THE EFFECTS OF ENVIRONMENTAL SANITATION AND WATER ON DIARRHEA IN CHILDREN UNDER THE AGE OF FIVE YEARS IN MSISI COMPOUND LUSAKA, ZAMBIA: A POPULATION BASED CASE CONTROL STUDY

By

Dr. Freddy Wathum Drinkwater Oyat

QUALIFICATIONS: MBchB, DPH

A DISSERTATION SUBMITTED TO THE UNIVERSITY OF ZAMBIA IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE DEGREE OF THE MASTER IN PUBLIC HEALTH

THE UNIVERSITY OF ZAMBIA LUSAKA

15 MAY 2007

DEDICATION

TO FATHER AND MOTHER

I dedicate this piece of work to my late father Methodio Olango rip whose guidance has made me what I am today and to my mother Regina Auma who has continued to struggle with me to this day.

DECLARATION

I hereby declare that the work presented in this study for the Master of Public Health has not been presented whether wholly or in part for any other study programme and is not being submitted for any other Masters programme. This work is entirely the result of my own independent investigation. The various persons and resources to which I am indebted are acknowledged.

Signed: _____ 13/12/06

Dr. Freddy Wathum Drinkwater Oyat — Date

We have read this dissertation and approve it for examination

Signed: _____ 22 May 2007

Supervisor — Date

Prof. S. Siziya

Signed: _____ 22 May 2007

Co-supervisor — Date

Mr. F. Shibalatani

APPROVAL

This dissertation of Dr Freddy Wathum Drinkwater Oyat has been approved as fulfilling requirements for the award of the Masters degree in Public Health by the University of Zambia

Signed..... Date..... 22 May 2007

Examiner I

Signed..... Date..... 22nd May 2007

Examiner II

Signed..... Date..... 22nd May 2007

Examiner III

ABSTRACT

Msisi compound is a high density, low -income residential slum within the city of Lusaka. It has poor environmental health services, inadequate water supply and unhealthy housing. The poor environmental health and hygiene conditions expose children aged less than five years to various health problems including watery diarrhea. Watery diarrhea is a major health problem in Zambia. It is ranked one of the top three causes of mortality in children aged less than five years after malaria and acute respiratory infections.

Objective

To determine environmental health and personal hygiene factors which put children aged less than five years old at risk of contracting watery diarrhea.

Setting

Msisi compound in Lusaka, Zambia

Method

A case control study was carried out in which a 1 in 2 systematic random sampling method was used to select cases and controls. Totals of 50 and 150 cases and controls, respectively, were to be recruited into the study. Data collection was carried out using face- to- face interviews on socioeconomic and demographic characteristics; environmental health and personal hygiene conditions; and, environmental sanitation and personal hygiene knowledge and practice of the respondents. Additional data were also collected by observation of the environmental sanitation and personal hygiene conditions of the respondents' households. Pre-tested and validated structured questionnaires along with a check list were used as instruments

Results

A total of 45 cases and 142 controls were enrolled in the study. The following factors were significantly associated with diarrhea in bivariate analyses: knowledge that flies cause diarrhea; knowledge that dirty water and dirty food cause diarrhea; and, presence of too many flies and too much garbage around the house. Upon considering these factors, and , adjusting for the age of the child and educational level of the caretaker in a multivariate logistic regression, only knowledge that dirty food causes

diarrhea, presence of too much garbage around the house, and, education level of the caretaker were significantly associated with diarrhea.

Respondents who knew that dirty food causes diarrhea were 60% less likely to have a child suffering from diarrhea (OR=0.40, 95%CI 0.24-0.67) compared to respondents who had no knowledge. Children from homes where too much garbage was observed around the houses were twice (OR=2.04, 95%CI 1.16-3.60) more likely to suffer from diarrhea compared to children from homes where no garbage was observed around the houses. Parents with low education level were 60% (OR=0.40, 95%CI 0.39-0.91) less likely to have a child suffering from diarrhea compared to parents with higher education.

Conclusion

Poor environmental health services were associated with diarrhea in children aged less than five years old in Msisi compound. The main environmental health factor which put children aged less than five years at risk of contracting watery diarrhea in this compound was the presence of too much garbage around the houses. Mothers with higher education could have been more likely to be away from home at work, thus leaving the children under the care of older siblings or other relatives who might not have taken good care of the children. Practical interventions involving the community are urgently required.

Interventions should focus on health education, environmental health awareness, behavior change, community participation and funding for infrastructure development.

ACKNOWLEDGEMENTS

The author thank the International Development Research Center (IDRC) for financial support for this study, Prof. S. Siziya, Mr. F. Shibalatani, Prof. E. MacLellan , Mr. E. Nyirenda , for valuable advice and comments; Lubinda, Innocent, Zimba and Mwandila for data collection; Mr. J. Banda for data entry and analysis and the residents of Msisi Compound for their support for and participation in the research.

A special appreciation to my wife Winnie who has endured so much in my absence during the period of my studies

TABLE OF CONTENTS

Chapter 7

LISTS OF TABLES

LISTS OF ABBREVIATIONS

BCG	B*acillus calmette guerine*
CBOH	Central Board of Health
CSO	Central Statistical Office
HELI	Health and Environmental Linkage Initiative
IDRC	International Development Research Centre
IDSR	Integrated Disease Surveillance And Response
LDHMB	Lusaka District Health Management Board
NGO	Non-Governmental Organization
OR	Odds Ratio
ORS	Oral Re- hydration Salts
SPSS	Statistical Package for Social Science
STATCAL	Statistical calculation
SEA	Standard Enumeration Area
WHO	World Health Organization
UNZA	University of Zambia
ZDHS	Zambia Demographic and Health Survey

INTRODUCTION

Msisi compound is a high density urban residence situated south of Zambia's capital city of Lusaka, less than 5 minutes walk from the city center, the compound has 5231 households with a total population of 30,365 (CSO, Census 2000). The Health Facility used by the residents is Kamwala Health Center, less than 10 minutes walk from the compound; it is administered by the Lusaka District Health Management Board (LDHMB) of the Ministry of Health. Majority of the residents in Msisi are not engaged in formal employment or big businesses, therefore, incomes are low.

The main economic activities are small -scale street vending businesses, combined with excavating, breaking, and crushing rocks which is sold nearby in which many households are involved, employing mainly women and children. The stone quarrying businesses leave behind many trenches which become dumping sites for solid waste. These trenches get filled with water during the rainy season. Feces also get washed into those trenches once there is heavy rains. Pools of water become important reservoirs for enteric bacteria, worms, breeding grounds for mosquitoes, and sources of pollution and contamination of surface and ground water.

Solid waste dumps cause serious environmental degradation and provide ready breeding grounds for flies and rats; these are important vectors of various diseases including diarrhea illness. Poor feces and solid waste disposal, unsafe water for drinking, ignorance and unhygienic practices represent a growing environmental health challenge in many developing countries including Zambia. Poorly constructed overcrowded dwellings and substandard unhygienic pit latrines are a striking environmental health hazard in Msisi compound.

Lack of environmental health services has led to a deterioration of the environment, as a result, various infections associated with poor environmental sanitation are common and serious among children. Much of the infections include watery diarrhea which is associated with significant morbidity and mortality in children aged less than five years in Zambia. Unsafe feces disposal, is a source of fecal-oral transmission of pathogens responsible for many preventable enteric diseases including watery diarrhea.

The most important reservoirs and source of transmission of the majority of enteric infections causing diarrhea and dysentery are humans.

The fecal- oral route of transmission primarily, by hand- to -mouth contact, but also by food handlers and insect vectors, are by far the most significant factors in the intensity and the persistence of infections.

In Msisi compound, children are allowed to defecate indiscriminately around the yard, caretakers also throw children's feces anywhere and no attention is paid to the feces deposited in this manner, and, yet, children's feces could be the most important source from which diarrhea and worm infestation is transmitted from one child to another (Park, 2002). Intestinal parasites, virus and bacteria are the causes of diarrhea, in children (NIDDK, 2001).

Children brought up in surroundings with good sanitation are less exposed to enteric pathogens because good sanitation isolates fecal material away from the human environment. The endemic pattern of diarrhea disease in Zambia is a reflection of inadequate environmental sanitation, unsafe and unwholesome water supply.

It was observed in the Zambia and Demographic health Surveys (ZDHS) that water quality has a strong influence on the health of households members especially young children, and that potentially fatal diseases including typhoid, cholera, and dysentery are prevalent in unprotected sources (Central Statistical Office Zambia, Central Board of Health Zambia, and Orc Macro, 2003).

In Mexico and Palestine diarrhea disease was associated with inadequate sanitation, household overcrowding and water related practices (Cifuentes et al, 2002; Abu Mourad, 2004).

The prevalence of watery diarrhea in the two weeks preceding the survey among children less than 5 years old in Lusaka urban district was reported as 24.5% by the Zambian Demographic and health Surveys (Central Statistical Office Zambia, Central Board of Health Zambia, and Orc Macro, 2003). According to Central Statistical Office Zambia ,et al (2003), only 32.2% of Zambian households had access to piped water, one in three households in Zambia had no toilet facilities, most households 53% used traditional pit latrines, flush toilets were mainly found in the urban areas and were used by 42% of households, compared to only 2% in rural areas.

Severe dehydration resulting from acute diarrhea was ranked one of the top three causes of death in children under the age of five years after Malaria and Acute Respiratory Infections (Central Statistical Office Zambia, Central Board of Health Zambia, and Orc Macro, 2003).

Diarrhea illness is a serious health problem in children aged less than five years in Zambia. Accordingly, diarrhea in children age less than five years has been placed under constant surveillance as a notifiable condition in all the Institutions throughout the Country (CBOH, 2002). Based on hospital admissions for the whole country, the Central Board of Health ranked non bloody diarrhea number three both as a cause of illness (incidence rate 290.7 per 1000 population) and as cause of death in children under the age of five year with a case fatality rate of 80.4 per 1000 admissions (CBOH, 2003).

Non-bloody Diarrhea was ranked number three both as a cause of illness in the 'under -five years' (incidence rate of 132/1000 population) and as a cause of death in the same age group (case fatality rate of 44/1000 admissions by the Lusaka Urban District Health Management Board) (LUDHMB, 2003).

Diarrhea illnesses remain one of the most important causes of morbidity and mortality in children despite better understanding of the pathogenesis and management of the disease. Prevention strategies which include vaccinations and the reduction of persisting inequalities between the developed and the developing countries, targeting nutrition , sanitation and access to safe water for drinking, might hold the greatest potential for reducing the burden of diarrhea diseases in these countries (Thapar et al, 2004). At present there is no proper environmental health management in Msisi compound; this is a major threat to the physical, social, and mental well being of the residents, and poses a serious burden on the health sector and the economy in general. The management of environmental health in Msisi compound by the authorities (in partnership with the communities and Non governmental Organizations (NGO), utilizing scientifically proven low- cost technology) may be an economically feasible and sustainable option that need to be accorded serious attention, given the current poor performance of the Zambian economy.

This is the first study that has been carried out in Msisi compound to assess the association of environmental health and personal hygiene conditions with watery diarrhea in children under five years old.

The objectives of the study were to answer the following research question: What environmental health and personal hygiene factors are

associated with watery diarrhea in children under five years old in Msisi compound?

STATEMENT OF THE PROBLEM

Msisi compound has grown over the years without any planned services for water and sewerage reticulation, solid waste collection and disposal because the Lusaka city authority never recognized it as an official residential area. Housing is unplanned, sub standard, overcrowded, and unhealthy. There are no sewage networks, no proper roads and no storm water drainage.

The environmental problems in Msisi compound are multiple and include a high population density and over crowding, poverty, unhealthy housing, lack of safe and wholesome water supplies, lack of sanitary excreta and solid waste disposal mechanism. Dumping of solid waste and refuse is done along the railway line nearby, along all the roads within Msisi, and in disused quarry pits all over the compound and within the yard.

The most common method of feces disposal is in pit -toilet latrines; most pit-latrines are poorly constructed with inappropriate materials like old cotton sacks, cardboard paper and grass.

The latrines are dirty, closely sited adjacent to the houses and are never maintained.

There are few taps for water ; these are owned by individuals who charge Zambian Kwacha (K)100 for a 20- liter container. It is common to see long queues of residents waiting to fetch water from leaking main pipes or from the few taps scattered all over the compound. The only perennial surface water within Msisi compound is a dam which has developed from a disused quarry. Severe water shortage, has made residents ignore visible warning prohibiting fishing, bathing and fetching of water from this dam.

The seasonal cholera outbreaks that has characterized some high density peri-urban compounds around the city of Lusaka during the rains in the last three years has not spared Msisi compound. The coming of the rains is associated with a considerable amount of anxiety amongst the residents, because the rainy season brings cholera, watery diarrhea, and dysentery, which makes their lives extremely perilous, difficult and miserable.

Purpose of the Study

We aimed to determine environmental health factors in Msisi compound which put children at risk of contracting diarrhea disease and to recommend an appropriate intervention based on the findings. The study was intended to provide baseline information and recommend how a community based environmental sanitation intervention project in Msisi compound, could be initiated using the community and a multidisciplinary team.

Research Hypothesis

1) Unhygienic and insufficient quantity of water for drinking, bathing and cooking is associated with watery diarrhea in children in Msisi Compound.

2) Unsanitary feces disposal mechanism is associated with watery diarrhea in children in Msisi compound.

3) Unsanitary solid waste management is associated with watery diarrhea in children in Msisi.

4) Unhygienic living conditions and poor personal hygiene knowledge and practices are associated with diarrhea in children.

CHAPTER 2

OBJECTIVES

General Objectives

To determine environmental health and personal hygiene factors which put children less than five years old in Msisi compound at risk of contracting watery diarrhea.

Specific Objectives

1. To determine the association between drinking water source, and diarrhea in children in Msisi.
2. To determine the association between feces disposal methods and watery diarrhea in Msisi.
3. To determine the association between solid waste disposal methods and watery diarrhea in Msisi children.
4. To determine the association between the knowledge levels of the care takers about the cause and prevention of diarrhea and the occurrence of diarrhea in the children.
5. To determine the association between unhygienic living conditions and personal hygiene practice and watery diarrhea.
6. To make appropriate recommendation based on the findings of the investigation.

Study Variables

In this survey a number of variables were studied, the variables of interest were divided into two major groups namely the dependent variable and the independent variables. The dependent variable was watery diarrhea. The measure of interest was to compare the occurrence of the hypothesized independent variables between the cases and the unmatched controls.

The independent variables were source of water for drinking, bathing, washing, cooking, the availability of storage facility, cash payment for water, and distance from household, bathing the children, washing hands after using toilets, washing hands before preparation of food, and before feeding children, boiling of water for drinking or application of chlorine. The other independent variables of interest were availability of a sanitary feces disposal method, availability of solid waste collection, storage, and disposal methods, the condition of the dwelling house, presence of disease vectors around the house, the presence of garbage around the house, employment status, feeding methods, immunization status, and the knowledge of the cause of diarrhea.

Significance of the Study

Our intention was to initiate a community based environmental sanitation intervention using a multidisciplinary team.

There was a need to have a reliable base line information which could be used for future planning, implementation, and monitoring of the project. Currently the health sector is experiencing a severe resource constraints, it is therefore critically important to identify disease risk factors which are amenable to prevention, so that health programs can focus on particular interventions. The study is therefore part of a situation analysis which is expected to contribute to better planning and realistic objective setting for an effective project implementation. This study is being carried out with the intention of a specific intervention involving the community in the management of their own environmental health.

Good community based environmental health services combined with good personal hygiene could significantly contribute to a reduction in the incidence of diarrhea with dehydration in Msisi compound. This could in turn, contribute in a small way to a reduction in the national infant mortality of 95/1000 live births and the under five mortality of 168/1000 live births which are unacceptably quite high at present.

Operational Definition

The term environment is defined as all the external factors that surround man, this includes all living and non living things, man made and natural, water, air, soil, animals, plants, buildings, vehicles and many others. Added to these are social, political, and economic conditions. The National Sanitation Foundation of the USA has defined sanitation as follows: Sanitation is a way of life, it is the quality of living that is expressed in the clean home, the clean farm, the clean business, the clean neighborhood and the clean community.

Environmental sanitation is used here to imply the control of all those factors in the environment in order to prevent disease and promote health, the term environmental health is now being used to imply environmental sanitation, with emphasis on a multidisciplinary approach combining medical and engineering science.

Meanwhile, the World Health Organization defines the term environmental health as "the control of all those factors in man's physical environment, which exercise or may exercise, a deleterious effect on his physical development, health and survival" (Park, K. 2002)

Diarrhea is defined as the passage of frequent watery stools, usually more than three episodes in a 24 hour period. However it is the consistency of the stool which is important rather than the frequency.

When blood is visible in the stool the condition is referred to as dysentery (Park,K. 2002)

A caretaker is any person (parent, guardian, relative or a hired worker) who looks after a child for most of the day

CHAPTER 3.

LITERATURE REVIEW

There is a weight of evidence in the literature linking poor environmental practices, poor water supply, and poor personal hygiene as risk factors in the etiology and transmission of diarrhea diseases, malaria and respiratory infections in children in developing countries including Zambia. When the World health Organization (WHO) initiated the diarrhea disease control program in 1980, about 4 million children under the age of five years were dying every year from severe dehydration caused by diarrhea. Over two decades later, severe diarrhea with dehydration is still ranked second only to acute respiratory infection as the cause of morbidity on a worldwide scale and is still killing close to 3,000,000 children annually in developing countries; with an estimated 1.8 billion episodes of diarrhea, and 80% of the deaths occurring in children under the age of two years.

Lack of water supply and sanitation is the main reason why diseases transmitted via feces are so common in developing countries. The most important of these diseases, diarrhea and intestinal worm infestations, account for 10% of the total burden of disease in developing countries (Park, 2002).

Poor water quality, sanitation and hygiene are currently responsible for 1.7 million deaths annually (3.1% of all deaths world wide) mainly through infectious diarrhea; 90% of such deaths occur in children in the developing world (Ashbolt, 2004).

The source of water was found to be significantly associated with a high prevalence of infections from water borne parasites, including intestinal parasites and diarrhea (Chunge, et al, 1992; Omar et al, 1995).

Transmission routes are unlikely to be affected by water quality alone, but by the improvements in hygiene which result when a household has access to sufficient quantity of water for washing food, hands and utensils used for feeding children. This kind of disease transmission has been called 'water- washed' and not 'water –borne' and it is applicable to diarrhea diseases including cholera , typhoid, dysentery, non- bloody diarrhea, and others associated with poor hygiene (Cairncross, 1990). Even the classic waterborne diseases like cholera and typhoid may be transmitted from person to person in other ways including the fecal contamination of hands, food, or utensils. A case - control study in Bangladesh demonstrated that sanitation, water availability and use were extremely important in the effort to reduce secondary cholera and non- cholera watery diarrhea transmission (Emch, 1999).

Meanwhile, a follow- up study at St. Lucia in the West Indies involving 75 babies found that the prevalence of diarrhea and helminth infections reduced as sanitation improved. Ascaris and Trichuris infections dropped 30% and 50% respectively after sanitary water supply and latrines were installed (Henry , 1981). Similarly, in the Philippines, a case control study to assess the impact of water supply and sanitation showed that improved environmental sanitation and water supply reduced the episodes of bacterial diarrhea in children under the age of two years by 40% (Baltarzar et al, 1988).

The impact of compliance with measures of hygiene, water supply and oral re hydration on diarrhea in children aged less than five years in Southern Ivory Coast was studied in four villages over a period of two years. Morbidity and mortality was compared in two villages without the interventions and in two villages before and after the interventions. The results showed a 50% reduction in the incidence of diarrhea and a 85% reduction of the proportion of death related to diarrhea in the villages with interventions (Messou et al, 1997).

Meanwhile, in Eritrea diarrhea in children was one of the leading causes of morbidity and mortality and the major outcome predictor was found to be associated with environmental and socioeconomic factors (Woldemicael, 2001).

A significant association was also observed between the source of drinking water and deaths due to acute respiratory infections and the conditions of latrines and deaths due to diarrhea diseases after controlling for confounding variables (Hoque et al, 1999). The use of surface water was found to be a greater risk factor for diarrhea in children than water from the well; this risk factor increased when the child was not breast fed (Sunoto ,1982; Van Derslice et al, 1994; Plate et al, 2004).

It is evident from the foregoing account that good community- based environmental health services combined with good personal hygiene could contribute to improvement in environmental sanitation and personal hygiene in Msisi and lead to a reduction in the incidence of diarrhea with dehydration in the compound. However, the long term diarrhea disease control strategy should focus on improved nutrition, adequate and safe water supplies, improved sanitation, better personal and domestic hygiene, better food hygiene, and more health education (Ayres, 1990).

CHAPTER 4

METHODOLOGY

Study Design

Case- Control Study

Study Population

Children less than 5 years old (with caretakers)who have been living in Msisi compound for a minimum of four weeks.

Diagnostic, Inclusion and exclusion Criteria for Cases

Case definition: Any child less than five years of age who had three or more loose stools or watery stools in 24 hours. There was no laboratory confirmation of this surveillance case definition.

Included were children under five who have suffered from diarrhea in the past two weeks as defined above and who have been resident in Msisi for 4 weeks.

Excluded were children under five years of age with visible blood-stained diarrhea, also excluded were children visiting and those who were resident for less than 4 weeks in Msisi.

Controls' Inclusion and exclusion criteria

Included as controls were children under five who were not suffering from diarrhea on the day of the survey and who had not suffered from

diarrhea in the past two weeks. In addition, they must have been resident in Msisi compound for a minimum of 4 weeks.

Children under five who were sick from other causes were included as controls as long as they satisfied the residence requirement.
Excluded were children under five who were visiting for less than 4 weeks, living in the same household as cases and siblings of cases and those who have suffered from dysentery.

Funding

The author designed and implemented a case control study with financial assistance from the International Development Research Centre (IDRC) in cooperation with the Department of Community Medicine, Medical School of the University of Zambia (UNZA). This was a baseline study to be followed by an IDRC – funded Health and Environmental Linkages Initiative (HELI) project in Msisi compound. The baseline study was carried out from April to June 2005.

Ethical considerations

Prior ethical approval for the study was granted by the University of Zambia Research Ethics Committee Number FWA00000338 IRB0001131 of IORG0000774 on 4th March 2005. The proposal was also approved by the Graduate Study Committee of the School of Medicine on 7th April

2005. Written informed Consent was obtained from the Msisi Community Leadership and individual respondents. Full details of the benefits and risks associated with participation was also provided.

Sample size determination

Epi Info STATCAL program was used to calculate the required sample sizes. Sample sizes of 32 cases and 96 controls were obtained upon assuming the following: 3 controls to 1 case to be sampled; a quarter of the controls had knowledge on the causes of diarrhea and to be able to detect an odds ratio of 3.5 at 95% confidence level with a power of 80. By considering further a response rate of 80%, the sample sizes to be drawn were 50 cases and 150 controls.

Sampling

A map for Msisi was obtained from the Central Statistics Office (CSO). Msisi had 19 Standard Enumeration Areas (SEAs) out of which 11 SEAs were randomly sampled for data collection. A 1 in 2 systematic random sampling technique was used to select both cases and controls.

Quality assurance

Interview and questionnaire training was provided by the author. The questionnaire was validated by experts in the field of statistics, epidemiology and environmental health. Each questionnaire was pre-tested using 5 respondents who were not included in the sample from the study area; the questionnaire was modified as necessary for reliability.

The parents or guardians were interviewed by two trained interviewers. In case the parents or guardian were absent the field team left a message to return at a later time and date. One interviewer read out the questions while the second interviewer recorded the responses.

Face –to- face interviews were conducted by two teams each team consisted of two trained interviewers with one guide who knew the boundary of Msisi compound very well. The questionnaire included questions relating to background information such as age and level of education of the respondents, employment status, age and sex of the child, immunization status, method of feeding, public health questions on diarrhea, and, the accompanying signs of the disease.

The question about the occurrence of diarrhea was limited to two weeks before the interviews took place to minimize the recall bias.

The question on diarrhea also explored the health seeking behavior of respondents when their children were sick with diarrhea, knowledge of the respondents with respect to the causes of diarrhea, (whether they have

heard of Oral Re- hydration Salts (ORS)) or they knew the composition of ORS.

Questions on environmental health status included the household source of water for drinking , cooking, bathing and washing, the 'round –trip' walking distance to the source of water, how water was stored and wether water was paid for cash or not. There were also questions on household methods of feces and solid waste disposal.

Questions relating to the respondents' practice and knowledge of environmental sanitation and personal hygiene included knowledge of chlorine and whether they used chlorine for water purification, or boiled water for drinking.

The questions on personal hygiene explored the practice of respondents with respect to hand washing before preparing food for the children, hand washing before feeding the children; washing of the children's hands before and after eating food; washing hands after passing stool and the method of disposal of the children's feces.

The interviewers also used a check- list for reporting their observations on the environmental health and hygiene among the investigated households. The check list included the following items: cleanliness of the home,

including the exterior and interior; the presence of flies inside and around the house; the presence of garbage in and around the house; the status of the toilet facility; personal cleanliness of the respondents; cleanliness of the children and the presence of feces around the house.

The check -list was designed with a 'three point observation scale' such as 'good', ' fair', 'poor', and 'much', little', and 'none'.

Data Entry and Analysis

Double data entry into a computer was carried out using an epidemiological information computer software EPI-INFO. The data were validated and then analyzed using both EPI-INFO and the Statistical Package for Social Science (SPSS).

The Chi-square test was used to test associations between the independent variables and the dependent variable. Odds Ratios were calculated to estimate the risks of contracting diarrhea when exposed to environmental and personal factors. Where statistically significant association was found multivariate logistic regression was used to control for confounding factors. The level of statistical significance was set at 5%.

CHAPTER 5

RESULTS

Response Rate

A total of 200 households were investigated. The total response for the questionnaire interview was 187/200 or 93.5%. The response rate for cases was 45/50 or 90% while that of controls was 142/150 or 94.7%.

Socioeconomic and demographic characteristics as reported by respondents

Four (8.9%) of the 45 cases were under six months old compared to 34 (23.9%) of the 142 controls. Nine cases (20%) were aged between 7-12 months compared to 14 (9.9%) of the 142 controls.

The majority of cases (16/45)(35.6%)) were children aged between 13-24 months while the control group comprised (37/142) (26.1%)) of children in the same age- group. The majority of the children investigated were males, 24 out of 45 (53.3%) of cases were males compared to 81 out of 142 (57%) of the control group.

Immunization status was found to be low among investigated children; only six (13.3%) of the cases were fully immunized compared to (26/142)(18.3%)) in the control group.

Only four (8.9%) of the cases were fed exclusively on breast milk compared to 23/142 (16.2%) in the control group. Most of the cases were fed exclusively on adult food and porridge; 23 out of 45 (51.1%) of cases were fed by this method compared to 65 out of 142 (45.8%) in the control group.

There was no significant statistical association of diarrhea illness with either children's immunization status, feeding methods or their socioeconomic and demographic status. The age, sex , immunization status and feeding methods of the children are shown in Table 1. The socioeconomic and demographic characteristics of respondents are shown in Table 2.

Table 1. Age distribution, sex, immunization status and feeding methods of investigated children.

	Cases (n=45)		Controls (n=142)		
Variable	Frequency	%	Frequency	%	p value
Age group (Months)					
0-6	04	8.9	34	23.9	0.869
7-12	09	20.0	14	9.9	
13-24	16	35.6	37	26.1	
25-36	12	26.7	28	19.7	
>36	04	8.9	29	20.4	
Sex					
Male	24	53.3	81	57.0	0.663
Female	21	46.7	61	43.0	
Immunization					
Completed	06	13.3	26	18.3	0.441
Part completed	39	86.7	116	81.7	

Feeding Method					
Breast milk only	04	8.9	23	16.2	0.301
Breast/Adult Food	18	40.0	54	38.0	
Adult Food/ Porridge	23	51.1	65	45.8	

Table 2. The socioeconomic and demographic characteristics of the respondents.

	Cases (n=45)		Controls (n=142)		
Variable	Frequency	%	Frequency	%	p value
Age group (years)					
<24	30	66.7	100	70.4	0.634
25-29	15	33.3	42	29.6	
Sex					
Female	41	91.1	136	95.8	0.227

Male	04	8.9	06	4.2	
Education					
Primary	27	60.0	106	74.6	0.060
Secondary	18	40.0	36	25.4	
Employment Status					
Formal	15	33.3	62	43.7	0.068
Informal	23	51.1	71	50.0	
Not Employed	07	15.6	09	6.3	

Environmental Health Status as reported by the respondents

Table 3 shows the environmental health status of the respondents in both groups. All the respondents whose children suffered from diarrhea 100% (n=45); indicated that their source of water was piped or protected compared to 99.3% (n=141) in the control group.

Only 9.8% (n=4) of respondents whose children had diarrhea walked for over 30 minutes to fetch water compared to 20.7% (n=28) of the control group. Meanwhile, 39.0% (n=16) of respondents whose children suffered from diarrhea walked for 5 minutes or less to fetch water compared to 28.1% (n=38) of respondents in the control group.

The majority of respondents reported paying cash for water requirements; 83.7% (n=36) of respondents whose children suffered from diarrhea paid cash compared to 81.0% (n=115) of the controls. Meanwhile, 75.7% (n=28) of respondents whose children suffered from diarrhea paid cash for all types of water requirement (drinking, cooking, bathing and washing) compared to 67.8% (n=78) of the controls. Only 21.6%(n=8) of the respondents whose children had diarrhea paid cash for water for drinking and cooking compared to 31.3% (n=36) of the control group.

Having no toilet facility was comparable across the two groups of respondents: 22.2% (n=10) of the respondents whose children suffered from diarrhea reported having no facilities compared to 21.1% (n=30) of those in the control group.

All the respondents reported dumping as the only method of garbage disposal, with 37.7% (n=17) of respondents with diarrhea cases dumping around their houses compared to 26.8% (n=38) of the control group. Meanwhile, 28.9% (n=13) of caretakers with diarrhea cases dumped their rubbish into the dam compared to 24.6%(n=35) of the controls.
No statistically significant association was found with respect to reported environmental health status and diarrhea in the investigated children

Table 3. Environmental health status as reported by the respondents

	Cases (n=45)		Controls (n=142)		
Variable	Frequency	%	Frequency	%	p value
Source of drinking water					
Piped/Protected	45	100	141	99. 3	0.573
Unprotected	0	0.0	01	0.7	
Distance of water source (round trip)					
Over 30 min.	04	9.8	28	20.7	0.065
30 minutes	06	14.6	24	17.8	
15 minutes	07	17.1	22	16.3	
10 minutes	08	19.5	23	17.1	
5 minutes	16	39.0	38	28.1	
Paid Cash for water					
Yes	36	83.7	115	81.0	0.686
No	07	16.3	27	19.0	
Which water is paid for					
Drinking only	01	2.7	01	0.9	0.519

Cooking and drinking only	08	21.6	36	31.3	
All types	28	75.7	78	67.8	
Types of toilet facility					
Pit latrines	35	77.8	112	78.9	0.876
No facility	10	22.2	30	21.1	
Solid waste Disposal					
Dumping around the house	17	37.7	38	26.8	0.071
Dumping at dam	13	28.9	35	24.6	
dumping at roadside	15	33.3	69	48.6	

Practice and Knowledge of Environmental Sanitation and Personal Hygiene

Tables 4 (a)- (e) summarize the knowledge and practice of the respondents with regard to environmental sanitation and personal hygiene. Thirty (66.7%) of the respondents whose children suffered from diarrhea knew that dirty food was associated with diarrhea compared to (131/142)(92.3%)) in the control group. There was a statistically significant association between the knowledge of the respondents and dirty food with the occurrence of diarrhea in the investigated children ($p<0.001$).

Forty (88.9%) of the respondents whose children suffered from diarrhea knew that house flies were associated with diarrhea compared to (138/142)(97.2%)) in the control group. There was a statistically significant association between the knowledge of the respondents and house flies with the occurrence of diarrhea in the investigated children ($p=0.024$).

Forty (88.9%) of the respondents whose children suffered from diarrhea knew that dirty water was associated with diarrhea compared to (139/142)(97.9%)) in the control group. There was a significant

association between the knowledge of the respondents on dirty water with the occurrence of diarrhea in the investigated children (p=0.010).

All the respondents representing cases 100% (n=45) had heard of chlorine compared to 95.8%(n=135) of the controls. There was no difference between the two groups of respondents with regard to their reported use of chlorine, only 40% (n=18) of the case respondents were using chlorine for purifying their water compared to only 38.3% (n=54) of the control group. A large percentage of the respondents did not boil their drinking water, 86.7% (n=39) of case group and 82.4% (n=117) of the controls. The majority of the respondents reported always washing their hands after using the toilets, 93.3% (n=42) of case group compared to 96.5%(n=137) of control group.

The respondents who reported always washing their hands before preparing food for the children were 91.1%(n=41) for the case group compared to 88.0% (n=125) of the control group. The respondents who regularly washed hands before feeding the children were 86.7% (n=39) of the case group compared to 94.4% (n=134) of the control group. The majority of the respondents whose children suffered from diarrhea 88.9% (n=40) reported that they regularly washed the children's hands before and after they ate food compared to 91.5% (n=130) of the controls.

There was no difference in the practice of the respondents with regard to reported washing of the children's hands after they used the toilets, with 73.3% (n=33) of the case group reporting this practice compared to 74.6% (n=106) of the controls.

When respondents were interviewed about their methods of water storage 95.6% (n=43) of the respondents whose children suffered from diarrhea reported using closed containers for storing their water for drinking compared to 93.7% (n=133) of the control group.

The majority of the respondents whose children suffered from diarrhea 88.9%(n=40) disposed of children's feces into toilets compared to 94.4% (n=134) in the control group. Eleven percent (n=5) of the caretakers representing cases disposed of children's feces into the rubbish pit or dump compared to only 1.4% (n=2) of the control group.

There was no association between the environmental health practice, and personal hygiene practice of the respondents and diarrhea in the children

Table 4 (a). Knowledge of environmental sanitation associated with diarrhea.

Knowledge	Cases (n=45) Frequency	%	Controls (n=142) Frequency	%	p value
Dirty food					
Knowledgeable	30	66.7	131	92.3	<0.001
Not knowledgeable	15	33.3	11	7.7	
House flies					
Knowledgeable	40	88.9	138	97.2	0.024
Not knowledgeable	05	11.1	04	2.8	
Dirty water					
Knowledgeable	40	88.9	139	97.9	0.010
Not knowledgeable	5	11.1	03	2.1	
Dirty hands					
Knowledgeable	39	86.7	126	88.7	0.709
Not knowledgeable	06	13.3	16	11.3	
Dirty surroundings					
Knowledgeable	39	86.7	134	94.4	0.088
Not knowledgeable	06	13.3	08	5.6	

Table 4 (b). Associations of water purification with diarrhea.

	Cases (n=45)		Controls (n=142)		
	Frequency	%	Frequency	%	p value
Heard **of chlorine**					
Yes	45	100	136	95.8	0.162
No	0	0.0	06	4.2	
Uses chlorine					
Yes	18	40.0	54	38.3	0.839
No	27	60.0	87	61.7	
Always boils drinking water					
Yes	06	13.3	25	17.6	0.503
No	39	86.7	117	82.4	

Table 4 (c). Associations of washing hands and diarrhea.

	Cases (n=45)		Controls (n=142)		
	Frequency	%	Frequency	%	p value
Always washes hands after toilet					
Yes	42	93.3	137	96.5	0.365
No	03	6.7	05	3.5	
Washes hands before preparing food					
Yes	41	91.1	125	88.0	0.569
No	04	8.9	17	12.0	
Washes hands before feeding children					
Yes	39	86.7	134	94.4	0.088
No	06	13.3	08	5.6	
Washes children's Hands before and After eating					
Yes	40	88.9	130	91.5	0.590
No	05	11.1	12	8.5	
Washes children's Hands after toilet					
Yes	33	73.3	106	74.6	0.861
No	12	26.7	36	25.4	

Table 4 (d). Association of water storage with diarrhea.

	Cases (n=45)		Controls (n=142)		
	Frequency	%	Frequency	%	p value
Water Storage in containers					
Closed	43	95.6	133	93.7	0.639
Open	02	4.4	09	6.3	

Table 4 (e). Association of disposal of children's feces with diarrhea.

	Cases (n=45)		Controls (n=142)		
	Frequency	%	Frequency	%	p value
Disposal of children's Feces					
Into toilets	40	88.9	134	94.4	0.917
Into rubbish					
Dump	05	11.1	02	1.4	
Burying	0	0.0	03	2.1	
Other methods	0	0.0	03	2.1	

Environmental sanitation and Personal Hygiene Condition as Observed by the interviewers

Table 5 summarizes the observations of the interviewers on personal hygiene and the environmental situation outside and inside the house. Only 15.6%(n=7) of the cases' homes were observed to be clean outside and inside compared to 21.1% (n=30) of the homes of the control group. Meanwhile 13.3% (n=6) of cases' homes were classified as poor compared to 23.9% (n=34) of the controls.

Only 44.4% (n=20) of the homes of cases had no flies inside the house compared to 41.5% (n=59) of the controls; and, 4.4% (n=2) of the cases houses had many flies inside compared to 10.6% (n=15) of the controls. Meanwhile, 57.8%(n=26) of cases had many flies around their houses compared to 41.8% (n=59) of controls. Only 2.2% (n=1) of the cases had no flies around their houses compared to 7.1% (n=10) of the controls. The presence of flies around the house was significantly associated with diarrhea illness in the children (p=0.043).

Much garbage was observed around houses belonging to cases 37.8% (n=17), compared to 25.4%(n=36) of the controls. Meanwhile, only 20.0% (n=9) of the cases had no garbage outside their houses compared to 33.1% (n=47) of the controls.

There was some evidence that the presence of much garbage outside the house was significantly associated with diarrhea in the investigated children ($\chi 2=3.80$; DF=1; $p \leq 0.05$).

Sixty percent (n=27) of cases had no garbage inside the houses compared to 71.1% (n=101) of the controls.

The status of the majority of the respondents' toilets were classified as poor with 72.1% (n=31) of the cases' toilets graded as poor compared to 65.5% (n=93) of the controls. Only 4.7% (n=2) of the cases' toilets were graded as good compared to 5.6% (n=8) of the controls.

Personal cleanliness of caretakers was graded as good for 20.0% (n=9) of the cases compared to 26.1% (n=37) of the controls, and as poor for 11.1% (n=5) of the cases compared to 7.0% (n=10) of controls.

Personal cleanliness of the children were graded as good for 15.6% (n=7) of the cases compared to 16.9% (n=24) of controls. Meanwhile, 15.6% (n=7) of cases were graded as poor on the cleanliness scale compared to 19.7% (n=28) of the controls.

No feces were observed around the cases houses 100% (n=45) compared to 95.8% (n=136) of the controls.

Table 5. Environmental Sanitation and Personal Hygiene Condition as Observed by the Interviewers .

	Cases (n=45)		Controls (n=142)		
	Frequency	%	Frequency	%	p value
Cleanliness of homes Outside and inside					
Good	07	15.6	30	21.1	0.647
Fair	32	71.1	78	54.9	
Poor	06	13.3	34	23.9	
Flies inside the House					
Many	02	4.4	15	10.6	0.408
Few	23	51.1	68	47.9	
None	20	44.4	59	41.5	
Flies around the house					
Many	26	57.8	59	41.8	0.043
Few	18	40.0	72	51.1	
None	01	2.2	10	7.1	

Garbage around the house					
Much	17	37.8	36	25.4	0.051
Little	19	42.2	59	41.5	
None	09	20.0	47	33.1	
Garbage Inside the house					
Much	00	0.0	04	2.8	0.348
Little	18	40.0	37	26.1	
None	27	60.0	101	71.1	
Status of toilet facility					
Good	02	4.7	08	5.6	0.459
Fair	10	23.3	41	28.9	
Poor	31	72.1	93	65.5	
Cleanliness of Respondents					
Good	09	20.0	37	26.1	0.280
Fair	31	68.9	95	66.9	
Poor	05	11.1	10	7.0	
Cleanliness of Children					
Good	07	15.6	24	16.9	0.782
Fair	31	68.9	90	63.4	
Poor	07	15.6	28	19.7	
Feces around the house					
Little	0	0.0	06	4.2	0.163
None	45	100	136	95.8	

Multivariate analysis

The factors that were significant in bivariate analysis were considered in a multivariate logistic regression analysis. In addition, age of the child and education level of the caretaker were considered as possible confounding factors in the model and Table 6 shows results of this analysis.

Respondents who knew that dirty food causes diarrhea were 60% less likely to have a child suffering from diarrhea (OR=0.40; 95%CI 0.24-0.67) compared to respondents who had no knowledge. Children from homes where too much garbage was observed around the houses were twice (OR=2.04; 95%CI 1.16-3.60) more likely to suffer from diarrhea compared to children from homes where no garbage was observed around the houses. Parents with low education level were 60% (OR=0.40; 95%CI 0.39-0.91) less likely to have a child suffering from diarrhea compared to parents with higher education

The results of the multivariate logistic regression analysis are shown in table 6.

Table 6. Results of the multivariate analysis .

Factor	OR	95% Confidence Interval
Age of child (months)		
0-6	0.34	0.12-0.95
7-12	2.10	0.91-4.84
13-24	1.54	0.80-2.98
25-36	1.75	0.84-3.65
>36	1	
Knowledge that dirty food is associated with diarrhea		
Knowledgeable	0.40	0.24-0.67
Not knowledgeable	1	
Knowledge that dirty water is associated with diarrhea		
Knowledgeable	0.41	0.16-1.06
Not knowledgeable	1	
Garbage around the house		
Too much	2.04	1.16-3.60
Little	1.18	0.69-2.02
None	1	
Education level		
Primary	0.60	0.39-0.91
Secondary	1	

CHAPTER 6

DISCUSSION

We found poor environmental sanitation practice to be the major risk factor associated with watery diarrhea in children in Msisi compound. Watery diarrhea was associated with too much garbage around the households. In addition, knowledge that dirty food causes diarrhea was a protective factor for diarrhea in Msisi children. The finding that mothers with low education were less likely to have children suffering from diarrhea compared to more educated mothers, indicates the need to provide health education to caretakers who take care of children in the absence of mothers. Educated mothers are likely to be away from home at work. Our findings with regard to dumping of garbage are supported by studies done elsewhere which have linked watery diarrhea to dumping of garbage around the houses (Jinadu, et al, 1991; Heller et al, 2003; Abu Mourad , 2004; Mbonye, 2004)

The results of the multivariate logistic regression analysis confirms the multidimensional nature of the causes of diarrhea in children in Msisi compound. The results suggest that other vehicles of transmission might be more important than food and water

We found caretaker's knowledge of the causes of diarrhea in children to be protective against diarrhea disease even when the caretakers have low educational status. Overall, respondents whose children suffered from diarrhea were better educated as 40% had attained secondary education or higher compared to 25.4% of their control counterparts.

This contrasts with studies done elsewhere which reported a 5- fold increase in the incidence of diarrhea among infants of non-literates compared to educated mothers (Elegbe et al, 1982). This finding suggests that exposure of caretakers to educational intervention focusing on specific diarrhea transmission vehicles are more likely to result in beneficial health outcomes for children in Msisi compound.

In addition, mothers with low education are more likely to fully breast feed their children because they can not afford expensive breast milk substitutes. The mothers who are away from home at work leave their children to be fed on adult food or breast milk substitutes which are not hygienically prepared. It is a good reminder that education alone is not a sufficient safeguard against disease if poverty is rampant and environmental sanitation and personal hygiene are poor.

The current health center based health education messages (delivered primarily by nurses) may not be yielding any positive impact on the environmental sanitation and personal hygiene practices of the residents. There is need for the LDHMT to restructure environmental health education and personal hygiene messages including their delivery mechanisms to make it responsive to the needs of households.

Face -to -face educational intervention in Msisi should focus on the problems of garbage, and improving caretakers knowledge about the vehicle of transmission of diarrhea disease in children.

Intervention should be focused on changing behaviors to improve overall hygiene. However, the enormous solid waste problem in Msisi compound is beyond the power of individual households to tackle without the intervention of the Lusaka city council and the LDHMT.

The Lusaka city council and the LDHMT need to cooperate to find a permanent solution to indiscriminate solid waste disposal in Msisi compound.

Socioeconomic and demographic Characteristics

Socioeconomic and demographic factors that were hypothesized in our study were not associated with diarrhea in the investigated children.

Overcrowding was found to be associated with diarrhea in children in Palestinian refugee camps (Abu Mourad, 2004), while in Eritrea the age of weaning and households with large number of children were associated with diarrhea (Woldemicael, 2001).

However, we did not measure overcrowding and the age of weaning in the investigation of the children in Msisi, but from the observation based on the total population and the types of housing units which in most cases were single room dwellings, overcrowding was likely to be a serious problem in Msisi compound.

Future studies should measure the crowding index in Msisi because it is an important social and economic indicator.

The majority of the respondents were either employed in the formal (41.2%) or the informal sector (50.3%). Employment has a beneficial health effect but where the environmental health and living conditions are generally poor as in Msisi this benefit is difficult to demonstrate. Future studies in Msisi should take into account the household income and asset, and job classification. This would shed more light on the household ability to afford sufficient water for daily needs, a decent home, sufficient food and detergent.

In our study the majority of cases were aged 13-59 months. They were less dependent on their mothers. The fact that they contracted diarrhea is a reflection of the multifactorial nature of the determinants of diarrhea disease; some of which were beyond the power of the individual to influence.

The majority of the respondents whose children had diarrhea were females and were generally young. We did not investigate their marital status. Single mothers in Zambia tend to be disadvantaged in terms of access to health services and young mothers tend to have a poor health outcome for children.

These and other factors might explain the poor health of their children. In addition, the age group 13-59 months were more independent of the caretakers and were likely to play around in the dirty environment compared to their younger counterparts. They were old enough to be left on their own in the care of their older siblings who would take charge of feeding and bathing them, whenever their parents went out in search of daily livelihood.

This practice was common in the compound. The children were likely to defecate anywhere around the yard , feed themselves without washing their hands and were likely to eat and drink from dirty utensils.

Meanwhile the dirty environment exposed children to consumption of food and water contaminated with coliforms.

The majority (91.1%) of the children who had diarrhea were fed on a combination of breast milk and adult food or adult food only. Very few (8.9%) of the children who had diarrhea were fed exclusively on breast milk, breast milk feeding is important because it minimizes the exposure of infants to water and food which may be contaminated with bacteria. Breast milk also offers the infants, resistance against infections. Feeding of the children on adult food would expose them to the dirty hands of their caretakers , their own dirty hands, dirty utensils and contaminated food and water. In Bangladesh, it was shown that the incidence of diarrhea in infants was positively correlated with the frequency of consumption of weaning foods contaminated with fecal coliforms from contaminated water and domestic environment(Rowland, 1986). Breast feeding and good sanitation have been identified as important barriers that protect children from diarrhea pathogens. Full breast feeding have been found to have strong protective effects among infants living in crowded, highly contaminated settings (Van der Slice et al, 1994).
It was also observed that the risk of contracting diarrhea among mixed-fed infants where environmental sanitation was poor was generally high (Ahiadeke, 2000).

Urgent intervention to improve general living conditions in Msisi is needed; intervention should be accompanied by funding for poverty reduction.

Environmental Health Status

The majority of Msisi respondents (99.5%) reported access to piped water. Water was collected from a distance and stored in small containers before use. More time was spent in queues collecting water than doing other chores. Water was paid for in cash. These factors impacted negatively on the quantity of water available for household daily needs, and were likely to force residents to turn to unsafe but readily available source of water like the nearby dam or unprotected wells. Availability of water in sufficient quantity throughout the day is as important as water quality if personal hygiene is to be maintained. We did not investigate the quantity of water available for households which would have shed more light on whether or not residents were accessing sufficient quantity of water on a daily basis.

Washing hands after defecation, before preparing food, and before feeding a child is very important in reducing the transmission of disease, but without abundant water in or near home, hygiene becomes difficult or impossible (Park, 2002).

Availability of water in sufficient quantity and good quality within the house has been found to be associated with a low prevalence of diarrhea in children (Van der Hoek et al. 2002).

The majority of the respondents (78.6%) reported using pit latrines for feces disposal. Most of these toilets (it was observed) were located very close to the houses. The latrines were poorly constructed and lacked maintenance. Many toilets were observed to be dirty and full of flies. They had no roofs, no doors and no covers on the pits, thus permitting free movement of flies from toilets into houses. As a result, the toilets were a potential source of transmission of fecal oral infection. In a Malawi refugee camp, visible feces from the family latrine was significantly associated with an increased incidence of diarrhea in children under five years (Roberts et al, 2001).

Dumping was the only method of solid waste disposal in Msisi compound. The refuse was dumped in disused quarry pits, some of which were located two to three meters away from the doors of the single room dwellings.

The Lusaka city authority have moral and civic obligation to give Msisi residents a clean environment. The city authority should take this advice seriously to prevent the poisoned environment (only a few hundreds of meters away) from engulfing the whole city. This will require political will on their part, an informed community willing to stand up for their civic rights, and a committed community leadership.

Policy makers in Zambia need to come to terms with the fact that economic development and health development can only be sustained if the environment is adequately protected. Improvement in environmental health has been identified as one of the major prerequisites for health development (WHO. 1991).

Knowledge and Practice of environmental health and Personal Hygiene

The knowledge that dirty water is associated with diarrhea was high in all respondents, 88.9% of respondents whose children had diarrhea and 97.9% of the controls. Similarly, the knowledge that dirty surrounding is associated with diarrhea was equally high in all respondents, 86.7% of respondents whose children had diarrhea and 94.4% of controls. While the majority of respondents knew that dirty water and dirty surroundings are associated with diarrhea in children, this knowledge was not put into practice.

Only a small percentage of respondents always boiled their water for drinking, 13.3% of respondents whose children had diarrhea and 17.6% of controls. Similarly, all the respondents whose children had diarrhea had heard of chlorine but only 40% of them used it for water disinfection, compared to 38.3% of their control counterparts. However economic circumstances might have precluded others from the use of chlorine since it had to be purchased. There is need for in depth studies to elucidate the reasons behind this apparent lack of practice in the presence of a high level of awareness.

Ignorance about the role of dirty food in the transmission of diarrhea in children was more wide- spread among respondents whose children suffered from diarrhea (33.3%) compared to only 7.7% of their controls. Similarly, 11.1% of respondents whose children suffered from diarrhea did not know the association between house flies and diarrhea compared to only 2.8% of their control counterparts. The children whose caretakers knew the dangers associated with dirty food and houseflies were less likely to suffer from diarrhea illness compared to those children whose parents were ignorant of this potential danger.

Ignorant parents were more likely to feed their children with dirty hands, use dirty utensils and would do nothing to keep away flies from the dwellings. Watery diarrhea was significantly higher among the children whose parents were ignorant of these important dangers. The hands of caretakers contaminated with fecal matter are important in the transmission of pathogens causing diarrhea in children (Pickering et al, 1986).

The practice of storing drinking water in containers is widespread in Msisi compound. About 94.1% of all respondents indicated that they stored their drinking water in closed containers. This practice exposes drinking water to contamination from dirty containers, dirty hands, and dirty environment. We did not find association of watery diarrhea with the storage of water in small containers in our study. However, storage of water in small utensils was significantly associated with watery diarrhea in children under five years in a Karachi slum (D'Souza, 1997). Meanwhile, children from houses with a large storage capacity for water in the house had a much lower prevalence of diarrhea (Vander Hoek et al, 2002).

The practice of dumping solid waste was equally widespread in Msisi despite a high awareness level in most respondents.

Some respondents, 11.1% of the parents whose children suffered from watery diarrhea and 1.4% of controls reported disposing of children feces into the solid waste dumps. This practice was more widespread among caretakers whose children suffered from diarrhea. This unhygienic practice expose children to various infections including diarrhea and need to be corrected.

Most respondents reported a good personal hygiene practice notably hand washing after using toilets: 93.3% of the respondents whose children suffered from diarrhea and 96.5% of controls. Reported hand washing before feeding children was equally high (86.7%) for respondents whose children suffered from diarrhea and 94.4% for controls. Washing children's hands after using toilets was reported by 73.3% of the respondents whose children suffered from diarrhea and 74.6% of the controls.

The reported practices of the respondents were not supported by what the researchers observed on the ground, as most of the respondents and children were generally unclean. The fact that their children had diarrhea cast serious doubts on their reported favorable practices.

Most parents probably knew the answers expected of them because of the health education knowledge received from the health centers and ante natal clinics.

This attitude need to be improved, but in the absence of sufficient quantity of water for daily use close to the households, this important personal hygiene practice becomes difficult to uphold. The reported regular hand washing practice must therefore be viewed with caution. The respondents had a high knowledge, but knowledge alone was not sufficient to influence their attitude and behavior pattern to adopt beneficial personal hygiene practices. It is important to make sure that children always wash their hands because it has been shown that the incidence of diarrhea is significantly related to contaminated children's hands. This relationship therefore strongly support the promotion of hand washing as an important method of controlling diarrhea diseases (Henry and Rahim ; 1990).

There is urgent need for Lusaka District Health Management Board to intensify environmental health and personal hygiene awareness in Msisi compound, with behavior change as the primary objective.

Environmental Sanitation and Personal Hygiene Condition as Observed by the Interviewers

Overall only 15.6% of the respondents whose children had diarrhea lived in clean houses compared to 21.1% of their control counterparts, implying that the majority of all respondents were living in dirty houses.

Only 2.2 % of the respondents whose children had diarrhea had no flies outside their houses compared to 7.1% of their control counterparts. The presence of many flies in Msisi compound was an indication of the extent of environmental degradation resulting from uncontrolled dumping of solid waste, poor feces disposal and poor personal hygiene and underscores the need for urgent environmental health intervention. The majority of the toilets were dirty: 72.1% of the respondents whose children had diarrhea were observed to have poor toilet facilities compared to 65.5% of their control counterparts. Similarly the majority of the investigated children were generally dirty as only 15.6% of the children who had diarrhea were observed to be clean compared to 16.9% of their controls.

The observation of dirty homes, many flies around the houses, lots of garbage, poor toilet facilities, and unclean care takers are a reflection of poor environmental sanitation and personal hygiene and suggest that both environmental sanitation and personal hygiene are a potential source of diarrhea in the children in Msisi compound.

These findings are important as they point to the multifactorial environmental issues and personal hygiene factors which could expose children in Msisi compound to the danger of fecal oral transmission of pathogens.

Strengths And Limitations

There were several limitations to this study despite a good response rate. Recall bias could have occurred on the selection of diarrhea cases. This was minimized by considering only a two weeks recall period. The data were collected by four interviewers, increasing the possibility of inter observer errors.

An attempt was made to reduce this by training and the provision of a standard check lists. Intra and inter personal variations may have occurred during the use of a three point observation scale of the check list.

An attempt was made to reduce this by conducting intensive field work training for data collectors in order to unify their assessment and to minimize these variations as much as possible.

Finally, the sampling of '1 case to 3 controls' of comparable background and location reduced the bias that could have arisen due to confounders.

Selection bias was reduced by the application of a '1 in 2' systematic random sampling technique.

Some of the studies referred to in our discussion are based on cross-sectional data. Although the results are consistent with current theories on association of diarrhea with environmental sanitation, cross-sectional studies can not provide conclusive evidence on the direction of causality.

Responses recorded using face to face interviews also tend to be distorted by what the respondents consider socially acceptable. These could be some of the weaknesses in this study. There is need for in depth interviews and longitudinal studies to confirm some of the risk factors associated with diarrhea disease found in this study because a case-control study does not provide a direct measure of disease risk or incidence rate.

CHAPTER 7

CONCLUSION

Poor environmental health was associated with watery diarrhea in children aged less than five years in Msisi compound .

Parents who kept solid waste away from their households , and knew the dangers associated with dirty food were less likely to have a child suffering from diarrhea.

The majority of Msisi residents had access to limited quantity of piped water, which made it extremely difficult to practice good personal hygiene.

Most residents had access to pit toilets, but the toilets were unsanitary and offered no protection against fecal contamination of food and water for drinking.

There was no disposal mechanism for solid waste, as a result dumping refuse was widespread and became a potential source of diarrhea disease in Msisi compound.

Recommendations

Multidisciplinary efforts are needed to overcome environmental and health related problems in Msisi compound

Awareness and educational programs must be done by the health authority to improve upon environmental health awareness and practice of residents.

There is need for the LDHMT to embark on promotion of health education programs to overcome problems of disease prevalence in Msisi compound.

The Lusaka city council and the government need to Intervene to improve housing conditions, fecal disposal mechanism, water reticulation and solid waste disposal in Msisi compound

The city council should provide free communal taps close to the households.

There is urgent need for the Lusaka city council and the LDHMT to cooperate to reconstruct current pit toilets into VIPs.

The Lusaka city council should extend refuse collection into Msisi compound.

Longitudinal and in- depth environmental health studies should be carried out in Msisi to better inform researchers, the community and policy makers. Community participation is a prerequisite to solving all the above problems.

References

Abu Mourad, T.A. 2004. Palestinian refugee conditions associated with intestinal parasites and diarrhea: Nuseirat refugee camp as a case study. Journal of the Royal Institute of Public Health 118(2), 131-42

Ahiadeke, C. 2000. Breast feeding, diarrhea and sanitation as components of infant and child health: a study of a large scale survey data from Ghana and Nigeria. Journal of Biosocial Science 32(1), 47-61

Ashbolt, N.J. 2004. Microbial contamination of drinking water and disease outcomes in developing regions. Toxicology 198 (1-3) , 229-39

Ayres, D. 1990. Oral Rehydration therapy: A cure but not a solution: Community Health and Sanitation. Intermediate Technology Publications 36-39

Baltazar, J; J. Briscoe; V. Mesola; C. Moe; F. Solon; J. Vanderslice; and B. Young. 1988. Can the case control method be used to asses the impact of water supply and sanitation on diarrhea? A study in the Philippines. Bulletin of the World Health Organization 66(5), 627-35.

Cairncross , S. 1990. Health aspects of water and sanitation. Community health and sanitation. Intermediate Technology Publications 24-29

Campos Gde. J; S.A. dos Reis Filho; A.A. da Silva; M.A. Novochadlo; R.A. da Silva;and C.E. Galvao.1995. Infant morbimortality due to acute diarrhea in a Metropolitan area of Northeastern Brazil, 1986-1989. Revista de .Saude Publica; 29 (2), 132-9

Central Board of Health. 2002. Integrated Disease Surveillance and Response. CBOH: Lusaka, Zambia

Central Board of Health. 2003. Health Management Information System. Annual Report. CBOH: Lusaka, Zambia

Central Statistical Office Zambia; Central Board of Health Zambia; and Orc Macro. 2003. Zambia Demographic and Health Survey 2001-2002. Calverton, Maryland, USA: Central Statistical Office, Central Board of Health, and ORC Macro.

Central Statistical Office Zambia . 2000. Census of Population and Housing Report. CSO: Lusaka, Zambia.

Chunge, R.N; J.M. Simwa; P.N. Karumba; et al. 1992. Comparative etiology of childhood diarrhea in Kakamega and Kiambu Districts Kenya. East African Medical Journal. 69, 437-41

Cifuentes, E; L. Suarez ; M. Solano and R. Santos .2002. Diarrhea diseases in children from a water reclamation site in Mexico City. Environmental Health Perspective 110, 619-24

D'Souza ,R.M. 1997. Housing and environmental factors and their effects on the health of children in the slums of Karachi, Pakistan. Journal of Biosocial Science 29 (3), 271-81

ElegbeI.A; E.O.Ojofeitimi; I. Elegbe and M.O.Akinola. 1982. Pathogenic bacteria isolated from infants feeding teats. Contamination of teats used by illiterate and educated nursing mothers in Ile-Ife, Nigeria. American Journal of Diseases of Children . 136, 672-4

Emch,M. 1999.Diarrhoeal disease risk in Matlab, Bangladesh. Social Science and Medicine 49 (4), 519-30

Heller,L; E.A.Colosimo and C.M.Antunes.2003.Environmetal sanitation condition and health impact: a case control study. Revista de Societies de . Brasilia de Medicines Tropica . 36 (1), 41-50

Henry F.J. 1981. Environmental sanitation, infections and nutritional status of infants in rural St.Lucia, West Indies. Transactions of the Royal Society of Tropical Medicine and Hygiene 75 (4), 507-13

Henry, F.J and Z. Rahim. 1990. Transmission of diarrhea in two crowded areas with different sanitary facilities in Dhaka Bangladesh. Journal of Tropical Medicine and Hygiene 93, 121-6

Hoque, B.A; J.Chakraborty; J.F. Chowdhury; U.K. Chowdhury; M. Ali; S. el Arifeen and R.B. Sack.1999.Effects of environmental factors on child survival in Bangladesh: a case control study. Public Health 113 (2), 57-64

Jinadu ,M.K; S.O. Olusi ; J.I. Agun; and A.K. Fabiyi. 1991. Childhood diarrhoea in Rural Nigeria. I. Studies on prevalence, mortality and socio-environmental factors. Journal of Diarrhoeal Disease Research 9 (4), 323-7

Lusaka District Health Management Board. 2003. Annual report. LUDHMB: Lusaka, Zambia.

Mbonye, A.K. 2004. Risk factors for diarrhea and upper respiratory tract infections among children in a rural area of Uganda. Journal of Health Population and Nutrition 22 (1), 52-8

Messou, E; S.V.Sangare ; R. Josseran; C.Le Corre and J. Guelain. 1997. Effects of hygiene measures, water, sanitation and oral rehydration therapy on diarrhea in children less than five years old in the South of Ivory Coast. Bulletin de la Societe de Pathologie Exotique. 90(1), 44-7

Park, K. (ed), 2002. Acute diarrhea diseases: Park's text book of preventive and social medicine 17th ed. M/s Banarsidas Bhano: Prem Nagar, Jabalpur,.175-178

Park, K. (ed), 2002. Environment and Health: Park's text book of preventive and social medicine 17th ed. M/s Banarsidas Bhano: Prem Nagar, Jabalpur, 489-562

Pickering, LK; A.V. Bartlett and W.E. Woodward . 1986. Acute infectious diarrhea among children in day care: epidemiology and control. Review of Infectious Diseases 8, 539-47

Plate D.K; I.S. Beverly and L.W. Mark. 2004. Water sources are associated with childhood diarrhea prevalence in Rural East –entral Mali. Tropical Medicine and International Health 9 (3), 416-26

Roberts, L; Y. Chartier; O. Chartier; G. Malenga; M. Toole and H. Rodka.2001. Keeping clean water clean in a Malawi refugee camp: a randomized intervention trial. Bulletin of the World Health Organization.79, 280-7

Rowland MG.1986. The Gambia and Bangladesh: the seasons and diarrhea. Dialogue on Diarrhea. (26), 3.

Sunoto. 1982. Diarrhoeal problems in Southeast Asia. Southeast Asian Journal of Tropical Medicine and .Public Health 13(3), 306-18

Thapar, N; I.R. Sanderson. 2004. Diarrhea in children an interface between developing and developed Countries. Lancet (9409), 641-54

US National Institute of Diabetes and Digestive and Kidney Diseases (NIDDK) 2001. US Department of Health and Human Services. Digestive Diseases. Available from http://www.niddk.nih.gov/health/digest/pubs/diarrhea.htm

Van der Hoek W; S.G. Feenstra; and F. Konradsen. 2002. Availability of irrigation water for domestic use in Pakistan, its impact on the prevalence of diarrhea and nutritional status of children . Journal of Health Population and Nutrition 20(1), 77-84

Van Derslice, J; B. Popkin and J. Briscoe. 1994. Drinking Water quality, Sanitation, and Breast feeding, their interactive effects on Infant Health. Bulletin of the World Health Organization 72 (4), 589-601

Woldemicael, G. 2001. Diarrhoeal morbidity among young children in Eritrea: Environmental and socioeconomic determinants. Journal of Health Population and Nutrition 19 (2), 83-90

World Health Organization. 1991. Accelerating the achievement of health for all Africans within the framework of the three-phase health development scenario. Drinking water supply, sanitation and habitat. WHO, Brazzaville

APPENDIX A

INFORMATION SHEET

Title of the study

The Study: Effects of Environmental Sanitation and Water on Diarrhea in Children under the age of five years in Msisi Compound, Lusaka, Zambia: a case control study

Introduction

I am writing to you to seek your permission to enable me undertake a study in your compound to determine the risk factors associated with watery diarrheoa in children age less than five years old. I am a postgraduate student at the Medical School of the University of Zambia, Department of Community Medicine.

As you are probably aware your compound is one of many such compounds around the City of Lusaka which are lacking basic environmental sanitation services. Studies which were carried out elsewhere and in Zambia have shown that poor environmental sanitation is associated with increased risk of diarrhoea disease in children and other diseases like Cholera, which you have been experiencing as a community. In Zambia, diarrhoea in children is ranked number three

after acute respiratory infections and malaria, as one of the top three killer diseases of children under the age of five years old.

Purpose of the Research and Procedures

Our intention is to carry out a baseline study to determine the risk factors associated with this killer disease.This study will involve face to face interviews with some sampled households members of your community and the questions will be related to environmetal sanitation practices, and diarrhea disease.

Based on the findings, we shall make recommendation to a Non governmental Organization which has already shown interest in working with your community to improve environmental sanitation. Our recommendations will also be given to the health authority , the Lusaka city council and to yourselves, the residents of Msisi compound.

We are hopeful that with your cooperation and that of the entire community of Msisi, we can make some contribution, no matter how small, to the improvement of the environmental sanitation and the prevention of disease in this community. We are, therefore, looking forward to your full cooperation and that of the residents you represent.

Risks, Discomfort and Benefits

There are no risks or discomforts, associated with being a participant in this study. However if a child is ill with diarrhoea during the visits of the survey staff, the child will be provided with Oral Rehydration Salts free

of charge and a reference note will be given to the caretaker to take the child to the nearest clinic. Children suffering from other illnesses should also be shown to the survey staff for advice. The staff will also give a brief talk on diarrhea if they feel that a participant need to know something about diarrhea or its treatment.

Confidentiality

Information about the study findings and the study participants will remain confidential and will not be made available to any one who is not connected with the study.

Correspondence

This study is being carried out by Dr. Freddy W.D.Oyat of the Department of Community Medicine, School of Medicine, University of Zambia, if you have any queries please direct them to Dr.F.W.D. Oyat P.O.Box 50110 Lusaka. Tel.097-414390 or to the Head of the Department of Community Medicine P.O.Box 50110 Lusaka. Tel 252641or 096-748988. or to the Chairman, Research Ethics Committee of the University of Zambia.Ridgeway Campus. P.O.Box 50110. Lusaka.

The above section is to be detached and given to the Community Leadership

Consent Form

By signing below I confirm that I understand the purpose of this research and its benfits to the residents of Msisi compound. The material in this consent has been explained to me and my questions has been answered to my satisfaction. I understand that participation in this study by our residents will be on a voluntary basis and that refusal to participate will not affect the health care of the individuals concerned and their families. I understand that the rights of the participants and privacy will be maintained.

I hereby give consent for the study " Effects of environmental sanitation and water on diarrhea in children under the age of five years in Msisi compound: a case control study. " to be conducted.

.....

Signature /thumb print of Community Leader

Date.....

Name of Community Leader (BLOCK LETTERS)

.....

Witness (Name and Signature

Date.....

APPENDIX B

INFORMATION SHEET FOR PARTICIPANTS (CARETAKERS)

Introduction

This form gives you information on the study in which you are being requested to participate. To make sure that you have all the facts about this study you must read this form or have some one read it for you. If you agree to participate in this study you must sign the consent form below or put your thumb print in the space provided if you cannot write. You will be allowed to keep a copy of this form and to discuss anything which is not clear to you concerning this study with the staff of the survey . If you feel that you cannot take part in the study you are free not to participate in the study, and your refusal will in no way jeopardize the care you will receive from the health care workers.

Purpose of the Research and Procedures

You are being requested to take part in a study which seeks to determine the association of diarrhoea with environmental sanitation and water; in children under the age of five years in your community. As you are probably aware, your compound is one of many such compounds around the city of Lusaka which are lacking basic environmental sanitation services.

Studies which were carried out elsewhere and in Zambia have shown that poor environmental sanitation is associated with increased risk of

diarrhoea disease in children (including other diseases like Cholera) which you have been experiencing as a community.

In Zambia, diarrhea in children is ranked number three after acute respiratory infections and malaria, it is one of the top three killer diseases of children under the age of five years old. This baseline study is intended to provide information which can be used to start community based environmental interventions for your community in partnership with a Non governmental Organization.

This study involves a face- to - face interview with a member of staff who is about to ask you a set of questions about the occurrence of diarrhoea in the children under your care, aged less than five years, who have fallen ill with diarrhoea in the two weeks preceding today's interview.

The questions require your response on the source of your water for drinking,cooking, bathing and washing; the presence or absence of a toilet facility for your household, how the children's feces and household refuse is disposed .

You are also being requested to tell the staff what you know about the cause of diarrhoea and how it is treated. The staff is going to gather some data by observing cleanliness around and inside your households.

After agreeing to take part in this interview the staff can proceed to ask you all the relevant questions.

Risks, Discomfort and Benefits

There are no risks or discomforts, associated with being a participant in this study. However if a child under your care is ill with diarrhoea now, please feel free to let the staff see the child immediately. After seeing the child the staff is going to provide you with Oral Rehydration Salts free of charge for the child, and a reference note to take the child to the nearest clinic. Children suffering from other illnesses should also be shown to the survey staff for advice. A brief talk on diarrhoea will follow this interview if the staff feel that you need to know something about diarrhoea or its treatment.

Confidentiality

Information about the study findings and the study participants will remain confidential and will not be made available to any one who is not connected with the study.

Correspondence

This study is being carried out by Dr. Freddy W.D.Oyat of the Department of Community Medicine, School of Medicine, University of Zambia, if you have any queries please direct them to Dr. F.W.D. Oyat P.O.Box 50110 Lusaka. Tel.097-414390 or to the Head of the Department of Community Medicine P.O.Box 50110 Lusaka. Tel 252641or 096-748988. or to the Chairman, Research Ethics Committee of the University of Zambia.Ridgeway Campus. P.O.Box 50110. Lusaka.

The above section is to be detached and given to the participants

Consent Form

By signing below I confirm that I understand participation in this research is entirely voluntary. The materials in this consent has been explained to me, and my questions answered to my satisfaction. I freely and voluntarily choose to participate. I understand that participation or not will not affect my health care or that of my family members. I understand that my rights and privacy will be maintained. I hereby give my consent to participate in this study "The Effects of environmental sanitation and water on diarrhoea in children under the age of five years in Msisi compound: a case control study. " to be conducted.

.....

Signature (Thumb print) of Participant Date.....

Name of Participant (BLOCK LETTERS)

.....

Witness (Name and Signature) Date.....

APPENDIX C

INTERVIEW SCHEDULE

Questionnaire.

English

Identification

Q 01 Name of community (Compound). Msisi Compound

Q 02 City - Lusaka

Q 03 District - Lusaka Urban

Q 04 Country - Zambia

Q 05 Case/Control No……..

SEA No…….

Q 06 Interview Visits

VISIT NO.	1	2	3	FINAL
DATE	dd/mm/yy	dd/mm/yy	dd/mm/yy	dd/mm/yy
	……..	……	……	……..

INTERVIEWER'S

NAME: …….. ……..

RESULT …….. ……

NEXT VISIT:

DATE …….. ……

TIME ....

TOTAL NO. OF VISITS:.....

RESULT CODES: 1 COMPLETED

2 SUITABLE INFORMANTS COULD NOT BE LOCATED

3 POSPONED

4 REFUSED

5 OTHER(SPECIFY).....

.....

SUPERVISORS: 1)

NAME:.....

DATE .....

FIELD SUPERVISOR: 1) NAME

.....

DATE .....

FIELD EDITOR: 1)

NAME.....

DATE.....

DATA ENTRY BY : 1) NAME:

.....

Informants Information

No.	QUESTION	CODES	GO TO
Q 01	Permission received to continue?	Yes.....1 No. 2	
Q 02	Language of interview	Local language.....1 English .....2 Other (Specify).....3	
Q 03	Relationship to child	Mother.....1 Father.....2 Sister.....3 Brother.....4 Others (Specify).....5	
Q 04	Age of respondent	.....	
Q 05	Sex of respondent	Female.....1 Male.....2	
Q 06	Educational standard of respondent	No education.....1 Grade 1-7 .....2 Grade 8-12.....3 Higher education.....4 Others (Specify).....5	
Q07	No. of eligible		

	children (under five) in household.	……..	
Q 08	Age of this child	……..	
Q09	Sex of this child	Male ……..1 Female……2	
Q10	Immunisation Status	Completed……..1 Partially completed…..2 Not immunized…….3	
Q11	Feeding Methods	Breast only…….1 Breast/ Adult food…..2 Adult food only……3	
Q12	Employment Status	Formal……1 Informal…..2 None……..3	

Environmental Health Status			
No.	QUESTIONS AND FILTERS	CODES	GO TO
H 01	What is the main source of drinking water for members of your household?	Piped water into dwelling.....1 Piped water into yard.....2 Public tap.....3 Piped water purchasing.....4 Water from open well in dwelling.....5 Water from open well in yard.....6 Water from open well public.....7 Water from open well purchasing.....8 Water from protected well or borehole in	

		dwelling.....9 Water from protected well in yard.....10 Water from protected well public.....11 Water from protected well purchasing.....12 Surface water Protected spring.....13 Unprotected spring.....14 Rivers/streams.....15 Dams.....16 Others(specify).....17	

NO.	QUESTIONS AND FILTERS	CODES	GO TO
H02	What is the round trip walking distance of this source from your house?	Over 30 min. walk....1 30 min.walk.....2 15 min. walk.....3 10 min. walk.....4 5 min.walk.....5	
H03	Do you pay cash for your water on a daily basis?	Yes.....1 No.....2	
H04	What kind of toilet facility does your household have?	Flush toilet.....1 Pit. Toilet latrine....2 VIP Latrine.....3 No facility/bush/field.....4 Others Specify).....5	
H05	How do you	By dumping around	

	dispose of garbage and other waste from the house?	the house.....1 By burying.....2 By burning.....3 Others (Specify).....4	

Caretakers Practice, and Knowledge of Environmental Sanitation and Personal HygienE			
NO.	QUESTIONS AND FILTERS	CODES	GO TO
E01	Have you ever heard of chlorine?	Yes.....1 No.....2	If NO go to Quest.No.E 03
E02	If Yes: What is it used for in the home ?	Water purification.....1 Cooking food.....2 Don't know.....3	
E03	Have you ever heard of any method of purifying your drinking water at home?	Adding chlorine to water.....1 Boiling water....2 Others (Specify).....3	
E04	Do you always	Yes.....1	

	wash your hands with clean water after using a toilet?	No.....2	
E05	Do you always wash your hands with clean water before preparing food for the children?	Yes.....1 No.....2	
E06	Do you always wash your hands with clean water before feeding the children?	Yes.....1 No.....2	
E07	Do you always wash the children's hands before and after they eat food?	Yes.....1 No.....2	
E08	Do you always wash the children's hands before and after they pass stool?	Yes.....1 No.....2	

NO.	QUESTIONS AND FILTERS	CODES	GO TO
E09	How do you store your drinking water?	In open drum....1 In a closed drum...2 In open 20lit tin....3 In a closed 20lit tin...4 No storage facilty.....5 Others (Specify) 6	
E10	How do you dispose of children feaces?	Into toilet.....1 Into rubbish.....2 Around yard.....3 By burying.....4 Others (Specify).....5	

Practice, Knowledge of Caretakers, and Occurrence of Diarrhoea in the 14 days preceding the interviews as reported by caretakers

No	Questions and Filters	Coding catergory	GO TO
C 01	Did any child from this house who is under five years old, suffer from diarrhoea within the last 14 days?	Yes.....1 No.....2	
C02	Symptoms associated with diarrhoea	Watery.....1 Mucous.....2 Blood Stained.....3 Fever.....4 Vomiting.....5 All the above.....6	
C 03	How many times did the child passed stool in a day?	Three times.....1 More than three times.....2	
C 04	What do you think causes diarrhoea in children	Dirty food.....1 Dirty water.....2 Dirty Hands.....3	

		Dirty surroundings.....4 Flies.....5 Don't Know.....6	
C 05	Have you ever heard of Oral Rehydration salts?	Yes.....1 No.....2	If No Go Question No.
C 06	If Yes Composition of ORS	Salt,sugar,water.....1 Salt and water.....2 Don't Know.....3	
C 07	What action did you take when the child was ill with diarrhoea?	Took to clinic/hospital.....1 Gave ORS.....2 Others (Specify).....3	

Environmental Sanitation and Personal Hygiene Condition as Observed by the Interviewers			
NO.	OBSERVATION	CODES	GO TO
S01	Cleanliness of the home	Good.....1 Moderate...2 Poor.....3	
S02	Flies inside the house	Many.....1 Few.....2 None.....3	
S03	Flies around the house	Many.....1 Few.....2 None.....3	
S04	Garbage around the house	Much.....1 Little.....2 None.....3	
S05	Garbage inside the house	Much .....1 Little.....2 None.....3	
S06	Status of the toilet facility	Good.....1 Moderate.....2 Poor.....3	

S07	Personal cleanliness of the caretakers	Good.....1 Moderate.....2 Poor.....3	
S08	Personal cleanliness of the children	Good.....1 Moderate.....2 Poor.....3	
S09	Feaces around the house	Much.....1 Little.....2 None.....3	

APPENDIX D

THE UNIVERSITY OF ZAMBIA

RESEARCH ETHICS COMMITTEE

Telephone: 260-1-250067
Telegrams: UNZA, LUSAKA
Telex: UNZALU ZA 44370
Fax: + 260-1-250753
E-mail: onzarec@zamtel.zm

Ridgeway Campus
P.O. Box 50110
Lusaka, Zambia

Assurance No. FWA00000338
IRB00001131 of IOR G0000774

4 March, 2005
Ref.: 007-01-05

Dr Freddy Wathum Drinkwater Oyat, MBChB, DPH
Department of Community Medicine
School of Medicine
LUSAKA

Dear Dr Oyat,

RE: **SUBMITTED RESEARCH PROPOSAL**

The following research proposal was presented to the Research Ethics Committee meeting held on 26 January, 2005 where changes were recommended. We would like to acknowledge receipt of the corrected version with clarifications. The proposal has now been approved. Congratulations!

Title of proposal: **"The effects of environmental sanitation and water on diarrhoea in children under the age of five years in Misisi compound Lusaka, Zambia: A case control study"**

CONDITIONS

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

Yours sincerely,

Prof. J. T. Karashani, MB, ChB, PhD
CHAIRMAN
RESEARCH ETHICS COMMITTEE
Date of approval: 4 March, 2005 **Date of expiry:** 3 March, 2006

APPENDIX E

THE UNIVERSITY OF ZAMBIA
SCHOOL OF MEDICINE

Telephone: 252640
Telegram: UNZA, Lusaka
Telex: UNZALU ZA 44370
Fax: + 260-1-250783
Email: kbowa@yahoo.com

Dean's Office
P.O. Box 50110
Lusaka, Zambia
Your Ref

28th June, 2005

Dr. Wathum Freddy Drinkwater Oyat
Department of Community Medicine
School of Medicine

Dear Dr. Oyat,

Re: MASTER OF PUBLIC HEALTH RESEARCH PROPOSAL

Your research proposal for the Master of Public Health entitled: **"The Effects of Environmental Sanitation and Water on Diarrhoea in Children under the age of Five Years in Misisi Compound, Lusaka, Zambia: A Case Control Study"** was presented at the Graduate Studies Committee of the School held on 7th April, 2005.

I am pleased to inform you that your proposal was approved by the Committee. You can proceed to Part II of the programme and your Supervisor is Prof. S. Siziya and your Co-supervisor is Mr. F. Shibalatani.

I wish you every success in your studies.

Yours sincerely,

Mr. K. Bowa
ASSISTANT DEAN, POSTGRADUATE

c.c Director, Graduate Studies
Dean, School of Medicine
Head, Department of Community Medicine
Prof. S. Siziya, Department of Community Medicine
Mr. Shibalatani