RICKETS IN CHILDREN AGED 6-59 MONTHS AT MBAGATHI HOSPITAL NAIROBI COUNTY, KENYA

BY

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DECLARATION

I, Micheni Gillian Kagwiria, declare that this research dissertation is my original work and has not been presented by any other person for examination in any other university.

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Signature  Date: 1st September, 2020

For Supervisors

We confirm that the work reported in this dissertation was carried out by the candidate under our guidance and has been submitted for examination with our approval as University supervisors.

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DEDICATION

I dedicate this dissertation to my loving and supportive parents William Micheni and Margaret Wanja, my son Myles Munene and my brother Jim Ian Ngari . God bless you abundantly.

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

ABSTRACT

Rickets is a disease associated with bone deformity that is caused by inadequate mineralization in growing bones. Despite the high declines in the prevalence of nutritional rickets since the discovery of vitamin D and role of ultra violet light in prevention of the disease, the condition is still a concern in many affluent and developing countries. Rickets affects bone growth and mineral homeostasis that is associated with high infant and childhood deaths especially when accompanied with lower respiratory tract infections. In Kenya, there is scanty data on the predisposing factors associated with the re-emergence of rickets, yet recent research shows increasing numbers of cases of rickets being reported at health facilities. The broad objective of this study was to establish the predisposing factors that influence the occurrence of rickets in children aged 6-59 months at Mbagathi Hospital, Nairobi County, Kenya. A case- control study, of the children with rickets (cases) and those without rickets (controls). Mbagathi Hospital, is a level four public Hospital located on the outskirts of Kibera, in Nairobi County, which serves people from various informal settlements. The study population consisted of children aged 6-59 months and their mothers or caregivers who sought health care services at the Hospital during the month of April 2019. The cases (53) and controls (104) were picked alternatively in the ratio of 1:2 until the sample size of 157 respondents. Data was collected using semi-structured questionnaires that were uploaded on ODK and analyzed using SPSS. The results of the study show that large household size (p=0.04), low birth weight (p=0.000), birth order (p=0.03), use of family planning methods(p=0.000), malnutrition (wasting & underweight) (p=0.000), exclusive breastfeeding (p=0.008), lack of sun bathing (0.000), positioning children under the shade during sunbathing and attending day care (0.037) were significantly associated with the occurrence of rickets. In conclusion the following factors; household size, income expenditure on medical expenses, birth order, birth weight, underweight, wasting, sunbathing, position during sunbathing, attending daycare and practice of family planning are the predisposing factors of rickets. The study recommends that caregivers should adopt sunbathing their children under direct sunlight, that further studies be conducted on the following factors household size, birth weight, birth order and attending day care. It also recommended that the Government of Kenya through the Ministry of Health and relevant bodies should formulate an elaborate policy on rickets.

OPERATIONAL DEFINITION OF TERMS

Attending day care This term was used to refer to children who have ever been taken to day care facilities during the day for care in absence of the caregiver.

Caregiver The person/ institution who give children aged 6- 59months care during the day. It included their mother, relatives or any other person taking care of the children with and without rickets selected participants in this study.

Child spacing age Age in months between the index child and the child either younger or older than him or her

Childcare Practices The actions taken by the caregivers in the households or institutions that affect a child's growth and development. For this study they include breastfeeding, complementary feeding, exposure to sunlight and children attending daycare centres.

Daycare Refers to a set up facilities where children are taken during the day which provide supervised child care facilities to the children while the parents are away.

Family planning It referred to the number of caregivers using either pills, depo provera and implants.

Household Refers to a set up made of the number of people living under one roof, depend on the same livelihood source, under one household head.

Nutritional status It referred to wasting, underweight, stunting based on weight for height weight for age and height for age z-scores respectively; and the MUAC cut –off points to describe severe, moderate and acute malnutrition

Occurrence of rickets Frequency of children suffering from rickets in the described regions in the dissertation

Predisposing factors The investigated socio-economic, demographic, nutritional and child care behaviors that were significantly associated with the presence or absence of rickets in children aged 6-59 months

Rickets cases The existing diagnosed cases of rickets by a health practitioner by physical examinations, blood test or X-rays.

Special food This has been used to refer to foods prepared for the child only alongside family food. These are the foods that were consumed by the children alone e.g. mashed potatoes.

Sunbathing The act of caregivers exposing children's skins directly to sun rays.

LIST OF ABBREVIATIONS

µg	Microgram
ANC	Ante-natal Clinic
ANOVA	Analysis of Variance
FAO	Food and Agriculture Organization
IDH	Infectious Disease Hospital
IU	International Units
KDHS	Kenya Demographic Household Survey
KES	Kenyan shilling
KMTC	Kenya Medical Training College
KNH	Kenyatta National Hospital
LBW	Low Birth Weight
Mg	Milligram
MUAC	Mid-Upper Arm Circumference
NCRSP	National Collaborative Research Support Project
NGOs	Non-Governmental Organizations
ODK	Online Data Kit
OPD	Out-Patient Department
UNICEF	United Nations Children's Funds
UON	University of Nairobi
UV	Ultra-Violet
WHO	World Health Organization

CHAPTER ONE: INTRODUCTION

1.1 Introduction

Rickets is a disease associated with bone deformity caused by inadequate mineralization in growing bones. Rickets among other factors is associated with use of medication, hereditary syndromes or renal disease, however rickets in the world is mostly attributed to nutritional insufficiency. Nutritional rickets in developing countries is receiving attention from the public health. In developing countries, attention has been focused on rickets because of its effect on bone growth and mineral homeostasis and due to its association with high infant and childhood deaths especially when accompanied with lower respiratory tract infections (Thacher, Fischer, Strand, & Pettifor, 2006).

In developing countries, protein energy malnutrition is wide spread and strongly related to vitamin D deficiency (rickets). Unless mineral elements required for bone formation are provided in adequate quantities no amount of vitamin D would enhance normal bone formation (Peacock, 2010). Globally, many countries in the world report increasing prevalence of rickets during the past three decades. In some countries, nutritional rickets is reported sporadically while others have up to nine percent clinically affected children (Thacher et al., 2006). Rickets is common in many countries including Middle Eastern countries, developing countries such as Ethiopia, Yemen, Asian countries such as China and Mongolia (Pettifor, 2008). In Africa in general and specifically Kenya, there is scanty data about predisposing factors of rickets. Yet in recent studies research has shown that the number of cases of rickets reported in health facilities continue to rise.

1.2 Statement of the Problem

With the introduction of the supplementation of vitamin D, rickets became rare in most nations during the 20th century (Chances, 2008). However, at the end of the century rickets re-emerged as an important and widely seen problem in developing countries. Even with strategies like food fortification with vitamin D, cases of rickets recorded in Kenya Hospitals are on the increase. The re-emergence of rickets in many parts of the world and Kenya specifically raise the speculation on the predisposing factors of rickets. It is mainly attributed to nutrition insufficiency but a study conducted in Nigeria established that low dietary intake of calcium and inadequate vitamin D intake could not account for rickets in Africa (Thacher et al., 2006) indicating that rickets is a disease with many casual factors. Studies on rickets have been conducted but scanty data exist on predisposing factors of rickets in Kenya specifically at Mbagathi Hospital. There is concern over the reoccurrence of rickets in Kenya and more research should be conducted to better understand other casual factors of rickets.

1.3 Justification of the Study

According to the constitution of Kenya (2010), chapter four sub-section 53c, every child has the right to basic nutrition, shelter and healthcare. It is consistent with the UNICEF Convention on the Right of the Child that state; every child shall be entitled to grow and develop in health, the child shall have the right to adequate nutrition, housing, recreation and medical services (UNICEF, 2008). Identifying how various child care practices influence the prevalence of rickets would help in advocating for certain changes in order to reduce the burden of the disease in the country. The results of the study would also assist with formulating strategies and programs targeting the prevention of rickets in the

Hospitals, communities and country at large. Table 1.1 predicts the ways different groups would benefit from the results of the study.

Table 1.1 Beneficiaries of this study

BENEFICIARY	HOW
Children	Reduce cases of rickets, improved nutrition and ultimately health status
Caregivers	It will enlighten them on the ways of alleviating rickets
Researchers	Provide more information on the factors predisposing children to rickets
Government	Formulating strategies to promote a rickets free Country
NGO's	Contribute data to enable them making decisions about various programs and policies based on evidence

1.4 Aim of the Study

The aim of this study was to contribute more knowledge to assist in tackling the re-emerging cases of rickets in Kenya among children at Mbagathi Hospital, Nairobi County.

1.5 Purpose of the Study

The purpose of this study was to produce data that will be used to make recommendations about how predisposing factors of rickets can be handled to reduce and ultimately eradicate rickets. This would help in attainment of vision 2030 which aims at providing high quality life for all its citizens.

1.6 Study Objectives

1.6.1 General Objective

To establish the predisposing factors that influence the occurrence of rickets in children aged 6-59 months at Mbagathi Hospital, Nairobi County, Kenya.

1.6.2 Specific Objectives

i. To describe the association between socio-demographic characteristics of the caregivers of children 6-59 months and rickets.
ii. To establish the relationship between nutritional status and the occurrence of rickets in 6-59 months old children at Mbagathi Hospital.
iii. To establish child care practices that predisposes children aged 6-59 months to rickets.

1.7 Research Hypothesis and Questions

1.7.1 Hypothesis

There is no significant association between the investigated factors and the occurrence of rickets.

1.7.2 Research Questions

i. Which socio-demographic characteristics influence the occurrence of rickets among 6-59 months old children at Mbagathi Hospital?
ii. What is the association between nutrition status and rickets in children?
iii. Which are the child care practices that predispose children aged 6-59 months to rickets?
iv. Is there a relationship between the child care practices and the occurrence of rickets?

CHAPTER TWO: LITERATURE REVIEW

2.1 Introduction

Rickets is a condition resulting from inadequate mineralization in growing bones resulting to bone deformity, delayed motor development, growth failure and seizures. These abnormalities can vary according to the developmental stage and age of the children (Elder & Bishop, 2014). Nutritional rickets is primarily attributed to dietary vitamin D deficiency impairing the absorption of calcium and rickets. Nutritional rickets which is the most common type of rickets can be corrected by providing a diet adequate in vitamin D or supplementation (Thacher, 2006).

The bone is formed by three primary cells namely: osteoclasts, osteoblasts and osteocytes. A protein mixture (osteoid) is formed by these three cells, which mineralizes and becomes bone. Poor mineralization can be described either as hypocalcemic rickets caused by calcium deficiency or hypophosphatemic rickets as a result of inadequate phosphate. Vitamin D aids in absorption of phosphorous in the gut. In rickets there is accumulation of poorly mineralized osteoids due to defective mineralization of phosphorus and calcium salts. These osteoids cause disorganization of growth plates leading to growth plate expansion and skeletal deformities. Over time it also results to weak, bent and bowing bones (Manisha, 2012).

Worldwide rickets has been reported in a dozen of countries in the last three decades, they include: The United States of America, England, Libya, Tanzania, Sudan, Tunisia, South Africa, Nigeria, Gambia, Ethiopia and Kenya. Rickets is sporadically reported in some places, while in others up to 9% of the children population is affected (Kabir et.al, 2004). The actual incidence rate of rickets is unknown regardless of the persistent

concerns about the possibility of an increase in its incidence in the United States and other countries (Holick, 2006).

In a study of 126 patients with rickets in Australia 11% were from the Middle East, this was related to their cultural behaviors that hinder pregnant mothers and children from exposure to sunlight despite the abundant sunshine. In an urban Hospital in Saudi 59% of the women deliver newborns with rickets (Elidrissy, 1991). A prevalence rate 1.2% of children aged one to four years with lower limb deformities associated with rickets was reported in a study in Bangladesh (Karim, 2003). In Nigeria a community based study reported a prevalence of 2.4% confirmed cases and 14.9% abnormalities suggesting rickets in children under five years while in Ethiopia it was at 10.5% in a study conducted in a pediatric ward in Jimma University specialized Hospital (Kenenisa, Ewnetu & Sime, 2014).

In Kenya the first cases of rickets were reported in the 1930s in a Hospital in central Kenya. A study by the Nutrition Collaborative Research Support project (NCRSP) in the 1980s in Embu District, there were no characteristics of rickets observed, nevertheless studies in the same region by the Child Survival Project rickets was encountered (Mwesigye, 2012). Although proper data and documentation on rickets in Kenya is limited, various researchers have identified and studied rickets in different regions across the country. Studies have been done on rickets in Hospitals such as Kiambu Hospital, Kenyatta National Hospital, Embu and in a community study in the informal settlements of Mathare.

A study by Wairimu (2012), conducted at Kiambu Hospital showed a prevalence rate of 3.4% with males being more affected by rickets at 58% and females at 42% these findings

were consistent with those of Muriithi (2018) in Embu where 50.6 males were affected compared to 49.4% of the females. The male gender in Kenya seem to be more affected by rickets compared to the females though studies by Pettifor (2013) show no significance gender bias in the occurrence of rickets. Bwibo et.al (2013), found out that 8% of the children in Kenya had rickets, in a clinical baseline assessment. The studies in Kenya have look into various aspects that could be associated with rickets such as malnutrition, socio-demographic characteristics, exclusive breastfeeding, complementary feeding, and sun basking among others. Some of the findings were consistent for example exclusive breastfeeding by both Wairimu (2012) and Muriithi (2018) provided protection against the occurrence of rickets while others were inconsistent.

Mwesigye (2012) stated that rickets can be cured but not healed implying that the metabolic lesions can be rectified using supplements or diets with adequate Vitamin D or calcium but can leave the children permanently disabled if orthopedic treatment is not sought. Treatment of rickets is dependent on severity, cause, and age of the affected person. In children treatment of nutritional rickets is either by vitamin D2 (ergocalciferol) or vitamin D3 (cholecalciferol). The dosage varies according to age 1000IU for newborns daily, 1000-5000IUfor infants between one and twelve months, and 5000-10000 IU daily for children of one year and above. The dosage is reduced to 400 IU per day when there is radiographic evidence of recovery. Intake of calcium is maintained at 100miligrams per day, this combined treatment results to resolution of radiological and biochemical defects within 3 months. Skeletal deformities regress completely with physiotherapy (Manisha, 2012).

2.2 Causes of Rickets

Nutritional rickets continues to be observed in developing areas of the globe such as the Indian subcontinent, Latin, Asia, Africa and the Middle East. Rickets in children is mainly due to prolonged lack of exposure to direct sunlight and inadequate dietary intake of diet with vitamin D. The sources of vitamin D include egg yolk, butter, oily fish such as salmon and cereals fortified with synthetic Vitamin D. In tropical and sub-tropical climate regions, there is abundant exposure to sunlight but there are other factors associated with vitamin D deficiency such as atmospheric pollution, covering skin for religious or cultural reasons and darker skin pigmentation. In such settings, deficiency of vitamin D is likely not the only cause of rickets. In a study by Braithwaite et al. (2016), chronic dietary deficiency of calcium was revealed in the pathogenesis of rickets and showed nutritional cure with calcium supplementation alone (Braithwaite et al., 2016). The cause of rickets in this region may be multi-factorial, as calcium deficiency exacerbates rickets in presence of vitamin D deficiency and may also interact with other micronutrient deficiencies such as iron (Thandrayen & Pettifor, 2014).

Although the causes of rickets differ from one region to another throughout the world, it is primarily attributed to vitamin D deficiency, which impairs the absorption of calcium and phosphorous (Thacher, 2006). The skin synthesizes vitamin D through a process that is dependent on exposure to sunlight, or it can be obtained from dietary intake. Rickets associated with vitamin D deficiency can be caused by cold climate when there is less sunlight (Chalfield, 2007). Other factors that could lead to vitamin D deficiency include; Extensive burns that reduce the amount of vitamin D synthesized by the skin, maternal vitamin D deficiency that predisposes the fetus to rickets, premature infants as they lack

adequate time to accumulate vitamin D, exclusive breastfeeding and gastrointestinal diseases that could lead to malabsorption of vitamin D (Oduwole, 2010).

In some regions such as South Africa and Nigeria inadequate calcium intake has been reported to be the cause of rickets after a randomized trial in Nigeria which showed that calcium was superior to vitamin D in the treatment of rickets in children (Braithwaite, 2016). Hsu et al. (2017), also noted that despite sufficient sunlight which is the major source of vitamin D there are still incidences of rickets in many tropical countries he associated rickets with inadequate calcium intake in Bangladesh and India.

Nutritional rickets is a continually evolving multi-factorial problem globally. The spectrum of these factors, range from isolated calcium deficiency to isolated vitamin D deficiency. Various consistent emphases should be placed on aspects such as prevention of maternal vitamin D deficiency, vitamin D supplementation of infants and children at risk, provision of calcium diets in areas with low calcium to help curb the occurrence of the disease (Mwesigye, 2012).

In Kenya, urbanization maternal and child nutrition and cultural factors are some of the factors that could be used to explain the differences in regional rickets cases. For instance in western Kenya where nutrient-rich indigenous vegetables and fish (*dagaa*) are consumed regularly or added to weaning flours to make porridge, rickets was less common. In central Kenya on the other hand, where diets are less diverse with their main foods being cereal based and early weaning on cereal porridge, this practices deprived the infants were deprived of the micronutrients and proteins found in the breast milk, which predisposes the children to vitamin and mineral deficiencies, such as anemia and rickets. Swaddling of babies in the colder regions of central Kenya, such as in Nyeri

whose temperatures in the coldest months drop to lows of 10°C, as compared to warmer weather in the western region where the coldest month yields lows of 22°C in Kisumu, was also associated with rickets. In the warmer regions, children are minimally clad and thus more exposed to sunlight which prevents rickets (Kilonzo, 2017).

2.3 Consequences of Rickets

If untreated rickets leads to delays in development, skeletal abnormalities and fractures, bones soften and may bend. It may also result to long-term growth problems that can result in dental defects, short stature and seizures. Infants and young children develop skeletal abnormalities that differ according to developmental stage and age including; spinal deformity, wrist widening and bow legs (Jones et al., 2018). Apart from the function of vitamin D in bone mineralization, it is vital in regulating responses of the immune system to infections (chun et al., 2011). Holter (2016) observed an association between rickets and the risk of acute lower respiratory infections, diarrhea and pneumonia among children. There is a high relative risk of death of children with rickets against their counterparts without rickets. In female children rickets may cause deformity of the pelvic bone resulting to obstructed labor and prenatal mortality and morbidity (Kaludjerovic, 2010). Rickets affects community by limiting individual physical abilities, impacting on their emotion al development, draining the economic prospects of households and increasing the risk of morbidity and mortality in children (Mwesigye, 2012).

2.4 History of Rickets

Essentially, rickets was unknown until in the mid-1600s when the first cases of rickets were reported in Northern Europe. It was described as deformity of the bones characterized with the curving of legs (Glisson et al., 1650). There is a difference of

almost 18 centuries between when the first cases of rickets were reported and clarification of the etiology of the disease. The situation was known as the 'English disease' as a result of rickets outbreak which was verified in England in a detailed description (Glisson et al., 1650). The prevalence of rickets was reported to have increased in the 18th and 19th centuries and were as high as 40-60% in the children of England, United States, Germany, Poland and England (Harrison 1996). This raised speculations about the cause and treatment of the disease. Reports of rickets were made century after century until in the 1800s when cod-liver oil and sunlight were found to treat rickets effectively. In the early 1900s, vitamin D was isolated and found to be an essential ingredient in the oil (Highlights, 2000).

The first rickets epidemic occurred in the western world during the industrial revolution due to lack of sunlight and cod liver oil was found to be an effective remedy. Children received vitamin D supplementation and milk was fortified with orgosterol; and rickets which had become a major public health problem from1900-1925 disappeared (Bachrach et al., 1979). In the 1960s and 1980s rickets reoccurred and it was associated with breastfeeding women who had minimal exposure to sunlight due to religious or cultural believes that required women to be fully covered leaving only the face and hands from the wrist uncovered. According to Welch (2000), the re-emergence of rickets could be an unintentional consequence of the worthy health initiative that seeks to promote exclusive breast feeding during an infant's early life. Over the decades frequency and duration of breastfeeding has increased, of which both are risk factors for the development of rickets due to the low levels of vitamin D of about 15-50 IU/l in the human milk. In Kenya the

first cases of rickets were reported around the 1930s in a Hospital in central (Bwibo, 2013).

2.5 Diagnosis of Rickets

Rickets is diagnosed using clinical analysis with a nutritional and medical history and a physical exam done by a health practitioner. During the taking of history the caregiver gives information about the child's diet, geographic location, extent of exposure to sunlight and age. Dietary history encompasses the consumption of calcium and vitamin D rich foods. In case a child is suspected to have rickets and no other symptoms that suggest rickets such as short stature, tenderness or bone pain, delayed formation of teeth, dental deformities, predisposition to infections, decreased muscle strength, impaired growth, and skeletal deformities, including rib-cage abnormalities (rachitic rosary), bow legs, spinal deformities and abnormally shaped skull (craniotabes); then X- rays of the ribs and bones such as the ulna, radius and femur are take. If the X-rays shows bowing of the femur, rachitic rosary, fractures or a metaphysic that is abnormally shaped, the levels of vitamin D, electrolytes, parathyroid hormone, alkaline phosphate and measures of kidney function such as cretinine and blood urea nitrogen are examined to confirm the presence of rickets. Vitamin D deficiency rickets will be indicated by decreased levels of active vitamin D, increased parathyroidhormone and decreased phosphate and calcium (Onyango, 2012).

2.6 Kenya Health Policy

The goal of the Kenya policy 2-14-2030 is to ensure attainment of the highest standards of health in a manner responsive to the needs of the Kenya population. The policy reflects awareness of the significant burden of disease from communicable and non-communicable

diseases as well as maternal, child health and nutrition challenges. Ill health among children remains high regardless of improved coverage of the interventions. Non-communicable diseases such as rickets represent an increasing burden of morbidity and mortality in the country. The policy does not address rickets specifically but recognizes the emerging threat of non- communicable disease.

2.7 Socio-Demo-Economic Characteristics and Prevalence of Rickets

Preventive disability is a public heath burden to Kenyans due to poverty, lack of proper health education and ignorance. In the long term the cost of technical intervention, rickets therapy, and medical rehabilitation becomes a nightmare to most Kenyans. Children with delayed milestones or disability put a huge financial strain to their families eventually leading to psychological torture to their immediate relatives.

Early childhood malnutrition is attributed to lack of economic resources and poverty (Ajao et al., 2010). In large African families, there is a significant relationship between birth order, nutrition status and mortality. Poorer outcomes have been observed in late born children (Hassan, 2015). Studies by Megid & Karim (2011), and Combs & Hassan (2005), showed that children with rickets were from households with more members.

In an article from the daily nation 11th July 2017, Tabitha Mwangi, reports how children of women living below the poverty line are suffering from rickets which is preventable. The mothers have too little earnings and they prioritize rent and daycare over feeding the children (Mwangi, 2017). From this article it is evident that poverty is contributing greatly to the occurrence of rickets in children. This research will find out whether there is a relationship between the occurrence of rickets in children taken to the day cares and those

who stay with their mothers all day. And what possible programs can be initiated in the daycare centers to prevent the occurrence of rickets in children.

2.7.1 Birth Weight

Birth weight refers to weight taken immediately after a baby is born. Low birth weight is defined as the birth of an infant less than 2500grams regardless of their gestational age. Developing countries account for 92% of LBW; 22% in Africa and 70% in Asia (WHO & UNICEF, 2013). In Kenya the prevalence of LBW is estimated to be 11% and 6% by WHO & UNICEF and the Kenya Demographic Health Survey respectively. A study in Kenya by Oyatsi (1991), found that the prevalence of rickets in LBW children was 60%. Beneket (2005) observed that rickets in LBW babies was due to poor skeleton development. Findings of a study in Nigeria also found LBW to be a factor causing rickets (Adejuyigbe, 2008).

2.7.2 Family Planning

Family planning refers to the ability of couples or individuals to anticipate and have their desired number of children, timing and spacing of their births (WHO, 2008). Statistically 58% of women in Kenya use family planning. The injectables are the most usedat 26%, followed byb implants at 10% and pills are the least used at 8%. Depo-provera which is an injectable administered every three months compromises bone mineral density in women; this occurs because depo-provera increases cortisol levels in the blood plasma, this in return increases the amount of calcium excreted in urine and reduces the intestinal absorption of calcium. This results to decreased calcium availability in women using depo-provera causing bone mineralization (Muriithi, 2018). High usage of Depo-Provera compromises bone mineral density by suppression of ovarian production of estradion

which the sex hormone involved in the development of bone mineral density and attainment of peak bone mass (Clark et al., 2006).

2.8 Nutrition and Rickets

There is great need to invest in child nutrition. The first two years of life plays a key role in dictating the health of infants and young children, cognitive development, height of the child and most importantly it assists infants and children to achieve developmental milestones at the designated stage of life (WHO, 2005). Malnutrition occurs when the body lacks adequate nutrients, thus children with inadequate Vitamin D and calcium are malnourished (Onyango, 2012). A study in Nairobi among pre-school children by Kelsey (2017) observed that rickets presented itself with acute malnutrition alongside other symptoms, nevertheless obese children have low vitamin D levels due to sequestration in the fat under their skin thus they have higher vitamin D requirements (Parikh, 2004).

Nutrition status in children is assessed using the following parameters; anthropometrics, biochemical tests, clinical observations and dietary history. Anthropometric measurements in children below five years include weight for age, weight for height, height for age, MUAC and the head circumference. Weight for age is used to monitor growth and identify flattering, height for age checks stunting while weight for height is used to describe wasting. The standard WHO z-scores are used to categorize various nutrition statuses. A z-score ≤ -3SD indicates severe underweight, stunting or wasting; z-score > -3sd but ≤ -2SD represents moderate underweight stunting or wasting; while z-scores >-2 SD but ≤ -1 indicates mildly underweight stunting or wasting (WHO, 2013).

Dietary assessment involves taking record of food and fluid intake within a given period of time and, providing information on the quality and quantity of food intake. The findings are then compared with the recommended dietary allowance, and direct the type of measures to be taken to improve or treat conditions caused intake of foods and nutritional status. A 24-hour recall requires the client to remember in details the foods and drinks taken in the previous 24 hour (WHO, 2013).

2.9 Child Care Practices

Child care practices are the behaviors of the caregivers in the households that affect a child's growth and development. These include breastfeeding and determining when a child is ready for supplementary feeding, preparing quality complementary foods and the level of feeding frequencies. Other aspects of child care practices are health seeking practices which include attending post-natal clinic for child immunization and growth monitoring, visiting health centers child for treatment, and encouraging child to eat during the event of illness rather than withholding food. Care giving also involves providing shelter, supervision to child's toilet, protecting from exposure to pathogens, and providing a relatively safe environment and a clean place for a child to play(Abate, 1998). In this study however child care practices will be used to refer to practices that could lead to the occurrence of rickets such as breastfeeding, exposure to sunlight and attending daycare.

2.9.1 Breastfeeding and Rickets

Exclusive breastfeeding is recommended for infants from birth up to six months of age. Balasubramanian (2011), stated that infants who are exclusively breastfed without adequate exposure to sunlight or supplementation of vitamin D are at an increased risk of

developing rickets. According to Welch (2000), the re-emergence of rickets could be an unintentional consequence of the worthy health initiative that seeks to promote exclusive breast feeding during an infant's early life. Although it is incontrovertible and clear that breast milk is the best nutritive substance of infants during the first two years of life, there is concern about adequacy of vitamin D in the human breast milk (Balasubramanian S. Dhanalakshmi K. Amperayani S., 2013). Breast milk contains only about 40 IU of vitamin D which is very low compared to the recommended 400IU daily intake of vitamin D of infants. This puts infants who are exclusively breasted for a prolonged period of time at an increased risk of rickets.

2.9.2 Complementary Feeding in Etiology of Rickets

Complementary feeding refers to the introductions of variety of foods alongside breastfeeding which happens after six months of exclusive breastfeeding. According to (WHO, 2016), complementary feeding takes a duration of 6-24 months of age and is a crucial period of development and growth when infants are exposed to a greater risk of morbidity and nutrient deficiencies. WHO initially recommended that the age to begin complementary feeding is 4-6 months, however in their 2001 recommendations it was advised that complementary feeding should begin at six months. This brought about a lot debate on the appropriate age of weaning. Challenges encountered during weaning include diarrhea, vomiting, colic and allergic reactions which limit nutrient intake (Brennan, 2015).

In developing countries poor complementary practices have been documented (Brennan, 2015), in Kenya limited variety of foods are introduced to children under the age of five years with most children being fed on mashed foods and cereal based flour porridges to

complement human breast milk (Kimani-Murage et al., 2011). Milk is rich in calcium however; some children may experience milk allergy or intolerance due to lactose in milk. This in turn results to further need to diversify the diet else the child may suffer from rickets due to inadequacies (Fox, Du Toit, Lang, & Lack, 2013).

2.9.3 Attending Daycare

Mothers are the most influential people on children's feeding practices in their early years. However due to the slowdown in economy growth in many developing countries, mothers have to work away from their homes, thus their children are entrusted to alternative caregivers such as the daycare centers where they are fed and cared for (UNICEF, 2001). Information about the quality of care and services given to children at the daycare centers in Kenya is scanty (Ivan, 2016).

2.10 Vitamin D and Rickets

Vitamin D is a fat-soluble vitamin which is found in a small number of foods and it can be manufactured in the body in the skin when exposed to sunlight. Since vitamin D can be endogenously produced and can be retained for a long period of time in the body, it is hard to determine the minimum daily intake requirements precisely. The daily requirement is dependent on sex, age, degree of sun exposure and the season (Teotia & Teotia, 2008). The Food and Nutrition Board of the Institute of Medicine of United States of America recommend that children and infants take at least200 International Units (IU) of vitamin D per day.

Vitamin D is a nutrient required by the body to assist in absorption of calcium from the gut and regulate the amount of calcium and phosphorus that is stored in the bones and the amount excreted in form of urine. Vitamin D is provided abundantly by sunlight;

nevertheless, one must be exposed to the right wavelength of sunlight for a given period of time to make enough vitamin D for bone health. Other sources of foods rich in vitamin D include egg yolks, saltwater fish, liver, fortified milk and foods fortified with vitamin D

Vitamin-D deficiency rickets is as a result of inadequate amounts of vitamin D in the body and is mainly diagnosed during infancy or childhood. Poor nutrition, lack of exposure to sunlight, and malabsorption a condition where the intestines do not absorb adequate nutrients from the food may cause vitamin D deficiency.

2.11 Role of Vitamin D and Calcium in Rickets

The body requires vitamin D to absorb calcium. Without enough vitamin D one cannot absorb enough dietary calcium; the insufficient vitamin D results to little formation of hormone caleitriol (known as the “active vitamin D"). This in turn leads to inadequate calcium absorption. In such a situation, the body takes calcium from the skeleton stores, weakening the bones and inhibiting the formation of strong new bone. Human bodies do not store most vitamins thus the need to consume them regularly to prevent deficiency. Intake of calcium is critical for everyone from infants and children to mature adults. Calcium helps in building strong bones during the early stages of life and keeps bones strong during the middle years (Ward, 2007).

2.12 Role of Multiple Micronutrient Powders in Rickets

Multiple micronutrient powders consist of the following 15 micronutrients; vitamin A, vitamin D, Vitamin E, Vitamin B1, B2, B6 and B12, folic acid, niacin, vitamin C, selenium, copper, iron, zinc and iodine (Wolfgang et al, 2016). Micronutrient malnutrition can be prevented by consumption of a diet that is adequate in every nutrient however, this is far

from achievable due to lack of universal access to adequate food and appropriate dietary practices. Multiple micronutrient powders are cheap and readily added to semi solid foods at the point of se. A study in Nepalia on the impact of micronutrient powders on improving iron deficiency showed a reduction of anemia from 18% to 14%, however very little documentation exist on the role of multiple micronutrient powder in the management of rickets. Nevertheless, Wolfgang, 2016 states that rickets is preventable and can be eradicated by supplementation with micronutrients powders containing calcium or vitamin d or both.

2.13 Sunlight

Globally the major cause of vitamin D deficiency among infants is lack of exposure to sunlight. The recent observed vitamin D deficiency may be explained partially by the deliberate avoidance of exposure to sunlight in the world(Abrams, 2010). Modern lifestyle has greatly increased the occurrence of rickets. In addition, exposure to sunlight for the introduction of vitamin D is determined by period of time outside, percent of available epidermis, UV protection devices used and distribution of ultraviolet over the human body. For example, occurrence of hypovitaminosis D was 77% in children in India who were not exposed to sunlight and 16.4% of who had rickets(V. H. Ekbote, 2010). Some of the risk factors for rickets and vitamin D deficiency are confinement in doors at day time, staying in metropolitan areas with tall complexes, polluted air, darker pigmentation of the skin, covering much or all of the body when outside and use of sunscreen (Balasubramanian S. Dhanalakshmi K. Amperayani S., 2013).

When exposed to sunlight, the epidermal layer of the skin synthesizes a form of Vitamin D called Cholecalciferol. Cholecalciferol is derived from the steroid cholesterol in the

skin. It is transported to the liver where it is converted to Calcidiol which is then converted into Calcitriol in the kidneys. Calcitriol is the active form of Vitamin D. Infant's vitamin D deficiency results from lack of exposure to sunlight due to religious and cultural practices. Cultural practices associated with increase in body covered with clothing and less time spent outdoors may reduce manufacture of vitamin D in skin. Child care practices of caregivers may contribute to rickets and vitamin D deficiency as some caregivers restrict sunlight for the first eight months of a child's life due to inadequate knowledge of the importance of exposing the skin to sunlight or for unknown reasons (Weisberg, Scanlon, Li, & Cogswell, 2004).

Children from different ethnicity require different duration of sunbathing depending on the pigmentation of the skin. For instance, an infant from Caucasia will meet his or her vitamin D requirements from exposure to sunlight for 30 minutes per week dressed in a diaper only or for 2 hours per week fully dressed without a hat. The protective skin pigmentation of the Asians makes them require threefold longer periods of exposure to sunlight while the Africans will require upto six times of the similar exposure (Manisha, 2012).

2.14 Methodologies

A number of study designs have been used in various rickets studies; for instance, a study in Uganda was conducted using a cross-sectional study design and questionnaires were used to collect data to assess nutritional rickets among children at Mulango Hospital. A prospective cohort study design was used at Al-Sabeen Hospital in Sana'a, Yemen to study various nutrition outcomes on rickets with different interventions. In Kenyan studies on rickets which mainly have been conducted in higher institutions of learning the

controlled case study design has been used by Muriithi (2018) to determine the factors contributing to rickets among children under five years.

The cross-sectional study design was used to analyze data from children at a specific period in time. Unlike case control studies and cohort studies where participants are selected based on the outcome or exposure respectively cross-sectional participants are selected on basis of the inclusion and exclusion criteria only. However, they are faster and inexpensive especially when compared to cohort studies. They provide information that is useful for planning a cohort study, monitoring and evaluation. Nevertheless, it is difficult to describe a causal relationship from this study design as it is a onetime measurement of exposure and outcome (Maninder, 2016).

Case control studies were used to determine if select variables (exposure was related to the rickets (outcome). It involved first identifying the group with the rickets (cases) and those free from rickets (controls). This study design is considered appropriate for studying outbreaks and rare diseases. It is very effective in establishing associations between the exposure and outcome; however, it can be a challenge if record keeping is unreliable or inadequate (Lewallen, 1998)

2.15 Management of Rickets in Kenya

There is little documentation on the management of rickets in Kenya. Even strategies like the Malezi Bora which was initiated to provide services such as de-worming for under-fives and pregnant women, immunization of children, treatment of childhood diseases, family planning and improved ANC services does not address rickets (Mwaura, 2013). However, in a study by Bwibo et al., (2013), ultra-heated milk and; vitamin D3 500 milligrams per day were crushed and mixed with water and given to pre-school children

with rickets for treatment. The study went further to advice the mothers of the children to increase their milk intake and expose them to sunlight daily. A nurse the conducted a weekly follow up and within the first month almost all the children had shown improvement; features of rickets had reduced or disappeared within 3-6 months.

2.16 Summary

Rickets is mainly attributed to nutritional deficiency of vitamin D and calcium. Many factors play a role in the occurrence of rickets which include socio-economic and demographic characteristics, child care practices and nutrition status. Malnutrition occurs when the body lacks adequate nutrients, thus children with inadequate Vitamin D and calcium are malnourished (Onyango, 2012). Child care practices are important to ensure that diets consumed are diverse and provide nutrients in their required amounts to prevent nutrient inadequacies that lead to diseases such as rickets.

Although the causes of rickets differ from one region to another throughout the world, it is primarily attributed to vitamin D deficiency, which impairs the absorption of calcium and phosphorous (Thacher, 2006). Nutritional rickets is a continually evolving multi-factorial problem globally. The spectrum of these factors, range from isolated calcium deficiency to isolated vitamin D deficiency. Various consistent emphases should be placed on aspects such as prevention of maternal vitamin D deficiency, vitamin D supplementation of infants and children at risk, provision of calcium diets in areas with low calcium to help curb the occurrence of the disease.

The re-emergence of rickets in many parts of the world and Kenya specifically raise the speculation on the predisposing factors of rickets. Limited data exist on the following factors; birth weight, birth order, day care attendance and occurrence of rickets. Different

studies show different relationships between rickets and the nutrition status of children, others indicate that no relationship exists between malnutrition and rickets while others indicate that there is actually a relationship. Different geographic regions are affected differently by factors that result to rickets thus this study will be conducted at Mbagathi Hospital where the documented information on predisposing factors of rickets is scanty

CHAPTER THREE: RESEARCH DESIGN AND METHODOLOGY

3.1 Study Design

This research was conducted as a hospital based retrospective case- control study design. The children with rickets constituted the cases while those without rickets were the control. It involved looking back to compare frequency of exposure to selected risk factors in each of the study groups. This study design enabled the researcher to identify whether the selected predisposing had an association with the occurrence of rickets in children 6-59 months of age at Mbagathi Hospital.

3.2 Study Setting

The study was conducted at Mbagathi Hospital, it is a level four public Hospital located on the outskirts of Kibera, in Nairobi County, Kenya as shown on figure 3.1.

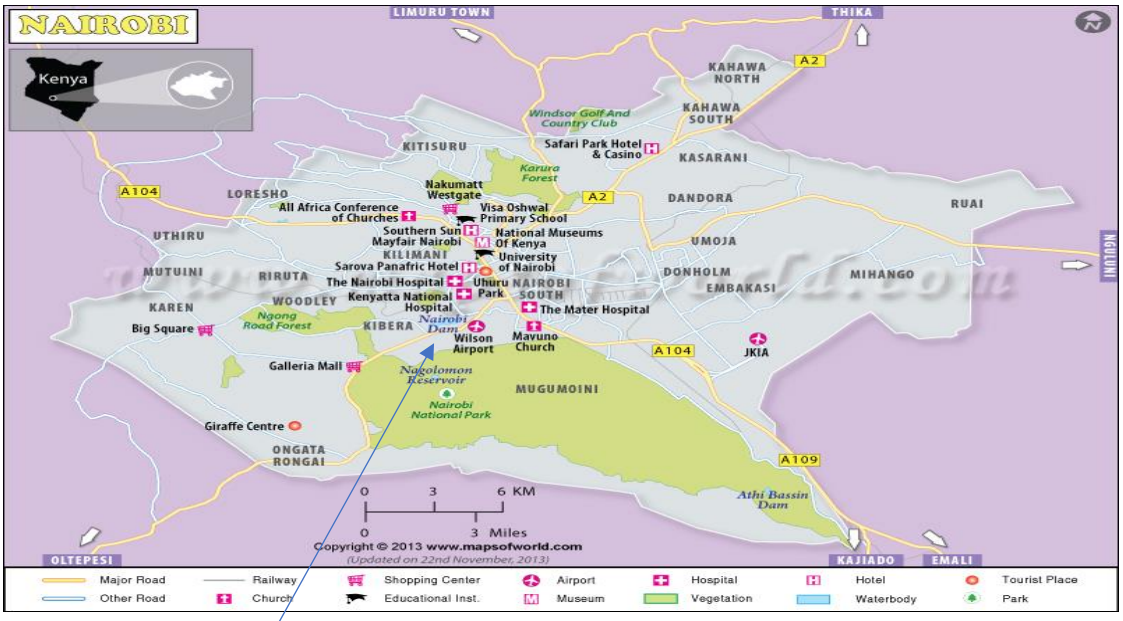

Figure 3.1: Nairobi County Map Showing Mbagathi Hospital

It was built in the 1950s to offer health care services for infectious diseases such as leprosy, meningitis, measles and tuberculosis which needed isolation. Mbagathi Hospital was initially known as “infectious disease Hospital (IDH), under the Kenyatta National Hospital then known as “King Goerge VI Hospital. In 1955 it separated from the KNH and transformed into a District Hospital for Nairobi. It is approximately 6.8 km from the Central Business District of Nairobi. It is accessible by road using both public and private means (Ondera, 2013). Mbagathi Hospital is within the capital city of Nairobi

Mbagathi Hospital serves people from various informal settlements such as Kibera slum which is has a population of approximately 1.2 million people. The hospital provides outpatient and inpatient services with a bed capacity of 200 patients and the following units; Newborn unit, Maternity ward, Medical wards and outpatient with facilities such as the pediatric clinic, dental clinic, family planning, eye clinic, MCH, antiretroviral therapy, HIV counseling and testing, tuberculosis diagnosis centre, physiotherapy unit and radiology services. It has medical officers, clinical officers, nurses, physiotherapist, sonographers, laboratory technicians, pharmacist, nutritionists, counselors and social workers. Per month the Hospital admits at least 340 children and provides healthcare services to approximately 2,600 children in the outpatient department (Fondo, 2013).

Data abstracted from the Mbagathi Hospital physiotherapy department showed the following cases of rickets for the year 2014, 2015, 2016, 2017 and 2018; 308, 317, 419, 600, and 846 respectively. These show an alarming upward and steep curve of the number of cases being reported annually especially from year 2016 to 2018 as in figure 3.2.

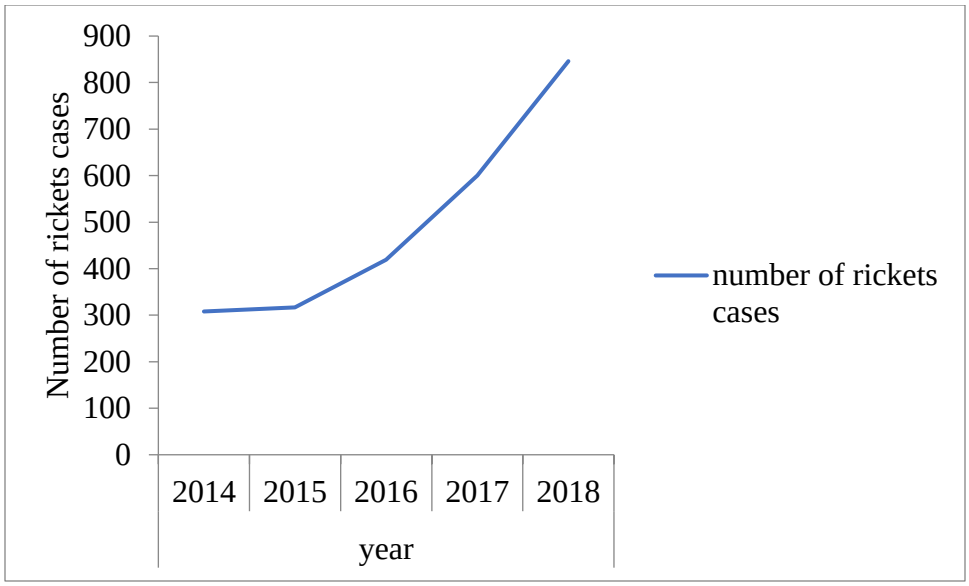

Figure 3.2: Ricket Cases from the Physiotherapy Department, Mbagathi Hospital

3.2.1 Health Records

Mbagathi Hospital uses a combination of electronic and manual systems to keep the records of their patients. The patients register their details such as name, age, physical address, and gender at the health records office on arrival before receiving any treatment. The details are recorded into a desktop computer by the health records officer. After registration they are given an identification number and a manual file is opened for them, which is produced during the subsequent visits without the need to re-register. The identification number is used for file retrieval during a patient re-visit. The file contains details of the patient and all assessments and investigations carried out, diagnosis and treatment given during each visit at Mbagathi Hospital (Meredith et al 2016)

3.2.2 Identification of Rickets

Rickets cases are identified by a clinical officer through a physical examination to check for pain or tenderness in the bones by pressing on them lightly, delayed tooth eruption, widening of joints, knocked and bowed knees. It is also identified using Hospital records

that show rickets diagnosis in a child. In some instances, blood test is carried out to check calcium and vitamin D levels while in others x-rays of bones are used to identify cases (Tom, 2013).

3.3 Study Population

The study population consisted of children aged 6-59 months and their mothers or caregivers seeking health care services at Mbagathi Hospital during the month of April 2019. This target population was chosen because rickets mainly affects children in early life (Nyakundi et al, 2008). Mbagathi hospital was selected because it provides a fair representation of different origins of people, adequate number of children visiting the hospital seeking medical attention, and fewer competing demands such as other studies that would have interfered with the study (Warden, 2011).

3.4 Sampling Frame

3.4.1 Sample Size Determination

The sample size was calculated using Fisher's formula (1991):

$$N = \frac{Z^2pq}{d^2}$$

Where:

N- Desired sample size

p- Proportion of children assumed to have rickets (0.5) (Onyango, 2012)

q- Proportion of children assumed to have no rickets (1- 0.5) = (1-0.5) =0.5

Z- The standard deviation 1.96 at a 95% confidence interval.

d- Degree of accuracy which is set at 0.05significance.

Therefore N $= (1.96)^2(0.5)\ (0.5)/\ (0.05)^2$

$=3.8416\ (0.5)\ (0.5)\ /\ 0.0025$

$= 384.16 \approx \mathbf{385}$ children

The population size was less than 10,000 adjusted Fischer's formula 1991 was used:

nf= N/ 1+(N/n)

Where nf- was the adjusted sample size

N- Was the calculated sample size (385 children)

n- Was the assumed average population visiting Mbagathi Hospital for outpatient services monthly (264 children)

= 385/1+ (385/264)

= 156.6≈ 157

About 264 was the assumed average number of children visiting Mbagathi Hospital for outpatient services monthly.

3.4.2 Sampling Procedure

The study used a multistage sampling design the researcher purposively selected Mbagathi Hospital for conducting the study. Children with and without rickets aged 6-59 months visiting Mbagathi Hospital in April 2019 were selected alternatively in the ratio of 1:2 respectively to participate in the study. The ratio was used due to the limited of rickets cases in the given time frame. The rickets cases were exhaustively selected while the control cases were selected using systematic random sampling, to establish the interval the n^{th} number was computed. The hospital serves approximately 42 clients per day it was divided by six which was the desired number of control cases per day so every 7^{th} caregiver was selected for the study (Theuri, 2012).

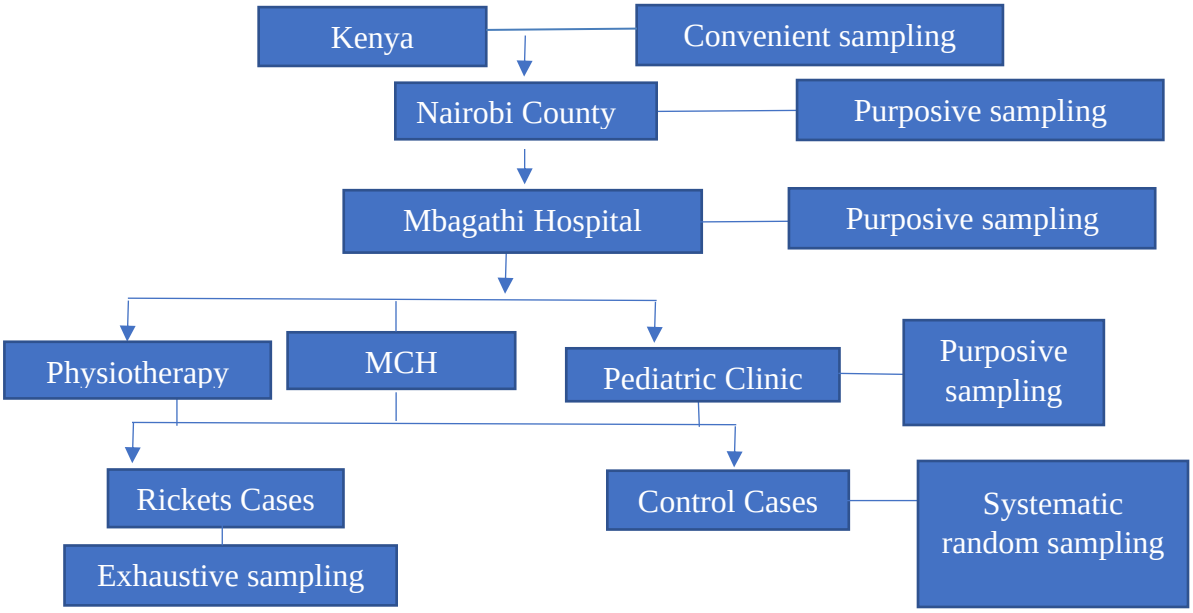

Figure 3.3 Sampling Schema

Inclusion criteria

The respondents included in this study were caregivers with children aged 6-59 months attending Mbagathi Hospital in the month of April, 2019.

Exclusion criteria

Very sick children

Caregivers who met the inclusion criteria but declined to voluntarily participate in the study were excluded from the study.

3.5 Data Collection

Prior to data collection pretesting of questionnaires and recruitment of research assistants was done refer to section 3.6.

Objective 1: To describe the association between socio-demographic characteristics of the care givers of children 6-59 months and rickets.

The study collected data on socio-demographic characteristics collected by administering semi-structured questionnaires (refer to appendix 2). The detailed questionnaire had been uploaded to the online data kit (ODK); an application for data collection available on Google play store for android smart phones. The application was used to fill in the information given by the caregivers about the following independent variables; age, sex, income, marital status, level of education, birth order of children, birth weight of the children, spacing of children and household size.

Objective 2: To establish the relationship between nutritional status and the occurrence of rickets in children 6-59 months at Mbagathi Hospital.

Nutrition status was assessed using three anthropometric measurements; weigh, height and MUAC. A 25 kg hanging spring Salter scale marked out in increments of 0.1kg was used to take weight. The scale was placed on a suitable point ensuring that the dial on the scale is at eye level. The weighing pants were suspended on the scale and the scale needle re-adjusted to zero every time before weighing. The child was then put into the weighing pants with minimal clothing and hooked on the Salter scale, ensuring that the child was properly suspended. Then the reading was done at eye level to the nearest 0.1 kg (WHO, 2008). The weighing was repeated and a second reading recorded, the average of the two reading with a difference of 0.1kg was generated automatically on SPSS during data organization and used on ENA for SMART 2008 for analysis.

The length was measured for children who could not stand using a measuring board (No child was deformed in this study). The board was placed horizontally on a leveled flat surface; the child was placed lying on the back facing upwards, with the child's head touching the head board and held in position, the knees were pressed down, and toes

pointing up. The foot board was then moved up to the sole of the child's feet and then one foot was removed and a reading made to the nearest 0.1centimeter. For height the child would remove their shoes and head covering and stand on a vertically placed measuring board with the heels, knees, buttocks, shoulders and head touching the measuring board and a reading was made. The height was repeated and a second reading recorded, where the second reading had a difference greater than 0.1 the first reading was discarded and measurements for that child repeated after which the average of the two reading with a difference of 0.1cm was generated automatically on SPSS during data organization and used on ENA for SMART 2008 for analysis (WHO, 2008).

The enumerators took the MUAC measurements using a well calibrated MUAC tape. The tape is colored, sterilizable and durable; it resembles a bracelet and is wrapped on a child's mid-upper arm to describe malnutrition. It has three colors red yellow and green and is calibrated in centimeters. They folded the child's arm at the elbow at an angle of $90^0$and the length from the tip of the shoulder to the elbow measured, the measurement was divided into two to find the mid-point the child's arm was stretched straight and a measurement taken around the mid-upper arm circumference and recorded to the nearest 0.1cm this was done twice and the average of the two readings used for analysis to increase accuracy. A reading on the red part which is below 11.5 cm indicate severe malnutrition, the yellow part between the 11.5cm and 12.5cm indicates moderate malnutrition while a reading greater than 12.5cm on the green region shows the child's nutrition status is normal (WHO, 2008).

A 24-hour recall was used to assess the children's' dietary intake (refer to appendix 3) of a sub sample of 59 (38%) children involved in the study. This information was used to

compute the estimated nutrients in the foods consumed by the children. It involved recording of the foods and beverages consumed by the child over the 24-hour period. The amounts of food consumed, ingredients used and method of preparation (WHO,2008).

Objective 3: To establish child care practices that predispose children aged 6-59 months to rickets.

Data on child care practices that sufficed as independent variables were collected using a semi-structured questionnaire (appendix 2). The independent variables were; exclusive breastfeeding, continued breastfeeding, complementary feeding, attendance of day care, and sunbathing.

3.6 Data Quality Management

Every morning all the equipment were calibrated. Equipment used were calibrated after every four children had been weighed to avoid instrumental errors due to faulty equipment. Research enumerators were trained on taking correct anthropometric measurements with emphasis on key steps to observe when taking measurements to increase accuracy and validity. The range was used to detect extreme values to detect and exclude outliers from the analysis. The ODK was programmed in a way that no question could be skipped and any incomplete information was discarded immediately and a new questionnaire generated. The number of questionnaires completed was viewed and errors detected were rectified daily. Enumerators were supervised in the field as they collected data.

Pre-testing was done by the enumerators at the Mbagathi Hospital on the caregiver and children aged 6-59 months who were excluded from the main study. The questionnaires were pre-tested to ensure that the mothers and caregivers understand the questions as

intended and all data required by the researcher were obtained from questions answered on the questionnaire. Ambiguous questions were removed or clarified and questions that required to be answered to meet the objectives of the research that might have been omitted were included. This enabled the researcher to collect only the required and correct information ensuring the data was valid and reliable. The tools to be used were also pretested to ensure their accuracy in measurements. For weight a kilo of salt was used to calibrate the Salter scale and readjust the scale after every five readings.

Recruitment was done to select two enumerators, with skills on data collection and taking of anthropometric measurements, had to have an android smart phone. The enumerators were also required to be patient, with good communication skills and ability to speak English and Kiswahili. They were selected from the nutrition interns at Mbagathi Hospital taking a Diploma in Nutrition and Dietetics course at Kenya Medical Training College who had the ability to take correct measurements and record correctly. The enumerators were then trained on the research topic objectives of the study and purpose of the study, sampling, taking of the anthropometric measurements and use of the ODK. The purpose and general procedure of the study and its expected duration were also explained. Finally, the enumerators were informed on the importance of research ethics and desirable ethical behaviors during the data collection exercise and entire research process (appendix 4).

The enumerators were supervised daily by the researcher. During supervision the following aspects were checked; presence of the enumerator at the required station, number of questionnaires filled and their completeness and transmission of data from the enumerators ODK application to the server. The researcher was supervised weekly by their university supervisor who checked the number of questionnaires filled and made observations and recommendations during the data collection.

3.7 Statistical Data Analysis

Objective 1: To describe the association between socio-demographic characteristics of the care givers of children 6-59 months and rickets.

Socio-demographic data collected were entered into the SPSS software version 22, then analyzed using range, mean, ANOVA, chi-square and the independent t-test. Gender of caregivers, religion, education level, birth order of index children and use of family planning methods were analyzed using chi-square. The mean and ANOVA were used to compare data on age of the caregivers of children with and without rickets respectively. Range was used for the household size and birth weight while the independent t-test was used to analyze distribution of household by income expenditure on food and birth weight. If a variable had a p-value < 0.05 it was interpreted to have a significant relationship with the occurrence of rickets.

Objective 2: To establish the relationship between nutritional status and the occurrence of rickets in children 6-59 months at Mbagathi Hospital.

The dependent variable in this objective was rickets while nutrition status was independent. Data on nutritional status of the children were converted into weight for age z-scores using Emergency Nutrition Assessment (ENA, 2008) software. Nutrition status was based on three indicators namely; wasting, stunting and underweight. It was assessed using the following anthropometric indices; weight for height and MUAC to measure wasting, weight for age to check for age to check for underweight and height for age to assess stunting. Data on weight height and age were filled on the specific rows on a table on the software which then automatically generates the weight for age and weight for height z-scores highlighting errors in the data. A z-score $\leq$ -3SD indicated severe

underweight, stunting or wasting; Z-score > -3sd but ≤ -2SD represented moderate underweight stunting or wasting; while Z-scores >-2 SD but ≤ -1 indicated mildly underweight stunting or wasting (WHO, 2013). MUAC readings below 11.5 were categorized as severe wasting from 11.5cm to 12.5cm moderate malnutrition and normal were readings above 12.5cm. The nutrition statuses were then compared with the two study groups using chi square to establish whether there was a significant relationship between the nutrition status of children and the occurrence of rickets. The mean and independent t-test were used to analyze the MUAC measurements (WHO, 2013)

Objective 3: To establish child care practices that predispose children aged 6-59 months to rickets.

The following dietary practices were analyzed using chi-square; exclusive breastfeeding, initiation of breastfeeding within the first 24hours, complementary feeding, special foods and cooking methods. Non dietary practices were also analyzed using chi-square they included use of napkins baby carrier, attending day care, sun bathing and position of children during sunbathing.

3.8 Ethical Considerations

Ethical clearance was obtained from UoN-KNH Ethics board and permission to conduct the study from the Mbagathi Hospital administration. Those who agreed to participate gave both oral as well as written consent form that they appended their signatures. Confidentiality was upheld as no information was revealed to others. Data protection was done by ensuring data collected were stored safely by the researcher and only authorized persons such as the research supervisors and enumerators had access to the data.

However, finding of the research were communicated to the Hospital and the University of Nairobi.

This is research was a case control study to identify predisposing factors that promote development of rickets. The respondents received free anthropometric and dietary assessment of their children. Malnourished children were referred to the Mbagathi Hospital nutrition department for further management.

3.9 Dissemination Plan

The results of this study will be disseminated on the University's web site, which will serve as references to other researchers in future. Additional dissemination will be done through presentations at meetings, such as in the Mbagathi's Hospital continuous health & nutrition education forums. The findings and analysis will be published as an article in a peer reviewed

Journal.

CHAPTER FOUR: RESULTS

These were the results of the data collected from 157 caregivers and children who were aged 6-59 months attending Mbagathi Hospital in the month of April 2019. The study had 53 cases and 104 control cases.

4.1 Demographic and Socio-Economic Characteristics of Caregivers of Households of Caregivers of Study Children Attending Mbagathi Hospital

The study examined the following demo-socio-economic characteristics 10 and 4 for adults and children respectively: Gender, age, religion, education level, caregiver, household size, education level, family planning method used, household income, distribution of households by income level and family planning; siblings, child age, child space, birth weight and birth order.

4.1.1 Gender of Caregivers of Study Children Attending Mbagathi Hospital

Figure 4.1 shows the gender of the caregivers who participated in this study, 98.1 % were female caregivers while 1.9% were male for the cases while 100% of the control cases were female.

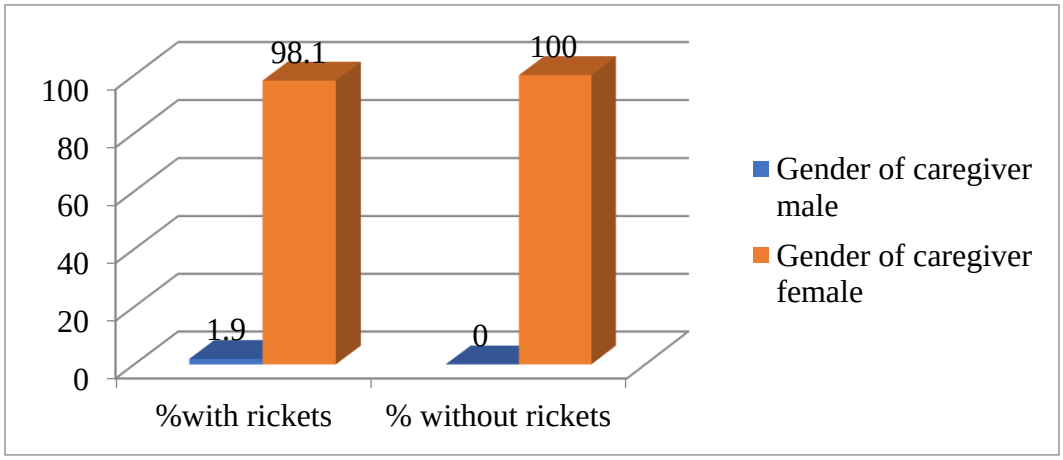

Figure 4.1: Gender of caregivers of study children attending Mbagathi Hospital

4.1.2 Age of caregivers of study children attending Mbagathi Hospital

The mean age of the caregivers was 28.18 years, 28.49 years for caregivers of children with rickets and 28.02 for caregivers of the control cases. In table 4.1, 34% of the caregivers with children with rickets were aged between 24-29 years, while only 11.3% and 8.7% of the caregivers with and without rickets were aged 36 years and above respectively. The difference between the means was not significant as shown by the ANOVA test (1 df, p-value 0.676).

Table 4.1: Distribution of Age of caregivers of study children attending Mbagathi hospital

Caregivers age category	%with rickets N=53	%without rickets N=104
12-17	0	1.9
18-23	24.5	21.1
24-29	34	42.3
30-35	30.2	26
36-41	9.4	4.7
42-47	1.9	2
47-65	0	2

4.1.3 Socio-Demographic Characteristics of Caregivers of the Study Children Attending Mbagathi Hospital

Data in table 4.2 shows a comparison of religion, education level and caregivers of children between children with rickets and without rickets.

From table 4.2 majority of the caregivers were Protestants (58.5%) while 35.8% were Catholic and only 5.7% were Muslims. The chi square test (chi-value 1.31, 2df, p-value0.73) showed that there was no significant difference between those with and without rickets based on their religion

The education level of 37.7% of the caregivers of children with rickets had attained at least secondary education compared with the caregivers of children without rickets at 41.3%. The difference in the level of education between the caregivers of the children with rickets and those without rickets was not significant (chi-value 0.84, 7df, p-value 0.97) as in table 4.2.

Table 4.2 shows that majority of the children with rickets had their biological mothers as their caregivers (92.4%) while 82.6% were caregivers of children without rickets, the difference between the two groups was not significant (chi-value 5.13 ,7df, p-value 0.14).

Table 4.2 show a comparison on use of family planning between caregivers of children with and without rickets. Family planning was used by 56.6% of caregivers with children with rickets while only 28.8% of children without rickets used it. The chi-square test indicated a significant association between the use of family planning techniques and occurrence of rickets (chi-value 11,456, 1df, 0.000).

From table 4.2 30.2% of the caregivers of children with rickets used depo-provera, 20.8 used implant, 3.7%oral pills and 1.9% intra-uterine devices. For caregivers without rickets 13.5% used depo-provera, 10.5% implants and 5.8% oral pills.

Table 4.2: Socio-Demographic Characteristics of Caregivers of the Study Children

Socio demographic characteristics of the caregivers		% with rickets N=53	% without rickets N=104	chi-value	p-value
Religion				1.31	0.73
	Protestant	58.5	62.5		
	Catholic	35.8	29.8		
	Muslim	5.7	4.8		
	Traditionist	0	1		
	Pagan	0	1.9		
Education level				0.84	0.97
	never went to school	1.9	2		
	lower primary	9.4	6.7		
	upper primary	35.9	34.6		
	Secondary	37.7	41.3		
	tertiary education	11.3	9.6		
	University	3.8	5.8		
Caregiver				5.513	0.14
	Mother	92.4	82.6		
	Grandmother	5.7	4.8		
	Auntie	0	6.7		
	Sister	0	2.9		
	Daycare	0	1		
	Cousin	0	1		
	Househelp	1.9	0		
	nuns	0	1		
Family planning				11.456	0.000
	Yes	56.6	28.8		
	no	43.4	71.2		
Type of family planning					
	Depo-Provera	30.2	13.5		
	Implants	20.8	10.5		
	oral pills	3.7	5.8		
	intra uterine devices	1.9	0		
	None	43.4	71.2		

4.1.4 Household Size and Occurrence of Rickets among Study Children Attending Mbagathi Hospital

Household size ranged between two and eight members, 69.8% of the children with rickets were from households with four or more than four members while only 30.2% of the respondents with rickets were from households with three or less than three members. These findings were highly significant (chi-value 8.233, df1, p-value 0.004).

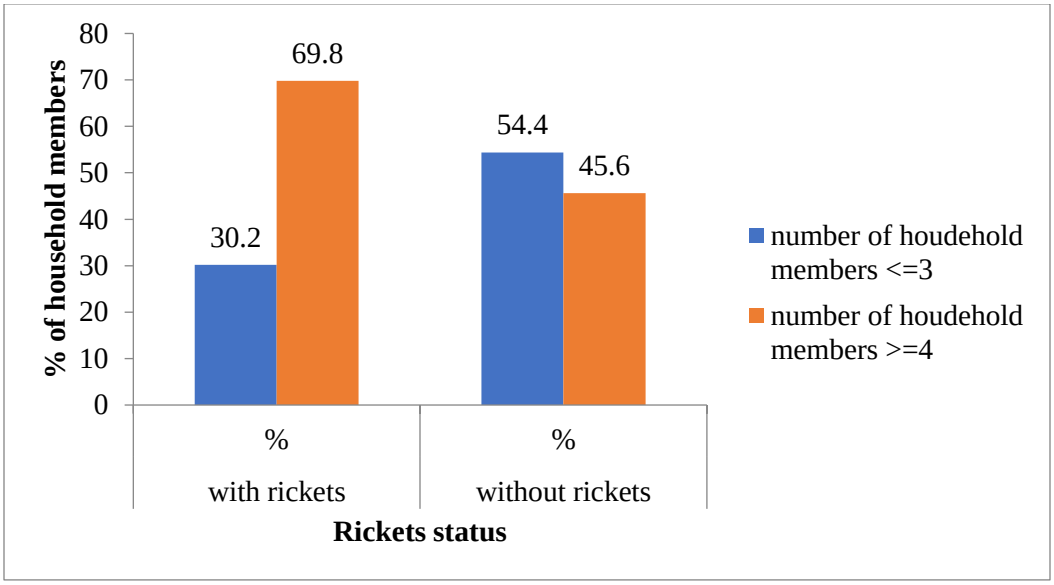

Figure 4.2: Distribution of Households by Size and Rickets Occurrence

4.1.5: Siblings of Study Children Attending Mbagathi Hospital

Table 4.3 shows the percentages of children with rickets with siblings and their numbers compared to those of children without rickets. Majority (62.4%) of the children with rickets had siblings while 37.7% had no siblings. There was no significant relationship between having siblings and occurrence of rickets despite more than half of the children having rickets.

Table 4.3: Siblings, Sibling Numbers and Occurrence of Rickets among Study Children Attending Mbagathi Hospital

		% with rickets N=53	% without rickets N=104	chi-value	p-value
Siblings					
	yes	62.3	47.1		
	no	37.7	52.9		
Siblings number				5.8	0.2
	0	37.7	52.9		
	1	30.2	27.9		
	2	20.8	10.5		
	3	7.5	7.7		
	4	3.8	1		

4.1.6: Study Children's Household Distribution by Income Levels of their Caregivers

Data on table 4.4 show household income according to occurrence of rickets starting from below 10,000 Kenyan shillings to 70,000 per month. Two thirds,33 out of the 53 cases of rickets were from households with income of less than 20,000. For the control cases50 out of the 104 had an income of less than 20,000, clearly there were differences in income of children with rickets and without rickets although the chi-square test (chi-value 8.55 6df, p-value 0.2). suggest that the differences were insignificant.

Table 4.4: Household Distribution by Income Levels

Category of income of study households	% with rickets N=53	% without rickets N=104	chi-value	p-value
			8.55	0.2
less than 10001	11.2	11.5		
10001-20000	51	36.5		
20001-30000	20.8	38.4		
30001-40000	13.2	9.6		
40001-50000	1.9	2		
50001-60000	0	2		
60001-70000	1.9			

4.1.7: Distribution of Study Children Households Income Expenditure by Food, Transport and Rent

According to table 4.5 on distribution of household by expenditure on food, transport and rent, most children with rickets came from households that spend less than 10,000 Kenyan shillings on food per month. It was almost the same for children without rickets with most of them also spending less than 10,000 per month. However, income in most households was spent on food as compared to transport and rent. The mean expenditure for food was KES 4260and KES 4440 for the cases and control cases respectively. The differences in the mean were however not significant (t-value 0.527, 155df, p-value 0.599, CI 95%). 92.5% of the respondents spent less than 3000 per month indicating they do not travel a lot from their home environment just like their counter parts 82.7% of them spent a similar amount. Majority of the respondents of children with rickets spent less than 3,000 shilling on rent an indication of level of poverty in the households than in households of children without rickets who had 32.7% of the respondents paying less than 3,000.

Table 4.5: Distribution of households by income expenditure on food, transport and rent

Income expenditure on:		% with rickets N=53	% without rickets N=104	chi value	p-value
Food				10.54	0.1
	below 3000	3.8	4.8		
	3001-5000	43.4	40.4		
	5001-10000	41.5	46.2		
	10001-15000	1.9	6.7		
	15001-20000	7.5	0		
	20001-30000	1.9	1		
	above 30000	0	1		
Transport				3.88	0.28
	below 3000	92.5	82.7		
	3001-5000	5.7	15.4		
	5001-10000	1.9	1		
	10001-15000	0	1		
Rent				2.5	0.65
	below 3000	43.4			
	3001-5000	32.1	41.3		
	5001-10000	20.8	20.2		
	10001-15000	3.8	4.8		
	20001-30000	0	1		

4.1.8 Income Expenditure on Medical Care of Study Children Attending Mbagathi Hospital

Figure 4.3 shows the amount of money that the respondents spent on medical care. Most (96%) children without rickets spent less than 3,000 shillings on medical, while 26.4% of the children with rickets spent between 3000 and 5000. The differences in expenditure on medical care between the two groups was significant (chi-value 23.7, df2, p value 0.000).

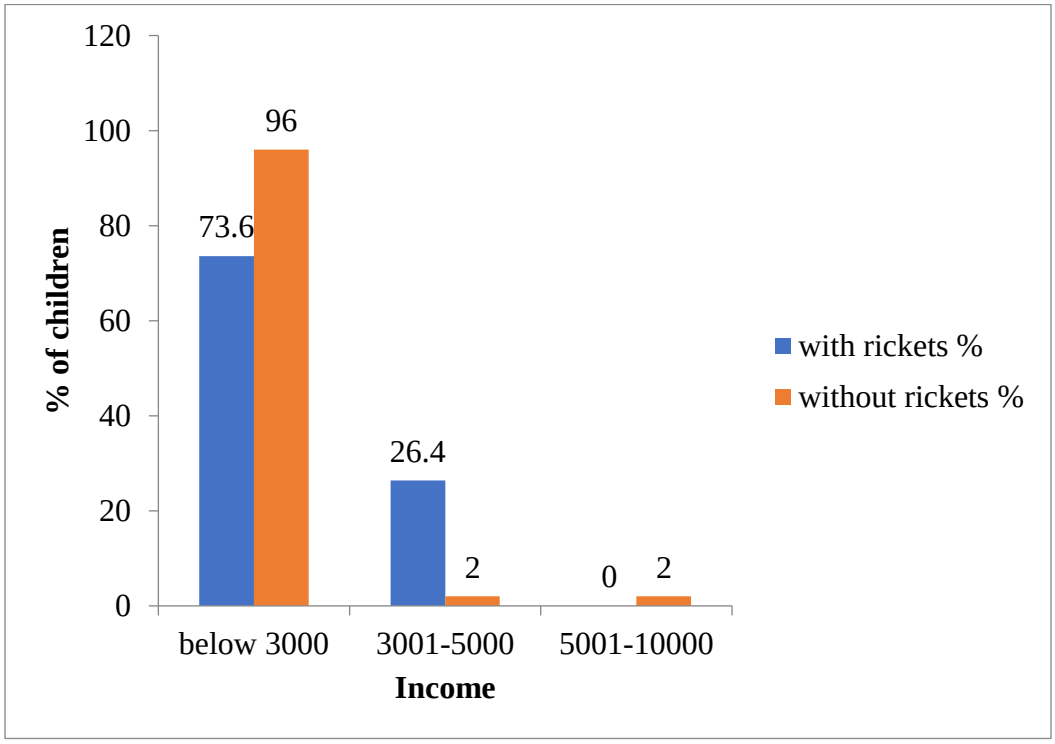

Figure 4.3: Income Expenditure on Medical Care

4.1.9 Child Characteristics in Relation to Occurrence of Rickets at Mbagathi Hospital

Data on table 4.6 shows child characteristics in the study; child age, child space, birth weight and birth order of the index children. From the table 83% of children with rickets

were aged between 6-24 months there was no significant difference in the age between the children with rickets to those without rickets. The age group with the least rickets cases was between 37-59 months with only 7.6% of the children having rickets.

The child space in 43.4% of the children with rickets was less than 24 months between the index child and the younger or older sibling as shown in the table 4.6. It was followed by those children who had a space of between 24 and 47 months at 30.2%. A decreasing trend in rickets cases was observed with increase in the child space. The difference in child spacing between those with rickets and those without rickets was however not significant (chi-value 4.68, p value 0.321).

The birth weight of the index children ranged from 2.0kgs to 5.6kgs. The mean weight of the children with rickets was 2.8kg while for those without rickets was 3.2kgs. The mean weight of children without rickets was calculated with N=103 as one respondent had an extremely high birth weight of 5.6kgs which was an outlier that would have affected the mean. The difference between their means was significant (155df, p-value 0.000, CI 95%). According to table 4.6 13.2% of the children with rickets were born underweight with less than 2.5 kilograms, most (49%) of those with rickets were born weighing between 2.5 and 2.9 kilograms. Only 4.8% of the children without rickets had been born underweight and 69.2% were born weighing between 3.0 and 3.9 kilograms.

The findings of this research show 66 % of the children with rickets were in other birth orders and 34% were first born, while 52% of children without rickets were first born and 48% were in other birth orders. The difference between the cases and control cases was significant from the chi-square test (chi-value 4.56, 1df, p-value 0.03).

Table 4.6: Child Characteristics in Relation to Occurrence of Rickets at Mbagathi Hospital

Child characteristics		with rickets N=53 %	without rickets N=104 %	chi value	p value
Child-age				5.27	0.15
	6-12	30.2	47.1		
	13-24	52.8	35.6		
	25-36	9.4	11.5		
	37-59	7.6	5.8		
Child space				4.68	0.321
	0-23	43.4	59.6		
	24-47	30.2	18.3		
	48-71	17	16.3		
	72-95	5.6	3.8		
	94-143	3.8	2		
Birth weight				17.5	0.002
	2.0-2.4	13.2	4.8		
	2.5-2.9	49	24		
	3.0-3.9	35.8	69.2		
	4.0-4.9	1	1		
	5.0-5.9	0	1		
Birth order				4.56	0.03
	first born	34	52		
	others	66	48		

The study examined 10 and 4 adults and child related socio-demographic factors respectively. For adult related factors, the study established an association between household size (p=0.004), expenditure of income on medical care (p=0.000) and family planning (p=0.000) with rickets occurrence. For children both low birth weight (p=0.000) and birth order (p=0.03) were associated with the occurrence of rickets.

4.2 Nutrition Status of the Study Children at Mbagathi Hospital

Table 4.7 shows the nutrition status of the study children aged 6-59 months at Mbagathi Hospital. Majority (52.8%) of the children with rickets were severely wasted as compared to only 14.4%of the children without rickets who were also wasted. The proportion of children that were not wasted and with rickets was 15.1%. The findings showed there was an association between wasting and occurrence of rickets (chi value 44.65, 3df, p-value 0.00)

About 58.4% of the children with rickets were not affected by stunting while 66.4% of the controls were normal. The differences however were not significant therefore no relationship was established between rickets and stunting. On underweight the finding showed that 40.4% of the children with rickets were severely underweight compared to 4% of the children on the study without rickets. This difference was highly significant at p value of 0.000 showing that children with rickets were more likely to be underweight than children without rickets. There were no overweight or obese children in this study.

The mean of MUAC in children with rickets was 12.32cm and 13.72cm in those without rickets. The difference in the means was significant (95% CI, 155df, p-value 0.000). Figure 4.7 shows that 49.1% of children with rickets had a normal MUAC compared to 86.5% of children without rickets. It further shows that severe wasting affected 26.5%of the cases and only 5.8% of the control cases.

Table 4.7: Distribution of Children by Nutrition Status and by Occurrence of Rickets in Study Children at Mbagathi Hospital, Nairobi County

Nutrition status of study children		% with rickets N=53	% without rickets N=104	chi-value	p-value
Wasting				44.65	0.000
	Normal	15.1	68.3		
	Mild	15.1	12.5		
	Moderate	17	4.8		
	Severe	52.8	14.4		
Stunting				2.79	0.425
	Normal	58.4	66.4		
	Mild	13.2	11.5		
	Moderate	7.6	10.6		
	Severe	20.8	11.5		
Underweight				51.17	0.000
	Normal	19.2	64.4		
	Mild	9.6	20.2		
	Moderate	30.8	10.6		
	Severe	40.4	4.8		
MUAC				3.9	0.000
	Normal		86.5		
	Moderate		7.7		
	Severe		5.8		

4.3 Child Care Practices and the Occurrence of Rickets

The study examined 14 child care practices, 7 of them were dietary practices while the other 7 were non-dietary. The dietary practices were; initiation of breastfeeding, exclusive breastfeeding, continued breastfeeding, complementary feeding, special foods, cooking methods and consumption of porridge; the non-dietary practices were sunbathing, position of children during sunbathing, use of napkins, baby carriers, child illness and attendance of day care centers. Table 4.9 shows three dietary practices studied in this research.

4.3.1 Dietary Practices of the Study Children at Mbagathi Hospital

4.3.1.1 Breastfeeding

Breastfeeding within the first twenty-four hours was initiated by 84.9% of the caregivers while 95.2% of the children without rickets had been breastfed within the first 24 hours this difference was significant (chi-value 8.37, 2df, p-value 0.015). Table 4.8 shows that 37.7% of the children with rickets were exclusively breastfed for six months while the remaining 62.3% were not. For the controls only 18.7% had been exclusively breastfed and 81.7% had not been exclusively breastfed. These differences were significant as shown by the results of chi square test (chi-value 7.13, 1df, p-value 0.008). It shows that exclusive breastfeeding is a predisposing factor for the occurrence of rickets in children.

Continued breastfeeding was practiced by 71.7% of the caregivers of children with rickets slightly lower percentage than without rickets who were at 78.8%. The remaining 28.3% and 21.2% were respectively still not breastfeeding due to; having inadequate milk, being over two years thus had stopped breastfeeding and the rest reported that their children refused to breastfeed on their own at certain ages.

Table 4.8: Breastfeeding of the Study Children at Mbagathi Hospital

Breastfeeding practices of caregivers of study children		%with rickets N=53	%without rickets N=104	chi-value	p-value
Initiation of breastfeeding within				8.37	0.015
	first 30 minutes	41.5	30.8		
	first 1 hour	43.4	64.4		
	after 24 hours	15.1	4.8		
Exclusively breastfed for six months				7.13	0.008
	Yes	37.7	18.3		
	No	62.3	81.7		
Continued breastfeeding After six months				0.996	0.32
	Yes	71.7	78.8		
	No	28.3	21.2		

4.3.1.2 Complementary Feeding of the Study Children at Mbagathi Hospital

The study used a 24-hour recall to assess the amounts of nutrients consumed by a sub-sample of 59 respondents. The amounts were compared with the recommended dietary intake for children to find out the adequacy of nutrient consumption in children with and without rickets.

Table 4.9 shows the mean intake of the carbohydrates, fats, proteins, iron, magnesium, potassium, sodium, zinc, vitamin A, vitamin B1, b2, b3, b6, b12, folate, selenium, vitamin E, and calcium

Table 4.9: Mean Nutrient Intake of the Study Children at Mbagathi Hospital

	Children without rickets	Children with rickets	
Nutrient	**N=104 mean**	**N=53 mean**	**RDA**
Energy	1004.46 Kcal	1098.71 Kcal	1200 Kcal
Fat	37.12	32.88	37.46g
Carbohydrates	109.2	108.56	30g
Protein	24.07	24.71	20g
Iron	11.93	25.2	10mg
Magnesium	154.2	154.62	90mg
Potassium	1,424.95	1,571.18	3000mg
Sodium	904.92	1,038.67	1500mg
Zinc	3.49	3.73	3mcg
Vitamin_A_retinol	179.72	269.83	300mcg
Vitamin_B1_thiamin	0.11	0.19	0.6mg
Vitamin_E	0.02	0.01	6mg
Vitamin_B2_riboflavin	0.68	0.83	0.5mg
Vitamin_B3_niacin	4.11	3.95	7mg
Vitamin_B6_pyridoxine	0.22	0.17	0.6mg
Folate	128.33	150.31	120mcg
Vitamin_C	29.92	38.52	20mg
Selenium	16.41	15.61	15mcg
Vitamin_B12	3.04	3.54	1.2mcg
Calcium	711.57	648.32	700mg

The adequacy of the following nutrients was computed; carbohydrates, proteins, calcium, zinc, magnesium, selenium, vitamin A, vitamin C, vitamin B1&B2 and folate.

Carbohydrates, calcium, zinc, selenium, vitamin C and folate were the nutrients that most children had in adequate amounts. Table 4.10 shows that children with rickets consumed fewer carbohydrates (47%) compared to the control cases (48%), calcium intake was higher (71%) in children with rickets than in control cases (68%), the difference in calcium intake between the two groups was significant (chi-value 0.0053, p-value 0.94). More (76%) children without rickets had adequate zinc intake compared to the rickets cases (71%). The difference in intake of vitamin A and riboflavin between the cases and control cases was significant (chi-value 0.0014, p-value 0.97). The least adequate nutrients were vitamin B2, protein and magnesium at 29%, 21% and 18% respectively for children with rickets.

Table 4.10: Proportion of Children with Adequate Nutrient Intake

	Nutrient Met	Rickets Absent (%) N=25	Rickets Present (%) N=34	p-value	Chi-value
Carbohydrates	Yes	48	47	0.037	0.85
Protein	Yes	12	21	0.268	0.60
Calcium	Yes	68	71	0.0053	0.94
Iron	Yes	48	1	0.0657	0.80
Zinc	Yes	76	71	0.0275	0.87
Magnesium	Yes	8	18	0.4689	0.49
Selenium	Yes	52	41	0.3138	0.58
Vitamin_a_retinol	Yes	88	91	0.0014	0.97
Vitamin_c	Yes	52	44	0.1125	0.74
Vitamin_b1_thiamin	Yes	64	53	0.0641	0.80
Vitamin_b3_niacin	Yes	36	29	0.4159	0.52
Folate	Yes	76	65	0.1674	0.68
Vitamin_b12	Yes	24	32	0.1674	0.68
Vitamin_b2_Riboflavin	Yes	40	29	0.0014	0.97

4.3.2 Other Dietary Practices Among Children Attending Mbagathi Hospital

Table 4.11 shows the percentage of children consuming special foods, method of cooking used to prepare meals for the children and those that consumed porridge. It also shows comparison between children who were fed using nipple bottles among children with and without rickets.

Special foods had been prepared for 60.4% of the children with rickets the remaining 39.6% were fed on family foods. For the controls only 39.4% of the children had been made special foods while 60.6% were fed on family foods. The p-value of 0.013 show that there was a relationship between the feeding of children on special meals and the occurrence of rickets.

From table 4.12 51% of the children with rickets had their foods fried while 49% of the caregivers boiled their children's food. 36.5% of the children without were fed on fried food and 63.5% were fed on boiled food, this difference was however not significant.

There was no significant relationship between those children who were given porridge and those who were not and the occurrence of rickets. 90.6% of the children with rickets were given porridge while 92.6% of the children without rickets were fed with porridge (P=0.708).

Majority of the children with rickets (75.5%) were not fed using the bottle and nipple, more children without rickets (28.8%) used bottle nipple feeding compared to 24.5% of the children with rickets.

Table 4.11: Special food, cooking method, bottle nipple feeding and porridge intake of study children at Mbagathi Hospital

		with rickets		without rickets			
Dietary practice		**N=53**	**%**	**N=104**	**%**	**chi-value**	**p-value**
Special food						6.197	0.013
	Yes	32	60.4	41	39.4		
	No	21	39.6	63	60.6		
Fried food						3	0.83
	Yes	27	51	38	36.5		
	No	26	49	66	63.5		
Boiled							
	Yes	26	49	60	57.7	1.057	0.304
	No	27	51	44	42.3		
Bottle nipple feeding						0.33	0.57
	Yes	13	24.5	30	28.8		
	No	40	75.5	74	71.2		
Porridge						0.14	0.708
	Yes	48	90.6	96	92.3		
	No	5	9.4	8	7.7		

4.4 Non-Dietary Practices and the Occurrence of Rickets

4.4.1 Sunbathing

Table 4.10 is shows the percentage of children with and without rickets who were sunbathed. The results showed that 47.2% of the children with rickets had been sun bathed while 95.2% of the controls had been sunbathed. The difference between those who were sunbathed and those who were not between the cases and controls was highly significant (chi-value 48.77, 1df, p-value 0.000). The table also show where the caregivers who

sunbathed their children positioned them. For the children with rickets 80% were sunbathed under the open sky while for the children without rickets the percentage was 99%, almost all. The remaining 20% and 1% of the children respectively were put under the shade during sunbathing. The differences show relationship between the position of the children during sunbathing and occurrence rickets in the chi square test (chi-value 15.63, df1, p-value0.000).

4.4.2: Use of Napkins Baby Carriers and Child Illness Records

Table 4.10 shows a comparison between the children with rickets and those without and practices of using napkins and baby carriers. It also compares the number of children who had fallen ill two weeks prior to the data collections. Napkins were used by 56.6% of the children with rickets and 48.1% of the children without rickets, most of the study children did not use baby carriers only 13.2% of the children with rickets used baby carriers and12.5% controls used the carriers to carry their babies. In the previous two weeks 59.6% of the children without rickets had fallen ill this was slightly higher than for the children with rickets who had 54.7% of the children getting sick. The differences between the two groups in these variables were however not significant as shown by $p > 0.05$ using the chi-square test.

4.4.4: Daycare

A higher percentage (43.4%) of the study children was attending daycare, compared to the 26.9% of the control cases. The difference was significant showing that there was a relationship between taking children to daycare and the occurrence of rickets (chi-value 4.322, 1df, p-value 0.037).

Table 4.12: Non-Dietary Practices of the Study Children Attending Mbagathi

Non-Dietary practices		with rickets % N=53	without rickets % N=104	chi value	p-value
Sunbathed children				48.77	0.000
	Yes	47.2	95.2		
	No	52.8	4.8		
position during sun bathing				15.63	0.000
	Under direct sunlight	80	99		
	Under the shade	20	1		
Napkin				1.02	0.312
	Yes	56.6	48.1		
	No	43.4	51.9		
Child illness				0.346	0.557
	Yes	54.7	59.6		
	No	45.3	40.4		
Baby carrier				0.016	0.9
	Yes	13.2	12.5		
	No	86.8	87.5		
Children attending day care				4.322	0.037
	Yes	43.4	26.9		
	No	56.6	73.1		

4.5 Risk Factors for Rickets Among Children Attending Mbagathi Hospital

Table 4.11 shows the variables that showed most likelihood for the occurrence of rickets when various variables were combined at a 95% confidence interval. First born were almost twice unlikely to suffer from rickets compared to the subsequent children, while being children aged 6-12 months were 4 times more likely to have rickets than children greater than 12 months of age. Children born to mothers who were using family planning prior to the pregnancy were three times at higher risk of developing rickets. The

multivariate regression analysis also showed that being a male child was twice a predisposing factor to rickets than being a female child.

Table 4.13: Logistic regression of risk factors for rickets among children attending Mbagathi Hospital

Category of factors associated with Ricket in children	Odds Ratio	coef	std_err	P-value
Birth order	1.5	0.4	0.2	0.061
Child age	1.9	0.7	0.4	0.093
Underweight	1.2	0.2	0.3	0.497
Wasting	1.6	0.5	0.4	0.205
Child age category_6 thru 12	3.6	1.3	0.7	0.057
Child space category_24 thru 47	1.2	0.2	0.8	0.827
Child space category_48 thru 71	2.8	1.1	0.8	0.185
Child space category_72 thru 95	1.9	0.7	1.2	0.58
Child space category_96 thru 144	0.5	-1	1.7	0.583
Using family planning yes	2.9	1.1	0.4	0.007
Gender child male	1.5	0.4	0.4	0.364
Intercept	0.1	-3.7	1.6	0.019

CHAPTER FIVE: DISCUSSION

5.1 Socio-Demographic Characteristics of Children Aged 6-59 Months and their Caregivers at Mbagathi Hospital

This research studied various demographic and socioeconomic of children aged 6-59 months at Mbagathi Hospital to establish the socio-economic characteristic that expose the children to risk of having rickets. According to the chi-square test the following variables had a significant association with the occurrence of rickets: household size, income expenditure on medical care, birth weight and birth order of the index children.

5.1.1 Household Size of the Study Children at Mbagathi Hospital

Majority (68.9%) of the children with rickets were from household with more than three household members. Although vitamin D from sunlight is available, if dietary calcium levels are low vitamin D requirements are higher than normal. Low calcium levels can be attributed to financial difficulties that limited access to foods rich in calcium such as fish milk and dairy products; as the number of people in a household increases it strains further the already scarce foods rich in calcium, leading to very little dietary intake of these foods (Onyango, 2012). These findings are similar to those of Muriithi (2018) that found children with rickets were from families with more members than those with fewer.

5.1.2 Income Expenditure on Medical Care of the Study Children at Mbagathi Hospital

Most households (73.6%) of the children with rickets spent less than 3000 Kenya shillings per month on healthcare. This indicated that quality of health care they sought was compromised considering the high cost associated with diagnosis and treatment of rickets which involves purchasing of medication and supplements, weekly physiotherapy

services and treatment of other opportunistic infections such as pneumonia. Access to basic healthcare in Kenya is still a challenge to majority poor and increasingly, the low income due to the high cost of living (World Bank Report, 2014).

5.1.3 Birth Weight of the Study Children at Mbagathi Hospital

A multivariate logistic regression test showed that whose birth weight was less than 2.5kgs had a higher likelihood of having rickets. The likelihood decreased for children born weighing between 2.5-3.9kgs which is considered the normal birth weight while the risk increased again for children born above 4kgs which is considered overweight. This suggests that being both low weight and overweight are predisposing factors for developing rickets. Early in the 1980s the prevalence of rickets in low birth weight babies was 50%, but this situation reduced to 30% after introduction of fortified mineral formulas. Rickets was diagnosed in 43.9% of children with low birth weight in a study in Korea. Inadequate calcium and vitamin D intake plays major role in causing rickets in low birth weight babies (Soon, 2012).

5.1.4 Birth Order of Study Children at Mbagathi Hospital

First born were at a significantly lower risk of developing rickets according to this study. These findings are consistent with those of a study (Magdy, 2016) conducted at Damietta University Hospital where children with rickets were those with an advanced birth order. This is explained by the fact that vitamin D and calcium deficiency in the pregnant and lactating mothers predisposes children to risk of development of rickets, which increases with repeated pregnancies.

5.1.5 Child Age of Study Children at Mbagathi Hospital

The age bracket of 6-24 months had 83% of the children with rickets. This suggests that 6-24 months is a high risk period for development of rickets. This was attributed to exclusive breastfeeding without supplementation without adequate intake of vitamin D and calcium leading to the development of rickets in the rapid growth period of infancy. It could also be attributed to prolonged exclusive breastfeeding and limited intake of foods rich in vitamin D and calcium as breast milk is insufficient in nutrients for an infant from six months of age. According to WHO (2019) the peak incidence of rickets occurs to infant and young children aged six to twenty-four months but can also occur in children aged two to eleven years.

5.2 Nutrition Status and Occurrence of Rickets in Children at Mbagathi Hospital

A study conducted in Riyadh on weight for age (Underweight) in children with rickets and without rickets established no significant difference between the two groups. It was therefore deduced that occurrence of rickets in that study was an isolated phenomenon related to deprivation of vitamin D and calcium, not associated with the nutritional status (Albdelwahab, 1986). However recent studies in Ethiopia show that being underweight is associated with rickets (Singh et al, 2009).

The underweight and wasted children were found to be different between the between cases and control cases. This suggests that development of rickets at Mbagathi Hospital is not an isolated phenomenon of vitamin D and calcium deficiency but also an issue of protein energy malnutrition as 52.8% were severely wasted and 40.4% were severely underweight with the difference being very highly significant, as shown by the p-value of 0.000. These figures are way above those in the KDHS 2014 which shows that only

4% of the children are wasted and 11% are underweight. A range of factors such as food insecurity caused by persistent droughts, high cost of domestic food production and low purchasing power of the respondents; lack of proper follow up in existing nutrition programs of the children with malnutrition and inadequacy of variety of food products and morbidity that affect nutrient absorption could be attributed with this poor nutrition status (Onyango, 2012). This study established that there was no relationship between

5.3 Child care practices and occurrence of rickets in study children attending Mbagathi Hospital

This study established a relationship between selected childcare practices and the occurrence of rickets. These practices include: breastfeeding, complementary foods, cooking methods, use of pacifiers, napkins, and baby carrier, attendance of daycare and sunbathing.

5.3.1 Dietary Practices of the Study Children at Mbagathi Hospital

5.3.1.1 Breastfeeding

In this study on child care practices and occurrence of rickets at Mbagathi Hospital has shown an association between the occurrence of rickets and being breastfed within the first one hour of birth which offered protection against rickets. In this study show that exclusive breastfeeding for the first six months showed is a predisposing factor for rickets. The finding is consistent with that of a study by S. Balasubramanian (2013), which concluded that exclusively breastfed infants received less than 20% of the recommended daily dose of 400IU per day. The World Health Organization currently promotes as a global public health recommendation that infants be exclusively breastfed for the first six months after birth to achieve optimal growth, development and health

(WHO, 2016). Exclusive breastfeeding for infants is a great practice with beneficial effects on child survival. However, a report by the American Academy of pediatrics has shown that adequate intake of vitamin D cannot be met with human milk as the sole source of vitamin D (Gartner et.al, 2003).

5.3.1.2 Complementary Feeding

After the first six months, to meet their evolving nutritional requirements, infants should receive nutritionally adequate and safe complementary foods while breastfeeding continues, for up to two years of age and beyond (WHO, 2016). The children involved in this study were above six months and should have started complementary feeding. Most (60.6%) of the children without rickets fed on family food, compared to only 39.6% of the children with rickets. This indicated that family foods are more nutrient dense compared to special foods. The method of preparation compared in the research were boiling and frying, and none showed a relationship with the occurrence of rickets.

5.3.2 Non-Dietary Practices of the Study Children at Mbagathi Hospital

5.3.2.1 Sunbathing and Position During Sunbathing.

This study found that sunbathing was associated with occurrence of rickets in the study children. This study further shows that sunbathing the children under the open sky provided protection against rickets for the children compared to sunbathing under the shade or umbrella. Studies conducted by Muriithi (2018) and Wairimu (2013) on rickets indicate significant relationship between sunbathing and the occurrence of rickets.

5.3.2.2 Attendance of Daycare

This study showed that 43.4% of the children with rickets were attending day care compared to the 26% of those without rickets. This difference is significant as shown by

the p value of 0.037 an indication that having children in the care of daycare actually predisposed them to the occurrence of rickets at Mbagathi Hospital for children aged 6-59 months. Little is known about the style and quality of feeding and care provided in child daycare centers. A purposive study conducted in five daycare centers in Nairobi Kenya found that caregivers were often distracted and rarely encouraged children to feed, with most children eating less than half of their served meal (Ivan et al., 2016).

5.3.2.3 Use of Family Planning

The finding of this study provide evidence that shows there is an association between the use of modern family planning methods with the occurrence of rickets. Majority (53.3%), of the caregivers of the children with rickets are using Depo-Provera which concurs with Muriithi (2018) findings. This is because depo-provera increases cortisol levels in the blood plasma, this in return increases the amount of calcium excreted in urine and reduces the intestinal absorption of calcium. This results to decreased calcium availability in women using depo-provera causing bone mineralization (Muriithi, 2018).

According to the KDHS 2014, 58% of women aged 15-49 years are using a method of family planning. Modern methods of contraception are more used, at the rate of 55%, than traditional methods which rate at 5%. Of the modern methods, injectables are the most commonly used at a rate of 26%, implants at 10% and pills at 8% in Kenya. In this study 38.2% of the respondents were using a method of family planning, 50% were using Depo-Provera, 35% implants, 13.3% oral pills and 1.7% intra uterine devices.

CHAPTER SIX: CONCLUSION AND RECOMMENDATION

6.1 Conclusion

Considering the results and discussion the study has established that the following are the predisposing factors of rickets among children aged 6-59 months; large household size, birth weight, birth order, use of family planning methods, malnutrition (wasting & underweight), exclusive breastfeeding, consumption of special foods, lack of sun bathing, positioning children under the shade during sunbathing and attending day care. Therefore, the study rejected the null hypothesis that there is no significant association between investigated factors and the occurrence of rickets as the fore-mentioned factors were found to be the predisposing factors of rickets. Several factors make important contributions to the risk of developing rickets. Among these, lack of exposure to sunlight, prolonged breast feeding without complementary feeding and inadequate weaning practices.

6.2 Recommendations

The researcher recommends that:

1. The mothers and caregiver of all children from birth should be expose them to sunlight especially in the morning or evening sun rays under open sky and while in minimal clothing to enhance synthesizes of vitamin D through the skin.
2. Kenyan government Ministry of Health and NGOs bodies concerned with health of children should advocate for sunbathing, position of children under direct sunlight, regulating the quality of services offered at the daycare centers.

3. Nutritionists and other health practitioners and stakeholders should take the battle against malnutrition that has shown to be a risk factor for rickets in children aged 6-59 months at Mbagathi Hospital.
4. Quality of feeding at the daycares should be improved especially their feeding practices to ensure they do not contribute to the occurrence of rickets.
5. Further studies to be conducted on the following variables in relation to the occurrence of rickets household size birth weight, birth order and attendance of daycare because there is little documentation particularly in Kenya.
6. Kenyan government through the Ministry of Health and other relevant bodies to formulate elaborate policies on the issue of rickets to provide proper baseline for data interpretation and discussions in the Country.

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APPENDIX 1: INFORMED CONSENT

Title of Study: PREDISPOSING FACTORS OF RICKETS IN CHILDREN AGED 6-59 MONTHS AT MBAGATHI HOSPITAL NAIROBI COUNTY, KENYA

Principal Investigator\and institutional affiliation: GILLIAN KAGWIRIA MICHENI, UNIVERSITY OF NAIROBI

Co-Investigators and institutional affiliation: PROFESSOR WAMBUI KOGI-MAKAU & DR. MULWA KAINDI DASEL, UNIVERSITY OF NAIROBI

Introduction:

I would like to tell you about a study being conducted by the above listed researchers. The purpose of this consent form is to give you the information you will need to help you decide whether or not to be a participant in the study. Feel free to ask any questions about the purpose of the research, what happens if you participate in the study, the possible risks and benefits, your rights as a volunteer, and anything else about the research or this form that is not clear. When we have answered all your questions to your satisfaction, you may decide to be in the study or not. This process is called 'informed consent'. Once you understand and agree to be in the study, I will request you to sign your name on this form. You should understand the general principles which apply to all participants in a medical research: i) Your decision to participate is entirely voluntary ii) You may withdraw from the study at any time without necessarily giving a reason for your withdrawal

iii) Refusal to participate in the research will not affect the services you are entitled to in this health facility or other facilities. We will give you a copy of this form for your records.

May I continue? YES / NO

This study has approval by The Kenyatta National Hospital-University of Nairobi Ethics and Research Committee protocol No. _____

WHAT ARE YOUR OTHER CHOICES?

Your decision to participate in research is voluntary. You are free to decline participation in the study and you can withdraw from the study at any time without injustice or loss of any benefits.

CONSENT FORM (STATEMENT OF CONSENT)

Participant's statement

I have read this consent form or had the information read to me. I have had the chance to discuss this research study with a study counselor. I have had my questions answered in a language that I understand. The risks and benefits have been explained to me. I understand that my participation in this study is voluntary and that I may choose to withdraw any time. I freely agree to participate in this research study.

I understand that all efforts will be made to keep information regarding my personal identity confidential.

By signing this consent form, I have not given up any of the legal rights that I have as a participant in a research study.

I agree to participate in this research study: Yes No

I agree to have data collected to be preserved for later study: Yes No

I agree to provide contact information for follow-up: Yes No

Participant name: _____

Participant signature / Thumb stamp _____ Date _____

KIAMBATISHO 1: FOMU YA RIDHAA

FOMU YA MSHIRIKI YA IDHINI NA MAELEZO

IDHINI YA MTU MZIMA

KWA AJILI YA KUHUSISHWA KATIKA UTAFITI

Kichwa cha utafiti: MAZOEA YA KUTUNZA MTOTO NA MAAMBUKIZI YA CHIRWA KATIKA WATOTO WENYE UMRI 6-59 MIEZI KATAKA HOSPITALI YA MBAGATHI KAUNTI YA NAIROBI

Mchunguzi \ na uhusiano wa taasisi: GILLIAN KAGWIRIA MICHENI, Chuo Kikuu cha Nairobi

Wachunguzi wenza na uhusiano wa taasisi: PROFESSOR WAMBUI KOGI-MAKAU & DR. MULWA KAINDI DASEL, Chuo Kikuu cha Nairobi

Utangulizi:

Ningependa kukuambia kuhusu utafiti unaofanywa na watafiti waliotajwa hapo juu. Madhumuni ya fomu hii ya idhini ni kukupa taarifa unayohitaji kukusaidia kuamua kama utakuwa mshiriki katika utafiti huu. Jisikie huru kuuliza maswali yoyote kuhusu madhumuni ya utafiti, kile kinachotokea kama wewe kushiriki katika utafiti, kuna uwezekano wa hatari na faida, haki zako kama kujitolea, na kitu kingine chochote kuhusu utafiti au fomu hii ambayo si wazi. Tukishajibu maswali yako yote kwa kuridhika kwako, unaweza kuamua kuwa katika utafiti au la. Utaratibu huu inaitwa 'ridhaa'. Mara baada ya kuelewa na kukubali kuwa katika utafiti, nitakuomba wewe uweke sahihi ya jina lako kwenye fomu hii. Unafaa kuelewa kanuni za jumla zinazotumika kwa washiriki wote katika utafiti wa matibabu: i) Uamuzi wako wa kushiriki ni kwa hiari yako kabisa ii) Unaweza kuondoka kutoka utafiti wakati wowote bila lazima kutoa sababu ya kujitoa

kwako iii) kukataa kushiriki katika utafiti hautaathiri huduma unazofaa kupata katika kituo hiki cha afya au vifaa vingine. Tutawapa nakala ya fomu hii kwa kumbukumbu zako.

Ninaweza kuendelea? NDIYO / HAPANA

Utafiti huu umepitishwa na Kenyatta National Hospital-Chuo Kikuu cha Nairobi Maadili na Kamati ya Utafiti itifaki No. _____

UTAFITI HUU NI KUHUSU NINI?

Watafiti waliotajwa hapo juu niwakuhoji walezi watakaochaguliwa ambao wana watoto wenye umri wa miezi 6-59 na na bila chirwa. Madhumuni ya mahojiano ni kutafuta namna huduma ya watoto inavyoathiri kiwango cha maambukizi ya chirwa miongoni mwa watoto ambao kutembelea Mbagathi Hospital kwa matibabu. Washiriki katika utafiti huu watatakiwa kujibu maswali kuhusu habari yao ya kijamii na idadi ya watu, afya ya mtoto, mazoea ya kulisha na mazoezi mengine ya kutunza watoto. Washiriki pia watakuwa na uhuru wa kuamua kama mtafiti anaweza kuchukua uzito na MUAC ya watoto wao. Kutakuwa na takriban washiriki 157 katika utafiti huu ambao watachaguliwa kwa nasibu. Tunakuomba idhini ya kuzingatia kushiriki katika utafiti huu.

NINI KITAKACHOTE DEKA UKIAMUA KUSHIRIKI KATIKA MASOMO YA UCHUNGUZI?

Ukikubali kushiriki katika utafiti huu, mambo yafuatayo yatatokea: Utahojiwa na mtaalamu wa kuhojiana ambaye amepokea mafunzo katika eneo binafsi ambapo utaweza kujibu maswali vizuri. Mahojiano yatadumu takriban dakika ishirini. Mahojiano itafikia mada kama vile hali ya kijamii na idadi ya watu, afya ya mtoto na lishe na kutunza watoto. Baada ya mahojiano ya kumaliza, Tutakuomba nambari ya simu ambapo tunaweza kuwasiliana na wewe kama ni lazima. Ukikubali kutoa taarifa ya anwani yako, zitatumika

tu kwa watu wanaofanya kazi kwa ajili ya utafiti huu na kamwe haitapewa watu wengine. Sababu tunaweza kuhitaji kuwasiliana na wewe ni pamoja na: kufafanua taarifa yoyote iliyotolewa wakati wa uchambuzi na ushiriki katika utafiti mwingine ambayo inahitaji ushiriki wako kama utakubali hivyo.

JE, KUNA HATARI, AU MADHARA YA KUHUSISHWA NA UTAFITI HUU?

Utafiti wa matibabu ina uwezo wa kuanzisha kisaikolojia, kijamii, kihisia na kimwili hatari. Juhudi lazima iwe imewekwa ili kupunguza hatari. Moja ya hatari uwezo wa kuwa katika utafiti ni hasara ya faragha. Tutaweka kila kitu kutuambia kama siri kama iwezekanavyo. Tutatumia simu kodi kukutambua katika nywila ili kulinda database Kompyuta na kushika yote ya kumbukumbu zetu karatasi katika imefungwa faili baraza la mawaziri. Hata hivyo, hakuna mfumo wa kulinda usiri yako inaweza kuwa salama kabisa, hivyo ni bado inawezekana kwamba mtu anaweza kujua ungekuwa katika utafiti huu na inaweza kujua kuhusu wewe. Pia, kujibu maswali katika mahojiano inaweza kuwa na wasiwasi kwa ajili yenu. Kama kuna maswali yoyote hutaki kujibu, unaweza kuachana nayao. Una haki ya kukataa mahojiano au maswali utakayo ulizwa wakati wa mahojiano. Huenda aibu kwako kuwa kutoa mtoto wako nguo kwa kuchukua uzito. Sisi tutafanya kila kitu tunaweza kuhakikisha kwamba hii ni itafanyika kwa siri. Zaidi ya hayo, kila wafanyakazi katika utafiti huu na watafiti ni wataalamu nawana mafunzo maalum katika hizi zoezi hili / mahojiano

KUNA FAIDAYOYOTE KATIKA UTAFITI HUU?

Unaweza kufaidika kwa kuangaliwa bure hali ya lishe ya mototo wako na ushauri. Sisi kukutaja wewe kwa idara ya lishe Hospitali kwa matunzo na msaada inapobidi. Pia, kutoa taarifa itakayotusaidia kuelewa jinsi matendo huduma ya watoto kuathiri kiwango cha

maambukizi ya chirwa katika watoto wenye umri wa miezi 6-59. Habari hii ni mchango kwa sayansi na kuzalisha data ambazo zitatumika kutoa mapendekezo juu ya namna mazoea huduma ya watoto inaweza kurekebishwa ili kupunguza na hatimaye kutokomeza chirwa. Hii itasaidia katika kufikia 2030 ambayo ina lengo la kutoa maisha bora kwa wananchi wake wote.

KUWA KATIKA UTAFITI HUU UTAKUGHARIMU CHOCHOTE?

Utafiti huu itagharimu muda wako takriban 20-30 dakika na hakuna fedha utatakiwa kutokana na wewe kushiriki katika utafiti huu.

UTAPATA KURUDUSHIWA FEDHA ZOZOTE UTAKAZOZITUMIA KAMA SEHEMU YA UTAFITI HUU?

Washiriki hawatatakiwa kutumia fedha yoyote kama sehemu ya utafiti huu hivyo hakuna fidia zitafanywa. Hata hivyo hali ambapo mshiriki anaitwa baada ya kuondoka Hospitali na amekubali kuja na kutoa taarifa fulani ambayo inaweza kuwa imeachwa nje na inahitaji uwepo wao kimwili pesa iliiyotumka katika usafiri kutumika itarejeshwa.

UFANYE JE KAMA UNA MASWALI BAADAYE?

Kama una maswali au matatizo kuhusu kushiriki katika utafiti huu, tafadhali piga simu au kutuma ujumbe wa maandishi kwa wafanyakazi utafiti katika namba zinazotolewa chini ya ukurasa huu. Kwa habari zaidi kuhusu haki zako kama mshiriki wa utafiti unaweza kuwasiliana Katibu / Mwenyekiti, Kenyatta National Hospital-Chuo Kikuu cha Nairobi Maadili na Utafiti wa Kamati Namba No. 2726300 Ext. 44102 email uonknh_erc@uonbi.ac.ke. wafanyakazi utafiti kulipa nyuma kwa madai yako kwa namba hizi kama simu ni kwa mawasiliano utafiti yanayohusiana.

MAAMUZI YAKO MENGINE NI YAPI?

Uamuzi wako wa kushiriki katika utafiti ni kwa hiari yako. Wewe una uhuru wa kukosa kushiriki katika utafiti na unaweza kuondoka kutoka utafiti wakati wowote bila udhalimu au kupoteza faida yoyote.

FOMU YA IDHINI (Maelezo ya Makubaliano)

Taarifa ya Mshiriki

Nimesoma fomu hii ya idhini au nimesomewa ujumbe huu. Nimekuwa na nafasi ya kujadili utafiti huu na mshauri wa utafiti. Na maswali yangu akajibu kwa lugha ambayo naelewa. Hatari na faida ya utafiti zimeelezwa kwangu. Naelewa kwamba ushiriki wangu katika utafiti huu ni wa hiari na naweza kuchagua kujiondoa wakati wowote. Nina uhuru wa kukubali kushiriki katika utafiti huu utafiti.

Naelewa kwamba juhudi zote zitafanywa ili kuweka maelezo kuhusu utambulisho wangu wa kibinafsi faragha.

Kwa kutia sahihi fomu hii ya idhini, cjaziuzuru haki zangu za kisheria nilizo nazo kama mshiriki katika utafiti.

Ninakubaliana na kushiriki katika utafiti huu: Ndiyo Hapana

Nakubali ya kuwa data itakayokusanywa inaweza kuhifadhiwa kwa ajili ya utafiti baadaye:

Ndiyo Hapana

Nakubaliana na kutoa taarifa za mawasiliano ya kufuatilia: Ndiyo Hapana

Jina la mshiriki

lilochapishwa:_____

Sahihi ya mshiriki _____ Tarehe _____

APPENDIX 2: QUESTIONNAIRE

PREDISPOSING FACTORS OF RICKETS IN CHILDREN AGED 6-59 MONTHS AT MBAGATHI HOSPITAL NAIROBI COUNTY, KENYA

ID NUMBER……

Residence……..

Name of Interviewer……

Date……

Section 1: demographic and socio-economic information

1. What is the age of caregiver in years?…….
2. Sex male ☐ female ☐

Tick where appropriate in the questions below

3. What is the main religion of the household?

   Protestant ☐ Muslim ☐

   Catholic ☐ Traditionist ☐

   Others specify……

4. What is your average house hold income per month?

   Below Ksh 10,000 ☐ Ksh 10,000-20,000 ☐

   Ksh 20,000-30,000 ☐ Ksh 30,000-50,000 ☐

   Above Ksh 50,000 ☐

5. What is the highest level of education you attained?

   Primary ☐ Secondary ☐ College ☐ University ☐

   Others

(specify)……

….

6. What is your household

   number?……

7. What is the birth order of the child participating in the study?

   1st ☐ 2nd ☐ 3rd ☐ 4th ☐

   Others

   (specify)…… ☐ …… ☐ ……

   ….

8. Does the child have siblings? Yes no

9. What is the space between this child and the previous child (in months)

   ……

10. How much do you spend on the following items per month

Amount (Ksh)	Below 3,000	3,000-5,000	5,000-7,000	7,000-10,000	Above 10,000
Food					
Rent					
Transport					
Medical care					
Others specify					

11. Were you using family planning before the conception of the indexed child?

12. If yes what type of family planning were you using/

Section 2: Nutrition status and health

1. Name of the child _____
2. Age of the child in months _____
3. Birth weight of the child _____
4. Does the child suffer from rickets?(from previous diagnosis by a physician; to be confirmed by the nurse from the medical records) Ye☐ No ☐
5. Does your child suffer from milk intolerance or allergy?_____
6. Which conditions does your child experience during illness? (tick all that apply)

   Vomiting ☐ Fever ☐ Diarrhea ☐ Poor appetite ☐

   Others (specify) ……..

7. Anthropometric measurements

	1st Reading	2nd Reading	Average
Child's weight			
MUAC			

Section 3: Feeding practices

1. a) Is the child still breastfeeding? Yes ☐ No ☐

   b) If no at what age did you stop breast feeding? _____

2. How soon after delivery was breastfeeding intiated? _____

3. a) What method of cooking do you use to cook the child's food? _____

b) Do you use cooking oil in the child's food?_____

4. Does the child take family foods?

5. Is the child made special food?

6. Do you use bottle and nipple to feed liquids?

7. Do you feed the child with cup and spoon?

8. Do you feed your child with porridge?

9. How many times do you feed the child in a day <6 times ☐ ≥6 times ☐

Section 4: child care practices

1. Do you take your child to a day care?
2. Do you use a baby carrier
3. Do you use napkins
4. Has the child been attending child welfare clinic monthly?
5. Is the child sun bathed during the day? Yes ☐ No ☐
6. If yes for how long is the child sunbathed?
7. How do you dress the child during sunbathing?
8. Where do you position the child during sunbathing?

KIAMBATISHO 2: HOJAJI

MAZOEA YA KUTUNZA MTOTO NA MAAMBUKIZI YA CHIRWA KATIKA WATOTO WENYE UMRI 6-59 MIEZI KATAKA HOSPITALI YA MBAGATHI KAUNTI YA NAIROBI

Sehemu ya 1: Habari ya Idadi ya watu na ya kijamii na kiuchumi

1. Miaka ya mlezi katika miaka .....

2. Jinsia ya mlezi kiume ☐ ☐ike

Sahihisha inapobidi katika maswali hapa chini

4. Kiwango wastani cha mapato nyumbani kwa mwezi ni kipi?

Chini ya shilingi 10, 000 ☐ 10,000-20,000 ☐

20,000-30,000 ☐ 30,000-50,000 ☐

Juu ya shilingi 50,000 ☐

5.Kiwango cha juu kabisa cha Elimu ulichofika ni kipi?

Msingi ☐ Sekondari ☐ Chuo Kikuu ☐

Kingine(taja) .....

6. Idadi ya watu katika kaya yako ni wangapi?
..... ☐ ☐ ☐ ☐

7. Uzazi safu wa mtotto anayeshiriki katika utafiti 1 2 3 4

Wengine (taja) ....

8. Nafasi kati ya mtoto huyu na mtoto awali (katika miezi) ....

9. Kiasi gani cha pesa hutumia katika vitu vifuatavyo kwa mwezi (shilingi)?

Kiasi cha pesa Chakula	Chini ya 3000	3000-5000	5000-7000	7000-10000	Juu ya 10000

Kodi ya
nyumba
Usafiri

Huduma za
afya
Mengine
bainisha

Sehemu ya 2: Hali kwa Lishe na afya

1. Jina la mtoto
2. Jinsia ya mootto ni ipi?

3. Umri wa mtoto katika miezi

4. Uzazi uzito wa mtoto

5. Mtoto anakabiliwa na chirwa (kutoka utambuzi wa awali kwa daktari, kuthibitishwa na muuguzi kutoka rekodi ya matibabu) Ndiy☐ Hakuna ☐

6. Mtoto wako anakabiliwa na kutovumilia maziwa au allergy?

7. Ni hali gani inayompata mtoto wako mara kwa mara wakati wa ugonjwa? (Weka alama zote zinazotumika) ☐apika joto jingi n☐lini K☐ara ☐
hamu duni

Zingine (taja) ....

8. Vipimo

Somo la kwanza Somo la pili Wastani

Uzito wa mototo

MUAC

sehemu ya 3: Kulisha mazoea

1. a) Je, bado unanyonyesha mtoto? Ndiyo Hapana

b) Kama hunyonyeshi uliacha mototo akiwa na umri upi?

2. a) Je, umeanza kumpa mtoto wako chakula kingine chochote isipokuwa maziwa ya mama?

Ndiyo Hapana

b) Ulianza kumpa mtoto chakula au vinywaji zaidi maziwa ya mama akiwa na umri upi?

3. a) Unatumia njia gani ya kupikia chakula cha mtoto?

b) Je, unatumia mafuta kupikia chakula cha mtoto?

4. Mtoto amepata dozi iliyopendekezwa ya vitamini A? Ndiyo Hapana

4. Mtoto hulishwa mara ngapi kwa siku? <mara 6 > 6 mara

5. Jinsi gani unaweza kupata chakula?

Ununuzi Wafadhili Kilimo

Zingine (taja) .....

Sehemu ya 4: huduma ya watoto mazoea

1. Wakati wa mchana anayemtunza mtoto?

2. Mtoto anashiriki kwenye kliniki ya ustawi wa watoto kila mwezi?

3. Je motto wako huota jua wakati wa mchana?

Ndiyo Hapana Wakati mwingine

4. Kama ndiyo motto huota jua kwa muda upi?

APPENDIX 3: SAMPLE 24 HOUR RECALL

Time	Meal	Ingredients used in preparation				Amount consumed
		Description	Amount used	Weight	Source	

APPENDIX 4: TRAINING CURRICULUM FOR DATA COLLECTION

Day	Activities
Day one	• The research assistants will be recruited from the nutrition interns at Mbagathi and only two selected to engage in the study.
Day two	• Training on the objectives of the study and the data intended to be collected. • Then going through the questionnaire to understand the kind of responses required and familiarize with the questions • Explaining the research ethics to the research assistants • Revise how to take the anthropometric measurements
Day three	Rehearse collecting data with and pretest the questionnaires and correct mistakes noted.