FACTORS ASSOCIATED WITH RICKETS AMONG CHILDREN AGED 6-59 MONTHS AT KIAMBU DISTRICT HOSPITAL

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BED. HOMESCIENCE AND TECHNOLOGY (HONS)

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Declaration

I, Alice Wairimu Theuri, hereby declare that this 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.....

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 almighty God,

My loving husband Amos,

Sons Austin and Westin

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Abbreviations

ASF	Animal Source Foods
Ca	Calcium
CHC	Child Health Card
CWC	Child Welfare Clinic
HH	Household
HHH	Head of household
IU	International Units
IYCF	Infant and Young Child Feeding
KDH	Kiambu District Hospital
KDHS	Kenya Demographic and Health Survey
MCH/FP	Maternal and Child Health/Family Planning
MOH	Ministry Of Health
NCAPD	National Coordinating Agency for Population and Development
OPD	Out Patient Department
POPC	Paediatric Outpatient Patient Clinic
RDA	Recommended Dietary Allowance
US	United States
µg	Micro grams
WHO	World Health Organization

Operational definitions

Alternative care givers	Other care givers apart from the mother taking care of the child during the day
Calcification	Is the process in which calcium salts build up in soft tissue, causing it to harden for example formation of bones
Cartilage	The flexible connective tissue found in many areas in the bodies of humans and other animals, including the joints between bones
Etiopathogenesis	The cause and development of a disease
Fortified foods	Foods to which nutrients and minerals are added that never had them before. One of the most popular examples is milk fortified with vitamin D.
Hydroxyapatite	A mineral that is the main inorganic constituent of tooth enamel and bone.
Hydroxylation	Is the first step in the oxidative degradation of organic compounds in air.
Hypovitaminosis D	Low vitamin D serum levels.
Malnutrition	A uniform physical condition or process that results from interaction of adequate diet, imbalance in diet and infection.
Osteoid	The un mineralized organic component of bone.
Osteomalacia	Essentially the same pathogenesis but refers to the disease in adults once the growth plates have closed.
Phytates	Substances found in cereals that inhibit iron, zinc and calcium absorption
Sun bathing	To expose the body to the sun
Unfortified foods	Foods to which nutrients and minerals are not added for example vitamin D

Abstract

Rickets is a metabolic bone disease and is caused by low calcification of bones. It is a nutrient deficiency manifestation particularly for calcium and vitamin D from sunlight. Rickets among children in Kiambu District Hospital as reported by doctors is high with about 100 cases per month. The causative factors for the seemingly high cases of rickets are not clearly understood. Low socio-economic conditions lead to low education status and empowerment. At the same time, the purchasing power of foods rich in calcium and vitamin D that prevent rickets may be affected. Insufficient dietary intake of vitamin D and calcium, inhibitors of calcium absorption, covered dressing, remaining indoors for long periods and living in urban flats are some of the common causes of rickets. The purpose of the study was to establish the factors associated with rickets among children aged 6- 59 months at Kiambu District Hospital. More specifically, the objectives of the study were to determine the socio-economic and demographic characteristics of households with children suffering from rickets and their feeding and care practices as likely underlying and immediate determinants of rickets status among children attending Kiambu District Hospital.

A controlled case study design was used involving 200 children with rickets and a similar number without rickets, all who were attending Kiambu District Hospital for health care services. Children with rickets were exhaustively selected for the study while the children without rickets were selected systematically after every case was selected. Data collection was from August 2011 to September 2011, and was done using structured questionnaires with mothers as respondents. The specific data collected was on the socio-economic and demographic characteristics, feeding and child care practices.

Statistical data analysis was carried out using SPSS version 16 and Nutrisurvey 2007 and descriptive statistics, t test, Chi squares and logistic regression were performed. Food adequacy for the children was determined using a 24 hour dietary recall and a food frequency questionnaire on various foods rich in vitamin D, calcium and phosphorus.

The prevalence of rickets in Kiambu District Hospital is 3.4%. Males were slightly more (58%) than the females (42%). Children of unemployed mothers were 0.8 times at risk of developing rickets. Children who were not breast feeding were 0.3 times more likely to develop rickets compared to the ones who were breast feeding. The likelihood of developing rickets was significantly higher for children who started complementary feeding before six months of age ($p<0.01$). A higher percentage of the non rickets children (99%) were sun bathed every day compared to 63% of the rickets cases. These figures were highly significant ($p<0.01$).

The prevalence of rickets in Kiambu District Hospital is high as raised by the medics and worrying and the age most vulnerable to rickets was 6-12 months. Children of employed mothers were at a lower risk of developing rickets. Early introduction of complementary foods, short period of breast feeding, inadequate complementary practices and lack of exposure to the sunlight are the risk factors associated with rickets in Kiambu District Hospital.

The government and other development partners should design interventions to curb the upsurge of rickets in Kiambu District Hospital. These interventions should target parents and caregivers of children below one year as they are more vulnerable to rickets. The government and other development partners should design interventions to promote exclusive breast feeding and increasing the intake of calcium and phosphorus rich foods

among children. The caregivers should be educated on the need to sunbathe the children with more emphasis on alternative care givers.

CHAPTER 1: INTRODUCTION

1.1 Background information

Rickets is a nutritional deficiency disease caused by lack of vitamin D and calcium. Vitamin D is naturally synthesized under the skin of mammals exposed to ultra-violet light or sunshine (Bishop and Thomas, 2009). Calcium is found in milk and its products, fish, and vegetables.

Taylor (2008) observed that rickets remained a major public health problem in many developing countries, and its prevalence was reported to be increasing in these countries. Overall, it has been estimated that as many as 1 billion people in the world have rickets. The majority of cases occur in children suffering from severe malnutrition, usually associated with famine or starvation during the early stages of childhood.

Although cases of rickets have declined since the Industrial Revolution, certain populations remain at risk. Nutritional rickets remain prevalent in developing regions of the world such as Africa ,the Indian Subcontinent , Asia and in the Middle East. There is resurgence in rickets, and several factors are likely to be involved including decreased sun exposure for the population as a whole, failure to practice exclusive breast feeding and few physicians prescribing vitamin D supplements (Bouillon, 2010).

Bouillon(2010) notes that majority of cases occuring in the developed world over the past decade have occured in dark skin people or those that remain fully clothed for religious or social reasons.

In the recent years, global public health and nutrition interventions has focused primarily on obesity and specific micronutrient interventions, downplaying or somehow ignoring diseases like rickets. In Kenya, the consequences of insufficient nourishment continue into adulthood and are passed on to the next generation of children. This impacts heavily on the community's future physical health, economic well being and welfare. If proper interventions are not delivered to children suffering from rickets before the age of five years, they could suffer irreversible damage into their adult life and to the subsequent generations.

1.2 Problem statement

Kiambu District Hospital medics have expressed concern over the rising number of children suffering from rickets. Statistics from the hospital indicate that the hospital treats close to 100 new cases every month. This is quite high compared to hospitals like Narok District Hospital where rickets is a rare occurrence (HMIS, 2011). It is not clear what has been the cause of this trend. At the same time no documentation exists in the hospital and occasionally, the hospital medics treat the symptoms of the disease without going to the underlying cause of the problem. There is need to carry out further study to unravel this problem and come up with an appropriate interventional strategy.

1.3 Justification of the study

According to the UNICEF Convention on the Rights of the Child (2008), 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.

However, we cannot provide this basic right to our children if our hospitals are overcrowded with patients. It is therefore important to provide prophylactic rather than therapeutic management services for rickets in children.

Children under five years comprise 4.3 percent of Kiambu County population (NCAPD, 2011). There is need to take care of these children in the county as they will be tomorrow's adults.

The government and the Non Governmental Organizations(NGO's) will use the results generated from this study to devise appropriate policies for the betterment of the health of its citizens.

1.4 Aim of the study

The study aims at documenting the prevalence of rickets in the county for action by the government, NGO's and other development partners with interest in health care.

1.5 Purpose

The purpose of the study was to establish the factors responsible for the reported high prevalence of rickets cases at Kiambu District Hospital.

1.6 General objective

To determine the prevalence of rickets and the contributing factors among children aged 6-59 months treated at Kiambu District Hospital.

1.7 Specific objectives

The specific objectives of the study are:

1) To determine the prevalence of rickets in children aged 6-59 months old attending Kiambu District Hospital for treatment of rickets
2) To determine the socio-economic and demographic characteristics of households with children aged 6-59 months at Kiambu District Hospital for treatment of rickets
3) To determine the feeding and child care practices among children aged 6-59 months attending Kiambu District Hospital for treatment of rickets.

1.8 Research questions

1. What is the prevalence of rickets among children aged 6-59 months old and attending Kiambu District Hospital (KDH) for treatment of rickets?
2. To what extent does socio- economic and demographic characteristics of households in Kiambu contribute to rickets causation among children attending KDH?
3. To what extent do feeding and child care practices contribute to rickets causation among children attending KDH?

CHAPTER 2: LITERATURE REVIEW

2.1 Children malnutrition and rickets

UNICEF conceptual framework was used in this study to facilitate a logical assessment and analysis of the causes and determinants of rickets in Kiambu District Hospital as shown in Figure 2.1 below.

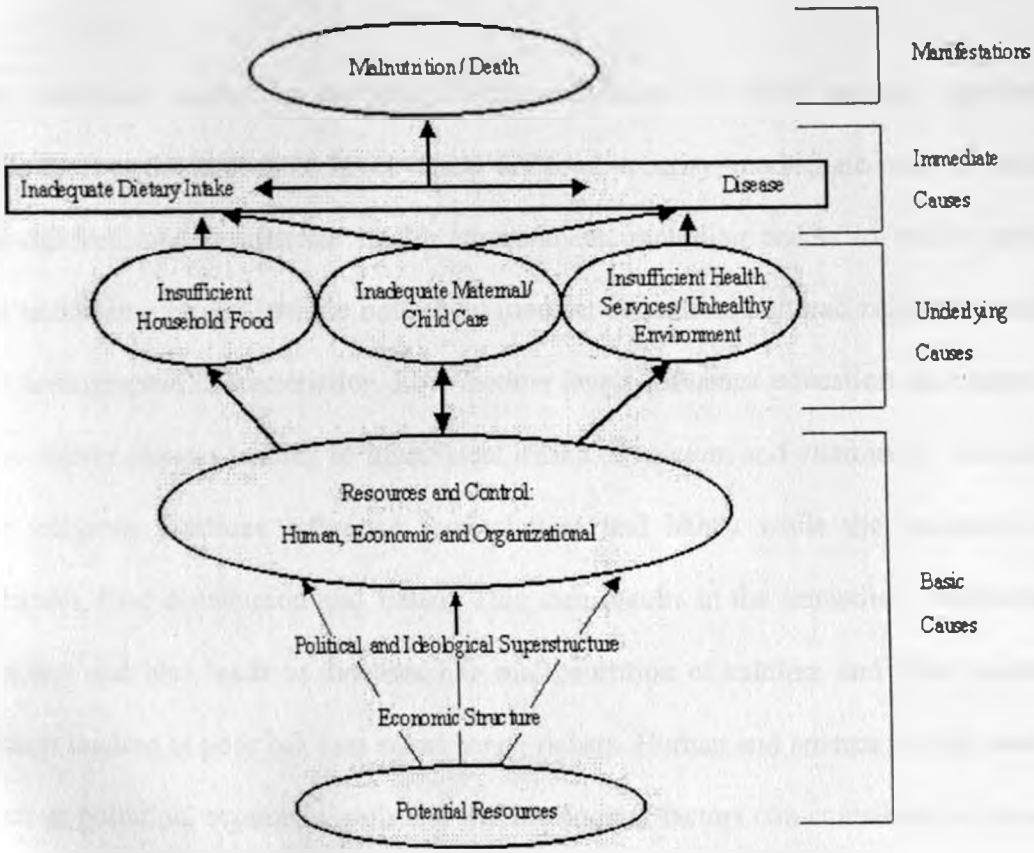

Figure 2.1: Conceptual framework for malnutrition

Source: Adopted from UNICEF Conceptual Framework for Malnutrition (UNICEF,1998).

According to this framework, malnutrition occurs when there is inadequate dietary intake and diseases. Rickets is an outcome of malnutrition in children and can be determined by the two classes of factors namely inadequate dietary intake and diseases. In developing countries, diseases like rickets weaken the child's immune system predisposing him/her to respiratory infections, diarrhea and fever which creats poor nutrition status.

The immediate causes of malnutrition are influenced by three causes manifesting themselves at the household level. These are food security, inadequate care for mothers and children, and insufficient health environment, including access to health services. The underlying causes include household income, education, cultural/ religious practices and demographic characteristics. Low income levels influence education attainment and poor dietary choices leading to insufficient intake of calcium and vitamin D. The cultural and religious practices influence food choices and habits while the household size influence food distribution and intake. This then results in the immediate manifestation (rickets) and also leads to diseases like malabsorption of calcium and other metabolic defects leading to poor calcium status hence rickets. Human and environmental resources such as pollution, economic, political and ideological factors can contribute to causation of rickets as basic causes.

2.2 Definition of rickets

Rickets is a classic metabolic bone disease of man caused by deficiency of calcium, phosphorus and vitamin D (Whyte, 2002). Rickets is caused by failure of calcification of

osteoid and physeal cartilage (Klein, 1999). Rickets is the clinical consequences of impaired mineralization of bone matrix throughout the growing skeleton in children (Thakkera and Whytea, 2009). At the turn of the 20th century, nutritional rickets were epidemic among infants and young children in many areas of Asia, North America, and northern Europe. One of the well-studied communities with a high prevalence of rickets is the Asian community in the United Kingdom. Since the early 1960s, numerous studies have highlighted the predisposition of this community to rickets (Iqbal and Whittaker, 1995; Bishop and Thomas, 2009).

2.3 Clinical manifestation of rickets

Symptoms of rickets include; big forehead, rough skin on the stomach and under feet and persistent fever and diarrhea. Other symptoms include late teething, poor weight gain, hypersensitive feet and general body weakness (Bishop and Thomas, 2009).

2.4 Rickets in developing and developed countries

Vitamin D deficiency rickets in children is one of the commonest disorders prevalent in the rural population of India (Teotia and Teotia, 2008). Some cases have been reported in Britain in recent years of rickets in children of many social backgrounds caused by inability to make vitamin D because the sun's ultra-violet light was not reaching the skin. This is because of persistent use of strong sun block, or too much "covering up" in sunlight, or spending too much time indoors; the British Medical Journal reported in 2010 that doctors in Newcastle on Tyne saw 20 cases of rickets per year (Daily telegraph ,2011).http://en.wikipedia.org. In the United States, sun exposure is the primary

determinant of vitamin D status and non-whites require more sunlight exposure to obtain adequate vitamin D levels because of skin pigmentation (Holick , 2007; Forrest and Stuhldreher,2011).

In Greece, hypovitaminosis of vitamin D has been recently reported in the adolescent and neonate population the unexpected findings was that those were associated associated with limited sunlight exposure (Aglaia et al., 2006). In a Child Survival Project (CSP), carried out in Embu in 2000-2003 where toddlers were enrolled in a feeding intervention study, twenty-four cases of clinically diagnosed rickets were reported out of 324 children registered for the CSP project. The children with rickets shared the following risk factors: Short breast feeding duration, Vegetable and cereal-based complementary foods. Negligible cow's or goat's milk, and Confinement indoors when the mothers were cultivating the fields (Bwibo and Charlotte, 2003a).

Bwibo and Charlotte (2003a) noted that multiple factors were at play including a low intake of milk and hence of calcium and phosphorus, no intake of fish hence a low vitamin D intake, and perhaps reduced exposure to sunshine and ultra-violet light. All these factors operate jointly, but the lack of milk in the diet was a major factor. The affected children were provided with milk supplements and vitamin D-3 for 1 month, which caused a noticeable regression of their rickets. In less developed countries, fortification programmes for other nutrients are increasing, but little for vitamin D and calcium. However, efficacy for fortification of low-extraction flours with calcium is disputed (Darnton-Hill and Nalubola, 2002).

2.5 Consequences of rickets

Teotia and Teotia (2008) observed that under nutrition in childhood lead to a skeletal deficit that could not be repaired during adolescent life, and presumably lead to an increase in the risk of osteoporotic fracture in later life. The two writers further noted that low calcium intakes early in life not only predisposed children to osteoporosis later in life, but made bones more fragile in childhood and adolescence as well. The relative risk of death for children with rickets compared with children without rickets is high. Furthermore, bony deformity of the pelvis in women leads to obstructed labor and increased perinatal morbidity and mortality (Kaludjerovic and Vieth ,2010). Besides bone changes, pneumonia is commonly present, perhaps reflecting the effect of vitamin D on either the immune system or softened ribs that reduces the efficiency of breathing and coughing to clear a lung infection (Martha and Sif, 2011).

2.6 Treatment, control and management of rickets

Thakkera and Whytea (2009) proposed that treatment of rickets should aim at reversal of short stature and deformity and prevention of bone pain and fracture. In this regard, treatment with vitamin D, or its active metabolites will generally provide relief of bone pain, improve mobility and prevent fractures; but must be carefully monitored (Michael and Rajesh, 2009). Michael and Rajesh recommended 200–400 IU of vitamin D that would significantly reduce the risk of this disease, and that all pregnant women should have adequate sunshine and intake of dairy products.

Dietary calcium and vitamin D intake of children should be raised by consuming fortified foods and supplements, and parents should be educated on dietary sources of calcium,

phosphorus and vitamin D (Bishop and Wharton, 2003; Lawson and Shaw, 2008). In areas with nutritional rickets, calcium rich food sources preferably fortified dairy products should be provided during the weaning period and onwards. Breast feeding should be encouraged especially in calcium deficient areas, to provide enough calcium. Children should have adequate sunshine of 30 minutes a week naked (Lawson and Shaw, 2008).

2.7 Predisposing factors

Breast fed infants of vitamin D deficient mothers or infants who are prematurely born, and those who receive inadequate sun exposure are at risk of developing rickets. It is inevitable that the children who do not maintain their vitamin D production by adequate exposure of their unprotected skin to sunlight are at risk of developing rickets (Teotia and Teotia, 2008).

Multiple micronutrient deficiencies may contribute to early onset of stunting and poor child development but lack of calcium together with vitamin D deficiency are responsible for the resurgence of rickets. There is an urgent need to increase the intake of animal source foods to provide these required nutrients by Kenyan children (Bwibo and Charlotte, 2003b).

In developing countries, detrimental feeding practices and poor weaning diets, characterized by inadequate calories, protein, and micronutrients account for high levels of malnutrition, morbidity, and mortality among children 6–24 months of age (Huffman and Luann, 1994). Dark-skinned individuals are more prone to vitamin D deficiencies

than those with a fair skin, because dark skin requires more sunlight to produce vitamin D; and particularly in latitudes with low levels of sunlight (Aglaia et al., 2006).

The extensive use of tropical sunscreens and environmental factors such as air pollution would account for inadequate sunlight exposure and intensified need for dietary intake of vitamin D (Aglaia et al., 2006).

Dietary patterns, particularly characterized by low intake of dairy products and low socio-economic status (as indicated by education level) are usually associated with rickets (Holick, 2007; Forrest and Stuhldreher, 2011).

Overweight people may tend to spend more time indoors and receive less ultra-violet rays of the sun that spur the production of vitamin D (Camargo and Scragg, 2008).

Fluoride levels in water or foods consumed by children under five have been shown to interfere with calcium uptake by bones in India, South Africa and Nigeria (Badru et al., 2003). This interaction has also been shown to cause rickets in experimental studies (Mellanby, 1921; Norman, 2001).

2.8 Vitamin D

Vitamin D is a fat soluble vitamin that occurs in a small number of foods while the body manufactures it in the skin when exposed to sunlight (Darwin and Hark, 2007). Since vitamin D can be endogenously produced and is retained for very long periods by the human body, it is very difficult to determine the minimum daily requirements precisely (Dawson-Hughes and Harris, 1998; Bishop and Thomas, 2009).

This requirement depends on age, sex, degree of sun exposure and the season (Teotia and Teotia, 2008). The current Adequate Intake (AI) of vitamin D recommended in 1998 by

the Food and Nutrition Board of the Institute of Medicine of United States of America is 200 International Units (IU) /day (5 μg/day) for infants and children (Food and Nutrition Board, 1998).

Rauch (2003) and Linus Pauling Institute (2010) noted that vitamin D is supplied by gastrointestinal absorption and synthesis in the skin, after exposure to solar ultra-violet radiation. Vitamin D in its native form is relatively inactive. It is hydroxylated in the liver to a more active form, 25-OH Vitamin D. The most active form of Vitamin D is 1, $25(OH)_2$ Vitamin-D, which is formed after 1-alpha hydroxylation in the kidneys (Rauch 2003; Linus Pauling Institute, 2010).

2.8.1 Sources of vitamin D

Animal sources constitute the bulk sources of vitamin D that occur naturally in unfortified foods. Fish and fish liver oils are good sources (Aglaia, et al., 2006). However, the best source is sunlight. Between 1919 and 1920, Sir Edward Mellanby, working with dogs raised exclusively indoors (in absence of sunlight or ultra-violet (UV) light) devised a diet that allowed him to unequivocally establish that rickets was caused by deficiency of a trace component present in diet, and that the condition was treatable by administering fish liver oil (Mellanby, 1921). He established the causes and effects of vitamin D deficiency.

2.9 Calcium

Profound deficiency of dietary calcium despite intact stores of vitamin D can also impair skeletal mineralization. In a placebo- controlled trial done in Nigeria, rickets healed more in children who received both calcium and vitamin D (61%) or calcium alone (59%) than in those who received vitamin D only (19%). A combination of calcium and vitamin D was more effective than vitamin D alone in Turkish children aged 6—30 months (Bishop and Wharton, 2003). Children below 5 years require approximately 270-500 mg of calcium daily.

2.9.1 Sources of calcium

Breast milk contains limited amounts of calcium (breast milk 50 mg/100 kcal or 35 mg/100 ml. Infant formula contains 70 mg/100 kcal or 43 mg/100 ml but the proportion absorbed and retained (about a third) meets the requirements (Bishop and Wharton, 2003).

Bishop and Wharton noted that after infancy, cows' milk with 180 mg/100 kcal or 120 mg/100 ml calcium and milk products are major sources of calcium. Other sources of calcium include fish, sardines and broccoli, spring onion, parsley, eggs, soya products and breakfast cereals.

2.9.2 Bioavailability of dietary calcium

Members of religious, ethnic and other groups that do not consume dairy products are at risk. Correcting the diet or using calcium supplements should readily reverse this disorder (Thakkera and Whytea, 2009).

Children who do not like milk or are lactose intolerant have much lower intakes. In societies without a tradition of milk drinking, calcium intake is often below 300 mg daily and predisposes the children to rickets. The absorption of calcium is limited by other plant substances, such as phytates present in many cereal foods, oxalates in spinach and tannates (Bishop and Wharton, 2003; Bishop and Thomas, 2009).

2.10 Phosphorus

The importance of phosporus cannot be overlooked. Phosphorus and phosphate ions play an important role in bone formation. Calcium and phosphorus combine in body to form a structure called hydroxyapatite, which is the main component of bone. When bones grow, the body uses hydroxyapatite to create their structure and ensure that newly formed bones are strong (Bishop and Thomas, 2009).

If there is not enough calcium and phosphorus in blood, hydroxyapatite cannot be formed hence new bones are weak and soft resulting in rickets. Children under five years require 275-500 mg per day of phosphorus. It is present in most foods but the main sources are protein rich foods such as meat, poultry, fish, eggs, dairy products, nuts and legumes.

2.11 Gaps in knowledge

Though the threat of rickets is increasingly being recognized in Africa as a whole and Kenya specifically, there is little documentation on the causes or prevalence of the disease in Kenya. In Kiambu County of Kenya, no documentation exists on the prevalence of rickets. Focus on Protein Energy Malnutrition (PEM) and micronutrient deficiencies has neglected rickets as demonstrated in the Kenya Demographic Health

Survey of 2008-09, which reported on stunting, wasting and underweight only (KDHS, 2010).

Many countries have a policy on dietary supplementation of vitamin D but indications for prescription and actual uptake are variable. Few obstetricians prescribe supplementation of vitamin D and calcium to pregnant women in order to help cater for their new borns (Bishop and Wharton, 2003).

CHAPTER 3: SOCIO-ECONOMIC AND DEMOGRAPHIC CHARACTERISTICS FOR HOUSEHOLDS WITH CHILDREN HAVING RICKETS

Abstract:

Rickets among children in Kiambu District Hospital as reported by doctors is high with about 100 cases per month. The causative factors for the seemingly high cases of rickets are not clearly understood. It is not fully appreciated how socio-economic and demographic, ecological and cultural variables interact to contribute to the occurrence of rickets at a population level (Guo et al., 2009).

The objective of this study therefore was to determine the socio-economic and demographic characteristics for households with children having rickets attending Kiambu District Hospital for medical care.

A controlled case study design was used involving 200 children with rickets and a similar number without rickets for children attending Kiambu District Hospital for health care services. Children with rickets were exhaustively selected for the study, while the children without rickets were selected systematically after every case was selected. Data collection was from August 2011 to September 2011 and was done using structured questionnaires with mothers as respondents. Data on age, marital status and household income was collected.

The prevalence of rickets in Kiambu District Hospital is 3.4%. Males were slightly more, (58%) than the females (42%). Children of unemployed mothers were 0.8 times at risk of developing rickets.

The prevalence of rickets in Kiambu District Hospital is high as raised by the medics and worrying and the age most vulnerable to rickets was 6-12 months. Children of employed mothers were at a lower risk of developing rickets.

The government and other development partners should design interventions to curb the upsurge of rickets in Kiambu District Hospital. These interventions should target parents and caregivers of children below one year as they are more vulnerable to rickets

The study recommends the need to empower women to attend school and later look for employment to prevent the rising cases of rickets in Kiambu District Hospital.

3.1 Introduction

A large body of epidemiologic data shows that diet quality follows a socio-economic gradient. Whereas higher-quality diets are associated with greater affluence, energy-dense diets that are nutrient-poor are preferentially consumed by persons of lower socio-economic status (SES) and of more limited economic means (Darmon and Drewnowski, 2008).

Diet quality is affected not only by age and sex , but also by occupation, education, and income levels, and the conventional indexes of socio-economic status or socio class (Krieger et al., 1997).

Dietary patterns, particularly characterized by low intake of dairy products and low socio-economic status (as indicated by education level) are usually associated with rickets (Holick, 2007; Forrest and Stuhldreher, 2011).

Low socio-economic conditions lead to low education status and empowerment as shown in figure 3.1. At the same time, the purchasing power of foods rich in vitamin D and

calcium that prevent rickets may be affected. Low socio economic status also leads to development of slums and air pollution that may lead to inadequate sun rays from reaching the ground leading to rickets.

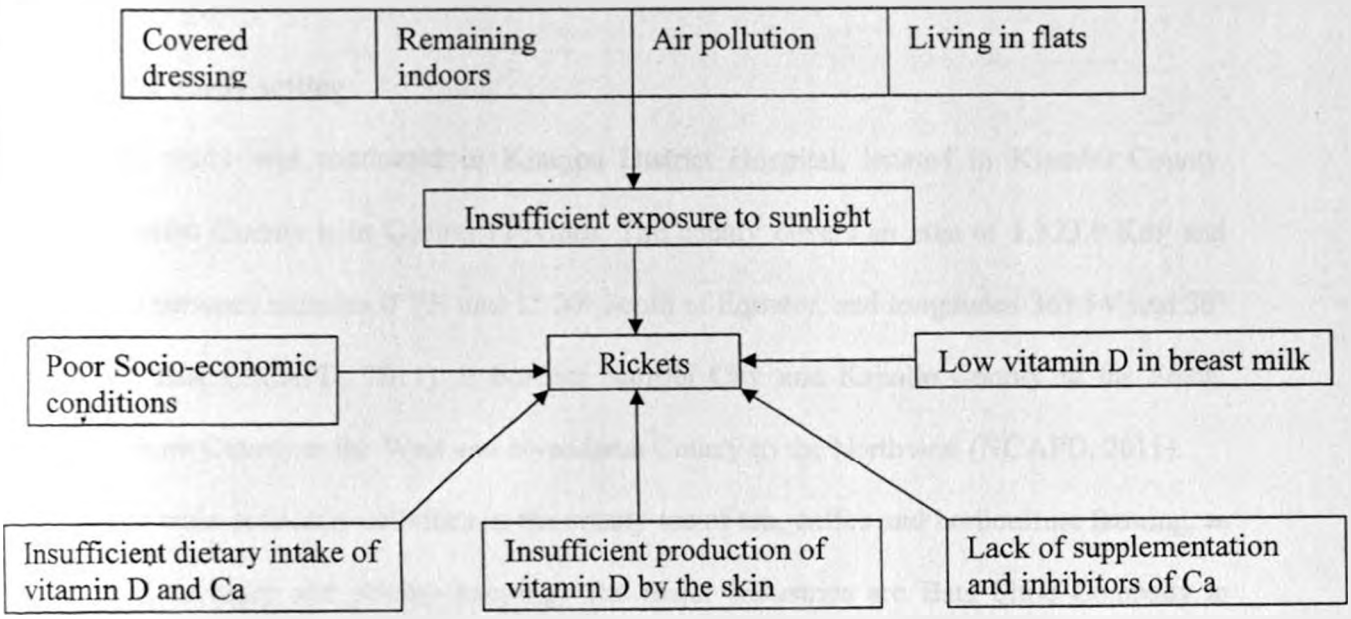

Figure 3.1: Etiopathogenesis for nutritional rickets in developing countries

Source: Adopted from Etiopathogenesis for Nutritional Rickets in Developing Countries (Hochberg, 2003).

The objective of this study was to determine and compare the socio-economic and demographic factors associated with rickets among the children.

3.2 Study design and methodology

3.2.1 Study design

The study involved a controlled case study design with mothers of participating children who serving as study respondents. Two hundred children with rickets and a similar

number of children without rickets making a total of 400 children aged 6-59 months were selected for the study. Children with the rickets formed the case group while those without served as control group.

3.2.2 Study setting

The study was conducted in Kiambu District Hospital, located in Kiambu County. Kiambu County is in Central Province. The county covers an area of 1,323.9 Km^2 and lies between latitudes 0°75' and 1° 20' South of Equator, and longitudes 36° 54' and 36° 85' East (NCAPD, 2011). It borders Nairobi City and Kajiado County to the South, Nakuru County to the West and Nyandarua County to the Northwest (NCAPD, 2011).

The main economic activities in the county are of tea, coffee and horticulture farming, as well as dairy and poultry keeping. The major industries are Bata Shoe Company in Limuru, Carbacid Mining in Lari and Dairy processing in Githunguri, Lari and Limuru and various tea and coffee processing factories (NCAPD, 2011).

The total population is 1,623,282 of which 802,609 are males and 820,673 females (NCPAD, 2011). There are over 250 health facilities spread across the county with an average distance of 5 Km. The Kiambu District Hospital is the main hospital serving the population of Kiambu, Thika and Nairobi. It is a Level Four District Hospital (Appendix 5-Map).

3.2.3 Study population

The study population was children aged 6-59 months who visited Kiambu District Hospital for health care services during the months of August and September 2011 and

suffering from rickets. The children were selected as they visited the Out Patient Department (OPD), pediatric ward, and physiotherapy Division of the Hospital.

3.3 Study methodology

3.3.1 Sample size for the study children

Mothers with children suffering from rickets were exhaustively sampled together with the children as they attended Kiambu District Hospital during the months of August 2011 to September 2011. Systematic random sampling was employed to get a similar number of children without rickets. In total 200 children with rickets and 200 without rickets was obtained.

3.3.2 Data collection tools

Structured questionnaires were used to collect data from the mothers of the study children. The parameters measured were on socio-economic and demographic characteristics. Both open and close ended questions were used. The baseline information obtained from participating households included age, sex, marital status, education level and occupation. The socio-economic characteristics investigated were income and household size.

3.3.3 Data handling and quality management

The questionnaires were pretested to make sure that it was well understood and correctly filled by enumerators. Discussions with enumerators were done on daily basis to identify encountered problems and how to address them. The field assistants were trained on

ethical and human rights issues. Such involved the need to explain to the respondents the objectives of the study, the contents of the questionnaire and the expected outcomes. The training was conducted for three days prior to pre-testing period (Appendix 3- Training curriculum).

3.4 Pre-testing and administration of questionnaire

The questionnaire was pretested in Nguriunditu Village in Kikuyu Division. Thirty homesteads with children aged 6-59 months old were visited. The information gathered was used to rectify and update the tools. The pre-tested and semi- structured questionnaire was used to conduct interviews with the mothers.

3.5 Statistical data analysis

Data processing was done using SPSS version 16 software. The data entered into the computer was cleaned before analysis. Means were generated for ages and family sizes, while Chi square test was used for comparisons between the case and control group.

The relationship between rickets and different roles played by socio-economic and demographic, characteristics were assessed using multiple regression analysis to show relationship.

3.6 Inclusion criteria

The respondents included in the study were mothers with children aged 6-59 months old suffering from rickets and those not suffering from rickets visiting Kiambu District Hospital and willing to participate in the study.

3.7 Ethical issues

Research permit was sought from the Kiambu District Hospital administration before the work began. Scientific merit, equitable selection of subjects, seeking informed consent, confidentiality and avoidance of coercion were considered while conducting the research. Written and oral consent to take part in the study was obtained from literate and illiterate respondents respectively.

3.8 Results

3.8.1 Prevalence of rickets

Table 3.1 shows the total number of children who visited Kiambu District Hospital during the months of August and September 2011. A total of 2793 males and 3048 females visited the hospital during this period. During this period, a total of 200 children suffering from rickets were studied translating to 3.4 % of the total children who visited the hospital.

Table 3.1: Prevalence of rickets

Period of visit	With rickets			Number of children who visited Kiambu District Hospital in the study period			
	Male(%)	Female(%)	%	Male	Female	Total	%
August 2011	31	20	51	1501	1292	2793	48
September 2011	27	22	49	1689	1359	3048	52
Total	58	42	100	3190	2651	**5841**	100

3.8.2 Household size distribution

A total of 400 households were studied in the area. The households had a population of 1567 out of whom 47.6 % were males and 52.5% were females. Table 3.2 shows the age

distribution of persons in the households. From the table, the age group 19 years and above comprised of the highest number of members while those aged 64 years and above had the least members.

Table 3.2: Age distribution for persons in households with study children (N=1567)

With rickets					Non rickets					
Age category	Male	%	Female	%	Male	%	Female	%	Total	%
0-5 years	142	9.1	125	7.9	137	8.74	118	7.53	522	33.3
6-14 years	52	3.32	56	3.57	53	3.4	52	3.32	213	13.6
15-18 years	3	0.2	12	0.77	9	0.57	9	0.57	33	2.11
19-63	178	11.4	232	15	171	10.9	215	13.72	796	50.8
64 onwards	0	0	2	0.1	1	0.1	0	0	3	0.19
Total	**375**	**23.9**	**427**	**27.4**	**371**	**23.7**	**394**	**25.1**	**1567**	**100.0**

3.8.3 Sex of the children suffering from rickets

Figure 3.2 shows the sex of the children suffering from rickets who visited Kiambu District Hospital during the study period. According to the results, males were slightly more, (58%) than the females (42%). This means that males were more likely to develop rickets than females.

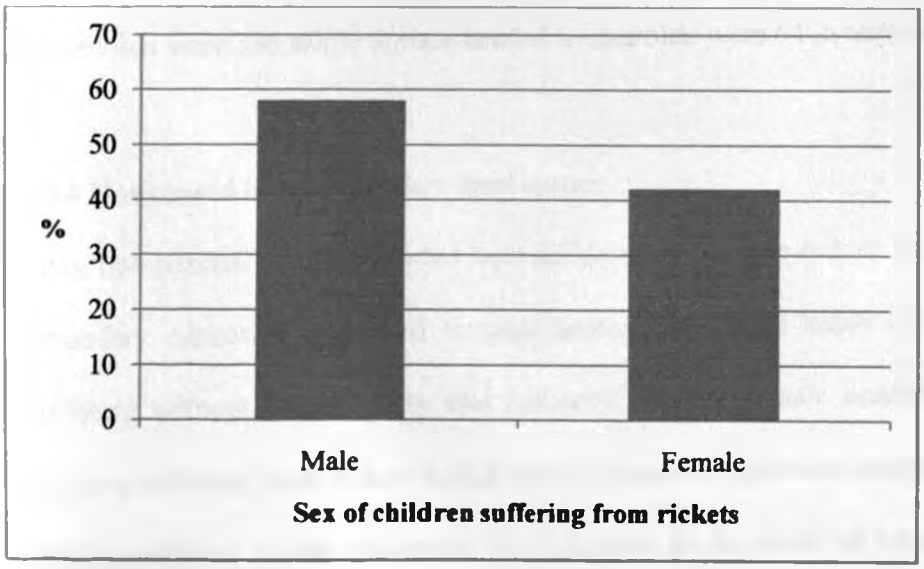

Figure 3.2: Sex of children suffering from rickets

3.8.4 Age of study children

Table 3.3 shows the age categories for the study children. According to the table, the age category of 6-12 months had the largest number (58.5%) of children suffering from rickets compared to 43.5% for children without rickets.

This means that the child's age was a significant determinant of possibility of developing rickets and the age most vulnerable was 6-12 months old.

Table 3.3: Distribution of the study children according to their age

Age category (Months)	Percent of Children with rickets	Percent of Children without rickets
6-12	58.5	43.5
13-19	26.5	29.5
20-26	12	10
27-33	2.5	5.5
34-40	0.5	5.5
41-47	0	3.5
48-57	0	2.5

3.8.5 Characteristics of the household head

Table 3.4 shows characteristics of the household head. From the table, male headed households were 336 while female headed households were 64 in number.

3.8.6 Household head education level status

Sixty one percent of male headed households with children rickets had attained at least secondary education compared to male headed household heads (56%) with children suffering without rickets. Fifty two percent (52%) of female headed households with children suffering from rickets had attained secondary education compared to 30% of the children without rickets. However, the difference in the levels of education between the male and the female headed households was not significant ($p<0.05$).

3.8.7 Marital status of household head

Marital status was not a strong factor in the households having rickets children as the highest rickets cases came from married families (98%) with very few cases from single or divorced families (1.7%). The largest proportion of both rickets and non rickets cases were in married families as shown in Table 3.4.

Table 3.4: Characteristics of household head

Characteristic	Male headed HH		p value	Female HH		p value
	With rickets	Non rickets		With rickets	Non rickets	
Sex of household head	51	49	**0.261**	44	56	**0.162**
Education level			**0.344**			**0.421**
Post secondary	61	56		52	30	
Pre sec. education	39	44		48	70.	
Marital status			**0.235**			**0.301**
Married	98.3	99.4		70.4	86.5	
Single, Separated/divorced	1.7	0.6		29.6	13.5	

3.8.8 Age of the mothers for the study children

Table 3.5 shows the characteristics of the mothers of the study children. The youngest mother was 18 years old while the oldest was 45 years. The mean age for the mothers with children suffering from rickets was 28 ±4.9 (Mean, SD) and for non rickets cases 27 ±4.6 (Mean, SD). The observed distribution of the mother's age was different from the expected distribution (20) as shown in table.

Table 3.5: Characteristics of the mothers for the study children

Characteristic	With rickets	Non rickets	Expected distribution
Age category(yrs)			
18-23	15.5	17.7	**20**
24-29	49.4	52.4	
30-35	25.6	24.4	
36- 41	8.7	4.9	
42 0nwards	0.6	0.6	
Education level			**50**
Post secondary	49	47	
Pre secondary	51	53	
Mothers occupation			**50**
Employed	41	47	
Non employed	69	63	

3.8.9 Mother's level of education

According to table 3.5 above, 49% of the mothers with rickets children and 47% of non rickets mothers had completed secondary school. The rest (51%) of the rickets cases and 47% non rickets cases did not have post secondary education. The observed distribution of the mother's education was different from the expected distribution (50) as shown in table.

3.8.10 Occupation of the mother

About half of the mothers were employed comprising 41% of the rickets cases and 69 % of the non rickets cases (table 3.5).The rest (69%) of the rickets cases and 47 of the non rickets cases were unemployed. The observed distribution of the mother's occupation was different from the expected distribution (50) as shown in table.

3.8.11 Income distribution of the study group

Data on the economic status of the study households is shown in table 3.6. Monthly income for the households with children suffering from rickets ranged from Kenya Shillings 500 to 70,000 with a mean of 12,217.4, while for those without rickets was 500 and 60,000 and with a mean of 11,971.5. From the table, the largest proportion of the population earned between 7000-10000 Ksh in the monthly incomes. The observed distribution of the household income was different from the expected distribution (12.5) as shown in table. There was no significant difference ($p<0.05$) between the mean income for households with rickets children and that for households with children not suffering from rickets.

Table 3.6: Monthly income distribution of the study group

Income distribution (Ksh)	With rickets (%) n=200	Non rickets (%) n=200	Expected distribution
500-1000	1.5	0.5	**12.5**
1001-5000	26	21.5	
5001-7000	14.5	16.5	
7001-10000	25	26.5	
10001-15000	9	13	
15001-18000	1.5	2	
18001-20000	8.5	8	
20001-70000	14	12	

3.8.12 Determinants of rickets using multivariate analysis

Logistic regression analysis was performed to identify the effect of each explanatory variable on rickets. As can be seen in table 3.7, the regression analysis identified the child's age and the age of the mother as determinants of rickets in the study sample. The analysis showed that the younger children are 0.93 times more likely to develop rickets compared to the older children. The difference was highly significant ($p<0.05$). The

logistic regression also showed that children of older mothers were 1.1 times more likely to develop rickets compared to the children of the younger mothers. The difference was highly significant ($p<0.05$). The sample analysis showed that male children are 1.1 times more likely to develop rickets as compared to the female children. Though not significant, post secondary education of the mother increased the likelihood of a child developing rickets 0.8 times. Children raised by both parents were also at a risk of developing rickets than children raised by single mothers. However, the difference was not significant ($p<0.05$).

Table 3.7: Logistic regression of the effect of the SES on rickets status in KDH

Explanatory variables	β	Std. Error	p value	Exp(β)
Intercept	-0.639	0.669	0.340	
Sex of child				
Male [RC]	0.102	0.213	0.631	1.108
Female				
Age of child	-0.072	0.015	**0.000	0.930
HHH				
Male [RC]	-0.216	0.879	0.806	0.806
Female				
Marital status				
Married [RC]	0.235	0.848	0.782	1.265
Separated/divorced				
HH monthly income	0.000	0.000	0.831	1.000
HHH education				
Post secondary [RC]	-0.235	0.247	0.340	0.790
Pre secondary				
Age of mother	0.065	0.025	**0.008	1.067
Education of mother				
Post secondary [RC]	0.238	0.244	0.328	1.269
Pre secondary				
Mothers occupation				
Employed [RC]	-0.164	0.235	0.486	0.849
Unemployed				

0=rickets and 1= non rickets, RC: Reference Category, ** Highly significant at $p<0.01$, Unmarked: Not significant, Expo β: Odds ratio, SES: Socio- Economic Status, KDH: Kiambu District Hospital, HH: Household, HHH: Household head.

3.9 Discussion

3.9.1 Prevalence of rickets

According to the Daily Nation dated 11th March 2012, Naivasha District Hospital treats fifteen new cases of rickets in a month. This translates to 0.04% of the population of the under fives in visiting Naivasha District. From the results obtained in this study the prevalence of rickets in Kiambu District Hospital is higher than in Naivasha District Hospital.

3.9.2 Household's socio-economic and demographic profile

3.9.2.1 Distribution of household occupants by age and sex

Data in the current study indicates there are more persons less than 18 years which accounts for nearly half of the population and another half of the population above 19 years but below 65 years. This data is consistent with the KDHS 2008/09 where those aged 0-63 years account for more than half of the population (KDHS, 2010). Those aged 60 years and above make up 0.19% of the total population surveyed. The age dependency ratio for the two groups is 0.5. According to the KDHS 2008/ 09, those aged 65 years and older make up 4% of the total household population.

The results of the current study indicate a lower dependency ratio and percentage for persons above 65 years. The lower percentage could have been due to the study setting being peri-urban which meant most of the residents were young and middle aged people able to earn an income to sustain themselves.

3.9.2.2 Sex of the study children

The current study indicates that males were slightly higher than the females for the two study groups.The male to female ratio was 1.2:1. This is similar to a study carried out at Kenyatta National Hospital to assess the incidences of rickets of prematurity where rickets was more predominant in male infants compared to female infants.

3.9.2.3 Distribution of the study children according to their age

It is clear from this study that rickets is predominant in children less than one year of age. This is in line with WHO (2012) where the younger children are more prone to infections compared to their older counterparts. As the age increases, immunity to infections also goes up. This is similar to a study carried out at Lady Reading Hospital in Peshawar, Jordan where rickets was more predominant in children below one year of age. In the study, 66% children were less than one year of age, 24% were 1-2 years of age 6% were 2-3 years old while 4% were above 3 years of age (Khan et al., 2001).

3.9.2.4 Head of the household

The data from this study show that 84% of households are male headed and only 16 % are female headed while the data for house head composition show that at the national level, women head 34% of the Kenyan households.According to the results male headed households were 0.9 times less likely to develop rickets and this could be because of shared parenting.

3.9.2.5 Age of mothers

From the findings of the study, majority of the mothers are aged between 24-35 years. Only a few mothers are teenagers. This may be attributed to improved level of education

and as stated in the KDHS that the proportion of teenage mothers have declined from 19% to 15% between 2003 to 2009. The study area being a peri-urban set up conforms to other social indicators of development such as education and use of family planning that influence a delay in onset of child bearing. It was expected that children of older mothers would less predisposed to rickets because of a long experience in child care practices. Results of this study show that as mother's age increased, the risk of rickets increased.

3.9.2.6 Marital status

It was expected that children raised by both parents were less likely to have rickets because of shared parenting but this is contrary to this study where majority of the parents are married. Results of this study show that children raised by both parents were 1.3 times at risk of developing rickets. However, the difference was not significant ($p < 0.05$).

3.9.2.7 Education attainment in the households

Over half of the household heads with children suffering from rickets have post secondary education in this study. This is contrary to a similar study carried out in Isra University Hospital, Pakistan, to determine the factors contributing to nutritional rickets among the children below five years, maternal education played an important role (Ali et al., 2007).

Kiambu being a peri-urban setting the results show that the education attainment is higher than in the rural areas and this compares well with the 2008/2009 KDHS where the educational attainment by type of residence shows that respondents in uban areas are more educated than their rural counterparts.

3.9.2.8 Mother's occupation and monthly income for the households

There is no difference between the incomes of the two groups ($p<0.05$). However, mothers who were employed reduced the risk of rickets 0.8 times and this could be because the increased income led to empowerment of these mothers leading to better dietary choices for their children.

3.10 Conclusion

The study concludes the following:

1. The prevalence of rickets in Kiambu District Hospital is high as raised by the medics and worrying
2. Boys were more vulnerable to rickets than girls
3. The age most vulnerable to rickets was 6-12 months
4. Children of employed mothers were at a lower risk of developing rickets.
5. Children born by older mothers were at an increased risk of rickets.

3.11 Recommendations

1) The government and other development partners should design interventions to curb the upsurge of rickets in Kiambu District Hospital. These interventions should target parents and caregivers of children below one year as they are more vulnerable to rickets
2) The study recommends the need to empower women to attend school and later look for employment to prevent the rising cases of rickets in Kiambu District Hospital.

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CHAPTER 4: FEEDING AND CHILD CARE PRACTICES OF CHILDREN WITH RICKETS

Abstract:

Rickets among children in Kiambu District Hospital as reported by doctors is high with about 100 cases per month. However, the causative factors for the seemingly high cases of rickets are not clearly understood. Insufficient dietary intake of vitamin D and calcium, inhibitors of calcium absorption, covered dressing, remaining indoors for long periods and living in urban flats are some of the common causes of rickets. The objective of this study therefore was to determine the feeding and childcare practices associated with occurence of rickets among children aged 6-59 months and attending Kiambu District Hospital for medical care.

A controlled case study design was used involving 200 children with rickets and a similar number without rickets for children attending Kiambu District Hospital for health care services. Children with rickets were exhaustively selected for the study, while the children without rickets were selected systematically after every case was selected. Data collection was from August 2011 to September 2011, and was done using structured questionnaires with mothers as respondents. Information collected included breast feeding, complementary feeding and child care practices by the mothers. SPSS version 16 statistical software was used for data entry, validation and analysis. The 24 hour recall data was analyzed first using Nutrisurvey for windows software 2007 to determine whether the children were meeting their RDA or not based on their age.

Children who were not breast feeding were 0.3 times more likely to develop rickets compared to the ones who were breast feeding. The likelihood of developing rickets was

significantly higher for children who started complementary feeding before six months of age ($p<0.01$). A higher percentage of the non rickets children (99%) were sun bathed every day compared to 63% of the rickets cases. These figures were highly significant ($p<0.01$). Early introduction of complementary foods, short period of breast feeding, inadequate complementary practices and lack of exposure to the sunlight are the risk factors associated with rickets in Kiambu District Hospital.

Early introduction of complementary foods, short period of breast feeding, inadequate complementary practices and lack of exposure to the sunlight are the risk factors associated with rickets in Kiambu District Hospital.

The government and other development partners should design interventions to promote exclusive breast feeding and increasing the intake of calcium and phosphorus rich foods among children. The caregivers should be educated on the need to sunbathe the children with more emphasis on alternative care givers.

4.1 Introduction

Rickets is re-emerging in developing countries and dietary assessment studies have shown that low calcium intake is an important causal factor (Bwibo and Charlotte, 2003b). The effect of other factors such as cultural barriers, food taboos hindering intake of animal source food (ASF) and the lack of knowledge on the importance of ASF such as meat and dairy products have also been documented. Figure 4.1 shows the etiopathogenesis for nutritional rickets in developing countries.

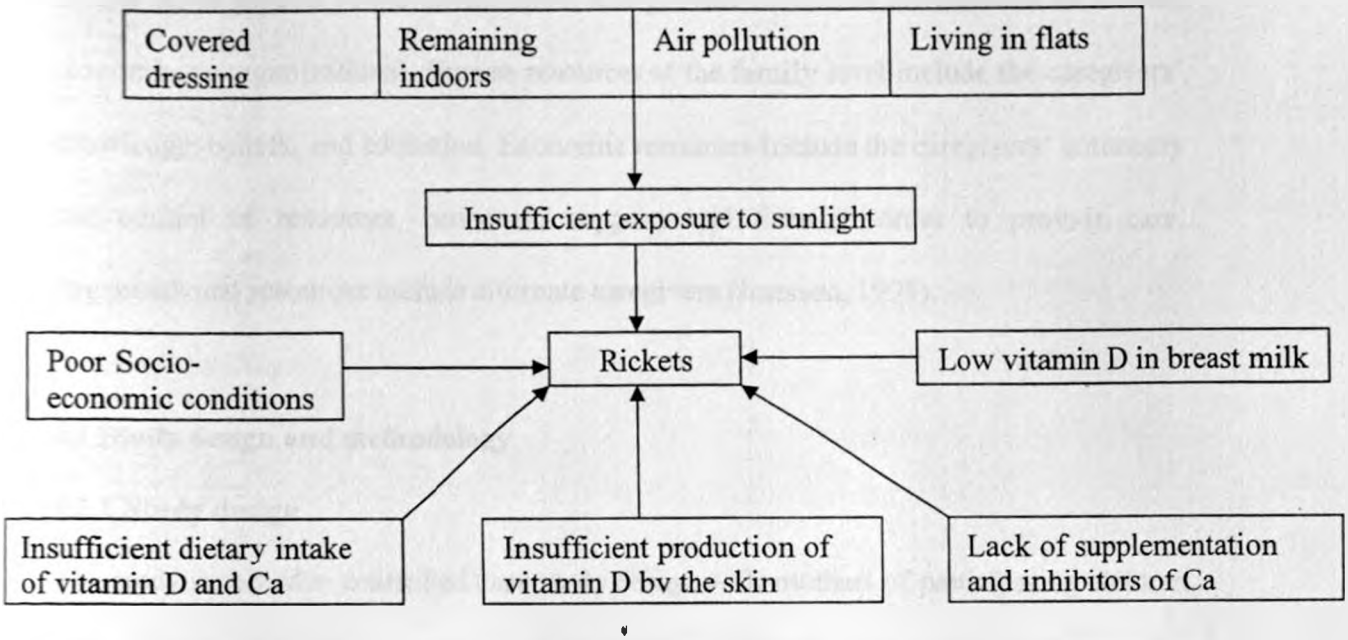

Figure 4.1: Etiopathogenesis for nutritional rickets in developing countries

Source: Adopted from Etiopathogenesis for Nutritional Rickets in Developing Countries (Hochberg, 2003).

From the figure, insufficient dietary intake of vitamin D and calcium, inhibitors of calcium absorption, covered dressing, remaining indoors for long periods and living in urban flats are some of the common causes of rickets. Blocking of ultra- violet light from the sun reduces the ability of the skin to synthesize vitamin D (Kinuthia et al., 1994).

According to Huffman and Luann (1994), prevalence of indefinite morbidity and rickets would remain unchanged unless child survival and development programs emphasize exclusive breast feeding during the first six months of life, improved complementary foods and better feeding practices.

According to Bwibo and Charlotte (2003b), nutritional rickets can be largely eliminated through preventive measures of fortification of cow's milk, infant formulas with vitamin

D. The distal aspects of the environment that provide resources for care can be human, economic, or organizational. Human resources at the family level include the caregivers' knowledge, beliefs, and education. Economic resources include the caregivers' autonomy and control of resources, economic support, and time in order to provide care. Organizational resources include alternate caregivers (Jonsson, 1995).

4.2 Study design and methodology

4.2.1 Study design

The study involved a controlled case study design with mothers of participating children who serving as study respondents. Two hundred children with rickets and a similar number of children without rickets making a total of 400 children aged 6-59 months were selected for the study. Children with the rickets formed the case group while those without served as control group.

4.2.2 Study setting

The study was conducted in Kiambu District Hospital, located in Kiambu County. Kiambu County is in Central Province. The county covers an area of 1,323.9 Km^2 and lies between latitudes 0°75' and 1° 20' South of Equator, and longitudes 36° 54' and 36° 85' East (NCAPD, 2011). It borders Nairobi City and Kajiado County to the South, Nakuru County to the West and Nyandarua County to the Northwest (NCAPD, 2011).

The main economic activities in the county are tea, coffee and horticulture farming, as well as dairy and poultry keeping. The major industries are Bata Shoe Company in

Limuru, Carbacid Mining in Lari and Dairy processing in Githunguri, Lari and Limuru and various tea and coffee processing factories (NCAPD, 2011).

The total population is 1,623,282 of which 802,609 are males and 820,673 are females (NCPAD, 2011). There are over 250 health facilities spread across the county with an average distance of 5 Km. The Kiambu District Hospital is the main hospital serving the population of Kiambu, Thika and Nairobi. It is a Level Four District Hospital (Appendix 5-Map).

4.2.3 Study population

The study population was children aged 6-59 months who visited Kiambu District Hospital for health care services during the months of August and September 2011. The children were selected as they visited the Out Patient Department (OPD), pediatric ward, and physiotherapy Division of the Hospital.

4.3 Study methodology

4.3.1 Sample size for the study children

Mothers with children suffering from rickets were exhaustively sampled together with the children as they attended Kiambu District Hospital during the months of August 2011 to September 2011. Systematic random sampling was employed to get a similar number of children without rickets. In total 200 children with rickets and 200 without rickets was obtained.

4.3.2 Data collection tools

Structured questionnaires were used to collect data from the mothers of the study children. The parameters measured were on feeding and child care practices.The type of variables measured were breast feeding practices, complementary feeding practices, types of care givers, houses occupied, sunbathing and morbidity experience. A 24 hour recall questionnaire was administered to sub-sample of 100 children to obtain information on adequacy of the vitamin D, calcium and phosphorus in the children's diet in the previous 24 hours. Before conducting the 24 hour dietary recall questionnaire it was first determined whether the previous 24 hour period was a usual day for the household. Salter kitchen food scale was used for measuring foods while a food scale was used to weigh particular foods or volumes equivalent to foods during conversion of household food measures in metric units.

4.3.3 Data handling and quality management

4.3.3.1 Calibration and standardization of tools

The questionnaires were pretested to make sure that it was well understood and correctly filled by enumerators. Calibration of scales was also done regularly to ensure accuracy. Adjustments were made to ensure the scale reading is correct.

4.3.3.2 Training of enumerators and field assistants

Discussions with enumerators were done on daily basis to identify encountered problems and how to address them. The field assistants were trained on ethical and human rights issues. Such involved the need to explain to the respondents the objectives of the study,

the contents of the questionnaire and the expected outcomes. The training was conducted for three days prior to pre-testing period (Appendix 3- Training curriculum).

4.4 Pre-testing and administration of questionnaire

The questionnaire was pretested in Nguriunditu Village in Kikuyu Division. Thirty homesteads with children aged 6-59 months old were visited. The information gathered was used to rectify and update the tools.

4.5 Statistical data analysis

SPSS version 16 statistical software was used for data entry, validation and analysis. The 24 hour recall data was analyzed first using Nutrisurvey for windows software (2007) to determine whether the children were meeting their RDA or not based on their age. The data was then transferred to SPSS for further analysis. Means for consumption of vitamin D, calcium and phosphorus were used while Chi square test, t test and multiple regression analysis were used to test associations among different variables.

4.6 Inclusion criteria

The respondents included in the study were mothers with children aged 6-59 months old suffering from rickets and those not suffering from rickets visiting Kiambu District Hospital and willing to participate in the study.

4.7 Ethical issues

Research permit was sought from the Kiambu District Hospital administration before the work began. Scientific merit, equitable selection of subjects, seeking informed consent, confidentiality and avoidance of coercion were considered while conducting the research. Written and oral consent to take part in the study was obtained from literate and illiterate respondents respectively.

4.8 Results

4.8.1 Breast feeding between the two groups

Figure 4.2 shows the breast feeding status at the time of carrying out this study by the two study groups. According to the figure, a lower percentage (15%) of the children without rickets was not breast feeding at the time of the study compared to those with rickets (27%). The difference between the two groups was highly significant ($p<0.001$) indicating children who were not breast fed were more predisposed to rickets compared to the ones who were breast fed.

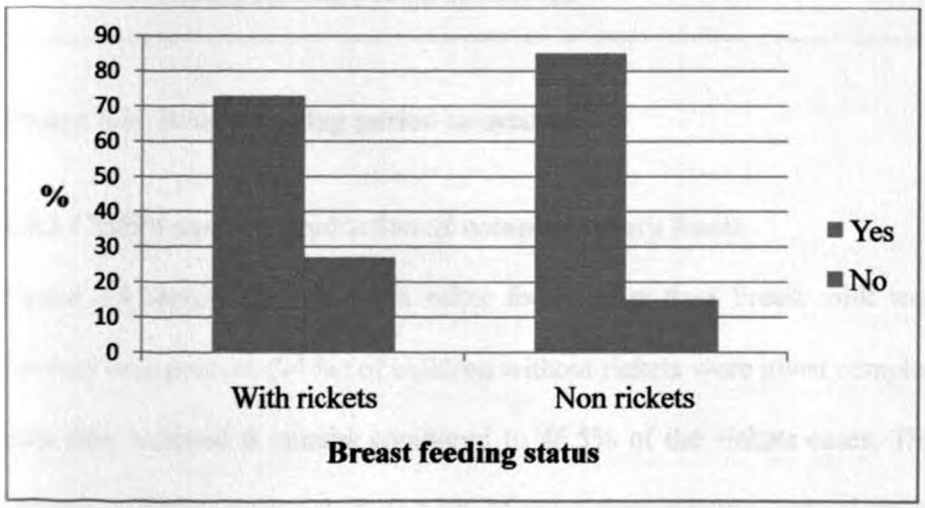

Figure 4.2: Breast feeding among the children

4.8.2 Breast feeding period for children

Figure 4.3 shows the period of breast feeding among study children and the control group. From the figure, 28.6% of the children suffering from rickets stopped breast feeding before attaining six months compared to 4.8% of the non rickets. Thirty one percent (31%) of the children with rickets stopped breast feeding between 7-12 months compared to 11% of the non rickets children. The difference between the two groups was highly significant ($p<0.001$) meaning that children with rickets stopped breast feeding earlier than those without rickets.

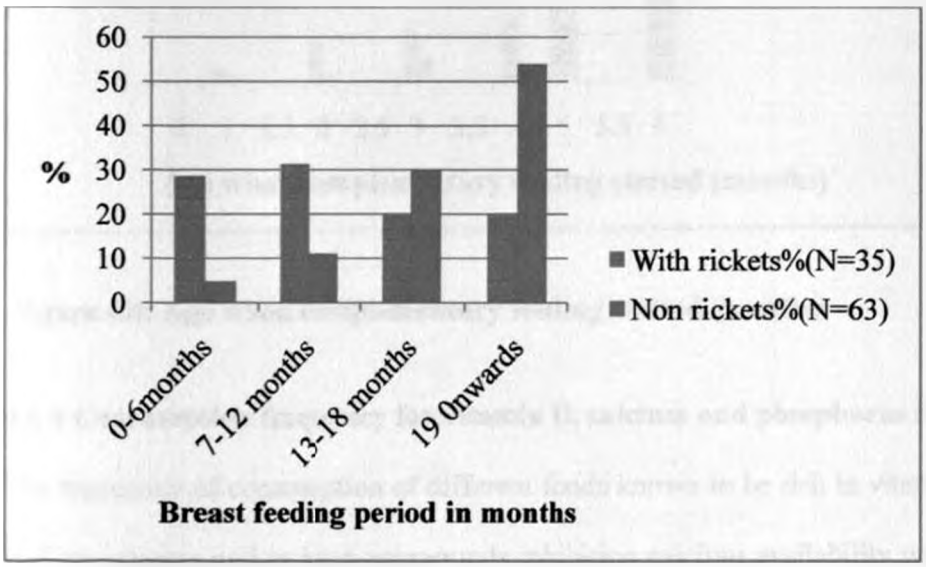

Figure 4.3: Breast feeding period in months

4.8.3 Child's age at introduction of complementary foods

Figure 4.4 shows the age when other foods other than breast milk were introduced. Seventy four percent (74 %) of children without rickets were given complementary foods after they attained 6 months compared to 46.5% of the rickets cases. Three percent of children suffering from rickets and 1% of non rickets children were given complementary

foods at one month of age. This was highly significant difference ($p<0.01$) indicating that children suffering from rickets were given complementary foods earlier than the children without rickets.

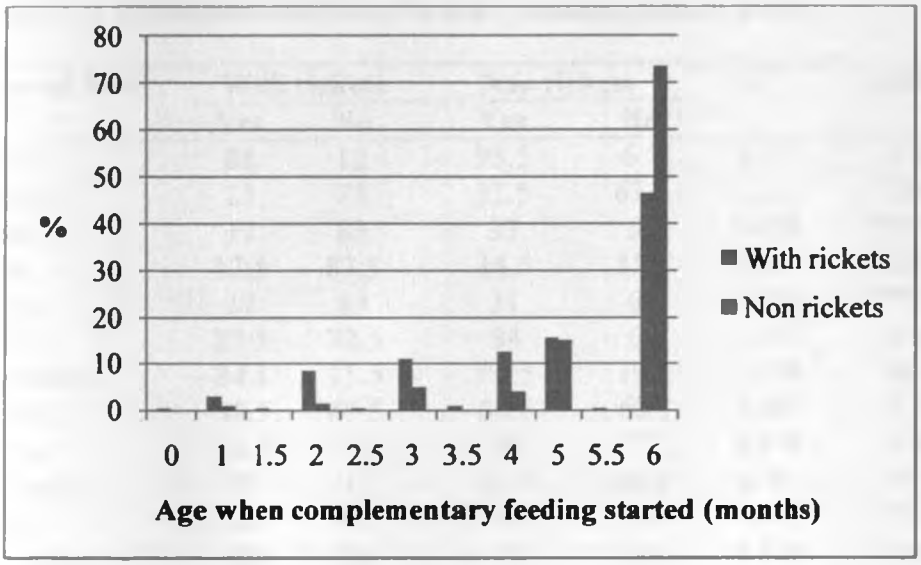

Figure 4.4: Age when complementary feeding started (months)

4.8.4 Consumption frequency for vitamin D, calcium and phosphorus rich foods

The frequency of consumption of different foods known to be rich in vitamin D, calcium and phosphorus and to have compounds inhibiting calcium availability was determined. The frequency of consumption of different foods in the study households is shown in table 4.1. There was a significant difference in the frequency of consumption of meat, liver, cabbages, and eggs between the two groups. Very few children from both groups were fed on fish which is a good source of vitamin D. Seventy six percent of the rickets cases and 76% of the non rickets children were fed on bananas respectively. There was no significant difference ($p<0.05$) in the frequency of consumption between the two groups.

Majority of the children suffering from rickets were fed on spinach and the breakfast cereal compared to those without rickets. This means that children suffering from rickets were fed more on foods containing calcium inhibitors compared to the non rickets children.

Table 4.1: Chi square analysis of weekly consumption of foods

Type of food	With rickets		Non rickets		λ^2	p-value
	Yes	No	Yes	No		
Milk	88	12	93.5	6.5	3.60	0.058
Yogurt	22	78	32.5	67.5	5.56	*0.018
Meat	17	83	37	63	20.29	**0.000
Peas	12.5	87.5	14.5	85.5	0.343	0.558
Liver	17	83	31	69	10.75	**0.001
Fish	27.5	72.5	34	66	1.98	0.159
Tomatoes	84.5	15.5	80.5	19.5	1.108	0.292
Bread	30.5	69.5	39.5	60.5	3.560	0.059
Kales	25.5	74.5	29	71	0.618	0.432
Spinach	87	13	75.5	24.5	8.68	**0.003
Eggs	39	61	49	51	4.06	*0.044
Bananas	79	21	76	24	0.516	0.472
Beans	65	35	73.5	26.5	3.39	0.065
Breakfast cereal	68	32	41	59	29.4	**0.000

* Significant at $p<0.05$

** Highly significant ($p<0.01$)

4.8.5 Dietary intake of vitamin D, calcium and phosphorus

Results of the 24 dietary recall are presented in table 4.2. From the table, the mean daily dietary intake of calcium was 191 ±114.1 mg (Mean, SD) for children with rickets and 264 ±114.1 mg (Mean, SD) for children without rickets. The mean difference in the calcium intake between the children with rickets and those without rickets was highly significant ($p<0.01$). This means that the children suffering from rickets had a lower intake of calcium than those without rickets. The mean daily dietary intake of phosphorus was 228 ±137 mg (Mean, SD) for children with rickets and 332 ±124.8 mg (Mean, SD)

for children without rickets. The phosphorus intake between the children with rickets and those without rickets was highly significant ($p<0.01$). This means that the children suffering from rickets had a lower intake of phosphorus than those without rickets.

Table 4.2: Daily intake of vitamin D, calcium, and phosphorus according to 24 hour recall

	With rickets(n=51)		Non rickets (n=49)		
Food nutrient	**Mean±SD**	**95% CI**	**Mean±SD**	**95% CI**	**p value**
Calcium	190.7±114.1	158.6- 222.8	264±114.1	232.1-297.6	**0.002
Phosphorus	227.6±137	189.1 - 266.2	332.1±124.8	296.3-367.9	**0.000
Vitamin D	0.02±0.05	0.0004 - 0.0310	0.03±0.09	0.0005-0.06	0.415

**Highly significant ($p<0.01$)

4.8.6 Type of house occupied by the study children

Figure 4.5 shows the type of houses occupied by the study children. From the results, 29.5% of rickets children and 16% of the non rickets children lived in flats. These figures were highly significant ($p< 0.01$) indicating that the type of house occupied by the children was a strong determinant of the rickets status.

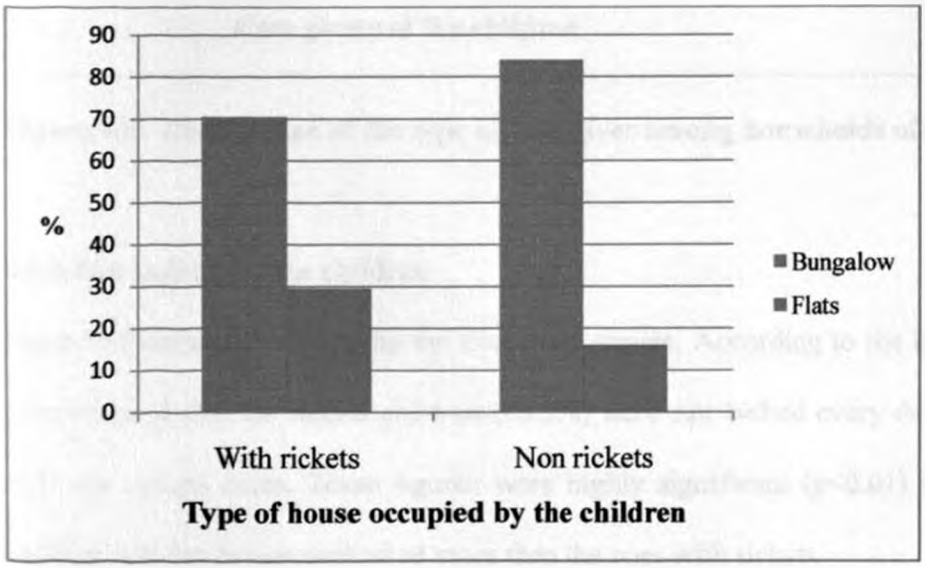

Figure 4.5: Type of house occupied by the study population

4.8.7 Types of care giver's for the study children

Figure 4.6 shows the care givers for the study children. According to the table, mothers were the principal care givers for the rickets children (78.5%) compared to 86.5 % of non rickets children. The rest, (21.5 %) of the rickets cases and (13.5%) non rickets children had other care givers during the day. The figures were statistically significant ($p<0.05$) indicating that children raised by mothers were less likely to develop rickets compared to the ones raised by other care givers.

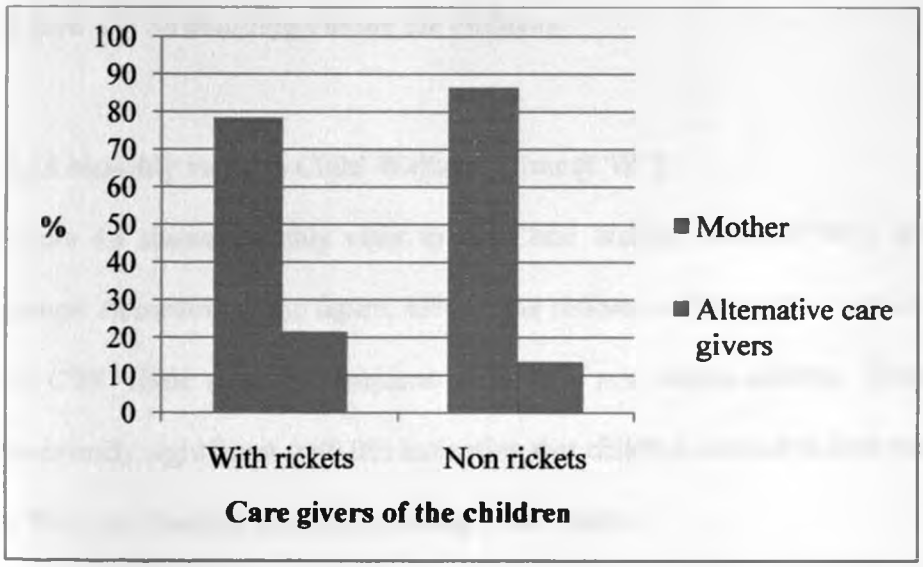

Figure 4.6: Distribution of the type of care giver among households of the children

4.8.8 Sun bathing of the children

Figure 4.7 shows sunbathing by the two study groups. According to the figure, a higher percentage of the non rickets children (98.5%) were sun bathed every day compared to 63% for rickets cases. These figures were highly significant ($p<0.01$) indicating that children without rickets sunbathed more than the ones with rickets.

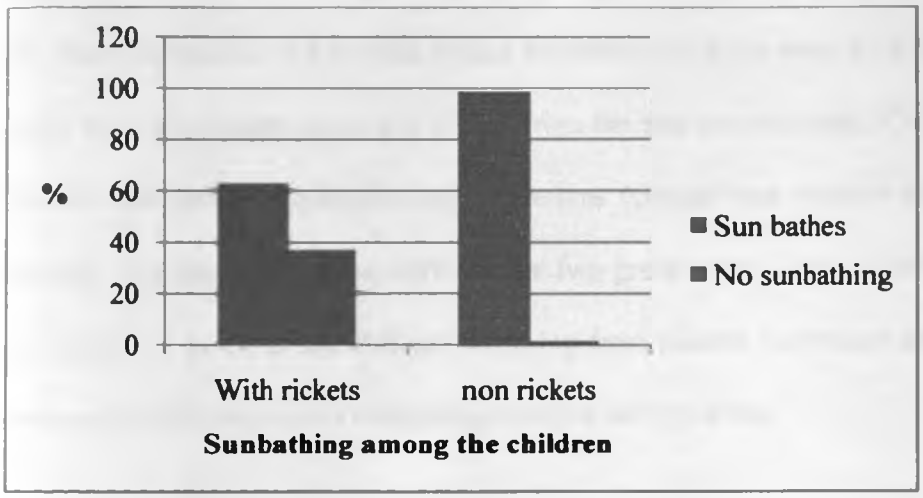

Figure 4.7: Sunbathing among the children

4.8.9 Monthly visits to Child Welfare Clinic (CWC)

Figure 4.8 shows monthly visits to the Child Welfare Clinic (CWC) of the two study groups. According to the figure, 63% of the children suffering from rickets were taken to the CWC clinic monthly compared to 74 % of non rickets children. These figures were statistically significant ($p<0.05$) indicating that children without rickets were taken to the CWC more than the children suffering from rickets.

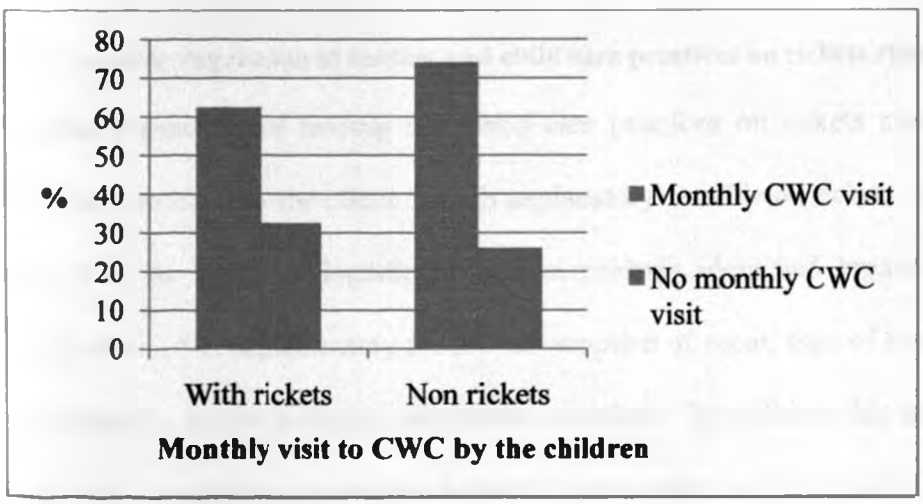

Figure 4.8: Monthly visits to the Child Welfare Clinic

4.8.10 Disease prevalence in the study group

Table 4.3 shows the morbidity status among the children. Among the children who were sick within the period of 3 months before the interview, there were 82.5 % incidences of disease from the rickets cases and 47.5% from the non rickets cases. The most common illnesses were lower respiratory tract infections (coughs and tonsils) and diarrhea and vomiting. The morbidity status between the two groups was highly significant ($p<0.01$). Accordingly, it is clear that children suffering from rickets were more prone to diseases most importantly respiratory infections, diarrhea and vomiting.

Table 4.3: Disease prevalence in the study group

Disease	With rickets Frequency (%) N=200	Non rickets Frequency (%) N=200
Lower respiratory tract infections	63	26.5
Diarrhea and vomiting	10.5	12.5
Infections	4.5	3
Malaria	1.5	0.5
Malnutrition	0.5	2
Chicken pox	1.5	2
Measles	1	1
Total illnesses within the children	**82.5**	**47.5**

4.8.10 Logistic regression of feeding and child care practices on rickets status in KDH

Logistic regression of feeding and child care practices on rickets status in KDH was performed to identify the effect of each explanatory variable on rickets. As can be seen in table 4.4, the multiple logistic regression analysis identified breast feeding, age of introduction of complementary foods, consumption of meat, type of house occupied and sunbathing as factors reducing occurrence of rickets. In addition, this study revealed that there was a significant association between consumption of the breakfast cereal to rickets.

The sample analysis showed that children who were not breast feeding were 0.3 times more likely to develop rickets compared to the ones who were breast feeding.

It was also observed that the likelihood of developing rickets was significantly higher for children who started complementary feeding before six months of age ($p<0.01$). The analysis also showed that consumption of meat by the children was a preventive factor to rickets. The risk of developing rickets for children who lived in flats was 0.4. Children who were not taken Child Welfare Clinics (CWC) were 0.6 times likely to develop rickets compared to the ones taken to the CWC. However, this was not significant ($p<0.05$). Though not significant, children who were raised by mothers according to this model were at a higher risk of developing rickets compared to children raised by other care givers.

Table 4.4: Logistic regression of feeding and child care practices on rickets status in KDH

Explanatory variables	β	Std. Error	p value	Exp(β)
Intercept	4.457	0.838	**0.000	
Breast feeding status				
Yes [RC]	-1.114	0.330	**0.001	0.328
No				
Age of complementary feeding				
> 6 months [RC]	-0.942	0.269	**0.000	0.390
< 6 months				
Meat				
Yes [RC]	-1.079	0.328	**0.001	0.340
No				
Liver				
Yes [RC]	-0.277	0.323	0.392	0.758
No				
Spinach				
Yes [RC]	0.645	0.337	0.055	1.906
No				
Breakfast cereal				
Yes [RC]	1.355	0.271	**0.000	3.876
No				
Type of house occupied				
Bungalow [RC]	-0.866	0.310	**0.005	0.420
Flats				
Sunbathing				
Yes [RC]	-3.341	0.625	**0.000	0.035
No				
CWC visits				
Yes [RC]	-0.522	0.292	0.074	0.593
No				
Types of care giver				
Mother [RC]	0.050	0.365	0.891	1.051
Alternative care givers				

0=rickets and 1= non rickets, RC: Reference Category, ** Highly significant at p<0.01, Unmarked: Not significant, Expo β: Odds ratio, CWC: Child Welfare Clinic

4.9 Discussion

4.9.1 Breast feeding and complementary feeding practices

WHO (2011) recommends that children be exclusively be breast fed in the first 6 months of life and complementary feeding in addition to continued breast feeding from 6 months until 24 months. This is because breast milk contains all the required nutrients in the

right amounts including calcium and vitamin D needed by the child from birth. However, young children who are weaned early are particularly at risk of developing rickets. Results of the logistic regression show breast feeding reduced the risk of developing rickets by 0.3 times. This could explain why children introduced to complementary foods early in this study were suffering from rickets compared to the non rickets children. The current study establishes a higher percent (85%) breast feeding children without rickets compared to 73 % for rickets children.

In a controlled case study carried out in Pakistan, poor weaning diets as well as breast-feeding contributed to rickets. Twenty three percent (23%) and 25% children of rickets and controls respectively were on formula milk. In control group, significantly higher number 86.7% as compared to rickets started weaning at age of 4-6 months (Ali et al., 2007). This is not in agreement with this study where 46.5% rickets children were exclusively on breast feeding, as compared to 73.5% of control group.

From the findings of this study, 74% of the non rickets children were exclusively breast fed for six months while 47% of the rickets children were exclusively breast fed.The results are higher than the national results of 32% (UNICEF, 2006). This could be due to increased Infant and Young Child Feeding (IYCF) program in the maternal clinics and in health facilities where majority of the mothers give birth. Much training is ongoing on IYCF to the mothers.

4.9.2 Consumption frequency for vitamin D, calcium and phosphorus rich foods

From the results obtained from the study population, the frequency of consumption of animal source foods rich in calcium and phosphorus is higher in the children without

rickets compared to the children with rickets. According to Schlenker (2011), eggs contain 220 mg of phosphorus per 100 g, meat contains 170 mg per 100 g while liver has 400 mg per 100g of phosphorus. The lower intake of these foods could predispose children to rickets.

According to Schlenker (2011), 250g of kales contain 179 mg of calcium. Green leafy vegetables such as spinach contain calcium but oxalic acid and phytates compromise bio availability (Joshi, 2010). According to Andrew (1976), a 125g cup of cooked spinach contains 750 mg of oxalates compared to 125 mg in kales. Results show that children fed on the breakfast cereal were 3.9 times at risk of developing rickets. The results also show that children who fed on spinach were 1.9 times at risk of developing rickets.

4.9.3 Dietary intake of nutrients

From the results obtained from the 24 hour dietary recall, the daily consumption of foods rich in vitamin D were below the recommended intake of 5 µg/day. This is because Vitamin D is rare in foods (Holick et al., 1992). Fish, a good source of vitamin D is not a staple food in Central Province.

The Food and Nutrition Board recommends 270 -500 mg per day of calcium. From the results given in this study, this does not compare well with the board's recommendations. The board further recommends a phosphorus intake of 275-500 mg per day. From the study, the mean phosphorus intake for the rickets cases was 227.6mg/day and for non rickets was 332.1mg/ day. Hence, the non rickets cases met their daily requirements while the rickets cases did not.

4.9.4 Type of house occupied by the study children

More rickets children occupied flats compared to the non rickets children. Results of this study show that living in bungalow houses reduced the occurrence of rickets. This is similar to an earlier study conducted in Pakistan where majority of the rickets children lived in flats while a very small percent lived in open houses.

4.9.5 Care givers of the study children

The fact that most of the mothers were unemployed could be the reason why they were the principal care givers for both the groups. Results from logistic regression show that children raised by the mothers were at risk of developing rickets. However, this is not significant ($p<0.05$).

4.9.6 Sunbathing by the children in the study

All children should have adequate sunshine at least 30 mins/week naked or with minimal clothing to receive the required vitamin D (Kinuthia et al., 1994). Results from this study show that the sunbathing reduced the risk of rickets. Children suffering from rickets were not sunbathed. One of the reasons could be living in the crowded flats as shown above which make the sun rays not to reach the ground. Living in flats may make it difficult to reach the lower grounds for the children to sun bathe. This could be the reason why they were suffering from rickets.

4.9.7 Morbidity experience among the children

Low calcium levels impair the child's immune system. The rickets children are more prone to infections (mostly chest infections), diarrhea, motor delay and sometimes

hypocalcemic tetany and convulsions (Khan et al., 2001). This could be the contributing factor for the high morbidity status of the rickets children compared to the non rickets.

It was evident from this study that chest infections were the common infections associated with rickets. This is higher than in a similar study carried out at Lady Reading Hospital in Peshawar, Jordan where chest infections and diarrhea were 40% and 20% respectively (Khan et al., 2001).

From the findings of this study, a higher percent of the non rickets children were taken for the monthly CWC visits where they could be getting information on IYCF compared to the rickets children. This could be the reason why they were not suffering from rickets.

4.10 Conclusion

Rickets can be considered a multifactorial condition in which early introduction of complementary foods, short period of breast feeding, inadequate complementary practices and lack of exposure to the sunlight are central.

4.11 Recommendations

The study therefore recommends the following:

1. The government and other development partners should design interventions to improve Infant and Young Child Feeding (IYCF) practices. The interventions should aim at promotion of exclusive breast feeding and increasing the intake of calcium and phosphorus rich foods among children. The Ministry of Health (MOH) needs to come up with guidelines on vitamin D and calcium supplementation to ensure the children meet the daily requirements of these nutrients.

2. The caregivers should be educated on the need to sunbathe the children with more emphasis on alternative care givers.

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APPENDICES

Appendix 1: Questionnaire to the mothers

SECTION 1: IDENTIFICATION

Location..... Sub-location.....Respondent No.....

Name of Interviewer.....

Date of interview...../...../2011

Respondent's name.....

Household Profile: 1) Married 2) Single /Separated/ divorced

1) Bungalow 2) Storey building (Indicate the floor).....

Name of the child..... Sex.....

SECTION 2: SOCIO- ECONOMIC AND DEMOGRAPHIC CHARACTERISTICS

2a Household head 1) M 2) F

2b Age of the HHH in years .....

2c Level of education for the HHH.....

2d If married spouse level of education .....

2e What is the main source of livelihood for HHH?

1) Farming
2) Formal employment
3) Self employed
4) Others(specify) .....

2f If married .what is the main source of livelihood for the other spouse?

1) Farming
2) Formal employment
3) Self employed
4) Others(specify) .....

2g Number of people in the HH (M/F) .....

0-5 YEARS M..... F .....

6-14 YEARS M..... F .....

15-18 YEARS M..... F.....

19 YEARS + M..... F.....

Above 64 years M ..... F.....

2h Estimated average household income per month (KSh).....

SECTION 3: CHILD HEALTH

Ask for the child health card

3a How old is the child? (In months) .....

3b Has your child been sick in the last 3 months? 1) Yes 2) No

3c If Yes in **3b** above, what was the nature of illness? .....

SECTION 4: FEEDING PRACTICES

4a Does the child breast feed? 1) Yes 2) No

4b If No in **4a** above, when did he /she stop breast breast feeding? .....

4c At what age did you introduce other foods/ drinks to your child other than breast milk?

4e Underline the frequency by which you feed the child with the following foods

FOOD ITEM	FREQUENCY (Average feeding per week)
Glass of milk	0 1 2 3 4 5 6
Yogurt	0 1 2 3 4 5 6
Meat (mutton/ beef)	0 1 2 3 4 5 6
Peas	0 1 2 3 4 5 6
Fish	0 1 2 3 4 5 6
Liver	0 1 2 3 4 5 6
Tomatoes	0 1 2 3 4 5 6
Bread	0 1 2 3 4 5 6
Kales	0 1 2 3 4 5 6
Spinach	0 1 2 3 4 5 6
Eggs	0 1 2 3 4 5 6
Bananas	0 1 2 3 4 5 6
Beans	0 1 2 3 4 5 6
Breakfast cereal	0 1 2 3 4 5 6

4f Indicate the type of food fed to the child during the last 24 Hours

Time	Meal	Ingredients used in preparation				Total amount cooked	Amount consumed	Any left over
		Description	Amount used	Weight	Source			

SECTION 5: CHILD CARE PRACTICES

5a Who takes care of the child during the day? .....

5b Does the child attend Child Welfare Clinic every month? 1)Yes 2) No

5c Does the care giver sun bathe the baby during the day? 1) Yes 2) No

5d If Yes in **5c** above, how long does the sun bathe take?.....(Specify in hours)

Appendix 2: Informed consent form

REQUEST FOR CONSENT TO PARTICIPATE IN THE STUDY

Name of client .....

Age.....

Address.....

I would like to ask you to allow the study team to ask you a few questions regarding feeding and childcare practices for your baby. As part of the study , eligible people visiting Kiambu District Hospital are being asked to provide information about household characteristics, feeding and child care practices.

Benefits

The aim of the study is to create awareness of the unique high cases of rickets for children treated in Kiambu District Hospital and the factors associated and look for the solution.

The results of the study will assist decision makers and programme planners at the Ministry of Health to come up with appropriate response on the prevention, care and management of rickets.

Risks

There are no risks associated with your participation in the study.

Confidentiality

The information which you will give will be kept confidential and it will not be linked with your identity. Your identity will not be disclosed in any public reports or publication or any other parties.

Do you have any questions?

Do you agree to be a respondent in this study? Yes..... No .....

Date: .....

Name of respondent .....Signature/ Thumb print .....

Name of interviewer: .....Signature: .....

Appendix 3: Training curriculum for data collection

DAY	COMPONENT
1	Introduction to the study objectives Introduction to data collection tools How to use data collection tools
2	Interview skills Filling in questionnaires
3	Assessment of each research assistant on all aspects learnt using role play Pretesting

Appendix 4: Daily intake of foods according to the 24 hour recall

	Rickets	Non rickets
Food	Quantity(g)	Quantity(g)
Milk	7470	7715
Sugar	68	92
Wheat flour	140	280
Maize flour	640	730
Rice	80	235
Bananas	650	760
Passion fruits	20	45
Tree tomato	10	30
Beef	10	-
Potatoes	610	990
Oil	69.5	20
Water melon	50	20
Spinach	232	210
Kales	30	45
Oranges	50	45
Arrow roots	-	40
Weetabix	260	166.5
Carrots	30	80
Pumpkin	290	180
Pawpaw	40	30
Beans	135	75
Chicken	80	-
Avocado	50	15
Eggs	5	-
Liver	-	20
Pine apple	-	15
Cabbage	30	25
Pea nut	-	92
Blue band	7	-
Peas	10	-
Fish	30	-
Pasta	-	30
Millet flour	416	110.5

Appendix 5: Map of Kiambu District Hospital