southern African Research and Documentation Centre (SARDC) produced in 2000 revealed that in 1994, 61 960 cases of cholera resulting in the death of 4 389 were reported in Angola, the Democratic Republic of Congo, Malawi, Mozambique and Tanzania. During the same period 171 000 of dysentery resulting in over 600 deaths were reported in Malawi, Mozambique and Zimbabwe. From the above cases, it is clear that safe disposal of solid waste is an immediate and pressing health challenge facing Sub-Saharan countries.

2.5 Urban solid waste disposal in Zimbabwe

A nationwide study was commissioned by the Ministry of Local Government and National Housing Rural and Urban Development (MLGRUD), in 1995 this revealed that throughout the country that urban solid waste disposal in Zimbabwe is achieved through crude dumping, landfilling, open burning, incineration, burying and to a lesser extent compositing. These disposal practices are discussed below.

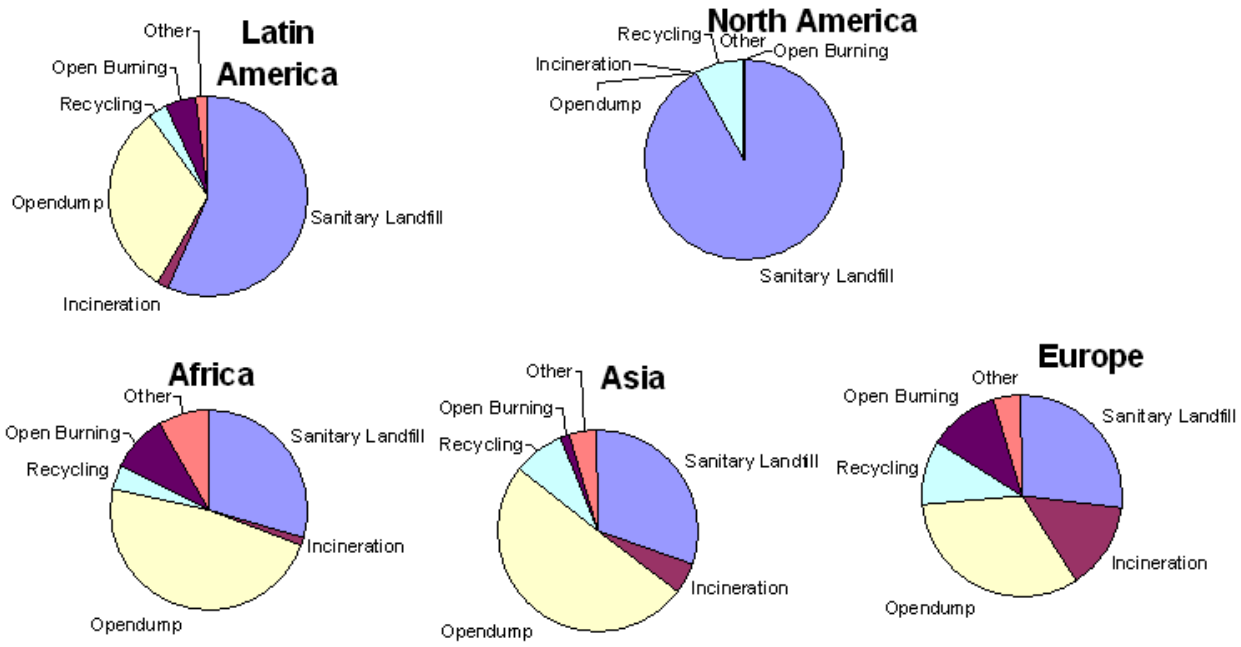


Figure 2.3: Waste Management Practices in Different Parts of the World

Source: Adapted from Chandak (2010)

2.5.1 Open Dumping

This is the disposal method whereby waste is merely mechanically tipped or dumped and left uncovered in open areas. It is the pre-dominant method through which the bulk of urban solid waste over (60%) are disposed of in urban centres of Zimbabwe (Johnsson, 1993; MLGRUD, 1995). Otten

(1999) noted that in economic terms crude dumping is the cheapest method. However, from an environmental point of view crude tipping or dumping is the most polluting method. In Zimbabwe a majority of local authorities practice crude tipping as a way of disposing solid waste at open waste dumps, which are usually natural depressions or open expanses of abandoned land or disused mine pits. Furthermore, most of these waste dumps are unfenced or unprotected and have no on site management facilities hence dumping becomes unruly and results in health problems and environmental damage.

Apart from crude tipping designated sites, large quantities of solid waste are openly dumped on insecure properties, where there are multiple access points, poorly lit road sections and fallow land. Even in large cities like Harare were there are anti-dumping and anti-litter by laws private companies and individuals frequently dump their waste indiscriminately. Solid waste dumped at urban waste dumps in Zimbabwe is mixed that is, it comprises of industrial, residential, commercial and construction wastes all dumped at one site. In Zimbabwe, the hardest hit by erratic waste collection are low-income residential areas such as Mbare, Highfield, and Budiriro (Hardoy *et al.*, 2001; Gumbo, 2005), and also the rapidly expanding informal settlements such as Epworth, Hopely and Mahalape among others. This means that most of the waste being generated in such locations is mismanaged and consequently it is dumped in open spaces (Tibaijuka, 2005). However, the urban solid waste streams in the country are dominated by fairly high amounts of organic materials and plastics mostly packing materials. MLGRUD, (1995) noted that "plastics of all types constitute about 20% of the urban solid waste bulk", and over the past two decades the figure have since gone up. Studies done in industrialized countries revealed that most colored plastics have a harmful pigment that pollutes the environment and when burnt in the open, plastics produce toxic substances such as dioxin, which are harmful to human health. As a result, industrialized countries have taken a stance to phase out the use of colored including some parts of India. However, Zimbabwe no such legislation exists in the country. In view of the former there are reasonable grounds to suspect that waste dumps are major sources of heavy metals such as lead (Pb) which promote ground and surface water contamination.

Mugabe *et al.,*(1998) observed that although practices to contain, treat and process and harvest landfill gases like methane are desirable from environmental and economic perspectives, in Zimbabwe due to lack of adequate funds, equipment and technical expertise nothing is done in those regards. In essence this means that although disposal sites classified as landfills in Zimbabwe reduce

visual pollution, they are nonetheless environmentally unsafe. Worldwide, leachate from waste dumps and landfills is considered a serious environmental hazard which must be handled in an environmentally friendly manner, (Otten, 1999). In Zimbabwe, there is abundant evidence that water resources are under threat from leachates and landfill gases (Tevera 1991b).

2.5.2 Incineration

Incineration is the controlled combustion of solid wastes in built-in chambers at high temperatures. This procedure involves high operational and maintenance costs hence it is the most expensive and least employed disposal method of waste in Zimbabwe. Beede and Bloom (1995) noted that in developing countries, the high biodegradable and moisture contents of urban solid wastes streams make incineration without the addition of supplementary fuels economically unviable. Currently in Zimbabwe, incineration is practiced mostly to destroy medical waste at large hospitals such as Mpilo Hospital. Although huge amounts of waste can be destroyed this way that is about 90% volumetric reduction, it contributes to the pollution of air, water and soil if no facilities for processing and treating the by-products of combustion are present as is the case in Zimbabwe hence resulting in health risks through pollution. Otten (1999) is of the view that incineration attracted considerable criticism in both industrialized and developing countries over the past decades because it generates harmful substances like toxic ash, which require special treatment before being landfilled.

2.5.3 Open waste burning

Open waste dumping involves simple combustion of waste materials without regulating oxygen and maintaining adequate ambient temperatures for efficient combustion to occur. It is characterized by the non-containment of the combustion reaction in an enclosed device such as a furnace to provide sufficient residence time necessary to complete combustion to occur. This method involves setting of fire to uncollected waste materials. The method is practiced throughout the low income residential suburbs of Zimbabwe where waste collection is never consistent but rather abrupt. Informal settlements are also disadvantaged when it comes to waste collection since they do not receive waste collection services from the local authorities hence they opt for open waste burning. Informal sector businesses and private firms also practice this method due to the poor provision of waste collection services. Within the Central Business District CBD waste materials such as cardboard boxes, plastic containers and last but not least are set ablaze in the night time by street dwellers as a way of warming themselves when temperatures are cold.

At waste dumps flammable materials are set ablaze by dump attendants and informal waste pickers in or order to reduce volumes of waste as a way to preserve the lifespan of dumpistes. Unfortunately open burning results in the release of products of incomplete combustion (PICs) these are carbon monoxide, and oxides of nitrogen which are harmful to health and contribute to global warming.

2.5.4 Composting

Composting is defined by (Salvato 1982) as the controlled decay of organic matter in a warm, moist environment by the action of bacteria, fungi and other micro-organisms. It entails piling of organic waste or burying them in a pit and covering them with soil until they decompose. This method embraces the principle of resource conservation and results in minimal environmental damage at the same time creating some economic benefits (Hoornweg *et al.,* 2000) When the process is complete, the end product is a rich dark solid that is odor free and can be used as a soil conditioner or natural fertilizer. In Zimbabwe, due to various reasons including low levels of waste collection households are forced to use composting to dispose of their organic waste at the same time generating manure, which is used in their back yard gardens. This practice from an operational point of view reduces the quantity of waste to be collected.

2.6 Conclusion

Various literatures within the context of solid waste management and solid waste disposal were reviewed in this chapter. The literature review looked at various issues which later prompt communities to engage in the act of dumping solid waste indiscriminately. The chapter also highlighted being faced in Zimbabwe which are promoting various solid waste malpractices.

CHAPTER 3

DATA COLLECTION AND METHODS OF ANALYSIS

3.0 Introduction

This chapter describes the study area, research design, materials, data collection methods and procedures and the methods of analysis used in this research.

3.1 Study area

The research was conducted in the high density suburb of Highfield located to the south west of Harare the capital city of Zimbabwe. Highfield is bordered by Glen Norah to the southwest, Waterfalls to the southeast, Willowvale and Southerton spanning the northeast to northwest. The coordinates of the area are as follows 17 53 28.85S by 30 59 14.72E. Highfield is divided into zones which include Lusaka, Egypt, Jerusalem, Canaan, Engineering, Cherima, Zororo, Western triangle, Old highfields and Paradise. Highfield has a population of approximately 75 000 and above residents and consists of at least 10 000 houses.

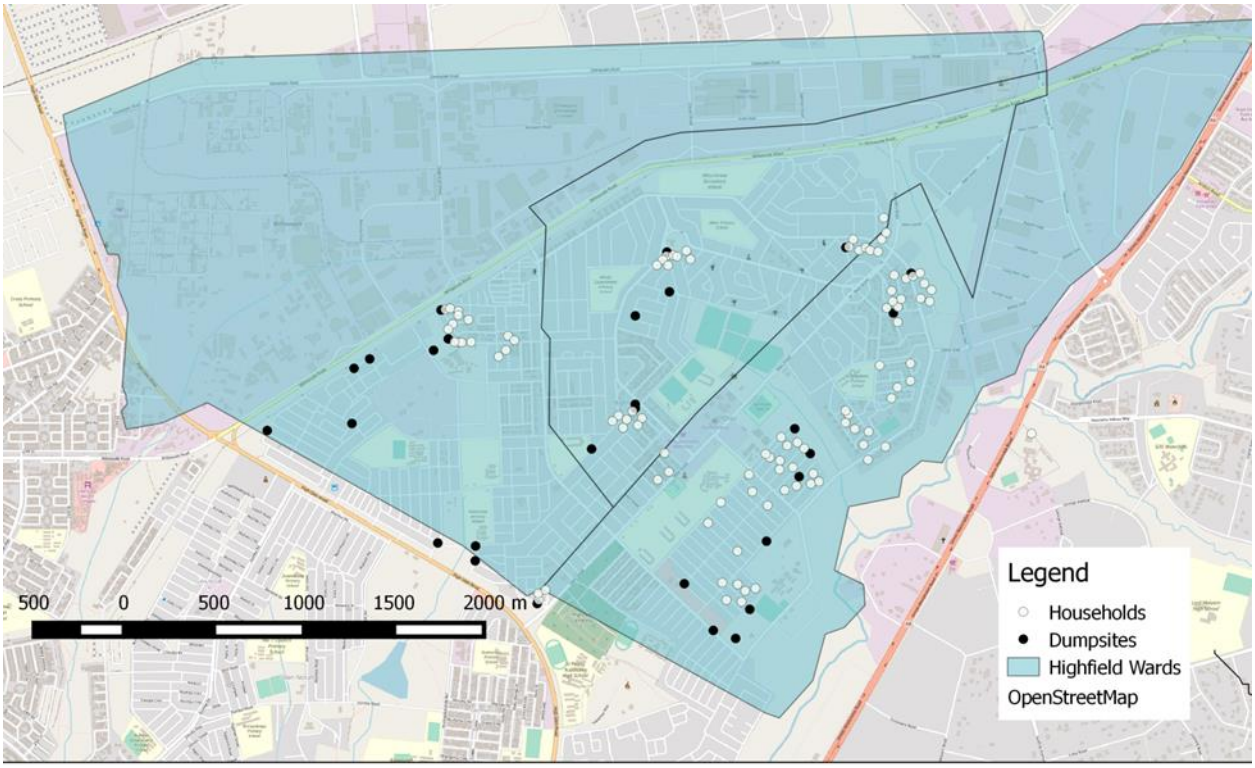


Figure 3.1 The study area

3.2 Research design

This study followed a framework that is similar to the one used by Ziraba *et al.,* (2016) in his study of "A review and framework for understanding the potential impact of poor solid waste management on health in developing countries" that sought to understand the linkages between poor solid waste management and the adverse health outcomes. Hence this study utilized both quantitative and qualitative research methods. The quantitative method consisted of structured questionnaires as the chief instrument: These consisted of close-ended questions that meant to elicit information on the health risks facing the people as a result of poor waste disposal. The qualitative method in which Abdulai and Owusu-Ansah (2014) state that the qualitative design is an inquiry process of comprehending a social or human problem based on building a complex holistic picture formed with words, reporting detailed views of informants and conducted in a natural setting. This consisted of in-depth Interviews. Interview sessions were conducted among the key informants in the community these included the elderly with a historic background of the area, health practitioners were also interviewed so as to gain knowledge on the possible health risks faced by communities due to poor solid waste disposal, streets sweepers were also interviewed as a way of getting their perspectives on the dangers they face since they are always in contact with different types of waste materials and lastly a councilors was also interviewed these are directly in contact with the local authorities. The questions were semi-structured. The questions were seeking information on challenges being faced in tackling solid waste, history of probable health diseases arising from poor waste disposal amongst others.

3.3 Sample size and sampling procedure

Raj (1972) defined sampling as a procedure where a fraction of the data is taken from a large set of data and the inference drawn from the sample is extended to the whole group. The study commenced by randomly selecting dumpsites across the zones in Highfield.)

Samples were selected because it is naturally difficult to carry out a research on each and every individual element of the population. The most important thing is to have a sample that is representative enough to enable appropriate results to be reached. Hence the research worked with a sample size of 107 respondents and this figure was reached through the use of the following formula

$$n = \frac{(d(Za/2)^2)p(1-p)}{i^2}$$

Where n is the sample size and the calculation was based on 50% (p) of knowledge on perceived health risks associated with poor solid waste disposal, $Za/2$ = 1.96; a 3% margin of error, i); a design effect of 1 (d) and a 10% non-response rate. This gives a sample size of 107 households that were distributed proportionally in all zones. A similar method was used by Serengbe *et al.,* (2015) in his study on the "Knowledge and perceptions about malaria in communities in four districts of the Central African Republic", the above formula was used to determine the sample size in that study hence its adoption in this one.

Further on households were put into two clusters according to their proximity to the dumpsites. The study mainly focused on the households that are within a 500metre range of the selected dumpsite and those that are outside the 500metre range of the selected dumpsites. Within the households identified that is those found in the 500metre range, random selection of the households was conducted to ensure that every household had an equal chance of being selected, as was the case for the households outside the 500metre range. The researcher targeted 107 respondents to represent all the households within the vicinity of the dumpsite that is those within the 500metre range and those households which are outside the 500metre radius of the selected dump sites.

3.4 Data collection methods

The researcher made use the following data collection methods in conducting the research with the aid of a handheld GPS machine to assign coordinates to dumpsites and capture household coordinates:

- Questionnaire surveys
- Interviews
- Observations.

3.4.1 Questionnaire surveys

This is a method which involved the distribution of questionnaires that contained questions to the residents or respondents so as to gather information about the health risks being faced by

residents of Highfield due to poor disposal of waste. Large samples can be made use of and thus the results can be made more dependable and reliable (Kothari 2004). The questionnaires contained questions which required only the appropriate answer to be ticked and some which required respondents to give full explanations of their answers (see appendix 1 for household head questionnaire). A total of 107 questions were distributed in all areas where a dumpsite was chosen and upon their return 100 were found to be without error and 7 were spoiled meaning that they could not be made use of.

3.5.2 Key informant interviews

An interview method is a direct method of obtaining primary information in a face to face situation which is a critical aspect of qualitative data collection. According to ACAPS (2012) key informant interviews provide individual perspectives and experiences through direct discussion. The mentioned technique provides an opportunity to get in-depth information and detailed explanations from key informants hence a complementary of data from other sources. During the interview the researcher took down notes of the responses as they were being given by the respondents. Purposive sampling was done to select the key informants (see appendix 2 for key informant interview guide). Black (1999) referred to purposive sampling as selecting all knowledgeable persons on the subject issues. Therefore, key informant interviews were used in this research to complement information from questionnaires and other sources. Key informants interviewed included two health practitioners, who were interviewed so as to gain more knowledge on the possible health risks that arise due to poor solid waste disposal. Furthermore the researcher interviewed two street sweepers these were chosen due to the fact that they are always in contact with solid waste hence the dangers they face are vital in relation to the population of Highfield. Two elderly people were also chosen and these were chosen for their knowledge dating back to the previous years and this knowledge is vital for this study as it helps in the understanding of the current situations. Lastly a councilor was interviewed and these are purposively selected for their knowledge of the areas they save and also for the fact that they work hand in hand with the local authorizes hence their input is vital for this study especially in trying to understand the measures in place to curb risks associated with poor solid waste disposal and other cases of disease outbreaks in Highfield related to undesignated solid waste disposal.

3.5.3 Observations

In order to identify dumpsites in the suburb the researcher conducted field observation of major illegal dumpsite areas and captured the locations of these sites with a GPS device Germin etrex 10. Once identified, the coordinates of the dumpsites were saved as waypoint data which was later entered into Microsoft excel to be used for spatial analysis. Also through observations the research took note of the materials that made up the dumpsites that is materials regularly disposed by the residents of Highfield using an observation matrix (see appendix 3).

3.6 Data analysis

Data analysis and interpretation is the process of data processing and converting raw data into meaningful statements. LeCompte et al (1999) defined data analysis as the process a researcher uses to reduce data to a story and its interpretation. The researcher made use of the statistical package for social sciences (SPSS) version 16.0 to enter data acquired through questionnaires surveys, Microsoft Excel and also QGIS GIS software. Responses were numerically coded and inputted into an SPSS editor. Several analysis functions were used to generate frequency tables, cross tabulations and other descriptive statistics. During key informant interviews the researcher noted down responses as they were being given by the respondents. Manually the researcher proceeded to conduct content analysis in order to generate themes which were later used as supportive evidence for the data acquired through questionnaire surveys and observations.

3.7 Spatial Analysis

As a way of analyzing data GIS (QGIS software) concepts were incorporated, the researcher made use of spatial analysis tools. Interpolation method was used, although the methods vary in their complexity and in their accuracy, the researcher used methods of interpolation that best present spatial variations of the health risks associated with poor waste disposal. Inverse distance weighting (IDW) method of interpolation was applied in this study; this method is useful for health related analyses, as it accounts for distance between data points, that is to say the farther away a sampled point from the area of interest the less weight it holds in the calculation. In IDW method, it is assumed that the rate of correlations and similarities between neighbors is proportional to the distance between them that can be defined as a distance reverse function of every point from neighboring points (Saffari, Yasrebi, Sarikhani, & Gazni, 2009).

3.8 Limitations

The researcher faced the following challenges during data collection, respondents especially during key informant interviews tended to personalize issues thus leading to little information being shared on the questions pertaining to the study hence the researcher had to ensure that respondents are kept at bay concerning their personal issues and focus on the aim and objectives of the study.

Furthermore the respondent's especially household heads were reluctant to fully cooperate citing that they did not want to be involved in any interviews as this might be politically affiliated. However to overcome this, the researcher disclosed his identity and provided authentic documentation proving the academic affiliation of the study. In addition, the questionnaires issued did not disclose the identity of the respondents to ensure free and objective participation from respondents.

3.9 Ethical considerations

The researcher ensured that respondents during data collection granted their informed consensus to be part of the study that is, respondents were free to choose to respond to questions presented to them or not. Furthermore the researcher ensured of confidentiality in that information gathered would be used for study purposes only thus also ensuring the safety of participants. Last but not least the researcher obtained permission from rightful authorities during the research period.

3.10 Conclusion

This chapter focused on the description of the study area, study design, research instruments used, sampling procedure, data collection methods and procedures, data processing tools and data analysis procedures. Therefore, the subsequent chapter will present, analyze and discuss the results pertaining to the study.

CHAPTER 4

RESULTS AND DISCUSSION

4.1 Introduction

This chapter presents the study's findings according to the order of objectives in chapter 1 and also discussed the results. The results obtained from field work were presented in the form of tables and graphs.

4.2 Socio-demographic data

4.2.1 Gender of respondents

From the study conducted in Highfield suburb the majority of the respondents were male as they constituted the greatest proportion in the study. The male respondents constituted 51% of the population as compared to their female counterparts who numbered only 49% of the study.

4.2.2 Age of respondents

Age is a vital aspect the study as it determines one's knowledge and experience with the solid waste disposal system. From the results it was determined that respondents in the age range of 25-40 dominated the study. The age group between 16-24 constituted 17% of the study, while those in the range of 25-40 constituted 50%, the 41-64 population made up 30% of the study population and lastly the 65 and above constituted only 3%.

4.3 Perceived health risks associated with poor solid waste disposal in Highfield.

4.3.1 Gender and perceived health risks

The study revealed that men are generally more aware off health risks than their female counterparts. From the 51 male respondents who took part in the study, 57% highlighted that cholera has a high level of risk while 43% women agreed with this claim; however more women stated that cholera has a low level of risk that is 51%, while 49% of the men were of the same view. Men were the greater population to state that typhoid also has a higher level of risk with 64% highlighting as compared to 36% of women stating this. However a greater population of women 58% highlighted that malaria poses high levels of risk and 42% of the males were of the same view. Respiratory diseases that are asthma and lung cancer are the only health risks were both males and females shared the same view that their levels of risk are low to medium.

4.3.2 Solid waste disposal

The study indicated the most prevalent method of waste disposal practiced in Highfield. The most common method practiced as indicated by the respondents is dumping which constitutes 56% and this is followed by burning which accounts for 31% and last but not least respondents also indicated is the use of burying waste materials as a way of disposing and this accounts for 13%. From the study it was highlighted that non resort to composting solid waste as a way of disposing their waste.

4.3.3 Waste collection

The study also found that waste collection in Highfield is erratic and inconsistent as waste is collected on a monthly basis as indicated by the respondents. The majority of respondents stated that waste collection by the local authorities was done once a month. From the data it was derived that 62% stated that waste is collected monthly, while 12% stated weekly and 26% were of the view that waste is never collected. Looking from a gender perspective it was the women who were the majority that is 53% in stating that waste is collected monthly. Whereas it was 58% of men who stated that waste is never collected.

Gender perspectives vary towards waste collection rates and table 4.1 shows the difference between men and women and how they perceive the waste collection rates.

Table 4.1Table 1 Gender perspective on waste collection

		Waste Collection Rates			
		Weekly	Monthly	Never	Total (%)
Gender of respondents (%)	Female	7	33	9	49
	Male	5	29	17	51
Total (%)		12	62	26	100

4.3.4 Perceived health risks associated with poor solid waste disposal

The data gathered from the field showed that people have general awareness of health risks associated with poor solid waste disposal as illustrated below by the figure 4.1. The figure clearly states how people perceive health risks and the levels of risk they are prone to. From the

data acquired Malaria was outlined to be the health risk with the highest level of risk with 24% followed by Cholera with 14% and typhoid which had 11%. Generally the respondents highlighted that they face low levels of risk as a result of the perceived risks. Furthermore data acquired from key informant interviews also highlighted the risks in figure 4.1 below and also highlighted new ones such as tetanus and injuries and cuts. As highlighted by one health practitioner they stated that

"Poor waste disposal can also pose health threats to human beings especially children leading to diseases like tetanus."

Further, a street sweeper supported the above claim by stating that

"In this line of work, at times we sustain injuries from glass bottles and scrape metal that is rusty resulting in injuries"

Figure 4.1 shows the perceived health risks associated with poor solid waste disposal and the estimated levels of risk.

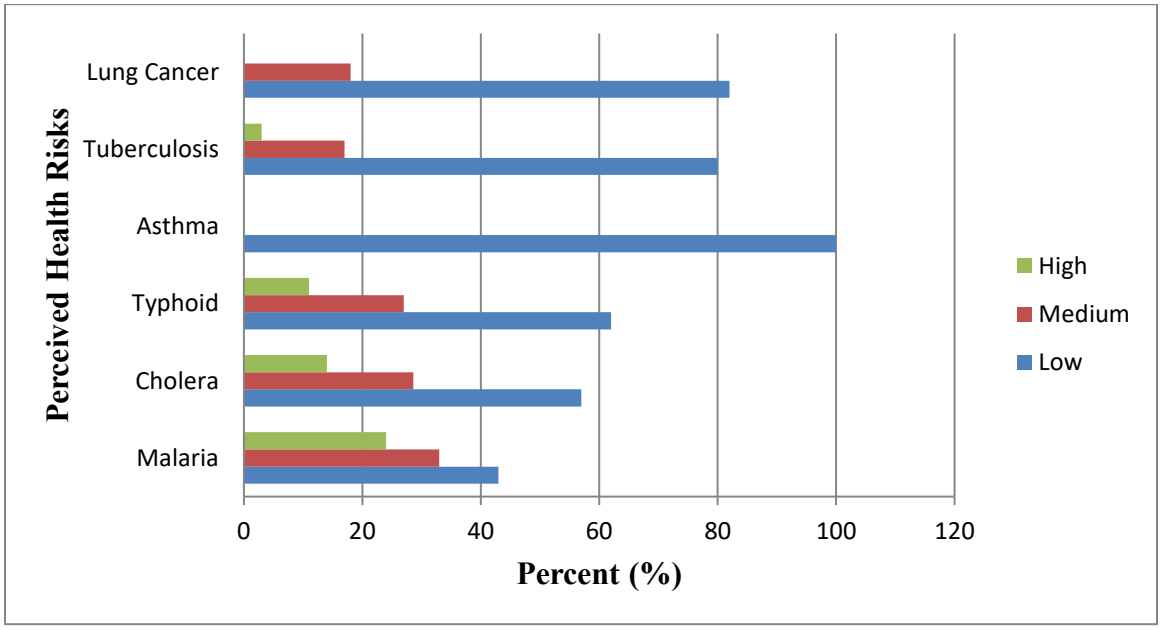


Figure 4.1 Perceived health risks and the estimated levels of risk

4.4 Perceived level of household risks

4.4.1 Cases of diseases experienced

The study found only six cases within Highfield that were mentioned to have been as a result of poor solid waste disposal. 2 cases were of malaria, 2 of typhoid, 1 cholera case and 1 of tuberculosis in which it was stated that incineration worsened the case. Health practitioners interviewed as key informants stated

"We receive numerous cases of cuts and injuries due to unsafely disposed glasses, small wires and scrape metal; also we receive other cases of cholera, typhoid and malaria amongst others which are treated early before they cause much damage to affected individual."

The table 4.2 shows cases of diseases that were highlighted during the study to have affected households as a result of poor waste disposal

Table 4.2 Diseases experienced due to poor waste disposal

Type of disease	Cases	Year	Month	Sex	Age
Cholera	1	2018	October	Male	23
Malaria	2	2012 2017	November April	Female Male	17 26
Typhoid	2	2018 2011	October November	Female Male	5 9
Tuberculosis	1	2015	May	Female	35

Cases as presented in table 4.2 are cases which occurred as a result of poor solid waste disposal and this was highlighted during the questionnaires administered during the survey. Malaria and Typhoid had the highest number of cases with 2 cases each and cholera and tuberculosis had each 1 case.

4.4.2 Household composition.

The study revealed that of the households within Highfield 43% have families containing 5 to 8 members, those with members ranging from 1 to 4 constituted 39% while 18% constituted those households with 8 and above family members. The figure 4.2 highlights the perceived cholera risk affecting households with different household composition.

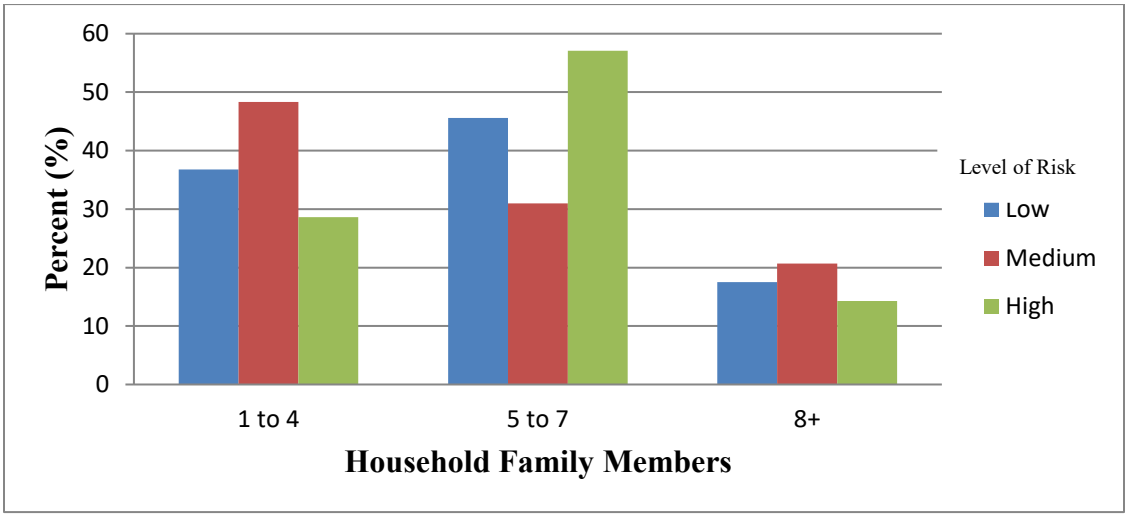


Figure 4.2 Perceived Cholera Risk in Highfield suburbs in Harare

Furthermore households with members ranging from 5 to 7 people within them highlighted to facing the highest risk to cholera with 57% highlighting this fact. These were followed by with families with members ranging from 1 to 4 and lastly families with 8 and more members as presented in fig 4.2 above. An elderly key informant also highlighted that,

"Families that are large in numbers and live near dumpsites face high levels of health risks because if one member catches an illness, the disease can be easily spread in the household if the disease is not detected early."

Malaria was highlighted to be high mostly by families with 1 to 4 members thus 41.7% stated this to be at high risk of contracting malaria from poor solid waste disposal, followed by those with 5 to 8 members and those with 8 and above members both stating that they face high risk of contracting malaria due to poor waste disposal both that is 29.2% highlighted to facing the same level of risk.

Figure 4.3 presents the perceived malaria risk in Highfield suburbs and how they affect families with different compositions.

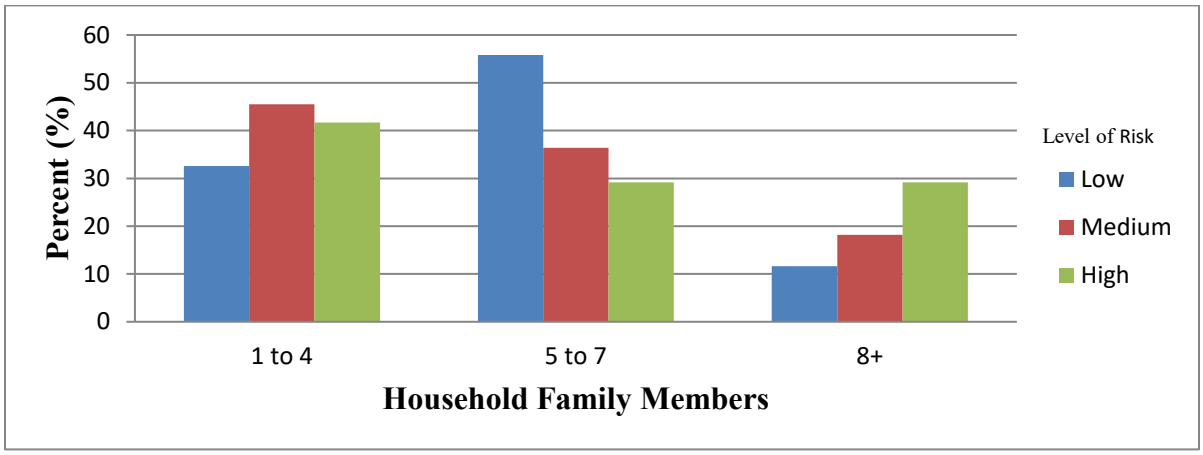


Figure 4.3 Perceived Malaria Risk in Highfield suburbs in Harare

Another significant health risk identified was Typhoid with families with members 1 to 4 highlighting that they face the greatest risk, 54% stated this, followed by those with 8 and more members that is 27% highlighting this fact and lastly 18% of those with members between 5 and 7 saying they face this risk also. Figure below illustrates this,

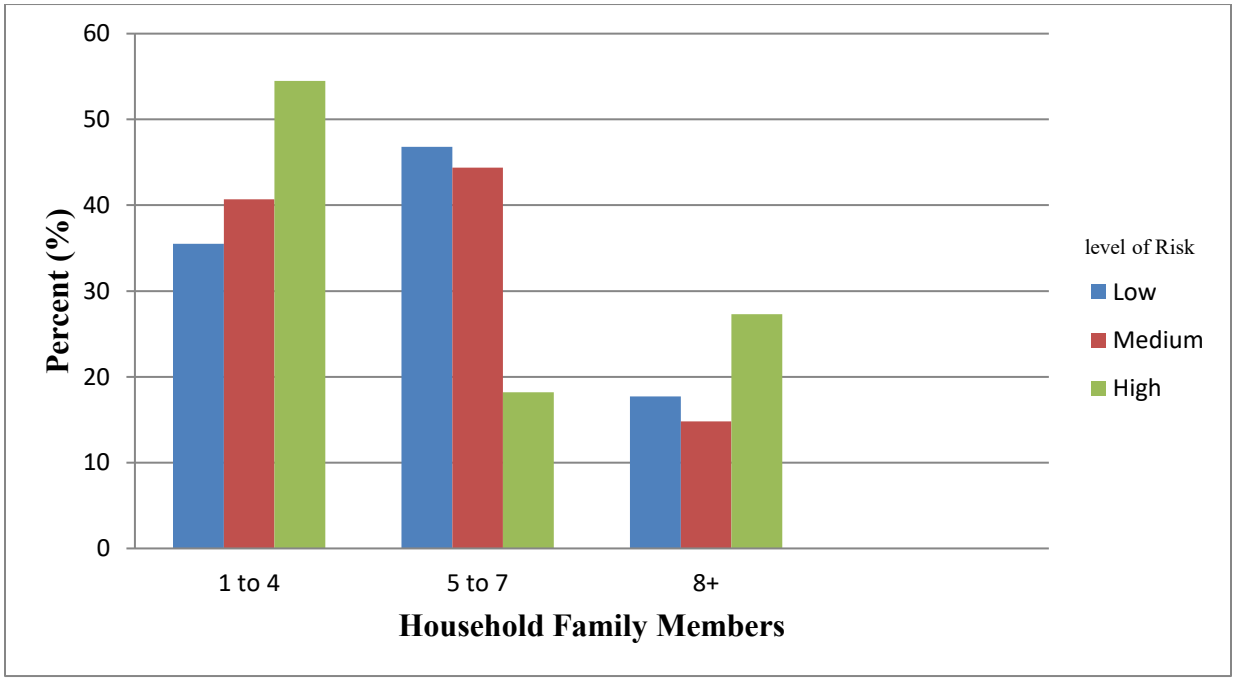


Figure 4.4 Perceived Typhoid Risk in Highfield suburbs in Harare

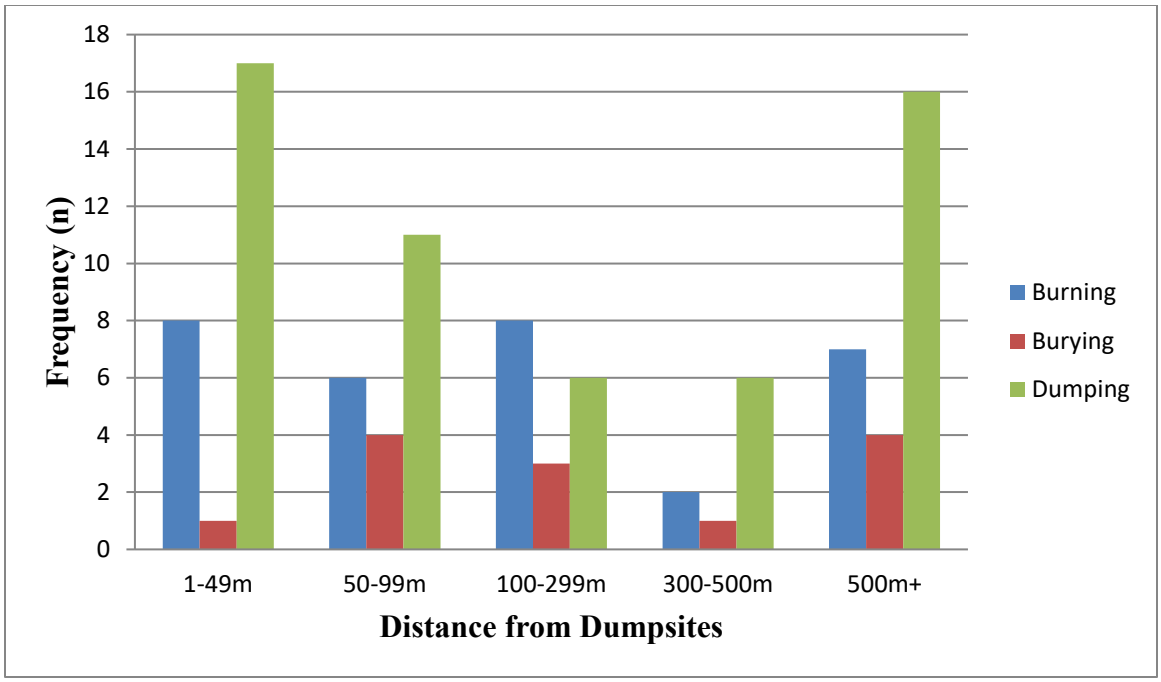
4.4.3 Waste generation and household composition

37 of the respondents indicated to living with other families within their houses whereas 63 of the study respondents iterated they do not have any other families within their households. From the 37 who agreed to living with other families, 46% of the families stated that the total number of the members in those families ranged from 1 to 5 family members, while 38% of the families stated that the families they stay with range from 6 to 10 members and lastly only 16% families stated to living with families ranging from 11 to 15. From the data gathered plastic waste generation was high among families who live with other families 43% stated this while food waste followed with 11% stating and paper waste also is generated with 8% revealing this. From the study no family stated that they generate metal waste within Highfield.

4.4.4 Type of solid waste disposal method and distance from dumpsite

Waste generated in households affects their risk levels. From the two clusters studied during the study those within 500m of dumpsites 24% indicated that they resort to burning whereas those outside the 500m+ range that is 7% highlighted to burning. Furthermore those who practice burying in the 500m range were only 9% whereas only 4% highlighted the use of burying for households outside the 500m range. Lastly the majority that is 40% of households situated in the 500m range of dumpsites indicated the use of dumping whereas only 16% outside the 500m range indicated the use of dumping to rid of their solid waste.

Households in different vicinities practice different disposal methods of solid waste disposal and the figure 4.5 presents the different distances from dumpsites and the methods of solid waste disposal.



n = sample size

Figure 4.5 Illustrates the relationship between disposal methods and the distance to dumpsites.

4.4.5 Health risk reduction measures

According to 55% of the respondents, they were of the view that households are at risk because the local authorities do not have adequate measures to deal with the cases that are reported at local clinics of diseases. From the data gathered from households and also from key informant interviews, both parties where agreeing on the fact that as it stands the council does not have any sound measures to curb health risks associated with waste disposal one key informant stated

"The council does not have measures to deal with health risks associated with poor solid waste disposal because the first measure to curbing these health risks is waste collection."

4.5 Perceived spatial variations of risk of households in Highfield.

4.5.1 Distance from dumpsite

The results gathered during the study revealed that of the total population studied 27% stay 500m or more from a dumpsite and of the population living in the vicinity of dumpsite 26% highlighted living within a distance of 1-49m of a dumpsite, followed by 21% living about 50-99m from a dumpsite. 17% stated that their proximity to a dumpsite is about 100-299m whereas 9%

highlighted that they live in a 300-500m range of dumpsites. From the 26 respondents living in the 1-49m range of a dumpsite the highest perceived health risk was malaria with 46%, followed by cholera with 31%, whereas 8% stated that they face high level of typhoid risk and only 4% stating that they face high tuberculosis risks. However non stated that they face high levels of asthma or lung cancer risks but the respondents stated that the level of risk to these two health risks ranges from low to medium.

Distance from a dumpsite affects households and the perceived levels of risk. The figure below presents the 1-49m distance from a dumpsite and the perceived level of health risks.

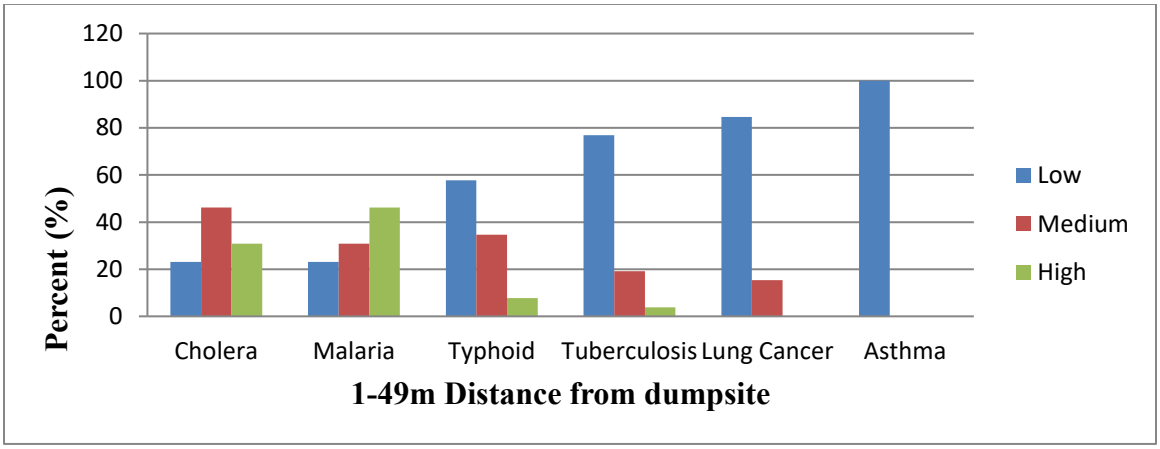


Figure 4.6 1-49m distance from dumpsite and perceived health risk

21 respondents living the in 50-99m range of dumpsites stated that they face high levels of typhoid and malaria and 24% stated this for both diseases whereas 14% stated that they face high levels of cholera, only 5% where of the view that tuberculosis is a high risk due to improper waste disposal. However none highlighted to facing high levels of Lung Cancer and Asthma.
Below is a figure which presents the 50-99m distance from a dumpsite and the perceived health risks and the estimated levels of risk.

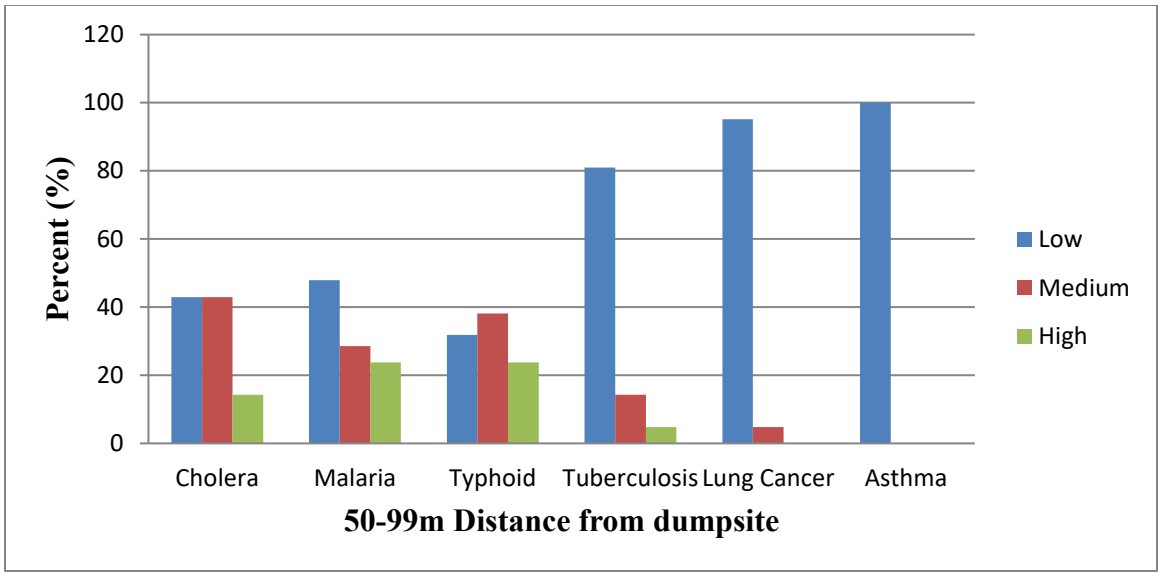


Figure 4.7 50-99m distance from dumpsite and perceived health risks

Furthermore, 17 respondents in the 100-299m range of dumpsites stated that the highest health risk they face is Malaria as 29% stated this, and this is followed by typhoid were 12% highlighted this lastly 6% were of the view that they face high risk levels of cholera, from the respondents in the category none stated to facing high risks of asthma, lung cancer and tuberculosis.

Figure 4.8 presents the 100-299m distance from a dumpsite and the perceived health risks and the estimated levels of risk.

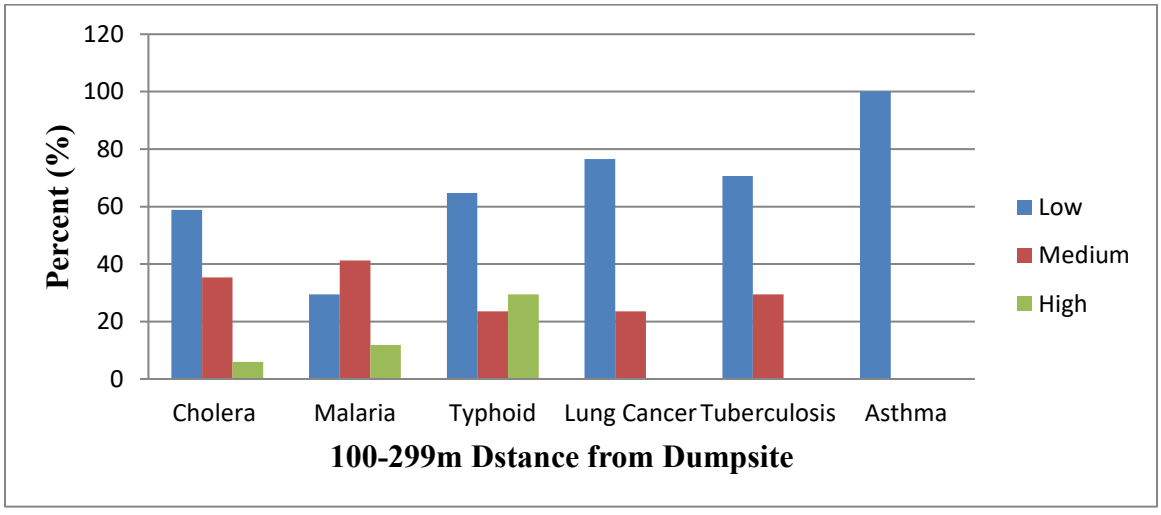


Figure 4.8 100-299m distance from dumpsite and perceived health risk

Moreover, 9 respondents stated that they reside within 300-500m of dumpsites. Of these only typhoid and malaria were stated to have high levels of risk. 22% stated that they face high level of typhoid whereas 11% were of the view that they face high levels of risks to malaria. 27 respondents highlighted residing in the 500m and above range of dumpsites. In this cluster 7% highlighted to facing high levels of risk to cholera whereas 4% highlighted to facing higher levels of risk to malaria and tuberculosis. Other health risks were considered to be low to medium risks.

4.5.2 Spatial Variations of Household Risks

Dumpsites and households chosen were spatially spread across Highfield and the map below shows these spatial spreads of dumpsites and households.

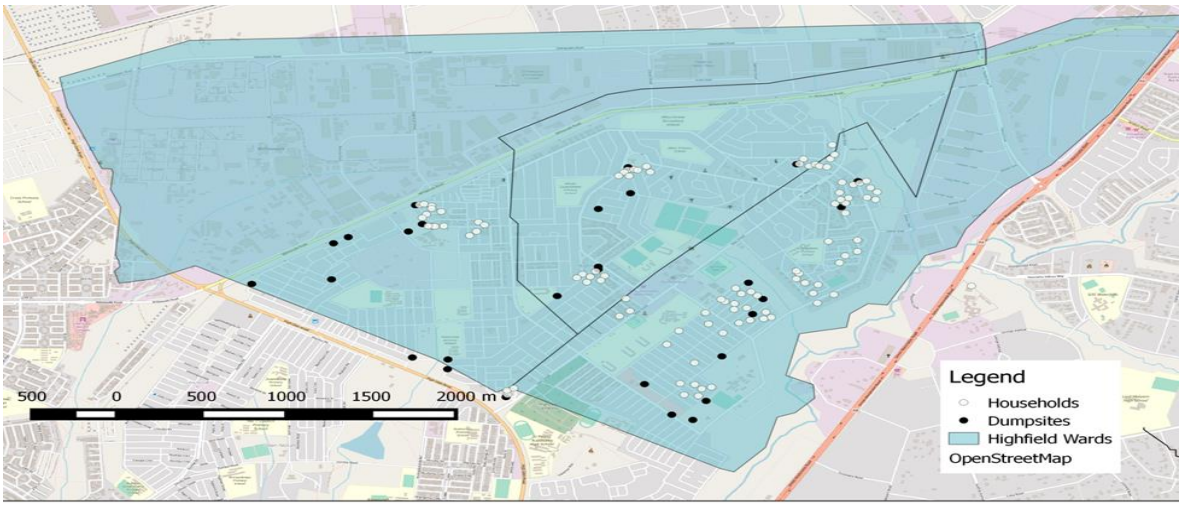


Figure 4.9 Spatial distributions of dumpsites and households

Spatial variations of the perceived health risks including cholera, malaria, typhoid, and tuberculosis and lung cancer are presented in the figures 4.9, 4.10, 4.11, 4.12 and figure 4.13.

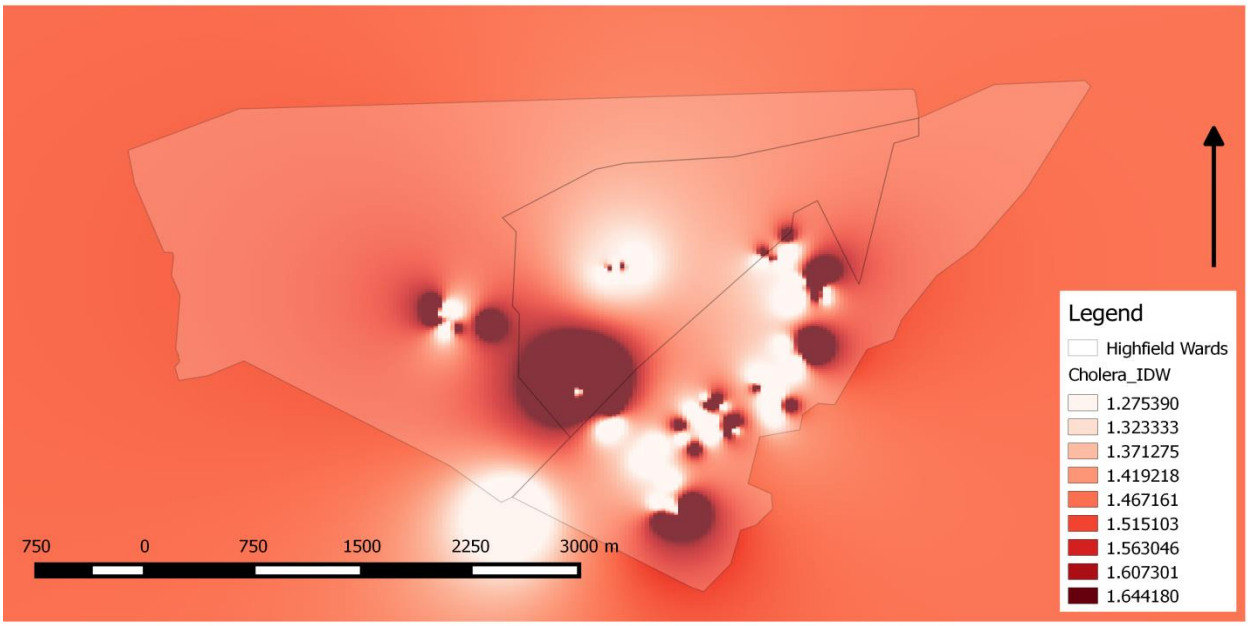


Figure 4.10 IDW for perceived Cholera health risk

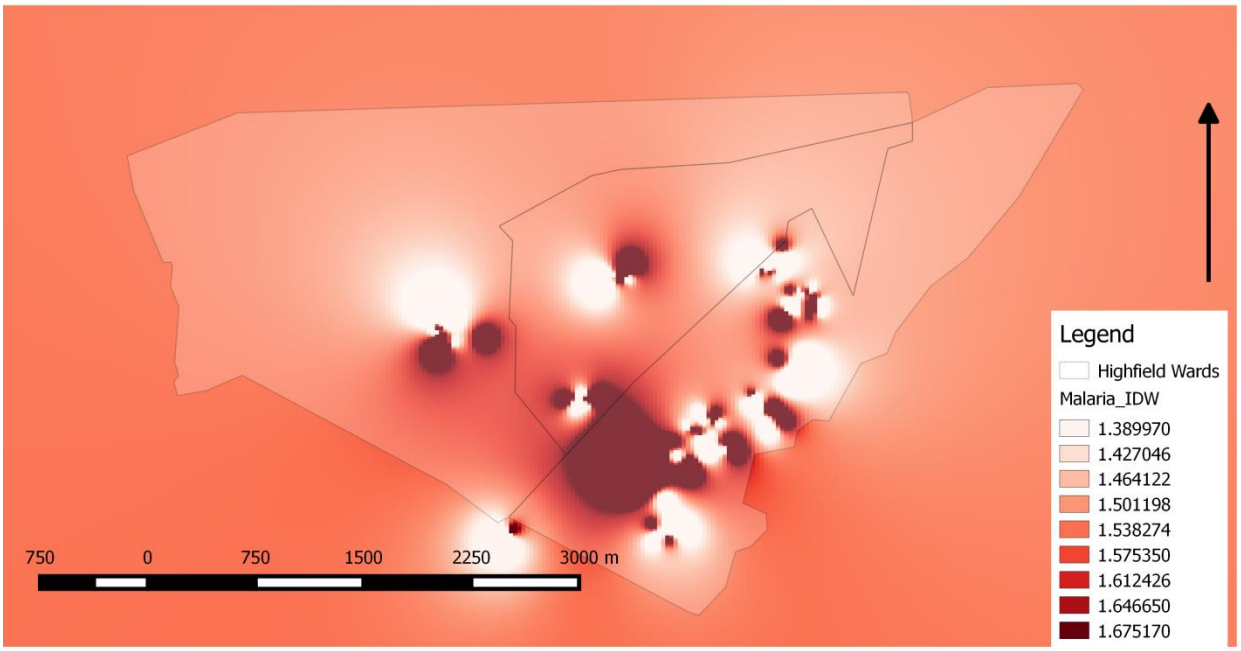


Figure 4.11 IDW for perceived Malaria health risk

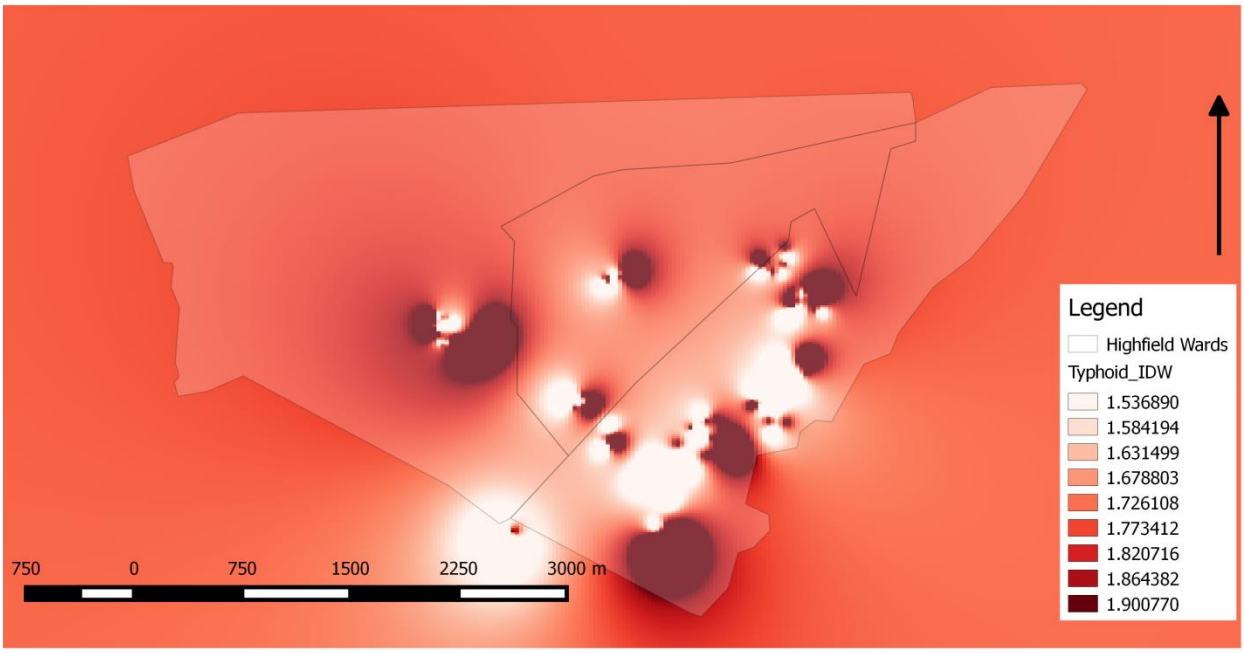


Figure 4.12 IDW for perceived Typhoid health risk

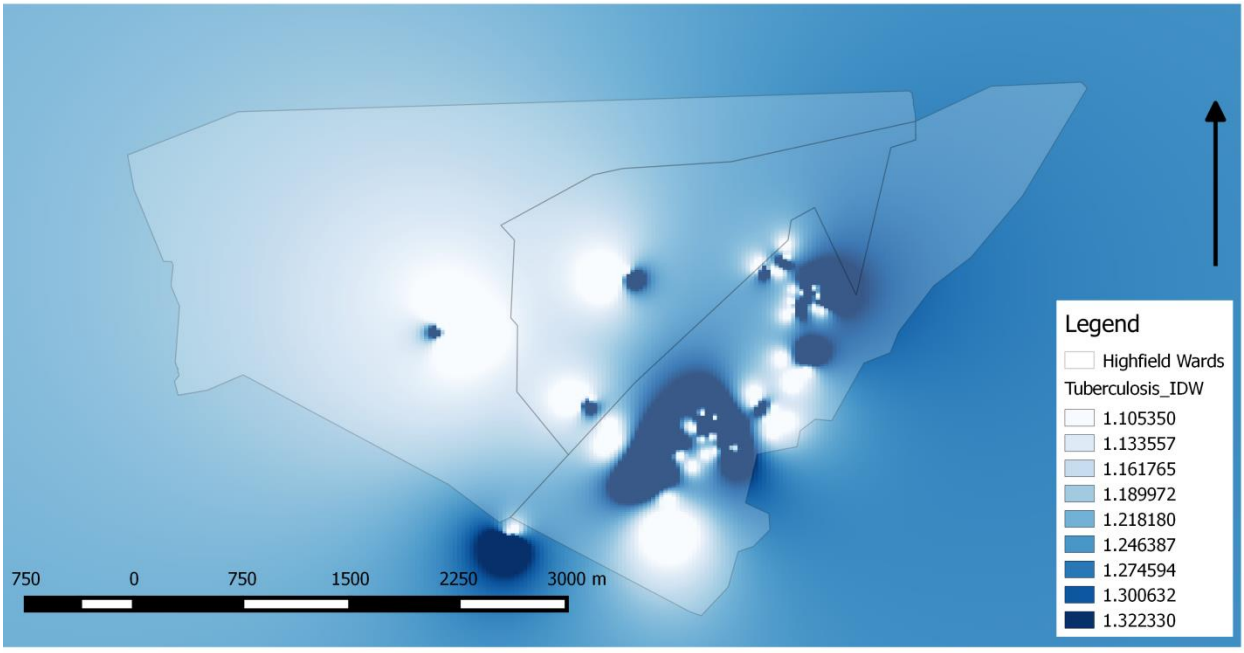


Figure 4.13 IDW for perceived Tuberculosis risk

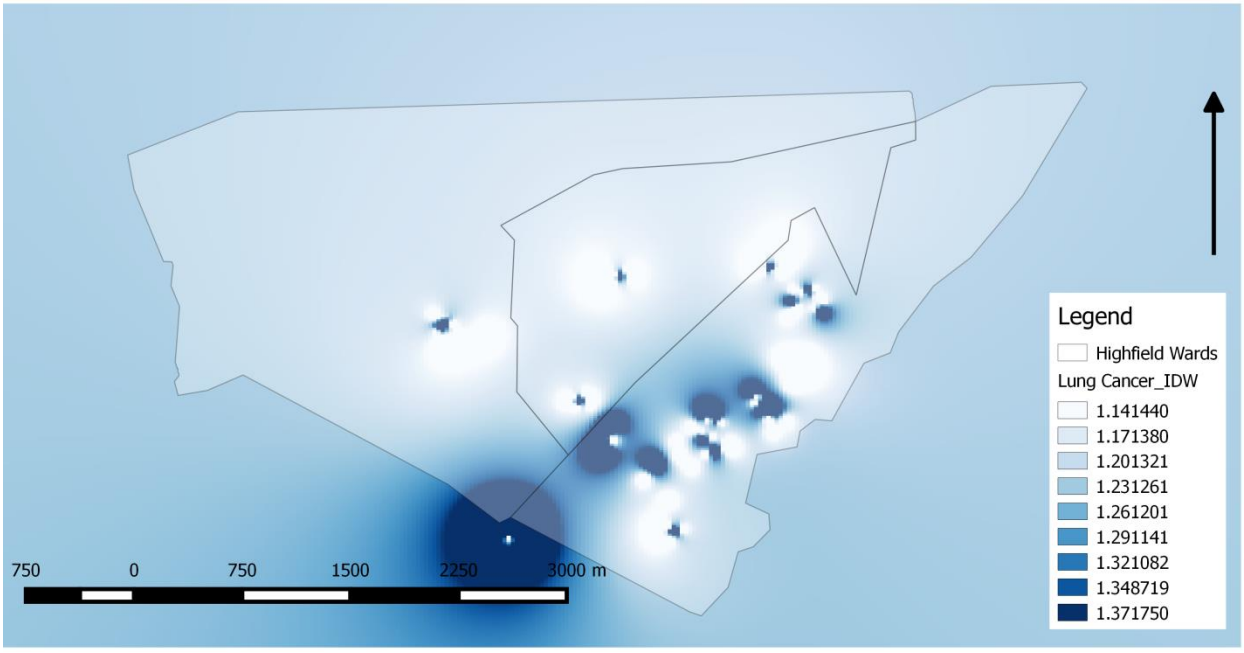


Figure 4.14 IDW for perceived Lung Cancer health risk

Health risks associated with poor solid waste disposal vary from place to place and from household to household. The variations in terms of risk are due to various factors and these include distance from the dumpsite, household composition, types of waste material found at the dumpsite and the measures taken to reduce the probability of disease outbreaks. From the analysis done on spatial variations using QGIS, it revealed that households across Highfield face low to medium level of risks. Figure 4.9 above shows that households in Highfield are more prone to typhoid and cholera risks as evidenced by its spatial spread and its likely risk is low to medium. Furthermore malaria also poses another threat to the Highfield community as shown in figure 4.10 the risk is generally lower as compared to typhoid and cholera according to the IDW analysis. Tuberculosis, Asthma and Lung Cancer all present significant low levels of risk in Highfield and this is supported by data collected through questionnaires also.

4.6 Measures to reduce disease outbreaks at household and at community level

At household level the Highfield community showed a great deal of knowledge on the measures to be taken in order to ensure that there are no disease outbreaks within households as a result of

poor waste disposal. Of the measures mentioned 23% stated that they use malaria nets, while 25% practice treating of water before use. A further 8% stated that they practice proper waste disposal to ensure that they reduce risks of contracting waste associated diseases, 17% stated that they seek health services regularly and lastly 27% stated that they practice other methods of ensuring that their households area safe such as practicing clean hygiene to reduce the risk of diseases. A key informant interviewed stated that

"The Highfield community should practice cleaning and burning solid waste dumps in order to ensure that diseases such as cholera and malaria do not affect their households"

4.7 Discussion

The study was dominated by the male population as compared to their female counterparts revealing that most households are male headed, however a significant figure represented the female population showing that women are also heading households within Highfields.

The dominant age group in the study was the 24-40 years which is economically viable and has more knowledge and experience with solid waste and the perceived health risks due to exposure to various solid waste types dumped illegally. Their views on waste disposal are generally progressive in comparison to those of the younger generations below 20.

According to the residents of Highfield poor solid waste disposal is a cause for concern as this is putting the residents at risk of contracting various diseases associated with the poor handling of solid waste. Like any other suburb or urban center in the world, waste generation is on the increase in Highfield due to a number of factors including among others population density, levels of income and attitude. These factors coupled with a crippled economy in Zimbabwe have resulted in illegal solid waste disposal which is causing health related illnesses for the Highfield population as identified by health practitioners operating within the area interviewed during the course of the study. The poor state of the economy in Zimbabwe has resulted in most residents being unable to pay their municipal rates and levies that are meant to be channeled towards waste collection and management by the local authorities. Chikobvu and Makarati, (2011) are of the view that the inability by the residents to pay their municipal rates and levies violates two environmental principles, first the User Pays Principle (USP) and secondly the Polluter Pays Principle (PPP). This failure by the local people means that local authorities are not capacitated

to collect waste regularly resulting in the undesignated disposal of solid waste which has promoted exposure to certain health risks

This study revealed that the most prevalent waste disposal method is dumping 56% followed by burning with 31% and lastly burying 13%. This may be due to inadequate solid waste management by the local authorities; illegal waste disposal has become the most efficient way of getting rid of any type of waste generated within households and other enterprises. Solid wastes found at illegal dumpsites in Highfield are generated from households, markets, retail shops and small scale industries found within the area. A study by Miraftab (2004) carried out in Cape Town on waste collection using the method of interviewing city officials and collecting waste data from the city council, concluded that most refuse generated in urban areas is from households, and this is true also for Highfield. As people gather at some points for functions, they generate waste at schools, hospitals, bus stops and even at workplaces.

The respondents attributed their practices to a number of various factors which include lack of waste collection services on a regular basis, lack of equipment by the local authorities and lastly lack of proper waste storage facilities due to their high costs of purchasing 75% indicated the use of plastic bins, while 23% stated that they own metal bins and only 2% stated having neither the plastic or metal bins and resorted to using small sacks which are incapable of carrying large amounts of waste. Highfield has a large population and numerous households, the bigger the households the large the amount of waste generated. This was supported by Chikobvu and Makarati, (2011) when they stated that “the amount of litter is influenced by the size of the household to a larger extent.” Using a field observation matrix the most common types of solid waste disposed of at illegal dumping sites include food, plastic, paper, construction and last but not least garden waste (plant remains and leaves).

Furthermore, Akhtar (2014), is of the view that the common practice for household solid waste disposal in the local areas is to dump solid wastes openly in backyard gardens or in an open space. Such malpractices of undesignated solid waste disposal threaten human health and safety. The majority of solid waste dumps in Highfield receive yard trimmings, waste paper and plastics, vegetable remains, fruit peeling and glass. At these dumpsites, food waste, diapers (paper waste) attract flies, and also empty plastic bottles and glass that collect water become breeding places

for mosquitoes making households closest to these dumps, that is those within 1-49 m and those who are 50-100m of the dumpsites are more vulnerable to health risks such as cholera, malaria and other related diarrheal diseases. However a study by Hardoy *et al.,* (1992), showed that mosquitoes and houseflies can travel up to 5km meaning that everyone within that range is at risk, but according to data collected the respondents leaving within the 500m range were of the view that their household are more at risk as compared to those living outside the 500m range who were of the view that their household risk level to diseases emanating from solid waste was low. Furthermore households within 1-49m and 50-100m of dumpsites iterated that their level of risk is increased to these health threats such as cholera, cuts and injuries emanating from poor solid waste management by the fact that children visit these dumpsites to play thereby putting their households at risk as they interact with household members.

A study carried out by Singh (2013), in Varanasi City in India also revealed that malaria and typhoid can result from poor solid waste disposal to a greater extent. The study by Singh (2013), further showed that malaria is the most prevalent disease more than typhoid, cholera and other related health risks making valid to some extent the findings gathered during the study. Furthermore a study by De and Denath (2015), identify other indirect health risks associated with poor solid waste from pollution. They state that "A more serious risk is the transfer of pollution to ground water and land as well as the pollution of air from improper burning of waste. Many waste activities generate greenhouse for example landfills generate methane and refuse fleets are significant sources of carbon dioxide and nitrous oxide. Open burning dumpsites produce volatilized heavy metals (for example, mercury and lead), dioxins, and furan. Leachate from unlined and uncovered dumpsites contaminates surface and ground waters. Chances of water pollution both underground and ground water are present in Highfield as chances that waste and its contaminants can be washed into the Mukuvisi river which passes through the suburb thereby putting the people at risk as they tend to make use of the water during periods of water cuts within the area. Also a dumpsite identified in the zone Engineering is close to a borehole meaning that chances are leachate from the dumpsite can sip through the ground and contaminate the borehole water putting people who make use of the borehole at risk.

4.8 Conclusion

Through the results obtained from the study, it is clear that people are aware of the health risks that they face as they continue to practice illegal solid waste disposal hence there is need by the local authorities to enact measures and laws that will govern how waste is disposed of in Highfield and put also in place measures to deal with the current health risks that the Highfield community is facing. The proper disposal of Municipal Solid Waste is a necessary step, to minimize the environmental health risks and degradation of land resources.

CHAPTER 5

SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.0 Introduction

The study sought to spatially analyse the perceived health risks at household level emanating from poor solid waste disposal in Highfield, Harare. This chapter highlights main conclusions drawn from the study and makes key recommendations, which seek to tackle the problem of illegal solid waste disposal, reduce the perceived health risks associated with poor solid waste disposal practices in the suburb and reduce the levels of risk at household level

5.1 Summary of main Findings

The study established that solid waste collection services provided by the HCC are erratic, this is shown by the level of waste collection were 62% stated that waste is collected monthly and at times never collected even with an increased demand for these services. The later has resulted in the emergence of open waste dumps that have become a permanent feature in the open spaces of Highfield. These waste dumpsites have become a health hazard to the residents of Highfield as they pose health threats to the residents. The perceived Health threats are numerous as established by the study; among this Malaria has the highest level of risk, followed by Cholera, then typhoid and lastly tuberculosis. As for lung cancer and asthma the study revealed that they pose a low level of risk.

Furthermore the study established that what increases the level of risk within households is family, the methods of waste disposal in those households and last but not least the distance from a dumpsite. That is to say the more people are concentrated in a household the more the waste that is generated and this resulting poor disposal as the solid waste gathers posing health risks from factors such as odour and also the method of disposal plays a role. Methods such as burning result in emission of gases that human health negatively leading to respiratory and areas where this method is practiced are prone to respiratory illnesses such as influenza and other long term diseases such as lung cancer. Last but not least the study the established that distance from dumpsites affects households negatively, that is to say households near dumpsites are more prone to health risks associated with unsanitary waste disposal as compared to those households that are far from dumpsites because the risk reduces as the distance between households and the dumpsite increases.

5.2 Conclusion

The first objective of the study was to identify the key perceived health risks associated with poor solid waste disposal, from the study it was noted that malaria, cholera, typhoid, tuberculosis, lung cancer and asthma are some of the health risks that are faced in Highfields as a result of poor solid waste disposal. Malaria was stated to have the highest level with 24% stating this, followed by cholera 14%, then typhoid 11% and lastly tuberculosis. Lung cancer and asthma were noted but their perceived level of risks was stated to range from low to medium.

The second objective of the study was to determine the perceived level of household risk. The study found out that households face risks due to a number of factors which include their distance from a dumpsite, household composition, waste disposal practices within households and also the health risk reduction measures households practice. From the study it was noted that household composition puts households at risk that is 37% of in Highfields stated that they have other families in their households leading to more waste generation. The data obtained that within households living with other families the most common type of waste generated is plastic 43.2% followed by food waste 10.8% and lastly paper waste 8%. The high levels of waste generation promote the illegal dumping of waste as waste collection is erratic in Highfields. The distance factor plays a part in household risk as households leaving near dumpsites face more risks than those living outside the vicinity of dumpsites.

The final objective of the study was to examine the perceived spatial variations of risks of households in Highfield. From the analysis done using QGIS it was revealed that risk is available although the risk is low to medium and in cases of health risks such as typhoid it distributed across Highfield whereas for health risks such as cholera, malaria, tuberculosis and lung cancer the risks are more concentrated in some areas of the suburb more than other areas. Asthma according to the analysis presents generally very low levels of risk.

Despite the findings of this study, there is need to ascertain the exact levels of risks that households are faced with due to poor waste disposal and also there is need to identify more health risks which are associated with poor solid waste disposal.

5.3 Recommendations

Therefore the study recommends that,

- There be institutional capacitating of the municipality of Harare through provision of refuse collection trucks and containers to be installed at suitable points and local health clinics to be provided with adequate working equipment and drugs so as to ensure that waste is collected consistently thereby reducing the practice of illegal waste dumping and also that health threats are treated within local areas to avoid spread of diseases.

- Involvement and cooperation of all stakeholders, thus stakeholder cooperation should be fostered for both private and public stakeholders. These stakeholders include Harare City Council, Ministry of Health and Child Care, Non-Governmental Organizations, Highfield residents and street vendors. All these stakeholders working together would ensure sound measures are enacted to curb poor solid waste disposal and the imminent health risks they pose to the Highfield community

- The HCC install containers that are situated away from household so that Highfield residents can dump their solid waste at those points and the local authorities can collect from those points.

- HCC needs an educational department that is responsible for educating households and the general public on the importance of proper solid waste disposal. This will help foster attitude change which is a contributing factor to illegal dumping practices among residents and the public leading to reduction in illegal solid waste disposal thereby reducing the health risks associated with poor solid waste disposal.

- Enforcement of laws and regulations is a vital requirement from the HCC and agencies such as EMA as this will ensure reduction in illegal waste disposal practices. Also this will promote the practices of proper waste disposal methods and ensure a culture of reusing, reducing and recycling of solid waste materials generated in households and other settings.

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APPENDICES

Appendix 1

QUESTIONNAIRE **Questionnaire number** ☐

My name is **Mandaza Itai. P**, a student at Bindura University of Science Education undertaking **Bachelor of Science Honours Degree in Disaster and Management Studies**.

I am carrying out a research on a topic which reads "**Spatial analysis of the perceived health risks at household level emanating from poor solid waste disposal in Highfield Harare**"**.** Please be advised that the information gathered will be used for academic purposes only and the responses will be treated with strict confidentiality, so feel free to complete the questionnaire. Your identity details and names are not required on this questionnaire so as to maintain your anonymity. Your cooperation will be greatly appreciated and the results of this research can be shared with participants as well as stakeholders.

Please read the following instructions:

- Please tick where applicable.
- Tick only one box per question.
- Provide an explanation if needed.

HOUSEHOLD HEAD QUESTIONNAIRE

Coordinates

	Dumpsite coordinates	
Zone	x	y

SECTION A: SOCIO-DEMOGRAPHIC DATA

1. Gender of respondent

   Male ☐

   Female ☐

2. Age category of respondent

16- 24	
25-40	
41-64	
65+	

3. How many are you in your household?

1-4	
5-7	
8+	
Others (specify)	

3(a). Please state the number of your household members in each age category.

Age category	**No. of people in category**
0-5	
6-10	
11-14	
15-19	
20-24	
25-30	
31-34	
35-39	
40-44	
45-50	
51-54	
55-60	
61-64	
>65	

4. Are there any other families living within your household

   Yes ☐ No ☐

   If Yes please answer the questions (4a), (4b), if No go to 5

4(a). How many are the families?

1	
2	
3	
>4	

4(b). State the number of people in those families

No. of families	**Size of the families**
F 1	
F 2	
F 3	
> F 4	
total	

SECTION B: PERCEIVED HEALTH RISKS ASSOCIATED WITH WASTE DISPOSAL

5. What is your opinion on the illegal disposal of solid waste?

   ……

   ……

   ……

6. As a household which are the most common types of waste you generate?

Type of waste	**Volume**

	low	**medium**	**high**
Food waste			
Plastic waste			
Paper waste			
Metal waste			
Others (specify)			

7. What kind of waste storage facility do you own as a household?

Plastic Bin	
Metal Bin	
None	

8. How often is waste collected by the Municipality in your area?

Weekly	
monthly	
never	

9. How do you dispose your uncollected waste

Burning	
burying	
dumping	
composting	

10. Please state how far you are from your nearest dumpsite?

1-49m	
50-99m	
100-299m	
300-500m	
500m+	

11. Considering your distance from a dumpsite and how you dispose your uncollected waste, what are the probable health risks that could affect you and your family?

Health risk	Level of risk		
	low	medium	high
Cholera			
typhoid			
malaria			
tuberculosis			
asthma			
Lung cancer			
Others (specify)			

12. Have there been disease outbreaks in your household as a result of poor solid waste disposal? YES ☐ NO ☐

If YES please fill the table below

Type of disease	Year	Sex	Age
Cholera			
typhoid			
malaria			
tuberculosis			
asthma			
Lung cancer			
Others (specify)			

SECTION C: WASTE DISPOSAL AND HEALTH RISK MANAGEMENT

13. What measures do you have in place to reduce these risks at household level?

Possible options	
Use of nets for malaria	
Treating of borehole water before use	
Seeking of health services regularly	
Proper waste disposal	
Others (specify)	

14. Are there measures being implemented by the Local Authorities to curb these possible health risks such as Cholera, typhoid etc?

    YES ☐ NO ☐

    Give reasons for your answer.

    ……

    ……

    ……

    ……

    ……

15. What challenges do you think are being encountered in trying to address waste disposal malpractices?

    ……

    ……

    ……

    ……

16. Can you suggest any measures that can be put in place to curb undesignated solid waste disposal?

    ……

    ……

    ……

    ……

    ……

THANK YOU FOR YOUR TIME

Appendix 2

INTERVIEW GUIDE FOR KEY INFORMANTS

My name is **Mandaza Itai. P**, a student at Bindura University of Science Education studying for a Bachelor of Science Honors Degree in Disaster and Management Studies. I am here conducting research on the health risks emanating from poor solid waste disposal. May you please help me in acquiring the necessary information? All the information gathered during the course of the research will be used for academic purposes only. I therefore humbly ask for your attention. Thank you.

My research topic reads: **SPATIAL ANALYSIS OF THE PERCIEVED HEALTH RISKS EMANATING FROM POOR SOLID WASTE DISPOSAL IN HIGHFIELD, HARARE.**

1. What is your opinion on the undesignated disposal of solid waste?
2. How would you describe the quality of service offered by the Council?
3. What probable health risks do you think are likely to arise from poor solid waste disposal?
4. Are there measures being implemented by the Local Authorities to curb possible health risks associated with poor solid waste disposal? IF YES/NO GIVE REASONS.
5. Have there been cases reported of disease outbreaks as a result of poor solid waste disposal in Highfield? If Yes please give the zones of the disease outbreak and year.
6. What challenges do you think are being encountered by the urban councils in trying to address waste disposal malpractices?
7. Are there measures in place to curb undesignated solid waste disposal in Highfiled? IF YES/NO GIVE REASONS.
8. Do you think community participation is necessary in combating poor waste disposal practices in Highfield?
9. What is the way forward in addressing illegal solid waste disposal challenges?

Appendix 3

DUMPSITE OBSERVATION MATRIX

Dumpsite			Food	Plastic	Paper	Construction	Metal	Garden
zone	x	y						

Appendix 4

List of Dumpsites

dumpsites	X	Y
1	31.001	-17.8849
2	31.00007	-17.8869
3	30.99759	-17.8836
4	30.98821	-17.8838
5	30.98833	-17.8858
6	30.9949	-17.8926
7	30.99513	-17.8926
8	30.99572	-17.8927
9	30.98654	-17.8927
10	30.97792	-17.8927
11	30.97637	-17.8927
12	30.9717	-17.8928
13	30.96725	-17.8928
14	30.96854	-17.8928
15	30.99254	-17.8928
16	30.99342	-17.8928
17	30.98911	-17.8928
18	30.99064	-17.8928
19	30.9918	-17.8928
20	30.97597	-17.8928
21	30.97263	-17.8929
22	30.9718	-17.8929
23	30.97818	-17.8929
24	30.9814	-17.8929
25	30.9762	-17.8929
26	30.98969	-17.8929
27	30.97815	-17.8929
28	30.9872	-17.8929
29	30.97675	-17.8929
30	30.98426	-17.8929