THESIS ABSTRACT

Master of Public Health

Adventist University of Africa

School of Postgraduate Studies

TITLE: DETERMINANTS OF DIARRHOEA AMONG UNDER-FIVE CHILDREN IN UMZINGWANE DISTRICT, ZIMBABWE: A CASE-CONTROL STUDY

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Diarrhoeal disease remains a leading cause of mortality and morbidity among children less than five years old in the developing world. The average annual incidence rate of diarrhoea in children less than five years of age (under-fives) is estimated to be 2.6 episodes in developing countries. It is also estimated that there are 100 million episodes and 3.3 million deaths occurring each year among under-fives globally. In Africa, a child typically experiences five episodes of diarrhoea per year, and 800,000 children die each year from diarrhoea and dehydration. In Zimbabwe diarrhoea is the fourth highest cause of death for children under five and is the reason for 12% of child hospital admission (Zimbabwe Maternal and Child Health Integrated Programme, 2014). According to World Bank Collection of Development Indicators, 2014 the prevalence of diarrhoea in under-fives in Zimbabwe was 16%.

Umzingwane District recorded a high number of diarrhoea cases in under-fives in 2016. The total number of diarrhoea cases from under- fives was 1 018 and

constituted 40% of the total number of diarrhoea cases in the district. The figure constitutes an overrepresentation of morbidity among this age group since the under-fives make up 13.7% of the total population. The cause for the upsurge of diarrhoea cases was not documented by epidemiological studies or the literature.

The aim of this study was to examine or discover context-specific conditions in Umzingwane district that may have led to an uptick in diarrhoea cases among under-fives in 2016. The study was a 1:1 unmatched case-control study. The research surveyed 200 cases and 200 controls. The cases were under-fives in Umzingwane District who had diarrhoea in 2016. The researcher used the standard case definition for diarrhoea as cited in the literature.

The controls were under-fives who did not have diarrhoea in 2016 and came from the same neighbourhood as cases. A pre-tested, interviewer-administered questionnaire, was used to collect data from caregivers of cases and controls and under-fives. The questionnaire was filled by trained research assistants. Sanitary inspections were conducted through visual assessment of the infrastructures and the sanitary state surrounding the household water supply, water-holding containers, household sanitary conditions, food storage, personal hygiene, kitchen hygiene and vaccination status of the children as these factors have a potential risk to health and wellbeing of the child. Water samples were collected from boreholes and shallow unprotected wells to check for Escherichia Coli (E. coli) contamination and turbidity

Data were analyzed using Epi Info 7.2.1.0 version. Odds ratios and Chi-square tests at 5% significant levels and 95% confidence intervals were generated using the software. Forward stepwise logistic regression analysis was used to control for confounding and effect modification. The adjusted odds ratios were calculated to

quantify the strength of association between risk factors and outcome and factors with a p-value less than 0.05 were considered significant.

Out of 35 borehole water samples tested, 33(94.29%) were below the threshold limit for contamination with *Escherichia coli* and 2 of the 35 (5.71%) borehole water samples tested were above the threshold for contamination with *Escherichia coli*. Out of 50 unprotected shallow wells water samples tested 9(18%) were below the threshold limit for contamination with *Escherichia coli* and 41(82%) unprotected shallow wells water samples tested were above the threshold for contamination with *Escherichia coli*.

Independent risk factors for contracting diarrhoea were: source of water [OR=2.2457, CI=1.0924-4.6164, p-value=0.0278], disposal of solid waste [OR=4.62, CI=1.9380-11.0330, p-value=0.0006], sanitary state of the kitchen [OR=2.2307, CI=1.0185-4.8854, p-value=0.0449]. Independent protective factors for contracting diarrhoea were: household income [OR=0.2273, CI= 0.1180-0.4378, p-value=0.0000], caregiver knowledge on diarrhoea prevention and control [OR=0.2940, CI=0.1316-0.6566, p-value=0.0028], washing hands by caregivers at all critical times [OR=0.0461, CI=0.0227-0.0937, p-value=0.0000]

The study has highlighted the disaggregated household level risk factors for diarrhoea in under-fives in Umzingwane District. The environmental risk factors were drinking water from contaminated sources, indiscriminate disposal of waste around the home and unsanitary status of the kitchen where food is prepared. This clearly indicates the importance of environmental health as a determinant of child health. Therefore, there is a need for effective measures to enhance universal access to safe water, improved food hygiene practices and appropriate waste management strategies at the household level.

The socioeconomic protective factors were knowledge of diarrhoea prevention and economic stability of the caregivers. The behavioural protective factor was washing of hands at all critical times by caregivers. This implies that hygiene promotion interventions should prioritise protective factors such as increasing caregiver knowledge of diarrhoea prevention, establishment and use of hygienic hand washing facilities and improving socioeconomic status of households.

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A thesis

presented in partial fulfillment

of the requirements for the degree

Master of Public Health

by

Sifelani Mkandla

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This work is dedicated to my wife, Nomathemba Mkandla, and my daughter, Nicole S. Mkandla, for their support and understanding throughout this study.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

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CHAPTER 1

INTRODUCTION

Diarrhoeal disease remains a leading cause of mortality and morbidity in children of the developing world. The average annual incidence rate of diarrhoea in children less than five years of age (under-fives) is estimated to be 2.6 episodes in developing countries. It is also estimated that there are 100 million episodes and 3.3 million deaths occurring each year among under-fives globally. In Africa, a child typically experiences five episodes of diarrhoea per year, and 800,000 children die each year from diarrhoea and dehydration. Diarrhoea is also responsible for 25% to 75% of all childhood diseases and accounts for about 14% of outpatient visits and 16% of hospital admissions. In addition to the excess mortality and morbidity, diarrhoea predisposes children to malnutrition, which makes children highly susceptible to other infections (WHO, 2013).

In Zimbabwe, diarrhoea is the fourth highest cause of death for children under- five and is the reason for 12% of child hospital admission (MCHIP\Zimbabwe, 2014). According to World Bank Collection of Development Indicators, 2014 the prevalence of diarrhoea in under-fives in Zimbabwe was 16%.

The most severe threat posed by diarrhoea is dehydration. During a diarrhoeal episode, water and electrolytes (sodium, chloride, potassium and bicarbonate) are lost through liquid stools, vomit, sweat, urine and breathing. Dehydration occurs when these losses are not replaced. Death can follow severe dehydration if body fluids and

electrolytes are not replenished, either through the use of oral rehydration salts (ORS) solution or through an intravenous drip.

The causes of diarrhoea can be bacterial, viral or parasitic. Bacterial causes of diarrhoea include *Vibrio cholerae, Escherichia coli, Campylobacter jejuni, Salmonellae* and *Shigella* species. Viral causes of diarrhoea include rotavirus, adenovirus, and corona viruses. Parasitic causes of diarrhoea include *Giardia, Entamoeba, Cryptosporidium* and the helminths (Strongyloides, Schistosoma).

According to the World Health Organization (WHO, 2013), key measures to prevent diarrhoea include access to safe drinking water, improved sanitation, exclusive breastfeeding for the first six months of life, good personal and food hygiene and health education about how infections are spread.

Background of the Study

In 2016, Umzingwane District, Zimbabwe had an estimated 65, 548 inhabitants, of these 8,995 were under-fives based on the 2012 census projection (Zimbabwe National Statistics Agency, 2012). The under - fives contributed 13.7% to the total population. Umzingwane District recorded a high number of diarrhoea cases in under-fives in 2016.

The cases were picked up through the Public Health Surveillance system, which is a system of monitoring disease incidence in order to track trends, detects epidemics and evaluates programme effectiveness. The cause for the upsurge of diarrhoea cases was not documented by epidemiological studies or the literature.

Prior to this high number of diarrhoea cases, Umzingwane District had implemented a four year UNICEF sponsored Rural Water and Sanitation Programme. The programme started in 2013 and ended in 2016 with the objective of improving access to safe water and basic sanitation in rural areas of Umzingwane District. The

expected outcome was to reduce the incidence of water and sanitation-related diseases. Despite considerable improvement in water sources and sanitation facilities, the continuing prevalence of disease seems to indicate the need for more attention.

Problem Statement

Umzingwane District reported 1 018 cases of diarrhoea in children less than five years old, which accounted for 40% of total diarrhoeal cases reported in the District in 2016 (Ministry of Health and Child Welfare, 2016). The figure constitutes an overrepresentation of morbidity among this age group since the under- fives make up 13.7% of the total population.

During the same period, the District experienced diarrhoea outbreaks. In fact, the weekly diarrhoea cases crossed the action threshold line ten times in 2016 during weeks 9, 12, 15, 16, 17, 18, 19, 33, 36 and 37. The action threshold is defined as the maximum allowable prevalence of diseases that will flag immediate public health investigation followed by an appropriate response. The action threshold was calculated using data from five previous years (defined as the mean plus 1.5 standard deviations).

Further, an analysis of the first quarter 2017 cases indicated that the increase continued into 2017. In the first quarter of 2017, the District was on alert from week 1, and the cases crossed the action threshold in week 7, causing another outbreak of diarrhoea. It is against this background that this study gathered data to examine the risk factors underlying the 2016 uptick in diarrhoeal cases.

Research Objectives

Broad Objective

To examine and/or discover context-specific conditions in Umzingwane district that may have led to an uptick in diarrhoea cases among children less than five years old in 2016.

Specific Objectives

The following specific objectives fundamentally support the broad objective. This delineation was chosen so that the research included known risk factors and could also assess any previously undetected factors or combination of factors that may have contributed to the uptick of diarrhoea cases in 2016. The specific objectives were:

1. To assess the relationship between behavioural risk factors and the occurrence of diarrhoeal disease in under-fives in Umzingwane District.
2. To investigate the relationship between socioeconomic risk factors and the occurrence of diarrhoeal disease in under-fives in Umzingwane District.
3. To postulate the relationship between environmental risk factors and the occurrence of diarrhoeal disease in under-fives in Umzingwane District.

Conceptual Framework

The conceptual framework for potential determinants of diarrhoea morbidity is shown in Figure 1.

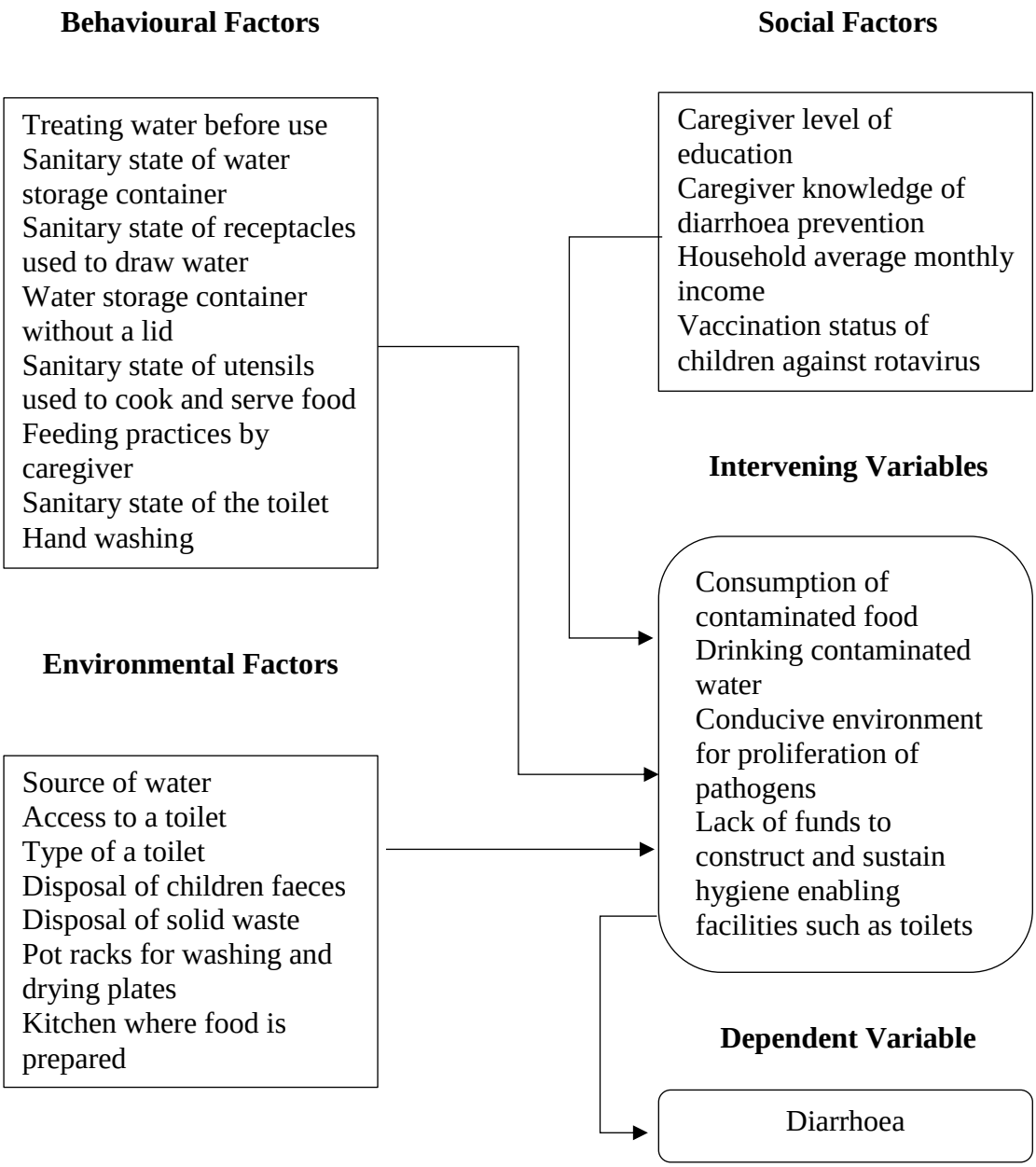

Figure 1. Conceptual Framework

Purpose and Significance of the Study

The purpose of the study was to retrospectively examine the relationship between risk factors in households and the 2016 upsurge of diarrhoea cases among under-fives in Umzingwane District. The District has not had this type of epidemiological study; in fact, this is the first such study in the District and the findings provide useful baseline information to the existing local health services and

to all other actors developing targeted interventions for preventing childhood diarrhoea in Umzingwane District.

Scope and Limitations of the Study

The study was limited to under-fives and their caregivers. These children comprised both the cases and controls. Cases were children who had had diarrhoeal disease in 2016 and controls hadn't had diarrhoeal disease in 2016. Both cases and controls lived in Umzingwane District and the study was carried out starting in January 2017 and ending in April of the same year. The limitation of the study is that since it was a case-control study, potential risk factors were collected retrospectively as a result may give rise to recall bias making it difficult to determine whether reported events relate to a time before the development of the disease rather than to the consequences of the disease process itself.

Operational Definitions

Adequate Knowledge of Diarrhoea prevention – caregiver ability to state ways of diarrhoea transmission and methods of blocking the routes of transmission.

Caregiver - the person who takes primary responsibility for someone who cannot care completely for themselves.

Diarrhoea - the passage of three or more loose or watery stools within 24 hours.

Independent risk factor- a variable that has a significant contribution to an outcome in a statistical model that includes established risk factors.

Odds ratio - a measure of association between an exposure and an outcome. The odds ratio represents the odds that an outcome will occur given a particular exposure, compared to the odds of the outcome occurring in the absence of that exposure.

Protective factor- refers to any factor that decreases the chances of a negative health outcome occurring.

Risk factor- any factor, such as a habit or an environmental condition that predisposes an individual to develop a particular disease.

Sanitary inspection- an onsite inspection and evaluation by a qualified individual of all conditions, devices and practices that pose an actual or potential danger to the health and well-being of communities.

Water quality analysis – measurement of the required parameters of water, following standard methods to check whether they are in accordance with the standards for human consumption.

CHAPTER 2

LITERATURE REVIEW

Definition of Diarrhoea

The standard case definition of diarrhoea is the passage of three (3) or more loose or watery stools in the past 24 hours with:

1. No dehydration – not a sufficient number of signs to classify as some or severe dehydration.
2. Mild to moderate dehydration- two or more of the following signs: restlessness, irritability, sunken eyes, thirst, poor skin turgor (skin pinch with slow return).
3. Severe dehydration- two or more of the following signs lethargy or unconsciousness, sunken eyes, poor ability to drink or inability to drink, poor skin turgor (Technical Guidelines for Integrated Disease Surveillance and Response for Zimbabwe, 2010).

Epidemiological data and the literature show that, worldwide, diarrhoea is a major cause of mortality in children under age of five years. In developing countries, children under the age of three years have an average of three episodes of diarrhoea per year. Each episode worsens the nutritional status of the body necessary for growth and development of the children. Consequently, episodes of diarrhoea are a major cause of malnutrition, and malnourished children are highly susceptible to further attacks of diarrhoea. Children who die from diarrhoea often have underlying malnutrition, which makes them more vulnerable to diarrhoea (WHO, 2013).

Pathology of Diarrhoeal Disease

It is important for those who care for under-fives to have a clear understanding of the pathophysiology of diarrhoea. The absorption and secretion of water and electrolytes throughout the gastrointestinal tract is a finely balanced, dynamic process

and when there is a loss of this balance caused either by decreased absorption or increased secretion, diarrhoea results. Therefore, diarrhoea can be considered to be either osmotic or secretory.

Osmotic diarrhoea occurs when excessive osmotically active particles are present in the lumen, resulting in more fluid passively moving into the bowel lumen down the osmotic gradient. Secretory diarrhoea occurs when the bowel mucosa secretes excessive amounts of fluid into the gut lumen, either due to activation of a pathway by a toxin or due to inherent abnormalities in the enterocytes. This is a manifestation of gastrointestinal infection induced by bacteria, predominantly, E. coli, Salmonella, Para-Typhi, Shigella species. The infection is spread through contaminated food or drinking water, or from person to person contact as a result of poor hygiene (Whyte & Jenkins, 2012).

Diarrhoea Management

The revised recommendations emphasize family and community understanding of managing diarrhoea. When they become routine practice, caregivers will act quickly at the first sign of diarrhoea, rather than waiting before treating the child. The aim is that the recommendations become routine practice both in the home and health-care facility.

Mothers and other caregivers should:

1. Prevent dehydration through the early administration of increased amounts of appropriate fluids available in the home, and ORS solution, if on hand.
2. Continue feeding (or increase breastfeeding) during, and increase all feeding after the episode.
3. Recognize the signs of dehydration and take the child to a health-care provider for ORS or intravenous electrolyte solution, as well as familiarize themselves with other symptoms requiring medical treatment (e.g., bloody diarrhoea).
4. Provide children with 20 mg per day of zinc supplementation for 10–14 days (10 mg per day for infants under six months old).

Health-care workers should:

1. Counsel mothers to begin administering suitable available home fluids immediately upon onset of diarrhoea in a child.
2. Treat dehydration with ORS solution (or with an intravenous electrolyte solution in cases of severe dehydration).
3. Emphasize continued feeding or increased breastfeeding during, and increased feeding after the diarrhoeal episode.
4. Use antibiotics only when appropriate, for example in the presence of bloody diarrhoea or shigellosis, and abstain from administering anti-diarrhoeal medicines.
5. Provide children with 20 mg per day of zinc supplementation for 10–14 days (10 mg per day for infants under six months old).
6. Advise mothers of the need to increase fluids and continue feeding during future episodes.

Health-care workers treating children for diarrhoea are encouraged to provide caregivers with two 1-litre packets of the new ORS, for home-use until the diarrhoea stops. Caregivers should also be provided with enough zinc supplements to continue home treatment for 10–14 days. Printed material (including text and illustrations) with advice on preventing and treating diarrhoea at home should accompany the ORS and zinc supplements (WHO & UNICEF, 2010)

Risk Factors for Diarrhoea among Children Under Five

The occurrence of diarrhoeal disease among under-five children is complex and the relative contribution of each factor varies as a function of the interaction between socioeconomic, environmental, and behavioural variables.

Behavioural Risk Factors

Behavioural factors play a primary role in the epidemiology of diarrhoeal diseases. Risk of exposure to diarrhoea causing organisms may be affected by

behaviour patterns common to the population, such as defecation habits and personal hygiene and by patterns of food preparation, storage and consumption.

A significant study conducted at Gummer Woreda in rural Ethiopia assessed behavioural factors associated with under-five children diarrhoeal morbidity in rural communities. The study focused on the sanitary state of latrines, hand washing after visiting a latrine, child feeding methods and maternal history of diarrhoea morbidity (Gambura, Birke, Terefe, Yohanes, & Laelago, 2016).

This study is important because it found out that the odds of developing childhood diarrhoea were 2.4 times higher in children from households in which faeces were observed around the pit hole or on the slab compared with households in which faeces were not observed around the pit hole or on the slab. The same risk factor was identified at Debre Berhan Town of Ethiopia (Alelign., Asegidew, & Abera, 2015) that acute childhood diarrhoea was as a result of improper utilisation of latrines. This has an important implication that the mere presence of latrine facility does not have a great contribution to preventing excreta-related disease, but it is the proper utilization that had a vital importance.

Children from households that were properly utilising their latrines and keeping them clean at all the times had a lower chance of diarrhoea than those from households with dirty latrines. This shows that it is not only the presence of a latrine which is important in diarrhoea prevention but also the sanitary state and proper utilisation of the latrine in the home. All families should have and use clean functioning latrines that are used by all members of the family old enough to do so.

Therefore, in diarrhoea prevention, it must be emphasised that households should properly utilise and keep their latrines clean at all times by regularly washing down dirty surfaces. Families who do not have a latrine should build one, following a

design recommended by Ministry of Health. When there is no latrine, families should defecate as hygienically as possible by making sure that faeces are covered or buried to reduce diarrhoea transmission.

Additionally, the Gummer Woreda study in rural Ethiopia noted that hand washing practice after visiting a latrine had a statistically significant association with childhood diarrhoea. Households who practised washing their hands with soap/ash prevented childhood diarrhoea two times as compared to households who did not practice handwashing with soap. The findings are consistent with a study conducted in Sebeta town of Ethiopia (A. I. Mohammed & Zungu, 2016) that the existence of a designated place for hand washing is a good predictor of actual hand washing practice, and closely related to diarrhoeal disease prevalence. Children from households with a specific place for hand-washing were 0.40 times less likely to have diarrhoea compared to those from households that did not have specific places for hand washing. While this decreased incidence may appear small, it should be emphasized that due to the morbidity and mortality associated with diarrhoeal disease even small impacts in reduction have merit.

The Gummer Woreda study in rural Ethiopia also noted a lower prevalence of diarrhoea in children whose caretakers thought that washing the children's hands, supervising what they ate, washing fruits and vegetables, and washing kitchen utensils are important preventive actions. All such practices were protective against diarrhoea, reducing risk by about 40% when compared with children of mothers who thought that these practices were unimportant in diarrhoea prevention. Monitoring by caregivers that children less than five years old wash hands every time after using the toilet and before handling food is an important factor in reducing diarrhoea incidence among under-fives at the household level.

This shows that all family members should wash their hands well at all critical times. Critical times for the purposes of this research mean washing hands after cleaning a child who has defecated, and after disposing of a child's faeces, after defecation, before preparing food, before eating and before feeding a child. Adult or older sibling should wash the hands of the young children. Diouf, Tabatabai, Rudolph and Marx (2014) noted that poor maternal hand washing practices were positively associated with the occurrence of diarrhoeal morbidity. This indicates that since the mothers are the main caregivers for their children they should wash their hands before feeding infants and young children to prevent the occurrence of hygiene-related diseases.

The practice of washing hands by caregivers can serve as an example to children, to inspire them to adopt healthy habits at a tender age as evidenced by Gordon (2017) who noted that children do not only pick the genes of their parents but also pick their habits too, for better or for worse. He said that children learn by example and if you look after and value your own wellbeing kids will learn to do the same. Geraldine Walford, a consultant in child and adolescent psychiatry says: "One of the ways children learn is by watching and imitating or modelling what others around them are doing."

This shows that childhood experiences play an important role in the health status of persons later in life. Extrapolating from Geraldine Walford's statement we can suggest that attitudes, beliefs and behaviours learned in the formative years, show strong tracking into adulthood. Therefore promoting healthy habits at a young age is of paramount importance.

The findings of the above-mentioned studies, therefore, mean that for the hygiene of a household to improve, the primary caregiver must have easy access to a

place to wash his or her hands, which has water and soap within easy reach. Access means that the members of the household can wash their hands when needed

The Gummer Woreda study in rural Ethiopia also noted that children from households who used bottle feeding method had almost three times more likely to have diarrhoea than households who did not use bottle feeding method. This might be due to use of unclean bottles given that they are an important route of transmission for pathogens in unhygienic situations. This is particularly true if there is low education, poverty or lack of knowledge on the part of caregivers hence a need to advocate for the protective value of breastfeeding. Breastfeeding protects because it avoids use of contaminated bottles, teats and formula. The contents of breast milk also help the baby's body build resistance to diseases. Therefore even if bottles are clean and formula is properly prepared, a bottle-fed child is at increased risk of disease.

The findings are consistent with two other studies, first in Kenya (Karambu, Matiru, Kiptoo, & Oundo, 2013) and second in Slums of Bankura, West Bengal (Gupta, Sarker, Rout, Mondal, & Pal, 2015) which showed that high incidence of diarrhoea was found in children who were not exclusively breastfed. Children who were exclusively breastfed had low chances of developing diarrhoea as compared to those who were not exclusively breastfed. The studies further noted that bottle-fed children had a high prevalence of diarrhoea

S. Mohammed and Tamiru (2014) noted that incidence of diarrhoea is higher in infants who are older than 6 months when inborn immunity is weak and exposure to contaminated weaning foods increases. This shows that suboptimal infant and young child feeding practices are a major contributor to child morbidity and mortality. The failure to exclusively breastfeed young infants to 6 months and the introduction of liquids and solid foods at the early age of life increase the risk of diarrhoeal disease

and are an important cause of infant and young child morbidity and mortality. This shows that weaning is a hazardous period for infants. Poor weaning practices are associated with increased risk of diarrhoea and diarrhoea death. Good weaning practices involve attention to the when, what and the how therefore it is important for families to follow nutritious weaning recipes developed by the ministry of health.

A study was done in Viet Nam (Takanashi et al., 2009) added that it is food-hygiene practices of mothers that might have an important impact on the prevalence of diarrhoea among children. The risk of diarrhoea was higher among children whose mothers did not separate utensils for raw and cooked food and whose mothers prepared food on the ground rather than on the table. The association with the prevalence of diarrhoea could indicate that the food prepared on the ground was contaminated, and the grounds or the floors are the important routes of transmission of diarrhoeal pathogens.

Similar practices may be common in Umzingwane District; therefore, this shows the importance of ensuring that caregivers wash hands before preparing weaning food and before feeding the baby, prepare food in a clean place, wash uncooked food in clean water before feeding it to the baby, cook or boil food well when preparing it, if possible prepare weaning foods immediately before they will be eaten, cover foods which are being kept and store them in a cool place or refrigerate if possible, feed the baby with a clean spoon and avoid the use of a bottle.

The other risk factor which was noted by the study in Gummer Woreda, Rural Ethiopia was a maternal history of diarrhoea morbidity. The study noted that maternal history of diarrhoeal morbidity was a determinant for diarrhoea in children less than five years old, children whose mothers had a history of diarrhoea were three times more vulnerable than children whose mothers did not have diarrhoeal morbidity. This

might be as a result of mothers being food handlers of the family, and also they are usual child care providers. This shows that caregiver's knowledge of diarrhoea transmission and prevention is vital in reducing diarrhoea incidence among under-fives in the home, hence it is important for mothers and caregivers to be equipped with key hygiene messages for diarrhoea prevention.

Socio-Economic Risk Factors

Childhood mortality and morbidity from different causes are significantly related to the socioeconomic status of the child's parent, which forms the immediate environment to the child. A study conducted in Pakistan found out that the risk factors associated with diarrhoea occurrence are child's own characteristics (gender and age), total number of children born, mother's characteristics (age and education), economic characteristics (ownership of agriculture land and housing) and geographical zones (Arif, 2012).

The same risk factors were noted in a study conducted in the Northeast Ethiopia (Woldu, Bitew, & Gizaw, 2016) which found that families who had two under-five children or above were more likely to have diarrhoea than those who had only one child. As the number of children increased, the frequency of diarrhoea increased significantly. This can be justified by the fact that when the number of children in the household increases, it is expected that children could be more vulnerable to contamination because the quality of care and attention from parents decreases as mothers become incapable of caring for children. Furthermore, children who get diarrhoeal disease may easily transmit the disease to others who live in the same area.

Since Umzingwane District has an average household size of 7 people (Zimbabwe National Statistics Agency, 2012), there could be a possibility of the

majority of households to contain two or more under-fives, leading to decreased quality of care from mothers such that if one child has an episode of diarrhoea he/she easily transmits the disease to others in the same household.

In addition, the study noted that the odds of having diarrhoeal morbidity were higher among children aged six months and above. This may be so because children aged more than 6 months start crawling or walking which increases their exposure to infectious agents.

Furthermore, the study indicated that maternal educational status was statistically associated with the occurrence of childhood diarrhoea. Children whose mothers had attended formal education were less likely to develop diarrhoea compared to children whose mothers had not attended any formal education. This may be due to the fact that education is likely to enhance household health and sanitation practices. Education can increase awareness about the transmission and prevention methods of diarrhoea. It also encourages changes in behaviour at the household level.

This is supported by findings of studies done in Bolivia and Ndola, in Zambia. In Bolivia, it was found that caregiver lack of awareness of practices related to personal and food hygiene for diarrhoea prevention were significant risk factors for diarrhoeal disease in children less than 5 years of age in Cochabamba. The findings suggest that these two knowledge factors are important in childhood diarrhoea prevalence for this population (George et al., 2014).

In Ndola, Zambia diarrhoea prevalence in under-fives was associated with knowledge levels of diarrhoea prevention at the household level. The study showed that the households that had no knowledge of diarrhoea prevention had a high incidence of diarrhoea in under-fives (Chilambwe, Mulenga, & Siziya, 2015).

A study was done in rural Burundi (Diouf et al., 2014) corroborated that maternal education status had a significant contribution to preventing diarrhoeal morbidity. Children whose mothers did not attend formal education were more likely to develop diarrhoea. This might be due to health education is given on hygiene, feeding and weaning practices and the management of childhood illness at school, and the role of different school clubs in personal hygiene and environmental sanitation.

These studies indicate that maternal education bears a significant impact on morbidity caused by diarrhoea. Educated mothers are more exposed to the importance of hygiene, better childcare and feeding practices, and are more aware of disease causation factors and preventive measures. Therefore this makes the researcher assume that caregivers in Umzingwane District might be lacking this vital information on diarrhoea prevention, hence contributing to an increase in diarrhoea cases

In a study done in Ethiopia (Woldu et al., 2016) household economic status was a statistically associated variable. Children whose families were poor economically had higher odds of developing diarrhoea compared with their counterparts. This may be due to the fact that rich families may have greater opportunity to use soap for hand washing and aqua-guard/aqua-tabs at their houses to protect microbial contamination in water and they may construct toilets. Lower income families are suffering from these diseases because they could not afford such facilities.

The household economic status was also a risk factor in a study done in India which noted that young age, low socioeconomic status, poor maternal literacy, presence of under-five sibling in the family, birth weight, inadequate breastfeeding, malnutrition, poor sanitation and hygiene practices of the mother are associated with a higher incidence of diarrhoeal diseases in young children. Children belonging to poor

socioeconomic status had a higher diarrhoeal incidence than the better socioeconomic group (Lakshminarayanan & Jayalakshmy, 2015). Umzingwane District households might be poor economically as the main source of livelihood is piecework especially in irrigation which is a primary source of employment followed by gold panning although it is an illegal activity, making the communities not able to have access to safe water and basic sanitation and hygiene enabling facilities.

A study conducted in Madagascar showed that malnutrition and wasting were associated with a higher risk of severe diarrhoea. Wasting was observed in 43.6% of children with diarrhoea (Randremanana et al., 2016). The same predominant risk factors were detected in a study done in Yemen (Bahartha & AlEzzi, 2015) which showed that recurrent diarrhoea is associated with malnutrition and failure to thrive which adversely affects immunity making the child more susceptible to diarrhoea.

However, malnutrition is highly unlikely to be the cause of upsurge of diarrhoea cases in Umzingwane District. Analysis of malnutrition data captured by the District Health Information System indicated that the problem of malnutrition is very insignificant in the District; hence we cannot correlate it to an uptick of diarrhoea cases in the District.

The other risk factors identified were living in crowded houses and vaccination. Living in crowded houses increased susceptibility to diarrhoea. Children who were not vaccinated were at risk for diarrhoeal diseases, lack of vaccination made children more susceptible to different diseases such as measles, whooping cough, and TB, so this will affect their health adversely, making them vulnerable to different diseases including diarrhoea. Basing on the findings of population census of 2012 that the average size of households in the district is seven people, Umzingwane

communities might be having children that are living under squalid conditions and not vaccinated, which could have led to this high incidence of diarrhoea in the district.

Environmental Risk Factors

A number of environmental factors influence the spread of communicable diseases. The most important of these are water supply, sanitation facilities, food and solid waste management. A lack of safe water, inadequate excreta disposal facilities, and unsafe food can all cause diarrhoeal diseases (WHO, 2005).

A study conducted in Sheko District, Southwest Ethiopia (Gebru, Taha, & Kassahun, 2014) showed that Children's whose families practised improper refuse disposal were more likely to develop diarrhoea when compared to children whose families practised proper refuse disposal. Poor refuse disposal is attributed to direct contact with human excreta when the child starts to crawl, and easily accessible for vector and rodents, which are means of diarrhoea transmission.

This shows that open disposal of waste around the house is a risk factor for diarrhoea. The explanation might be that inappropriate disposal of waste provides a breeding site for insects, which may carry diarrhoeal pathogens from the waste to water and food. Refuse disposal has an important role in diarrhoea prevention, hence an assumption that communities in Umzingwane District might not be managing their solid waste properly, households not having refuse pits and indiscriminately dumping solid waste around their homes, hypothetically contributing to the high incidence of diarrhoea in the district.

This was also noted by a study conducted in Madagascar (Randremanana et al., 2016) that children living in houses containing or surrounded by garbage were three times more likely to develop severe diarrhoea than those living in garbage-free

houses. This shows that is important for communities to properly manage waste as a way of addressing the incidence of diarrhoea at the household level.

Furthermore, communities should also ensure that children faeces are properly disposed of. Hygienic disposal of children faeces is important. In some communities, the stools of children are considered harmless and are indiscriminately thrown around the home together with other solid waste. However, stools are dangerous because they can transmit diseases to other children and parents; hence they should be disposed of quickly and hygienically.

A study conducted in Tanzania showed that getting water from shallow unprotected wells exposes the communities to the risk of having diarrhoea. It was noted that treating water by boiling, straining using cloth, use of chlorine and let it stand and settle has a protective effect to diarrhoea (Kakulu, 2012). Umzingwane district might be having some pockets of communities getting water from unprotected sources as evidenced by 65% safe water coverage in the district (District water reports, 2016).

This, therefore, means that communities should collect water from the cleanest available water source, protect water sources by keeping animals away, by locating latrines more than 10 metres away and downhill and by digging drainage ditches uphill from the source to channel storm water away from it. Collect and store water in clean containers. Empty and rinse out containers daily. Keep the storage container covered and not allowing children or animals to drink from it. Allowing no one especially children to put their hands into the storage container and obtain water using a long-handled dipper for drawing water. Water used for making food or for drinking by young children should be boiled.

The above findings were similar to what was found out in Nigeria where six important risk factors were identified, that could predispose children less than five years to the incidence of diarrhoea. The factors included: poor drinking water handling, lack of hand-washing with soap after defecation and before food preparation, clogged drainage around or near the house, breeding places for flies/insects near the house and total hygiene practice level (Oloruntoba, Folarin, & Ayede, 2014).

Material other than brick used in the construction of habitation was identified as a risk factor for diarrhoea occurrence in a study carried out in Sao Paulo. This suggests that the precarious housing conditions can result in home hygiene difficulty, a factor that can increase the occurrence of diarrhoeal diseases (Paz, Almeida, & Günther, 2012). The housing conditions were also found as a risk factor in a study conducted in Ghana which noted that kitchen hygiene, cleanliness of food and water storage containers and the sanitary condition of cooking and eating areas were strongly associated with high risk of severe diarrhoea (Osumanu, 2008).

Woldt and Moy (2015) agrees with a study done in Ghana that the most common problems that are associated with contamination of family foods with pathogenic microorganisms include, inadequate reheating of food in terms of temperature and/or time, storage of cooked food at ambient temperature for extended periods, contamination of hands with pathogens, use of raw food products that had a high level of contamination with pathogens, and use of water contaminated with pathogens. Other problems included contamination from utensils and inadequate initial cooking of food.

Poor kitchen hygiene might also be peculiar in Umzingwane District; households can be preparing food under dirty environments which promotes

contamination by disease pathogens. Kitchen hygiene is key in diarrhoea prevention and caregivers should ensure that food is prepared and served in a clean environment.

Open defecation, referring to the practice whereby people go out in fields, bushes, forests, open bodies of water, or other open spaces rather than using the toilet to defecate. The practice is rampant in India and the country is home to the world's largest population of people who defecate in the open and excrete close to 65,000 tonnes of faeces into the environment each day. Around 523 million people, which is nearly half the population of India, defecate in the open. India accounts for 90 percent of the people in South Asia and 59 percent of the 1.1 billion people in the world who practise open defecation. Open defecation poses a serious threat to the health of children in India. The practice is the main reason India reports the highest number of diarrhoeal deaths among children under-five in the world. Every year, diarrhoea kills 188,000 children under five in India (UNICEF, 2015).

The similar practice might be occurring in Umzingwane District, as the district has 58% basic sanitation coverage (District sanitation reports, 2016), meaning 42% of the people in the District have no access to basic sanitation facilities and they might be practising open defecation and posing a serious threat to health of the children in the District. The high incidence of diarrhoea might be linked to lack of sanitation facilities and rampant open defecation which might be occurring around the District.

Developing strategies to eliminate open defecation might prove to be one of the major ways of reducing the incidence of diarrhoea in Umzingwane District, as open defecation can be responsible for contamination of environment and water sources with diseases causing pathogens and proliferation of flies around households, which can contaminate food with faeces creating good environment for diarrhoea to strive.

Summary

Inferring from the findings of the studies above, poor sanitation, mode of water transportation, and poor handling of water at the household level, the presence of wastewater in the street, refuse storage, collection and disposal, domestic water reservoir conditions, faeces disposal and presence of vectors predispose the under-five children to diarrhoea. Indiscriminate stool disposal by the mothers, lack of hand-washing before feeding their children and hand-washing without soap increases the risk of diarrhoea in children less than five years old.

Many pathogens that cause diarrhoea are spread by the faecal-oral route. The primary routes of transmission for human faeces to cause diarrhoea include contaminated fluids, such as water contaminated with faeces; fingers, such as when hands become contaminated from one's own faeces, flies, which may carry faeces and contaminate food or other surfaces and fields/floors, such as when agricultural fields are contaminated with untreated faecal waste or rain/irrigation water that is contaminated with faeces, or when household floors are contaminated with faecal material that then is spread via fluids, fingers, and/or flies.

Diarrhoeal disease can be reduced through: improved sanitation, including sewer connections, effective water treatment at the household level (such as boiling water or treating water with chlorine or other appropriate agents) and safe water storage, hand washing with soap, appropriate food hygiene practices, such as thorough cooking, storage at appropriate temperature, and hand washing with soap before preparing food. These factors have been shown to play an important role in interrupting transmission of diarrhoeal diseases regardless of whether the source of the pathogen is human or animal faeces.

CHAPTER 3

METHODOLOGY

Study Design

The study was a 1:1 unmatched case-control study. The research surveyed 200 cases and 200 controls. The cases were children less than five years old in Umzingwane District who had diarrhoea in 2016. The researcher used the standard case definition for diarrhoea as cited previously in the literature review. The controls were children less than five years old who did not have diarrhoea in 2016 and coming from the same neighbourhood as cases.

Study Area

The study was conducted in Umzingwane District, shown in Figure 2.

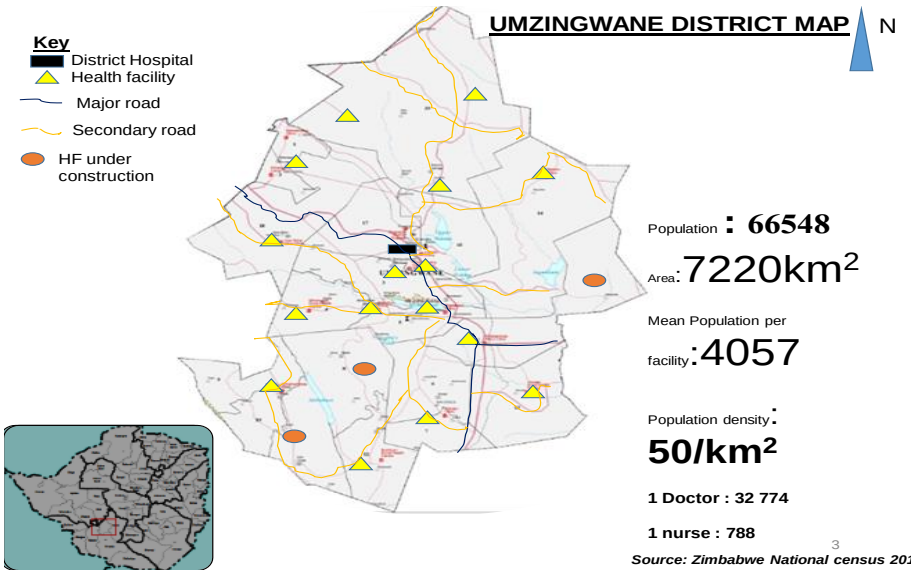

Figure 2. Umzingwane District Map

Umzingwane District is located in the Northeastern part of Matabeleland South province, and shares boundaries with Gwanda to the south, Insiza to the East, Umguza to the North and Bulawayo city to the west. It has a total population of 66 204 according to the 2012 census, average household size of 7 people and settled on a land area of 7 220sq.km but total arable land is 33 000 hectares.

The district is the most densely populated in the province with 50 persons per square kilometre in the communal lands. The district has a total of 20 wards, which can be separated into the North, Central, East and West regions. The district falls under Agro-Ecological Zone III, IV and V, with regions III and IV typically receiving 450 to 650mm of rainfall. The District is subject to periodic seasonal drought spells receiving no more than 400mm of annual rainfall.

In terms of water and sanitation, the District has 245 boreholes, 109 wells and 80 dams. Despite having dams as Ncema with huge masses of water, the major limiting factor to the utilization of water by communities in Umzingwane is that the City Council of Bulawayo owns these dams; hence an estimated 80% of water is for Bulawayo and only 20% is for use by communities. The district has a safe water coverage of 65% and sanitation coverage of 58%.

The main source of livelihood is piecework especially in irrigation which is a primary source of employment followed by gold panning although it is an illegal activity. Umzingwane District is serviced by 16 health facilities including one District Hospital, 9 Council clinics, 5 Government Rural Health Centres, 1 Army clinic and 1 Mine owned clinic.

Study Population

The study population was caregivers and children less than five years.

Inclusion Criteria

Households were eligible for inclusion in the survey if the following criteria were met:

1. Presence of mother or caregiver
2. Presence of at least one child under the age of five

Sample Size Estimation

The researcher used the formula for Case-Control Studies of childhood diarrhoea by Cousens, Feachem, Kirkwood, Mertens, and Smith (1988) to calculate sample size.

$N= 2XCXDX(S+T)^{2}/ (P- A) X (P- A)$

Where

N= desired sample size

A= PXR/1+P(R – 1.0)

C= A+P/2

D= 1-C

R= the odds ratio that the study is being designed to detect (2.5)

P= the proportion of the population exposed to the risk factor of interest (0.10)

S= the level at which results will be deemed statistically significant (0.05, the formula uses corresponding values, therefore, S = 2.0)

Value corresponding to level of significance (1%=1.7; 5%=2.0; 10%=2.6)

T= the required power of the study (0.80, the formula uses corresponding values, therefore, T = 0.9)

Value of T corresponding to the level of different powers (80%=0.9, 90%=1.3; 95%=1.7)

N was multiplied by 1.25, to allow for confounding

N= Therefore a minimum calculated number of the study population for this survey was 200 cases and 200 controls.

Data Collection Methods

A pre-tested, interviewer-administered questionnaire was developed and used to collect data from caregivers of cases and controls and under-fives. Independent variables included the following:

1. Behavioural risk factors (household hygiene, feeding practices, hand washing, sanitary state of latrines, treatment of water before use, sanitary state of the water storage container, availability of lid for the container, sanitary state of receptacles used to draw water, sanitary state of utensils used to cook and serve food)
2. Socio-economic risk factors (level of education, knowledge of diarrhoea prevention, vaccination status of children, household average monthly income)
3. Environmental risk factors (source of water, water storage container, availability of working toilet in the home, type of toilet, management of children faeces and solid waste, area used to store and prepare food)

The researcher was assisted by eight research assistants, recruited from a team of Environmental Health Technicians in the District. These are public health practitioners with experience in active surveillance and promotion of improved water and sanitation services, managing and supervising solid and liquid waste disposal, vector control and promotion of primary health care. They are qualified trainers in Participatory Health and Hygiene Education (PHHE) and also conduct capacity building of village health promoters and community health volunteers. They provide

technical support for the construction and maintenance of Blair latrines and train builders on latrine construction.

The research assistants were oriented for two days on filling the questionnaire, conducting sanitary inspections, the collection of water samples for bacteriological analysis and as well as on consent form. The orientation exercise also incorporated the testing and refinement of the questionnaire in five households. The questionnaire was refined based on the issues raised by research assistants to ensure that questions were properly understood by the local communities. The refined questionnaire was then used to collect data from communities. The pre-test also provided crucial information on the validity and usefulness of the data collected. The research assistants were conversant with the local language (Ndebele) and they were able to translate the questionnaire to local language when/if the need arose.

During the data collection phase, the questionnaire was filled by research assistants. Children less than five years old were asked two basic child level questions and were interviewed in the presence of the caregiver. The research assistants also conducted sanitary inspections through visual assessment of the infrastructure and the sanitary state surrounding the household water supply, water-holding containers, household sanitary conditions, food storage, personal hygiene and kitchen hygiene and photographs were captured during the above mentioned sanitary inspections. The sanitary inspections around water supply were done using a standard sanitary inspection form (see Appendix B). The water sources sanitary state was ranked using the standard scores provided in the form and from the sources that were found to have a risk of contamination, water samples were collected to the laboratory to check for Escherichia Coli (E. coli) contamination and turbidity. Escherichia Coli is an indicator organism and its presence in water suggests that water has been contaminated with

human faeces as they normally inhabit gastrointestinal tract of humans. The World Health Organisation (WHO) standard is zero Coliforms in water for drinking purposes.

Turbidity is a measure of the degree to which the water loses its transparency due to the presence of suspended particulates. The more total suspended solids in the water, the murkier it seems and the higher the turbidity. Turbidity is considered as a good measure of the quality of water. It is very important to measure the turbidity of domestic water supplies, as these supplies often undergo some type of water treatment which can be affected by turbidity. Where chlorination of water is practised, even quite a low turbidity will prevent the chlorine killing the germs in the water efficiently. The World Health Organisation turbidity standard in water for drinking purposes is less than five Nephelometric Turbidity Unity (N.T.U). Figure 3 below shows the criteria used for water samples collection.

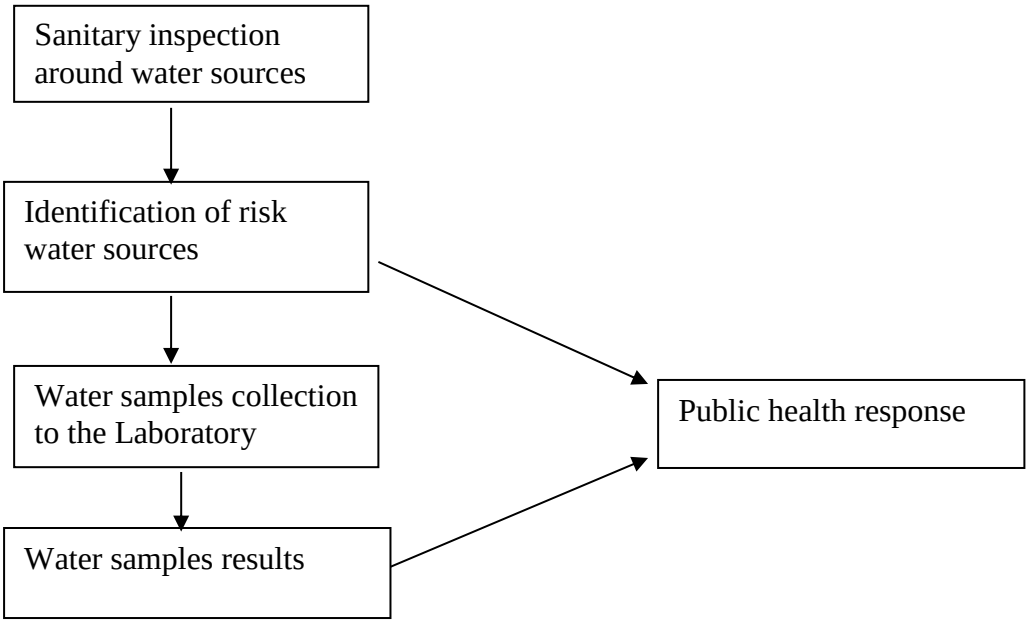

Figure 3. Criteria for Water Samples Collection

Sampling Procedure

The diarrhoea cases for 2016 were sorted according to the health facility where they were reported as shown in Table 1 below.

Table 1. Distribution of Diarrhoea Cases by Health Facility

Name of health facility	2016 Diarrhoea cases by gender		Total	Percentage contribution by facilities (%)
	M	F		
Esibomvu	51	50	101	9.9
Esigodini District Hospital	98	105	203	19.9
Habane	37	28	65	6.3
Howmine	12	27	39	3.8
Irisvale	19	25	44	4.3
Kumbudzi	31	35	66	6.5
Mawabeni	46	54	100	9.8
Mbalabala	30	20	50	4.9
Mbizingwe	29	40	69	6.8
Mhlahlandlela	24	19	43	4.2
Mpisini	21	26	47	4.6
Mzingwane	9	9	18	1.8
Nhlangano	14	27	41	4.0
Nswazi	23	14	37	3.6
Ntshamathe	42	33	75	7.4
Zimbili	9	11	20	2
Total	495	523	1 018	100

The sample size for each facility was determined using the formula mentioned above. Simple random sampling technique was used to select cases that participated in the study. The names of children with diarrhoea in 2016 were written in small pieces of paper in each health facility and then collected and picked at random to select households that were surveyed. This sampling method had no bias and all children representing households had equal chances to be picked. In each of the selected household, a primary caregiver and children from 3-5 years old were interviewed.

Ethical Considerations

To protect the respondents from possible harm related to the study, the researcher upheld principles of confidentiality; the information from the respondents was maintained between the researcher and the respondent. The participants were informed of the benefit of the study: that it may result in decreased incidence of diarrhoeal diseases among under-fives in Umzingwane District. The participants were told that they will not receive any payment or compensation for their participation in the study. The caregivers that participated in the research were required to complete a consent form and were treated as autonomous agents capable of self-determination and they retained their right to withdraw from the study at any time. The caregiver of the under-fives consented on their behalf. Identifiers were removed from photographs captured during sanitary inspections to protect participant identity.

Method of Data Analysis

Data were analyzed using Epi Info 7.2.1.0 version. Odds ratios and Chi-square tests at 5% significant levels and 95% confidence intervals were generated using the software. Forward stepwise logistic regression analysis was used to control for confounding and effect modification. The adjusted odds ratios were calculated to quantify the strength of association between risk factors and outcome and factors with a p-value less than 0.05 were considered significant.

Odds ratios are interpreted as follows;

1. OR=1 Exposure does not affect odds of the outcome
2. OR>1 Exposure associated with higher odds of the outcome
3. OR<1 Exposure associated with lower odds of the outcome

CHAPTER 4

RESULTS

Demographic Characteristics of the Participants

All the 400 caregivers from 400 households that were randomly selected for the study in Umzingwane District, participated in the interview, thus resulting in a response rate of 100%. All the caregivers were females who were at least 18 years of age. During the survey, 364 (91%) children between 3-5 years were interviewed from 364 households and 36 (9%) of households who participated in the study had children between 0-2 years and these were below age limit for the interview.

According to the results of the study, 60% caregivers from households of cases had primary education, 36.5% had secondary education and 3.5% had tertiary education. 29% of caregivers from households of controls had primary education, 58.5% had secondary education and 12.5% had tertiary education. The majority of households of cases (65%) had average monthly income less than $ 50 while 60% of households of controls had average monthly income greater than $50 as shown in Table 2 below.

Table 2. Demographic Characteristics of the Participants

Characteristic	Category	Frequency	Percentage (%)
Adults (n= 400)	Cases	200	50
	Controls	200	50
Under-five children (n= 400)	Cases	200	50
	Controls	200	50
Level of education			
Primary (n=178)	Cases	120	60
Primary (n=178)	Controls	58	29
Characteristic	Category	Frequency	Percentage (%)
Secondary (n=190)	Cases	73	36.5
	Controls	117	58.5
Tertiary (n=32)	Cases	7	3.5
	Controls	25	12.5
Average monthly income			
< $50 (n=210)	Cases	130	65
	Controls	80	40
>$50 (n=190)	Cases	70	35
	Controls	120	60.

Water Quality Test Results

35 borehole water samples were collected for bacteriological analysis. Out of 35 borehole water samples tested, 33 (94.29%) were below the threshold limit for contamination with *Escherichia coli* and two of the 35 (5.71%) borehole water samples tested were above the threshold for contamination with *Escherichia coli*. 50 water samples were collected from shallow unprotected wells. Out of 50 unprotected shallow wells water samples tested 9(18%) were below the threshold limit for contamination with *Escherichia coli* and 41(82%) unprotected shallow wells water samples tested were above the threshold for contamination with *Escherichia coli* as shown in Tables 3 and 4 below.

Table 3. Water Quality Results for Wards 1 to 10

Ward	Village	Type of water point	Turbidity/NTU	E.Coli
1	Sigola	Borehole	< 5	0
1	Ntshamathe	Borehole	< 5	0
1	Zanqaweni	Borehole	< 5	0
1	Mbizo	Shallow well	< 5	13
2	Sihlengeni	Borehole	< 5	0
2	Nhlozamandla	Borehole	< 5	0
2	Siphezini	Shallow well	< 5	20
2	Ngwabi	Borehole	< 5	3
3	Nhlekiyana	Borehole	< 5	0
3	Mtshede	Borehole	< 5	0
3	Vukuzenzele	Shallow well	< 5	10
3	Msizini	Borehole	< 5	0
3	Gongo	Shallow well	< 5	25
4	Sibambene	Shallow well	< 5	33
4	Mbizingwe	Borehole	< 5	0
4	Sibangani	Borehole	< 5	0
4	Ekuthuleni	Shallow well	< 5	0
5	Irrigation	Shallow well	< 5	15
5	Mawabeni	Borehole	< 5	0
5	Therelina	Shallow well	< 5	21
5	Spaba	Shallow well	< 5	19
5	Mlomoliwoto	Shallow well	< 5	16
6	Madilowola	Shallow well	< 5	22
6	Tshakambeba	Borehole	< 5	0
6	Mathendele	Borehole	< 5	0
6	Vulindlela	Borehole	< 5	0
6	Asithuthukeni	Shallow well	< 5	0
6	Ntshene	Shallow well	< 5	10
7	Mkhutshwa	Shallow well	< 5	11
7	Nswazi	Borehole	< 5	0
7	Nswazi	Shallow well	< 5	15
7	Sezhube	Shallow well	< 5	19
8	Shale	Shallow well	< 5	1
8	Dindindi Gante	Shallow well	< 5	8
8	Zhilo	Shallow well	< 5	7
8	Diana’s pools	Shallow well	< 5	14
9	Gabheni	Shallow well	< 5	12
9	Dobhi	Shallow well	< 5	5
9	Matopo	Shallow well	< 5	7
10	Sotsha	Shallow well	< 5	17
10	Silobi	Shallow well	< 5	23

Table 4. Water Quality Results for Wards 11 to 20

Ward	Village	Type of water point	Turbidity/NTU	E.Coli
11	Dula B	Shallow well	< 5	13
11	Dula Mazhowe	Borehole	< 5	0
11	Impu	Borehole	< 5	0
12	Kumbudzi	Borehole	< 5	0
12	Kumbudzi	Shallow well	< 5	0
12	Kumbudzi	Shallow well	< 5	25
12	Matolokisi	Shallow well	< 5	8
12	Bezha	Shallow well	< 5	9
12	Zidlabusuku	Shallow well	< 5	15
12	Munkula	Borehole	< 5	0
12	Munkula	Shallow well	< 5	0
12	Baza	Shallow well	< 5	17
12	Baza	Borehole	< 5	0
13	Village 1A	Borehole	< 5	0
13	Village 1B	Borehole	< 5	0
13	Village 2	Shallow well	< 5	0
13	Village 3	Borehole	< 5	0
13	Village 4	Shallow well	< 5	4
13	Village 5	Shallow well	< 5	9
13	Village 6	Borehole	< 5	0
13	Village 7	Borehole	< 5	0
13	Village 8	Shallow well	< 5	0
14	Mangweni	Borehole	< 5	0
14	Mpisini	Shallow well	< 5	2
14	Bafazi	Shallow well	< 5	13
14	Bayethe	Shallow well	< 5	11
14	Malungwane	Shallow well	< 5	6
16	Habane	Borehole	< 5	5
16	Habane	Borehole	< 5	0
17	Crocodile	Borehole	< 5	0
17	Crocodile	Shallow well	< 5	18
17	Khomani	Borehole	< 5	0
17	DA	Borehole	< 5	0
17	Council	Borehole	< 5	0
19	Ntabende	Shallow well	< 5	0
19	Godlwayo	Shallow well	< 5	16
19	Zimbili	Shallow well	< 5	6
19	Zimbili	Shallow well	< 5	27
19	Glengrey	Borehole	< 5	0
20	Portbury	Borehole	< 5	0
20	Portbury	Shallow well	< 5	0
20	Malilangwe	Shallow well	< 5	10
20	Swaite	Shallow well	< 5	0
20	Nyema	Shallow well	< 5	22

Analytic Epidemiology

A total of 200 cases and 200 controls were recruited into the study. The outcome odds were compared between cases and controls. The study noted that there were no significant differences in treating water before use, type of toilet in the home, food given to under-fives and exclusive breastfeeding between cases and controls as shown in Table 5 below.

Table 5. Non-risk Factors for Diarrhoea in Under-Fives, Umzingwane District

Factor		Cases	Controls	p-value
		n = 200	n = 200	
Treating water before use	Yes	35	20	0.065
	No	165	180	
Type of toilet in the home	BVIP	97	141	0.611
	Pit latrine	16	19	
Type of food given to under-fives	Solids	196	199	0.310
	Milk only	4	1	
Exclusive breastfeeding	Yes	41	54	0.888
	No	9	11	

Factors Associated with Diarrhoea

Behavioural Factors

The statistically significant factors were: water storage container sanitary state[OR=0.4828, CI=0.4050-0.5754, p-value= 0.0000], availability of lid in container used to store water[OR=0.2177, CI=0.1181-0.4015, p-value=0.000002154], sanitary state of receptacles used to draw water[OR=0.1043, CI=0.0548-0.1888, p-value=0.0000], sanitary state of the toilet[OR=0.2712, CI=0.1569-0.4687, p-value=0.00000161], sanitary state of utensils used to cook and serve food[OR=0.1028, CI=0.0537-0.1968, p-value=0.0000], washing of hands at all critical times by caregivers[OR=0.0293, CI=0.0167-0.0512, p-value=0.0000],

washing hands by children after using toilet[OR=0.0511, CI=0.0303-0.0859, p-value=0.0000], and washing hands by children before handling food [OR=0.0778, CI=0.0459-0.1317, p-value=0.0000], as shown on table 6 below.

Table 6. Behavioural Factors Associated with Diarrhoea

Factor	Category	Cases N=200	Controls N=200	Odds Ratio (95% CI)	p-value
Water storage container sanitary state	Clean	109	177	0.22(1.12-0.40)	0.000000
	Dirty	90	24		
Does the container have a lid	Yes	145	185	0.22(1.12-0.40)	0.0000022
	No	54	15		
Sanitary state of receptacles used to draw water	Clean	115	187	0.10(0.05-0.19)	0.000000
	Dirty	83	14		
Sanitary state of the toilet	Clean	62	130	0.27(0.16-0.47)	0.00000161
	Dirty	51	29		
Washing hands by children between 3-5years old after using the toilet	Yes	38	112	0.05(0.030-0.086)	0.000000
	No	144	70		
Washing hands by children between 3-5years old before eating	Yes	87	141	0.08(0.046-0.132)	0.000000
	No	104	32		
Utensils used to cook and serve food	Clean	124	189	0.10(0.054-0.197)	0.000000
	Dirty	76	11		
Washing of hands by caregivers at all critical times	Yes	35	176	0.03(0.017-0.051)	0.000000
	No	165	24		

Socioeconomic Factors

Statistical significant factors were: caregiver level of education [OR=0.1244, CI=0.0427-0.3624, p-value=0.0001], household-income [OR=0.3199, CI=0.1989-

0.4953], vaccination status of children less than five years old against rotavirus [OR=0.1355, CI=0.0464-0.3961, p-value=0.0000274], caregiver knowledge of diarrhoea prevention [OR=0.1105, CI=0.0632-0.1931, p-value=0.0000], as shown on table 7 below

Table 7. Socioeconomic Factors Associated with Diarrhoea

Factor	Category	Cases N=200	Controls N=200	Odds Ratio (95% CI)	p-value
Vaccination status of under-fives against rotavirus	Yes	170	193	0.136 (0.046-0.396)	0.0000274
	No	30	7		
Caregiver information on diarrhoea prevention	Yes	105	182	0.111 (0.063-0.193)	0.0000000
	No	95	18		
Household average monthly income	< $50	130	80	2.83 (1.88-4.24)	0.000000406
	> $50	70	120		
Caregiver level of education	Lower level (primary and secondary)	193	175	5.96 (2.24-15.80)	0.000064455
	Upper level(tertiary)	7	25		

Environmental Factors

Statistical significant factors were source of water[OR=0.2432, CI = 0.1462-0.4045, p-value= 0.0000], working toilet in the home[OR=0.3543, CI= 0.2241-0.5507, p-value=0.000002777], refuse disposal[OR=2.081, CI=1.2299-3.5219, p-value=0.00568], sanitary state of area used to store food[OR=0.0907, CI=0.0492-0.1670, p-value=0.0000], availability of two pot racks--one for washing plates and another for drying plates[OR=0.3671, CI=0.2325-0.5798, p-value=0.0000123395],

sanitary state of the kitchen[OR=0.1029, CI=0.0594-0.1781, p-value=0.0000], disposal of children's faeces[OR=0.0435, CI=0.0216-0.0873, p-value=0.0000], as shown on table 8 below.

Table 8. Environmental Factors Associated with Diarrhoea

Factor	Category	Cases N=200	Controls N=200	Odds Ratio (95% CI)	p-value
Source of water	Protected	124	177	0.24 (0.15-0.40)	0.000000
	Unprotected	76	23		
Working toilet in the home	Yes	114	159	0.35 (0.22-0.55)	0.0000028
	No	85	42		
Sanitary state of the area used to store food	Clean	109	187	0.091 (0.049-0.167)	0.000000
	Dirty	90	14		
Two pot racks in the home	Yes	39	177	0.367 (0.233-0.580)	0.0000123
	No	161	123		
Sanitary state of the kitchen	Clean	98	181	0.103 (0.059-0.178)	0.000000
	Dirty	102	19		
Refuse disposal	Open dumping	47	25	2.08 (1.23-3.52)	0.00568
	Refuse pit	153	175		
Disposal of children's faeces by caregivers	Toilet and buried	70	191	1.50 (16.05-61.82)	0.000000
	Open dumping	130	11		

Multivariate Analysis

The independent risk factors for contracting diarrhoea were: source of water [OR=2.2457, CI=1.0924-4.6164, p-value=0.0278], disposal of solid waste [OR=4.62, CI=1.9380-11.0330, p-value=0.0006], sanitary state of the kitchen [OR=2.2307, CI=1.0185-4.8854, p-value=0.0449] as shown in table 9 below.

Table 9. Independent Risk Factors for Diarrhoea in Under-Fives, Umzingwane District

Factor	Adjusted odds ratio (95% CI)	p-value
Source of water	2.2457(1.0924- 4.6164)	0.0278
Sanitary state of the kitchen	2.2307(1.0185- 4.8854)	0.0449
Disposal of solid waste	4.6200(1.9380-11.0330)	0.0006

Independent protective factors for diarrhoea were: household income [OR=0.2273, CI= 0.1180-0.4378, p-value=0.0000], caregiver knowledge on diarrhoea prevention [OR=0.2940, CI=0.1316-0.6566, p-value=0.0028], washing hands by caregivers at all critical times [OR=0.0461, CI=0.0227-0.0937, p-value=0.0000] as shown on table 10 below.

Table 10. Independent Protective Factors for Diarrhoea in Under-Fives, Umzingwane District

Factor	Adjusted odds ratio (95% CI)	p-value
Washing of hands by a caregiver at all critical times	0.0461(0.0227- 0.0937)	0.0000
Adequate information by caregivers on diarrhoea prevention and control	0.2940(0.1316- 0.6566)	0.0028
Household monthly average income	0.2273(0.1180-0.4378)	0.0000

CHAPTER 5

DISCUSSION, CONCLUSION AND RECOMMENDATIONS

Discussion

This study provides detailed information about household characteristics in a rural setting of Umzingwane District, Matabeleland South Province, Zimbabwe and their interrelation with diarrhoea prevalence among the under-five population. The statistically significant factors were:

Source of Water

Source of water was found to be an independent risk factor for contracting diarrhoea in children less than five years old in Umzingwane District. The households that were getting water from unprotected sources were 2.24 times more likely to get diarrhoea in under-fives as compared to a household that was getting water from protected sources. See Appendix E for some of the examples of unprotected water sources observed during the survey. The results corroborated a study conducted in Tanzania by Kakulu (2012), which showed that getting water from shallow unprotected wells and not treating it before use exposes the communities to the risk of having diarrhoea. Therefore, communities getting water from shallow unprotected wells should be encouraged to treat water before use in order to protect themselves from diarrhoea.

Sanitary State of Water Storage Containers

The study noted poor drinking water handling by households, as water storage containers were found dirty and having no lid. Households that were storing their

water in dirty containers that had no lid and also using dirty receptacles to draw water from the container were at higher risk of getting diarrhoea as compared to households storing water in clean containers that had lids. See Appendix E for examples of dirty water storage containers.

This is in agreement with the findings of a study done in Nigeria (Oloruntoba et al., 2014), which identified poor drinking water handling by households as a risk factor for diarrhoea. Dirty containers that have no lid increase the possibility of contamination by microorganisms. Even though the water was collected from protected sources, if the handling of water by the household was poor, there was an increased likelihood of water contamination. Proper handling of water by households is critical to the prevention of diarrhoea, as this study bears out also.

Refuse Disposal

The method of refuse disposal was noted to be an independent risk factor for diarrhoea in under-fives. Households that were not properly managing their refuse were 4.62 times more likely to get diarrhoea than households which were properly managing their solid waste. The explanation is that inappropriate disposal of waste provides a breeding site for insects, which carry diarrhoeal pathogens from the waste to water and food. Appendix E shows some of improper waste management practices observed during the survey. Solid waste such as decomposing organic substances, papers, metals, plastic containers and ashes were found in some households scattered around the home creating conducive environments for the proliferation of disease-causing pathogens.

Sanitary State of the Kitchen and Cooking Utensils

The diarrhoea incidence was noted to be high in households that have dirty kitchens, those who store food in dirty areas, use dirty utensils to cook and serve food, and do not have two dish racks—one for washing plates and another for drying plates. The dirty kitchen was observed to be an independent risk factor for diarrhoea incidence in under-fives. Households with dirty kitchen were 2.23 times at risk of getting diarrhoea as compared to households with clean kitchens. Appendix E below shows some examples of dirty cooking utensils observed during the survey.

The results of the study are in tandem with the findings of a study done in Viet Nam (Takanashi et al., 2009) which suggests that food-hygiene practices of mothers might have an important impact on the prevalence of diarrhoea among under-fives.

In our study, the risk of diarrhoea was higher among children whose mothers cooked and served food in dirty utensils, did not have two pot racks, one for washing plates and another for drying. These mothers also prepared food on the ground rather than on the table. The association with the prevalence of diarrhoea could indicate that the food prepared on the ground was contaminated, and the grounds or the floors are the important routes for transmission of diarrhoeal pathogens.

Availability of a Working Toilet and Its Utilisation

The study noted that a high number of cases were coming from households that had no working toilet and did not properly manage the faeces of children as compared to households that had toilets and who were either burying children's faeces or disposing of them in the toilet. Children's faeces were observed in 60% of the households of cases. This exposed faecal matter encourages flies to breed around the home, thus exposing the families to high risk of diarrhoea. Therefore, households

without toilets should be encouraged to construct toilets and/or bury faeces of children.

It was further noted that it is not only the mere presence of a latrine that is important in diarrhoea prevention but also its proper utilisation and maintenance in a clean state always. During the survey, it was observed that although some households had toilets, they were not spared from diarrhoeal disease because their latrines were dirty. The households with toilets should be encouraged to keep them clean all the times as some were also noted to contribute to diarrhoea incidence because of their unsanitary state. As shown in Appendix E, some toilets were found dirty and with visible faeces around the squat-hole, with a foul odour. This unsanitary state of the toilet creates ideal conditions for contamination of food by flies.

Knowledge of Diarrhoea Prevention by Care Giver

The knowledge of diarrhoea prevention by caregivers was found by this study to be a significant protective factor; knowledge of diarrhoea prevention by caregivers protected children from getting diarrhoea. Households with caregivers having adequate knowledge of diarrhoea prevention were noted to be less likely to have children developing diarrhoea.

The results of the study concurred with Woldu et al. (2016) that children whose mothers had attended formal education were less likely to develop diarrhoea compared to children whose mothers had not attended any formal education. This may be due to the fact that education is likely to enhance household health and sanitation practices. Education can increase awareness about the transmission and prevention methods of diarrhoea. It also encourages changes in behaviour at the household level.

Maternal education bears a significant impact on morbidity caused by diarrhoea. Educated mothers are more likely to have been exposed to the importance of hygiene, better childcare and feeding practices, and are more aware of disease causation factors and preventive measures. Therefore, it is important for caregivers to have adequate knowledge of diarrhoea prevention to reduce the incidence of diarrhoea.

Household Monthly Income

Household monthly income was noted as a significant protective factor for diarrhoea in children less than five years old. The odds of developing diarrhoea in households with higher income were low as compared to households with lower income.

This was also noted in the study by Woldu et al. (2016) referred to earlier. Children whose families were economically poor had higher odds of developing diarrhoea compared with their counterparts in more economically stable families. This may be due to the fact that economically stable families may have greater opportunity to use soap for hand washing and aqua-guard/tabs (water treating tablets or chemicals) at their houses to protect against microbial contamination in water and they may construct toilets. Lower-income families were observed to be at higher risk for this disease because they could not afford these facilities

Hand Washing

Washing hands after using the toilet and before handling food by caregivers were found to be a significant protective factor. The results are in agreement with the findings of the study conducted in Sebeta town of Ethiopia (A. I. Mohammed & Zungu, 2016), which noted that children whose caretakers thought that washing the children's hands, supervising what they eat, washing fruits and vegetables, and

washing kitchen utensils are important preventive actions that resulted in a lower prevalence of diarrhoea. Such practices are protective against diarrhoea and can reduce the risk of diarrhoea by about 40% when compared with children of mothers who thought that these practices were unimportant in diarrhoea prevention.

Our study found that monitoring by caregivers, that children less than five years old wash their hands at all times after using the toilet and before handling food is an important factor in reducing diarrhoea incidence among under-fives at the household level.

The existence of a designated place for hand washing is a good predictor of actual hand washing practice, and closely related to diarrhoeal disease prevalence. Children from households with a specific place for hand-washing were observed to be less likely to have diarrhoea compared to those from households that did not have specific places for hand washing. Appendix E below shows designated hand washing facilities observed during the survey.

Designated hand washing facilities in the form of tip-tapes in some of the surveyed households are portraying evidence for hand washing. Washing of hands by caregivers at all critical times was found to be a protective factor and the odds of developing diarrhoea in households with caregivers that are washing hands at all critical times were low as compared to households who did not wash hands at all critical times. A systematic review of several studies also confirmed that poor maternal hand washing practices were positively associated with the occurrence of diarrhoeal morbidity.

Many pathogens are known to cause diarrhoea is spread by the faecal-oral route. The primary routes of transmission for human faeces to cause diarrhoea include contamination through fingers, such as when hands become contaminated from one's

own faeces. This indicates that since the mothers are the main caregivers for their children they should wash their hands before preparing food and feeding infants and young children to tackle the occurrence of diarrhoea. Proper handwashing with soap before feeding this vulnerable age group has a great role in the prevention of diarrhoea and other diseases.

Conclusion

The study has highlighted the disaggregated household level risk factors for diarrhoea in under-fives in Umzingwane District. The environmental risk factors were drinking water from contaminated sources, indiscriminate disposal of waste around the home and unsanitary status of the kitchen where food is prepared. This clearly indicates the importance of environmental health as a determinant of child health. Therefore there is a need for effective measures to enhance universal access to safe water, improved food hygiene practices and appropriate waste management strategies at the household level.

The socioeconomic protective factors were knowledge of diarrhoea prevention and economic stability of the caregivers. The behavioural protective factor was washing hands at all critical times by caregivers. This implies that hygiene promotion interventions should prioritise protective factors such as increasing caregiver knowledge of diarrhoea prevention, establishment and use of hygienic hand washing facilities and improving the socioeconomic status of households.

Recommendations

Based on the findings of this study, the District should develop health promotion interventions focusing on:

1. Strengthening community-based management (CBM) of water infrastructure such as boreholes, through training of water point committees and village pump

minders to keep their water sources in the hygienic state, protected from contamination and functional all the time. These capacity development initiatives will empower communities with skills to repair their water sources urgently in cases of breakdown, to help reduce downtime and to improve the sustainability of such infrastructure to ensure community access to safe water. This will also ensure that water is properly handled at the household level to prevent contamination. Where communities are getting water from unprotected sources, people should be encouraged to treat their water before use, either by boiling or use of chemicals (aqua-tabs/aqua-guards).

2. Strengthening water quality monitoring through supporting the Public Health Officers with required resources and equipment to ensure that all water sources are monitored quarterly and, if contamination is detected, corrective measures are instituted promptly.

3. Ensuring that caregivers have adequate knowledge on diarrhoea prevention and control through formation and sustenance of community health clubs, door to door campaigns, community gatherings and developing cell phone based technological application that will enable sending of health and hygiene key messages on periodic bases to communities and other similar initiatives that will help in increasing community knowledge, capacity building and personal skills development in diarrhoea prevention and control.

4. Reaching out to communities with sanitation focused participatory health and hygiene education to trigger communities to eliminate open defecation and its associated risks through latrine construction and designated areas for hand washing with soap so that both caregivers and under-fives have access to hand washing facilities at all critical times.

5. Improving food hygiene practices by caregivers so that they store and prepare food in a clean environment through maintaining a clean kitchen and using clean utensils to cook and serve food at all times.

6. Sensitisation of communities on the importance of proper waste management and ensuring that every household has a standard refuse pit for proper refuse management.

7. Establishing income generating projects for the communities so that they are able to raise funds for constructing and sustaining hygiene enabling facilities such as water, toilets and hand washing infrastructure.

APPENDICES

APPENDIX A

QUESTIONNAIRE

SURVEY QUESTIONNAIRE FOR CAREGIVERS AND CHILDREN LESS THAN FIVE YEARS OLD

Good morning/afternoon my name is Sifelani Mkandla, a Public Health student at the Adventist University of Africa. I am conducting a study to determine the risk factors associated with diarrhoea uptick in 2016, in children less than five years old in Umzingwane District.

This study is expected to generate evidence-based recommendations for assisting in the development of effective health promotion strategies to prevent the occurrence of diarrhoea in children less than five years in Umzingwane District. This will be an interviewer-administered questionnaire which will take approximately 30 minutes to complete. Your identity will be kept confidential. All answers you provide in this survey will be kept confidential, therefore feel free to respond as accurately as possible to the questions. Participation in this study is entirely voluntary. If you choose to participate, please sign below.

Interviewee signature..... Interviewer signature.....

Questionnaire Number.....

Date of interview.....

a) Demographic information

1. What is your completed level of education?

Primary

Secondary

Tertiary

2. What is your household average monthly income?

< $50

>$50

b) Water supply

3. What is your main source of water?

Borehole

Deep well

Shallow well

River

4. Do you treat water before use?

Yes

No

5. If yes how do you treat it?

Boiling

Filtering

Use of chemicals

Other,
specify.....

6. What type of container do you use to store your water?
Metal
Plastic
Other specify
7. Does the container have a lid?
Yes
No
8. What is the container's sanitary state? Surveyor to check
Clean
Dirty
9. What is the sanitary state of receptacles used to draw water from the container? Surveyor to check
Clean
Dirty

c) Household sanitation

10. Is there a working toilet in this home?
Yes
No
11. If available, of what type?
BVIP
Pit latrine
Ecosan
Flush
Other specify

12. In what sanitary state is the toilet? Surveyor to check
Clean
Dirty
13. Are children less than five years able to use the toilet on their own?
Yes
No
14. If no, how are the faeces of children less than five years old disposed of?
.....
15. Where do you dispose your solid waste?
Bin
Refuse pit
Open dumping
Other specify

d) Food storage in the home

16. Where is food stored in your home?
.....
17. What is the hygiene status of the area where food is stored? Surveyor to check
Clean
Dirty

e) Kitchen hygiene of the home

18. Does the home have two pot racks, one for washing and the other for drying kitchen utensils? Surveyor to check
Yes
No

19. What is the hygiene status of the kitchen? Surveyor to check
Clean
Dirty

f) Feeding of children less than five years in the home

20. What type of food is given to children less than five years old in the home?
.....
21. What is the hygienic state of utensils used to cook and serve food? Surveyor to check
Clean
Dirty
22. Are there children less than 6 months in this home?
Yes
No
23. Is exclusive breastfeeding practised by mother for children less than 6 months in this home?
Yes
No
24. If No, are there any children given bottle milk?
Yes
No
25. If yes, how often is the bottle washed?
.....

g) Personal hygiene of the caregiver

26. When do you wash your hands?
.....
27. Does the caregiver wash hands always at all critical times? Surveyor to check for the established area for hand washing.
After using the toilet
Before food preparation and baby feeding
After changing baby nappies
Yes
No

h) Vaccination status of children less than five years in the home

28. Are there any documents proving that children less than five years were vaccinated against rotavirus? Surveyor to check
Yes
No

i) Knowledge of the caregiver on diarrhoea prevention and control

29. What measures would you put in place to protect your children from diarrhoea in your home?
.....
30. Does the caregiver have adequate information on diarrhoea prevention and control? Surveyor to check
Yes

No

j) Questions to children between 3 -5 years old

31. Do you wash your hands after visiting the toilet?
All the times
Sometimes
Not at all

32. Do you wash your hands before eating?
All the times
Sometimes
Not at all

APPENDIX B

SANITARY INSPECTION FORMS

INSPECTION FORM FOR A BOREHOLE

	Specific diagnostic information for assessment	Risk		if answered YES, add a point
		Yes	No	
1	Is there a latrine within 10m of the hand-pump?			6
2	Is the latrine on higher ground than the hand-pump?			6
3	Is there any other source of pollution (e.g. animal excreta, rubbish, surface water) within 10 m of the hand-pump?			1
4	Is the drainage poor, causing stagnant water within 2 m of the hand-pump?			1
5	Is the hand-pump drainage channel faulty? (is it broken, permitting ponding)			1
6	Is the fencing around the hand-pump inadequate, allowing animals in?			1
7	Is the concrete floor less than 1m wide all around the hand-pump?			1
8	Is there any ponding on the concrete floor around the hand-pump?			1
9	Are there any cracks in the concrete floor around the hand-pump which could permit water to enter the well?			1
10	Is the hand-pump loose at the point of attachment to the base so that water could enter the casing?			1
	Contamination risk score: 9-20 = very high; 6-8 = high; 3-5 = medium; 0-2 = low			
	TOTAL SCORE			
	5. Main Observations			
	1- Non-functional - 2- Poor or faulty drainage system - 3- Cracks in the concrete floor around the water point - 4- Insalubrity around the water point - 5- Animals access to the water point - 6-None			
	Other Observations			
	7. Action taken			
	1- Disinfection - 2- Complete Rehabilitation - 3- Hygiene education awareness - 4- Temporally suspended - 5- Maintenance and repairs			
	Other Actions taken			
	8. Conclusion and Recommendations			

Ministry of Health Standard Form for a Borehole Sanitary inspection

SANITARY INSPECTION FORM FOR A WELL

	Specific diagnostic information for assessment	Risk		if answered YES, add a point
		es	o	
1	Is there a latrine within 10 m of the well?			6
2	Is the nearest latrine on higher ground than the well?			6
3	Is there any other source of pollution (e.g. animal excreta, rubbish) within 10 m of the well?			1
4	Is the drainage poor, causing stagnant water within 2 m of the well?			1
5	Is there a faulty drainage channel? Is it broken, permitting ponding?			1
6	Is the wall (parapet) around the well inadequate, allowing surface water to enter the well?			1
7	7. Are the walls of the well inadequately sealed at any point for 3 m below ground?			1
8	8. Are there any cracks in the concrete floor around the well which could permit water to enter the well?			1
9	9. Are the rope and bucket left in such a position that they may become contaminated?			1
10	10. Does the installation require fencing?			1
	Contamination risk score: 9-20 = very high; 6-8 = high; 3-5 = medium; 0-2 = low			
	TOTAL SCORE			
	5. Main Observations			
	1- Non-functional - 2- Poor or faulty drainage system - 3- Cracks in the concrete floor around the water point - 4- Insalubrity around the water point - 5- Animals access to the water point - 6-None			
	Other Observations			
	7. Action taken			
	1- Disinfection - 2- Complete Rehabilitation - 3- Hygiene education awareness - 4- Temporally suspended - 5- Maintenance and repairs			
	Other Actions taken			
	8. Conclusion and Recommendations			

Ministry of Health Standard Form for a Well Sanitary Inspection

APPENDIX C

CONSENT FORMS

ENGLISH VERSION

Consent to Participate in a Research Study

Title of the study: Examination of Determinants of Diarrhoea in Children less than Five Years old in Umzingwane District, Zimbabwe, A Case-Control Study

Investigator:

Name: Sifelani Mkandla

Phone Number263 773 456 071

Place of Work: Ministry of Health and Child Care Esigodini District Hospital

Introduction

You are being asked to be in a research study to find out the factors behind diarrhoea increase in children less than five years old in Umzingwane District. You were selected as a possible participant because there were diarrhoea cases reported from your area and your response would valuable in our endeavour to identify specific factors linked to diarrhoea increase. If you are unable or would rather not read this form, the researcher can tell you what it says and answer any of your questions before you sign the form.

Purpose of Study

The purpose of the study is to understand factors linked to diarrhoea increase. Information gathered will help to come up with strategies to reduce diarrhoea incidence in children less than five years old in Umzingwane District. Ultimately, this research may be presented as a paper or published in international journals of diseases.

Description of the Study Procedures

If you agree to be in this study, you will be asked to respond to questions from a survey questionnaire which will take approximately 30 minutes to complete and during the process you will be asked to allow the interviewer to inspect and capture photographs of your kitchen, water storage containers, food storage area, area where you wash your plates, refuse disposal, toilet, hand washing facilities and vaccination documents for children less than five years.

Risks/Discomforts of Being in this Study

There are no reasonable foreseeable (or expected) risks for participating in this study.

Benefits of Being in the Study

The benefit of participation is that this study may lead to reduced incidence of diarrhoea in children less than five years in Umzingwane District.

Confidentiality

This study is anonymous. We will not be collecting or retaining any information about your identity.

The records of this study will be kept strictly confidential. Research records will be kept in a locked file and all electronic information will be coded and secured using a password protected file. We will not include any information in any report we may publish that would make it possible to identify you.

Payments

You will not receive any payment or reimbursement for participating in this study.

Right to Refuse or Withdraw

The decision to participate in this study is entirely up to you. You may refuse to take part in the study *at any time* without affecting your relationship with the investigators of this study. Your decision will not result in any loss or benefits to which you are otherwise entitled. You have the right not to answer any single question, as well as to withdraw completely from the interview at any point during the process; additionally, you have the right to request that the interviewer not use any of your interview material.

Right to Ask Questions and Report Concerns

You have the right to ask questions about this research study and to have those questions answered before, during or after the research. If you have any further questions about the study, at any time feel free to contact me, Sifelani Mkandla, by email at sifelanimkandla@yahoo.com or by telephone at 263 773 456 071. If you like, a summary of the results of the study will be sent to you. If you have any other concerns about your rights as research participants that have not been answered by the investigator, you may contact Esodini District Hospital by telephone at 0228 370/685. Alternatively, concerns can be reported by completing a Participant Complaint Form, which can found on the IRB website at http://www.smith.edu/irb/

Consent

Your signature below indicates that you have decided to volunteer as a research participant for this study and that you have read and understood the information provided above. You will be given a signed and dated copy of this form to keep, along with any other printed materials deemed necessary by the study investigator.

Participant's Name (Print).....

Participant's Signature..... Date.....

Investigator's Signature.....Date.....

NDEBELE VERSION

Igama lami ngu Sifelani Mkandla. Ngiyisisebenzi sikahulumende kugatsha lwezempilakahle njalo ngiyisifundiswa se Adventist University of Africa ngenza idegree ye Masters in Public Health. Ngicubungula ngembangela yomkhuhlane wesihudo kubantwana abangaphansi kweminyaka emihlanu yokuzalwa. Lokhu ku cubungula kuzaletha imbiko kumbe ulwazi oluza kwenza ukuthi senelise ukubumba indlela zokunqabela umkhuhlane wesihudo esigabeni sethu seMzingwane. Loba lokhu kucubungula ku ngeke kwaba lenzuzo kuwe ,kuzaletha ulwazi oluza nceda ukwehlisa inani lesihudo ebantwaneni.

Ekuvumeni kwakho ukuba yingxenye qiniseka ukuthi ozasitshela khona kuzaba yimfihlo. Ngiyacela ukuthi uphe impendulo ngokuqinisekileyo. Akula magama azasetshenziswa kulokhu kucubungula. Konke ozasipha khona akusoze kutshelwe muntu ongela mvumo yakho njalo leyo ncwadi izagcinwa endaweni elondekileyo. Abahlolisisi bazathatha imizuzu engaba ngama tshumi amathathu kusiyakumatshumi amane lanhlanu . Ukhululekile ukubuza imibuzo kuloluhlelo kunye lalokhu ongakuzwisisiyo ukuze uchazelwe . Ikheli lami lokuhlolisisa yileli elilandelayo Esigodini District Hospital , P. O. Box 49 ,Esigodini . Inombolo zocingo (0288)685 kumbe ezikakhalamakhukhwini 0773 456 071.

Ukuvuma kohlanganelayo

Isifundo esichaziweyo phezulu sichasisiwe kimi ngokujulileyo njalo ngiyavuma ukuhlanganela kulesisifundo

Ibizo ---------- usuku----------

APPENDIX D

PHOTOGRAPHS CAPTURED DURING THE SURVEY

Figure 4. Examples of Unprotected Water Sources

Figure 5. Examples of Dirty Water Storage Containers

Figure 6. Examples of Dirty Toilets

Figure 7. Examples of Improper Waste Management

Figure 8. Examples of Dirty Cooking Utensils

Figure 9. Examples of Designated Hand Washing Facilities

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Summary of Experience

I am an Environmental Health practitioner with eight years' experience in active surveillance and promotion of improved water and sanitation services, managing and supervising solid and liquid waste disposal, vector control and promotion of primary health care. I conduct monitoring and evaluation of sanitation and hygiene activities and support the development and dissemination of I.E.C materials on sanitation and hygiene. I am a qualified trainer in Participatory Health and Hygiene Education (PHHE) and also conduct capacity building of village health promoters and community health volunteers. I provide technical support for the construction and maintenance of Blair latrines and train builders on latrine construction. I conduct research, surveys and assessments on appropriate sanitation and water technologies. My main responsibility is to ensure the promotion and social marketing of improved water, sanitation, hygiene and health services.

Education

Institution	***Degree(s) or Certificates(s) obtained***
National University of Science and Technology (NUST)	Bachelor of Science Honors Degree in Environmental Science and Health
Institute of Water and Sanitation Development	Water and Wastewater Treatment
The University of Zimbabwe, Department of Community Medicine	Leadership, management and Governance

Key Areas of Expertise

- Promotion of improved water and sanitation services
- Solid and liquid waste disposal
- Vector control
- Promotion of primary health care
- Monitoring and evaluation of sanitation and hygiene activities
- Development of I.E.C. materials on sanitation and hygiene
- Training in Participatory Health and Hygiene Education (PHHE)
- Capacity building of village health promoters and community health volunteers
- Construction and maintenance of Blair latrines
- Training of builders on latrine construction

Employment Record

1. MINISTRY OF HEALTH AND CHILD WELFARE (Matabeleland South)

Position: District Environmental Health Officer

Period: 2009 – to date

2. CENTRE FOR DEVELOPMENT STUDIES

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Period: 2010 - 2012

Courses taught:

- Diploma in Water and Sanitation
- Diploma in Occupational Health and Safety
- Diploma in Environmental Management