HOUSEHOLD WATER HANDLING (TREATMENT AND SAFE STORAGE) AND PREVALENCE OF DIARRHOEAL DISEASES AMONG RESIDENTS OF KOROGWE TOWN

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Master of Public Health Dissertation

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CERTIFICATION

The undersigned certifies that has read and hereby recommends for acceptance by the Muhimbili University of Health and Allied Sciences a dissertation entitled **"Household water handling (treatment and safe storage) and prevalence of Diarrhoeal diseases among residents of Korogwe town, Tanzania",** in partial fulfillment of the requirements for the degree of Master of Public Health

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Date---10th Nov 2009---

DECLARATION AND COPYRIGHT

I, Suzana Joshua Mushi, declare that this dissertation is my own original work and that it has not been presented to any other University for similar or any other degree award.

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who contributed in one way or another to make this work successful. All I can say is thank you.

DEDICATION

This Dissertation is dedicated to my beloved husband Francis who took tireless care and encouragement throughout my study periods. My dear sons Isaac and Noel-freeman and my Mother Late Salome Joshua Mushi whose beliefs in importance of education have contributed much to make me the way I am and to take me where I am. May God rest her soul in eternal peace, Amen.

ABSTRACT

Household water treatment and safe storage (HWTS) are widely being described as biological effective and economically efficient approaches to control diarrheal diseases. Treating water at point of use ensures that water is safe before consumption even if water comes from unsafe sources, thus ensuring family or community protection against diarrhea. The extent of drinking water treatment and safe storage in households in Korogwe is not known. The main objective of the study was to assess household water handling (treatment and safe storage) and prevalence of Diarrhoeal diseases among Korogwe residents. A cross-sectional study was done in Korogwe Town whereby 400 members of the household was interviewed to get information on how water was treated at point of use and methods used to store the treated water. Response rate was 100%. To assess whether the stored drinking water was safe we took water samples to the laboratory and examined for E coli contamination. We also assessed prevalence of diarrhea in the past two weeks and its relationship to water quality (E coli) and household water treatment and safe storage.

The extent of household drinking water treatment and safe storage was 34.3 % and 49.5% respectively. Factors associated with household drinking water treatment were education and employment Chi square 22.14; p value<0.0001 and Chi square = 12.06; p value<0.01, respectively. Prevalence of diarrhoea diseases was 70%.Extent of water treatment and safe storage at point of use in Korogwe Town is low and we recommend that people (household's members) need to be educated on the importance of household water treatment and safe storage in reduction of death caused by diarrhoea in underfives.

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Acronyms and Abbreviations

CDC	Centres for Disease Control
DWE	District water Engineer
E.coli	Escherichia coli
H/h	Household
HWT	Household water treatment
HWTS	Household water treatment and safe storage
KTC	Korogwe District Council
l	liter
l//c//d	litres per capita per day
m	metre
MOHSW	Ministry of Health and Social Welfare
UNICEF	United Nations International Children Fund
URT	United Republic of Tanzania
VGA	Village General Assemble
VHC	Village Health Committee
WDC	Ward Development Committee
WEO	Ward executive officer
WHO	World Health Organization
WSS	Safe Water Supply and Sanitation

CHAPTER ONE

1.0 INTRODUCTION

1.1 Background Information

Water makes about 70% of human body and without it most of the socio-economic activities would be rendered impotent (VanHylckama, 1971). With increased urbanization and poor housing sanitation tends to be negatively affected whereby people resort to indiscriminate excreta disposal consequently contaminating water sources. The inhabited water logged areas has high water table that is contaminated through pit latrines. Pipes passing through such contaminated high water table tend to siphon polluted water during low pressure. Inadequate drinking water supply, quality and poor sanitation are among the world's major causes of preventable morbidity and mortality related to waterborne, water based and water washed diseases.

According to the World Health Organization (WHO) estimates, basic hygiene-related diseases have a significant impact on human health. Diarrhoeal disease alone causes 2.2 million of the 3.4 million water-related deaths per year. Many of the deaths involve children less than five years of age and the poorest households and communities especially in developing countries.

In many parts of the developing world, drinking water is collected from unsafe surface sources outside the home and is then kept in storage vessels at household level. Drinking

water may be contaminated at the source or during storage. Strategies to reduce waterborne disease transmission must safeguard against both events.

Household water treatment is effective, simple and inexpensive. For example, if household bleach solution is available, a dilute chlorine solution can be made up and used to disinfect water. Water can also be safety treated by exposing it to sunlight. All that is required is a discarded clear plastic bottle. Another option to treat water at home is the use of simple ceramic pot filters molded by local artisans. If households can afford, commercially produced tablets containing chlorine, or sachets with combined flocculation and disinfection properties are available and can also effectively remove pathogens from water. This approach empowers households and communities that lack potable water to protect themselves against a variety of waterborne pathogens and has the potential to decrease the incidence of waterborne diseases that form a major part of the burden of water related diseases responsible for high mortality in developing countries. Providing potable water for drinking and washing is critical to reducing diarrhea disease transmission in this setting.

However, improving source water quality alone does not always decrease diarrhea disease incidence (Mintz et al, 1995). Providing a safe drinking water source may fail to reduce diarrhea diseases because transmission of diarrheal pathogens continues through food contamination or person-to-person routes of spread or because people are exposed to contaminated water during bathing and other domestic activities. Drinking water also becomes contaminated during collection, transport or storage in the home.

Providing clean and safe water to those in rural areas in developing countries is a great challenge. In Tanzania, over 80% of the population lives in rural areas in which only 30 % are reported to have access to safe potable water (Mbogo, 2008).

In spite of many efforts to improve access to safe water supply, about 70 % of rural and at least 20 % of urban Tanzania populations live without the access safe water. Given the underlying poor sanitation and hygiene many of those who do not have access to safe water and some of those who do have the access stand a great risk of contracting waterborne diseases through consumption of unsafe water. While the cost requirement to provide the unprivileged households with the necessary access to safe water is not achievable within a foreseeable future, provision of effective short term alternatives to water safety at households remains a viable approach to protect families from the diarrhoea burden until they are reached with the desired long term safe water services.

Household water treatment and safe storage are widely being described as biologically effective and economically efficient approaches to control diarrhoea disease (Unpublished Report on National Consultative and Planning Workshop MoHSW, 2008). Treating water at point of use ensures that water is safe before consumption even if the sources were contaminated. The study done by Kjaer 2002 revealed that "even if drinking water of poor rural communities is obtained from a safe source, it can become contaminated during storage in the house".

According to United Nations Environmental Program (2003) water contamination is related to the following factors:

1. Old water nets which do not meet the recommended standard, therefore it needs rehabilitation.
2. Interruption of water supply.
3. Unavailability of proper sewage system and highly distribution of septic tanks.
4. Frequent interruption of water chlorination due to frequent disruption of chlorinating pumps.
5. Sometimes, sewage water is disposed near drinking wells. In addition to over use of fertilizers and pesticides.

Thus local solutions to these problems are highly desirable in order to minimize possible waterborne disease outbreaks, and to improve food safety and environmental security.

1.2 Why Household Water Treatment

There is a need to improve microbial quality of household water and reduce waterborne disease through the application of physical and chemical treatment methods. Household water treatment and safe storage (HWTS) interventions can lead to dramatic improvements in drinking water quality and reductions in diarrhoeal disease—making an immediate difference to the lives of those who rely on water from polluted rivers, lakes and, in some cases, unsafe wells or piped water supplies.

1.3 Types of Household Water Treatment

Chemical disinfection

Chlorine or iodine may be used to treat water. In this case water should be treated using directions that come with the tablets. Alternatively water may be disinfected by the use of existing types of chlorine compounds. Dose of a few mg/ litre and contact times of about 30 minutes, free chlorine generally inactivates > 99.99% of enteric bacteria and viruses, provided water is clear. The amount of chlorine needed depends mainly on the concentration of organic matter in the water and should ideally be determined for each situation.

Solar disinfection

Solar disinfection is an effective water treatment method. Ultra –violet rays from sun are used to inactivate pathogens present in water. This technique involves exposing water in clear plastic bottles to sunlight for a day, for example on the roof of a house. Bottles need to be cleaned, filled to three quarters full and shaken thoroughly 20 times, before being filled completely. The bottles are then exposed to sunlight for 6 hours to two days if the sun is obscured by clouds

Filtration

Furthermore, filtration is another option to purify water if filters are available. Ceramic filters with small pores, often coated with silver for bacteriostasis, have been shown to be effective at removing microbes and other suspended solids. Filters need to be cleaned regularly. Monthly maintenance consists of scrubbing the ceramic filter element to unclog pores and washing the receptacle tank and spigot to prevent bacterial growth. Ceramic filters can be mass produced or manufactured locally.

Combined flocculation/chlorination systems

Commercially available sachets (commonly known as water guard) can also dramatically improve the microbial quality of drinking water. These are formulated to coagulate and flocculate organic mater and other sediments in water followed by the addition of chlorine (to kill any remaining microbes) these typically treat 10 litres of water. The water is normally stirred for few minutes and then strained, and then allowed to stand for another half hour.

Boiling

Household can disinfect their drinking water by bringing to a boiling point which will kill pathogens effectively.

Safe storage

Regardless of whether household is initially of acceptable microbiological quality, it often becomes contaminated with pathogens of fecal origin during transport and storage due to unhygienic storage and handling practices. Studies show that the use of containers with narrow openings for filling, and dispensing devices such as spouts or taps/spigots, protect the collected water during storage and household use. Improved containers protect stored household water from the introduction of microbial contaminants via contact with hands, dippers, other faecal contaminated vehicles or intrusion of vectors.

1.4 Statement of the Problem

Drinking of unsafe water continues to underlay the diarrhea burden in developing countries. Four billion people suffer from diarrhea diseases and 2.2 millions die every year of causes

related to consumption of unsafe water and poor sanitation worldwide. About 1.7 million diarrhea cases occur every year in Tanzania mostly affecting lives of under fives. In spite of many efforts to improve access to safe water supply, about 50 % of rural and at least 20 % of urban Tanzania populations live without access to safe water. Given the underlying poor sanitation and hygiene conditions, communities are at risk of contracting waterborne diseases through drinking of unsafe water. While the cost requirement to provide the unprivileged households with the necessary access to safe water is far from reach within a foreseeable future, provision of effective short term alternatives to water safety at households remains a viable approach to protect families from the burden of waterborne diseases.

Most of Korogwe citizen are residing at unsurveyed areas. Furthermore water table in Korogwe is very high, thus making the area to be an endemic area for cholera, typhoid and other seasonal diarrhea diseases due to water contamination mainly through pit latrines. A number of areas in Korogwe are facing acute water shortage and majority of household get their drinking water from unprotected springs, rivers, streams and wells. No information on household water treatment and storages mechanism in Korogwe Town Council.

Therefore this study aims to assess and determine household water sources, treatment and storage mechanisms. Pattern of use will also be explored.

1.5 Problem Analysis Diagrams

Problem analysis diagrams for the study are provided in figures 1.1, 1.2, and 1.3. It is assumed that household drinking water treatment was hindered and faced by many factors,

among these factors includes: inadequacy water treatment skills, inability to buy water treatment agents, inadequacy of storage facilities, ignorance and inadequacy of domestic water supply which make water fetchers to spend more times in searching for domestic water and get tired, hence see no need for treatment. Furthermore these problem analysis diagrams shows that low social economic status contributed to the poor household treatment and poor safe water storage due to lack of money to buy treatment agents and recommended storage containers. It is also assumed that Diarrhoeal diseases caused by drinking contaminated water or foods, eating fruits and vegetables without washing or washed with contaminated water and not washing hands properly after toilets and before eating.

Figure 1.1 Household Water Handling

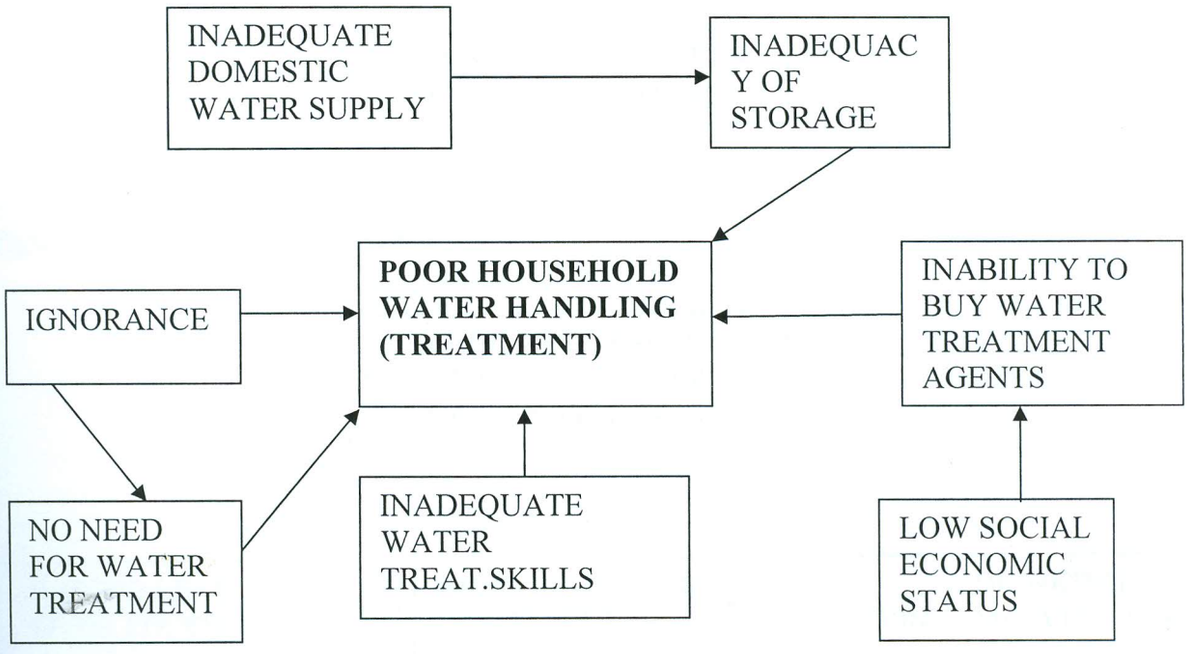


Figure 1.2 Unsafe Storage

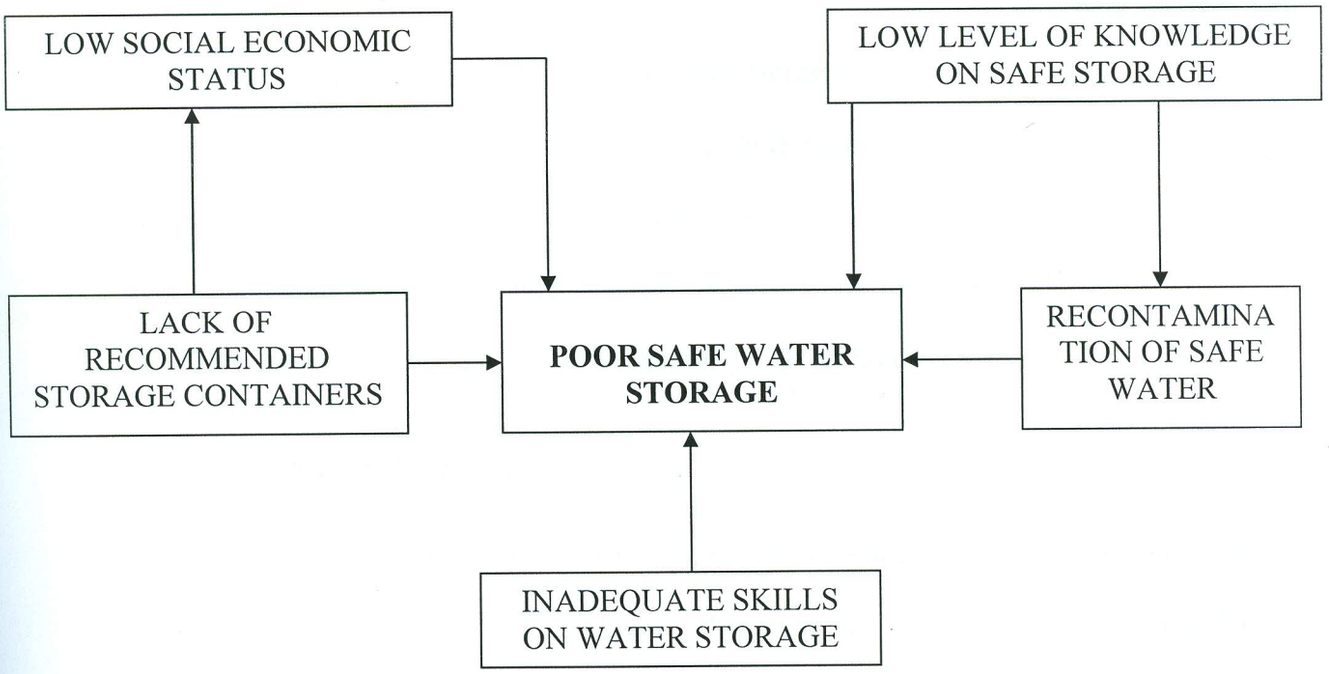
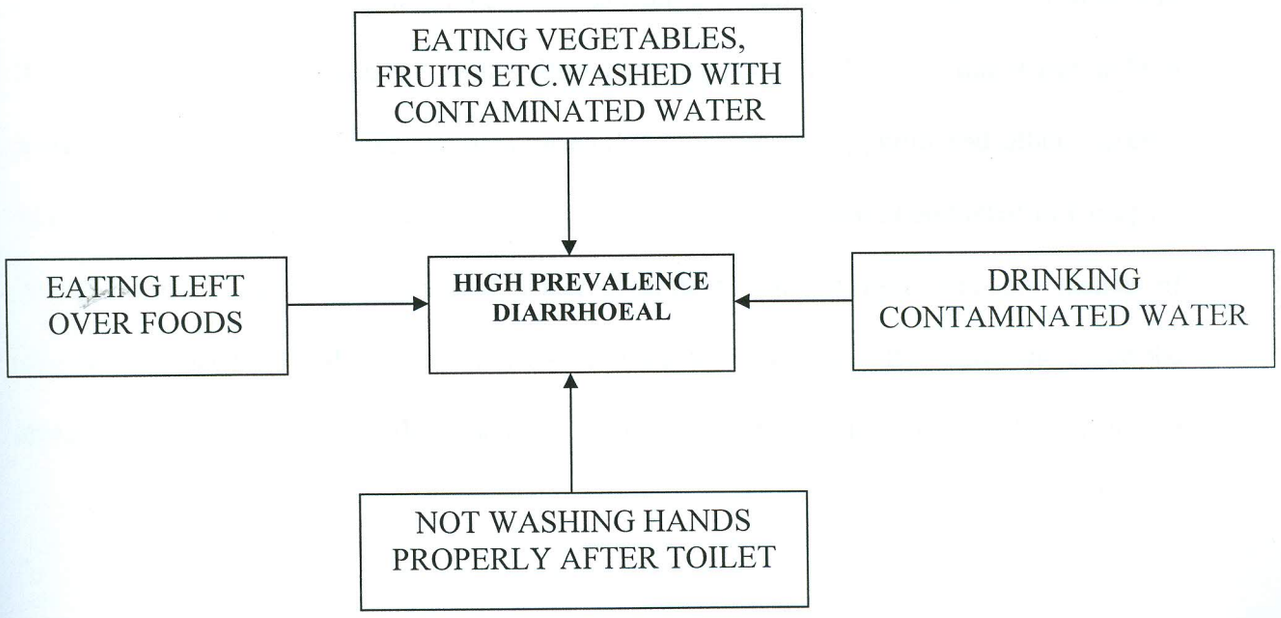


Figure 1.3 Diarrhoeal Disease



1.6 Research Questions

1. What is the level of water treatment and safe storage?
2. What are the sources and quality of household drinking water?
3. What methods are used to treat drinking water?
4. What type of storage containers are used to store water for household use?
5. Have there been any diarrihoeal diseases in the household recently?

1.7 Rationale of the Study

In developing countries, particularly Tanzanian, research on household water treatment and safe storage is a recent issue, and it is a known phenomenon of the community member that water contamination only be affected at the water source rather than or during storage at home. Furthermore majority of citizen in Korogwe get their domestic water from surface sources such as Pangani river and other streams from the highland areas such as Lushoto and Bungu. Other people use shallow wells within the town council. However that water table in Korogwe is high, thus making the area an endemic in Cholera, typhoid and other seasonal diarrhoeal diseases, due to water contamination. No study have been conducted in Korogwe Town Council regarding household water treatment, safe storage and prevalence of diarrhoeal hence the need for conducting such a study in the area. It is anticipated that the knowledge identified shall be used in designing health education packages to be

disseminated to the whole community through government leaders to educate community on how to improve the quality of water and consequently the reduction of waterborne diseases

1.8 Broad Objective

To assess household water handling (treatment and safe storage) and prevalence of diarrhoeal diseases among Korogwe residents

1.9 Specific Objectives

1. To assess the extent of household water treatment by age, sex, education, occupation, religion and type of treatment method in Korogwe Town Council.
2. To assess the level of household safe water storage by age, sex, education, occupation and religion in Korogwe Town Council.
3. To assess factors influencing household water treatment among those treating drinking water at household level:
    a. Level of awareness.
    b. Perception on the need for treatment
    c. Water treatment skills of Heads of household
    d. Ability to buy treatment reagents
4. To assess factors influencing household safe storage among those practicing safe storage of drinking water at household level:
    a. Adequate skills on water storage
    b. Presence of recommended storage containers
    c. Level of knowledge of safe storage
    d. Quality of safe water

5. To determine the prevalence of Diarrhoeal diseases in the household by age and sex.
6. To determine the relationship between prevalence of diarrhoeal in past 2 weeks by quality of drinking water
7. To assess faecal microbial contamination of water at Korogwe Town Council.
8. To identify sources of water for household drinking in Korogwe District Council and factors associated with diarrhoeal.

CHAPTER TWO

2.0 LITERATURE REVIEW

Water is essential for health and the maintenance of well being. The health aspects of hygiene, prevention of infection and nutrition all depend to some extent on access to water and to water quality. Water plays an important part in rest and relaxation, as well as in cleanliness and the supply of basic needs.

It is estimated that one billion people worldwide do not have access to treated drinking water and around three million people die annually from water borne disease. The study done in two districts of Tanzania by Mbogo show the potential of indigenous or natural water treatment methods as alternative to conventional chemical water treatment methods (Mbogo, 2008). Study findings found that there were only 41% of respondents who treated water.

In many parts of the developing world, drinking water is collected from unsafe surface sources outside the home and is then held in household storage vessels. Drinking water may be contaminated at the source or during storage. Household water treatment and safe storage are widely being described as biologically effective and economically efficient approaches to control diarrhoea disease. Treating water at point of use ensures that water is safe before consumption even if the water comes from unsafe sources, thus ensuring family or community protection against diarrhea (Report on national consultative and planning workshop of MOHSW, 2008 –unpublished).

Diarrhoea and water-borne diseases are leading causes of mortality in developing countries (Banda et al, 2007). To understand the socio-cultural factors impacting on water safety, knowledge, attitudes and practices of water handling and usage, sanitation and defecation has been documented (Banda et al, 2007). The study describes the development of health production functions and their application in the evaluation of the health impacts of investments in safe water and sanitation shows that, the health production functions exhibit constant return to scale, i.e., a simultaneous m-fold increase in both safe water and sanitation coverage produces a 1-1/m decrease in morbidity. Safe water was found to be more important for health than the sanitary disposal of excreta (Wibowo and Tisdell, 1993). The study also has shown that safe water supply and sanitation (WSS) improvements can decrease diarrhea morbidity and mortality, (Wibowo and Tisdell, 1993).

Preventing future cholera outbreaks in Africa will depend on interrupting both waterborne and foodborne of transmission this pathogen, in 2 case-control studies, cholera was significantly associated with placing hands into the storage container holding household drinking water (Swerlow et al, 1997)

Successful hygiene promotion programs in developing countries require identification of local risk practices and messages most likely to have a real impact on disease incidence, Example, the study done by Curts and Kanki in diarrhea prevention in Burkina Faso was determined that the most effective means for stopping fecal material from getting into the child's environment is to ensure that feces are disposed of safely and to ensure that hands that have come into contact with feces are thoroughly washed (Curts, 1998).

Improvements in water quantity may have a greater impact on diarrhea than improvements in quality alone through their effect on personal and domestic hygiene (Huttly et al, 1997). Children under 5 years experiences an average of 3.4 episodes of diarrhoea per year and a diarrhoeal mortality rate estimated at 12 per 1,000, leading to 4 million diarrhoea-associated deaths per year (Huttly, 1990).

Diarrheal diseases remain a leading cause of illness and death in the developing world (Bern et al, 1992). Providing a safe drinking water source may fail to reduce diarrhea because transmission of diarrheal pathogens continues through foodborne or person-to-person routes of spread or because people are exposed to contaminated water during bathing and other activities. However, improving source water quality alone does not always decrease diarrheal disease incidence (Briscoe, 1978).

The transmission of disease caused by pathogenic micro organism in drinking water represents a health risk in all societies. Unpolluted safe drinking water usually considered one of the primary requisites for healthy human life (Pillai et al, 1999). About 1.7million diarrhea cases occur every year in Tanzania alone mostly affecting lives of children under the age of five years (WHO, 2000).

Despite of such efficient of HWTS, being widely described as a biological effective and economically able and strong control of diarrhoea disease, effort of treating water have been mainly directed to water familiarly known as water treatment plants and measurements for quality from those sources. Indeed, very little efforts, if any, have been conducted on HWT. For example, a research done in Olorien village in Arusha on HWTS by looking number of household members boiling water found that a number of household members lack proper

knowledge on how to handle and store water carefully. In many developing countries including Tanzania the majority of population relies on water sources heavily polluted by animal excreta and sewage effluents and other water pollutant such as physical and chemical matters.

Improvements in quality of water sources generally depend on expensive, long-term, centralized projects, such as construction of wells, water treatment plants, and water distribution systems. During the World Health Organization's (WHO's) Drinking Water Supply and Sanitation decade (1981 to 1990), an effort was made to increase access to potable water in developing countries but was nearly outstripped by population expansion and migration from rural to urban areas (WHO, 1992). Safe drinking water for all remains an elusive and expensive goal.

In many developing countries, even municipal piped well water is unsafe, because of inadequately maintained pipes, low pressure, intermittent delivery, lack of chlorination, and clandestine connections. For example, Vibrio cholerae was repeatedly isolated from unchlorinated municipal water systems in Peru that caused large epidemics of cholera (Swerdlow, 1992). The risk of diarrheal disease due to contamination of drinking water during household storage was noted in surveys conducted by the WHO in the 1960s (van Zilj, 1966).

Many observations suggest that treating water in the home can prevent illness. Recent epidemiologic studies have demonstrated that persons whose families boil drinking water at home are at lower risk of cholera specifically and diarrhea in general (Blake, 1993; Patel, 1989; Santon, 1992). After cooling, boiled water can easily be recontaminated, especially if it is transferred to a storage container (Arlington, 1993).

Several field investigations have identified behaviors or storage vessel characteristics associated with contamination of water in the home or with disease resulting from contamination. For example, researchers investigating epidemics in Malawi (Swerdlow, 1991) and Peru (Swerdlow et al, 1992), Ries et al, 1992) reported that patients were more likely than healthy control subjects to live in households where stored drinking water was dipped out with hands or utensils. Similarly, in a recent investigation of epidemic Shigella dysenteriae type 1 infection in Zambia, stored water was more likely to be dipped out in patients' homes and more likely to be poured in the homes, of healthy neighbors, suggesting that hands and objects introduced into stored water were a source of contamination (Tuttle et al, 1995).

However stages at which the water may be contaminated includes water collection at stand pipe, water transferring from vender's vessels to the purchaser's containers, and hygienic manipulations of domestic water containers within households (Swerdlow et al, 1997). Stored water usually has a higher level of bacteria contamination than source waters (Han et al, 1990). Drinking un boiled water or water solid by street venders has been associated with cholera during previous outbreak in Latin America (Taux et al., 1995; Weber et al, 1994;

Ries et al, 1992). Also the study done in Lake Victoria region the village of Chato shows that 21 % of households whose did not treat and boil drinking water, there were recurrent of cholera disease in the area.

It has been estimated that inadequate water, sanitation and hygiene account for 2.2 million death annually or 4% of the global total, and 5.7% of the global burden of disease in disability adjusted life years (Pruss et al, 2002). Most of these deaths are in children under the age of five (Kosek and Guerrant, 2003). The millennium development goals stipulate that many more people should have access to improved water sources and sanitation by 2015 (United Nations, 2002), and the mortality children under five should be reduced by two thirds. The mere provision of water supply and sanitation facilities is not enough to lower mortality and morbidity rates significantly; hygienic behavior such as treating and proper storage of household water has a greater impact on health. Household water treatment and safe storage therefore recommended as an adjunct to most water and sanitation programs in the developing World (WHO/UNICEF, 2000).

Education regarding proper storage and household water treatment techniques is currently lacking. Though such procedures are easy to administer, many residents are unaware of how to do so. For example, improper storage techniques led to outbreaks of Dengue Fever in India (WHO, 2003). As people began storing extra water so as to help themselves during droughts, they created an ideal breeding environment for the disease.

Tanzania, a country in sub-Saharan Africa, has a population of over 35 million people (URT, 2002). In Tanzania alone water related diseases account for over half of all diseases affecting the population. (Tanzania Government, 2004). Rivers and streams are often contaminated with trash and litter which gather on the rocks and needs. The presence of such contamination creates ideal conditions in which water borne illness can thrive. In 2001, the World Health Organization noted an outbreak of cholera in Tanzania after 109 cases were reported.

Microbial contamination of drinking-water contributes to disease outbreaks and background rates of disease in developed and developing countries worldwide. Control of waterborne disease is an important element of public health policy and an objective of water suppliers (WHO, 2004). The potential of drinking water to transport microbial pathogens to great numbers of people, causing subsequent illness, is well documented in countries at all levels of economic development (Bruce-Grey-Owen Sound Health Unit, 2000). The number of outbreaks that has been reported throughout the world demonstrates that transmission of pathogens by drinking water remains a significant cause of illness. However, estimates of illness based solely on detected outbreaks are likely to underestimate the problem. A significant proportion of waterborne illness is likely to go undetected by the communicable disease surveillance and reporting systems.

Several researchers have attempted to estimate the total burden of waterborne disease world-wide (Huttly 1990) reported a total number of 1.4 billion annual episodes of diarrhoea in

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children under five years of age, with an estimated 4.9 million children dying as a result (although these were due

to all water causes of diarrhoea and not just water-related cases). While (Prüss et al, 2002) estimated that, sanitation and hygiene was responsible for 4.0% of all deaths and 5.7% of the total disease burden occurring worldwide (accounting for diarrhoeal diseases, schistosomiasis, trachoma, ascariasis, trichuriasis and hookworm disease). Clearly, in countries where a large part of the population does not have access to safe drinking water, a substantial number of these infections will be waterborne, indeed, Hunter (1997) estimated that waterborne disease might account for one-third of the intestinal infections world-wide.

Waterborne disease is not restricted to developing countries. Morris and Levine (1995) infection each year. The diseases most frequently associated with water are enteric infections (such as infectious diarrhoea) that are also often associated with food (Mead et al, 1999). In many cases, the disease is relatively mild and self-limiting. However, a proportion of the infected population will suffer more severe outcomes, especially when the health care system is lacking. Several waterborne pathogens, such as Vibrio cholerae, hepatitis E virus and Escherichia coli O157:H7, have high mortality rates (Hunter, 1997). Unpolluted safe drinking water usually considered one of the primary requisites for healthy human life (Pillai et al, 1999). About 1.7 million diarrhea cases occur every year in Tanzania alone mostly affecting lives of children under the age of five years (WHO, 2000).

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Consumption of unsafe water continues to underlay the diarrhea burden in developing countries. Four billion people suffer from diarrhea diseases and 2.2 millions dies every year

for causes related to consumption of unsafe water and poor sanitation worldwide. About 1.7 million diarrhea cases occur every year in Tanzania alone mostly affecting lives of children under the age of five years. In spite of many efforts to improve access to safe water supply, about 50 % of rural and at least 20 % of urban Tanzania populations live without the access safe water. Given the underlying poor sanitation and hygiene many of those who do not the access to safe water and some of those who do not have the access stand a great risk of contracting waterborne diseases through consumption of unsafe or otherwise contaminated water. While the cost requirement to provide the unprivileged households with the necessary access the safe water is far from being achievable within a foreseeable future, provision of effective short term alternative to water safety at households remains a viable approach to protect families from the diarrhea burden until they are reached with the desired long term safe water services. Example the study done by Harston, (2004) indicate that, with proper education of how to handle and store water carefully, residents can take control over their well- being and many lives may be saved.

Every fifteen seconds a child's life is lost somewhere in the world to diarrhea, caused largely by poor sanitation and contaminated water (WHO, 2003). Five million deaths occur every year due to water borne illness, which could be reduced by half if proper access to safe water was available. The United Nations estimates that 1.2 billion people still lack access to a reliable source of water, while other sources note the number to be higher (The United Nations, 2004). "Reasonable" access as defined by the United Nations is providing

each person with twenty liters of water per day within one kilometer of their house (The United Nations, 2004).

However, the World Health Organization (WHO, 2003) claims that at least twenty five liters is needed per day for basic human survival and one hundred liters per day is needed for sustainable livelihoods.

CHAPTER THREE

3.0 METHODOLOGY

3.1 The study area

The study was conducted in Korogwe Town council; Korogwe Town Council is a new rapid growing town in Tanga region. Korogwe Town Council (KTC) is one of the eight Councils of Tanga Region and with its central location is well connected to the rest of the region to the northern, central and coastal areas of Tanzania. It is the second largest urban area in Tanga Region after the Tanga City and is the headquarters of both Korogwe Town and Korogwe District Council. Other District in Tanga region are Lushoto, Muheza, Pangani, Handeni, Mkinga, Kilindi and Korogwe rural.

Korogwe District has population of 260,004 (National population census 2002) whereby 128,208 are male and 132,796 female. The district has one division, 8 wards and 45 streets and 13 villages whereby 5 wards are in urban and 3 wards in peri-urban.

The major economic activities of Korogwe Town Council are commercial, small industries, (Carpentry welding, masonry, mills etc) animal keeping and poultry farming. Majority of the people are peasants, followed by wage laborers (at sisal estates) self employment and government employees.

Korogwe is a strategic area due to the passage of (highway road) from Dar es Salaam to Arusha, Tanga to Arusha. In the urban area there are several streets joining different parts of the town and other districts of Tanga region as well as the nearby regions such as Morogoro and Arusha; few are tarmac roads while many are dry weather roads. Another important

infrastructure is the Northern zone railway line passage connecting Tanga with Moshi and Arusha. Other communication systems include Telephone, fax and E-mail. The inhabitants are mainly Sambaa and Zigua, majority of who are Moslems, Christian and pagans.

3.2 Study design

The study was a cross-sectional using quantitative method. The study used interview based questionnaires having both open and closed ended questions. Four Research Assistants were trained for two days to assist in the interview of household members so as to assess treatment methods of household drinking water, storage containers used and prevalence of diarrhoeal diseases in Korogwe Town in the month of July 2009.

3.3 Study Population

The study target population was household members (Inhabitants) of Korogwe Town Council whereby any adult member found at home (male or female), older children (over 14 years old) during interview time were interviewed. These people were selected purposely since they are the one concern with drinking water treatment, also can be able to provide needed information.

3.4 Sampling Procedure

(a) A multistage sampling method was employed whereby four wards were selected out of eight; two from urban and other two wards form peri-urban by simple random sampling. Four streets (urban) and four sub villages (peri -urban) were selected by random sampling from each of four wards to make a total of sixteen (16) hamlets. Twenty five (25)

households were then selected from each street / hamlet by simple random sampling to have a total of 100 household from each ward to make a total of 400 household in the 4 wards.

(b) Four hundred households were studied on drinking water treatment and prevalence of Diarrhoeal diseases, 50 samples of water were taken to laboratory to test for E coli, 10 samples from sources available in the Community and 20 samples of drinking water from households responded that they had diarrhea diseases and other 20 samples of drinking water from household which had no Diarrhoeal diseases. Therefore , Laboratory testing for E coli was done based on 40 households whereby sub sample of 20 household was randomly selected from the household found with diarrhoea. Another sub sample of 20 households was again randomly selected from household without diarrhea in order to measure the quality of water and prevalence of diarrhea diseases. Water samples for Ecoli testing were collected with sterile technique in 150ml sterile bottles, and were transported on ice packs to the MUHAS – Microbiology laboratory for processing within eight hours of collection.

3.5 Sample size

The sample size N was arrived using the following statistical formula:

$$N = \frac{Z^2 P(1-P)}{d^2}$$ Whereby

N= Sample Size

Z= 2 corresponding to 95% confidence interval.

P= Estimated sample proportion (since the proportion of household treating drinking water was not known, then 50% was taken as the proportion of households treating water).

d= Margin of error of 5%

N= $\frac{2^2 \times 50\,[100-50]}{5x5}$ = 400 households.

3.6 Data collection tools

The following tools were used to collect data.

A questionnaire

Microbial testing of faecal contamination of water (membrane filtration test)

3.7 Data collection techniques

Data collection tool was a structured interview questionnaire. Interview Questionnaire consisted of three parts, one part was about respondent particulars (socio-demographic characteristics). Part two was on the means / levels of household drinking water treatment, sources of household's water, storage facilities, and prevalence of Diarrhoeal diseases in

Korogwe Town. Water samples were collected from two sources, these includes the main sources of water for domestic purposes including drinking and from storage containers at household level.

3.8 Pre-testing of data

Pre-testing of research tools with a selected sample of the target population (not from the actual targeted study areas) was done before conducting the actual study and then adjustment and corrections of the tools (questionnaire) was made.

3.9 Ethical Clearance

Prior to the study ethical approval was obtained from Muhimbili University of Health and Allied Sciences (MUHAS) Research and Publication Committee. The District Authorities were consulted before starting the study. These included: The District Commissioner, The Town Director, and Local Government leaders (village and street chairpersons). Verbal consent was obtained from the participants before interviews and after being informed on the aim and objectives of the study.

3.10 Data processing and analysis

In order to perform quality control all the information was properly collected and recorded in the field. Data were entered into a computer with the help of a computer clerk, and then the author did data cleaning. Computer Technician assisted in running frequencies and cross tabulation of same variables using Epi Info6 program.

The level knowledge of household drinking water treatment was measured by collecting information on methods used to treat drinking water The level of knowledge of household member in dinking water treatment at point of use had been measured at three levels using the following scores respectively:

- High level of knowledge on water treatment: 4- 6 positive answers
- Moderate level of knowledge: 2-3 positive answers.
- Low level of knowledge: 0-1 positive answers.

. The level knowledge of household on safe storage was measured by collecting information on methods used to store drinking water. The level of knowledge of household member in safe storage had been measured at three levels using the following scores respectively:

- High level of knowledge on safe drinking water storage: 6- 8 positive answers
- Moderate level of knowledge on safe drinking water storage: 3-5 positive answers.
- Low/poor level of knowledge on safe drinking water storage: 0-2 positive answers.

The social economic status of the household was obtained by asking household questions on ability to obtain and use treatment agents and safe drinking water containers. Those households responded on those questions were measured at three levels of social economic status using the following scores respectively:

- High social economic status: 6- 8 positive answers.
- Middle social economic status: 3- 5 positive answers.
- Low social economic status: 0- 2 positive answers.

3.12 Operational Definitions of Terms

1. Household Water Treatment (HWT) would be described as those processes used to make water more acceptable for a desired end-use. These could include use as drinking water and other domestic purposes. The goal of all water treatment process is to remove existing contaminants in the water, or reduce the concentration of such contaminants so the water becomes fit for its desired end-use. The processes involved in treating water for drinking purpose might be solids separation using physical process such as settling and filtration, chemical application such as coagulation and disinfection.
2. Safe water storage means maintaining the microbiological quality of the water by storing it in containers (plastic containers) with a narrow mouth, lid and a spigot to prevent recontamination as described by Mintz et al, (1995). Drinking water is said to be safe if stored/ put in a narrow mouthed, closed vessels designed to prevent contamination.

3. Diarrhoeal Diseases are conditions showing frequent and excessive discharge of watery material from the bowel. Diarrhoeal diseases mostly result from ingestion of harmful germs with food and water, although in some cases short episodes of diarrhoea may result from eating poisonous substances, and difficult to digest food, or through physiological intolerance of certain foods. Diarrhoea caused by virus, bacteria or parasites possesses two characteristics- firstly, the offending organisms colonize the intestine and as a consequence cause inflammation of the intestine or enteritis; and secondly, they upset the balance of intestinal fluid absorption and secretion mechanism, often enhancing the latter very considerably, which is then manifested as watery stool discharged frequently in large

volumes. Most diarrhoeal episodes are acute infections of the intestine and are self-limiting illnesses lasting for a few days but requiring treatment either to correct the lost fluid or to contain the tissue damage or other complications of the infection.

CHAPTER FOUR

RESULTS

Table 1.Distribution of the study sample by age and sex

Age group in years	Sex		Total No (%)
	Male No (%)	Female No (%)	
<=30	147 (49.7)		178 (44.5)
31 – 40	66 (22.3)	26 (25.0)	92 (23.0)
41 – 50	34 (11.5)	12 (11.5)	46 (11.5)
51 – 60	24 (8.1)	16 (15.4)	40 (10.0)
61+	25 (8.4)	19 (18.3)	44 (11.0)
TOTAL	296 (74.0)	104 (26.0)	400 (100)

Mean age = 37 years Std = 16.069 M: F= 1:0.35

Of the population, males were more (74%) than females and that the age group <=30 had more respondents (44.5%). The sample population was 400

Table2. Distribution of the respondents by socio-demographic characteristics and water treatment

CHARACTERISTICS	WATER TREATMENT		X^2 (P-value)
	YES (n=137(34.3%)	NO (N=263(65.7%)	
	No (%)	No (%)	
AGE GROUPS			10.07 (0.07)
<= 30	65 (36.5)	113 (63.5)	
31 – 40	28 (30.4)	64 (69.6)	
41 – 50	11 (23.9)	35 (76.1)	
51 – 60	11 (27.5)	29 (72.5)	
61+	22 (50.0)	22 (50.0)	
SEX			p-value???
Males	105 (35.5)	191 (64.5)	.7561, (.385)
Female	32 (30.8)	72 (69.2)	
EDUCATION			
None	12 (54.5)	10 (45.5)	22.14 (0.0001)
Primary completed	97 (31.1)	215 (68.9)	
Primary not completed	12 (33.3)	24 (66.7)	
Secondary	3 (21.4)	11 (78.6)	
College+University	13 (81.3)	3 (18.8)	
OCCUPATION			
Student	13 (41.9)	18 (58.1)	
Employed	3 (25.0)	9 (75.0)	
Non employed	108 (38.0)	176 (62.0)	14.89 (0.010)
Farmer / peasant	4 (11.4)	31 (88.6)	
Business	3 (14.3)	18 (85.7)	
Housewife	6 (35.3)	11 (64.7)	
RELIGION			
Moslems	92 (37.2)	155 (62.8)	2.96 (0.22)
Christians	45 (29.6)	107 (70.4)	
Others	0 (0.0)	1 (100)	

From table 2, two factors i.e. education and occupation seem to significantly influence household drinking water treatment. Education has great significance in household water

treatment, it was observed that the differences between different education levels with respect to treatment is statistically significant p= 0.0001 whereby college + University level of education were more likely to treat water compared to the other level of education. People employed in different occupations showed different levels of household water treatment. As reported above, the different levels of water treatment are statistically significant. (Chi square= 14.87; p value 0.010)

Table 3: Distribution respondents by socio-demographic characteristics and drinking water safe storage

Characteristics	Safe storage		X^2 (P-value)
	YES (N=198=49.5%)	NO (N=202=50.5%)	
	No. (%)	No. (%)	
AGE GROUPS			
15 – 30	82 (46.1)	96 (53.9)	
31 – 40	49 (53.3)	43 (46.7)	
41 – 50	26 (56.5)	20 (43.5)	
51 – 60	20 (50.0)	20 (50.0)	
60+	21 (47.7)	23 (52.3)	
SEX			
Males	145 (49.0)	151 (51.0)	
Females	53 (51.0)	51 (49.0)	
EDUCATION			
None /no formal education	4 (18.2)	18 (81.8)	12.06(0.01)
Primary completed	158 (50.6)	154 (49.4)	
Primary not completer	21 (58.3)	15 (41.6)	
Secondary	9 (64.3)	5 (35.7)	
College and universities	6 (37.5)	10 (62.5)	
OCCUPATION			
Student	17 (54.8)	14 (45.2)	10.32 (0.06)
Employed	8 (66.7)	4 (33.3)	
Non employed	145 (51.1)	139 (48.9)	
Farmer / peasant	13 (37.1)	22 (62.9)	
Business	5 (23.8)	16 (76.2)	
Housewife	10 (58.8)	7 (41.2)	
RELIGION			
Moslems	115 (46.6)	132 (53.4)	3.42 (0.18)
Christians	83 (54.6)	69 (45.4)	
Others	0 (0.0)	1 (100.0)	

Table 3 shows that 56.5% of respondents in the age of 41- 50 were practicing safe storage of drinking water compared to the other age groups. Also the study shows that as the level of education increases also the awareness on safe storage increases although the change is not very informative (increase up to secondary, then decrease for college).

Table 4: Distribution of study sample / respondents by socio-demographic characteristics and prevalence of Diarrhoeal diseases

Characteristics	Diarrhoeal prevalence				X^2 (P-value)
	YES (N=280=70.0%)		NO (N=120=30.0%)		
	No.	(%)	No.	(%)	
AGE GROUPS					
< = 30	129	(72.5)	49	(27.5)	
31 – 40	64	(69.6)	28	(30.4)	
41 – 50	33	(71.7)	13	(28.3)	
51 – 60	24	(60.0)	16	(40.0)	
61+	30	(68.2)	14	(31.8)	
SEX					
Males	206	(69.6)	90	(30.4)	
Females	74	(71.2)	30	(28.8)	
EDUCATION					
None education.	15	(68.2)	7	(31.8)	
Primary completed	213	(68.3)	69	(31.7)	
Primary not complete	27	(75.0)	9	(25.0)	3.73 (0.44)
Secondary	11	(78.6)	3	(21.4)	
College+University	14	(87.5)	2	(15.5)	
OCCUPATION					
Student	25	(80.6)	6	(19.4)	
Employed	9	(75.0)	3	(25.0)	
Non employed	183	(64.4)	101	(35.6)	
Farmer / peasant	28	(80.0)	7	(20.0)	16.73 (0.00)
Business	20	(95.2)	1	(4.8)	
Housewife	15	(88.2)	2	(11.8)	
RELIGION					
Moslems	174 (70.4)		73 (29.6)		
Christians	105 (69.1)		47 (30.9)		0.57 (0.77)
Others	1 (100)		0 (0.0)		

Table 4 shows that, prevalence of diarrhea ranges from 60-73%.among different age groups. The observed differences between age groups are not statistically significant. Prevalence of diarrhea is higher among females but the observed difference is small. The prevalence of diarrhea increases as the level of education increases, but the observed differences are also not significant. Prevalence of diarrhea by employment ranges from more than 64% in non-employed to 95% among the businessmen (the group which is at greater risk is businessman / women). The observed differences among different employment categories are statistically significant (chi square = 16.73; p value 0.00).

Table 5: Water sources and prevalence of Diarrhoeal

Type of water source	Prevalence of Diarrhoeal					
	+ve		-ve		Total	
	No	%	No	%	No	%
River	86	(78.9)	23	(21.1)	109	(100.0)
Deep well drilled	151	(64.0)	85	(36.0)	236	(100.0)
Tap water	10	(76.9)	3	(23.1)	13	(100.0)
Shallow well	33	(80.5)	8	(19.5)	41	(100.0)
Total	280		119		399	

Note:one variable(covered spring) have been removed from analysis because have very few cases.

Chi square=12.96 P value=0.011

Table 5 shows that people who are more at risk of getting Diarrhoeal prevalence are people who collected water from shallow well followed by the one from river and tape water. People who had the lowest prevalence of Diarrhoeal was collecting water from deep well drilled.

Table 6: Frequency table showing level of knowledge on water treatment, perceived attitudes toward drinking water treatment, ability to buy water treatment reagents and social economic status toward water treatment. (n = 137) *

Variable			Frequency	Relative Frequency
Level of knowledge on water treatment				
SCORE GADE	4-6	High	6	4.4
	2-3	Moderate	57	41.6
	0-1	Poor	74	54.0
		TOTAL	137	100.0
Perceived attitudes toward water treatment household level				
		+ ve	49	35.8
		- ve	88	64.2
		TOTAL	137	100.0
Ability to buy treatment agents				
		Ability present	54	39.4
		Ability absent	83	60.6
		TOTAL	137	100.0
Social economic status				
		High	33	24.1
		Middle	50	36.5
		Low	54	39.4
		TOTAL	137	100.0

* n = 137 Households treating water only.

Table 6 shows that 54.0% of all respondents treating drinking water had poor knowledge on water treatment. about 64 % of the respondents treating drinking water had negative attitude toward drinking water treatment. Of the interviewed households 60.6% of households had no ability to buy treatment reagents. More than 39% of household treating drinking water had low social economic status.

Table 7 .Drinking water treatment methods

Treatment methods	No of households	
	No	%
Boiling	49	35.7
Adding chlorine (water guard)	14	10.2
Filtration	8	5.8
Store for a while	66	48.2
TOTAL	137	100.0

Table 7 shows that 48.2% of the households treated their drinking water through storage method of treatment i.e. store for a while after being fetched and let settled, more than 35% through boiling and about 10% by adding chlorine/ water guard.

Table 8: Frequency showing level of knowledge on safe storage, availability of storage containers and availability of storage containers at affordable cost (n = 198) *

Variable	Frequency	Relative Frequency
Level of knowledge on safe water Storage		
High	3	1.5
Moderate	26	13.1
Poor	169	85.4
TOTAL	198	100.0
Availability of recommended storage containers		
Present	50	25.3
Absent	148	74.7
TOTAL	198	100.0
Availability of storage containers at affordable cost		
Yes	36	18.2
No	162	81.8
TOTAL	198	100.0

* n = households practicing drinking water safe storage

More than 85% of respondents who were practicing safe storage of drinking water had poor knowledge on safe storage of drinking water. Almost three quarters of household practicing safe storage had no access to recommended storage containers. About 82% of the household practicing safe storage responded that they had no accessibility of storage containers at affordable cost.

Table 9: Perceived causes, occurrence of Diarrhoeal diseases and affected group

Attributes	Occurrence of Diarrhoeal diseases		Total
	Yes	No.	
	No %	No %	No %
Perceived causes of Diarrhoeal diseases			
Water contamination	241 (86.1)	39 (13.9)	280 (100)
Food contamination	123 (43.9)	157 (56.1)	280 (100)
Eating unwashed fruits and vegetables	187 (66.8)	93 (33.2)	280 (100)
Not washing hands after toilets and before eating	183 (65.4)	97 (34.6)	280 (100)
Malaria	26 (9.3)	254 (90.7)	280 (100)
Season of occurrence			
Dry season	224 (80.0)	56 (20.0)	280 (100)
Rain season	13 (4.6)	267 (95.4)	280 (100)
Any season	43 (15.4)	237 (84.6)	280 (100)
Group of people affected by Diarrhoeal			
Children under five yrs old	145 (51.8)	135 (48.2)	280 (100)
Elders	13 (4.6)	267 (95.4)	280 (100)
Youth	16 (5.7)	264 (94.3)	280 (100)
Adult	11 (3.9)	269 (96.1)	280 (100)
Both age group	122 (30.5)	158 (69.5)	280 (100)

In this study, about 86% of respondents who had diarrhea were mainly due to water contamination compared to 66.8% due to eating unwashed fruits and vegetables, 65.4% due to not washing hands after toilets and before eating and 43.9% due food contamination. A diarrhea diseases occurrence was higher in dry season compared to other seasons. Diarrhea episodes were common in children less than five years old, however both age groups also affected (30.5%).

Table 10: Laboratory quality of water testing for E coli

Water quality	CASE(WITH DIARRHEA)	CONTROL GROUP (WITHOUT DIARRHEA)	TOTAL
Ecoli +ve	16(51.6%)	15(48.4%)	31(100%)
Ecoli –ve	4(44.4%)	5(55.6%)	9(100%)
Total	20	20	40

Relative risk = 1.33 95% CI = (0.3, 5.93)

From table 10, there is difference in risk of getting diarrhea when one uses water contaminated with fecal matter (presence of E Coli) and without contamination. (RR = 1.33, 95% CI = 0.3, 5.95).

CHAPTER FIVE

5.0 DISCUSSION

This study was designed to assess the level of household drinking water treatment and safe storage and the extent to which socio demographic characteristics and other factors contributed to drinking water treatment and safe storage among household members in Korogwe Town. This study found that the proportion of respondents by socio- demographic characteristics and drinking water treatment as well as safe storage is quite low. This study showed that two factors i.e. education and occupation have great significant in household drinking water treatment. It might be difficult to compare the findings of this study with other publications because very few studies are published on this topic.

(a) Drinking water treatment and safe storage

The study found that, the extent of household drinking water is less than 35% this is not much different from findings reported by Mbogo (2008) from two district in semi arid areas of Tanzania which found only 41% of respondents were treating drinking water. These differences might be contributed by small sample size and area of the study as this study included only few small parts of one district whereas Mbogo studied two districts.

(b) Prevalence of diarrhea

Results from the study also indicate that prevalence of diarrhea diseases among respondents is quite high. The prevalence of diarrhea diseases is in more than two thirds out of studied households. The result shows that the prevalence of diarrhea diseases increases as the level of education increases. This is contrary to reality and this could be explained by the small

samples. The observed differences are not statistically significant (Chi square= 3.73; p value 0.44).

Water sources and prevalence of diarrhea

Most of the households who reported to have diarrhea episodes were collecting water from different sources which were all contaminated with fecal matter as indicated by the laboratory results. This study revealed that there was a significant relationship between prevalence of diarrhea and water sources. Our surprise from table 5 was that even water from deep drilled well was contaminated. This can be explained by different concept of respondents had in mind on deep drilled well. Since we relied on just information for the respondents it is difficult to ascertain whether the deep well was really deep. Studies done elsewhere have shown water from deep well is of better quality and free from E Coli.

According to Table 10 prevalence of diarrhea was the same in people taking contaminated water and those not taking contaminated water. From this finding we can conclude that there is more cause of diarrhea than drinking water, in the dry season the prevalence of diarrhea was high and this could be contributed by mangoes being harvested this time. and increase of domestic flies, due to the fact that water is scarce by that time, then it can be many people especially children don't wash these fruits properly. Contrary to that is because during that time there is high scarcity of water and that people got water from heavily contaminated sources like from river. By the time I was preparing this report it was reported in various media that the study area has cholera epidemic and that one person has passed away where more than twenty eight (28) patients were admitted. This is a dry season

where in the study area there is high scarcity of water. It is hoped that findings of this study will be used for planning of effective intervention and programs to overcome the situation.

5.1 CONCLUSION

Extent of drinking water treatment and safe storage at point of use in Korogwe is low and study recommends that:

5.2 RECOMMENDATIONS

1. Campaign on water treatment and safe storage at point of use should be carried out in the district as most of household get their drinking water from contaminated sources.
2. Korogwe Town Council should do regularly chlorination to all wells and to cover all open well and springs so as to reduce number of microbes causing Diarrhoeal diseases and improve quality of water.
3. Concerted efforts to provide basic factual information to the household members as well as society at large on the health hazards of drinking untreated water are needed. These could be effected through community meetings such as Village Health Committee (VHC), Village General Assemble (VGA), Ward Development Committee (WDC), school health program, school baraza as well as media
4. Because our study was not designed to assess an effect on drinking water treatment and reduction of diarrhea diseases among household treating water, then further research is needed to better understand the relation between household drinking water treatment and safe storage and reduction in diarrhea diseases.

CHAPTER SIX

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APPENDICES

APPENDIX 1: INFORMED CONSENT (ENGLISH VERSION)

MUHIMBILI UNIVERSITY OF HEALTH AND ALLIED SCIENCES

DIRECTORATE OF RESEARCH AND PUBLICATIONS

INFORMED CONSENT

ID-NO ☐☐☐

Consent to participate in this study

Greetings! My name is ….. I am working on this research project with the objective of investigating HOUSEHOLD WATER HANDLING AND PRIVALENCE OF DIARRHOEAL DISEASE AMONG KOROGWE RESIDENTS

Purpose of the study

This study has the purpose of collecting information on HOUSEHOLD WATER HANDLING AND MAGNITUDE OF DIARRHOEAL DISEASE AMONG KOROGWE RESIDENTS. You are being asked to participate in this study because you have particular knowledge and experiences that may be important to the study.

What Participation Involves

If you agree to participate in this study the following will occur:

1. You will sit with a trained interviewer and answer questions about what mechanisms you think are used to treat household drinking water and factors associated with diarrhoeal diseases and finally your comments on what should be done to improve

quality of household drinking water. The interviewer will be recording your responses in the questionnaire.

2. No identifying information will be collected from you during this interview, except your age, level of education, marital status, religion and your current occupation.

3. You will be interviewed only once for approximately 30 minutes in a private setting.

Confidentiality

I assure you that all the information collected from you will be kept confidential. Only people working in this research study will have access to the information. We will be compiling a report, which will contain responses from several household members regarding household water treatment and safe storage.

Rights to Withdraw and Alternatives

Taking part in this study is completely your choice. If you choose not to participate in the study or if you decide to stop participating in the study you will not get any harm. You can stop participating in this study at any time, even if you have already given your consent. Refusal to participate or withdrawal from the study will not involve penalty or loss of any benefits to which you are otherwise entitled.

Benefits

The information you provide will help to increase our understanding on household drinking water treatment methods and safe storage practices and hence factors associated with diarrhoeal diseases in Korogwe Town Council and therefore to prepare effective interventions/programs or training packages of this population group. Individual benefit may include advice on household water treatment and safe storage.

In Case of Injury

We do not anticipate that any harm will occur to you or your family as a result of participation in this study

Who to contact

If you ever have questions about this study, you should contact the study Coordinator or the **Principal Investigator, SUZANA J. MUSHI.** Muhimbili University of Health and Allied Sciences (MUHAS), P.O. Box 65001, Dar es Salaam (Tel. no. 0754 848392 or 0715 848392). If you ever have questions about your rights as a participant, you may call **Prof. E .F. Lyamuya, Chairman of the university Research and Publications Committee,** P. O. Box 65001, Dar es Salaam. Tel: 2150302-6 and **Dr. L. RONGO who is the supervisor** of this study (Tel. 0754 575709)

Signature

Do you agree?

Participant Agrees [__]

Participant disagree [__]

I _____ have read/understood the contents in this form. My questions have been answered. I agree to participate in this study.

Signature of Participant _____

Signature of witness (if participant cannot read) _____

Signature of research assistant _____

Date of signed consent _____

APPENDIX 2: INFORMED CONSENT (SWAHILI VERSION)

MUHIMBILI UNIVERSITY OF HEALTH HEATH AND ALLIED SCIENCES

DIRECTORATE OF RESEARCH AND PUBLICATIONS

FOMU YA RIDHAA

Namba ya Utambulisho ☐☐☐

Ridhaa ya Kushiriki katika utafiti huu

Habari! Jina langu naitwa ..... nafanya kazi katika mradi huu wa utafiti wenye lengo la kuangalia njia au vitendanishi vinavyotumiwa kuyafanya maji ya kunywa kuwa salama, kuchunguza njia salama zinazotumika kuhifadhi maji ya kunywa na sababu zinazohusishwa na magonjwa ya kuhara katika mji wa Korogwe wilayani Korogwe.

Malengo ya Utafiti

Utafiti huu una lengo la kukusanya taarifa juu ya njia zinazotumiwa kuyafanya maji ya kunywa kuwa safi na salama na sababu zinazohusishwa na magonjwa ya kuhara mji wa Korogwe. Unaombwa kushiriki katika utafiti huu kwa sababu una uelewa na uzoefu ambao unaweza kuwa muhimu katika utafiti huu.

What Participation Involves

Ukikubali kushiriki katika utafiti huu yafuatayo yatatokea:

1. Utakaa na msaili/mtafiti aliyepewa mafunzo ya jinsi ya kuhoji na kujibu maswali yahusuyo ufahamu wako kuhusu njia zinazotumika kwenye kaya kuyafanya maji ya

kunywa na sababu zinazohusishwa na magonjwa ya kuhara na mwisho kabisa kwa maoni yako ni nini kifanyike kuboresha hali ya maji kwa matumizi ya kunywa katika kaya. Msaili atakua ananukuu majibu yako katika dodoso.

2. Hakuna taarifa zozote za utambulisho tutakazokusanya wakati wa usaili isipokua umri, kiwango cha elimu, dini na kazi yako kwa sasa.

3. Utahojiwa mara moja tu kwa takriban dakika 30 kwenye sehemu ya faraga.

Usiri

Nakuhakikishia kwamba taarifa zote zitakazokusanywa kutoka kwako zitakua ni siri, ni watu wanaofanya kazi katika utafiti huu tu ndio wanaweza kuziona taarifa hizi. Hatutaweka jina lako au taarifa yoyote ya utambulisho kwenye kumbukumbu za taarifa utakazotupa.

Haki ya kujitoa na mbadala wowote

Kushiriki katika utafiti huu ni uchanguzi wako, kama utachagua kutokushiriki au utaamua kusimamisha kushiriki hutapata madhara yoyote. Unaweza kusimamisha kushiriki katika tafiti hii mda wowote hata kama ulisharidhia kushiriki. Kukataa kushiiriki au kujitoa katika utafiti hakutaambatana na adhabu yoyote au upotevu wa faida yoyote unayotakiwa kupata.

Faida

Taarifa utakayotupatia itasaidia kuongeza uelewa wetu kuhusu njia zinazotumiwa kutibu na njia salama za kuhifadhi maji ya kunywa, pamoja na kuainisha sababu zinazohusishwa na magonjwa ya kuhara katika mji wa Korogwe ili kuwezesha kutayarisha mipango na mikakati na mafunzo kwa wahusika. Faida binafsi ni pamoja na kuweza kupewa ushauri juu ya njia bora za kutibu maji ya kunywa na njia salama za kuhifadhi maji ya kunywa.

Endapo Utadhurika

Hatutegemi madhara yoyote kutokea kwa kushiriki kwako katika tafiti hii.

Watu wa kuwasiliana nao

Kama una maswali katika utafiti huu unaweza kuwasiliana na **mratibu mkuu wa mradi, SUZANA J. MUSHI,** Chuo Kikuu cha Muhimbili, S.L. P 65001, Dar es Salaam (Simu. no. 0754 848392 au 0715 848392). Kama utakua na maswali yoyote kuhusu haki zako kama mshitriki unaweza kupiga simu kwa **Prof. E .F. Lyamuya,** ambaye ni **Mwenyekiti wa kamati ya chuo ya utafiti na machapisho,** S.L.P 65001, Dar es Salaam. Simu namba: 2150302-6 na **Dk. L. RONGO** ambaye ni **msimamizi wa utafiti huu** (Simu nambari. 0754 575709)

Sahihi

Unakubali?

Mshiriki amekubali [__]

Mshiriki amekataa [__]

Mimi _____ nimesoma/nimeielewa hii fomu, maswali yangu yamejibiwa. Nakubali kushiriki katika utafiti huu.

Sahihi ya mshiriki _____

Sahihi ya shahidi (kama hawezi kusoma na kuandika) _____

Sahihi ya mtafiti muandamizi _____

Tarehe ya makubaliano _____

APPENDIX 3: QUESTIONNAIRE (ENGLISH VERSION)

A QUESTIONNAIRE OF A STUDY ON HOUSEHOD WATER HANDLING AND PREVALANCE OF DIARRHOEAL DISEASE AMONG KOROGWE RESIDENTS AT KOROGWE TOWN COUNCIL

IDENTIFICATION

1. QUESTIONNAIRE NUMBER----------
2. DISTRICT----------
3. WARD----------
4. VILLAGE / STREET----------
5. DATE _____/_____/ 2009----------
6. NAME OF RESEARCH ASSISTANT----------
7. CHECKED BY PRINCIPAL INVESTIGATOR (NAME) --------

1. Respondent information

1. Age (at your last birthday)----------years
2. sex
    1. Female
    2. Male
3. occupation
    1) Employed
    2) Non employed

3) Farmer

4) Business

5) Livestock-keeper

6) Home mother

7) Other(specify)----------

4. Household size

1) Number of adults ----------

2) Number of children ----------

5. What is your level of education?

1. No formal education
2. Primary school
3. Secondary
4. College + university
5. Others(specify)----------

6. What is your religion?

1. Christian
2. Muslim
3. No religion
4. Any other (specify)----------

7. Where do you get your water for domestic purposes?

a) At home

1. from pipe

2. from well

b) Outside home

1. from pipe
2. from well

8. From what type of source do you get your water?

1. River
2. Tape water
3. Lake
4. Dam/Bore hole
5. Spring
6. Deep drilled well
7. Shallow well
8. Rain water
9. Covered spring
10. Uncovered spring

9. How far is it from home? (m.)

1. In between the length of 400 m.
2. More than the length of 400 m.

10. What is your comment about the quality of water you get from the source you mentioned above?

1. Very good

2. Good
3. Poor
4. Very poor

11. Give reason for the answer above

1. It is good looking
2. We never got health problems from it
3. Technical analysis showed the water was not safe
4. The source is protected safely
5. Source is polluted by people
6. Other reason(specify)----------

12. Water from the source you mentioned above you use for which domestic purposes?

1. Drinking
2. Cooking
3. Washing
4. House cleaning
5. Bathing
6. Other purposes(specify)----------

13. How many plastic containers of water do you collect per day?..... (lt..)

14. How many plastics (lt.) of water do you spend on the following?

1. Drinking .....lt.
2. Cooking .....lt.
3. Bathing.....lt.

4. Other purposes (specify).....lt.

15. Does the water source operate throughout a year?

    1. Yes
    2. No

16. If not, when does it cease to operate?

    1. During dry season
    2. During heavy rain falls
    3. During rationing seasons

17. Is your family treating drinking water?

    1. Yes
    2. No

18. What treatments method/methods do you know are used to treat drinking water?

    1. To add germs treating agents
    2. I know nothing
    3. Boiling
    4. Put in the sunrise
    5. Distilled with vessel
    6. water funnel
    7. Other(specify) ----------

19. Which method(s) do you use to treat drinking water in your household?

    1. Boiling
    2. Chlorine/water guard

3. filtration
4. stored for a while
5. Nothing
6. Others.(specify)

20. If answer of question number 19 is nothing, why?

1. No need of treating the water
2. Don't know how to treat water
3. Don't have money
4. Ability to buy water treatment agents
5. Others.(specify)----------

21. In your opinion, do you see there is need for water treatment (feeling/perception)?

1. Strongly agree
2. Agree
3. Disagree
4. Strongly disagree

22. Do you afford the household drinking water treatment cost?

1. Yes
2. No

23. What is your opinions concerning utensils and agents for drinking water treatments? ------

---

24. Do you know how to handle treated/to store drinking water?

1. Yes

2. No

25. How does your family store drinking water

1. After application of treatment method, they let water cool and store in normal bucket
2. After treatment, they leave water for few minutes and start using water
3. After treatment, they leave water for few minutes and store in a narrow mouthed instrument
4. After treatment, they just start using treated water

26. Do you know the recommended design and criteria for drinking water storage vessels?

1. Yes, I know
2. No, I don't

27. If yes, can you mention the criteria?

1. Nonrusting
2. With single opening, but easy to fill the container and add disinfectant
3. Allow air to enter as water extracted
4. Hold appropriate standard volume (e.g. 20 lt)
5. Narrow mouthed with vessel
6. Difficult to immerse hands or utensils
7. Constructed with polyethylene plastic material that is durable lightweight
8. Easy to clean and inexpensive

28. Do the storage containers with the recommended design and criteria mentioned above available in your area?

1. Yes

2. No

29. Is it available for affordable cost?

1. Yes
2. No

30. What is the size of storage facilities do you use to store treated drinking water?

1. 20 litres buckets
2. 20-60 litres buckets
3. Gallons 5-20 litres
4. others(specify)----------

31. Is the water storage container provided with cover?(observe)

1. Covered
2. Not covered

32 Do you separate drinking water from water for other domestic uses?

1. Yes
2. No

33. How often do you clean the drinking water storage vessel?

1. Every day
2. Two times per day
3. One time a day
4. After water have finished
5. don't remember

34. Do you know diarrhoeal diseases?

    1. Yes

    2. No

35. Can you mention any type/types of diarrhoeal diseases you know?

    1) Normal diarrhea

    2) Dysentery (blood diarrhea)

    3) Cholera (rice watery stool)

    4) Mucous diarrhea(amoeba)

36. Do you suffer diarrhea diseases in your area?

    1. Yes

    2. No

37. Has there been any diarrhoeal diseases in the household in the past 2 weeks?

    1. Yes

    2. No

38. If yes, what was the appearance of the stool?

    1. Watery stool

    2. Blood diarrhea

    3. Rice watery stool

    4. Mucous diarrhea

39. What do you think is the main cause of diarrhoeal in your family?

    1. Due to water contamination

    2. Due to food contamination

3. Eating unwashed fruits and vegetables
4. Not washing hands after toilets and before eating
5. Other (specify) ----------

40. When do diarrhoeal diseases normally occurred (Season) in your area
    1. During dry season
    2. During rain season
    3. Irregularly
41. Who are most affected by diarrhoeal outbreak in your family?
    1. children under five years old
    2. elders
    3. youth
    4. adults
    5. both

APPENDIX 4: QUESTIONNAIRE (SWAHILI VERSION)

Dodoso kuhusu utafiti jinsi ya kuyahifadhi na kufannya maji ya kunywa kuwa safi na salama na kiwango cha magonjwa ya kuhara miongoni mwa wakazi wa Korogwe katika mji wa Korogwe.

UTHIBITI WA TAKWIMU NA UTAMBULISHO

1. NAMBA YA DODOSO----------
2. WILAYA----------
3. KATA----------
4. KIJIJI/MTAA----------
5. TAREHE YA MAHOJIANO _____/_____/ 2009----------
6. JINA LA MTAFITI MSAIDIZI----------
7. IMEKAGULIWA NA MSIMAMIZI MKUU (JINA) --------

1. Taarifa za mhojiwa

umri (katika tarehe ya mwisho ya mwaka wako wa kuzaliwa)----------(miaka)

2. Jinsi

1. ke

2. me

3. kazi

1. Nimeajiriwa
2. sijaajiriwa
3. Mkulima
4. Mfanyabiashara
5. Mfugaji
6. Mama wa nyumbani
7. Nyingine (taja) ----------

4.Idadi ya watu katika kaya yako

1. watu wazima ---------
2. watoto----------

5. Nini kiwango chako cha elimu?

1. Sijasoma
2. Elimu ya msingi
3. Elimu ya sekondari
4. Elimu ya juu na chuo kikuu
5. Nyingine(taja)----------

6. Dini yako ni ipi?

1. Mkiristo
2. .Muislam
3. Sina dini
4. Nyingineyo(eleza) ----------

7. Maji yako unapata wapi?

(a)Nyumbani

1. kuna bomba
2. Kutoka kwenye kisima

(b)Nje ya nyumba yangu

1. Maji ya bomba
2. Maji ya kisima

8.Unapata maji kutoka katika chanzo gani?

1. Mto
2. Bomba
3. Ziwa
4. Bwawa/lambo
5. Chemchemi
6. Kisima kirefu cha kuchonga
7. Kisima kifupi cha kuchimba
8. Kuvuna maji ya mvua
9. Chemchemi iliyofunikwa
10. Chemchemi wazi

9. Ni umbali gani kutoka hapa nyumbani ?(mita)

1. Ndani ya umbali wa mita 400

2. Zaidi ya umbali wa mita 400

10. Je una maoni gani juu ya ubora wa maji toka chanzo ulichotaja hapo juu kwa matumizi ya kunywa?

    1. Ni bora sana

    2. Ni bora

    3. Si bora

    4. Si bora kabisa

11.Toa sababu kwa jibu lako

    1. Kwa kuyaangalia kwa macho

    2. Hayajawahi kuleta madhara ya kiafya

    3. Yalishapimwa na matokeo ya maabara yalionyesha sio bora

    4. Chanzo hicho kimefunikwa salama

    5. Huchafuliwa na watu

    6. Sababu nyinginezo (taja)----------

12. Maji kutoka chanzo ulichotaja hapo juu unayatumia kwa matumizi gani ya nyumbani?

1. Kunywa
2. Kupikia
3. Kufulia
4. Usafi
5. Kuogea
6. Matumizi mengineyo (taja) ----------

13. Unatumia plastiki ngapi za maji kila siku?..... (lt..)

14.Unatumia maji kiasi gani kwa kazi zifuatazo?

1. Kunywa .....lt
2. Kupika.....lt
3. Kuoga.....lt
4. Mengineyo (taja) .....lt

15. Je chanzo hicho hutoa maji majira yote ya mwaka?

1. Ndiyo
2. Hapana

16. Kama jibu ni hapana ni kipindi gani ambapo maji hayapatikani?

    1. Kiangazi
    2. Masika
    3. Vipindi vya mgao

17. Je familia yako inatibu maji ya kunywa?

    1. Ndiyo
    2. Hapana

18. Ni njia zipi unazozifahamu zinazotumika kutibu maji ya kunywa?

    1. Kuweka dawa ya kuuwa vijidudu
    2. Sifahamu yoyote
    3. Kuchemsha
    4. Kuanika juani
    5. Kuchuja kwa kitambaa
    6. Chujio maalum
    7. Ingine (taja) ----------

19. Ni njia ipi / zipi unazotumia kutibu maji ya kunywa nyumbani kwako?

    1. Kuchemsha
    2. Klorine(water guard)
    3. Kuchuja
    4. Kuyahifadhi kwa muda
    5. Sifanyi chochote
    6. Nyinginezo (taja) ----------

20. Kama jibu la swali namba 19 ni sifanyi chochote ni kwa nini?

    1. Sioni haja ya kutibu maji
    2. Sijui jinsi ya kutibu maji
    3. Sina pesa
    4. Uwezo wa kununua vitendanishi vya kutibu maji
    5. Sababu nyinginezo.(taja)

21.Kwa maoni yako,unaona kuna umuhimu wa kutibu maji ya kunywa (hisia/mtazamo)?

    1. Nakubali sana

2. Nakubali

3. Sikubali

4. Sikubali kabisa

22. Je kaya yako inamudu gharama za matibabu ya maji ya kunywa?

1. Ndiyo

2. Hapana

23.Je una maoni gani kuhusu dawa na vifaa vya matibabu ya maji kunywa?----------

---

24. Je unajua jinsi ya kuyaweka /kutunza maji salama ya kunywa

1. Ndiyo

2. Hapana

25. Familia yako inatunzaje maji ya kunywa?

1. Baada ya kutibu maji,tunayaacha yapoe kisha tunayatunza kwenye ndoo ya kawaida

2. Baada ya kuyatibu tunaacha yapoe kwa dakika chache kisha tunaanza kunywa

3. Baada ya kuyatibu tunaacha yapoe kwa dakika chache kisha tunayaweka kwenye chombo chenye mdomo mwembamba

4. Baada ya kuyatibu tunaanza kunywa hapohapo

26. Je unafahamu maji kwa ajili ya kunywa yanatakiwa yawekwe kwenye chombo chenye vigezo na sifa gani?

1. Ndiyo, nafahamu

2. Hapana,sifahamu

27.Kama unafahamu taja sifa hizo

1. Kisichoweka kutu
2. Kinachofungukia sehemu moja tu,lakini rahisi kujaza maji na kuweka dawa ya kutibu maji
3. Kinachoruhusu hewa kupita wakati wa kuchukua maji kutoka ndani
4. Chenye ukubwa wa standadi iliyokubalika(angalau lt.20)
5. Chenye mdomo mwembamba
6. Ambacho ni vigumu kutumbukiza mkono au chombo ndani yake
7. Kilichotengenezwa kwa mpira aina ya polyethylene ambayo ni imara na nyepesi
8. Rahisi kusafisha na kisicho na gharama kubwa

28.Je vyombo vya kuhifadhia maji salama na vyenye sifa ulizotaja vinapatikana madukani katika eneo lako?

1. Ndiyo

2. Hapana

29. Je vyombo hivyo vinapatikana kwa bei nafuu katika eneo lako?

1. Ndio

2. Hapana

30. Je unatumia chombo chenye ukubwa gani kuhifadhia maji ya kunywa?

1. Chombo cha lita 20

2. chombo cha lita 21-60

3. Dumu la lita 5-20

4. Chombo chenye ukubwa mwingine (taja) ----------

31.Je chombo unachohifadhia maji ya kunywa kina mfuniko (angalia)

1. Ndiyo

2. Hapana

32. Je unatenganisha chombo cha kuhifadhia maji ya kunywa na vyombo vingine?

1. Ndio

2. Hapana

33. Ni mara ngapi unasafisha chombo cha kuhifadhia maji kwa wiki?

1. Kila siku

2. Mara mbili kwa siku

3. Mara moja kwa siku

4. Mara maji yanapoisha

5. Sikumbuki

34. Je unafahamu magonjwa ya kuhara?

1. Ndiyo

2. Hapana

35. Unaweza kutaja aina yeyote ya magonjwa ya kuhara?

1. Kuhara

2. Kuhara damu

3. Kipindupindu (kinyesi cha maji meupe ya mchele)

4. kuharisha malendalenda (Amoeba)

36. Je katika eneo lenu mnasumbuliwa na magonjwa ya kuhara?

1. Ndiyo

2. Hapana

37. Je kuna mtu yeyote ameumwa magonjwa ya kuhara katika kaya yako kwa muda wa wiki mbili zilizopita?

1. Ndiyo

2. Hapana

38. Kama ndiyo,choo kilikuwaje?

1. Kinyesi laini cha majimaji

2.Kuhara damu

3. Kinyesi cha maji meupe kama mchele

4. Kuhara malendalenda

39. Unafikiri ni nini sababu kubwa ya magonjwa ya kuhara katika familia yako

1. Kwa ajili ya uchafuzi wa maji

2. Kwa ajili ya uchafuzi wa chakula

3. Kula matunda au mbogamboga ambazo hazijaoshwa

4. Kutonawa mikono baada ya kutoka chooni na kabla ya kula

5. Sababu nyinginezo(taja) ----------

40. Ni wakati gani kwa kwaida magonjwa ya kuhara yanatokeaga(msimu) katika eneo lako?

1. Wakati wa ukame

2. Wakati wa masika/mvua

3. Wakati wowote

41. Ni nani wanaadhirika zaidi na mlipuko wa magonjwa ya kuhara katika familia yako?

1. Watoto walio chini ya umri wa miaka mitano
2. Wazee
3. Vijana
4. watu wazima
5. Makundi yote

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