Influence of Dietary Intakes, 'WASH' and Diarrhoeal Morbidity on Stunting Among Children below Five Years in Kaptembwo and Milimani, Nakuru County

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A thesis submitted in partial fulfillment for the degree of Master of Science Human Nutrition of Kenya Methodist University

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DECLARATION

This thesis is my original work and has not been presented for a degree or any other award in any other University.

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We confirm that the work reported in this thesis was carried out by the candidate under our supervision."

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DEDICATION

To My wife Mary, my children Jonah, Presley and Joysilvia for being my inspiration.

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I acknowledge my supervisors, Dr. Job Mapesa, and Mr. Lawrence Mugambi for their technical support. I also thank my research assistants for their tireless efforts in collecting the right data without whom, the quality of this work could not be realized. I thank my entire family for the humble times and immense moral supports that I received throughout the study period, May God bless you abundantly.

ABSTRACT

Stunting is a form of undernutrition in which affected children are too short for their age. Stunting affects 21.3 % of children under five years globally. The prevalence of stunting in sub-Saharan Africa in 2019 was 34%, while Kenya's national average is 26%. The prevalence of stunting in Nakuru County is 28%, in which 9% are severely stunted. The high prevalence of stunting in Nakuru prompted this cross-sectional study with an analytical design in Kaptembwo and Milimani estate. The study aimed at establishing the contribution of water, sanitation and hygiene towards episodes of diarrhea and if these factors have influence on stunting. Objectives of the study were to determine the socioeconomic status, to evaluate the dietary intakes of children below five years, to determine the water, sanitation and hygiene practices, to determine the diarrheal morbidity of children below 5 years, and to determine the level of stunting of children below 5 years. The study included 314 children (0-59 months) sampled using systematic random sampling. Data was collected using questionnaires programmed in Survey CTO platform, which had been installed in mobile phones and or Tablets. Descriptive data was analyzed using SPSS version 22 software while Stata was used for regression analysis. Other statistical tests such as t-test and chi-square test were also used. The mean age of sampled children was 24.5months while their mean height was 81.82cm. The mean maternal age was 28.5 years. 19.1% of the mothers were single while 80.89% were married. 32.69% of mothers had at least secondary education. 10.81% of mothers in Milimani had university degree compared to 1.01% of mothers in Kaptembwo. The dietary intakes, dietary diversity and food frequencies of children sampled in the two study areas was not any significant $P>0.05$. The mean dietary Intakes (energy (Kcal)) was within the recommended dietary intake (RDI). Diarrhoea morbidity was high in Kaptembwo (38.61%) than in Milimani (16.96%). High diarrhoea episodes were associated with eating vended foods e.g. (Nuts; Coef. = -1.313667, Githeri; Coef. = 0.4715581). Low diarrhoea episodes were associated with deworming within 3 months (coef. = 0.8902153) and use of ORS (coefficient. 1.000825). However, the level of stunting was high in Kaptembwo than Milimani. Stunting levels for children were measured and classified based on z-score cut-off less than -2 SD of height for age (HAZ). Among the 314 children, 162 (51.59%) were male and 152 (48%) were female. Of the 202 children sampled in Kaptembwo, 25% were stunted, while of the 112 children sampled in Milimani, only 3.33% were stunted. The percentage of boys stunted in Milimani was (5%) while the percentage for boys stunted in Kaptembwo was 30%. The percentage of girls stunted in Milimani was 1.67% compared to 20% in Kaptembwo. Of the stunted children, boys accounted for a higher percentage (35%) than girls (26.67%). However, the Average stunting percentage was 14.17%. Results further showed that the risk of stunting increased with gender, age, and decreased with increase in hand washing. Maternal age, Education level, marital status did to influence stunting, $P=0.097$, $P=0.016$ and $P=0.0285$ respectively. Dietary intake did not have significant influence on stunting of children of all ages. Diarrhoea had very significant influence on stunting between 21-27 months $P=0.004$ and a general influence across all age groups $P=0.050$. Government at both levels should make deliberate efforts towards making basic utilities such as safe drinking water and good sewerage systems available for the people and further carry out public education on good sanitation and hygiene practices.

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ABBREVIATIONS AND ACRONYMS

DHS Demographic Health Survey

NAWASSCO Nakuru Water Supply and Sewerage Company

EED Environmental Enteric Dysfunction

FFQ Food Frequency Questionnaire

HAZ Height –for-age Z-score

HIV/AIDS Human Immune Virus/ Acquired Immune Deficiency Syndrome

KEMU Kenya Methodist University

KNBS Kenya National Bureau of Statistics

LMICs Low and Middle-Income Countries

NACOSTI National Commission for Science Technology and Innovation

NNAP National Nutrition Action Plan

SPSS Statistical Package for Social Sciences

CTO survey- a secure and reliable mobile data collection platform for researchers

UNICEF United Nations International Children Education Fund

WHO World Health Organization

WASH Water, Sanitation and Hygiene

WWDR World Water Development Report

CHAPTER ONE

INTRODUCTION

1.1 Background information

Stunting has been rated as the most common form of undernutrition across the world (Campisi et al., 2017). Stunting is associated with an increase in morbidity and mortality due to infectious diseases in childhood, a reduction in physical, neuro-developmental, poorer educational outcomes, lower adult earnings and high risk of developing metabolic disease in adulthood (Alderman et al., 2006; Caulfield et al., 2004; Grantham-McGregor et al., 2007; Prendergast & Humphrey, 2014) Stunting is attributed to about 15% of deaths among children under the age of 5 years (Black et al., 2013).

According to United Nations children education fund (UNICEF, 2019), globally, an estimate of 149 million (21.9%) of children less than 5 years old were stunted by 2018. Studies have shown that 34% of children below 5 years in sub-Saharan Africa are stunted, with about 37% of the children being stunted in the Eastern Africa (Nshimyiryo et al., 2019). Out of a total of 7 million children under the age of 5 years in Kenya, 1.82 million, which is about 26% are stunted. 11.4% of these children are severely stunted (Below -3 Standard deviation) (Kenya National Bureau of Statistics [KNBS], 2015). Despite this alarming trend, as a country, Kenya has made recognizable progress towards decreasing the levels of stunting, having fallen from 35% to 26% between 2008 and 2014 (KNBS 2014, 2015). It is most prevalent in Eastern, Coast and Rift valley regions of Kenya among the children aged between 18-23 months. According to KNBS (2015) report, poor complementary feeding practices, poor hygiene and sanitation have contributed to the increased stunting levels in children of this age group. In the Rift Valley region, Nakuru County's level of stunting stands at 28% of which 9% are severely stunted, slightly below the national average of

severe stunting (11.4%), in which the highest levels of stunting are recorded in West Pokot County with 45.9%. In the Eastern region, Kitui County records 45.8%. Other counties with high levels of stunting include Kilifi 39.1%, Mandera 36%, Bomet 35.5%, Tharaka-Nithi 32.9%, Narok 32.9%, Uasin Gishu 31.2% and Samburu 30.1% (KNBS, 2015).

The County Government of Nakuru, in its plan period 2018 to 2022, the County plans to promote nutrition education among community with its target focused on community units, and further strengthen them to provide broad based with the view of curbing cases of malnutrition (Nakuru County Integrated Development Plan (2018-2022).

Stunting is caused by many factors which many range from inadequate nutrition prenatally and inadequate dietary intake in the first 1,000 days of life. Chronic and recurrent acute infections and Environmental Enteric dysfunction (EED) may also play a significant role. EED tends to reduce the absorptive capacity of the small intestine thereby failing to make use of the nutrients consumed (Crane et al., 2015).

Undernutrition could be due to take inadequate diet and recurrent infections. Undernutrition includes a number of conditions such as being obese, overweight, underweight, being stunted, wasted and or lacking essential vitamins and minerals (Bain et al., 2013). Major causes of nutrition include poor feeding of children, especially lack of optimal breastfeeding and responsive complementary feeding, illnesses such as diarrhoea, and HIV/AIDS (Sint et al., 2013). About 226 million children under the age of 5 years are stunted globally, about 67 million wasted, and almost 180 million children have weight below the normal, expected weight (UNICEF, 2021). In Kenya alone, slightly above 32% of its under-five years population has chronic malnutrition (De vita et al., 2019).

The consequences of stunting on the child are bad for health. Of concern is the nutritional status of children under five years, as the first five years of life are crucial child growth and development. It is evident that hunger and inadequate dietary intakes have a role to play on early deaths for mothers, infants and young children. Beyond the age of two years, stunting may be irreversible and usually has life-long effects of the child's health and development (black et al., 2008). Damage caused by deficiencies of adequate nutrition, could ultimately bring about child's impaired cognitive development which may in turn, compromise his/her educational success (Prado et al., 2014).

In his meta-analysis of 2007, Grantham proposed that each year, around 200 million children do not attain their full potential due to stunting. (Grantham-McGregor et al., 2007). Some diseases in adulthood are associated with stunting at childhood (Crane et al., 2015). It is evident that if nutrition intervention alone is used to address the problems of stunting, it may not fully address the challege (Khalid et al., 2019).

Adequate nutrition intake is necessary for children's optimal growth but alone is not enough for good linear growth (Mbuya & Humphrey, 2016). For children to survive and have optimal growth and development, embracing good feeding practices is very important (Kumar et al., 2007). It is true that appropriate dietary intakes positively affect child growth and development and influence child survival (Mamiro et al., 2005).

Kenya national bureau of statistics has it that children between 18 months to 23 months are most affected by stunting and that the major factor for such stunting is inappropriate complementary feeding (KNBS et al., 2015). Kumar et al. (2007) established that late initiation of colostrum-feeding and inappropriate complementary feeding practices were major risk factors for

malnutrition in the under-fives (Kumar et al., 2007). An estimate of over 1 billion people globally lack access to safe water for drinking. Close to 2.5 billion people have no adequate sanitation and that the two factors contribute to deaths of over 5 million people, most of whom being children (UNICEF, 2006).

In Kenya for example, only 35% of low-income urban have access to piped water. (KNBS, 2011). The biggest reason for this inadequacy of water supply is inadequacy of water itself and the factor of water rationing system (NAWASSCO, 2007). It is obvious that clean water, basic toilets and good hygiene are important for children survival. Across the world, more than 3.4 million people due to factors related to water, sanitation, and hygiene. Of this population, 99% of them die in developing countries (World Health Organisation [WHO], 2019). Only 59% of Kenyan's population has basic water services. The human environment and its associated factors such as unsafe drinking water, poor sanitation and poor hygiene are responsible for about 94% of the diarrhoeal diseases (Oloruntoba et al., 2014). Kenyans does not have safe water for drinking nor does it have good sanitation, according to the United Nations International Children Education Fund (UNICEF, 2019). In a study done by the World Health Organization and United Nations (2013. Children are the most affected by the intake of unsafe water and poor sanitation practices (WHO & UNICEF, 2013).

Children do not only get infected with pathogens in the food and water but also from eating soil and animal feces (Ngure et al., 2013). Another risk factor for children infection is the feeding of children with complementary foods which often come with environmental contaminants (Kramer et al., 2012). Many children in low- and middle-income countries (LMIC) have intestinal infection with Rotavirus which accounts for close to 37% of child deaths caused by diarrhoea (Plats-Mills et al., 2015). Water accessibility is unequal between places resided by people with high income

and those resided by low-income people within urban settings (United States Agency for International Development [USAID], 2011). Places with poor water quality have in many cases experienced outbreaks of diseases such as cholera (Onjala, 2002). Nakuru town is inhabited by people of low income out of whom, the 50% fall under the poor category (National Dadiry Development Programme [NDDP], 2010).

Malnutrition in infants and young children is one of the most serious public health problems in developing countries. According to Malla and Shrestha (2004), Nutrition impacts a child's life while at the same time the way children are fed greatly influences their nutritional status and general health (Malla & Shrestha., 2004). Infancy is a critical period of child growth due to the fact that many children are at a greater risk of getting stunted due to a number of factors, some of them being poor complementary feeding practices, inaccessibility to water suitable for drinking, inappropriate sanitation and hygiene (Barker, 2007; Prendergast & Hamphrey, 2014).

The second leading cause of child deaths in the world is diarrhoea which accounts for almost 1.9 million child deaths annually. Linear growth faltering in children has been associated with diarrhoea (Richard et al., 2013). Intestinal infections by enteric pathogens which are common in low income countries are a common cause of diarrhea (Keusch et al., 2006). Enteric infections cause children to consume little food and may experience poor absorption of the little nutrients consumed (Rosenberg et al., 1977). They may lead to impaired by reduced dietary intake or by decreasing absorption of nutrients (Scrimshaw, 1962). Many studies have indicated that repeated diarrhoeal leads to growth faltering which eventually leads to stunting (Guerrant et al., 2013).

Nakuru town has a population of 349,560 inhabitants in the two sub-counties (Nakuru town East and Nakuru town West) within the Municipality, of whom 79,480 people live in one of the biggest informal settlement of Kaptembwo (KNBS, 2020). In size, Kaptembwo covers an area of 5.1 Km^2.

The main sanitation facilities in Kaptembwo are simple pit latrines. Rooms meant for renting are built within plots in which there are about 17 rooms per plot. (Mwanzia & Misati, 2013). A greater percentage of plots have one toilet at least. About quarter of the plots in Kaptembwo have a 1:4 or more, toilet to household ratio and in some situations, over 200 persons may share one toilet (Mwanzia & Misati, 2013). In Kaptembwo experiences open defecation and fecal pollution due to overflow from pit latrines, 'flying toilets', and poor waste disposal (Mwanzia & Misati, 2013).

This research was undertaken in order to help in addressing the high levels of stunting in the study area by comparing the socioeconomic status, dietary intakes, water sanitation and hygiene practices in Kaptembwo informal settlement and Milimani estate, Nakuru County, Kenya. The study aimed at bringing an understanding that socio-economic status, dietary intakes and environmental conditions (water sanitation, and hygiene) could play an important role in the stunting of children below five years in the study Kaptembwo and Milimani. In this study, the researcher sought to demonstrates that a nutritionally adequate diet is necessary but not enough for ensuring optimal linear growth, and that socioeconomic status, water sanitation and hygiene practices are proxies to stunting.

1.2 Statement of the problem

About 1.8 million children in Kenya have a low height for age (stunted). 11.4% of these children are severely stunted (Below -3 Standard deviation), (Kenya National Bureau of Statistics, 2015). Despite this alarming trend, as a country, Kenya has made recognizable progress towards decreasing the levels of stunting, having fallen from 35% to 26% between 2008 and 2014 (KNBS &ICF Macro, 2014; KNBS 2015). The Kenya demographic health survey reports that 28% of children under the age of 5 years in Nakuru County are stunted. It goes further to report that 5%

of children are wasted while 10% are underweight (Kenya Demographic Health Survey [KDHS] 2014). Out of the 28% stunted children, 9% are severely stunted (KDHS, 2014).

Stunting has negative implications on child growth, health, and development. Research has associated stunting with increased chances of dying of infectious diseases at an early age, dismal academic achievements and diminished adulthood earnings. Water sanitation and hygiene is key in alleviating problems to do with diarrhoea, which may lead to malnutrition i.e. stunting. Socioeconomic status is also taught to play a role in the elevated rates of stunting in Nakuru County. Studies which have previously been carried out on stunting in Nakuru have either assessed the levels of stunting or focused on dietary intakes, thereby putting little concentration on the holistic influence of socioeconomic status, dietary intakes, and water sanitation and hygiene in relation to stunting.

This study focuses on evaluating the influence of socioeconomic status, dietary intakes, and water sanitation and hygiene in stunting.

1.3 Objectives of the study

General objective

To evaluate the influence of dietary intake, water sanitation and hygiene on stunting among children less than 5 years in Kaptembwo and Milimani, Nakuru County

Specific objectives

i. To determine the socioeconomic status of residents of Kaptembwo and Milimani, Nakuru County
ii. To evaluate the dietary intakes of children below five years in Kaptembwo and Milimani, Nakuru County

iii. To determine the water, sanitation and hygiene practices of Kaptembwo and Milimani, Nakuru County

iv. To determine the diarrheal morbidity of children below 5 years in Kaptembwo and Milimani, Nakuru County.

v. To determine the level of stunting of children below 5 years in Kaptembwo and Milimani, Nakuru County.

1.4 Research questions

i. What is the socioeconomic status of Kaptembwo and Milimani,Nakuru County

ii. What is the dietary intake of children below five years in Kaptembwo and Milimani estate, Nakuru County?

iii. What are the water sanitation and hygiene practices of Kaptembwa and Milimani estate, Nakuru County?

iv. What is the diarrhoeal morbidity of children below five years in Kaptembwo and Milimani estate, Nakuru County?

v. What is the level of stunting of children below five years in Kaptembwo and Milimani estate, Nakuru County?

1.5 Scope, limitations and delimitations of the study

Scope of the study

The study was carried out in two locations, Kaptembwo and Milimani estate, Nakuru County. Kaptembwo is a multicultural low income and unplanned informal settlement in Nakuru west sub-county while Milimani is an estate medium to high income, planned formal settlement in Nakuru County.

Limitations of the Study

The household's dietary intakes were reported by mothers and was likely to have a bias in recall. In Milimani estate where homes were under lock and key gates, access at times was a challenge. The time of study might have affected the type of responses given to questions on dietary intakes, especially the 24-hour recall. This is because families tend to eat some foods on the first few days after salaries and wages are paid, but revert back soon later. As most qualitative methodologies cannot be truly replicated they may not be verified per se. Being a descriptive study, establishing direct linkages between study variables water, Sanitation and hygiene, dietary practices, diarrhoeal and stunting may be complex.

The study focused on water access, sanitation use and hygiene practices which form a key part of predicting episodes of diarrhoea. The rate of stunting of children below five years was determined upon taking anthropometric measurements using standard tools and reference values provided by WHO. The diarrhoeal morbidity was determined within a maximum period of 2 weeks. The dietary diversity and diet history were strong parameters that could help the researcher achieve the best results of the study.

1.6 Significance of the Study

Stunting affects a considerable number of children around the globe, with the problem dispersed disproportionately across low- and middle-income countries (LMICs) and rigorous in the needy and most ostracized families. The study results will give an informed perspective to the county Government of Nakuru and the general public on the link between dietary intakes, water, sanitation and hygiene with diarrhoea and stunting. This in turn will be a strong tool for the improvement of the health situation of not only children below 5 years but also the general human population.

1.7 Operational Definitions of Terms

Stunting: Height-for-Age Z-score (HAZ) ≤ -2

Severe stunting: Height-for-Age Z-score (HAZ) ≤ -3

Malnutrition: Deficiencies, excesses or imbalances in a person's intake of energy and/or nutrients

Micro-biome: Community of different micro-organisms (bacteria, fungi, and viruses) that inhabit in the human body

Household: Consist of one or more persons who live in the same housing unit and also share meals or living conditions

Open defecation: Refers to the act of disposing human waste in open undesignated places such us in fields, ditches, and damping sites.

Undernutrition: This refers to Lack of proper nutrition, caused by not eating enough food containing substances necessary for growth and health.

Dwelling: A building or place of shelter to live in that houses more than one household, more like a plot with many households

Diarrhoea: Is the condition of having at least three loose or liquid bowel movements each day

Complementary feeding: Process starting when breast milk alone is no longer sufficient to meet the nutritional requirements of infants and therefore other foods and liquids are needed, along with breast milk.

Anthropometric- the Measurements of the bodyweight, height, wrist and head circumference of the human body with the view of collecting information that will guide making judgement on the nutritional status (Encyclopaediawww.britannica.com).

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

Close to 144 million children below five years across the world are stunted (UNICEF, 2019). Although the global prevalence of stunting has reduced by more than half from 47%in 1985 to 23% in 2017, in some poorer regions of the world, progress has been slow (Budge et al., 2019). Kenya has made recognizable progress towards decreasing the levels of stunting, having fallen from 35% to 26% between 2008 and 2014 (KNBS, 2015). Stunting can be due to a number of factors in both the prenatal and postnatal stages of child growth and development, which may include infectious diseases, inappropriate dietary intakes and unhygienic living conditions (Grantham-McGregor et al., 2007). It is recommended by the World health organization (WHO) that mothers exclusively breastfeed for the first six months of life and continues to breastfeed alongside complementary feeding up to two years and beyond (Kramer & Kakuma, 2002). Microbial contamination of complementary foods is likely to be high in tropical low-income settings due to poor WASH provision. It is also noted that early introduction of complementary foods (before six months), is associated with morbidity and mortality from diarrhoea (Fawzy et al., 2011). Other presumed risk factors include micronutrient and protein deficiencies, toxins, abnormal gut micro-biome, and acute malnutrition.

In Kenya's National Nutrition Action Plan (NNAP), the government has set the target of reducing stunting by one-third, do away with disorders related to deficiency of iodine and further decrease cases of anaemia by 30% between 2010 and 2030 (Ministry of health [MOH], 2012). According to Kenya's Ministry of Public health, close to 1.8million children have chronic undernutrition (MOH, 2010). Both acute malnutrition and chronic malnutrition have been seen to be common

among populations living in rural areas and in some urban areas particularly those occupies by poor people (MOH, 2010). Malnutrition in developing countries is caused by diverse factors some of which are environmental, political, economic, poverty-related and disease-related (Rahman et al., 2016).

2.2 Exclusive breastfeeding and complementary feeding

Breastfeeding is crucial for child heath, growth and development. Exclusive breastfeeding requires that a child is fed on breast milk only for a minimum period of 6 months from birth, and continued together with complementary feeds until 2 years and beyond. (WHO, 2002). Community based programs have been initiated in many countries whose purpose is to provide health education and professional support to mothers where the mothers are advised to practice exclusive breastfeeding and encouraged to continue breastfeeding until their children are two years and even beyond (Sikorski et al., 2002). Mothers who are supported in their journey of exclusive breastfeeding have been found to be less likely to stop the practice unlike those who are not given any support. Such support programs have been found to help in reducing deaths of children below five years by close to 13% (Jones et al., 2003). Apart from preventing growth flattering, breastfeeding has been proved to confer cognitive benefits on the child (Anderson et al., 1999). Complementary feeds get introduced after six months, time when the mother's breast milk is not able to meet the nutritional needs of the child. At this time, the quantity of breast is also starting to decline. The commencement and continuation of complementary feeds come with many challenges and may fail to meet the expectations either in terms of timeliness, quality, quantity and or hygiene (Brown et al., 1998). The most common challenges related to complementary foods across many African communities include starting the complementary foods either too early or too late. Some mothers fail to serve their children with these foods at the required frequency and sometimes the amounts served may be too little or may not be of good quality to meet the nutritional needs of the child in terms of macronutrients and micronutrients (Brown et al., 1998). In other circumstances, complementary foods may be contaminated with potential pathogens which end up causing enteric infections leading to diarrhea. Other challenges include intolerable the food consistency.

2.3 Nutrition during pregnancy and childhood

The consequences of childhood malnutrition come as a result of the body trying to force its metabolism to adopt with the deficits of energy and nutrients created by malnutrition. This adoption endeavor is the one responsible for the metabolic disorders at adulthood. This fact confirms that stunting in childhood will have a negative effect on the quality of life in adulthood.

In order to prevent stunting, proper nutrition must start with period before conception. Before conception, all mothers intending to conceive must get adequate nutrients in order to keep a reserve for the baby. During this time and soon after conception, expectant mothers should eat a balanced diet, exercise appropriately and most importantly supplement folic acid, and Iron adequately. Proper nutrition should be maintained throughout the pregnancy period.

Postnatal care requires appropriate and hygienic exclusive breastfeeding for six months before starting complementary feeding. Complementary feeds to start after six months and continued breastfeeding for two years and beyond. Children must be provided with a balanced diet comprised of proteins, carbohydrates, vitamins such as vitamin A, Vitamin D, Vitamin B12, minerals and water. The food quantity must also be enough to meet the energy needs of the growing child. Food must be served timely at appropriate intervals. Hygiene is important as it helps to prevent infections which could otherwise cause diarrhea. Proper immunization programs must also be adopted. In order to ensure that child growth and development is appropriate, weight gain checks must be done regularly until the age of two years.

2.4 Dietary intakes

Malnutrition in infants and young children is one of the most serious public health problems in developing countries. According to Malla and Shrestha (2004), Nutrition has a direct impacts on the child's life determined by the way the child is fed, which ends up determining his nutritional status and general health (Malla & Shrestha, 2004). Infancy is a critical period of child growth due to the fact that many children are at a greater risk of getting stunted due to a number of factors,

some of them being poor complementary feeding practices, poor access to water which is safe for drinking and lack of good sanitation and appropriate hygiene (Barker, 2007; Hamphrey, & Prendergast, 2014).

It is suggested that good nutrition is a requirement for optimal growth in children but it is not enough to realize good linear growth (Mbuya & Humphrey, 2016). However, in order to realize good growth, development and survival of infants and children, it is important to adopt good feeding practices for children (Kumar et al., 2007).

Good dietary practices positively affect child growth and development and greatly influence the survival of children and infants (Mamiro et al., 2005).

According to the Kenya national bureau of statistics, children most affected by stunting are those between the ages of 18 months to 23 months, which could highly be contributed by inappropriate complementary feeding (KNBS et al., 2015).

Late initiation of colostrum-feeding and inappropriate complementary feeding in infants and children are key risk factors for malnutrition among children under the age of years (Kumar et al., 2007). Proper child feeding is a field of interest not only in Kenya but all over the world because of its influence on the nutritional status of children. It is reported that about 8.9% of children in Kenya are wasted, 14.1% are underweight while over 18.8% are stunted (Omukhweso, 2007).

2.5 Micronutrient deficiency and under-nutrition

Vitamin A Deficiency

Vitamin A deficiency may develop out of inadequate consumption of animal foods or low intakes of fats. The following foods are rich sources of vitamin A; Milk, organ meats e.g. Liver, egg yolk, dark green vegetables and fruits such as oranges, just to mention a few. Deficiency of Vitamins such as Vitamin A causes eye blindness and tends to increase the magnitude through which infectious diseases occur. It is reported that if a child suffers blindness caused by lack of vitamin A, he/ she has a 50% chance of remaining alive that year. Annually, Vitamin A induced blindness causes close to 630, 000 deaths from infectious diseases (Rice et al., 2004). Even if blindness does not affect growth in children, it may have other detrimental consequences such as causing anaemia and may lead to death (Ramakrishnan et al., 2004). Research has established that if Vitamin A is supplemented in diet, it has the capacity to bring down the magnitude of diarrhoeal episodes and further decrease infections on the lower respiratory tract. The prevalence of deficiency of Vitamin A has decreased in the last few years due to increased public awareness followed by concerted efforts to fortify foods with Vitamin A.

Zinc deficiency and stunting

Zinc was first implicated in the stunting of Iranian adolescents by research findings by Prasad et al in 1960. He explained that Zinc deficiency had a role in the stunting and hypogonadism of Iranian children (Price et al., 1978). This finding created a curiosity upon which many supplementation trials have since then be been made in many parts of the world in view of trying to catch Zinc deficiency in the act of playing a role in growth retardation. Even if many experimental studies involving supplementation with Zinc have been done by many researchers

across the world, the results obtained are continually inconsistent and may not therefore be used to make vivid conclusions on whether zinc deficiency actually brings about growth retardation. There is evidence from some studies that even if the influence of Zinc on linear growth is not fully established, there are changes in body composition following Zinc supplementation (Tebekhla & Donally 1982). Zinc is essential for good heath of persons of all ages. Zinc has been rated to be the most abundant micro-element in the body cells. About 10mgper day of Zinc is recommended for children. Some of the good sources of Zinc include consumption of mushrooms, pumpkin seeds, Omena, beans and red meat. The risk of Zinc deficiency cuts across many parts of Africa and the world. In sub-saharan Africa for example, the risk of Zinc deficiency is averaged at 68%, and about 48% (Urga et al., 1997) of the people across the world are at risk of suffering deficiency of zinc. Unfortunately, it is not exactly known how much Zinc is sufficient for the body as excess Zinc could be harmful. It is however not abundant in red blood cells.

Zinc is a very important micro-element that performs many body functions and mediates a number of body processes. Some physiological processes taking place in our bodies such as enzyme function are Zinc dependent. Many enzymes have zinc as one of the components and its functions are not as limited as those of some macronutrients. The role of Zinc in various metabolic processes such as cell division, and protein synthesis probably makes it an important player in child growth (Lopez et al., 1987). Supplementation of Zinc together with oral rehydration salts (ORS) during periods of diarrhea in children has been found to decrease the intensity and duration of diarrhea, and further increases the chances of recovery from disease. It has been demonstrated that Zinc deficiency negatively affects the body's immune function and increases the chance of contracting infectious diseases other than increasing mortality (Ellis et al., 1987). Even if Zinc deficiency is a

global problem, it is difficult to say how big the problem is because there are no obvious signs of mild deficiency of Zinc (Maga, 1982).

Deficiency of Zinc has been associated with stunting over time. It is established that children with either moderate stunting and those with severe stunting respond to catch up growth quickly upon supplementing their diet with zinc than those not supplemented at all. Iron and iodine deficiency is associated with motor and cognitive delay. On short term, Zinc deficiency may decrease the appetite for food thereby one ends up consuming less than should have been. Deficiency may also pervert the smell of food, from good to bad and thereby bringing about depressed appetite. Is some studies, growth deficiency has been associated with Zinc deficiency and it therefore becomes associable that those regions of the world which have high stunting levels have high levels of Zinc deficiency. Deficiency of zinc in the body may be due to poor dietary intake of foods rich in zinc or when the body's need for Zinc goes high following infections or as a result of low bioavailability of Zinc in the foods we eat (Wise, 1983). Some food which may contain sufficient quantities of Zinc may contain other chemical substances which may make Zinc unavailable for absorption.

Iron deficiency

For decades, research has associated Iron deficiency with delayed development. Supplementation with iron has also shown to uplift cognitive abilities in children. While the deficiency of Iodine has been a known to be a contributor to mental retardation, iron deficiency has been a known cause of anaemia. Deficiency of iron is associated with loss of the capacity to do work and a cause of low productivity. Research findings point at anaemia in women as a cause of loss of about 19 US Dollars per year through lowered agricultural production (Aguayo, 2003). The stature of an individual greatly influences his/her capacity for work. Short stature may reduce productivity by a great fraction (Martorell, 1996). According to studies by Haddad and Bouis (1991), when the

stature of a person is low by 1%, productivity of that person goes down by 1.4% (Haddad & Bouis, 1991). It has also been demonstrated that when the stature of a person goes up by 1%, earnings from wages go up by about 2-2.4%.

Governments across the world have made efforts to address Iodine deficiency through public health campaigns, provision of high dose iodine supplementation and or through the deliberate effort to fortify appropriate fast moving consumer goods such as iodized table salt, Iodized injection oils and iodized tablets. These efforts are geared towards alleviating or even eradicating Iodine deficiency disorders

2.6 Under nutrition

Undernutrition and deficiency of micronutrients have been found to play a very crucial role in disease causation (Ezzati et al., 2002). High levels of under-nutrition pose a great risk of increased exposure to infectious diseases, which are often due to overcrowding and consequently inadequate water and sanitation facilities and practices. Most affected by under-nutrition and inadequate water and sanitation facilities are children and women of reproductive age. One of the key consequences of under-nutrition is the deprivation of body's nutrients and reduced immune function. The body therefore becomes vulnerable to diseases. The ultimate cost of Under-nutrition and infectious diseases is loss of wages, loss of good health, high cost of care, poor intellectual capacity. Undernutrition in early life has been associated with development of disorders such as obesity, obesity and cardiovascular conditions (Caballero, 2001; Gluckman & Hanson, 2004).

Stunting is as a result of chronic undernutrition which tends to retard child's growth. On the other hand, wasting occurs as a result of taking inadequate nutrients for a short time frame. Underweight cuts across stunting and wasting. Stunting is determined by comparing the age and height of

children of the same age and sex with height/length of a reference population of the same age and sex who are presumed healthy as determined by the WHO reference standards. Children whose height-for-age (Z-score value) is less than −2 SD is considered stunted. A weight-for-age Z-score of less than -2SD underweight while that whose weight-for-height Z-score is less than -2SD is considered to be wasted. When the effects of under nutrition (stunting, wasting and underweight) are decreasing significantly across the world, stunting seem to be increasing in most countries of Africa.

The intellectuality of children and their ability to undertake tasks declines as a result of under-nutrition. Women who are poorly nourished have a high a chance of giving birth either premature children or small babies children (Allen & Gillespie, 2001).Severely malnourished children have a higher chance of dying early compared to those with either mild or moderate malnutrition (Fishman et al., 2004).

Undernutrition is the result of inadequate dietary intake and recurrent infections by diseases. Under nutrition may include being overweight or obese, being underweight, being too short for ones' age (stunting), being excessively thin (wasting) or even lacking essential vitamins and minerals (Bain et al., 2013). Poor feeding of infants and young children, especially the lack of optimal breastfeeding and responsive complementary feeding, along with such illnesses as diarrhoea, Pneumonia, Malaria and HIV/AIDS, often exacerbated by helminthes, are major causes of undernutrition (Sint, et al., 2013). Across the globe, about 226 million children under the age of 5 years are stunted and about 67 million children wasted. It is also estimated that about 183 million children worldwide have weight below what they should weigh in respect to their age. (UNICEF, 2021). The percentage of children categorized under chronic malnutrition is about 33% (De Vita et al., 2019). It is postulated that if malnutrition is properly addressed, the overall effect is a reduction of children death by close to 53%. Moderate and severe malnutrition has in some studies

been attributed to diseases such as pneumonia (Fishman et al., 2004). Lack of essential vitamins and minerals in the diet affects immunity and healthy development.

2.7 Water, sanitation and hygiene

It is estimated that over 1 billion people lack access to safe drinking water and 2.5 billion people lack adequate sanitation. These factors contribute to deaths of more than 5 million people most of whom are children (UNICEF, 2006).

Low income areas in urban centres in Kenya that have access to piped water supply is only 35%. The residents' basic water requirements are met for only 45% (KNBS, 2011). The major factor linked to inadequacy is the shortage of water and the water rationing system introduced in 2004 in order to distribute water to different sectors of the city by rotation (Nakuru Water and Sanitation Service Company [NAWASSCO], 2007).

Clean water, basic toilets and good hygiene practices are essential for the survival of children. Annually, more than 3.4 million people die from diseases related to water, sanitation, and hygiene, whereby 99% of the deaths occur in developing countries (WHO, 2019). The Water Sanitation and Hygiene (WASH) joint monitoring programme report (2019) by The WHO and UNICEF found that only 59% of Kenyans have access to basic water services and only 29% have access to sanitary services. Over 50 percent of hospital visits in Kenya are for illnesses related to water, sanitation, and hygiene (Njuguna, 2019). An estimated 94% of the diarrhoeal burden of disease is attributed to the environment and is associated with risk factors such as unsafe drinking water, lack of sanitation and poor hygiene (Oloruntoba et al., 2014).

According to UNICEF, Kenyans does not have safe water for drinking nor does its people have good sanitation (UNICEF, 2019). Undernutrition, measured by growth standards is an important

underlying cause of child mortality and it is closely related to diarrhoeal (WHO, 2006a). In a study done by the World Health Organization and United Nations (2013), it was revealed that water and sanitation-relate crisis claim more lives through disease than claims any war through guns. In this situation, children are the most affected and therefore suffer more when it comes to use of unsafe water and unimproved sanitation (WHO & UNICEF, 2013).

In the study by Crow & Odaba titled "Scarce, costly and uncertain water access in Kibra, Nairobi indicate that services to do with the supply of water and use of sanitation facilities in Kenya is dominated largely by inaccessibility (Crown & Odaba, (2009). The study continues to point out that most affected areas are the those in urban areas but with low income, given that the quality of services offered are of poor quality and water supply is never consistent. (Crown & Odaba, 2009). Nakuru town has a population of 349,560 inhabitants in the two sub-counties (Nakuru town East and Nakuru town West) within the Municipality, of whom 79,480 people live in one of the biggest informal settlement of Kaptembwo (KNBS, 2020). In size, Kaptembwo covers an area of 5.1 Km^2. The main sanitation facilities in Kaptembwo are simple pit latrines. Rooms meant for renting are built within plots in which there are about 17 rooms per plot. (Mwanzia & Misati, 2013). A greater percentage of plots have one toilet at least. About quarter of the plots in Kaptembwo have a 1:4 or more, toilet to household ratio and in some situations, over 200 persons may share one toilet (Mwanzia & Misati, 2013). In Kaptembwo experiences open defecation and fecal pollution due to overflow from pit latrines, 'flying toilets', and poor waste disposal (Mwanzia & Misati, 2013). Studies reveal that malnutrition is not just a lack of food issue but also in large part due to environmental enteric dysfunction (EED) (Watanabe & Petri, 2016).

It has been reported that feco-oral contamination which often occur in children is not only from eating and or drinking contaminated food and water but also from eating soil and animal feces as

children explore (Ngure et al., 2013). Feeding children with complementary foods (weaning) poses another great risk of children getting feco-oral contamination (Kramer et al., 2012).

It is also becoming clear that children in low- and middle-income countries (LMIC) carry heavy burden of intestinal infection with Rotavirus (RV) causing about 37% of deaths due to diarrhoea (Plats-Mills et al., 2015). Access to water is highly unequal between the high income and low-income areas within urban centres (USAID, 2011). Majority of the urban poor Kenyans access water of poor quality and this has led to outbreaks of epidemics such as cholera among other diseases thereby affecting not only the health of the people but also their livelihoods (Onjala, 2002). Nakuru town is inhabited by people of low income out of whom, the 50% fall under the poor category (NDDP, 2010).

Many diseases that occur in many African countries are related to diarrhea and such diseases are preventable by provision of safe water (Rosen & Vincent, 2001). It is realized many studies which try to research on environmental aspects of disease either focus on the effects of water sanitation and hygiene or rather the effects of diarrhea than focus on the cause of diarrhea (Mozynski, 2018). Diarrhea can be due to infection with a number of pathogens ranging from bacteria, fungi, viruses and intestinal worms. Transmission of the agents of diarrhea on the other hand occurs through a number of routes. It is unfortunate that diarrhoeal morbidity in most developing is never reported to health institutions for appropriate containment nor is it addressed however much life-threatening it may be (Curtis & Cairncross, 2003).

Many studies conducted in many parts of the world have reported that containment of diarrhoeal morbidity must involve hand washing with running water and soap, improvement of the quality of water meant for drinking and disposing excreta appropriately (Classen et al., 2007). Interventions against diarrhea and its effects have shown to decrease deaths due to diarrhea or a reduction of the

risk of diarrhea or the risk of both death and diarrhea. Other interventions made to alleviate diarrhea and its effects involve proper disposal of excreta which is one of the most potential source of infection, especially through the oro-fecal route. This effort is geared towards minimizing or reducing either direct or indirect human contact with excreta. These measures include making and encouraging the use of simple pit latrines, composting toilets and other forms of improved excreta disposal. Studies have linked decrease in diarrhea episodes with hand washing at critical stages, proper disposal of excreta and proper vector control.

2.8 Diarrhoea morbidity and stunting

Diarrhoeal diseases are the second leading cause of child deaths in the world, accounting for almost 1.9 million child deaths per year, of which approximately 38% of the deaths are in Africa (Boschi-Pinto et al., 2008; Bryce et al., 2005). Diarrhoeal is also associated with linear growth faltering (Richard et al., 2013). In low-income countries, which are synonymous with inadequate water and sanitation facilities, intestinal infections by either bacteria, Viruses, parasites are a common cause of diarrhea (Keusch et al., 2006). Enteric infections may make children to consume little food and may experience poor absorption of the little nutrients consumed caused by either bacterial overgrowth or a damaged intestinal mucosa (Rosenberg et al., 1977)

Enteric infections may lead to impaired linear growth through reduced dietary intake or by way of elevated demands of body metabolism or even by decreasing absorption of nutrients (Scrimshaw, 1962). Studies indicate that repeated diarrhoeal infections in preschool children in the absence of catch-up growth leads to growth faltering resulting in stunting (Guerrant et al., 2013).

Across the world, it is agreed that clean water, basic toilets and good sanitation and hygiene are important factors for the survival of children. Despite this understanding, people, especially in developing countries continue to die from diseases related to water, sanitation, and hygiene, all of

which are otherwise preventable or avoidable (WHO, 2019). Unsafe water for drinking, poor sanitation and poor hygiene practices are responsible for about 94% of the diarrhoeal diseases in Kenya (Oloruntoba et al., 2014). In all circumstances across the world, the effects of poor water, sanitation and hygiene affect children more than any other category of people. This is because children are more exploratory and therefore get infected from not only pathogens harbored in water but also from the food and non-food materials which children eat such as soil and animal feaces (Ngure et al., 2013). Complementary foods are a potential source of child infection if it is not hygienically practiced since these feeds usually carry environmental contaminants in them (Kramer et al., 2012).

In many low and middle-income countries, diarrhea due to rotavirus infections is responsible for about 37% of child deaths (Plats-Mills et al., 2015). Outbreaks of waterborne diseases such as Cholera has been seen to strike in regions which do not have good quality water, have poor sanitation and hygiene (Onjala, 2002). Most episodes of diarrhea are due to environment based enteric pathogens such as *Shigella, Klebsiella, Campylobacter*, all of which are predominantly responsible for diarrhea in low ncome countries (Keusch et al., 2006). Infection by enteric pathogens usually cause children to eat little food and such children experience poor absorption of the little nutrients they consume (Rosenberg et al., 1977). According to studies which have been conducted across the world, repeated diarrhoeal episodes lead to growth faltering which in turn brings about child stunting (Guerrant et al., 2013).

2.9 Education levels mothers

Studies have demonstrated that the education level of the mother is an important factor in child stunting. Mothers without education and those with incomplete primary education are likely to have their children stunted compared to the children whose mothers have Secondary or higher

education (KNBS et al., 2015). Children from wealthy families are less likely to be stunted compared with the children from poor families (KNBS et al., 2015). There is almost consistent evident which indicates that there is a strong relationship between the education level of the mother and good child health (Glewwe ,1999). It has been established that the length of time mothers spend in school ultimately influences the health status of their children. Maternal education has been seen to increase the levels of child immunization and the general nutritional status of the child, all of which contribute towards fighting diseases such as whooping cough, diphtheria and measles in children (Claeson & Waldman, 2000). It was also found that father's education little influences the health status of a child (Astone et al., 2007). Some studies have demonstrated that higher education is linked with poor health status. High education has been captured as an important aspect that can be used to reduce infant deaths. The physical outlook of the child is one of the parameters used to measure both poor health and good health in children. If a child is too short for his age, weighs less for his height or weighs less for his age, then there is a problem.

Some studies have found that children of less educated mothers are well nourished as compared with children whose mothers are educated and working. This is rather unusual but can be explained using the theory that mothers who are not well educated and therefore not engaged in any form of employment have a lot of time to breastfeed on demand and for the longest time possible, and spend good time tending to their children than educated and employed mothers who could not have good time to nurse their children (Abuya et al., 2010). Thus, the mothers are available to breastfeed their infants for longer durations. Other studies have found that that children from mothers who listened to radio had a low likelihood of getting stunted compared to those whose mothers did not listen to radio. The influence of listening to radio on alleviating stunting is yet to be established, but it is thought to be two ways, i.e. the radio serving as a good source of information about

breastfeeding and childcare (Abuya et al., 2010). The radio could also be a factor for milk letdown during breastfeeding. There has always been a need to provide populations especially mothers and mothers to be on good feeding practices and the overall importance of breastfeeding, immunization, good sanitation and hygiene as this will translate to good health for all children. Teaching of mothers and mothers to be can be done through radio programs, television programs, Public barazas and also through the incorporation of the content in school programs (Abuya et al., 2010). An improvement of the education levels among mothers of childbearing age and the effort of making nutrition and hygiene knowledge-bank public are key in moving towards a reduction in child stunting, morbidity and mortality.

2.10 Effects of stunting

Stunting has devastating consequences for child health. Due to the fact that the first few years of the child's life are important determinants of how the child will grow and develop, its well-being automatically draws a lot of concern. Hunger and inadequate nutrition contribute to early deaths for mothers, infants and young children, and impaired physical and brain development in the young. Stunting may be irreversible after the age of 2 years and has almost life-long effects of one's health and development (black et al., 2008). Any damage caused by nutritional deficiencies, in the first two years of a child's life, being the critical stage of a child's growth and development, could lead to impaired cognitive development, compromised educational achievement and low economic productivity (Prado et al., 2014).

In 2007, upon conducting a meta-analysis, Grantham proposed that about 200 million children fail to reach their full developmental potential each year as a result of stunting and that stunted adults earn on average 22% less per year than their non-stunted counterparts (Grantham-McGregor et al., 2007). Certain non-communicable diseases in adulthood are associated with stunting in

childhood, perhaps through epigenetic regulation (which refers to long-term alteration in gene expression) or via chronic inflammation (Crane et al., 2015). It has been reported that nutritional intervention may not fully help to solve problems related to stunting if used alone (Khalid et al., 2019). Many studies have been done to establish the relationship between under-nutrition and intelligence and general educational achievements in school. In an effort to determine whether under-nutrition can bring about long-term cognitive inadequacies in life, it has been found that children who have suffered any form of severe malnutrition, especially stunting, have their IQ scores between 8 to18 points lower than children who never suffered any form of malnutrition. Some children who suffered stunting in early life have been shown to attain lowly in schools than those who never got stunted (Fishman et al., 2004). The cost of education for children who suffered stunting is higher than the cost of unstinted children. This is so because stunted children may have a delay in starting school and may not do so well in class (Behman, et al., 2004).

Malnourished children have a high chance of becoming sick than children who are not malnourished. When stunted children fall ill, the severity of the illness is always high compared to the severity experienced in healthy children. The frequency with which malnourished children fall sick is equally high than the frequency of falling sick for healthy children. The high frequency of illness and the intensity of disease require that a lot of money is allocated to take care of such situations, money that could otherwise be used to address many other family undertakings. There may not be a generally acceptable formula of determining the cost of time spent in providing nursing care of the sick but the losses of time are as enormous as losses in other resources. Children who often fall sick fail to get the best from school due to absenteeism and such children may delay in starting to school. When the effects of ill health are adverse e.g. adverse mental retardation, the cost of providing special education for such children is equally high.

It is reported that many countries in Africa are undergoing a struggle to manage chronic diseases such as diabetes, obesity, hypertension and other cardiovascular disorders among its old population simply because these countries failed to address problems of under-nutrition among children and pregnant mothers early in life (Jamison et al., 2006). This finding is true to the fact that, one, the lower the birth weight the higher the chance of developing a chronic disorder at adulthood and the fact that malnutrition in early life is associated with chronic disorders in later life.

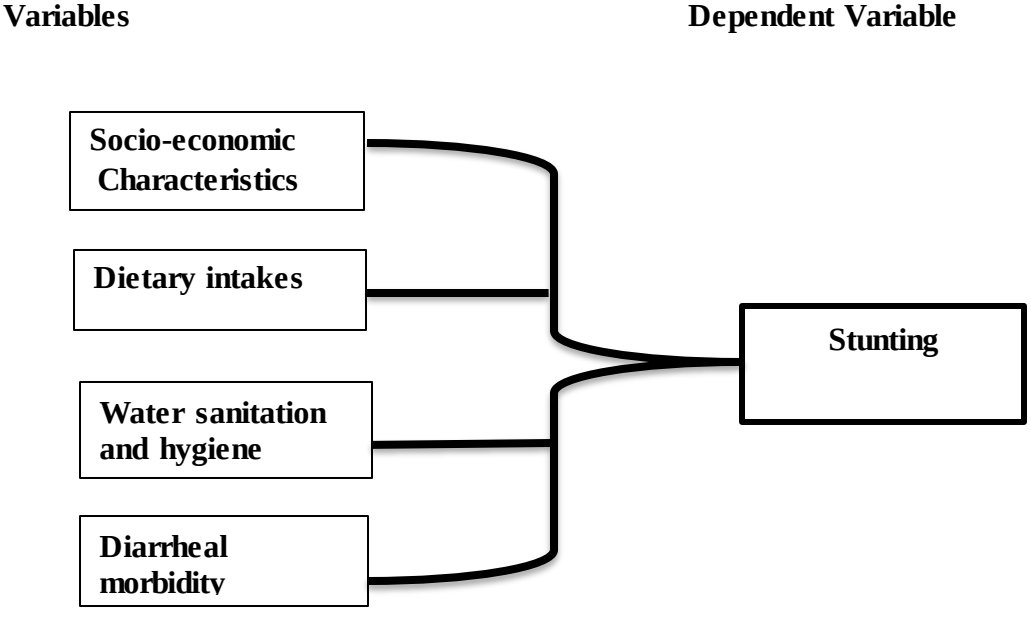
2.11 Conceptual framework/Operational framework

Below is a pictorial representation that shows how dietary intakes, water, sanitation and hygiene practices, episodes of diarrhoea lead stunting among children below five years.

The independent variables in the study were dietary intakes, water, sanitation and hygiene, diarrhoea. Stunting is the dependent variable.

Figure 2.1

Conceptual framework



CHAPTER THREE

METHODOLOGY

3.1 Introduction

The methodology section laid a pathway via which the objectives of the research were realized. It also provided an avenue through which the study hypothesis was tested. The chapter discusses the study area while bringing out its socioeconomic and demographic characteristics of the respondents.

3.2 Study area

The study was carried out in Kaptembwo and Milimani of Nakuru County, Kenya. Nakuru town is the head quarter of Nakuru County. Nakuru is the third-largest town in with a population of 57, 0674 inhabitants (KNBS, 2019). It covers an area of 7,242.3km^2 and is located between longitudes 35^o East and Latitude 0^o 13' and 1^{o}10' South.

It is reported that in 2018, Nakuru Town East is one of the most densely populated with 2,783 persons per KM^2. The County Government has predicted a population growth rate of 16.47% by 2022. (Nakuru County Integrated Development Plan [NCIDP], 2018-2022).

The population of children below five years is estimated to be 339,746. The Infant population was estimated to be 67,916 in 2018 and the County Government has also projected it to rise at the rate of 16.47% by 2022 (NCIDP, 2018-2022).

Kaptembwo is an informal settlement in Nakuru Town East with a population of 43,521in an area of 5.1 KM^2 (KNBS, 2019). Plots have an average of 17 rental room in each plot. (Mwanzia & Misati 2013). Most of its amenities including water and waste disposal are already overstretched

and children contract many diseases which affect their health, development and educational achievements (WHO, 2013).

The quality of life index of Kaptembwo is ranked 21 with the general quality of life being poor (KNBS, 2019). Kaptembwo has simple pit latrines as its main sanitation facilities. Almost every plot (98%) has at least one toilet of some description About quarter of the plots in Kaptembwo have a 1:4 or more, toilet to household ratio and in some situations, over 200 persons may share one toilet (Mwanzia & Misati 2013). Milimani estate on the other hand is in London ward with a total population of 26,643 in 20.9 square kilometer area (KNBS, 2019).

3.3 Target population

The study targeted children under the age of five years (0-59 months) in Milimani estate and Kaptembwo of Nakuru County. The study area of Kaptembwo has an estimated population of 43,521in an area of 5.1 KM^2 (KNBS, 2019) while Milimani has a population of 26,643 in area of 20.9 KM^2 (KNBS, 2019).

Study population

The study population was 314 children aged 0-59 months in both Kaptembwo and Milimani estate of Nakuru County. This study population is vulnerable to various health challenges such as diarrhoeall diseases as a result of their feeding practices and exposure to unsafe water, sanitation and poor hygiene practices. The immediate outcome of low hygiene practices and poor sanitation is diarrhoea, which in the long run leads to, stunting.

Inclusion criteria

- All healthy children (male and female) 0-59 months old.

- Mothers of healthy children (male and female) 0-59 months old who gave consent to participate in the study.
- Mothers of healthy children (0-59 months) who were able to participate in a verbal interview.

Exclusion criteria

- Children aged between 0-59 months that were sick were not sampled.
- Children who had moved into the study area less than 6 months from the time of the study.
- Mothers of healthy children (male and female) aged 0-59 months who did not give consented to participate in the study.
- Mothers of healthy children (male and female) aged 0-59 months that were unable to communicate in either English or Kiswahili.

3.4 Sample size determination

Sample size determination for the study was calculated using the Cochran formula (Cochran, 1977). The Kenya national prevalence of stunting was the key basis upon which the sample size was determined. The prevalence of stunting in Kenya is estimated to be 26% (Kenya National Bureau of Statistics; ICF International, 2015.

Cochran formula: $n=z^2 (pq)/e^2$

Where;

N = Sample size

z = critical value which is associated with the level of significance (usually 1.96) corresponding to 95%

p= the proportion of the target population which is estimated to have a particular characteristic p, the national prevalence for stunting was given as 26% (as fraction of 1) (0.26)

q=1-p (expected non-prevalence) (0.74)

e^2= the margin of error (5%=0.05)

n=1.96x1.96 (0.26x0.74)/0.05x0.05

n=295.649

n=300 children

Based on the difference in population density of Kaptembwo (43,521), and Milimani (23,640), it was observed that the population of Kaptembwo was 1.84 times more than the population of Milimani. The percentage sample collected from Kaptembwo was arrived at by increasing it 1.84 times more than the sample collected at Milimani i.e. 36% Milimani, 64% Kaptembwo.

43,521/67,161 x100 = 64% Kaptembwo

23,640 /67,161x100% =36% Milimani

3.5 Sampling design and data collection

A comparative study was carried out to compare stunting levels among children aged between 0-59 months in Kaptembwo and Milimani in an attempt to draw a conclusion about them. The researcher attempted to identify and analyse similarities and differences between the two groups of children and further try to associate them with stunting.

A descriptive cross-sectional study design was used in which data was collected using questionnaires programmed in the survey CTO platform. The study variables were analyzed and explained relative to dietary intakes, episodes of diarrhoea and then associated them with stunting.

Sampling procedure

Sampling is the selection of a subset of individuals from a population in order to give generalized information about the entire population. This study used both probability and non-probability sampling methods.

Data was collected using cluster random sampling method. Kaptembwo informal settlement was clustered into 10 big clusters, each with between 30-35 dwellings or plots. Using systematic random sampling method, 10 dwellings were sampled from each cluster. Using purposive sampling method, at least 2 households with a child 0-59 months were selected from each dwelling or plot; thereby making the final sample for Kaptembwo 202 children.

In Milimani, households were clustered into 14 clusters of between 20-25 households per cluster. Using Purposive sampling method, at least 8 households with a child 0-59 months were selected per cluster, making the total sample for Milimani 112 children. Data was collected using questionnaires programmed in Survey CTO platform.

Data collection

Six research assistants were recruited based on qualification and competence and trained for 3 days in readiness for data collection. During the training period, research assistants were explained what the study was all about and why the study was being done. They were taken through all the questions on the study questionnaire and explained why each question was asked and how important each question was to the findings of the study. Parts of the questionnaire that were not well defined were defined and fine-tuned by restructuring the questions that lacked either clarity or general flow. Since the questionnaire was written in English the research assistants were taught on how to ask each question in Kiswahili.

The closed ended questionnaire was then programmed in the Survey CTO platform and installed in tablets and or smart phones. Research assistants were then trained on conducting interviews and on how to record responses and or observations in the questionnaire programmed in the Survey CTO platform. The research assistants were also taught on how to check for completeness and how to send the completed questionnaire to the server for further processing. The Survey CTO platform required that each research assistant logs in using his personal details before accessing the Survey CTO questionnaire.

Research assistants ware trained on how to measure and or estimate the amount of food (in grams) eaten by reference the child using graduated measuring cups for various servings. They were also trained on how to measure the height of the reference child using Length/height board (Stadiometer), on how to measure the mid-upper arm circumference (MUAC) of the reference child using MUAC tape.

The survey CTO platform enabled the researcher to key in response to one question item before moving to the next. In cases where for example the answer to a question was 'No', the programme skipped all other questions which could only be responded to if the answer was 'Yes'. This helped a lot in saving time and allowed the researcher to collect data within a short period of time.

The survey CTO programmed questionnaire was pre-tested with 10 households at the Rhonda part of Kaptembwo. The pre-test gave the researcher a picture of what was expected to be done and the expected outcome. The data was sent to the server which was created to receive the data and a mock data analysis was done where validity and reliability were determined. After the pre-test, a survey visit by all enumerators to Kaptembwo was undertaken for familiarization and for purposes of mapping out the study area.

During data collection, the researcher and or research assistant read out to the responded each question and its choices to the respondent one at a time. The mother/caregiver of the reference child chose from a list of answers provided. The researcher or research assistant then tapped on the tablet or smart phone the option selected by the responded. In some incidences, the interviewer was required to observe and record the observation as required by the question.

Socio-economic status of each household was assessed through feedback given by respondents from the questionnaire.

The assessment of dietary intake was done using the 24-hour recall. This required that the respondent remembers all kinds of foods eaten by the reference child in the last 24 hours and the quantities of each and the method of preparation (if any). The food consumed was estimated in grams and all servings using household measurements and or graduated serving cups. The new trend content e.g. energy value (Kcals) of the foods determined. Dietary diversity was assessed using a 7 days' Food Frequency Questionnaire (FFQ) which was formulated in a manner that it captured most common foods eaten by a greater majority of families. This was to determine the frequency of consuming selected foods from the various food groups over 7 days.

Diarrhoeall morbidity was determined through feedback given by the respondent guided by the questionnaire. All the reference children who had diarrhoea in the last four weeks were recorded as required by the questionnaire.

Nutritional status of reference child in terms of Height- For- Age (HAZ) was determined by measuring and recording the height of the reference child and comparing the index of the result with (WHO, 2006b) reference standard for stunting for a child at that age. A height board/length board (Stadiometer) was used to measure the height or length of the reference child. Those children

that could not to stand on their own their standing height was measured and recorded to the nearest 0.1Centimetre (cm). The child to be measured would stand bare feet with the body leaning against a vertical board (WHO, 1995). The child was required to stand heels together, arms hanging freely at the sides, and head, back, buttock, heels in contact with the vertical board and the head positioned so that the eyes look parallel to the headboard to avoid parallax error. The horizontal headboard would then be moved into contact with the uppermost point on the child's head. To check for accuracy and reliability, three consecutive and independent readings were taken.

For children who had not attained the capacity to stand, their length was measured using a length board. The child was made to lie on a length board placed on a flat surface. The heels and the tip of the head of the child were then brought into contact with the two ends of the length board. In the same way, three consecutive and independent readings were taken to ensure accuracy and reliability. The age of each reference child was verified using birth certificate or health card. The programme ensured that genuine data was collected as it did not allow entry of invalid information nor did it permit collection of data from one spot of study area. Data on water, sanitation and hygiene was recorded using the feedback given by respondent from the questionnaire and from making observations.

The researcher or his assistant completed the questionnaires and checked them for both correctness and completeness. The principle researcher supervised the entire exercise. This was through selectively accompanying the research assistants in data collection to ensure that the right data was being corrected. The data was cross checked by the researcher for completeness and correct labeling daily before being uploaded to the SurveyCTO server which was opened for the reception of the data.

Anthropometric measurements were done using length/height board as required by WHO anthropometric standards and entered with high levels of accuracy. Anthropometric values were recorded to the nearest 0.1centimetre (cm). The geospatial distribution of households from which data was collected was captured. Using the same tools and keeping every factor constant, the results are reproducible.

3.6 Data analysis

Data received in the server was downloaded into Stata software and checked again for completeness. Data was cleaned using SPSS software and then converted to excel for purposes of generating appropriate graphs. The same programme was used for descriptive analysis.

Analyzes of the Variables such as social demographic data, distribution of children by gender, demographic characteristics of principle caregiver, animal enterprise distribution per household, housing characteristics and hygiene and sanitation was analyzed using SPSS version 22.

T-test was done to establish the relationship between WASH, diarrhea and stunting, and dietary intake and stunting. Data was converted to Stata software for regression analysis. *Probit* regression model was used to determine the relationship between diet, diarrhoeal and nutritional status. The data was converted to excel and used for the generation of appropriate graphs.

Mean height for each age was computed and then compared with standard height for age.

3.7 Ethical considerations

The first approval to carry out research was given by the Kenya Methodist University, herein attached as appendix II. The National Commission for Science, Technology, and Innovation (NACOSTI) gave authority and permit for research, herein attached as appendix III and IV respectively. The ministry of education through the County Director of education- Nakuru County authorized the research, herein attached as appendix V. The research was also authorized by the ministry of interior and co-ordination of national government, through the County commissioner- Nakuru County, herein attached as appendix VI. With the permission and the support from Chiefs, assistant chiefs, clan elders, community health volunteers and institution managers, the exercise was a success.

The researcher and or the research assistant identified himself/herself by name and phone number and the purpose of research which was purely academic and that findings of the study were meant to bring knowledge on board on stunting. The mothers or caregivers of our respondents were asked questions to which they responded. Those who met the criteria of acceptance were confirmed.

The parent/ guardian of respondents signed a written consent form. Each of the respondents/subjects was engaged only once for about one hour. The participants were made aware that all their responses were kept confidential and only accessible to the researcher. Any names on the interviewing tool were not made public and were not included in data entry and analysis. The parents were informed that there would be no risk if they took part in this study. The participants were provided with telephone numbers of the lead researcher and the Kenya Methodist University (KeMU) relevant authorities to contact should there be issues of great concern and clarifications. The participants were also assured that refusal to take part in the study did not have any effect on any usual services that the family members received in the region. The participants

were also informed that there was no reward or any monetary gain for those participating in the study. The participants were selected randomly from clustered households in the study area. Records identifying the participants were kept in a secure and confidential.

CHAPTER FOUR

RESULTS AND DISCUSSION

4.1 Sociodemographic characteristics of children 0-59 months old

Introduction

This study aimed at determining the influence of dietary intakes, water, sanitation and hygiene practices in stunting of children below five years in Kaptembwo informal settlement and Milimani estate, Nakuru County. Findings of the study are analyzed and were presented as either tables and or graphs.

Sociodemographic characteristics of children aged 0-59 Months old

The sociodemographic characteristics of children aged 0-59 months old is shown in table 4.1

Table 4.1

Demographic characteristics of children aged 0-59 months

Target child traits	Kaptembwa		Milimani	
	Male Mean	Female Mean	Male mean	Female mean
Age in months	26.00	24.00	25.00	23.00
Height in centimetres	82.54	80.01	83.84	80.90
MUAC in centimetres	14.95	14.81	15.13	15.61
Child's weight at birth in kgs	3.25	3.19	3.24	3.11

A total of 314 children aged between 0-59 months were sampled and consisted of 162 (51.59 %) male and 152 (48%) female children. The number of male against the number of female children was therefore not of any significant difference (Table 4.1). The mean height for males in Kaptembwo was 81.275cm while that of Milimani was 82.37cm. The mean average height for

Kaptembwo and milimani was 81.823 cm. The average age for the children is 24.5 months and their mean height is 81.82 Centimeters. The mean birth weight for children in Kaptembwo was 3.22kg while that of Milimani was 3.175kg. The overall average weight for the two areas was 3.195 kg. Children were born with a higher birth weight in Kaptembwo than in Milimani. In general, the birth weight of the sampled population was normal.

Verification of child's age and weight

The child' age and weight was verified as indicated below

Table 4.2

Verification of child's age and weight

Target child	**Kaptembwo**	**Milimani**	**Overal**
	n=220	n=112	n=314
How was child's age verified?			
Not verified	0.5	8.04	3.18
Yes, Health passport	58.91	52.68	56.69
Yes, Mother's recall	40.1	39.29	39.81
Other document	0.5	0	0.32
Was the child's weight verified?			
Not verified	0.5	14.29	5.41
Yes, Health Card	57.43	49.11	54.46
Yes, Mother's recall	42.08	36.61	40.13

The ages of a majority of children was verified either using health card (56.69%) or by mother's recall (39.81%). This was true with the verification of child's weight at birth either using health card (54.46%)or by using mothers recall (40.13%). Only 3.18% of children's age was not verified and another 5.41% whose weight at birth was not verified.

4.2 Maternal level of education

Education level is likely to influence feeding, sanitation and hygiene practices. It is expected that mothers with higher education have knowledge on good nutrition, good sanitation and hygiene. Some studies have however established that such mothers do not have time to nurse their childen having busy schedules such as attending to white choler jobs, unlike mothers who are less educated. Mothers had levels of education which spread from pre-school all the way to University education (Table 4.3).

Table 4.3

Maternal socioeconomic characteristics

Socioeconomic characteristics	Kaptembwa n=202	Milimani n=112	Average N=314
Maternal education level			
Preschool	13.13	2.7	9.39
Primary	48.99	17.12	37.54
Secondary	28.79	39.64	32.69
Certificate	5.05	9.01	6.47
Diploma	3.03	20.72	9.39
University degree	1.01	10.81	4.53
Marital status			
Single	17.33	14.29	16.24
Monogamously married	76.73	82.14	78.66
Polygamously married	1.49	0	0.96
Cohabiting	0	0.89	0.32
Widowed	1.49	0	0.96
Divorced	0.5	0.89	0.64
Separated	2.48	1.79	2.23

Close to half (39.64%) of mothers in Milimani had secondary education while slightly more than a quarter 28.79% of mothers in Kaptembwo had secondary education. 10.81% of mothers in Milimani had university degree compared to 1.01% of mothers in Kaptembwo. The level of

education for mothers has been associated with of stunting in some studies. Research has shown that the education level of the mother has high influence on child stunting (Abuya et al., 2012). The findings agree with Zottarelli et al. (2007) who in their studies in Egypt found that the proportion of children with stunting fell as parents' education increased. (Zottarelli et al., 2007). Mothers who are educated tend to know better the nutritional needs of their children than uneducated mothers (Abuya et al., 2012; Khanal et al., 2013).

Majority of the mothers in Kaptembwo (76.73%) and Milimani (82.14%) were monogamously married. Less than quarter (17.33%) of mothers in kaptembwo and (14.29%) of mothers in Milimani were single mothers. Research has shown that marital status has an influence on the quality of care provided to the child (Pan American Health Organisation [PAHO], 2003).

4.3 Household demographics

The household size is averagely 4 persons per household in both Kaptembwo and Milimani. The mean annual income for Kaptembwo and Milimani is Kenya shillings 132,477 and 332,089 respectively. The main house characteristics are shown in the table below.

Table 4.4

The Main house characteristics

Main house characteristics	Kaptembwa n=202	Milimani n=112	Overal n=314
Main floor material			
Earth/Sand/Animal dung	8.42	0	5.41
Stone/Brick	0.5	0	0.32
Cement	85.15	94.64	88.54
Tile	5.94	5.36	5.73
Main roof material			
Metal roof	99.5	85.71	94.59
Stone or tile roof	0.5	12.5	4.78
Asbestos	0	0.89	0.32
Cement	0	0.89	0.32
Main exterior walls materials			
Earth/Sand/Mud/Clay	34.65	0.89	22.61
Wood, Bamboo, corn stalks	0.5	1.79	0.96
Stone/ Fired Brick	19.31	51.79	30.89
Cement	45.54	40.18	43.63
Iron sheets	0	5.36	1.91

The average number of persons living in a household was 4.0 in both Kaptembwo and Milimani. This finding agrees with the study finding of Mokaya et al., (2016) who found that Kaptembwo had relatively large household sizes where 30.5% of the households had four people while 20 % had three people per household. There was a significant difference in annual family income between Kaptembwo and Milimani, (132,477 and 332,089 respectively). The mean annual family income provides information which is crucial in making assumptions on the living standards and the general quality of life of a household. Households with low income tend to consume less fruits

and vegetables, more sugars and other sweetened beverages. They have low quality diet compared to those with higher income, (French et al., 2019).

The study found that a small proportion of households in Kaptembwo (8%) lived in houses with earth/mud as the main floor material, unlike Milimani where there was no single household with earth as the main floor material. Majority of the households (89%) lived in cement houses with cement as the main floor material while an average of 5% lived in earth/sand/animal dung floor houses.

A relatively high number (34.65%) of households in Kaptembwo lived in earth wall houses. Less than 1% of the households in Milimani had earth wall. This is an indicator of some level of poverty. This finding is in agreement with the report by United Nations Development programme which characterizes the wall, floor and roof of poor households to be inadequate, of natural materials or rudimentary materials (UNDP, 2019).

The main house roof material for Kaptembwo and Milimani was Metal roof (99.5%) Kaptembwo, (85.71%) Milimani. There was 12.5% stone, or tile roof in Milimani.

4.4 Assets owned by family

Various assets owned by the family are shown in table 4.5 below:-

Table 4.5

Assets owned by family members

Assets ownership	Kaptembwo n=202	Milimani n=112	Overal n=314
Bicycle	18.81	10.71	15.92
Radio	66.83	77.68	70.7
Bed	93.56	99.11	95.54
Phone	97.52	98.21	97.77
Television	72.28	84.82	76.75
Fridge	4.46	23.21	11.15
Watch	25.25	29.46	26.75
Sewing machine	5.45	4.46	5.1
Motorcyle	7.92	7.14	7.64
Car	0.99	9.82	4.14
Tractor	0	0.89	0.32
Computer/laptop	0.99	3.57	1.91
Water dispenser	1.98	2.68	2.23

The study found that 18.81% in Kaptembwo and 10.71% in Milimani owned a bicycle. 66.83% in Kaptembwo and 77.63% in Milimani owned Radio, 93.56% in Kaptembwo and 99.11% in Milimani owned a bed, 97.52% in Kaptembwo and 98.21% in Milimani owned a phone, 72.28% in Kaptembwo and 84.82% in Milimani owned a Television set.23.21 % of Milimani respondents owned a refrigerator while 4.46% of respondents of Kaptembwo owned a refrigerator.

4.5 Dietary intakes

The mean energy intake for Kaptembwo and Milimani was considered adequate for normal growth. The daily energy intake for both groups were within the recommended intake for children of all age groups. Carbohydrates were the greatest contributors of the daily caloric intake.

Table 4.6

Dietary intake (Kcal/day) for children of various age groups

Age group	Estimated RDA	mean energy	t-test	p-value
0-6months	700	700	n/a	n/a
7-13months	910	902.77	0.5513	0.5838
14-20months	1100	1037.73	-0.3407	0.3673
21-27months	1200	1166.15	-0.0147	0.4942
28-34months	1300	1294.87	1.8196	0.0792
35-41months	1420	1391.91	-2.826	0.0072
42-48months	1520	1482.4	0.783	0.4402
49-59months	1610	1581	-0.3207	0.7526

Food group eaten by reference child in the last 7 days

Food group eaten by reference child in the last 7 days is shown below

Table 4.7

Food group eaten by reference child in the last 7 days

Food eaten by reference child in the last 7days	Kaptembwa n=202	Milimani n=112	ch2	P-value	Overall n=314
Carbohydrates	91.1	90.2	0.0713	0.79	90.8
Lipids	89.1	88.4	0.0373	0.847	88.9
Proteins	87.1	91.1	1.1034	0.294	88.5
Vitamins	90.6	90.2	0.0144	0.905	90.4

There was no significant difference between the recommended dietary intake and the actual intake for children of all age brackets in both Kaptembo and Milimani. There is a significant difference

in terms energy levels taken by age groups 28-34 months and 35-41 months P-Values 0.0792 and 0.0072 respectively.

Food eaten by reference child in the last 24hours

The food eaten by reference child in the last 24 hours was is shown in the table below: -

Table 4.8

Food eaten by reference child in the last 24hours

Food eaten by reference child in the last 24hours	Kaptembwa N=202	Milimani N=112	Overal N=314
Cereals	89.6	90.18	89.81
Pulses, legumes	45.54	36.61	42.36
Roots and tubers	52.48	40.18	48.09
Dark green leafy vegetables	64.85	72.32	67.52
Other vitamin-a rich vegetables	24.75	13.39	20.7
Other vegetables	85.64	89.29	86.94
Vitamin-a rich fruits	24.26	11.61	19.75
Other fruits	58.91	72.32	63.69
Meats & poultry	24.26	14.29	20.7
Organ meat	14.36	2.68	10.19
Eggs	27.23	21.43	25.16
Fish and sea food	27.23	13.39	22.29
Nuts and seeds	17.33	3.57	12.42
Milk, milk products	75.25	82.14	77.71
Oil/fats	89.11	88.39	88.85
Sugar and honey	86.63	86.61	86.62

It was found that in both Kaptembwo and Milimni and 89.81% of children consumed cereals, 42.36% consumed pulses/legumes, 48.09% consumed root tubers, 67.52% consumed dark green leafy vegetables while 86.94% consumed other vegetables. Other food consumed by a great majority of respondents include oil/fats (88.85%), Sugar and Honey (86.62%).

Food Frequency of the type of food eaten by reference child in the last 7 days

The food type eaten by reference child in the last 7days

Table 4.9

Food Frequency of the type of food eaten by reference child in the last 7 days

Food eaten by reference child in the last 7 days	Kaptembwa n=202	Milimani n=112	Overall n=314
Cereals	89.6	90.18	89.81
Pulses, legumes	45.54	36.61	42.36
Roots and tubers	52.48	40.18	48.09
Dark green leafy vegetables	64.85	72.32	67.52
Other vitamin-a rich vegetables	24.75	13.39	20.7
Other vegetables	85.64	89.29	86.94
Vitamin-A-rich fruits	24.26	11.61	19.75
Other fruits	58.91	72.32	63.69
Meats & poultry	24.26	14.29	20.7
Organ meats	14.36	2.68	10.19
Eggs	27.23	21.43	25.16
Fish & sea food	27.23	13.39	22.29
Nuts & seeds	17.33	3.57	12.42
Milk and milk products	75.25	82.14	77.71
Oil/fats	89.11	88.39	88.85
Sugar and honey	86.63	86.61	86.62

The number of days in the last 7 days various food groups were eaten

Table 4.10

The number of days in the last 7 days various food groups were eaten by reference child

Days in the last 7 days type of food was eaten	Kaptembwo Mean	Milimani Mean	Overall Mean
Cereals	7	7	7
Pulses, legumes	3	2	3
Roots and tubers	2	3	2
Dark green leafy vegetables	5	6	5
Other vitamin-a rich vegetables	2	1	1
Other vegetables	7	7	7
Vitamin-a rich fruits	2	1	2
Other fruits	3	4	4
Meats & poultry	2	2	2
Organ meat	0	0	0
Eggs	2	2	2
Fish and sea food	2	1	2
Nuts and seeds	1	1	1
Milk, milk products	5	6	6
Oil/fats	7	7	7
Sugar and honey	7	7	7

There was a high consumption of Pulses and legumes in Kaptembwo (45.54%) than in Milimani (36.61%); more roots and tubers (52.48%) than in Milimani (40.18%), more organ meats (14.36%) in Kaptembwo compared to Milimani (2.68%); more eggs in Kaptembwo (27.23%) compared to

Milimani (21.43%); more Fish and sea food in Kaptembwo (27.23%) compared to Milimani (13.39%); more nuts and seeds in Kaptembwo (17.33%) compared to Milimani (3.57%). Milk consumption was high for milk and milk products in Milimani (82.14%) compared to (75.25%) in Kaptembwo. There was a generally weak intake of proteins, and vitamin rich foods. This could be associated with stunting and poor immune function in children in the study area. These study findings agree with the U.S. Department of Health and Human Services, 2019. It was also established that respondents in Kaptembwo consumed more sugars than Milimani. This finding agreed with Blisard and Stewart (2006) it also agrees with (French et al., 2019; Appelhans et al., 2012; French et al., 2010). In a 7 days' food frequency for reference child, there was generally high consumption of organ meats with significance level of 10.7356, Fish and sea food with significance level 7.9609, meat and poultry with significance level of 4.3644, Vitamin A-rich fruits 7.2762, Roots and tubers with a significance level of 4.3643.

4.6 Water, Sanitation and Hygiene

Household access to drinking water

The household access to drinking water is shown in table 4.11

Table 4.11

Household access to drinking water

Main source of drinking water for household?	Kaptembwo n=202	Milimani n=112	Overall n=314
Piped into dwelling	0.5	22.32	8.28
Piped into compound, yard or plot	85.15	61.61	76.75
Piped to neighbor	1.98	0.89	1.59
Public tap / standpipe	3.47	8.93	5.41
Tanker-truck	3.96	0.89	2.87
Cart with small tank / drum	3.47	0	2.23
Bottled water	1.49	5.36	2.87
Treating water to make it safer for drinking	42.08	56.25	47.13

In this study, it was found that piped water supplied by NAWASSCO was the main source of drinking water 76.75%. Only 0.5 % of the households in Kaptembwo had drinking water piped into housing unit while 22.32% households in Milimani had drinking water piped into housing unit. 85.15% households in Kaptembwo fetched drinking water piped into a compound or dwelling for communal use. NAWASSCO does not meet the demand for water in Nakuru. The water demand for Nakuru is about 60 Litres daily (NAWASSCO, 2020). NAWASSCO can only supply 45 million litres per day thereby leaving a shortage of 15 million litres daily (NAWASSCO, 2020). In order to mitigate water shortage, supply is rationed and is made available to the residents mostly once or twice a week. This finding agrees with Mokaya et al. (2016) who in their study found a mere 25% households were in access of about 50 litres of water per day (Mokaya at al., 2016). In

Milimani, water harvested from rain substitutes the water supplied by NAWASCO. 3.47% of the respondents in Kaptembwo accessed drinking water from public tap while 7.43% bought drinking water from water vendors.

Water treatment before drinking

What is done to water before drinking is shown in the table below: -

Table 4.12

Water treatment before drinking

Treatment of water before drinking	Kaptembwo n=85	Milimani n=63	Overal n=148
Add Bleach/ chlorine	28.24	26.98	27.7
Use water filter (ceramic, sand, composite)	0	1.59	0.68
Let it stand and settle	3.53	0	2.03
No treatment	2.35	0	1.35

Majority of the respondents in both Kaptembwo (70.59%) and Milimani (87.3%) boiled water before drinking while 28.24% in Kaptembwa and 26.98% in Milimani added bleach/chlorine to make water suitable for drinking. A total of 3.88% of the residents of Kaptembwo did not treat water for drinking expressed confidence in the safety of water supplied by NAWASCO and therefore did nothing to make it safe. In their study, Kiruki et al. (2011) found the water at Kiti and Milimani, distributed by the municipality of Nakuru being safe for drinking. This was due to the fact that from the samples collected for examination, they had a mean total mean coliform count of below 0.03MPN per milliliter upon being subjected to laboratory studies. Contrary to the Milimani and Kiti waters, the water being used by the people of Ronda (neighbour to Kaptembwo)

and that used by the people of Bondeni was contaminated with coliforms of counts above 3.0MPN per milliliter. This then means that residents of the 3.88% residents of Kaptembwo obviously drink contaminated unsafe water.

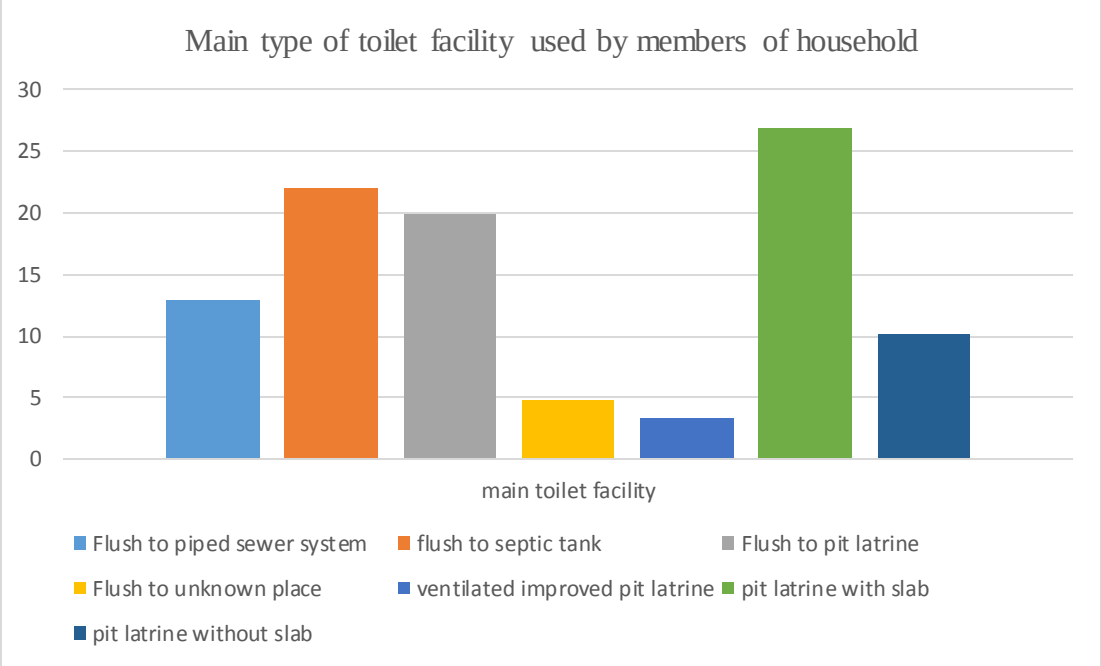
Sanitation and hygiene

Toilet facility used by household and de-worming habits

The main toilet facility type used by household is shown below

Figure 4.1

Toilet facility used by household



It was found that the main toilet facility for respondents in Kaptembwo was pit latrine with slab (26.88%) while in Milimani, the main toilet was flush to piped sewer (61.17%). Interestingly, 10.22% of the respondents in Kaptembwo used pit latrines without slab/cover on the squatting hole while only 1.94% of pit latrines in Milimani did not have cover on the squatting hole. This could

mean that insects such as flies could get into the pit and out, thereby picking potential pathogens in feaces, which are potential causes of diarrhoea. This finding agrees with the findings of by Regassa et al., 2008, who in their study on Environmental determinants of diarrhoea among under-five children in nekemte town, western Ethiopia, found that in households that had latrine facility, majority (64.3%) of pit holes did not have cover. It further concurs with Anteneh and Kumie (2010) who in their study on how the use of latrines affect diarrheal diseases in Amhara region Ethiopia. 4.84% respondents in Kaptembwo flushed into unknown places. Kaptembwo had most of its pit latrines either full or almost full (less than one metre deep). The finding agrees with Mwanzia and Misati (2013). Some pit latrines did not have doors, required cleaning, covering, emptying and ventilation. Most walls and floors of pit latrines were dirty, smell was intolerable. From this observation, contamination and infection was obvious. This finding further agrees with (Mwanzia & Misati, 2013). In the USAID/HIP, the standards of a pit Latrine of a household require that it should have access to a seal, cleaned, and maintained and well ventilated, should have access to a hand washing station with sufficient water for multiple hand washings and a cleansing agents, and that a system that dispose of raw sewage into a surface water source or into groundwater is not permitted. The pit latrines in the study area fail to meet the standard.

On deworming of children, 49.5% of respondents in Kaptembwo reported to have dewormed their children within the last three months, while 56.25% respondents in Milimani reported to have dewormed their children in the last three months. Respondents in both Milimani and Kaptembwo reported to be deworming their children twice a year. Deworming every after here months tended to lower the episodes of diarrhoea probably due to reduced worm infections leading to better absorption and utilization of nutrients by the child. Those who de-wormed after every three months are significantly less likely to experience diarrhoea.

On the source of de-wormers, 57.76% reported to get their de-wormers over the counter while in Milimani, 37.21% reported to get their de-wormers over the counter.

Hand washing occasions

Table 4.13

Occasions when hands are washed

Occasions when hands should wash your hands	**Kaptembwa n=202**	**Milimani n=112**	**Overal n=314**
Before eating	85.64	82.14	84.39
After eating	58.42	52.68	56.37
Before praying	2.97	8.04	4.78
Before breastfeeding or feeding a child	15.35	29.46	20.38
Before cooking or preparing food	27.23	58.04	38.22
After defecation/urination	62.38	76.79	67.52
After cleaning a child that has defecated or changing a child's nappy	49.01	55.36	51.27
when my hands are dirty	43.07	50.89	45.86
After cleaning the toilet or potty	21.29	25.89	22.93

This study found out that many respondents do not wash their hands after toilet use. 37.62% of respondents in Kaptembwo did not wash hands after visiting the toilet, against 23.21% who did not wash hands after visiting the toilet in Milimani. This finding agrees with Gawai et al. (2016) who found that a very small percentage (18%) wash hands after toilet use.

15.35% of breastfeeding mothers in Kaptembwo washed their hands before breastfeeding, compared with 29.46% in Milimani. This finding agrees with Ekanem and Johnson (2015) on mothers practice of washing hands before feeding their children in which (47%) of the respondent mothers claimed to always wash their hands before breastfeeding their children and (7.3%) never

did so (Ekanem & Johnson, 2015). The study found that slightly less than half (49.01%) of mothers in Kaptembwo washed their hands after changing the nappy of a child upon defecation while in Milimani, those that did were more than half (55.36%). This showed that a high number of mothers do not observe hygiene. This finding agrees with the findings of Curtis et al., 2003, who in their study found that only 42% of child caregivers washed hands after changing a dirty nappy (Curtis et al., 2003).

Only 27.23% washed their hands before cooking in Kaptembwo compared with 58.04% in Milimani. 49.01% washed their hands upon changing the child's nappies compared to 55.36% in Milimani. On the same environmental consideration, results show that washing hands before eating is significantly associated with diarrhoea. However, even those who wash hands after urination or defection tend to experience diarrhoea. This could be attributed to the fact that perhaps many children don't wash their hands properly for instance by using detergents. Results further showed that those who wash their hands before cooking or preparing food and after changing a child's nappy are significantly less likely to experience diarrhoea. Water was significantly inversely associated with diarrhoea implying that availability of water at the site of washing hands is more likely to reduce diarrhoea.

These factors could be responsible for high incidences of diarrhoea in Kaptembwo than in Milimani.

Hand washing facility and presence of soap

The table below shows the place where hand washing is usually done and presence of detergent.

Table 4.14

Hand washing facility and presence of soap

Can you show me where you usually wash your hands and what you use to wash hands	Kaptembwa n=202	Milimani n=112	Overal n=314
Within 10 paces of the toilet facility	10.89	41.07	21.66
Within 10 paces of the kitchen/cooking place	37.62	41.07	38.85
elsewhere in home or yard	9.9	6.25	8.6
Outside yard	1.98	1.79	1.91
No specific place	38.61	8.93	28.03
Not given permission to see	0.99	0.89	0.96
OBSERVE: There soap or detergent available	34.16	51.79	40.45
OBSERVE: There water available	71.29	97.32	80.57

The study established that only a few households in Kaptembwo (10.89%) and 41.07% households in Milimani had hand washing facility near toilet. The findings agree with the findings of Kenya Integrated Household Budgetary Survey [KIHBS], (2015-2016)). It was also found that 37.62% of Kaptembwo and 41.075 of Milimani had hand washing facility near kitchen/ cooking place. This could discourage hand washing during cooking as it was found by (Nizame et al., 2013).

The study found that 38.61% in Kaptembwo and 8.93% in Milimani had no specific place to wash hands. In Kaptembwo, only 34.16% had soap or detergent available at the hand-washing place compared with 51.57% in Milimani. The absence of soap and water at a hand washing facility could discourage the habit of hand washing. The study findings agree with Lopez-Quintero et al., (2009) and with Steinmann et al., (2015).

The absence of water and soap near toilet facility meant that people did not wash their hands at critical times. This could result into increased episodes of diarrhoea because hand washing promotion probably reduces diarrhoeal episodes among communities living in LMICs by about 30% (Ejemot-Nwadiaro et al., 2016). It was also found that hand washing facilities were far from source of water and most of them were not suitable for children. This finding agrees with (Mwanzia & Misati, 2013).

Place where cooking is usually done and the main source of lighting for household

Table 4.15

Place where cooking is usually done and the main source of lighting for household

Where is cooking usually done	Kaptembwo	Milimani	Overall
In a room used for living or sleeping	83.66	42.86	69.11
Separate room in the same building used as a kitchen	9.9	51.79	24.84
Separate building used as kitchen	2.97	1.79	2.55
Outdoors	3.47	3.57	3.5
Main source of lighting for the household			
Electricity	95.05	100	96.82
Kerosene	4.95	0	3.18
Generator	0	0	0
Crop residue	0	0	0
Solar power	0	0	0
LPG(gas)	0	0	0

It was found that majority respondents (83.66%) in Kaptembwo and 42.86% in Milimani cooked in the same room used for sleeping. 9.9% respondents in Kaptembwo and 51.79% respondent in Milimani cooked in a separate room in the same building where family members sleep. 2.97% of respondents in Kaptembwo and 1.79% of respondents in Milimani cooked food in a separate building used as Kitchen. In Kaptembwo, 3.47% of respondents in Kaptembwo and 3.57% of the respondents in Milimani cooked their food outdoors.

Animals housed in main house

Table 4.16

Animals housed in the main house

Animals housed	Kaptembwa n=11	Milimani n=7	Overal n=18
Cattle	0	0	0
Goat	0	0	0
Sheep	0	0	0
Chicken	63.64	14.29	44.44
Pigs	0	0	0
Horse	0	0	0
Donkey	0	0	0
Ducks	18.18	0	11.11

It was found that 11 (5.45%) respondents in Kaptembwo housed animals in their main house. 63.64% of the respondents housed chicken in the main house while 18.18% of the respondents housed Ducks in the main house. In Milimani, (14.29%) of the respondents housed chicken in the main house but there were no ducks housed in the main house. On average, 44.44% of the respondents housed chicken in the main house and 11.11% housed ducks in the main house. There were no cattle, Goats, sheep, pigs, Horses and Donkeys housed in the main house in both Kaptembwo and Milimani.

Cooked foods bought from vendors

The cooked foods bought from food vendors by household is shown in the table below

Table 4.17

Cooked foods bought from vendors

Cooked food you buy from vendor	Kaptembwa n=130	Milimani n=56	Overal n=186
Beans	74.62	44.64	65.59
Greengrams	13.08	1.79	9.68
Lentils(kamande)	5.38	0	3.76
Dolichos lab lab(Njahi)	4.62	0	3.23
Chapati/mandazi	61.54	60.71	61.29
Fish(fried,smoked etc)	33.08	17.86	28.49
Githeri	48.46	39.29	45.7
Chips/Bhajia	39.23	39.29	39.25
Eggs	13.08	5.36	10.75
Smokies/sausage/samosa/kebab	20	17.86	19.35
Groundnuts/simsim	13.08	5.36	10.75
Bone soup	0.77	0	0.54

In this study, it was found that top five most bought cooked food was Beans (65.59%), Chapatti/Mandazi (61.29%), Githeri (45.7%), chips/Bhajia (39.25%) and Fish (28.49%), in descending order.

In a study done by Mwangi et al. (2002) 50% of Nakuru residents consume street foods. Most of the street food vendors in Nakuru do not wash hands prior to food preparation (Muhonja & Kimathi, 2014). Studies indicate that food handlers may introduce disease causing organisms into food in the course of preparing (Falkeinstein, 2010). Results show that relative to those who don't

buy Githeri from vendors, those who buy are significantly more likely to experience diarrhoea. On the other hand, those who buy nuts are significantly less likely to experience diarrhoea.

Studies have also shown that many episodes of diarrhea occur mainly due to buying and eating foods which are prepared and sold by street food sellers or due to failure to wash ones hands after visiting the toilet or failure to wash hands before preparing a meal (Muhonja & Kimathi 2014). In their study, Muhonja and Kimathi (2014) found that 23% of the food Vendors in Nakuru operate in unhygienic conditions. The unsanitary operating conditions of food vendors is questionable and chances are that these vendors sell food which is of poor quality, unsafe and could be very contaminated (Obuobie et al., 2006).

Frequency of buying cooked foods from vendors

The frequency of buying cooked foods from vendors is shown in the table below: -

Table 4.18

Frequency of buying cooked foods from vendors

Frequency of buying these foods	Kaptembwa n=130	Milimani n=56	Overal n=186
More than three times a day	8.46	0	5.91
Three times a day	3.85	1.79	3.23
Two times a day	29.23	7.14	22.58
Once a day	58.46	91.07	68.28

The frequency of buying cooked foods from vendors was high in Kaptembwo than Milimani. 68.28% of the respondents bought cooked foods from vendors at least once daily, 22.59% at least twice daily, 3.23% at least thrice daily while 5.91% bought more than three times a day. The frequency of buying vended foods is as high as the diversity of food bought. This study finding agrees with findings of Mwangi et al. (2002) who in their studies found that 50% of Nakuru

residents consumed street foods (Mwangi et al., 2002). In a study by Kibitoka and Ndukoa (2016) it was found that the salads served with vended foods had *Escherichia coli* and *salmonella species* high above the recommended colony forming units by kenya Bureau of standards. The presence of these species of bacteria indicate food contamination.

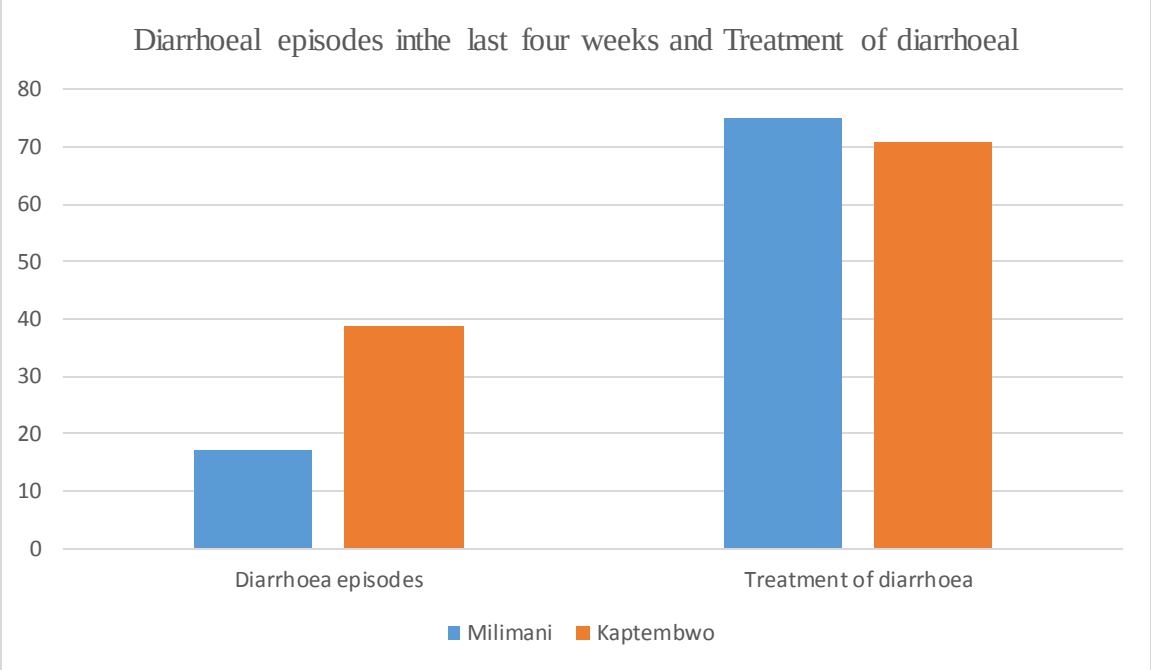
4.7 Diarrhoea episodes

Episodes of diarrhoea in the last 4 weeks and treatment for diarrhoea

Episodes of diarrhoea in the last 4 weeks and treatment of diarrhoea for Kaptembwo and Milimani is shown below.

Figure 4.2

Episodes of diarrhoea and treatment for diarrhoea



The study found that out of 202 children sampled in Kaptembwo and 112 sampled in Milimani, 78/202 (38.61%) and 19/112 (16.96%) respectively, had diarrhoea in the last 4 weeks. According to Bern et al. (1992), a child in sub-Saharan Africa will have, on average about 3-4 episodes of

diarrhoea annually among many other health problems (Bern et al., 1992). Of the 78 children who had diarrhoea in Kaptembwo, 55/202 (70.73%) children got treatment and 14/112 (75%) children got treatment in Milimani. Checkley et al. (2003) found that high cumulative burden of diarrhoeal increases the chance of childhood stunting (Checkley et al., 2003).

In a research by Richard et al. (2013) and Childhood Malnutrition and Infection Network (2013) it was found that a child who experienced an average age-specific monthly diarrhoea episode was shorter at 24 months of age compared to a child who never experienced diarrhea episode (Checkley et al., 2003). The same study found that a child who did not experience any diarrhoea episode in the first 6 months from birth but had diarrhoea from the 7^{th} month of life to the age of 24 months was also shorter compared with a child who never had any diarrhoea episode. Diarrhoea during the first 6 months of life resulted in height deficits that were likely to be permanent contrary to diarrhoea which occurred after 6 months of age which had transient effects. (Checkley et. al., 2003).

Treatment options for diarrhoea

The treatment options for diarrhoea in reference child is indicated below

Table 4.19

Treatment of diarrhoea

What was given to the child to treat diarrhea	Kaptembwa n=82	Miliman i n=20	Overal n=102
Nothing	25.61	35	27.45
ORS	45.12	45	45.1
Zinc	31.71	25	30.39
Home-made fluid (ort fluid)	10.98	5	9.8
Pill or syrup	15.85	0	12.75
Home remedies	1.22	5	1.96
Herbal medicines	2.44	5	2.94

This study found that majority (45.1%) of children who had diarrhoea in both Milimani and Kaptembwo were treated with ORS. Zinc treatment (30.39%) was the second option for treatment of diarrhoea. 25.61% of respondents in Kaptembwo and 35% in Milimani did give anything to children to treat diarrhoea. Results show that there is a positive correlation between those who have had diarrhoea and consumption of ORS. This implies that higher the rate of diarrhoea, the more ORS is consumed as one of the remedies. It was fond that despite the availability of affordable treatment options for diarrheoea, 27.45% did not utilize it. This agrees with (Walker et al., 2009).

The Source of ORS for treatment of diarrhea.

Out of the data collected from various households, it was established that different people obtained ORS from various sources in view of treating diarrhea.

Table 4.20

Source of ORS for treatment of diarrhea

Where do you usually get ORS from?	Kaptembwa n=159	Milimani n=75	Overal n=234
Hospital	62.26	94.67	72.65
Clinic	6.29	0	4.27
Health center	27.67	1.33	19.23
Private doctor	3.77	2.67	3.42
Drug store	13.84	2.67	10.26
Local store	1.89	0	1.28

It study found out that a greater majority of respondents in both Milimani (94.67%) and Kaptembwo (62.26%) got ORS from the hospital facility. 27.67% of respondents in Kaptembwo and 1.33% of respondents in Milimani got ORS from a health centre. 13.84% of respondents in Kaptembwo and 2.67% in Milimani got ORS from a drug store.

Contributors of diarrhoea

Various dependent factors (x) were tested using probit model against the independent variable (Diarrhoea) (y), to establish the factors that significantly contributes to diarrhoea in Kaptembwo and Milimani. Those factors whose statistical significance were within levels $p<0.05$, $p<0.01$, and $p<0.001$ were considered to have significantly had an influence on diarrhoea.

The negative coefficient implies that the predictor variable is reducing diarrhoea whereas a positive coefficient indicates that the predictor variable is increasing diarrhoea.

Table 4.21

Contributors of diarrhoea

Variables	Coefficients	SE
Food from vendors (Dolichos lablab=1)	-0.42708	0.854
Food from vendors (Lentils=1)	-0.63075	0.711
Food from vendors (Chapati=1)	-0.22011	0.262
Food from vendors (Fish=1)	0.083363	0.263
Food from vendors (Githeri=1)	.4715581*	0.296
Food from vendors (Chips=1)	-0.02017	0.273
Food from vendors (Eggs=1)	0.478737	0.451
Food from vendors (Smokies=1)	-0.35008	0.397
Food from vendors (Nuts=1)	-1.31366***	0.520
Food from vendors (Beans=1)	0.217611	0.309
Food from vendors (Green grams=1)	0.48816	0.479
Frequency of buying vendor foods (More than once a day=1)	0.352408	0.299
Ever used ORS (Yes=1)	1.000825***	0.301
Water source (Bottled water=1)	0.470545	0.953
Water source (Tanker/cart=1)	0.509178	0.797
Water source (Public tap/standpipe=1)	-0.68227	0.841
Water source (Piped into the compound/yard=1)	0.471395	0.635
What you do to make water safe (boil=1)	-0.0985	0.267
What you do to make water safe (add bleach/chlorine=1)	-0.11837	0.407
What you do to make water safe (let it stand and settle=1)	-0.6164	1.145
Occasion when you wash your hands (Before eating eating=1)	.5927564*	0.363
Occasion when you wash your hands (After eating=1)	-.5424461*	0.324
Occasion when you wash your hands (Before praying=1)	0.514296	0.590
Occasion when you wash your hands (Before Cooking/preparing food=1)	-0.12826	0.297
Occasion when you wash your hands (After defection/urination=1)	.5389589*	0.295
Occasion when you wash your hands (After changing a child's nappy=1)	-.4566494*	0.268
Occasion when you wash your hands (when hands are dirty=1)	0.092571	0.289
Occasion when you wash your hands (After cleaning the toilet=1)	0.195014	0.378
Washing hands site (Soap available=1)	0.33499	0.284
Washing hands site (Water available=1)	-.564757*	0.342
Main type of toilet (Pit latrine without slab=1)	0.818518	0.996
Main type of toilet (Pit latrine with slab=1)	1.23965	0.889
Main type of toilet (Ventilated Pit latrine=1)	1.692964*	1.154
Main type of toilet (Flush to Pit latrine=1)	0.551892	0.888
Main type of toilet (Flush to Septic tank=1)	1.110113	0.910
Main type of toilet (Flush to Piped sewage system=1)	0.544959	0.833
Dewormed in the last 3months	-.890215***	0.289
Constant	-2.11878	1.204
Observations	314	

Source: Survey Data

SE (Stand Error in Parentheses), p=p value and n=314.

$p<0.05$(*), $p<0.01$(**), and $p<0.001$(***),

*, ** and *** represent statistical significance at 10%, 5% and 1% levels respectively.

Using *probit* model to assess the factors that contribute to diarrhoea in Kaptembwo and Milimani at household level, the results, indicated with respective coefficients show that; Buying Githeri (0.4715581), Buying nuts (-1.31366), use of ORS (-1.00825), Washing hands before eating (0.5927564), washing hands after toilet (0.5389589), washing hands after changing child's nappy (0.4566494), presence of hand washing site near toilet facility (0.564757), use of ventilated pit latrines (1.692964) and deworming (-0.890215) were key factors that had influence on diarrhoea.

4.8 Anthropometric measurement of height-for-age (stunting)

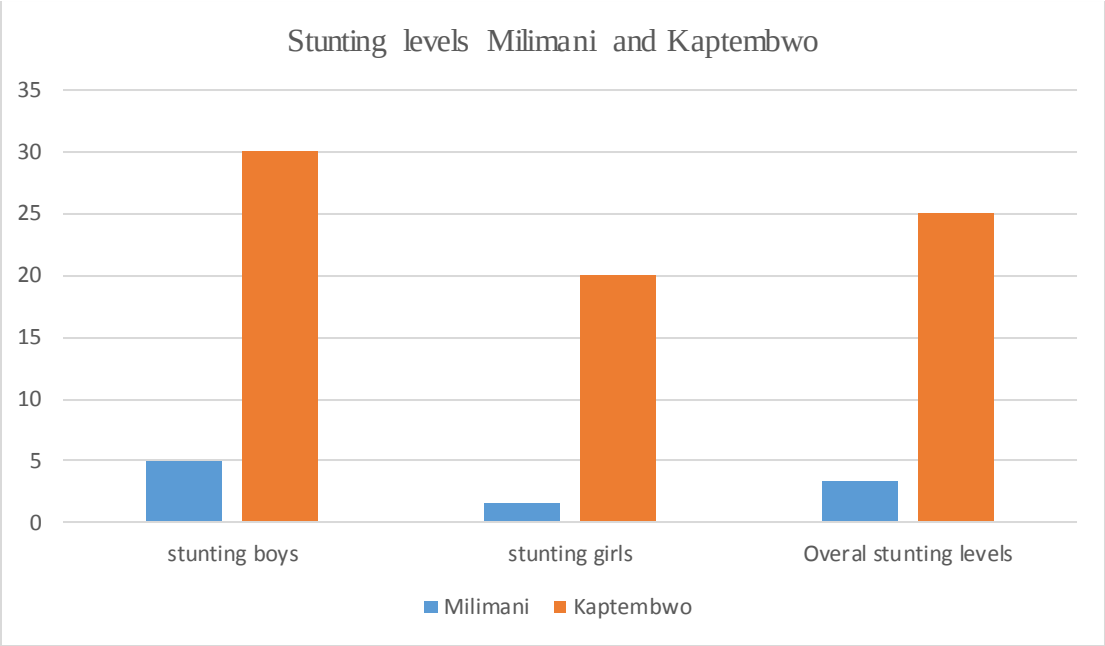
The height of each sampled child (0-59) months was taken and the height-for-age z-scores (HFAz) were generated based on the 2006 world health organization (WHO) growth reference, and used to determine whether the child is stunted or not i.e. HFAz <-2 for moderate stunting and HFAz<-3 for severe stunting. Results showed that the risk of stunting for children in both Kaptembwo and Milimani increased with increasing age from 8 months.

Stunting status for boys and Girls in Kaptembwo and Milimani

The stunting status for boys and Girls in Kaptembwo and Milimani is shown below

Figure 4.3

Stunting (HFAz) status for Boys and Girls, Kaptembwo and Milimani



The levels of stunting in Kaptembwo (25%) are higher than levels of stunting in Milimani (3.335%). The study found that stunting was higher in males (35%) than females (26.67%) in both Kaptembwo and Milimani. This finding agrees with Wamani et al. (2007); García et al. (2017) whereby male children were found to be more stunted than girls.

The findings too agree with Zottarelli et al. (2007), Abuya et al., (2012), & Bukusuba et al., (2017). However, the results disagree with Ndiku et al. (2010) who found that girls were severely stunted (24.6%) than boys (16.3%). Even if the average prevalence of stunting for Kaptembwo and Milimani (14.17%), is below the national stunting prevalence (26%), and below the stunting prevalence for Nakuru County (27.6%), it should be noted that stunting levels for Kaptembwo (25%) are quite high need to be addressed. It also disagrees with Kinyoki et al. (2020) who found

that stunting was significantly higher in girls (1.3%) than in boys (1.1%). Stunting was associated with parental education and family income (Soekatri et al., 2020). The children whose ages were between 7 moths to 27 months had a high level of stunting than children less than 7 months. This study finding agrees with Kismul et al. (2018) who found that children below six months had a lesser chance of stunting than children above 24 months. It also agrees with the findings of Tiwari et al. (2014); Nshimyiryo et al. (2019) who found similar results in their study in Rwanda. Given that the Kenya's national exclusive breastfeeding rate is 61.4% (KDHS, 2014) this result was associated with the benefits of exclusive breastfeeding by mothers which provides a protective effect against stunting in the first six months and early life. Upon the introduction of complementary feeding, possible unhygienic feeding practices trigger the stunting process.

Overall levels of stunting within various age brackets

The table below shows the levels of stunting in children for various age brackets

Table 4.22

Overall levels of stunting within various age brackets

Age group		Stunted	Not stunted	Total	t-test	P-value	mean energy	
0-6months	n	4	25	29				1
	n%	5.80%	10.20%	9.20%				
7-13months	n	14	39	53				
	n%	20.30%	15.90%	16.90%	0.5513	0.5838	902.7736	2
14-20months	n	13	44	57				
	n%	18.80%	18.00%	18.20%	-0.3407	0.3673	1037.737	3
21-27months	n	12	40	52				
	n%	17.40%	16.30%	16.60%	-0.0147	0.4942	1166.154	4
28-34months	n	8	23	31				
	n%	11.60%	9.40%	9.90%	1.8196	0.0792	1294.871	5
35-41months	n	11	33	44				
	n%	15.90%	13.50%	14.00%	-2.826	0.0072	1391.909	6
42-48months	n	6	24	30				
	n%	8.70%	9.80%	9.60%	0.783	0.4402	1482.4	7
49-59months	n	1	17	18				
	n%	1.40%	6.90%	5.70%	-0.3207	0.7526	1581	8
Total	n	69	245	314				

Dietary intake does not have any influence on stunting of children of all ages. The levels of stunting between the age brackets of 0-6 months is 4%. The level of stunting is seen to increase immediately after the first 6 months from 4% between 0-6 months to 14% between 7-13 months,

probably due to either gastrointestinal infections associated with the introduction of complementary feeding and or changes in dietary intakes.

Stunting levels are seen increasing with age from 4% (0-6) to 14% (7-13), and remain relatively high until the age of 21-27 months. This result shows that an increase in age of the child had a significant association with stunting.

This finding agrees with Nshimyiryo et al., 2019 who in their study found a similar trend.it also agrees with (Tiwari et al., 2011).

Influence of various aspects of the mother on stunting

Table 4.23

Influence of various aspects of the mother on stunting

Stunting	Coef.	Std. Err.	t	P>t	[95% Conf.	Interval]
Mother age	-0.0065032	0.0039026	-1.67	0.097	-0.01418	0.001176
Attended school	-40.55712	16.70703	-2.43	0.016	-73.4311	-7.68318
Education level	0.045452	0.0187324	2.43	0.016	0.008593	0.082311
Marital status	0.0642012	0.0599396	1.07	0.285	-0.05374	0.182143
_cons	41.34015	16.66068	2.48	0.014	8.55742	74.1228

The level of education for mothers has been associated with of stunting in some studies. Some research has shown that the education level of the mother has high influence on child stunting (Abuya et al., 2012). The findings agree with Zottarelli et al. (2007) who in their studies in Egypt found that the proportion of children with stunting fell as parents' education increased (Zottarelli et al., 2007). In this study however, mother's level education did not have any influence on stunting P= P=0.016.

Mother's age, attended school, education level, marital status did not influence stunting P=0.097, P=0.016, P=0.016, P=0.285.

Influence of diarrhea on Stunting

This study established that children who had high episodes of diarrhea were more likely to stunt than children who had low episodes of diarrhea. This finding agrees with findings of other studies which found that a child who experiences an average age-specific monthly diarrhoea episode was shorter at 24 months of age compared to a child who never experienced diarrhea episode (Checkley et al., 2003).

Table 4.24

Influence of diarrhea on Stunting within various age brackets

Age bracket	Coef.	Std. Err.	P>t
0-6months	-0.13	0.190817	0.501
7-13months	0.0826087	0.124024	0.508
14-20months	-0.0592593	0.1130295	0.602
21-27months	0.3563025	0.1165994	0.004
28-34months	-0.2626263	0.1722388	0.138
35-41months	-0.030303	0.1542325	0.845
42-48months	-0.003	0.202837	1.000
49-59months	0.0833333	0.1196784	0.496
Overall	0.0956345	0.049763	0.050

The findings of this research agree with Checkley et al., 2003, who found that a high cumulative burden of diarrhoea increases the chance of childhood stunting (Checkley et al., 2003). The study established that diarrhea significantly influenced stunting between age 21-27 months P=0.004 and in general had an influence on stunting P=0.50. It is therefore evident that stunting in both Milimani and Kaptembwo is majorly due to diarrhea more than any other factor.

CHAPTER FIVE

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

The chapter provides a synopsis of the study pointing out the purpose of the study and study objectives. It gives its conclusions based on the objectives and its recommendations based on the conclusions made from the results obtained from the study.

5.2 Summary

Stunting is defined as short height-for age based on the 2006 world health organization (WHO) growth reference standard. Children who are stunted are shorter than unaffected children of their age. Stunting has been rated as the most common form of under-nutrition across the world. According to United Nations children education fund (UNICEF), globally, an estimate of 149 million (21.9%) of children below 5 years old are stunted. Stunting is associated with an increase in morbidity and mortality and is attributed to about 15% of deaths among children under the age of 5 years. Studies have shown that 34% of children below 5 years in sub-Saharan Africa are stunted, with about 37% of the children being stunted in the Eastern Africa. Stunting has devastating consequences for child health. Hunger and inadequate nutrition contribute to early deaths for mothers, infants and young children, and impaired physical and brain development in the young. Stunting may be irreversible after the age of 2 years and has almost life-long effects of one's health. The impact of nutritional deficiencies especially in the first two years of a child's life, being the critical stage of a child's growth and development, could lead to impaired cognitive development, compromised educational achievement and low economic productivity.

In 2007, upon conducting a meta-analysis, Grantham proposed that about 200 million children fail to reach their full developmental potential each year as a result of stunting and that stunted adults earn on average 22% less per year than their non-stunted counterparts.

Certain non-communicable diseases in adulthood are associated with stunting in childhood, perhaps through epigenetic regulation (which refers to long-term alteration in gene expression) or via chronic inflammation. It has been reported that nutritional intervention may not fully help to solve problems related to stunting if used alone.

In Kenya, stunting is most prevalent in Eastern, Coast and Rift valley regions among children aged between 18-23 months. Nakuru County's level of stunting stands at 28% of which 9% are severely stunted.

The top 6 counties with high levels of stunting are West Pokot County (45.9%), Kitui County (45.8%), Kilifi (39.1%), Mandera (36%), Bomet (35.5%), Tharaka-Nithi (32.9%). Stunting is caused by many factors which many range from inadequate nutrition prenatally and inadequate dietary intake in the first 1,000 days of life. Chronic and recurrent acute infections related to water, sanitation, and hygiene and Environmental Enteric dysfunction (EED) may also play a significant role. EED tends to reduce the absorptive capacity of the small intestine thereby failing to make use of the nutrients consumed. Globally, it is estimated that over 1 billion people lack access to safe drinking water and 2.5 billion people lack adequate sanitation. Annually, more than 3.4 million people die from diseases related to water, sanitation, and hygiene, most of whom are children. An estimated 94% of the diarrhoeal burden of disease is attributed to the environment and is associated with risk factors such as unsafe drinking water, lack of sanitation and poor hygiene.

About 38% of diarrhoea related deaths occur in Africa. Diarrhoeal diseases have been rated as the second leading cause of child deaths in the world, responsible for close to 1.9 million child deaths

annually. Linear growth faltering in children has been associated with diarrhoeal (Richard et al., 2013). Environmental pathogens associated with poor water sanitation and hygiene are the greatest causes of diarrhoea globally. They make children to consume little food and may experience poor absorption of the little nutrients consumed. Repeated diarrhoeal infections in preschool children without catch-up growth may be a cause for stunting in children.

Child stunting, like other forms of malnutrition is a serious public health problem in developing countries because nutrition impacts the child's life. Feeding practices impact on the nutritional status. Studies have suggested that good nutrition is a requirement for optimal growth in children but it is not enough to realize good linear growth. The Kenya national bureau of statistics has reported that children most affected by stunting are those between the ages of 18 months to 23 months, either due to inappropriate complementary feeding ot other factors such as diarrhoea. Inappropriate complementary feeding and late initiation of colostrum-feeding of infants and children are risk factors for child malnutrition. It has been reported that close to 8.9% of children in Kenya are wasted, 14.1% are underweight while over 18.8% are stunted. The purpose of the study was to establish the influence of dietary intakes, water, sanitation & hygiene, diarrhoeal morbidity on stunting of children under five years in Kaptembwo and Milimani, Nakuru County. The objectives of the study were;

i. To determine the socioeconomic status of residents of Kaptembwo and Milimani, Nakuru County
ii. To evaluate the dietary intakes of children below five years in Kaptembwo and Milimani, Nakuru County
iii. To determine the water, sanitation and hygiene practices of Kaptembwo and Milimani, Nakuru County

iv. To determine the diarrheal morbidity of children below 5 years in Kaptembwo and Milimani, Nakuru County.

v. To determine the level of stunting of children below 5 years in Kaptembwo and Milimani, Nakuru County.

The comparative study was done in Kaptembwo informal settlement and Milimani estate of Nakuru County, Kenya. Nakuru County is estimated to have 339,746 children below five years, 67,916 of whom are infants. Kaptembwo is an informal settlement in Nakuru Town East and most of its amenities including water and waste disposal are already overstretched. On the other hand Milimani is a middle to high class estate and its amenities such as water are not overstretched. The study targeted children under the age of five years (0-59 months) in Milimani estate and Kaptembwo. The study population was 314 children aged 0-59 months in both Kaptembwo and Milimani estate. The Inclusion criteria was all healthy children (male and female) 0-59 months old and mothers of healthy children (male and female) 0-59 months old. The exclusion criteria was children aged between 0-59 months that were sick, children who had moved into the study area less than 6 months from the time of the study and mothers of healthy children (male and female) aged 0-59 months who did not give consented to participate in the study. Mothers of healthy children (male and female) aged 0-59 months that were unable to communicate in either English or Kiswahili were also excluded. The Sample size was determined using the Cochran formula.

The sample collected from two places was based on the total population of each place in which Milimani contributed 36% while Kaptembwo contributed 64% of the total sample. A comparative study was carried out to compare stunting levels among children aged between 0-59 months in Kaptembwo and Milimani in an attempt to draw a conclusion about them. The study design adopted was a descriptive cross-sectional study design. Data was collected using questionnaires

programmed in the survey CTO platform. Study variables were analyzed and explained relative to dietary intakes, episodes of diarrhoea and then associated them with stunting. This study used both probability and non-probability sampling methods. Data was collected using cluster random sampling method to sample 202 children in Kaptembwo and 112 children in Milimani. Six research assistants were trained on data collection for 3 days. Research assistants were taken through all the questions on the study questionnaire and explained why each question was asked. They were taught on how to take anthropometric measurements, how to measure food consumed. Data received in the server was downloaded into Stata and cleaned using SPSS software and then converted to excel for purposes of generating appropriate graphs. SPSS version 22 was used to analyze variables such as social demographic data, distribution of children by gender, demographic characteristics of principle caregiver, animal enterprise distribution per household, housing characteristics and hygiene and sanitation. T-test was done to establish the relationship between WASH, diarrhea and stunting, and dietary intake and stunting. *Probit* regression model was used to determine the relationship between diet, diarrhoeal and nutritional status. It was established that only 0.5 % of the households in Kaptembwo had drinking water piped into housing unit while 22.32% households in Milimani had drinking water piped into housing unit. 85.15% households in Kaptembwo fetched drinking water piped into a compound or dwelling for communal use. The main toilet facility in Kaptembwo was pit latrine with slab (26.88%) while in Milimani, the main toilet was flush to piped sewer (61.17%). 10.22% of the respondents in Kaptembwo used pit latrines without slab/cover on the squatting hole while only 1.94% of pit latrines in Milimani did not have cover on the squatting hole. Diarrhea episodes were high in Kaptembwo (38.61%) than Milimani (16.96%). Stunting levels were higher in Kaptembwo (25%) than in Milimani (3.34%). It was established that there is no significant difference in dietary intakes between Kaptembwo

and Milimani and that dietary intakes did not have significant influence on child stunting and that diarrheal morbidity was key player for stunting in Kaptembwo and Milimani. County and national government should make deliberate efforts in giving its people economic empowerment in order to alleviate poverty. NAWASSCO should put in place infrastructural facilities and systems to make water distribution better.

5.3 Conclusion

From this study, it is concluded that there is no significant difference in dietary intakes between Kaptembwo and Milimani and that dietary intakes did not have significant influence on child stunting. Having shown an increase in the levels of stunting with the increase in diarrhoeal morbidity, it is concluded that diarhhoea has a significant influence on stunting of children under five in Milimani and Kaptembwo. It was established that there were more episodes of diarrhoea in households which consumed pre-cooked foods bought from food vendors than those who did not. It is therefore concluded that buying and eating of precooked vended foods has influence on diarhoea. This is most probably due to the fact that many food vendors either do not was their hands when preparing food, the food vendors don't wash food and cooking utensils before cooking, the food vendors use contaminated water in preparing food. It is also probable that the consumers of this food contaminate the food along the process of buying consuming it.

There was a huge disparity in socio-economic status and the WASH situation of Kaptembwo and Milimani, yet their dietary intakes are of no significant difference although the consumption of cereals and sugars ifs slightly high in Kaptembwo than in Milimani. This leads to the conclusion that High stunting levels in Kaptembwo are influenced by poor WASH facilities.

The level of stunting in Kaptembwo is high than in Milimani. Stunting rates increase with age. This study proposes that the magnitude of stunting can be brought down if interventions are made

to improve water, sanitation and hygiene practices which are key factors contributing to high episodes of diarrhoea, reduction of poverty levels, maternal education, improvement of child nutrition and increased access to quality medical care services. Having an understanding on the influence of water, sanitation and hygiene on stunting is key to developing proper interventions towards reduction of stunting.

5.4 Recommendations

It is recommended that the national Government and the county Government of Nakuru should make deliberate efforts towards giving people an economic empowerment in order to alleviate poverty, which is a key contributor to poor water, sanitation and hygiene. All key stakeholders such as the church, non-governmental organizations, faith-based groups etc. should make efforts to educate populations on the importance of good sanitation and hygiene practices which are key in preventing diarrhea and related ailments. NAWASSCO, the key organized supplier of water in Nakuru County, should put in place systems and adequate infrastructural facilities in order to ensure that safe water is provided to the people adequately, safely and at all times. In order to make water distribution better, NAWASSCO should device ways of monitoring water supply in the two areas of Kaptembwo and Milimani. Leaders at various levels in Kaptembwo and Milimani should encourage residents to embrace roof-rain water harvesting to supplement piped tap water. Residents of the two places should invest in water storage facilities such as water tanks in order to save water. It is also recommended that further research be done in order to establish the actual role of diarrhea in stunting and the role of possible pathological changes in the Gastro-intestinal tract on stunting.

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APPENDICES

Appendix I: Questionnaire

A. Letter of introduction, Household Identification and Consent
Scripted Introduction:

Hi, my name is …….. I am part of a study team looking into **Evaluation of dietary intakes, Water, sanitation and hygiene on stunting among Children below five years in Kaptembwo and Milimani, Nakuru County**. The study includes a discussion of this issue and will take about 30 minutes. I would like to get information on this topic. In some areas on this

topic, I would require your permission to see some items/facilities. You are not obliged to participate in the study and no services will be withheld if you decide not to. If you agree to share your views with me, you will not receive any remuneration, gifts or services. Everything we discuss will be held in strict confidence and will not be shared with anyone else.

Would you like to participate in the study? [If yes, the interviewee to sign the consent forms. If not, the interviewer to thank interviewee for their time]

Record time the interview is started in 24hr. format	Hrs.: |__|__|		Min: |__|__|
Consent	You have been selected at random to participate in this study. We will be working with the Ministry of Health to improve your health and well-being of as well as the health and well-being of your children and household. To do so, we would like to ask you questions about your household socioeconomic and socio demographic characteristics and dietary practices. We would like to take height, weight and upper arm measurements of the selected child less than five years' age. We will not record any personal information which will be able to identify you with your responses, and your answers will be kept confidential. Please know, your participation is completely voluntary, and you may choose not to participate at any time and to stop the survey at any time. Do you have any questions for me?		
	Do you agree to participate in the survey? **Enumerator:** Is the respondent a mother of a child between the age of 24 and 59 months of age, AND does the respondent agree to participate in the survey?	01 = Yes 02 = No	If 02; thank them for their time and END, the session.

Participant's signature …….

IDENTIFICATION	**CODES**
QUESTIONNAIRE IDENTIFICATION	

COUNTY_____ **Nakuru** **SUPERVISION AREA _____** **1.Kaptembwo** **2. Milimani**	
Name of Respondent _____ **Researcher's name: _____** **Date of Interview _____ /_____ /_____** **Day /Month / Year**	

Character	Age in months
Child One	
Child Two	
Child Three	
Selected Child	

B. Child Information

The information below is collected for the living child of the women being interviewed. This child should be less than five years of age: between 24<59 months of age.

NO.	QUESTIONS AND FILTERS	RESPONSE CODE	
	Research assistant instruction: Identify the target child and assign code.		
AI	Is (child's name) male or female?	• 01=Male • 02=Female	
A2	Does (child's name) have a health child card/immunization card?	• 01= Yes • 02=No	
A3	When is the child's birth-date (actual age of child)	Write birth-date 98 = don't know	DD MM. YY
A4	**R. ASSISTANT**: VERIFY DO NOT READ How was index child's age verified?	01=Yes, Health passport (or health card, other document) 02= Yes, Mother's recall 03 = Other document 04= N/A, Not verified, not applicable	

A5	How old is index child? **NOTE**: Write actual age of child (Refer to month conversion calendar)	Write age in completed months 00= Less than 30 days 98= Don't	|__|__|
A6	What was index child's weight at birth	Write in kilograms 98 = Don't know	|__|__|.|__|
	R. ASSISTANT: VERIFY DO NOT READ. Was (child's name) weight verified:	01= Yes, Health Card 02= Yes, Mother's recall 03= N/A, Not verified, not applicable	

NO.	QUESTION FILTERS	RESPONSE CODE	
B1	How many people stay in this household? How many people (all ages) share food from the same pot?	**Writer number**	|__|__|
B2	Is your household currently participating in the productive safety net program (PSNP)?	• 01=Yes • 02= No	
B3	Does your household own any agricultural land?	• 01=Yes • 02= No	
B4	Do you own your house?	• 01=Yes • 02= No	
B5	I'm going to ask you about farm animals. How many… does your household own? a. Cattle/ (may be left as it is) b. Goat c. Sheep d. Chickens e. Pigs f. Horse g. Donkey h. Ducks i. Other j none	Write number of animals 00= None; <u>move to B6</u> 98= Don't know	**a.** |__|__| b. |__|__| c. |__|__| d. |__|__| e. |__|__| f. |__|__| g. |__|__| h. |__|__| i. |__|__|
B6	**Do you keep any animals inside the house at night where you sleep (including pets)?**	01= Yes, if yes ask B7 02= No skip to B8	
B7	What type of farm animals are kept inside the house at night where you/your family members sleep?	a. *Cattle/Cow* *b.* goat c. Sheep	

		d. Chickens e. Pigs f. Horse g. Donkey h. Ducks i Other

B8	Main material of the floor. **Researcher/research assistant:** Observe and record one response	01= Earth/Sand/Animal dung 02= Bamboo 03= Stone/Brick 04= Cement 05= Tile 06= Vinyl strip 07= Other (specify)
B9	Main material of the roof. **Researcher/research assistant:** Observe and record one response	01= Grass roof 02= Metal roof 03= Stone or tile roof 04= Plastic alone 05= Plastic plus grass 06= Asbestos 07= Other (specify)
B10	Main material of the exterior walls. Researcher/research assistant: Observe and record one response	01= Earth/Sand/Mud/Clay 02= Bamboo, corn stalks 03= Stone/ Fired Brick 04= Cement 05= Tile 06= Vinyl strip 07= Mud brick or wattle 08= Other (specify)_
B11	Where is cooking usually done?	01= In a room used for living or sleeping 02 = In a separate room in the same building used as a kitchen 03= In a separate building used as kitchen 04 = Outdoors 05= Other (specify):
B12	What is the main source of lighting for the household?	01=Electricity 02= Kerosene 03=Generator

		04=Crop residue 05=Solar power 06=LPG (gas) 07= Other, specify	
B13	Does your household own any of the following: Read all responses, record all that apply	a. Bicycle b. Radio c. Bed d. Mobile/other Telephone e. Television f. Refrigerator g. Cart pulled by animal	h. Watch/Clock i. Sewing Machine j. Motorcycle k. Car/Truck l. Tractor m. Small generator (for irrigation) n. Other (specify)
B14	What was your total household income before taxes during the past 12 months in (Kshs.)?	a. <5,000 b. 5,000<10,000 c) 1000<15,000 d) 15,000< 20,000 e) >20,000	

HOUSEHOLD DIETARY INTAKE

B. Household 24 hour Dietary intake

	How much of the following foods was consumed by child (6-59) eat last 24 hours. (***The enumerator to use graduated measuring cups to record the estimated quantity in grams)***	Morning	Mid-Morning	Lunch	Before Dinner	Dinner	other
1	Cereals, roots and tubers						
2	Proteins meat, poultry, organ meat, eggs, fish and seafood, milk and milk products						
3	Fruits and vegetables						
4	Others e.g. lipids						

Household Dietary Diversity

A. A seven-day Food Frequency Questionnaire (FFQ)

Please recall the foods eaten in the household and by the specific reference child (exclude foods purchased and eaten outside home) in the last seven (7) days

Number	Food group	Examples	Did child (0-59 months) eat any of following foods in the last 24 hours?	How many days has this household eaten this in the last 7 days
1	Cereals	Corn/maize, rice, wheat, sorghum, millet or any other grains or foods made from these (e.g. bread, porridge or other grain products) + insert local foods e.g. ugali, porridge or pastes or other locally available grains		
2	Pulses, legumes	Any food made from beans, peas, lentils, etc.		
3	Roots and tubers	Any potatoes, yams, cassava, carrots, or any other foods made from roots or tubers		
4	Dark green leafy vegetables	Amaranth, kales, spider plants, African knight shade, spinach, Cassava leaves		
5	Other vitamin-A rich vegetables	Carrots, red pepper, pumpkin, orange sweet potatoes, etc.		
6	Other vegetables	Onions, cabbage, brinjals, tomatoes, cucumber, radishes, green beans, peas, lettuce		
7	Vitamin-A rich fruits	Mangoes, papaya, apricot, peach		
8	Other fruits	Bananas, apples, lemons, oranges, tangerine	`	
9	Meat and poultry	Beef, pork, lamb, rabbit, duck, goat, chicken		
10	Organ meat	Liver, heart, kidney, offal's(matumbo)		
11	Eggs	Eggs		
12	Fish and seafood	Fresh, dried, shelled, canned fish, omena		
13	Nuts and seeds	Groundnuts, coconuts,		
14	Milk, milk products	Cheese, Yoghurt, milk, powder milk		

15	Oil/fats	Oil, fat, or butter		
16	Sugar and honey	Sugar, sweets, honey, chocolates		
17	Miscellaneous	Coffee, tea, sodas, salt, spices		

Water, Sanitation and Hygiene

A. Water

1. What is the main source of drinking water for members of this household	**Improved water source**	**Unimproved water source**
	1.[_] Household connection	5.[_] Unprotected dug well
	2.[_] Borehole	6.[_] Pond, river or stream
	3. [_] Protected dug well	7.[_] Unimproved rainwater collection
	4.[_] Improved rainwater collection	8.[_] Vendor-provided water
		9. [_] Bottled water
		10.[_] Tanker truck water

To be considered improved; the rainwater catchment tank needs to have all of the following: completely closed, tap to withdraw water, and at least 3,000 litres capacity.

2. Do you use the main water source all year or only part of the year?	1.[_] Whole year	Move to 4
	2.[_] Dry Sean Only	*Move to 3*
	3. [_] Wet season only	*Move to 3*
3. During the other part of the year (dry or wet season), what is the main source of drinking water for members of this household, school/day care centre or children's home?	**Improved water source**	**Unimproved water source**
	1.[_] Household connection	5.[_] Unprotected dug well
	2.[_] Borehole	6.[_] Pond, river or stream
	3. [_] Protected dug well	7.[_] Unimproved rainwater collection
	4.[_] Improved rainwater collection	8.[_] Vendor-provided water
		9. [_] Bottled water
		10.[_] Tanker truck water

4. What is the main source of water used in this household for hand washing?	**Improved water source**	**Unimproved water source**
	1.[_] Household connection	5.[_] Unprotected dug well
	2.[_] Borehole	6.[_] Pond, river or stream
	3. [_] Protected dug well	7.[_] Unimproved rainwater collection
	4.[_] Improved rainwater collection	8.[_] Vendor-provided water
		9. [_] Bottled water
		10.[_] Tanker truck water

Anthropometry of the Index Child

Height…….

Age (months)…….

MUAC ……

QUESTIONNAIRE FOR MOTHERS OF CHILDREN 0-59 MONTHS

WITH DIARRHOEAL IN THE LAST TWO WEEKS

RECOMMENDATIONS FOR THE INTERVIEWER

Verify that the mother has child aged 0-59 months of age who Has had diarrhoeal in the last two weeks (that is three or more loose or watery stools per day); use the health clinic treatment if possible, to verify.

If more than one child aged 0-59 months who has had diarrhoeal in the last two weeks lives in this household, choose one at random.

For all questions in this survey, never read the possible options unless there is a special instruction. Wait for the respondent to answer the question and then tap on the option of the response given.

Record the time the interview starts Hour …… Minute……

Section 1: Mother's Background

NO	Questions and filters	Coding categories	skips
MB1	In what month and year were you born?	Date of birth	
		Month …….	
		Don't Know Month…… 98	
		Year…….	
		Don't Know Year……98	
MB2	)w old are you? **PROBE**: HOW OLD WERE YOU AT YOUR LAST BIRTHDAY?	Age (in completed years) __ __	
MB3	\VE YOU EVER ATTENDED SCHOOL OR PRESCHOOL?	• Yes 1 • No 2	□MB5
MB4	What is the highest level of school you attended?	• Preschool ……..1 • Primary …… 2 • Secondary …… 3 • Certificate…… 4 • Diploma……5 • Degree…… 6	
MB5	What is your current marital status? **Read the responses**	• Single .....1 • Monogamously married ……2 • Polygamously married…..…3 • Cohabiting……4 • Widowed .....5 • Divorced ……..... 6 • Separated……..... 7	

Section 2: Child's Background

NO	**Questions and filters**	**Coding categories**	**skips**
CB1	Record the name of the selected child	Name of selected child	
CB2	What is the sex of [NAME]	Male……1 Female ……... 2	
CB3	NOW I WOULD LIKE TO ASK YOU SOME QUESTIONS ABOUT THE HEALTH OF (NAME). In what month and year was (NAME) born? ***PROBE:*** **what is his / her birthday?**	Date of birth Day…….___ ___ Don't know day 98 Month __ __	

	If the mother/caretaker knows the exact birth date, also enter the day; otherwise, click 98 for day **MONTH AND YEAR MUST BE RECORDED.**	Year __ __ __ __	
CB4	HOW OLD IS [NAME]? ***PROBE:*** **How old was (name) at his / her last birthday?** ***Record age in completed years.***	Age (in completed years) __	

Section 3: Diarrhoeal Case Management

Do you buy cooked foods for example Mandazi, Chapati, Githeri, Chips e.t.c from open vendors?

1. Yes

2. No

If yes, which foods?

1. Beans

2. Green grams

3. Lentils (kamande)

4. Dolichos lab lab (Njahi)

5. Chapati/Mandazi

6. Fish (fried, smoked etc)

7. Githeri

8. Chips/Bhajia

9. Eggs

10. Smokies/Sausage/Samosa/Kebab

11. Groundnuts/simsim

12. Other specify

What is the frequency of buying these foods?

1. More than three times a day

2. Three times a day

3. Two times a day

4. Once a day

NO	**Questions and filters**	**Coding categories**	**skips**
CM1	Has (NAME) had diarrhoeal in the last 4 weeks, (that is three or more loose or watery stools in a day?)	Yes 1 No 2 Don't know……..98	other child in 2 and 98
CM2	For how many days did the diarrhea last? **Probe for exact number of days and Key in.** **if same day then record 00** **If do not know, then probe to ensure that the child had diarrhea in the last two weeks.** **If more than two weeks then select a different child from the same household,** **otherwise, move to the nearest door**	☐☐ DAYS	
CM3	I would like to know how much (NAME) was given to drink during the diarrhoeal (including breast milk). During the time (NAME) had diarrhea, was he/she given less than usual to drink, about the same amount, or more than usual? **If less, probe:** **Was he/she given much less than usual to drink, or somewhat less?**	• Much less 1 • Somewhat less 2 • About the same 3 • More 4 • Nothing to drink 5 • Don't know 98	
CM4	During the time (NAME) had diarrhea, was he/she given less than usual to eat, about the same amount, more than usual, or nothing to eat? **If "less", probe:** **Was he/she given much less than usual to eat or somewhat less?**	• Much less 1 • Somewhat less 2 • About the same 3 • More 4 • Stopped food 5 • Never gave food 6 • Don't know 98	
CM5	What was given to (NAME) to treat the diarrhoeal? **Do not read the possible responses** **Probe for anything else.** **TAP ALL MENTIONED.**	• Nothing 1 • ORS 2 • Zinc .3 • Home-made fluid (ort fluid) 4 • Pill or syrup 5 • Injection 6 • Intravenous 7 • Home remedies 8 • Herbal medicines 9 • Other (specify)……98	

CM6	Did you seek advice or treatment outside the home for (NAME)'s diarrhea?	• Yes 1 • No 2	□CM9
CM7	From where did you seek advice or treatment? **Probe:** **anywhere else?** **Tap all providers mentioned,** **But do not prompt with any suggestions.** **Probe to identify each type of source.** **If unable to determine if public or private sector, write the name of the place.** _____ **(Name of place)**	**Public sector** • Govt. hospital 1 • Govt. health centre 2 • Govt. health post 3 • Community health worker 4 • Mobile / outreach clinic 5 • Other public (*specify)* *6* **Private medical sector** • Private hospital / clinic 7 • Private physician 8 • Private pharmacy 9 • Mobile clinic 10 • Other private medical (specify) 11 **other source** Relative / friend 12 Shop 13 Traditional practitioner 14 Other (specify) 96	
CM8	How many days after the diarrhea began did you first seek treatment for (NAME)? **Probe for exact number of days and record in the device.** **if same day then record 00**	**DAYS** Don't know 8	
CM9	Have you ever heard of ORS?	• Yes 1 • No 2	□ END
CM10	Have you ever used ORS?	• Yes 1 • No 2 • Donk know 98	□CM12
CM11	Where do you usually get ORS? **Tap on all mentioned**	• Hospital 1 • Clinic 2 • Health center 3 • CHW 4 • Private doctor 5 • Drug store 6 • Local shops 7 • Other (specify)____ ____96	
CM12	Do you know how to prepare ORS?	• Yes 1 • No 2	□ END

CM13	Could you please demonstrate how to prepare ORS? **(Provide the mother with a selection of ORS sachets found in the area).** **Record whether the mother prepared ORS correctly or not. Tap 1 [correctly] if the mother follows the five steps below:** **<u>ORS envelops (sachets)</u>** 1.Handwashing with soap ____ 2.Uses clean drinking water ____ 3.Use one litre clean drinking water By measuring the liquid using a marked container you have with you____ 4. Use the entire ORS packet ____ 5. Dissolve the powder fully ____	• Demonstrated correctly 1 • Demonstrated incorrectly 2	
	Record the time the interview ENDS	___ ___ : ___ ___	

<u>Section 4: Water Supply</u>

No.	Questions and Filters	Coding Categories	Skips
WS1	What is the **<u>MAIN</u>** source of drinking water for members of this household? **KEY IN ONLY ONE RESPONSE**	**Piped water** • Piped into dwelling 1 • Piped into compound, yard or plot 2 • Piped to neighbour 3 • Public tap / standpipe 4 • Tube well, borehole 5 **Dug well** • Protected well 6 • Unprotected well 7 • Water from spring 8 • Protected spring 8 • Unprotected spring 9 • Rainwater collection 10 • Tanker-truck 11 • Cart with small tank / drum 12 • Surface water (river, stream, dam, lake, pond, canal, irrigation channel) 13 • Bottled water 14 • Other (*specify*) _____96	

WS2	Do you treat your water in any way to make it safer for drinking?	• YES 1 • NO 2	□HW1
WS3	What do you usually do to the water to make it safer to drink? **KEY IN ALL RESPONSES MENTIONED**	• Boil 1 • Add bleach / chlorine 2 • Strain it through a cloth 3 • Use water filter (ceramic, sand, composite, etc.) 4 • Solar disinfection 5 • Let it stand and settle 6 • Other (*specify*) 96 • Don't know 98	

Section 5: Hand Washing

No.	Questions and Filters	Coding Categories	Skips
HW1	Please state all of the occasions when you should wash your hands **DO NOT READ THE ANSWERS** **KEY IN ALL MENTIONED** **PROBE: ANYTHING MORE?**	• Before eating 1 • After eating 2 • Before praying 3 • Before breastfeeding or feeding a child 4 • Before cooking or preparing food 5 • After defecation/urination 6 • After cleaning a child that has defecated or changing a child's nappy 7 • When my hands are dirty 8 • After cleaning the toilet or potty 9 • Does not know 98 • OTHER (SPECIFY) _____96	
HW2	Can you show me where you **usually** wash your hands and what you use to wash hands?	• Within 10 paces of the toilet facility 1 • Within 10 paces of the kitchen/cooking place 2 • Elsewhere in home or yard 3 • Outside yard 4 • No specific place 5 • Not given permission to see 6	
			LUI
HW3	**OBSERVE:** Is there soap or detergent available?	YES 1 NO 2	
HW4	**OBSERVE:** Is there water available?	YES 1 NO 2	

	TURN ON TAP AND/OR A CHECK CONTAINER AND NOTE IF WATER IS PRESENT THEN CIRCLE ONE RESPONSE		

Section 6: Latrine Usage

No.	Questions and Filters	Coding Categories	Skips
LU1	What is the main type of toilet facility used by members of your household**?** **KEY IN ONLY ONE RESPONSE**	**Flush / pour flush** • Flush to piped sewer system 1 • Flush to septic tank 2 • Flush to pit (latrine) 3 • Flush to somewhere else 4 • Flush to unknown place / not sure / • Don't know where 5 **Pit latrine** • Ventilated improved pit latrine (vip) 6 • Pit latrine with slab 7 • Pit latrine without slab / open pit 8 • Composting toilet 9 • Bucket 10 • Hanging toilet, hanging latrine 11 • No facility, bush, field 12 • Other (specify)___ _____ 96	□END
LU2	May I see the toilet facility?	• YES 1 • NO 2	□END
LU3	**OBSERVE AND RECORD THE TYPE OF**		
	TOILET FACILITY	**Flush / pour flush** • Flush to piped sewer system 1 • Flush to septic tank 2 • Flush to pit (latrine) 3 • Flush to somewhere else 4 • Flush to unknown place / not sure /don't know where 5 **Pit latrine** • Ventilated improved pit latrine	
		• (Vip) 6 • pit latrine with slab 7 • pit latrine without slab / open pit 8 • Composting toilet 9 • Bucket 10 • Hanging toilet, hanging latrine 11 • No facility, bush, field 12 • Other (specify) 96	

Appendix ii: Research Authorization letter Ministry of Interior

THE PRESIDENCY

MINISTRY OF INTERIOR AND

CO-ORDINATION OF NATIONAL GOVERNMENT

Telegram: "DISTRICTER" Nakuru
Telephone: Nakuru 051-2212515
When replying please quote

COUNTY COMMISSIONER
NAKURU COUNTY
P.O. BOX 81
NAKURU.

Ref No. CC. SR .EDU 12/1/2 VOL.111/171)

26th October 2018

DEPUTY COUNTY COMMISSIONER
NAKURU WEST SUB COUNTY

RE:- RESEARCH AUTHORIZATION -- DANIEL MATOKE AVIENDA

The above named student has been authorized to carry out research on ***"evaluation of the role of environmental enteric dysfunction in stunting of under-fives"*** in Nakuru West Sub County, Nakuru County for a period ending 19th July, 2019

Please accord him all the necessary support to facilitate the success of his research.

JOHN KICHWEN
FOR COUNTY COMMISSIONER
NAKURU COUNTY

Appendix iii: Research Authorization Ministry of Education

MINISTRY OF EDUCATION

STATE DEPARTMENT OF EARLY LEARNING AND BASIC EDUCATION

Telegrams: "EDUCATION",
Telephone: 051-2216917
When replying please quote

Ref.CDE/NKU/GEN/4/21/VOL.III/42

COUNTY DIRECTOR OF EDUCATION
NAKURU COUNTY
P. O. BOX 259,
NAKURU.

26th October, 2018

TO WHOM IT MAY CONCERN

RE: RESEARCH AUTHORIZATION –DANIEL MATOKE AYIENDA
PERMIT NO. NACOSTI/P/18/15505/23569

Reference is made to letter NACOSTI/P/18/15505/23569 dated 19TH July, 2018.

Authority is hereby granted to the above named to carry out research on "***Evaluation of the role of environmental enteric dysfunction in stunting of under-fives in Nakuru County***" for a period ending ***19th July, 2019.***

Kindly accord him the necessary assistance.

For COUNTY DIRECTOR OF EDUCATION
NAKURU COUNTY

G. N. KIMANI
FOR: COUNTY DIRECTOR OF EDUCATION
NAKURU COUNTY

Copy to:

√- Kenya Methodist University of
P.O Box267- 60200
MERU

Appendix iv: KeMU Ethical Clearance

KENYA METHODIST UNIVERSITY
P. O. BOX 267 MERU - 60200, KENYA
TEL: 254-064-30301/31229/30367/31171
FAX: 254-64-30162
EMAIL: info@kemu.ac.ke

18TH APRIL 2018

Daniel Matoke Ayienda
HND-3-6235-2/2014

Dear Daniel,

RE: ETHICAL CLEARANCE OF A MASTERS' RESEARCH THESIS

Your request for ethical clearance for your Masters' Research Thesis titled **"Evaluation of the Role of Environmental Enteric Dysfunction in Stunting of Under-fives in Nakuru County"** has been provisionally granted to you in accordance with the content of your project proposal subject to tabling it in the full Board of Scientific and Ethics Review Committee (SERC) for ratification.

As Principal Investigator, you are responsible for fulfilling the following requirements of approval:

1. All co-investigators must be kept informed of the status of the project.
2. Changes, amendments, and addenda to the protocol or the consent form must be submitted to the SERC for re-review and approval **prior** to the activation of the changes. The Proposal number assigned to the project should be cited in any correspondence.
3. Adverse events should be reported to the SERC. New information that becomes available which could change the risk: benefit ratio must be submitted promptly for SERC review. The SERC and outside agencies must review the information to determine if the protocol should be modified, discontinued, or continued as originally approved.
4. Only approved consent forms are to be used in the enrollment of participants. All consent forms signed by subjects and/or witnesses should be retained on file. The SERC may conduct audits of all study records, and consent documentation may be part of such audits.

5. SERC regulations require review of an approved study not less than once per 12-month period. Therefore, a continuing review application must be submitted to the SERC in order to continue the study beyond the approved period. Failure to submit a continuing review application in a timely fashion will result in termination of the study, at which point new participants may not be enrolled and currently enrolled participants must be taken off the study.

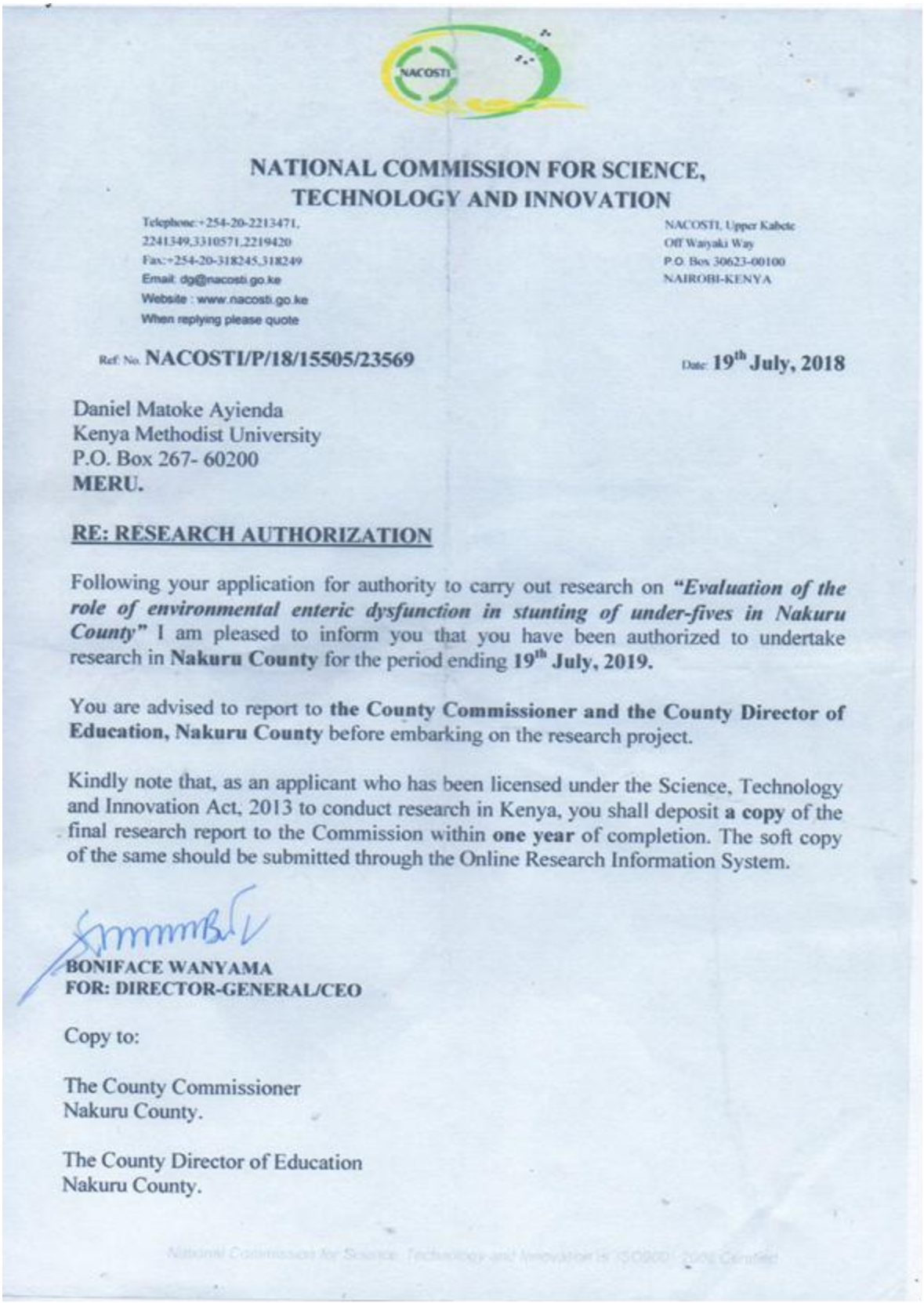
Please note that any substantial changes on the scope of your research will require an approval.

Yours sincerely,

DR. WAMACHI
Chair, SERC

cc: Director, RI & PGS

Appendix v: NACOSTI Clearance



NATIONAL COMMISSION FOR SCIENCE, TECHNOLOGY AND INNOVATION

Telephone: +254-20-2213471,
2241349,3310571,2219420
Fax: +254-20-318245,318249
Email: dg@nacosti.go.ke
Website : www.nacosti.go.ke
When replying please quote

NACOSTI, Upper Kabete
Off Waiyaki Way
P.O. Box 30623-00100
NAIROBI-KENYA

Ref. No. **NACOSTI/P/18/15505/23569**

Date: **19th July, 2018**

Daniel Matoke Ayienda
Kenya Methodist University
P.O. Box 267- 60200
MERU.

RE: RESEARCH AUTHORIZATION

Following your application for authority to carry out research on ***"Evaluation of the role of environmental enteric dysfunction in stunting of under-fives in Nakuru County"*** I am pleased to inform you that you have been authorized to undertake research in **Nakuru County** for the period ending **19th July, 2019.**

You are advised to report to **the County Commissioner and the County Director of Education, Nakuru County** before embarking on the research project.

Kindly note that, as an applicant who has been licensed under the Science, Technology and Innovation Act, 2013 to conduct research in Kenya, you shall deposit **a copy** of the final research report to the Commission within **one year** of completion. The soft copy of the same should be submitted through the Online Research Information System.

BONIFACE WANYAMA
FOR: DIRECTOR-GENERAL/CEO

Copy to:

The County Commissioner
Nakuru County.

The County Director of Education
Nakuru County.

CONDITIONS

1. The License is valid for the proposed research, research site specified period.
2. Both the Licence and any rights thereunder are non-transferable.
3. Upon request of the Commission, the Licensee shall submit a progress report.
4. The Licensee shall report to the County Director of Education and County Governor in the area of research before commencement of the research.
5. Excavation, filming and collection of specimens are subject to further permissions from relevant Government agencies.
6. This Licence does not give authority to transfer research materials.
7. The Licensee shall submit two (2) hard copies and upload a soft copy of their final report.
8. The Commission reserves the right to modify the conditions of this Licence including its cancellation without prior notice.

REPUBLIC OF KENYA

NACOSTI

National Commission for Science, Technology and Innovation

RESEARCH CLEARANCE PERMIT

Serial No.A 19555

CONDITIONS: see back page

THIS IS TO CERTIFY THAT:
MR. DANIEL MATOKE AYIENDA
of KENYA METHODIST UNIVERSITY, 0-20106 MOLO,has been permitted to conduct research in *Nakuru County*

on the topic: *EVALUATION OF THE ROLE OF ENVIRONMENTAL ENTERIC DYSFUNCTION IN STUNTING OF UNDER-FIVES IN NAKURU COUNTY*

for the period ending:
19th July,2019

Permit No : NACOSTI/P/18/15505/23569
Date Of Issue : 19th July,2018
Fee Recieved :Ksh 1000

.....
Applicant's Signature

.....
Director General
National Commission for Science, Technology & Innovation

Appendix vi: Area Map