NUTRITIONAL STATUS AND PREVALENCE OF DENTAL CARIES AMONG CHILDREN AGED 3-5 YEARS ATTENDING OUTPATIENTS HEALTH CARE AT GERTRUDE'S CHILDREN'S HOSPITAL IN NAIROBI, KENYA (2011-2012)

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Nutritional Status and Prevalence of Dental Caries among Children aged 3-5 Years attending Outpatients Health Care at Gertrude's Children's Hospital in Nairobi, Kenya (2011-2012)

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DECLARATION

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

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This thesis has been submitted for examination with our approval as the University supervisors.

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DEDICATION

This thesis is dedicated to all preschool aged children, their parents, care givers and health care providers who will access this information. To appreciate that the nutritional status of young children is their gold mine and good dental health is one of the tools that can help them mine the gold.

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LIST OF ABBREVIATIONS

ADA	American Dental Association
AOD	Adjusted Odds Ratios
BSS	Basic Screening Survey
CAPP	Country/Area Profile Program
CBS	Central Bureau of Statistics
CI	Confidence interval
COHO	Community Oral Health Officer
dmft	decayed, missing filled teeth (for primary teeth)
DMFT	decayed, missing filled teeth (for secondary teeth)
ECC	Early Childhood Caries
EPI	Expanded Program of Immunization
ERC	Ethical Review Committee
FDI	International Dental Federation
FF	Food Frequency
FFQ	Food Frequency Questionnaire
GA	General anesthesia
GCH	Gertrude's Children's Hospital
HAZ	Height for Age Z- score (used to measure/classify stunting)
IADR	International Association for Dental Research
IMCI	Integrated Management of Childhood Illnesses
IRIN	Integrated Regional Information Networks
ISO	International Organization for Standardization
KeBs	Kenya Bureau of Standards
KBS	Kenya Bureau of Statistics
KDHS	Kenya Demographic Health Survey
KEMRI	Kenya Medical Research Institute
KEPI	Kenya Expanded Program of Immunization
KIHBS	Kenya Integrated Household Business Survey

KNBS	Kenya National Bureau of Statistics
LBW	Low Birth Weight
MDGs	Millennium Development Goals
MOH	Ministry of Health
MUAC	Mid-Upper-Arm Circumference
NCC-WSD	Nairobi City Council–Water Supply Department
NCPD	National Council for Population and Development
NHANES	National Health and Nutrition Examination Surveys
NOHPS	National Oral Health Policy Secretariat
OHRQoL	Oral-Health-Related Quality of Life
OPD	Out Patient Department
OR	Odds Ratio
PEM	Protein Energy Malnutrition
QoL	Quality of Life
RNA	Rapid Nutritional Assessment
S- ECC	Severe Early Childhood Caries
SPSS	Statistical Packages for Social Sciences
SSA	Sub Saharan Africa
UNICEF	United Nations Children Education Fund
USA	United States of America
VLBW	Very Low Birth Weight
WAZ	Weight for Age Z – score (used to measure/classify underweight)
WHO	World Health Organization.
WHZ	Weight for Height Z – score (used to measure/classify wasting)
YLL	Years of Life Lost

OPERATIONAL TERMS

Caregiver	Parents/guardians of childrens/participants attending outpatient health care at GCH
Dental caries	Tooth decay, eroded hardened coating of the tooth identified when found decayed, missing due to caries or filled tooth
dmft	Lower case for decayed, missing, filled teeth of any of the primary 20 teeth
Fluorosis	Teeth with brownish discoloration or stained coating
HAZ	Anthropometric nutritional status indicator for stature: Height for Age measurements < -2 Z-scores below WHO reference median value as an indicator for stunting, which reflects chronic malnutrition
Knowledge	Familiarity, awareness or understanding gained from experience or study.
Nutritional status	State of health influenced by adequacies of food intake and utilization of nutrients from the foods to meet body physiological needs compared to a reference WHO population. It is expressed in measurable indices as Normal, Underweight, Wasting, Stunting and Overweight/Obese.
Participant	The child or the parent/guardian enrolled in the study.
Practices	Habitual performance of participants regarding dental health care
Reference Growth Charts	Reference WHO standards based on well-defined, large sample surveys, collected from healthy, well-nourished populations
Respondent	Parent/guardian of child recruited for the study

WAZ	Anthropometric nutritional status indicator for underweight: Weight for Age measurement < -2 Z-scores below the WHO reference median value which reflects a composite of acute and chronic malnutrition
WHZ	Anthropometric nutritional status indicator for wasting Weight for Height measurements < -2 Z-scores below the WHO reference median value which reflects acute malnutrition

ABSTRACT

Childhood nutrition tops the global agenda for socio economic development and children need healthy teeth to masticate food for their nutritional supply. This study determined the nutritional status, prevalence of dental caries and their relationships among children aged 3-5 years attending outpatient health care at GCH in Nairobi, Kenya during the year 2011-2012. This cross sectional descriptive study sampled 387 children aged 3-5 years, selected by systematic random sampling. Information was obtained from parents/guardians from well socio economic communities using structured questionnaire interviews. Anthropometric indices of weight/age, height/age, weight/height and Mid Upper Arm Circumference, based on World Health Organization, 2006 Z score standards were used to determine the nutritional status of children. Dental caries prevalence was determined as decayed, missing due to caries and filled teeth (dmft) occurrence. The prevalence of caries was 39.5% of which 77.1% had decayed, 9.8% missing and 13.1% filled teeth. Majority (84.5%) of children were within normal nutritional status. The prevalence of underweight was 2.6%, wasting 9.3%, stunting 0.8% and overweight 2.8%. Bivariate analysis showed that wasted children (WHZ< -2SD) were 5.4 times more likely to have caries than normal children (OR=5.36, 95% CI: 2.34-13.31, p <0.05). Underweight children (WAZ< -2SD) also had significantly higher caries prevalence (OR=6.4, p <0.05) although the prevalence of underweight was small. Stunting and overweight showed no significant association with caries (p >0.05). Significant risk factors for caries were; consumption of cariogenic sticky foods including (OR=3.54, 95% CI: 1.44-9.01, p =0.00), lack of knowledge regarding dentist's visit by the first birth day (OR= 2.24, 95% CI: 1.32-3.81, p <0.05), time to commence tooth brushing, pain when chewing food (OR=2.19, 95% CI: 1.23-4.96, p =0.04) and not ever visited a dentist (OR=2.59, 95% CI: 1.64-4.08, p <0.05). On multivariate analysis, the variables that had statistically significant association with dental caries when confounders were controlled were wasting and consumption of cariogenic food (2-6 times/week, Once/week) and Sweets/candies (Once/week) with ($p \leq 0.05$). This study concluded that the overall nutritional status of the 3-5 years old participants was good.

However the prevalence of wasting found was high, comparable to the national level and it was significantly associated with higher prevalence of dental caries than in children who were not wasted. The study recommends sensitization of parents/guardians and health care providers of children on the associations between nutritional status and dental caries and also the risk factors for caries. Further studies are needed to determine causality.

CHAPTER ONE
INTRODUCTION

1.1 Background information

Nutritional status is the balance between food intake and utilization of nutrients from the foods to meet the body physiological needs and metabolic integrity (WHO, 2010). Childhood nutrition is a pillar for a productive adult population since it impacts on a child's survival and optimal development (UNICEF, 2011). Oral health is regarded as an integral part of general health and well being as it determines the quality of life via speaking, smiling, touching, smelling, self esteem, tasting and chewing food (Anderson *et al.,* 2004; UNICEF, 2011). Preschool children aged 3-5 years need healthy teeth to masticate adult like foods, when they graduate from the weaning diet. Adequate dietary intake is among the immediate determinants of nutritional status of children in the multi factorial model (UNICEF, 1990). The digestive system breaks food into nutrients (chemical compounds such as proteins, fats, carbohydrates, vitamins and minerals) which are further broken down into amino acids, glucose, fatty acids and glycerol and are used for energy, growth and body immunity (WHO, 2003). Under nutrition and over nutrition are termed as malnutrition. In Africa, under nutrition of children under five years old contributes significantly to the morbidity and mortality. The prevalence of malnutrition in Kenya according to KDHS, 2008/09 is stunting (35.3%), underweight (16.1%) and wasting (7%) among children under five years old.

Two leading global oral afflictions are dental caries and periodontal disease. Caries have already been declared a pandemic. However, few studies worldwide focus on oral health of children under five years of age (WHO, 2003). Kenya lacks national epidemiological oral health surveys but regional studies concur that dental caries is a problem of public health concern (Kaimenyi, 2004). High prevalence of caries (59.5%) has been reported among preschool children in Kiambu County in Kenya (Njoroge *et al.,* 2010). Dental caries occurs when oral microorganisms (Streptococcus mutans and Lactobacillus) adhering on teeth plaque ferment sugars in foods and release organic acids that erode the

tooth enamel, cause loss of minerals (calcium and phosphates) and expose the inner sensitive tooth structures. Preschool children are vulnerable to caries due to frequent snacking on cariogenic sticky foods, common in nursery schools (Ngatia *et al.,* 2001). Identifying the groups at risk for caries is useful since public health intervention is beneficial when diagnosis is early. Left untreated, the disease progresses from the enamel to dentine and pulp (sensitive part) and may involve the surrounding tissue to form an abscess and granuloma (Knott, 2000). Preschool children depend on parents/guardians and primary health care providers for care of their teeth. However the misconception that primary teeth are replaced by better permanent teeth regardless of their diseases reduces prioritization, such that over 90% of their caries is untreated (Yee & Sheiham, 2002).

Evidence on the association between untreated dental caries and children's growth remains scanty, controversial and non conclusive (Sheiham, 2006). Some studies show that severe Early Childhood Caries (ECC) affects growth and development of a child while others have shown weak or no relationship between nutritional status and caries (Pinto *et al.,* 2007). Studies in New York and Kenya found differences in the percentiles of weights of under five years old children with caries and the caries free (Clarke *et al.,* 2006; Wasunna, & Dorah, 2012). Furthermore, consistent patterns of improvement in oral health related quality of life (OHRQoL) have been reported in children with caries after dental surgery. The pain, discomfort and irritability attributed to caries has been associated with reduced food intake, disturbed sleeping habits and impaired secretion of growth hormones (Filstrup *et al*., 2003; Hayes, 2006). Indicators that improved after surgery included complaints of dental pain, problems with eating, sleeping and facial expressions (Anderson *et al.,* 2004). The main aim of this study was to determine the nutritional status, prevalence of dental caries and establish the associations among preschool children (aged 3-5 years). Gertrude's Children's Hospital is a catchment area for children from middle and high socioeconomic status communities, a factor

associated with exposure to a lifestyle favorable for consumption of cariogenic sticky foods.

1.2 Problem Statement

Dental caries silently poses a threat to the health and growth of young children, despite efforts made by some countries on prevention, since the condition was declared a global pandemic (FDI/WHO, 2003**)**. There is lack of information on the associations between nutritional status and dental caries among children less than five years old in Kenya due to limited studies. The Kenya Demographic and Health Survey (KDHS) reports on under fives nutritional status include stunting (35%) but lacks data on dental caries (KDHS, 2008/2009). There is also inadequate information on the feeding challenges of children less than five years old after graduation from weaning diet. The pain and dysfunction experienced from the caries affects their chewing of food as well as the OHRQoL (Mishu *et al.,* 2013). Children with caries may practice food selection and this affects the quantity and quality taken. This can result in nutritional imbalances like under nutrition or over nutrition for those who select easy to eat fast foods, risking obesity and cardiovascular diseases. Dental surgery has been shown to demonstrate improved feeding among some children with caries but the cost and anesthetic risks involved are prohibitive (Jabarifar *et al.,* 2009). The 3-5 years old children are scantly explored since parents do not prioritize their dental issues in anticipation of replacement of the primary teeth by the permanent. Similarly, active growth monitoring of under fives declines when the children complete the active immunization period (below 3 years of age) which results in scanty information on the growth and nutrition pattern of the 3-5 years old. This is a challenge to the realization of vision 2030 in Kenya as well as the global agenda of well nourished children for a healthy productive population.

1.3 Justification of the Study

Caries disease remains of public health concern in all age groups and all races by its chronic nature but, the under fives are more vulnerable since they need adequate

nutrients for their rapid growth. Food availability to the children is not enough until it has been chewed adequately for nutrients to be absorbed from it to ensure good nutritional status. Untreated, dental caries disease progress beyond the teeth to involve the gum and result in swelling, pain and bone destruction. Unlike many issues about health that cannot be changed, it is possible to alter the course of caries in early stages by strategically targeting to modify some lifestyle risk factors. The GCH was selected for this study basing on the observed lifestyle risks of children's consumption of foods known to be cariogenic yet studies on the relationship with nutritional status had not been done there. The findings of this study on 3-5 years old children at risk for dental caries and the disease burden on the nutritional status is important for public health intervention. The study site is a high catchment area of children from middle and high social economic communities in Nairobi County whose life style exposes them to consumption of cariogenic food. Information gathered from this study is likely to help the growth monitoring program of children at the GCH and other health facilities.

1.4 Research Questions

1. What is the prevalence of dental caries among children attending outpatient health care at Gertrude's Children's Hospital?
2. What is the nutritional status of children attending outpatient health care at Gertrude's Children's Hospital?
3. What is the association between nutritional status and dental caries among children attending outpatient health care at Gertrude's Children's Hospital?

1.5 Objectives

1.5.1 General objective

To determine the nutritional status, prevalence of dental caries and their relationships among children aged 3-5 years attending outpatient health care at GCH in Nairobi, Kenya during the year 2011-2012.

1.5.2 Specific Objectives

1. To determine the prevalence of dental caries among children attending outpatient health care at Gertrude's Children's Hospital during the year 2011-2012.
2. To determine the nutritional status of children attending outpatient health care at Gertrude's Children's Hospital during the year 2011-2012.
3. To establish the association between nutritional status and dental caries among children attending outpatient health care at Gertrude's Children's Hospital during the year 2011-2012.

CHAPTER TWO
LITERATURE REVIEW

2.1 Dental caries in children

2.1.1 Definition and pathology of dental caries

Dental caries (tooth decay) is a pathological process of break down and destruction of the tooth structure (CDC, 2009). Caries occur when, microorganisms found in the mouth as oral flora adhere to the teeth in the form of dental plaque, ferment sucrose sugars from foods to release organic acids mainly lactic acid and others (formic, acetic and propionic). When the oral PH is < 5.5, the acids penetrate the dental tissues and dissolve the enamel (hardened coating of the tooth), dentin and cementum (tooth root) leading to loss of minerals (calcium and phosphates) and cavitations (Featherstone, 2004). Successful tooth destruction requires interaction of susceptible host, cariogenic microorganisms and a suitable substrate presence for a sufficient length of time while saliva buffers the acidic environment.

Predominant in the dental plaque and most important for caries formation is the genus Streptococcus (*S. mutans*). They are non-motile, gram positive cocci, non capsulated, short medium length chains, 0.5-0.75 micrometers in diameter and occur in pairs (Holt *et al*., 1994; Nester *et al.*, 1998). Microorganisms double their numbers about every 20 minutes when conditions are favorable but tooth brushing on time can reduces their rate of multiplication by eliminating their substrate (Bahador *et al.*, 2012). In the early stage of decay (non cavitated lesions), demineralization can be reversed by calcium and phosphate, together with fluoride as new deposits on the remnants of tooth enamel. The de-and re-mineralization process occur several times a day leading to damage, repair and reversal or maintaining the status quo of the tooth (Featherstone, 2004).

Earliest stage of caries is white and chalky appearance on the enamel close to the gum margin (enamel caries) which is difficult to identify, followed with dentine involvement appearing as visible cavity (dentinal caries). Tooth pain occur when the sensitive part of the tooth (dental pulp) is involved and formation of an abscess or necrosis may occur

(Perera *et al*., 2012). The American Academy of Pediatric Dentistry has defined preschool children tooth decay as, Early Childhood Caries (ECC). The ECC can continue the whole continuum of childhood from the under fives age group to adolescent (Li & Wang, 2002).

2.1.2 History and trends of dental caries

Pre human skeletons of more than 500,000 years ago show very little prevalence of caries which mostly appeared on the receding gums of older people. Change in agriculture and trade improved global trade and economy leading to adoption of the 'western' diet, high in carbohydrates and refined sugars (Poul, 2003; Poul *et al.,* 2005). Sipping of carbonated soft drinks like sodas for several hours during entertainments all promoted the rate of tooth decay (Drewnowski & Popkin, 1997; Nester *et al*., 1998). Primary tooth decay was enhanced by sweetened bottle feeds (adding sugar to formula milk), snacking on cariogenic sticky foods with lack of regular oral hygiene. Sri Lanka was ranked high in promoting ECC by their high practices of overnight bottle feeding of children beyond two years of age (Bowen & Lawrence, 2005; Perera *et al*., 2011).

Oral health surveillance is guided by goals set by the World Health Assembly priority goals for World Health Organization. The year 2000 targets for the children included 50% of 5-6 years old children to be free of dental caries, no more than 3 DMFT at 12 years of age and 85% of the population to retain all their teeth at the age of 18 years (FDI/WHO, 1982; WHO, 1982). Strategies to endorse oral health as an integral part of 'Health for All' have been in place for several years. The World Health Day in 1994 was dedicated to oral health to reflect the importance. Public health measures like changing lifestyles, improved self-care practices and use of fluoride have caused decline in caries in many developed countries while others are still struggling (FDI/WHO, 2003). The Federation Dentaire Internationale (FDI), International Association for Dental Research (IADR) and WHO have renewed goals for the year 2020 is particularly to reduce the 'D' decayed component of the dmft with special attention on high-risk groups (Hodbell *et*

al., 2003). The millennium goals are now designed to encourage health policy makers at regional, national and local levels to adopt the 'think globally and act locally' approach. The aim is setting feasible and achievable standards for localized oral health (Burt & Eklund, 2005).

2.1.3 Prevalence of dental caries disease in preschool children

Caries has been declared a pandemic by the World Health Organization since all age groups and nations show caries disease in varied proportions. The global report indicates a caries prevalence of 60-90% among school children (WHO, 2003). The United States of America (USA) categorize caries among the most common chronic disease in children with a prevalence of about five times that of asthma and seven times that of hay fever (Rockville, 2000). Developing countries in South East Asia have high prevalence of caries. Most industrialized countries in northern Europe, in North America, in Australia and New Zealand have decreasing prevalence of caries, often linked to an increased use of fluorides and various types of dental health education programs (Holm, 1990). Early Childhood Caries (ECC) is common in low socio economic communities. Nilza *et al*., (2004) found the prevalence of ECC of 44% among children ages 8–48 months in India while Kumar, (2010) reported the prevalence of 37.3% among preschool children in Bangalore city, India. Sri Lanka National Oral Health Survey of 2002/03 reported a prevalence of 65% among 5 year olds. In Juiz de Fora, of Brazil, 50.6% of the 338 preschool children from public nursery schools in low socioeconomic communities were caries free and the mean dmft index was 2.03 (Leite & Ribeiro, 2000). Wyne, (2008), found caries prevalence of 74.8% among a total of 789 randomly selected preschool children in of Riyadh, Saudi Arabia. In Lithuanian, Kaunas, ECC prevalence of 50.6% was reported among 950 kindergarten children aged 3 years old (Slabsinskiene *et al*., 2000).

In Sub Saharan Africa (SSA) caries prevalence varies in different parts of a country. The percentage of South African children affected by dental caries at the ages of 3, 4 and 5 is

47.00%, 58.00% and 63.00%, respectively (Khan & Cleaton-Jones, 1994). In Khartoum- Sudan, Ghandour *et al* (1992) found 40% girls and 48% boys among a group of 320 nursery preschool children aged 3-5 years old to be dental caries - free. Mean dmft for girls was 0.8 and for boys was 1.6 (Ghandor, 1992). Another study done by Raadal *et al*. (1993) among 275 preschool children aged 4-5 years found mean dmft of 1.68, 58% of the children were caries free. African countries including South Africa (Van Wyk, 2003) and Nigeria (Sofola *et al.,* 2004) have reported lower caries prevalence than other studies (Beiruti, 2001; El-Nadeef *et al.,* 2010) where higher prevalence of dental caries was reported.

In East Africa caries prevalence among preschool children is high. Urban and peri urban settings of Uganda reported caries prevalence of 56% in central Kampala and 64% in Nakawa among children aged 3–5-years old attending nursery schools (Kiwanuka *et al.,* 2004). Random selection of children aged 3-5 years old within Moshi Municipality, Tanzania, showed ECC prevalence of 30.1% with the highest component of 87% as the decayed (Rwakatema & Ng'ang'a, 2010).

In Kenya, 446 nursery school children aged 3 years old within the city of Nairobi were reported caries free (62%) with a mean DMFT 1.35 and 50% of the 5 years old were also caries free with a mean DMFT of 1.88 (Masiga & Holt, 1993). In Kiambaa division, Kiambu District, Kenya, Njoroge *et al.,* (2010) found caries prevalence of 59.5% among 336 preschool children aged 3-5 years old, the highest component (95%) was the decayed.

2.1.4 Relationship between nutritional status and dental caries

Dietary adequacy is one of the immediate determinants of the nutritional status in children (UNICEF, 1990). When 3-5 year old children graduate from weaning to adult like diet, they need good healthy teeth to help them masticate their food. Dental caries can affect their feeding process because of the pain and discomfort experienced while

chewing food. Previous studies are not conclusive regarding the association between nutritional status and caries among children (Alvarez, 1995; Cleaton-Jones, 1996). However other studies show that decay during early life sets the foundation for oral health disease throughout childhood and adolescence (Schroth *et al.,* 2009). Children with caries can easily develop malnutrition when they reduce the portions of feeds while others resort to easy to eat fast food predisposing them to the public health concern issues of childhood overweight and obesity, cardiovascular risks, hypertension, hypercholesterolemia, diabetes, future adult obesity and orthopedic consequences (Bailleul-Forestier *et al.,* 2007). Malnutrition also predisposes children to dental caries.

A cross-sectional study in Thailand by Ngoenwiwatkul and Leela-adisorn, (2009) reported caries prevalence of 80.2% and also found a significant association between caries prevalence and the nutritional status. Each extra carious surface (dmfs) increased the odds of being at risk for underweight between (5th - 15th) percentile by 3.1% after adjusting for gender and dental visits. A survey in Brazil during a national vaccination day reviewed 1,018 preschool urban children and found that underweight children with adverse socio-economic conditions had more significant evidence of caries experience (Oliveira *et al.,* 2008). A study on obesity and caries by Granville-Garcia *et al*., (2008) assessed 2651 preschool children from both public and private institutions in Brazil and found no statistical significance in the relationship between dental caries and obesity by correlation Pearson chi-square and Mann-Whitney tests (Means, 2003).

Oral Health Related Quality of Life (OHRQoL) experienced by preschool children with severe carries before and after treatment under general anesthesia (GA) has also demonstrated the relationship between nutritional status and caries. A significant change in complaint of pain, eating preferences, quantity of food eaten and sleeping habits before and after treatment of dental caries has been reported (Low *and* Schwartz, 1999). Sleeping habits have significant influence in the growth hormones production hence significant in tooth development. Disturbed sleeping due to dental carries pain interfere

with growth and development hormones in children. Later studies in London and Iran that engaged more valid, reliable generic instruments for measuring children's Oral Health Quality of Life (OHRQoL) gave consistent results (Sheiham, 2006; Jabarifar *et al.,* 2009). However, Thomas and Primosch, (2002), in USA only established improvement in the children's quality of life but no significant difference in weight gain.

2.1.5 Prevention and management of dental caries

Prevention and management of caries involves the individual, professional and community levels. Identification of the groups at risk is important since the disease is pandemic but not uniformly distributed. Observing good dental hygiene and control of consumption of the cariogenic sticky foods are the initial approach in the prevention of caries. Dental restoration is needed when caries have progressed to destroy the tooth structure. The American Dental Association recommendations for young children include wiping baby gums with a clean gauze pad after each feeding, brushing of child's teeth to begin when the first tooth grows, continued cleaning and massaging of gums in areas that remain toothless and flossing to begin when all the baby teeth have grown, usually by age 2 or 2½ (ADA, 2005; ADA, 2010). Children should not be allowed to fall asleep with a bottle containing milk, formula, fruit juice or sweetened liquids. Use of other comforters between regular feedings, at night, or during naps should be engaged for children who need comforters but to avoid sugar water and soft drinks. Dentist or physician recommendations can be helpful. The initial dental visits should start by the child's first birthday then regularly at least 6 monthly and as soon as possible for those who develop dental problems.

Preschool age children depend on parents/care givers for their dental health care, who should be equipped with adequate dental care knowledge of preschool children. Avoidance of prolonged exposure of sugary solutions on the teeth and replacement with

fruits, plain milk, cheese and more natural foods is beneficial. However some studies have found that oral health knowledge of caregivers does not necessarily translate in practices that are likely to prevent ECC. Schroth *et al.*, (2005) found that, 74.7% of primary caregivers agreed with the importance of a first preventive dental visit by age 1, but only 3.9% of children actually visited a dentist before this developmental milestone. Such a discrepancy has often raised concern over response bias when participants sometimes respond accordingly to please interviewers when they do not practice what they say (ADA, 2010).

Caries intervention has moved from the era of tooth sealants for use on the grinding surfaces of teeth to fluoride use primarily after teeth have erupted, as recommended by Centre for Disease Control (CDC, 2009). Fluoride is the ionic form of the element fluorine, the 13^{th} most abundant element in the earth's crust and it forms a stable compound with positive ions calcium or sodium on exposure. In humans, fluoride is mainly associated with calcified tissues (bones and teeth). In optimal levels, fluoride can inhibit or even reverse the initiation and early progression of dental caries. The water fluoridation and development of fluoride containing products like toothpaste, mouth rinse, dietary supplements, processed beverages and professionally applied gel, foam, or varnish can be used. Children with grown teeth should be assisted to use pea size fluoride tooth paste at least twice a day and avoid large portions and swallowing the tooth paste. Excessive ingestion of fluoride during tooth development can cause structural changes in tooth enamel named fluorosis. Only a small margin separates supposed beneficial fluoride levels from amounts that are known to cause adverse effects. A concentration of about 1 ppm is recommended in several countries (CDC, 1998). Both WHO and the Kenya Bureau of Standards (KEBS) recommend a maximum of 1.5 milligrams of fluoride per liter of water for human consumption (WHO/KBS, 1994). Some parts of the Rift valley in Kenya have particularly high levels of fluoride in their waters due to the volcanic soil. Within the fluoride belt, the worst hit community in Kenya is a small tribe, the El-Molo living near Lake Turkana, where 80 per cent of the

members suffer from the condition besides 56% of the Central Kenya population and some in Eastern (Omondi, 2007).

Management of oral health issues like advanced caries has been an uphill task because of the finances involved and the limited personnel (Kaimenyi, 2004). Previous Kenyan statistics showed that the dentist/population ratio as 1:378,000 in the public sector and 1:60,000 in private sector; where 20% are in the rural and 80% in the urban (Kaimenyi, 2004). In Africa, the dentist to population ratio is approximately 1:150 000 compared with about 1:2000 in most industrialized countries (WHO, 2005). The low budgetary allocation for oral health (NOHPS, 2002), contributes to constrain in public facilities. Furthermore, the tradition of segregating oral health from the general health hampered the integration of oral health care and dental disease intervention in general primary health care (Kaimenyi, 2004). Management of caries is still limited to pain relief or emergency care where surgery is done under GA. In USA, oral diseases were rated the fourth most expensive diseases to treat, estimated at US Dollars 3513 per 1000 children, which would exceed the total health budget for children in most low-income countries including Kenya (Yee & Sheiham 2002). Ngatia *et al.,* (2001) reported high prevalence of dental caries in the 3-5 year old nursery children in Nairobi but only 1.3% of them had filled teeth. The cost of treatment of dental carries in Kenya is also inhibitory (NOHPS, 2002).

2.1.6 The future views in the intervention of dental caries scourge

Since dental caries has only been controlled and not eradicated, there is still work in progress to explore management. Scientists from the University of Kentucky have developed a new chewing gum which could make brushing teeth a thing of the past (Rucker, 2005). Similar information was shared in the study by Bahador *et al.,* (2012). Cheese may be protective for carries (Paula, 2001). Governments are urged to sensitize their public regarding the oral health goals since most countries are lagging behind for a healthier people 2020 (WHO, 2010). Saudi Arabia is tackling 'Dental Phobia', fear of

dental visits by popularizing it in pop culture via comic films and cartoon. Japanese researchers have found that eating traditional sugarless yogurt may reduce the malodorous compounds that cause bad breath and possibly tooth plaque. Their study was presented at the International Association for Dental Research annual meeting, in Baltimore, 2009. To tackle the high cost of dental health care, medical tourism may be another option for those states with a large number of medical uninsured citizens.

2.2 Nutritional status of children

2.2.1 Definition of nutritional status

Nutritional status is the balance between adequacies of food intake and utilization of nutrients from the foods to meet body physiological needs and maintain normal metabolic integrity (WHO, 2010). The body is therefore in a state of either normal nutrition, under nutrition or over nourished in reference to standard populations of comparable age group. The under and over nutrition are termed as malnutrition.

2.2.2 Global situation –nutritional status of children

Childhood nutritional status is determined by a complex multi factorial process. The etiology of childhood malnutrition is related to many socioeconomic and socio demographic factors. In Baghdad, childhood malnutrition was found to be a major public-health problem, significantly related to insecure living areas where at least one family member having been killed in the past five years (Ghazi *et al.*, 2013). This study has assessed the nutritional status of children under five years of age from well socio economic communities to understand the nutrition challenges faced by 3-5 years old among them.

In the year 2011, the world wide estimates of child malnutrition by UNICEF/WHO/World Bank indicated that an estimated 165 million (26%) children, under-five years of age, were stunted (height-for-age below –2 SD). The prevalence was a 35% decrease from an estimated 253 million in 1990. However, more than 90% of the

world's stunted children live in Africa and Asia but the public health problem often goes unrecognized (de Onis *et al*., 2012). Globally, an estimated 101 million (16%) children, less than five years of age were also found to be underweight (weight-for-age below –2SD) which was a 36% decrease from an estimated 159 million in 1990. The overall progress in prevalence of stunting and underweight among children under five years old is insufficient and millions of children remain at risk. This study sought to assess the nutritional status of children aged 3-5 years old as a group at risk of malnutrition likely attributed to feeding difficulties among the victims of dental caries.

Worldwide, an estimated 52 million (8%) children, under-five years of age were found wasted (weight-for-height below –2SD) in 2011. Asia and mostly South-Central Asia holds 70% the world's wasted children. They are at increased risk of severe acute malnutrition and death (de Onis *et al*., 2012). This study looked at the acute malnutrition likely to result from inadequate food accessibility by the 3-5 years old children with caries when they graduate from weaning diet and are unable to masticate the food availed to them. Children with caries may not suffer from severe malnutrition likely to lead to death but experience poor oral health related quality of life

Globally, an estimated 43 million (7%) children, less than five years of age were overweight (weight-for-height above +2SD) in 2011, which was a 54% increase from an estimated 28 million in 1990. Most world regions have noted increasing trends in child overweight, the prevalence is highest (15%) developed countries (de Onis *et al*., 2012. Children with dental caries may resort to fast foods in their food selection and become victims of overweight. A lifestyle of snacking on snacking on cariogenic foods and fast foods is common among children from well socio economic communities hence risk development of caries and overweight.

2.2.3 Nutritional status of children in Sub Saharan Africa

Despite the MDGs target to reduce hunger by half by 2015, major failures have been recorded mainly in Africa (Bain *et al*., 2013). Out of the 800 million people still suffering from hunger in the world, over 204 million come from Sub-Saharan Africa and Children under five are the most affected (FAO, 2008). The problem is further aggravated by adverse climatic conditions, with droughts and floods in some areas. Government policy has not been very successful most of the time, because most governments fail to consider malnutrition as a serious issue, and rescue projects from the western world are vertical and do not consider socio cultural realities of target implementation sites (FAO, 2008).

Children in Africa are faced with, socioeconomic and demographic factors such as, poverty paternal and maternal occupation and education, marital status, family income, nutritional knowledge of mothers, location of house (urban or rural), gender, and water supply ignorance, big family size, climate change, policy and corruption (Mahgoub et al., 2006). The primary determinants of malnutrition are unsatisfactory food intake, severe and repeated infections, or a combination of the two. Diseases such as lower respiratory tract infections including tuberculosis, diarrhea diseases, malaria and anemia are the major cause of mortality, morbidity and malnutrition in developing countries (Mahgoub et al., 2006; Kandala *et al.,* 2009). These co-morbidities may prolong the duration of hospital stay and death among affected children (Ie Roux *et al.,* 2010). This study set to assess relationship between nutritional status and dental caries among the 3-5 years old as one of the scarcely taped information. The family-size and number of children living in the same house may affect the nutritional status of children under five years old due to the quality of care given to them. A study in Livingstone, Zambia, in 2005, among children aged 6 to 59 months found that 43% of undernourished children were associated with extended families (five to seven members) while 36% were associated with nuclear families (two to four members) (Chigali, 2005). This study has

sought to assess the nutritional status of children as influenced by the number of other under five years old siblings.

2.2.4 Nutritional status of children in Kenya

The KDHS, 2008/09, report indicated that nationally, 35 percent of children under five are stunted, while14% are severely stunted. At least 16 percent of children less than five years are underweight (low weight for age) and 4% are severely underweight. The proportion of wasted under-fives was 7% (Obonyo *et al.,* 2008). Studies done in Kenya have revealed a significant association between the nutritional status of the under five years with their co morbidity. High level of stunting, wasting, underweight and mortality (176/1,000 and 259/1,000) were reported among children below 24 months in rural western Kenya where there is high intense malaria transmission, severe anemia and human immunodeficiency virus. While their mean HAZ and WAZ stabilized from 24 months of age onwards, they still remained below the reference median with no evidence of catch-up growth (Kwena *et al.,* 2003; Ndirangu *et al.,* 2011). This study sought to determine how the nutritional status of children with less severe morbidity compares in view of the feeding challenges of the 3-5 years old with caries. The health economic impact of poor nutritional status is evident from the risk of dying per Province. It was shown that the relative risks of dying of a child aged 1–5 years in Nyanza, Western and North Eastern Provinces was 7–8 times greater than for a child of the same age in Central Province (UNDP, 2010). Better nutritional status should therefore be targeted at all cost. Economically, Kenya is ranked as the 128th out of 169 nations with comparable data, placing it amongst the 50 poorest nations in the world (UNDP, 2010).

2.3 Assessment of nutritional status in children

2.3.1 Rapid Nutrition Assessment (RNA) Survey

The assessment of nutritional status is commonly summarized by the mnemonic "ABCD," which stands for Anthropometric measurement, Biochemical or laboratory

tests, clinical indicators and dietary assessment. Each stage of human life has different nutritional considerations related to physiological needs, susceptibility to infection and cultural benefits or hazards. Rapidly growing children and pregnant women are the more vulnerable groups. Various research studies have often engaged rapid assessment procedures that help collect essential information relative to nutritional status in a brief time, approximately 10 – 15 minutes per person. Different indices are recommended depending on the goal for the nutritional assessment (WHO, 1995). Specifically, a cross sectional point prevalence survey is a single assessment of the sample population at one point in time conducted over a few days. A Rapid Nutritional Assessment (RNA) measurement includes age, sex, weight and height. Other components of the survey can include questionnaires and interviews on a child's diet and illness (Scrimshsw and Hurtado, 1987). The RNA survey may also include a physical and clinical examination.

2.3.2 Anthropometric indicators of nutritional Status

Anthropometry is based on noninvasive and inexpensive body measurements of children that include their weight, height and mid upper arm circumference. The anthropometric indices are used to screen children at risk of malnutrition over the short term, as well as to assess population changes over long term. Most commonly used indicators are Weight for Age (underweight), Height for Age (stunting) and Weight for Height (wasting) against their gender (Allen and Gillespie, 2001; WHO, 2006). Classification and statistical presentation research suggests that all children have the potential to grow at the same rate if they are under the same nutritional environmental conditions until they reach ten years of age. When reporting on nutritional status, anthropometric indices are generally expressed as percentiles, percentage of the median and Z- scores (FANTA, 2003).

Percentiles specify at what percent of the reference population an individual ranks. Percentiles do not catch distribution extremes and cannot be reported in means or standard deviations (WHO, 2006). Percent of the median is a ratio of observed value of

the child compared to the median value of the reference population (FANTA, 2003). It is used when the reference population distribution is unknown (WHO, 2006). Mild, moderate and severe malnutrition are classified as approximately 90%, 80% and 70% of the median weight for age (FANTA, 2003). The Z -Score shows the number of standard deviation above or below the reference median value (Fernandez *et al.*, 2002). The Z - Scores are more significance than percent of the median. The Z score identifies more malnourished children than the reference median. Minus 2 Z-scores is approximately 82.5% median weight for height (WHO, 2006; WHO, 2010). Mild, moderate and severe malnutrition are classified as -1, -2 and -3 Z-scores, respectively, below the median.

The Z - score classification system gives refined quality of results. It is the favored way to convey nutritional status when surveying acute and chronic malnutrition (FANTA, 2003) and is the best system for analysis and presentation of population growth data because it normalizes the population variance of each anthropometric measure (Allen and Gillespie, 2001; de Onis and Blossner, 2003). Global malnutrition rates are calculated by adding the number of children with minus 2 Z-scores and minus 3 Z-scores. The previous estimates of nutritional status in many countries of Sub Sahara Africa (SSA) may be over-estimates because nutrition surveys tended to concentrate in areas where the situation was bad so that action could be taken.

Nutritional status of children is categorized by interpretation of anthropometric indices such that Height for Age measurements less than -2 Z-scores below the reference median value, abbreviated as HAZ represent stunting, an indicator of chronic malnutrition. Weight for Height measurements of less than -2 Z-scores below the reference median value, abbreviated as WHZ represents Wasting and it is an indicator of current or acute malnutrition. Weight for Age measurements of less than -2 Z-scores below the reference median value, abbreviated as WAZ represents Underweight and it indicates both recent and long term malnutrition especially in children older than two years. Although WAZ has commonly been used to monitor growth and nutrition trends,

the underweight reported is the result of both short stature and thinness, it does not distinguish between stunting and wasting, chronic or acute (current) low food intakes (WHO, 2006). Underweight has significant implications as reported by Pelletier and Frongillo, (2002) that, if weight for age malnutrition is reduced by 5% points, under-fives mortality can be reduced by 13%. The rate of underweight is an indicator of poverty and hunger.

Mid Upper Arm Circumference (MUAC) is a valuable anthropometric indicator and predictor of immediate mortality risk in under five year old children. The MUAC changes only marginally for children under 5 years and does not need to be related to any other anthropometric measurement. It is reliable indicator of the muscular status of the child and is mainly used to identify children with a risk of mortality (FANTA, 2003). A low MUAC of < 11.5cm has been correlated to an increase risk of mortality. The MUAC cut-off levels between 11.5-12.4 cm indicated moderate malnutrition while measurements of 12.5-13.4 cm are considerd normal nutritional status. Some children have MUAC of >13.5cm as overweight categories.

CHAPTER THREE
MATERIALS AND METHODS

3.1 Study site

The study was conducted at Gertrude's Children's Hospital (GCH) within the outskirts of the Central Business District of the capital city Nairobi in Kenya, East Africa. Nairobi was founded in 1899 and it has an average area of 648 Km^2. Kenya lies between longitudes 34^o E and 42^o W and is divided by the Equator into approximately two equal parts, hence enjoys a tropical climate. Bordering Kenya are Somalia, Ethiopia, Sudan, Uganda, Tanzania and the Indian Ocean. The GCH hospital is about 5 km on the West of the tarmac Muthaiga road, off Thika, Kiambu and Muranga roads junction. It is now over 60 years since the inception of the hospital in 1947 when a British Colonel donated land in honour of his late wife. The GCH is the leading private children's hospital in East and Central Africa, run by a Board of Trustees. It operates the main branch within Muthaiga estate and 9 satellite clinics distributed within Nairobi. The hospital runs three dental clinics and a busy outpatient department (GCH, 2010). The study site is a high catchment area of children from middle and high social economic communities in Nairobi County. Appendix IX shows a map of the study site.

3.2 The study design

This was a cross-sectional descriptive study design. The study design was suitable for facilitating assessment of all variables in subjects at a single point in time in an Out Patient Department (OPD) setting, which has a fast turnover of clients.

3.3 Study population

The study population consisted of children aged between 3–5 years and their guardians/caregivers drawn from the normal outpatient pool while attending health care for mixed curative and preventive conditions. Children who seek health care at GCH are from middle and high socio economic communities within Nairobi County, its environs and countries outside Kenya making it ideal for the study since their lifestyle predispose

them to dental carries. The population served includes all age groups and mixed races, blacks, whites and those of Asiatic origin (GCH, 2010). Data from population statistics indicate that Kenya population in 2009 was 38 million, an increase from 28.7 million in 1999. Nairobi alone has 3.1 million people and 20% are children under 5 years old (NCPD, 2013; KBS 2009).

3.3.1 Inclusion criteria

Children aged between 3–5 years whom their guardian/caregivers consented to participate in the study were included. Those with non-emergency medical conditions and no birth disorders were included. Justification of the 3–5 years age group was guided by the study objective. The 3-5 years old have attained full primary dentitions (twenty teeth) which are expected to help them chew adult like foods for their nutrient needs. They are also vulnerable to caries development due to their habits of frequent snacking on cariogenic sticky foods during nursery school.

3.3.2 Exclusion criteria

The study excluded children below 3 years and above 5 years of age, those not yet attained full primary dentition of twenty teeth, children with emergency medical conditions and birth disorders and the ones whose guardians/caregiver did not consent to participate in the study.

3.4 Sampling procedure and Sample size determination

3.4.1 Sampling procedure

Systematic random sampling was done during a normal OPD functioning day as the subjects attended various curative and preventive services. The interval of sampling was the 12^{th} child aged 3-5 years old, derived from a calculation using the target population and sample size. The 12^{th} sample was determined for the purposes of randomization in order to minimize biasness in selecting the respondents. If the selected client's parent declined consent to participate, the next appropriate client was approached and the new n^{th} estimated from the consented respondent until the appropriate sample size was

achieved. To eliminate the bias of sampling subjects with similar periodicity in timing their hospital visit (those who preferred specific times of the day), data collection days varied the timings to include morning, afternoon and evening sessions for five days per week. This ensured adequate random sampling until 384 participants was achieved. The duration of data collection was three months, November 2011 to January 2012.

3.4.2 Sample size determination

The sample size was determined using statistical formula described by Fischer *et al.*, (1998). The significance level was at 95% (1.96, two tails). The prevalence of dental carries is not known in Kenya. Therefore the study uses the proportion of 50% as the p.

Formula: $\mathbf{n} = \frac{(Z_{1-\alpha})^2 \times (P \times Q)}{d^2}$

Where:

n = the sample size needed

$Z_{1-\alpha} = Z_{0.95} = 1.96$ (level of significance two tail) from the normal distribution table

P = the prevalence of dental carries is not known hence 50% was used as p

Q = (1 – P); d = Absolute precision required = 0.05%

Inserting the values in the formula

$\mathbf{n} = \frac{(Z_{1-\alpha})^2 \times (P \times (1-P)}{d^2}$ $\mathbf{n} = \frac{1.96^2 \times 0.5(1-0.5)}{0.05^2}$

$\mathbf{n} = \frac{3.8416 \times 0.5 \times 0.5}{0.0025}$ $\mathbf{n}$ = 384.16 rounded up to n = 384

3.5 Data collection procedure

3.5.1 Instruments for data collection

The principle investigator coordinated all the stages of the study, assisted by two trained assistants for anthropometric measurements and recording and a Community Oral Health Officer (COHO) for the dental examinations. Instruments for data collection included a questionnaire for the parents, the pediatrics Seca type of weighing machine (model 762 1011009, Vogel and Halke, Germany) calibrated and recording to the nearest 100g accuracy, the height board (stadiometer), measuring at 0.5cm accuracy, a length board (infantometer) on standby to measure those below 85.0 centimeters and a non-stretch, tear-resistant measuring tape for MUAC measurements. Dental examination instruments included caries explorers, plane oral mirrors, wooden spatulas, disposable gloves, facemasks paper hand towels and gauze pads and sterilizer for the appropriate instruments. Water and soap, backed up with alcohol based antiseptic solution for infection control. A straight chair for parents to sit on while holding the children to provide comfort, a small trolley or table to hold the instruments, copies of the modified WHO oral health assessment form (1997) as shown in Appendix 4, for recording the dental examination reports and a log book for recording the day's activities in summary.

3.5.2 Questionnaire variables assessed

A questionnaire for the caregivers/guardians was in English or Kiswahili language as found appropriate. The questionnaire was structured and interviewer administered. It was used to collect information on children's characteristics which were categorized as dependent and independent variables. The research question answered the prevalence of carries, nutritional status of the children 3-5 years and association between nutritional status and dental carries among the study participants.

3.5.2.1 Independent variables

Dental carries was the main independent variable in this study. The date of birth, gestation period at birth in months categorized as (born at term ≥ 8months of pregnancy or preterm born ≤ 8 months), weight of child at birth (normal ≥ 2.5kg and underweight <2.5kg) as per WHO recommendation. The demographic variables included the area of

residence, sex of children participating, number of other siblings less than five years old in the family and age of the children. The age of the children was determined from vaccination/insurance card plus the questionnaires. Mother's highest level of education attained categorized as low (only primary level), medium (secondary school complete or incomplete) and high for tertiary level (college training or university education).

Socioeconomic status was assessed by size of houses using number of bedrooms the family resided in and the financial income of the family. Housing was categorized as inadequate when they stayed in (one bed roomed), moderate (2 bed roomed) and was assumed adequate when (3 or > 3 bed roomed) houses. Family financial status was categorized as low when net family income was (< ksh 10,000) moderate (between ksh 10,000 <50,000) and high (> ksh 50,000) per month according to studies of Randa (2012) and Mathad *et al.,* (2011).

3.5.2.2 Dependent variables

Nutritional status of the participants (children 3-5 years of age) was he main dependent variable in this study. Breast feeding practices stated as exclusive (only breast milk) for the first six months after birth or not exclusive. The morbidity pattern recorded the frequency of visit to hospital with episodes of fevers, respiratory diseases, diarrhea diseases or features of malaria classified as highly frequent when hospital visit was once or more per month, moderate (once in 2-6 months) and low frequency (once in > 6 months). Self-report of pain when chewing food assessed possible presence of caries. Food intake was assessed by the 24 hour recall of foods ingested at breakfast, mid-morning, lunch and dinner. To complement the 24 hours food recall, the food frequency (FF) of types of foods taken was also determined as food groups (animal proteins, cereal, legumes, tubers vegetables and fruits). The FF intake was categorized as daily consumption, 2-6x/week, once/month or never taking the type of food.

On knowledge regarding dental carries and tooth decay, a three linkert scale was used. The scale categorized knowledge has good (represent correct answer, fair (represent incorrect answer) and poor (represent no knowledge). Parents' knowledge regarding dental health care of their preschool children included but was not limited to statements such as, their source of information, defining the meaning of caries, to suggest the appropriate time the children less than five need to start tooth brushing and visit the dentist (first dental visit by 12 months of age then 6 monthly), bottle feeding and dental caries. Children's dental health care practices evaluation included; the frequency and assistance of tooth brushing within the day, amount of fluoride tooth paste used, visit to the dentist at all for any reason and reasons for no dentist's visits and bottle feeding habits. Frequency of snacking on sticky cariogenic foods was classified as high (when consumed daily), moderate (2-6 times per week) and low when consumed only during outings.

3.5.3 Pilot study at a satellite clinics

A pretest of the study was done at the Nairobi West Satellite clinic of GCH for the questionnaire and other instruments. Any ambiguous questions from the questionnaire were adjusted to ensure accuracy, reliability and consistency in data collection. The average duration per interview session was 15-20 minutes. The Out Patient Department (OPD) staff and the research team ensured that minimal interruption of clinical services was experienced on data pretest day. The OPD staff helped identify the appropriate subjects and reported on their progress regarding the primary reason for hospital visit. The appropriate timing for data collection from respondents was upon completion of their primary doctor's consultation as they waited for a laboratory result or after completion of all transactions with pharmacy and the accounts. Informed consent was sought followed by the questionnaire interview. The age was reconfirmed from the parent and the well-baby clinic/immunization card if available. Anthropometric measurements were taken as per the WHO standards and clinical dental examination

performed under natural light. The COHO and a professional dentist inter examiners agreement was rated at kappa 0.88.

3.5.4 Anthropometric measurements of children

Parents were requested to let their children stay in light clothes, without shoes for body measurements of Weight, height and MUAC. The calibrated weighing scale was checked to be pointing at zero mark all the time before a child's weight was taken to the nearest 100.0g accuracy once. Height measurements were taken when the child was assisted to stand against the height board. The heels, buttocks, shoulders and occipital area touched the backboard while eyes looked forward, parallel to the floor to avoid wide curvatures of their trunk and lower limbs. Three measurements of height to the accuracy of 0.5cm were taken and the average of the three calculated. The MUAC measurement was the mid-upper point of the child's left arm, located by measuring the distance between the tip of the shoulder blade and the tip of the elbow and dividing the distance by two. The MUAC is a valuable anthropometric indicator that may be applied to predict immediate mortality risks of the under five year old children (FANTA, 2003). These categories were done during data collection and aided in analysis.

3.5.5 Dental assessment of the children

Basic Screening Survey (BSS) of dental status was conducted under natural light for consistency as the child stayed sited with the parent on a chair. A systematic approach to the oral dental examination proceeded from one tooth to another under sterile conditions. Caries lesions were recorded as present when a tooth showed visible signs of cavitations, undermined enamel or filled surface due to tooth decay. Where any doubt existed, the tooth was recorded as sound. Teeth were recorded as missing due to caries if the patient gave a history of a cavity prior to the extraction. The decayed, missing, and filled teeth (DMFT) scores for each child were recorded but the teeth with fluorosis and those lost to trauma or exfoliation were excluded. Dental findings were entered on the dental survey forms adapted from the modified WHO Oral Health Assessment Form (1997) shown in

Appendix 4. Only the areas concerning primary dentition were filled while the unused areas were cancelled with a diagonal line but retained on the forms. The oral information of interest regarding the teeth status included sound teeth, tooth decay, missing due to caries or filled due to caries and treatment needs. Survey forms standard codes enabled organized data processing and summary to ensure standardization.

3.6 Data management

3.6.1 Data Storage

All research materials including hard copy questionnaires and other scripts were securely kept in lockable cupboards and confidentiality maintained before and after analysis. The analyzed data was stored in electronic devices including CDs and flash disks that were locked up. Caution was taken by creating a back up of data in the researcher's internet documents in files that were pass word encrypted to protect from unauthorized access.

3.6.2 Data analysis

Data cleaning and validation was done by examining and assessing the primary data from the questionnaires. The systematically coded data was used to create Database in Ms Access and Ms excel spread sheet. The data was tabulated and descriptive statistics used to describe the mean, range and standard deviation of the basic variables and generate frequency tables. Statistical Package for Social Sciences (SPSS) was used for inferential analysis. The bivariate analyses were done to compare variables in contingency tables and the Odds Ratio and the 95% confidence interval as a measure of association. All the variables which revealed significant association at bivariate analysis were analyzed using multiple unconditional logistic regression model to asses individual effects after controlling for confounders (adjusted odd ratios). Statistical significance by Chi square and Fishers Exact test was set at p-value ≤ 0.05.

3.6.3 Analysis of anthropometric data

Anthropometric indices of the children Weights/Age, Height/Age and Height/Weight were determined based on the WHO (2006) Z scores standards. Under nutrition was defined as indices below minus two standard deviation (-2 SD/-2Z scores) from the median values of the standard WHO (2006) reference population, normal nutritional status had parameters (between -2 SD and + 2 SD) while over nutrition was (more than +2SD).

The proportion of **underweight** children was the percentage of children with a weight for their age < - 2 Z-scores below the reference Weight for Age (W/A), represented as (WAZ).

The proportion of **stunted** children was the percentage of children with a height for their age < -2 Z-scores below the reference Height for Age (H/A), represented as (HAZ).

The proportion of **wasted** children was the percentage of children with a weight for their height < -2 Z-scores below the reference Weight for Height (W/H), represented as (WHZ).

The MUAC measurements were categorized to demonstrate severe under nutrition when (< 11.5cm), moderate under nutrition (11.5 -12.4cm), normal nutrition when (12.5cm - 13.4) and over nutrition when (>13.5cm).

3.7 Ethical Consideration

Authorization to carry out the research was sought from Jomo Kenyatta University of Agriculture and Technology (JKUAT) and the Kenya Medical Research Institute (KEMRI). The Ethics Review Committees (ERC) of KEMRI (SSC No 1779 Appendix VI and VII) and GCH (Appendix VIII) reviewed and approved all ethical issues of collecting data from the humans and also approved all components of the informed consent document, questionnaires interview to the parents and examination of the children. The hospital administration granted permission for data collection from the subjects.

The dental professionals of GCH were informed of the study details. The OPD management was notified for purposes of organizing the smooth flow of events on data collection day, to ensure minimum interruption to the primary reason of the patient's hospital visit. A voluntary signed informed consent by parents/guardians/caretakers for their children participation in the study was sought from those who were eligible to participate (Appendix II). The parents were informed of the title of the study, the purpose, the anticipated risks harm and inconveniences, the benefits, the confidentiality issues and the remunerations. They had the freedom to withdraw from the study without penalty. A case where withdrawal occurred, the data was not included in the final analysis. Guardians/caregivers were informed that all the information in the questionnaire would be held in confidence. It would not be possible to link a name with the data since the labels would be done by the study codes. Only the research staff would have access to the information. Any additional useful information such as treatment needs was provided to the respondents appropriately during the study.

3.8 Assumptions

The study assumed that the parents/guardians of children who met the inclusion criteria were able to satisfactory participate in the questionnaire interview. Assumption that a residential house of three to four bedrooms was ample enough to limit crowding regardless of the number of residence of the household. Assumption that recall bias on the food consumption in the 24 hours and monthly food consumption would be limited by the multiple questions

CHAPTER FOUR

RESULTS

4.1 Social demographic characteristics of the participants

4.1.1 Respondents' residence and sex distribution of the children

The study sampled 387 participants out of a required sample size of 384, (50.4%) were male and (49.6%) were female children. More than half, (56.3%) of the participants were from Nairobi County, 42.4% came from other Counties within Kenya while a few (1.3%), were foreigners (Table 4.1).

Table 4.1: Residence/sex distribution of the categorization

Residence category	Male	Female	Total
Nairobi County	110(56.4%)	108(56.2%)	218(56.3%)
Other Counties	82(42.1%)	82(42.7%)	164(42.4%)
Non Kenyans	3(1.5%)	2(1.0%)	5(1.3%)
Total	195(100.0%)	192(100.0%)	387(100.0%)

4.1.2 Maternal/caretaker social economic status

Majority of Guardins/caregivers (59.4%), had attained university level of education, 29.5% had attained atleast diploma level of education while 3.1% had attained completed primary as their highest education attained during the study period. Majority (46.5%) and (46%) of the families in this study lived in three and more than three bed roomed houses, respectively while a small proportion (0.8%), lived in one bed roomed houses. Regarding income, the majority of the families (73.4%), had an average net monthly income of > kshs. 50000 and (20.4%) earned between kshs. (20000 and <50000) while (2.8%) were not willing to state or report their net monthly income (Table 4.2).

Table 4.2: Summary of maternal/caretaker social economic status (n = 387)

Characteristics	Count	Percent	Total
Highest education level attained by the child's mother			
Completed primary school	12	3.1	12(3.1%)
Incomplete secondary school	10	2.6	10(2.6%)
Completed secondary school	19	4.9	19(4.9%)
College	114	29.5	114(29.5%)
University	230	59.4	230(59.4%)
Don't know	2	0.5	2(0.5%)
Total	387	100.0	387(100.0%)
Size of house the child's family live in			
One roomed	3	0.8	3(0.8%)
Two roomed	26	6.7	26(6.7%)
Three roomed	180	46.5	180(46.5%)
More than three roomed	178	46.0	178(46.0%)
Total	387	100.0	387(100.0%)
Average net income of the household per month in ksh.			
5000 <10000	1	0.3	1(0.3%)
10000 <20000	12	3.1	12(3.1%)
20000 <50000	79	20.4	79(20.4%)
>50000	284	73.4	284(73.4%)
Don't know	11	2.8	11(2.8%)
Total	387	100.0	100.0%

Ksh – Kenya shillings,

4.2 Children characteristics gestation, birth weight, breastfeeding and morbidity

Majority (75.5%),of the participants had atleast one sibling whos was under five years of age. A small proportion (6.5%) had either 2 other siblings who were under five years of age while 18.0% had non (no sibling). Table 4.3 shows that 93% of children were born at term (> 8 months of pregnancy) and (92.2%) weighed more than 2.5kg at birth. Children who were exclusively breastfed for the first 6 months after birth were 48.3%. The morbidity report indicated that majority of children (56.2%), visited hospital once in the preceeding 2-6 months for treatment of illnesses like malaria, diarrhea, tonsillitis and pneumonia, 20.7% visited hospital once in > 6 months. Regarding dental pain, (86.8%) of children had not reported pain when biting or chewing food in the last 6 month before the study was done (Table 4.3).

Duration of breast feeding report showed that 33.1% of the children were completely stopped from breast feeding before they attained 1 year of age, 58.7% were stopped after one year of age, a smaller proportion (1.8%) were not breastfed at all while 6.5% of the children's duration of breast feeding was not known at all.

Table 4.3: Children gestation, birth weight, breastfeeding and ailments characteristics

Characteristics n = 387	Count	Percent	Total
Gestation at birth			
≥8 months of pregnancy (term)	360	93.0	360(93.0%)
<8 months of pregnancy (pre term)	23	5.9	23(5.9%)
Don't know/ don't remember	4	1.0	4(1.0%)
Total	387	100.0	387(100.0%)
Weight of the child at birth			
≤2.5 kg	24	6.2	24(6.2%)
> 2.5 kg	357	92.2	357(92.2%)
Don't know/ don't remember	6	1.6	6(1.6%)
Total	387	100.0	387(100.0%)
Child breastfed exclusively for the first 6 month after birth.			
Yes	187	48.3	187(48.3%)
No	183	47.3	183(47.3%)
Don't know/ don't remember	17	4.4	17(4.4%)
Total	387	100.0	387(100.0%)
Frequency of hospital visits with fever related illnesses			
At least once or more a month	74	19.2	74(19.2%)
Once in 2-6 months	218	56.2	218(56.2%)
Once in more than 6 months	80	20.7	80(20.7%)
Today is first visit to hospital	2	0.5	2(0.5%)
Don't know/ don't remember	13	3.4	13(3.4%)
Total	387	100.0	387(100.0%)
Pain when biting or chewing food during the past 6 months			
Yes	29	7.5	29(7.5%)
No	336	86.8	336(86.8%)
Don't know/ don't remember	22	5.7	22(5.7%)
Total	387	100.0	387(100.0%)

4.3 Knowledge and practices regarding dental health care of children

4.3.1 Caregiver/guardians source of information regarding dental health care of children

Majority of the guardians/caregiver (54.3%), obtained information on dental care of milk teeth from the media (Television, Radio, Newsprints and Magazines). The study revealed other sources of information were medical doctors (24.4%), well baby clinics (10.4%) when children are taken for vaccinations and from relatives, friends and undisclosed sources as shown in Figure 4.1.

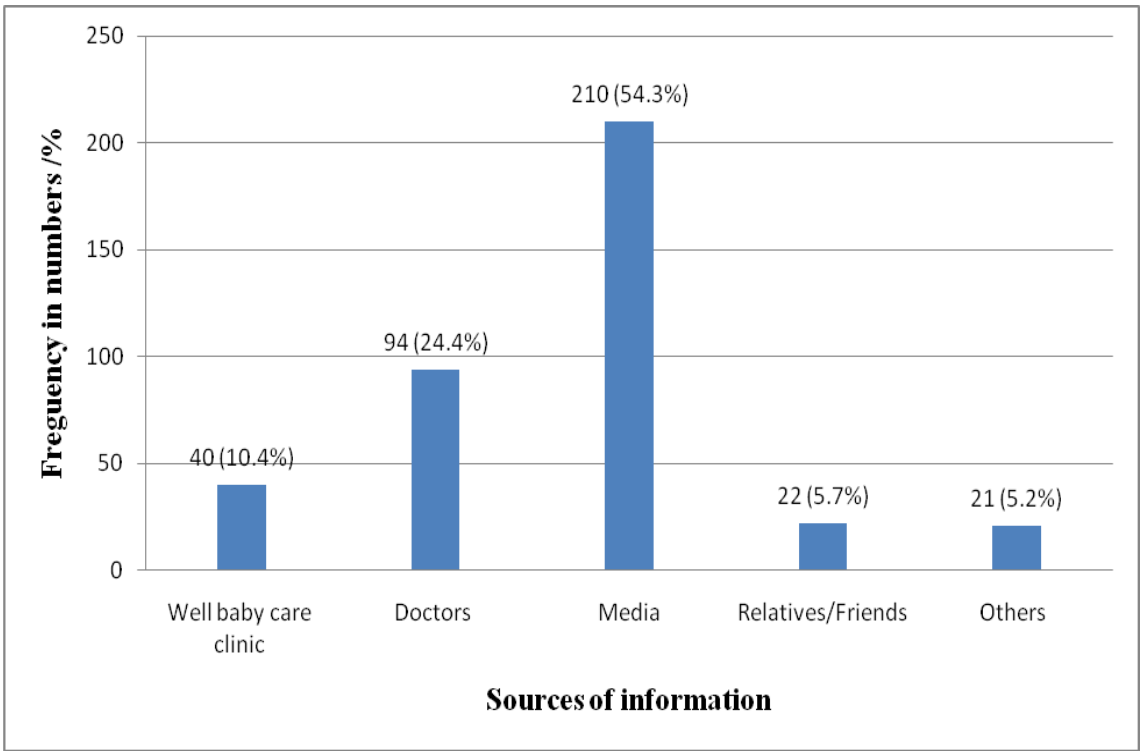

Figure 4.1: Information on children dental care of milk teeth to the caregiver/guardins

4.3.2 Caregiver/guardians information regarding childrens dental health care

Knowledge assessment showed that less than half (41.6%) of the parents knew the correct defination of caries as tooth decay hence good knoledge while 47.0% were had poor knowledge on dental carries defination. Regarding tooth brushing, 61.3% of caregiver had fair knowledge on commencement of tooth brushing to their children but 25.2% had good knowledge regarding comencing tooth brushing to their under five year children. Further assessment showed that 62.1% of parents had good knowledge regarding tooth decay progress, 30.1% indicated that bottle feeding at night can cause tooth decay hence good knowledge and 35.8% also had good knowledge regarding the first visit to dentist by their uner five years children. When asked if children should only visit the dentist when they have tooth decay or pain, majority of parents (80.5%), responded no to the statement hence good knowledge (Table 4.4).

Table 4.4: Knowledge of caregiver/guardians regarding dental health of children (n = 387)

Knowledge parameters assessed	Good N/ (%)	Fair N/ (%)	Poor N/ (%)
Definition of dental carries	161(41.6)	44(11.4)	182(47.0)
Appropriate age children to start tooth brushing	98(25.2)	237(61.3)	52(13.5)
Tooth decay stops when permanent teeth grow	240(62.0)	73(18.9)	74(19.1)
Bottle feeding at night can cause tooth decay	117(30.1)	188(48.6)	82(21.3)
Children should visit dentist by 1st birthday	139(35.8)	130(33.5)	118(30.6)
Dentist's visit should only be when child has tooth decay or pain	312(80.5)	59(15.3)	16(4.2)

Key: N – Number of counts, (%) percentage counts

4.3.3 Dental health care hygiene practices among the children

Majority of the children (72.4%), brushed their teeth at least twice a day, 87.6% were assisted by house members to brush their teeth, 48.8% used pea size fluoride tooth paste and 74.9 % had their toothbrushes renewed at least once within 6 months (Table 4.5).

Table 4.5: Dental hygiene practices among the children (n = 387)

Dental hygiene practices	Yes N (%)	No N (%)	Do not know N (%)	Total %
Child brushes teeth at least twice a day	280(72.4)	78(20.1)	29(7.5)	100
Child assisted to brush teeth	339(87.6)	31(8.1)	17(4.3)	100
Child uses pea size tooth paste	189(48.8)	191(49.3)	7(1.9)	100
Child too young to brush teeth	7(1.8)	380(98.2)	0(0.0)	100
Toothbrush renewed at least once within 6 month	290(74.9)	82(21.1)	15(4.0)	100

Key: N – Number of counts, (%) percentage counts

4.3.4 Dentist's visits practices among the children

The children who had ever visited a dentist were 34.6% of whom 65.7% had normal check up, advice and uprooted a loose tooth while 34.3% had their decayed teeth to be fixed or pain when chewing food. Majority of the children (65.4%), had never been taken to a dentist. Reasons for not visiting the dentist included child had not yet shown any problem requiring dentists visit (87.4%), teeth decay will clear when permanent teeth grow (5.1%), medical insurance cover does not include dental checkup (3.6%) while 3.9% gave mixed reasons. As to whether parents discussed dental health care issues of their preschool children when they visit doctors, 77.8% reported they did not discuss, 20.0% said they discussed while 2.8% did not know of dental discussions with general doctors other than with the dentists.

4.4 Dental caries status of the children

Dental examination showed that 153(39.5%) of children had dental caries categorized as (Decayed, Filled due to decay and Missing due to tooth decay) while 234(60.5%) had no caries categorized as sound teeth, those with trauma, loss due to exfoliation and others (Table 4.6). Among the 39.5% of children with caries, those with untreated decayed component were 77.1% of the dmf category, more in males (31.3%) than females (29.7%), 13.1% had filled teeth and 9.8% had missing teeth. All the children had sound left incisor teeth on their left lower jaw and sound second incisor on the right lower jaw (Table 4.6).

Table 4.6: Categorization of the dental caries decay missing filled teeth (n = 387)

Dental caries status	Male N (%)	Female N (%)	Total N (%)
Dental caries categories present			
Decay	61(31.3)	57(29.7)	118(30.4%)
Filled due to decay	13(6.6)	7(3.6)	20(5.2%)
Missing due to tooth decay	0.0	15(7.8)	15(3.9%)
Total			153(39.5%)
No dental caries present			
Sound teeth	110(56.4)	99(51.6)	209(54.2%)
Trauma	4(2.1)	2(1.0)	6(1.5%)
Exfoliation	4(2.1)	9(4.7)	13(3.3%)
others	3(1.5)	3(1.6)	6(1.5%)
Total			234(60.5%)

Key: N – Number of counts, (%) percentage counts

4.5 Nutritional status of children

4.5.1 Anthropometric measurements of the children

The mean weight of the 3-5 years old children was 17.9kg, standard deviation (SD) of 3.5kg and median weight was 17.0kg. The lightest children weighed 12.5kg and heaviest 32.0kg giving a range of 19.5kg between the weights. The children had mean height of 110.6cm, SD of 15.6cm, with a minimum height of 85.1cm and maximum height of 128.1cm giving a range of 43.0cm with a median height of 109.5cm. The mean Mid Upper Arm Circumference (MUAC) was 15.0cm with SD of 2.0cm. The minimum MUAC measured 11.0cm and the maximum MUAC measured 20.5cm and a median MUAC of 15cm.

4.5.2 Weight-for-age (WAZ) of the children

Assessment of weight parameters of the children in reference to WHO Z scores showed that 94.6% had normal Weight-for-Age Z scores (between -2 and +2 SD). Only 2.6% were underweight, (WAZ < -2 SD) and 2.8% were overweight (WAZ > + 2 SD). The weights of 2.1% of the children were above > +3 SD (Table 4.7).

4.5.3 Height for Age (HAZ) of the children

The height parameters of the children showed that 90.7% had normal Height for Age HAZ (between -2 and +2 SD). A few (0.8%) were stunted, (HAZ < -2 SD) and 8.5% were tall for their age (HAZ > + 2 SD). The heights for age of three children were > +3 SD while one was severely stunted, HAZ (< -3 SD) as shown in Table 4.7.

4.5.4 Weight for Height (WHZ) of the children

Weight for respective height measurements in reference to the WHO, (2006) growth charts showed that majority (89.1%) of the children were within normal WHZ -2 SD to +2 SD. However 9.3% were wasted. (WHZ< - 2 SD) while 1.6% were overweight (WHZ > +2 SD) as shown in Table 4.7.

4.5.5 Summary of anthropometric categories of nutritional status indicators

Table 4.7 shows the summary of the anthropometric nutritional status indicators of children in reference to the standards of the WHO (2006) Z score growth charts.

Table 4.7: Summary of anthropometric categories of nutritional status indicators (n = 387)

Nutritional status indicators	< -2 SD	Between -2 to +2 SD	> +2 SD	Total
Weight /Age Z scores	10(2.6%) underweight	366(94.6%)	11(2.8%) overweight	387(100%)
Height/Age Z scores	3(0.8%) stunted	351(90.7%)	33(8.5%)	387(100%)
Weight/Height Z cores	36(9.3%) wasted	345(89.1%)	6(1.6%)	387(100%)

Key: < -2 SD - Under nutrition, between -2 to +2 SD – Normal, > +2 SD - Over nutrition

4.5.6 Frequency of food intake by the children

4.5.6.1 Food intake by 24 hour recall as reported by caretakers

Recall and record of names of various types of foods and drinks without quantification, taken within the 24 hours prior to the time of data collection indicated that:

In the morning, 55% of the children took: - bread, scones, pancakes, dough-nuts, peanuts and weetabix, 30% took: - eggs, sausages and bacon while 15% took combinations. Children who took beverage were 45% (tea/cocoa), 35% (porridge) and 20% (milk/juice).

During lunch time, 50% of children took:-rice with legumes stew such as beans/green grams/ peas, 35% took: - chapatti/ugali/ spaghetti with beef/chicken and 10% took combinations of rice with legumes stew such as beans/green grams/ peas and chapatti/ugali/ spaghetti with beef/chicken.

During supper time/evening meal, 65% of children took: - rice/ugali/chapatti with beef/chicken/fish, 20% took; - rice / ugali/ spaghetti with beans/peas/green grams, 12% took combinations of rice with legumes stew such as beans/green grams/ peas and chapatti/ugali/ spaghetti with beef/chicken. About 3.0% did not take supper. Majority, 75% of the children took fruits and vegetables during lunch and supper while 25% did not take them.

4.5.6.2 Food frequency intake

Consumption of animal based food indicated that 244(63.0%) of children took them 2-6 times a week while 116(30.0%) consumed them once a week. Similarly cereals, fruits and vegetables were also taken in high frequency by majority of the children as shown in Table 4.8.

Table 4.8: Types and frequency of food consumed by the participants (n = 387)

Dietary foods	Daily N (%)	2-6 Times week N (%)	Once/week N (%)	Once/month N (%)	Never takes N (%)
Animal foods	7(1.8%)	244(63.0%)	116(30.0%)	19(4.9%)	1(0.3%)
Cereals	146(37.7%)	183(47.3%)	57(14.7%)	0(0.0%)	1(0.3%)
Roots & tubers	2(0.5%)	33(8.5%)	213(55.1%)	120(31.0%)	19(4.9%)
Fruits	114(29.5%)	197(50.8%)	56(14.5%)	19(4.9%)	1(0.3%)
Vegetables	198(51.2%)	156(40.3%)	26(6.7%)	4(1.0%)	3(0.8%)
Legumes	9(2.3%)	65(16.8%)	278(71.8%)	29(7.5%)	6(1.6%)

Key: N – Number of counts, (%) percentage counts

4.5.6.3 Frequency of consumption of cariogenic foods among the children

Cariogenic foods taken more frequently (2-6x/week) included juices/sodas by 54.5% of the children, crisps (46.0%), and cakes (36.4%). Consumption of other cariogenic foods mainly occurred during outings biscuits/cookies 180(46.5%), Sweets/candy 239(61.8%), chocolates 244(63.0) and chewing gums. Most of the children 295(76.2%), had never taken cheese (Table 4.9).

Table 4.9: Types and Frequency of cariogenic foods consumed by participants (n = 387)

Cariogenic foods	Daily N/ (%)	2-6 Times/week N/ (%)	Once/week N/ (%)	On outings N/ (%)	Never takes N/ (%)
Juices/sodas	14(3.6%)	211(54.5%)	77(19.9%)	70(18.1%)	15(3.9%)
Crisps	8(2.1%)	178(46.0%)	66(17.0%)	123(31.8%)	12(3.1%)
Cakes	3(0.8%)	141(36.4%)	92(23.8%)	141(36.4%)	10(2.6%)
Biscuits/cookies	1(0.3%)	75(19.4%)	91(23.5%)	180(46.5%)	40(10.3%)
Sweets/candy	1(0.3%)	33(8.5%)	70(18.0%)	239(61.8%)	44(11.4%)
Chocolate	0(0.0%)	29(7.5%)	70(18.1%)	244(63.0%)	44(11.4%)
Chewing gum	2(0.5%)	31(8.0%)	86(22.2%)	239(61.8%)	29(7.5%)
Cheese	3(0.8%)	26(6.7%)	43(11.1%)	20(5.2%)	295(76.2%)

Key: N – Number of counts, (%) percentage counts

4.6 Data analysis on factors associated with dental carries among the children

4.6.1 Univariate analysis of children weight, height and MUC

The children who were sampled had a mean weight of 17.93 kg, a standard deviation of 3.49 kg with a median weight of 17 kg. The lightest child had a weight of 12.5 kg and heaviest child weighed 32 kg which give a weight range of 19.5 kg (Table 4.10)

Table 4.10: Univariate analysis of children weight (n = 387)

Weight of the child		Statistic	Std. Error
Mean		17.9319	.17775
95% Confidence Interval for Mean	Lower Bound	17.5825	
	Upper Bound	18.2814	
5% Trimmed Mean		17.7032	
Median		17.0000	
Variance		12.164	
Std. Deviation		3.48767	
Minimum		12.50	
Maximum		32.00	
Range		19.50	
Interquartile Range		4.50	
Skewness		1.119	.124
Kurtosis		1.617	.248

The children had a mean height of 110.64cm, a standard deviation of 15.67 cm and a median weight of 109.5cm. The minimum height was 85.17cm and the maximum height of 380.17 cm which gave a range of 295 cm (Table 4.11).

Table 4.11: Univariate analysis of children height

Average height/ length (n = 387)		Statistic	Std. Error
Mean		110.6428	.79847
95% Confidence Interval for Mean	Lower Bound	109.0728	
	Upper Bound	112.2127	
5% Trimmed Mean		109.9664	
Median		109.5000	
Variance		245.461	
Std. Deviation		15.66720	
Minimum		85.17	
Maximum		380.17	
Range		295.00	
Interquartile Range		11.25	
Skewness		13.313	.124
Kurtosis		228.817	.248

The children had a mean mid upper arm circumference of 15.06cm with a standard deviation of 2.08cm. The child with the minimum mid upper arm circumference measured 11cm and that with the maximum measured 20.5cm which gives a range of 9.5cm. Six of these children had their mid upper arm circumference measuring much bigger than the expected range. All the children had normal weight as at their age. None of the child was overweight for his/ her age. None of the child was considered to be under grown for his/ her age. All the children attained their normal height as at their ages. All the children were above the underweight mark for their respective heights. All the children were above the normal weight mark for their respective heights. None of the child was above the overweight mark for their respective heights (Table 4.12).

Table 4.12: Univariate analysis of children mid upper arm circumference

Mid upper arm circumference (n = 387)		Statistic	Std. Error
Mean		15.0565	.10652
95% Confidence Interval for	Lower Bound	14.8471	
Mean	Upper Bound	15.2660	
5% Trimmed Mean		14.9606	
Median		15.0000	
Variance		4.335	
Std. Deviation		2.08201	
Minimum		11.00	
Maximum		20.50	
Range		9.50	
Interquartile Range		2.62	
Skewness		.596	.125
Kurtosis		-.306	.249

4.6.2 Bivariate analysis

Various factors were evaluated at bivariate analysis to determine the strength of association between different variables in this study. The bivariate analysis was performed to determine the possible risk or protective factors for dental carries among the study participants.

4.6.2.1 Relationship between maternal/guardian education level and caries in children

There was a significant statistical association between highest maternal/guardian education levels and dental caries. Children of mothers with tertiary education had lower caries prevalence compared to those with primary education level. Complete secondary education (OR= 0.0, 95% CI: 0.0-0.20, $p < 0.05$), college education (OR = 0.0, 95% CI:

0.0-0.29, p <0.05) and university level (OR= 0.0, 95% CI: 0.0-0.2, p <0.05) (Table 4.13). Analysis of the association between the financial net income and caries was not conclusive due to very small numbers of difference between noted in this study in terms of economic well being of the caretakers of children.

Table 4.13: Socio demographic variable and dental caries (n = 387)

Socio demographic characteristics	Dental caries present			OR(95% CI)	p value
	Yes	No	Total		
	N/ (%)	N/ (%)			
Highest maternal/ guardian education level					
Primary school	12 (100)	0 (0)	12	ref	
Incomplete secondary	7 (70)	3 (30)	10	0.0(0.0- 1.86)	0.07
Complete secondary	5 (26.3)	14 (73.7)	19	0.0(0.0-0.20)	0.00
college level	49 (43)	65 (57)	114	0.0(0.0-0.29)	0.00
University level	80 (34.8)	150 (65.2)	230	0.0(0.0-0.20)	0.00
Don't know	0 (0.0)	2 (100)	2	0.0(0.0-1.67)	0.08

Key: N – Number of counts, (%) percentage counts, p ≤0.05, OR – Odds Ratio, CI – Confidence Interval, ref - reference group, n = 387

4.6.2.2 Relationship between selected children's characteristics and carries

Low birth weight (<2.5kg) showed statistically significant higher caries prevalence (OR= 6.6, 95% CI: 2.37-23.74, p <0.05) compared to children who were not of low birth weight. Children who were not exclusively breastfed for the first 6 month after birth had

lower caries prevalence compared to the exclusively breast fed but the relationship was not statistically significant (OR= 0.79, 95% CI: 0.51-1.23, p >0.05). Children who had visited the hospital previously for treatment of illnesses like malaria, diarrhea, tonsillitis and pneumonia had lower caries prevalence compared to those children who were visiting the hospital for the first time, the relationships was however not statistically significant (p > 0.05) as shown in Table 4.14.

Table 4.14: Relationship between children characteristics and dental carries

Children's characteristics	**Dental caries present (n = 387)**			**OR(95% CI)**	**p value**
	Yes N/ (%)	**No N/ (%)**	**Total**		
Birth weight					
More than 2.5 kg	128 (35.9)	229 (64.1)	357	ref	
Less than 2.5 kg	19 (79.2)	5 (20.8)	24	6.6(2.37-23.74)	0.00
Don't know	5 (83.3)	1 (16.7)	6	8.9(1.03-44.31)	0.02
Breastfed exclusively 6 month after birth.					
Yes	79 (42.2)	108 (57.8)	187	ref	
No	67 (36.6)	116 (63.4)	183	0.79(0.51-1.23)	0.27
Don't know	10 (58.8)	7 (41.2)	17	1.95(0.71-5.35)	0.21
Frequency of hospital visits for treatment					
First visit to hospital	2 (100)	0 (0.0)	2	ref	
At least once or more in a month	27 (36.5)	47 (63.5)	74	0.0(0.0- 3.25)	0.07
Once in 2-6 months	89 (41)	129 (59)	218	0.0(0.0-1.27)	0.21
Once in > 6 months	32 (40)	48 (60)	80	0.0(0.0-3.74)	0.09
Don not know	11 (84.6%)	2 (15.4)	13	0.0(0.67-1.07)	0.91

Key: N – Number of counts, (%) percentage counts, p ≤0.05, OR – Odds Ratio, CI – Confidence Interval, ref - reference group

4.6.2.3 Relationship between caregivers knowledge on dental health care and carries among the participants

Table 4.15 shows that children of parents who defined caries as discoloration of teeth had higher prevalence of caries than those who knew the definition, but the relationship was not statistically significant (OR= 2.11, 95% CI: 0.98-4.52, p>0.05). Lack of caregivers information on when under five years old children should commence tooth brushing was significantly associated with higher caries prevalence among their children such as suggesting at 2 years (OR=2.51, p <0.05) and at 3 years (OR=10.2, p <0.05). Lack of knowledge that children should visit the dentist by their first birth day was significantly associated with a higher prevalence of caries in the children than having the information (OR= 2.24, 95% CI: 1.32-3.81, p < 0.05).

Table 4.15: Relationship between caregiver's knowledge on dental health and caries in children

Knowledge parameters assessed	Dental caries present (n=387)			OR(95% CI)	p value
	Yes N/ (%)	No N/ (%)	Total N/ (%)		
Definition of caries					
Tooth decay	55 (34.4)	105 (65.6)	160 (100)	ref	
Discoloration of teeth	21 (52.5)	19 (47.5)	40 (100)	2.11(0.98-4.52)	0.06
Painful gums	0 (0.0)	4 (100)	4 (100)	0.0(0.0-2.99)	0.32
Don't know/ not sure	77 (42)	106 (58)	183 (100)	1.38(0.87-2.2)	0.149
When to commence tooth brushing of children < 5 years old					
when first teeth appear	24 (24.7)	73 (75.3)	97 (100)	ref	
At 1 year of age	15 (24.6)	46 (75.4)	61 (100)	0.99(0.44-2.21)	0.98
At 2 years of age	61 (45.2)	74 (54.8)	135 (100)	2.51(1.37-4.66)	0.00
At 3 years of age	27 (77.1)	8 (22.9)	35 (100)	10.27(3.83-29.23)	0.00
When they join school	5 (100)	0 (0.0)	5 (100)	Inf(2.54 – Inf)	0.00
I don't know	21 (38.5)	33 (61.5)	54 (100)	1.9(0.86-4.16)	0.08
Children should visit a dentist by their first birthday.					
Yes	43 (31.2)	95 (68.8)	138 (100)	ref	
No	65 (50.4)	64 (49.6)	129 (100)	2.24(1.32-3.81)	0.00
Don't know/not sure	45 (37.3)	75 (62.7)	120 (100)	1.31(0.76-2.28)	0.30

Key: N – Number of counts, (%) percentage counts, p ≤0.05, OR – Odds Ratio, CI – Confidence Interval, ref - reference group

4.6.2.4 Relationship between participants dental health practices and dental carries

Self reported pain when chewing food was significantly associated with higher prevalence of caries (OR= 2.19, 95% CI: 1.23-4.96, P <0.05) compared to children who had not reported pain when chewing. Failure to brush teeth twice per day showed higher caries prevalence but not statistically significant (OR=1.27, 95% CI: 0.76-2.1, p > 0.05). Assisted tooth brushing was significantly protective of caries (OR=0.2, 95% CI: 0.09-0.40, p <0.05) compared to no assistance. None renewal of toothbrush at least once in 6 months was associated with high prevalence of caries in children in comparison with renewal, but the association was not statistically significant (p >0.05). Children who had never visited the dentist were 2.29 times more likely to have dental caries compared to those who had ever had a dentist's visit (OR=2.59, 95% CI: 1.64-4.08, p <0.05) (Table 4.16).

Table 4.16: Relationship between children dental health care practices and dental carries (n = 387)

Practices parameters assessed	Dental caries present			OR(95% CI)	p value
	Yes N/ (%)	No N/ (%)	Total		
Child complained of pains when chewing food in last 6 months					
No	169 (50.4)	167 (49.6)	336	ref	
Yes	20 (69.0)	9(31.0)	29	2.19(1.23-4.96)	0.04
Don't know	15 (68.2)	7 (32.8)	22	2.10(0.84-5.33)	0.15
Child brushes teeth at least twice a day					
Yes	106 (37.9)	174 (62.1)	280	ref	
No	34 (43.9)	44 (56.1)	78	1.27(0.76-2.11)	0.43
Don't know	12 (41.4)	17 (58.4)	29	1.16(0.53-2.52)	0.96
I or somebody assist child to brush teeth					
No	23 (72.9)	8 (27.1)	31	ref	
Yes	118 (34.8)	221 (65.2)	339	0.20(0.09-0.40)	0.00
Don't know	5 (29.4)	12 (70.6)	17	0.15(0.04-0.54)	0.00
Tooth brush renewed in 6 month at least once					
Yes	122 (42.1)	168 (57.9)	290	ref	
No	26 (32)	56 (68)	82	1.55(0.93-2.61)	0.12
Don't know	7 (46.7)	8 (53.3)	15	1.89(0.62-5.75)	0.3
Child has ever been taken to see a dentist					
Yes	73 (54.5)	61 (45.5)	134	ref	
No	80 (31.6)	173 (68.4)	253	2.59(1.64-4.08)	0.00

Key: N – Number of counts, (%) percentage counts, p ≤0.05, OR – Odds Ratio, CI – Confidence Interval, ref - reference group

4.6.2.5 Association between nutritional status indicators and dental caries

Children who were underweight (WAZ< -2SD) were 6.4 times more likely to have caries compared to the children who were not underweight (OR= 6.4, 95% CI: 1.25-62.45, p < 0.05). The confidence interval is very wide because of the small numbers of the most prevalence of the underweight children. Normal weight for age and overweight for age (WAZ > +2SD) had lower prevalence for caries but the relationships were not statistically significant (p>0.05). Children found to be wasted (WHZ < -2SD) were 5.4 times more likely to have caries than those who were not wasted (OR=5.36, 95% CI: 2.34-13.31, p <0.05). Children with normal weight for height had a significant low prevalence of caries (OR=0.32, 95% CI: 0.15- 0.65, p <0.05). Being overweight (WHZ > +2SD) showed no statistically significant association with caries (Table 4.17).

The association between stunting (HAZ < -2SD) and dental caries was not statistically significant (OR= 0.0, 95% CI: 0.0-3.7, p > 0.05). Being too tall for one's age was significantly associated with low prevalence of dental caries (OR= 0.18, 95% CI: 0.06-0.55, p <0.05). Children who had MUAC < 11.5cm were 6.29 times more likely to have caries than those who had MUAC > 11.5cm (p <0.05).

Table 4.17: Association between nutritional status and dental carries among the children (n = 387)

Nutritional status indicators	Dental caries present			OR(95% CI)	p value
	Yes N/ (%)	No N/ (%)	Total		
WAZ scores					
Under weight (WAZ<-2SD)					
Yes	8(80)	2(20)	10	6.4(1.25-62.45)	0.01
No	145(38.5)	232(61.5)	377	ref	
Normal (WAZ -2 to +2SD)					
Yes	144(39.2)	223(60.8)	367	0.79(0.29-2.21)	0.61
No	9(45)	11(55)	20	ref	
Over weight (WAZ >+2SD)					
Yes	1(9.1)	10(90.9)	11	0.15(0.0-1.06)	0.06
No	152(40.4)	224(59.6)	376	ref	
WHZ scores					
Wasted (WHZ<-2SD)					
Yes	27(75.0)	9(25.0)	36	5.36(2.34-13.31)	0.00
No	126(35.9)	225(64.1)	351	Ref	
Normal (WHZ -2 to +2SD)					
Yes	126(36.5)	219(63.5)	345	0.32(0.15- 0.65)	0.00
No	27(64.3)	15(35.7)	42	Ref	
Overweight (WHZ > +2SD					
Yes	0 (0.0)	6(100)	6	0.0(0.0- 1.29)	0.09
No	153(40.2)	228(59.8)	381	Ref	

Key: N – Number of counts, (%) percentage counts, p≤0.05, OR – Odds Ratio, CI – Confidence Interval, ref - reference group

4.6.2.6 Association between consumption of cariogenic food and dental carries

Consumption of biscuits/cookies 2-6x/week or once a week was a significant risk factor for caries (OR=3.54, 95% CI: 1.44-9.0, p <0.05), (OR= 4.42 95% CI: 1.84-11.02, p <0.05) compared to never consuming them. Taking biscuits/cookies only during outings was not significantly associated with caries (p>0.05). Consumption of sweets/candies 2-6x/week or once a week was a significant risk factor for dental caries (OR=3.24, 95% CI: 1.14-9.29, p <0.05) in comparison with never consuming them. Consumption of chewing gum only during outings was associated with low caries prevalence compared to never consuming them but the relationship was not statistically significant (OR= 0.51, CI: 0.22-1.20, p > 0.05). Consumption of cheese at both low and high frequency was not significantly associated with caries (p>0.05) as shown in Table 4.18. Children who consumed chocolates 2-6 times per week had significantly higher prevalence of dental caries compared to those who never took the chocolates (OR = 8.64, 95% CI: 2.63-29.22, p <0.05).

Table 4.18: Association between consumption of selected cariogenic foods versus dental caries (n = 387)

Frequency of consumption	Dental caries present			OR(95% CI)	p value
	Yes (%)	No (%)	Total		
Biscuits/ cookies					
Daily	0 (0.0)	1 (100)	1	0(0.00-106)	0.54
2-6 times/ week	43 (57.3)	32 (42.7)	75	3.54(1.44-9.01)	0.00
Once/ week	57 (62.6)	34 (37.4)	91	4.42(1.84-11.02)	0.00
During outings	42 (23.3)	138 (76.7)	180	0.8(0.35-1.94)	0.57
Never takes them	11 (27.5)	29 (72.5)	40	ref	
Sweets/ candies					
Daily	0 (0.0)	1 (100)	1	0.0(0.0-95.86)	0.52
2-6 times/ week	19 (57.6)	14 (42.4)	33	3.24(1.14-9.29)	0.01
Once/ week	48 (68.6)	22 (31.4)	70	0.52(2.13-12.92)	0.00
During outings	73 (30.5)	166 (69.5)	239	1.05(0.5- 2.32)	0.89
Never takes them	13 (29.5)	31 (70.5)	44	ref	
Chewing gum					
Daily	1 (50)	1 (50)	2	1.07(0.01-89.57)	0.96
2-6 times/ week	15 (48.4)	16 (51.6)	31	1.0(0.32-3.11)	0.99
Once/ week	46 (53.5)	40 (46.5)	86	1.23(0.49-3.13)	0.62
During outings	77 (32.2)	162 (67.8)	239	0.51(0.22-1.20)	0.09
Never takes them	14 (48.3)	15 (51.7)	29	ref	
Cheese					
Daily	2 (66.7)	1(33.3)	3	0.68(0.26-32.5)	0.57
2-6 times/ week	8 (30.8)	18 (69.2)	26	0.67(0.27-1.54)	0.32
Once/ week	16 (37.2)	27(62.8)	43	0.69(0.44-1.67)	0.66
During outings	7 (35.0)	13 (65.0)	20	0.68(0.30-2.02)	0.62
Never takes them	120(40.7)	175(59.3)	295	ref	

Key: $p \leq 0.05$, OR – Odds Ratio, CI – Confidence Interval, ref - reference group

4.6.3 Multivariate analysis

Multiple unconditional regression model was used to assess individual variable effects after controlling for confounders. Multivariate analyses of the variables were done by entering the variables that were found to be associated with dental carries (p value of ≤0.05) from bivariate analysis. These variables included; nutritional status indicators; Underweight <-2SD WAZ, Wasted <-2SD WHZ and Normal weight for height -2 to +2SD; consumption of cariogenic food Biscuits/ cookies (2-6 times/week, Once/week) and Sweets/candies (Once/week). The variables found to have statistically significant association with dental caries when confounders were controlled were wasting and consumption of cariogenic food like Biscuits/cookies (2-6 times/ week, Once/week) and Sweets/candies (Once/week) in the analysis (p≤0.05) (Table 4.19).

Table 4.19: Multivariate analysis of risk factors associated with dental carries among the study participants

Factors	AOR(95% CI)	p value
Nutritional status indicators		
WAZ scores		
Under weight <-2SD	1.8(14.4-49.9)	0.06
WHZ scores		
Wasted <-2SD	***2.2 (1.91-16.3)***	***0.02***
Normal weight for height -2 to +2SD	1.4(1.9- 19.7)	0.09
Frequency of consumption of cariogenic food		
Biscuits/ cookies		
2-6 times/ week	3.7(2.8-9.4)	0.014
Once/ week	***2.7(3.4-9.9)***	***0.02***
Sweets/ candies		
Once/ week	***1.5(4.4-5.9)***	***0.03***

Key: P ≤0.05, AOR – Adjusted Odds Ratio, CI – Confidence, p-value

CHAPTER
FIVE: DISCUSSION

5.1 Demographics, caregiver/children's characteristics, knowledge and practices

5.1.1 Socio demographic characteristics of the caregiver/guardians

This study has provided information on the prevalence of dental caries, nutritional status and factors associated with caries in a representative sample (n = 387) of three to five years old children from within Nairobi County, its environs and a few from countries outside Kenya. Both male and female children were represented in almost equal numbers.

The parents/guardian/caretakers demographics revealed that 73% of families had a net monthly income (> Ksh. 50,000), which is considered as a positive contribution to the nutritional status of children, consistent with previous studies where good socioeconomic status has been associated with better nutritional status of children as opposed to poverty (Kamiya, 2011; Mathad *et al.*, 2011). The small proportion (0.3%) of parents who reported a low net income of (between Ksh 5,000 <10,000) may be from the 10% charitable clients that Gertrude's Children's Hospital caters for. However even families with the lowest net monthly income still qualified to be in the category of those living above the global poverty index of 1.25 dollar (Ksh. 100.00) per day (Randa, 2012). The ample housing status where 46.5% and 46% of the families lived in 3 and 4 bed roomed houses, respectively, was further suggestive of good socio economic status of the respondents. The association between financial status and dental caries in this study was not statistically significant. This is contrary to studies in India where Socio-economic status/level had negative association with caries prevalence (Kuriakose and Joseph, (1999). In Denmark, caries prevalence was found highest in children from low income families (Christensen *et al*., 2010).

A high proportion of mothers/caretakers had tertiary education, university level (59.4%) and diploma or certificate college training (29.5%) which was found protective of caries compared to those with primary school level of education ($P<0.05$). The findings are

consistent with the study by Christensen *et al*., (2010) in Colombia Sri Lanka, which found the highest caries prevalence among children of mothers with low educational levels ($p < 0.001$). Elsewhere maternal education has also been associated with child nutritional status (Frost *et al.,* 2005; Mukuria *et al.,* 2005). About 75.5% of the families in which participants children came from had one or two siblings. These show that there is less crowding of under five in majority of families.

5.1.2 Children characteristics – gestation, birth weight, breastfeeding and morbidity

The study found that 92.2% had birth weights of >2.5kg and 93% were born at term (> 8 months of pregnancy) hence meeting WHO recommendation for a good start in nutritional status (WHO, 2005; Munguti & Buluma, 2008). This can be attributed to the good socio economic status of the study population. The findings are consistent with the report given in KDHS, (2008/09) regarding majority of children under five year old having met the recommended birth weight of 2.5 kg or more (Obonyo *et al.,* 2008). Low birth weight (<2.5kg) was a significantly associated with higher prevalence of caries among children in this study, however comparative studies are still not conclusive on the predisposition of low birth weight to caries occurrences (Brian and Satishchandra, 2001). The high prevalence of carries among low birth weight in this study can be attributed to a likely practice of bottle feeding premature babies who are not able to suckle hence predisposing the child to many diseases including dental carries.

The prevalence of exclusive breastfeeding for the first 6 months of life found in this study (48.3%) was in keeping with the observed rise in the breastfeeding figures in Kenya, as a result of the country's push for exclusive breastfeeding and limitation of formula feeding.

Morbidity among children in this study was low since 56.2% showed low frequency of hospital visits (once in 2-6 months) for treatment of illnesses such as diarrhea, tonsillitis, pneumonia, measles or malaria. This can be attributed to high maternal/guardian's

educational level, good financial status and ample housing for the majority of children. The results of this study compare well with the findings of Mashal *et al.*, (2008) in Afghanistan where a high prevalence of diarrhea (32.5%) and acute respiratory infection (ARI) of 41.0% were associated with emaciation (12.4%) and linear growth retardation (39.9%) among a total of 2474 children from 1327 households. The observation is consistent with the KDHS, (2008-09) report indicating that morbidity increases in overcrowding like in families with many under fives which facilitate the spread of various communicable diseases (respiratory infections and measles) and interfere with the children's nutritional status (Obonyo *et al.,* 2008; IRIN, 2012). The results of this study compare well with the findings of Mashal *et al.*, (2008) in Afghanistan where a high prevalence of diarrhea (32.5%) and acute respiratory infection (ARI) of 41.0% were associated with emaciation (12.4%) and linear growth retardation (39.9%) among a total of 2474 children from 1327 households. There was no statistically significant association between the morbidity pattern among the participants and carries prevalence ($p>0.05$). This can be attributed to the low morbidity pattern of the study participants in comparison to studies where children who are sickly and emaciated have high caries prevalence.

5.1.3 Source of information regarding dental health care

Gaps in knowledge regarding dental health care of the under five years old children was evident by lack of information on the appropriate time for preschool children to commence tooth brushing and visit the dentist for preventive care which was a significant risk factor for caries. The American Pediatric Dentistry Association (ADA, 2010) recommends tooth cleaning to commence as soon as the tooth appear in the mouth (since some children develop caries as early as 6 months of age) and dentist visit at first birthday then regularly after 6 months. There was statistically significant association between caries in children and parents/guardians lack of information on the time under fives should commence tooth brushing ($p<0.05$). Despite the high formal education of

the childrens parents/guardians there was still some gaps in knowledge on the dental health care of the under five children.

In general dental health care hygiene of children in this study was well practiced as 72.4% brushed their teeth twice a day. However it was the assisted tooth brushing by somebody that was significantly protective of caries. Similar findings have been found by Tinanoff *et al*., (2002) in the USA. Utilization of the dental health care facilities was low since only 34.6% of the children had ever visited a dentist for a curative or preventive purpose. This may be attributed to the misguided concept and assummption that better permanent teeth will soon replace the primary teeth and overcome whatever illnesses the primary teeth had, hence less priority given to the health condition of the primary teeth. Failure to ever visit a dentist was a significant risk factor for caries and high frequency consumption of cariogenic sticky foods like biscuits/cookies, sweets/candies chocolates was significant high risks for caries. Similar findings were reported by Ngatia *et al.,* (2001) and Kiwanuka, *et al*., (2004) in Nairobi Kenya and Uganda respectively among 3-5 years old nursery school children.

5.2 Prevalence of dental caries among the children

The prevalence of dental caries (39.5%) found among 3-5 years old children attending outpatient health care at GCH was within the WHO oral health goals of, achieving 50% of 5-6 years old children free of caries by the year 2000 (WHO, 2001). The decay component of the dmft categorization was the highest (79.1%) and only 19.8% of children had filled teeth due to caries. Previous similar studies by Ngatia *et al.,* (2001) among 3-5 years old nursery school children within Nairobi, Kenya, found a higher prevalence (63.5%) with a dmft of 2.95, d-component of 96% and only 1.3% filling of their decayed teeth. The difference can be attributed to this study as a hospital based on a more health conscious population. Higher dental caries prevalence (59.5%) has also been reported in Kiambu County, Kenya by Njoroge *et al*., (2010). The difference can be attributes to the study site such that urban setting has easier access to professional dental health care compared to rural area.

The prevalence of dental caries in preschool children varies greatly since the disease is found in both industrialized and non industrialized states as demonstrated by both earlier and recent studies. A study in Moshi, Tanzania by Rwakatema and Ng'ang'a, (2010) found caries prevalence of 30.1%, close to the prevalence of caries found by this study. Outside Africa, Singh *et al*., (2012) in Marathahalli, Bangalore, India found similar ECC prevalence (40%) in a cross sectional study of 717 preschool children aged 3-5 years old from six kindergarten schools, almost all of the dmft was due to untreated caries. Ferreira *et al.,* (2007) reported 40% prevalence in Brazil similarly to this study. However higher prevalence have still been reported in other areas whereby Shang *et al*., (2008) found caries prevalence (53%) in Shandong Province of China, Gokalp *et al.,* (2007) reported caries prevalence of 70% in Turkey while earlier studies found caries prevalence of 73% and 67.9% in Argentina and Amman of Jordan, respectively (Yankilevich *et al.,* 1993; Sayegh *et al*., 2002).

5.3 Nutritional status of children

5.3.1 Anthropometric indicators of nutritional status of children

The prevalence of malnutrition in this study, underweight {(WAZ < -2SD), 2.6%}, overweight {(WAZ > +2SD), 2.8%} and stunting {(HAZ < -2SD), 0.8%} was low compared to the national KDHS, (2008) report on malnutrition level. The study found high prevalence of wasting {(WHZ < -2SD), 9.3%}. The prevalence of malnutrition can be attributed to the socio demographics and children characteristics, consistent with reports of other studies which have demonstrated the association between socioeconomic status and children's nutrition (Adeladza, 2009; Kamiya 2011).

The prevalence of wasting in this study was particularly high (9.3%) but it is a combination of both moderate (< -2SD) and severe (< -3SD). Wasting is an indication of children's thinness usually resulting from recent nutritional deficiency that can be affected by seasonal shifts in the availability of foods and/or prevalence of disease

(WHO, 2010; UNICEF, 2011). In this study the high level of wasting is unlikely due to food unavailability since the participants came from middle to high economic status where food shortage is unlikely. It can possibly be attributed to accessibility of the available food, feeding challenges or food selection by the 3-5 years old children whereby dental caries is a likely contributor. Although nutrition was not analyzed against morbidity in this study therefore it could be a confounder.

Stunting, an indication of short stature (short height for age) was particularly low in this study (0.8%) hence does not concur with KDHS, (2008-09) report of 35.3%. Stunting usually results from prolonged periods of inadequate food intake, poor dietary quality and/or increased morbidity (frequent infections). The WHO (2005) report on nutrition monitoring of under fives indicate that height for age is significantly determined by the initial 1000 days of the child's life (9 months before delivery and the 2 years after birth). Chronic inadequate dietary intake within the initial 1000 days can result in stunting for life (KDHS, 2008-09). The observed low preference of stunting in this study can therefore be attributed to a previous adequate nutrition supply to the children prior to the 3-5 years of age consistent with the socio economic status.

Underweight for age (2.6%) as a measure of both acute and chronic malnutrition (a composite of weight for height and height for age) was lower than the > 20% given in the national report compiled by the NNAP, (2012) on the trends of nutritional status of children less than five years old in Kenya period (1998, 2003 and 2008). Other regional reports in Kenya showed disparities as found worldwide where rural areas and poorer regions have higher levels of malnutrition (Ngare and Muttunga (1999; Olack *et al.,* 2011). However Koksal *et al.,* (2011) report from the Turkish Demographic and Health Survey on the nutritional status of their under fives was consistent with the results of this study where underweight prevalence was 2.8% and obesity was 5.8%.

5.3.2 Twenty four hour recall of food taken prior to the interview

The 24 hours recall of foods taken by the children in this study prior to data collection established that the commonest foods taken included bread, pancakes and weetabix, with eggs/ sausages and beverage of tea/porridge and milk for breakfast. During lunch the children mostly took rice with legumes stew such as beans/green grams/ peas. For supper, majority (65%), of children fed on rice/ugali/chapatti with beef/chicken/fish. The 24 hours recall was suggestive of the relative guarantee of food availability in keeping with what Launer *et al.,* (1992) reported on the tool as a quality guide on food intake. The food frequency tabulation report confirmed the consistency of foods taken in form of animal protein, plant protein, cereals, vegetables and fruits by majority of children mostly 2-6 times per week or weekly, comparable to previous studies of Walingo and Kidake, (2013) on nutritional status of children under five years.

5.4 Association between nutritional status and dental caries

This study found that wasted children, wasted children (WHZ<-2SD) were 5.36 times more likely to have dental caries than those who were not wasted. The findings are consistent with what Cleaton-Jones *et al.,* (2000) found among 4-5 year old South African children where an association was found between wasting and decayed, missing and filled (dmf) surfaces (P=0.003). However their study did not find overall nutritional status clinically relevant to caries prevalence. Global information from comparable studies on the association between under/over nutrition and dental caries is inconclusive and controversial. Some studies have shown significant associations while others show weak or no relationship between nutritional status and severe ECC (Pinto *et al*, 2007; Willerhausen *et al*., 2007). In Sub Saharan Africa, wasting in children is closely associated with acute food deficiency where poverty is the main documented contributory factor (Mathad *et al.,* 2011). On the contrary the wasting found among children in this study may not be as a result of poverty and food unavailability since their financial income was good. Wasting is also associated with recent illness among children under five and could be a confounding factor in this study.

There was no significant association between stunting HAZ<-2SD and dental caries in this study. This can be attributed to the low prevalence of stunting (0.8%), a possibility that the children were not subjected to chronic or prolonged food deficiencies. The KDHS, (2008) report found that stunting in the under fives is highest at the age of 18-23 months.

The children who were underweight (WAZ<-2SD) were 6.4 times more likely to have caries than those who were not under weight. A comparable study by Wasunna and Dorah, (2012) done at Nyanza Provincial General Hospital in Kisumu County, Kenya has consistent findings. Their study reported that 3-5 years old children with severe early childhood caries (S-ECC) were 1.23 times more likely to be underweight than caries free children but statistical significant difference was not noted regarding stunting, underweight and wasting. Oliveira *et al.,* (2008) found similar results in urban Brazilian preschool children aged 12-59 months where low Z-scores in some indexes (underweight children) had an increased risk of having caries. Similar reports were given by Ngoenwiwatkul and Leela-adisorn, (2009), whose findings suggested that severe caries was a risk marker for malnutrition among children. Their study found caries prevalence (80.2%) and each extra carious surface (dmfs) increased the odds of being at risk for underweight by 3.1% after adjusting for gender and dental visits.

Association between overweight and dental caries was not statistically significant ($p>0.05$). The findings are consistent with what Pinto *et al.,* (2007) found in a cohort study in the USA following a report that the prevalence of overweight children had risen almost threefold in two decades. Their study found no correlation between dental decay in obese and non-obese children ($p=0.99$). On the contrary, some studies have revealed positive associations between obesity and dental caries (Clarke *et al.,* 2006; Bimstein and Katz 2009; Vazquez-Nava *et al.,* 2010). Confounders such as genetic composition, gestation period, birth weight, breast feeding exclusive and duration, underlying

illnesses or maternal highest level of literacy may have contributed to the weak association between overweight and caries.

The MUAC measurements of children further demonstrated statistical significant relationship with caries where children with MUAC< 11.5cm were 6.29 times more likely to have caries than their counterparts with MUAC >11.5cm.

5.3 Study Limitation

1. This was a cross sectional study which is not able to determine causality.
2. Hospital based study which may be selective, some participants nutritional status may be due to previous morbidity
3. Participation of guardians/caregiver in the study was a challenge regarding recall.
4. Financial status of family was assumed to be available for the childs nutritional needs. Social conflicts and domestic difference was not made regarding fathers and mothers/guardians/caregiver earnings.
5. Radiography of the teeth was not done because of the practicability. This could have been too expensive and also it was not part of the study objectives

CHAPTER SIX
CONCLUSION AND RECOMMENDATIONS

6.1 Conclusion

The prevalence of dental caries found among 3-5 years old children attending health care at Gertrude's Children's Hospital, Nairobi County in Kenya was 39.5%, hence within the expected WHO recommended levels of 50% for children less than 6 years old. The untreated decayed component constituted the highest proportion of the cases of dental caries.

Majority (84.5%) of children were within normal nutritional status. The level of malnutrition was low in comparison with the national prevalence level as noted by the prevalence of underweight (2.6%) and stunting (0.8%) except the prevalence for wasting (9.3%) which was high.

Children with wasting and underweight were 5.4 and 6.4 times respectively more likely to have caries than well nourished children. Following multivariate analysis with confounders controlled, wasting was significantly associated with higher prevalence of dental caries ($p< 0.5$). Having a MUAC <11.5cm was also associated with significantly higher prevalence of dental caries.

The main foods frequently consumed by the children were cereals, animal based foods and fruits. The main frequently consumed cariogenic foods were sodas/juices, crisps and cakes while biscuits/cookies, sweets/candies and chocolates were mainly taken during outings

Significant risk factors for caries found included low maternal/guardian education level, low birth weight, lack of information on the appropriate time for children less than five years old to commence tooth brushing and visit the dentist, self reported pain when chewing food, never having visited a dentist and high frequency of consumption of

cariogenic sticky foods. Only high consumption of cariogenic foods was significantly associated with high caries prevalence on multivariate analysis.

Parent/guardian health seeking behaviour was low as noted from the low (34.6%) utilization of dental health care services. Majority (65.4%) of parent/guardian indicated that their children had not yet shown any problem reguiring dental visit. The practice was an indication of adhoc dental visits that occur when there is a need compared to recommeded planned visits for preventive and curative services. Media was the main source of dental health care information.

6.2 Recommendations

1. There is need to raise awareness among the primary health care providers of the association between nutritional status and caries in the under five years old children so that they can champion integration of dental health care in the primary health care services.
2. There is need to encourage growth monitoring clinics (well baby clinic) to actively extend planned charting of anthropometric measurements of children beyond two years of age, compared to the practice of isolated weights and heights that are mainly taken only when the 3-5 years old children visit hospitals for curative purposes.
3. There is need to promote awareness campaigns among parents regarding dental caries due to gaps in knowledge/practices on dental health care of children under five years old.
4. There is need to sensitize parents regarding utilization of dental health care services for scheduled preventive and preservative purposes of the primary teeth as opposed to their practices of using dental services only when there is a dental need.
5. Good snacking behavior should be promoted to limit high frequency of consumption of sticky cariogenic foods, restrict them or replace them with fruits.
6. Further research is needed to establish causality so that health care policy makers can be advised.

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APPEDNICES

Appendix I: Consent Form

Dear parent,

Hallo to you. My name is Eunita A. O. Kagasi, a student at Jomo Kenyatta University of Agriculture and Technology/Kenya Medical Research Institute. I am carrying out a Public Health study on children, 3 to 5 years of age attending Out Patient Health care at Gertrude's Children's Hospital. I would like to inform you about the study using this form as I request you and your child's participation in it.

Title of the Study

'The Association Between Nutritional Status and Dental Caries of Children attending Out Patient Health Care at Gertrude's Children's Hospital'.

Purpose

It is to collect and analyze information about their Age, Weight, Height and Arm Circumference in relation to the status of their teeth and compare with appropriate international standard of what they should be. Their nutritional status help the health providers determine how well the children grow compared to what they are expected to be and how well they recover from diseases. When children have healthy teeth, they are able to chew their food well and absorb enough nutrients for their growth and development and protection from illnesses.

Potential Harm, Risks, Inconveniences or Discomfort

Anticipated inconveniences for you and your child include: you to kindly spare some extra time of about 10 - 15 minutes for the examination and questionnaire response. You will please be the link between the research team and the child since the child would have already been checked by the primary clinician. Your child may feel cold for a brief time when the reweighing and height measurements are taken since the child will barely be dressed and without shoes to help standardize measurements of all the children

involved in the study and increase the accuracy. However, the place for examination will be assessed to ensure it is not too cold. There may be some anxiety and fright to the child for a dental check up based on possible foretold stories regarding dental visits and the teeth. The research team will ensure they win the child's confidence to communicate that it is looking at the teeth and not uprooting them. All measures of sterility will be observed as per the recommendations of the Centers of Disease Control (CDC).

The benefit of the study will include:

Individual benefit to you and your child will include highlight areas that may not be clear on issues of child nutrition dental caries as core to their growth, development and defense against diseases. Alertness of the presence of dental caries and their association to the nutritional status is useful information to determine the children who are victims of food selection because of inability to chew all their foods properly. The food selection habit exposes the child to gradual deficiency in kilocalories, muscle bulk, nutrients and vitamins. The child could fail to grow to their full potential and fall into any of the following categories; short for their age (stunted), under weight, wasted or over weight for those whose food selection is a preference of easy to eat fast foods that has the risk of cardiovascular diseases, high blood pressure and diabetes in future life. Stunting is the manifestation of the chronic form of under nutrition expressed as low expected height for the age. Dental caries are likely to give such progressive under nutrition because they interfere with the child's ability to chew their nutritious food for a progressively long time. Besides energy needs are micronutrients like, Iron associated with cognitive functions, motor functions, and weak defense against infections and poor oxygen carrying capacity resulting in low vitality. All these can be taking place despite the fact that the parents bring home appropriate food but the child does not maximally benefit from the food due to the dental caries. The information gathered from the study will be utilized in the management of caries which cause pain on the gums, give disturbed sleep at night producing a sleepy child in the daytime that cannot concentration and learn properly as they approach school time. Stunted children are likely to grow into stunted

adults who remain mentally inferior to their peers since they may have lacked nutrients like iron at the time of their rapid growth. The under five year old dental programs are not as organized as the school age programs in anticipation that the primary teeth will sooner be replaced by permanent teeth. However, information reveals that some children dental caries that started in the primary teeth can continue the whole length of their life time. Hence the importance to determine the association with the nutritional status since the relationship may be slow and gradual but progressive likely to give stunted children. The stunting is not easily detected unless it is compared to the international reference standards on growth charts. This should not happen if it can be determined and avoided. Any further information that will be found useful to help parent seek more professional advice will be conveyed to you. Information collected will also contribute to the knowledge of science in management of the under fives year olds.

Alternatives: Your participation in this study is voluntary. You are free to ask questions to the main researcher before you consent to participate or any other time at will as they arise. You are also free to withdraw from the study if necessary without any consequences. However, it will be useful to complete it.

Confidentiality: All the information in the questionnaire and files will be held in confidence. At the end of the study there will be no way to link your name with the data. It will be labeled by study code number and kept in lockable cabinets and only the research staff will have access. Any additional information will be provided to you including the final results

Costs: There are no financial benefits to participate in this study however your participation are highly appreciated.

Questions: If you have any questions, you can ask at the moment; ----------
If you do not have any question at the moment and yet a question may arise later; I do hereby provide you with the contacts that you can use to have any arising maters solved.

Contact:

a. If you get any questions or concerns about the study or in the event of the study including related injury: please contact the principal investigator and/or the representative on; Telephone numbers: 0720 792594, 0737 443987; P. O. Box 25328 00603, Nairobi; email address: e_kagasi@yahoo.com; ekagasi@gerties.org
b. For any questions concerning your rights as a research participant, please contact: The Secretary, KEMRI Ethics Review Committee, P. O. Box 540840 00200, Nairobi; Telephone numbers: 020 272-2722541, 0722205901, 0733400003; Email address: erc-secretariat@kemri.org

Should you agree to participate in this study about 'The Association between Nutritional Status and Dental Caries of Children attending Health Care at Gertrude's Children's Hospital' then I do request you to fill a questionnaire attached. It includes; personal information regarding your child and yourself, the feeding and dental habits of the child. Then the child will be weighed, height taken and teeth checked. Your height will also be taken.

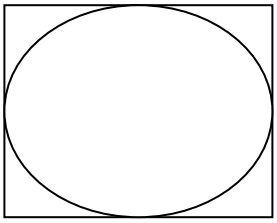
If you are in agreement to participate in this study, please sign your name below, indicating that, you have read and understood the nature of the study, your responsibilities as a study participant, the inconveniences associated with voluntary participation in the study as well as an indication that all your concerns regarding the study have been addressed satisfactorily.

Subject's statement

I have been clearly explained to about this study of; the association between nutritional status and teeth decay in children. I volunteer to participate in it. I have a chance to still ask questions about it in future if I get any using the contacts I have been given.

I do accept to participate in this study

Name and Signature of study participant and Date



Name and Signature of person obtaining Consent and Date ----------

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---------- Thumbprint of participant

Name and Signature of Witness and Date

You will receive a copy of his signed consent form to take a way with you

Appendix II: Consent slip for caregiver/guardians

Child's Name: ----------	Child's Age: ----------
---------- **Yes, I give permission** for my child to have his/her teeth checked & weighed ---------- **No, I do not give permission** for my child to have his/her teeth checked & weighed	
---------- Signature of Parent	---------- Date

Appendix III: Questionnaire

Number……

Child's date of birth: dd/mm/yy ……..

Residence: ……

Date of data collection: dd/mm/yy ……..

Instructions

1. Please complete all the questions on the form.
2. Put a tick in the box that corresponds to your correct answer.

Part A: Demographic Data

1) Child's date of birth: dd/mm/yy …… …… ……

2) Sex of the child?

1. Male ☐ 2. Female ☐

3) After how many months of pregnancy was this child born?

1. Term (after 8 months pregnancy) ☐ 2. Pre term (before 8 month) ☐

9. Don't know/ don't remember ☐

4) Weight of the child at time of birth?

1. Less than 2.5 kg ☐ 2. More than 2.5 kg ☐

9. Don't know/ don't remember ☐

5) Other under five years old brothers or sisters that this child has. (State number) ……

6) What was the highest education level of this child's mother?

1. Incomplete primary school ☐ 2. Completed primary school ☐

3. Incomplete secondary ☐ 4. Completed secondary ☐

5. College ☐ 6. University ☐

9. Don't know ☐

7) What is the size of the house you live in? Number of bedrooms.

1. One roomed ☐ 2. Two roomed ☐

3. Three roomed ☐ 4. More than three roomed ☐

8) How much does the family earn per month in Ksh

1. <5,000 ☐ 2. 5,000 < 10,0☐

3. 10,000 < 20,000 ☐ 4. 20,000 < 50,000 ☐

5. >50,000 ☐ 9. Don't know ☐

9) How frequent does this child come to hospital for any of the following illness (malaria, pneumonia, tonsillitis, acute diarrhea or another frequent illness)?

1. At least once or more a month ☐ 3. Once in More than 6 months ☐

2. Once in 2-6 months ☐ 4. Today is first visit to hosp ☐

9. Don't know/ don't remember ☐

10) Has this child reported toothache when biting or chewing food during the past 6 months?

1. Yes ☐ 2. No ☐ 9. don't know/don't remember ☐

Part B: Knowledge

11) Where do you get most of the information about care of the child's milk teeth?

1. Well baby clinic when child goes for vaccination ☐
2. Medical doctors when child goes for treatment ☐
3. TV/ Radio/Newsprint/Magazine advertisement ☐
4. Family/Relatives/Friends/church/mosque ☐
6. Others specify ----------

12) What is dental caries?

1. Discoloration of teeth ☐ 3. Painful gums ☐
2. Tooth decay ☐ 9. I am not sure/don't know ☐

At what age should tooth brushing of young children below five years old begin?

1. As soon as the first teeth appear ☐ 4. At 3 year of age ☐
2. At 1 year of age ☐ 5. When they join school ☐
3. At 2 year of age ☐ 9. I don't know ☐

13) Please indicate Yes, No or don't know to the following statements Yes No Don't know

1. Tooth decay of milk teeth stops when permanent teeth grow ☐ ☐ ☐
2. Bottle feeding at night can cause tooth decay ☐ ☐ ☐

3. Children should visit a dentist by their first Birthday

4. Visit to dentist should only be when child has tooth decay or pain ☐ ☐ ☐

Part C: Practices

14) If this child has ever visited a dentist, what was the reason? (can tick more than one choice)

1. Normal check up for advice ☐
2. To uproot a loose tooth ☐
3. To fix/fill a decayed tooth ☐
4. Child had pains to chew food ☐

16) If this child has never visited a dentist what are the reasons (can tick more than one choice)

1. Not had any problem to require dentist visit ☐
2. The decayed teeth decay clear when permanent teeth grow ☐
3. My medical insurance cover does not include dental check up ☐
4. Any other reasons ----------

17) Please tick Yes or No or don't know to the following statements Yes No Don't know

1. Child brushes teeth at least twice a day ☐ ☐ ☐
2. I or somebody assist child to brush teeth ☐ ☐ ☐
3. Nobody assists Child but brushes properly by him/ herself. ☐ ☐ ☐

4. Child tooth brush is renewed at least once in 6 months ☐ ☐ ☐

5. I discuss about child's teeth with doctor at vaccination clinic ☐ ☐ ☐

6. Child used to bottle feed at day or night time ☐ ☐ ☐

18) What amount of tooth paste does the child's use for tooth brushing?

1. Pea size tooth paste ☐ 2. Half tooth brush surface tooth paste ☐

3. Full size surface tooth paste ☐

4. Child still small, not using any toothpaste to brush teeth. ☐

Rapid Nutrition Survey

19) Child breastfed exclusively (only) for the first 6 month after birth.

1. Yes ☐ 2. No ☐ 9. Don't know/don't remember ☐

20) Age when child stopped breastfeeding completely?

1. below 1 year ☐ 2. after 1 year ☐

3. Never breastfed ☐ 9. Don't know/don't remember ☐

21) Please try to remember and enter all foods that the child has eaten in the last 24 hour.

Time of Day	List of types of foods eaten
Morning	
Mid morning/ Break time	
Lunch time	
Evening	

22) Please indicate how frequently child takes the following categories of foods in the last 6 months

How frequently child eats these types of foods

Food/Drink	Daily	2-6 x/week	Once a/week	Once a/month	Never takes them
Animal foods Beef Chicken Fish Eggs					
Cereals Ugali Rice Chapati Spaghetti					
Roots & tubers Sweet potatoes Irish potatoes					
Fruits Bananas grapes Mangoes Apples water melon Oranges					
Vegetables Cabbage Kales spinach					
Legumes Beans peas Githeri **Any other food** -- ----------					

23) Please indicate how frequently the child takes the following snacks:

Food/Drink	Daily	2-6 x/week	Once/week	During outings	Never takes them
Plain milk					
Milk with sugar					
Plain Tea/cocoa					
Tea/cocoa/sugar					
Chewing gum					
Cheese					
Juices/sodas					
Crisps					
Cakes					
Biscuits/cookies					
Sweets/candy					
Chocolate					
Any Other snacks - **----------**					

24) 1. Weight of child of child ----------Kilograms

2. Height/ Length 1st ----------2nd ----------3rd---------Average --------- centimeters 3. Mid Upper Arm Circumference----------Centimeters

Appendix IV: Modified WHO oral health assessment form (1997)

GENERAL INFORMATION

Date Year Month Day Serial Number

……. …….. …….. …… ----------

Age in months ……
Residence……

CLINICAL ASSESSMENT

Extra oral examination

0 = Normal extra-oral appearance

1= Ulceration sores, erosions, fissures (commissures)

2= cancrum oris

3= abnormalities of upper and lower lip

ORAL MUCOSA STATUS

CONDITIONS	LOCATION
0=No abnormality	
1=Leukoplakia	1=Vermilion border
2=Reccurent aphthous ulcers	2=Commissure
3=Primary herpetic gingivostomatitis	3=Lips

4=ANUG

5=Geographical tongue

6=Angular cheilitis

7=Candidiasis

8= Dental alveolar abscess

9= others (specify)……

4=Sulci

5=Buccal mucosa

6=Floor of mouth

7=Tongue

8=Hard or soft palate

9= Alveolar ridge

PERIODONTAL STATUS

Plaque index

0= Not present …….

1=Present

Bleeding index

0= Not present …….

1= Present

DENTITION STATUS AND TREATMENT NEED

55	54	53	52	51	61	62	63	64	65

Treatment Status

85	84	83	82	81	71	72	73	74	75

STATUS

0= Sound tooth

1= decayed

2= filled with decay

3= filled, no decay

4= fissure sealant

5= Trauma

6= missing as a result of caries

7= specify ……

TREATMENT

0= none

1= caries arrest or sealant care

2= one surface filling

3= two or more surface filling

4= crown

5= pulp care and restoration

6= need for other care

NEED FOR IMMEDIATE REFERRAL

Life threatening 0= absent

Pain or infection 1= present

Other condition (specify) ----------

Referral

0= No

1= Yes

OTHER FINDINGS/ SPECIAL COMMENTS

……
……
……

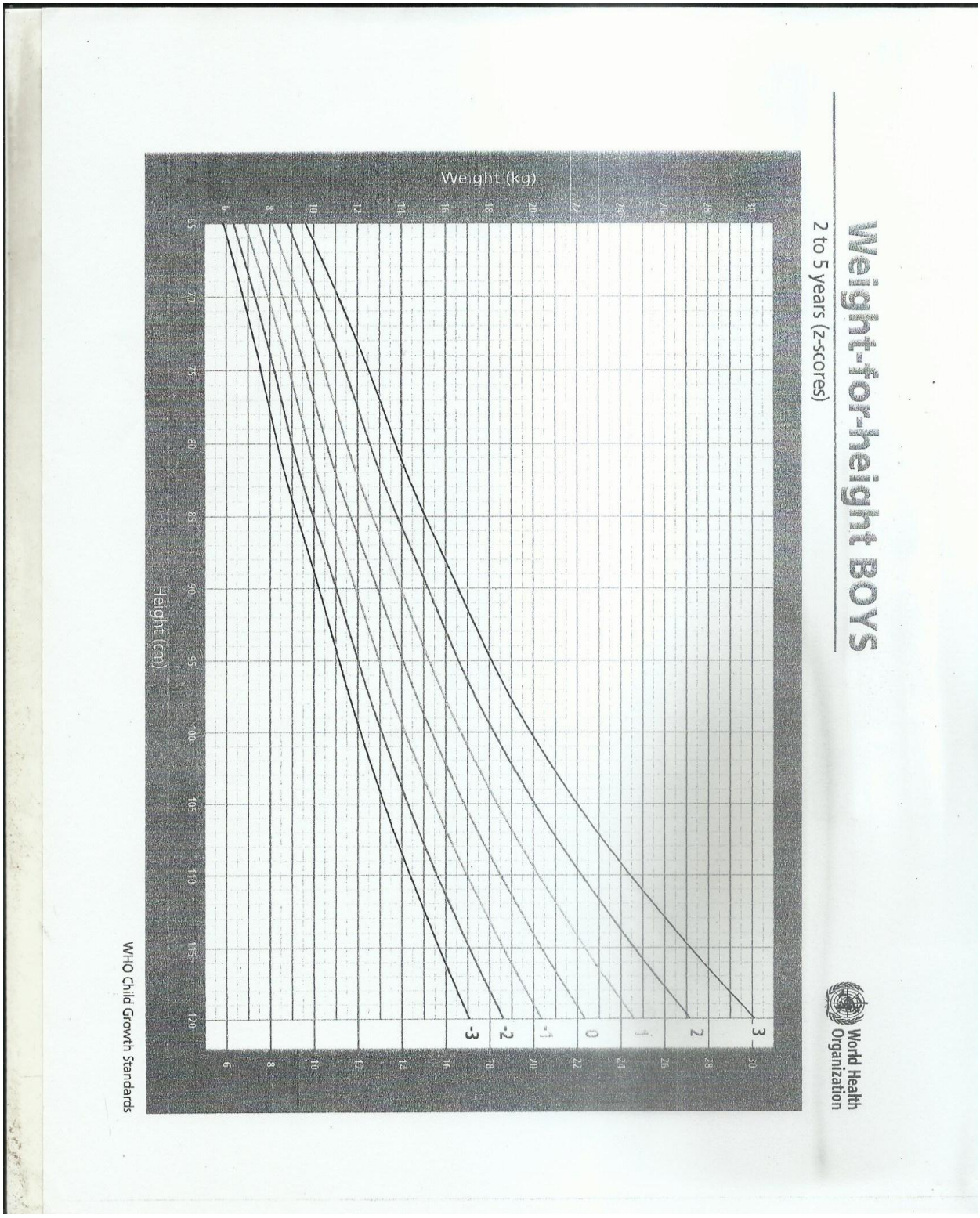
STATUS:

0 = Well nourished

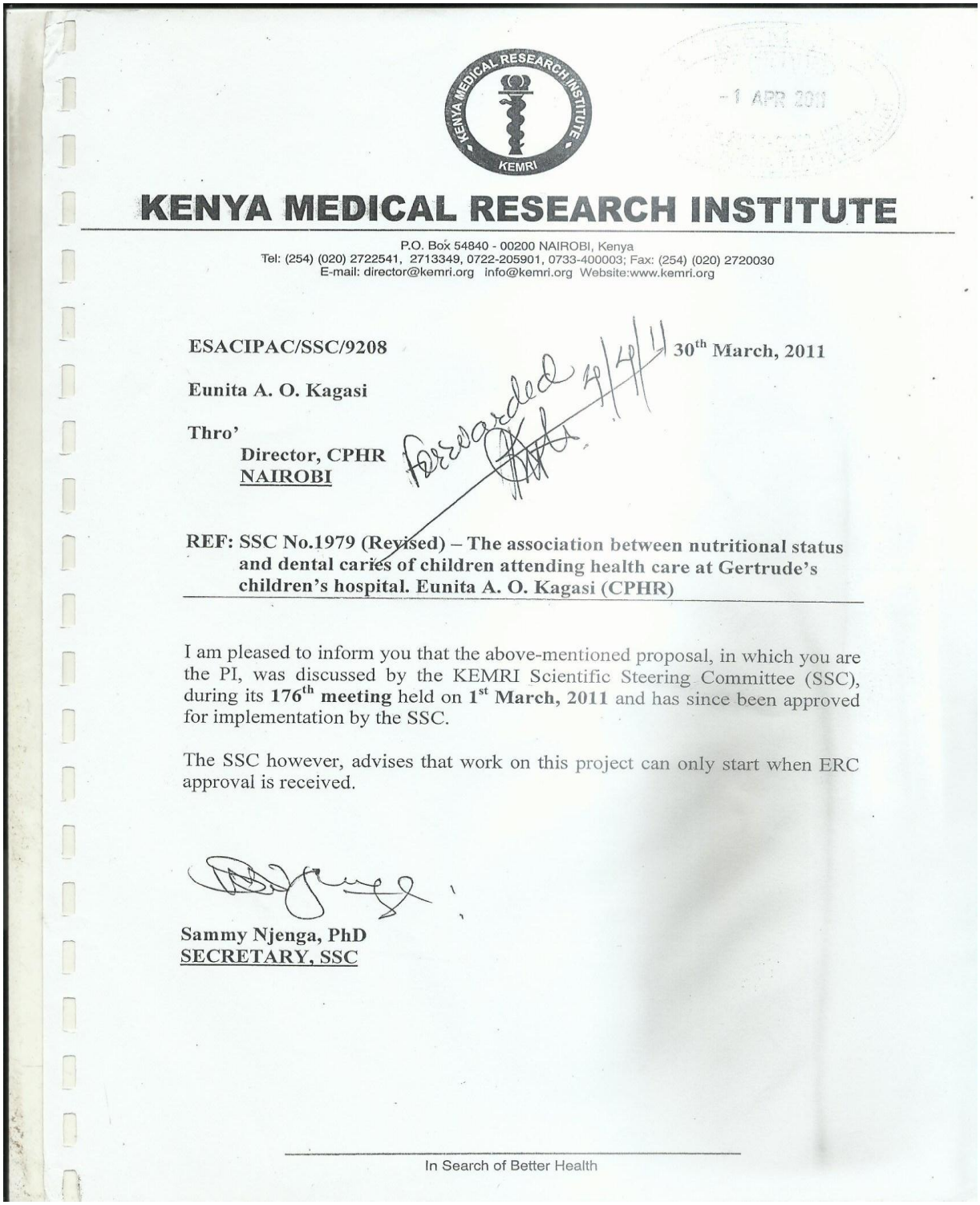
1= Malnourished

Specify----------

Appendix V: WHO Z scores growth chart (standards) weight/height for boys



Appendix VI: KEMRI Scientific Steering Committee clearance letter



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E-mail: director@kemri.org info@kemri.org Website:www.kemri.org

- 1 APR 2011

ESACIPAC/SSC/9208 **30th March, 2011**

Eunita A. O. Kagasi

Thro'
Director, CPHR
NAIROBI

Forwarded 29/4/11

REF: SSC No.1979 (Revised) – The association between nutritional status and dental caries of children attending health care at Gertrude's children's hospital. Eunita A. O. Kagasi (CPHR)

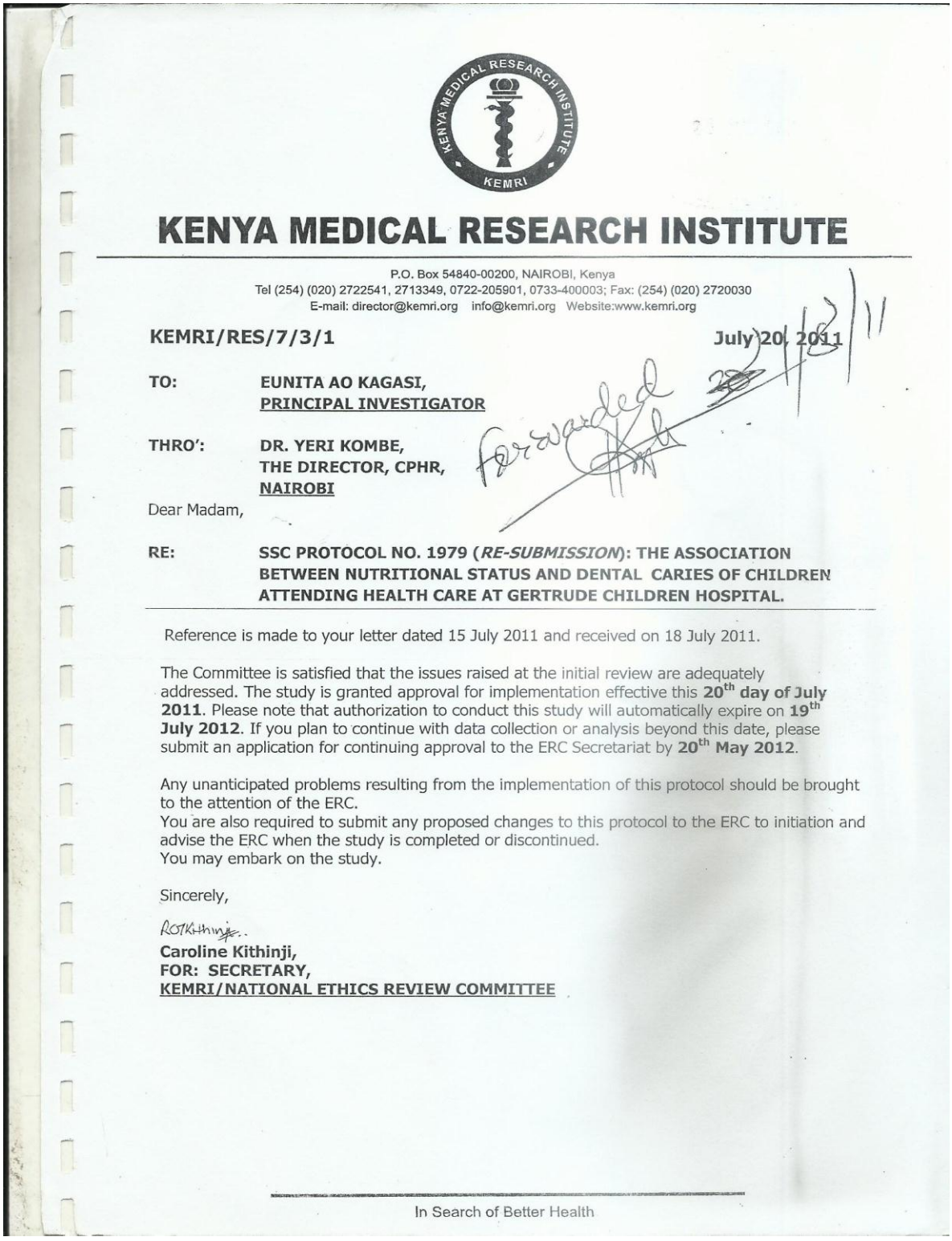
I am pleased to inform you that the above-mentioned proposal, in which you are the PI, was discussed by the KEMRI Scientific Steering Committee (SSC), during its **176th meeting** held on **1st March, 2011** and has since been approved for implementation by the SSC.

The SSC however, advises that work on this project can only start when ERC approval is received.

Sammy Njenga, PhD
SECRETARY, SSC

In Search of Better Health

Appendix VII: KEMRI Ethical Clearance Letter



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KEMRI/RES/7/3/1 **July 20, 2011**

TO: **EUNITA AO KAGASI,**
PRINCIPAL INVESTIGATOR

THRO': **DR. YERI KOMBE,**
THE DIRECTOR, CPHR,
NAIROBI

Dear Madam,

RE: **SSC PROTOCOL NO. 1979 (*RE-SUBMISSION*): THE ASSOCIATION BETWEEN NUTRITIONAL STATUS AND DENTAL CARIES OF CHILDREN ATTENDING HEALTH CARE AT GERTRUDE CHILDREN HOSPITAL.**

Reference is made to your letter dated 15 July 2011 and received on 18 July 2011.

The Committee is satisfied that the issues raised at the initial review are adequately addressed. The study is granted approval for implementation effective this **20th day of July 2011**. Please note that authorization to conduct this study will automatically expire on **19th July 2012**. If you plan to continue with data collection or analysis beyond this date, please submit an application for continuing approval to the ERC Secretariat by **20th May 2012**.

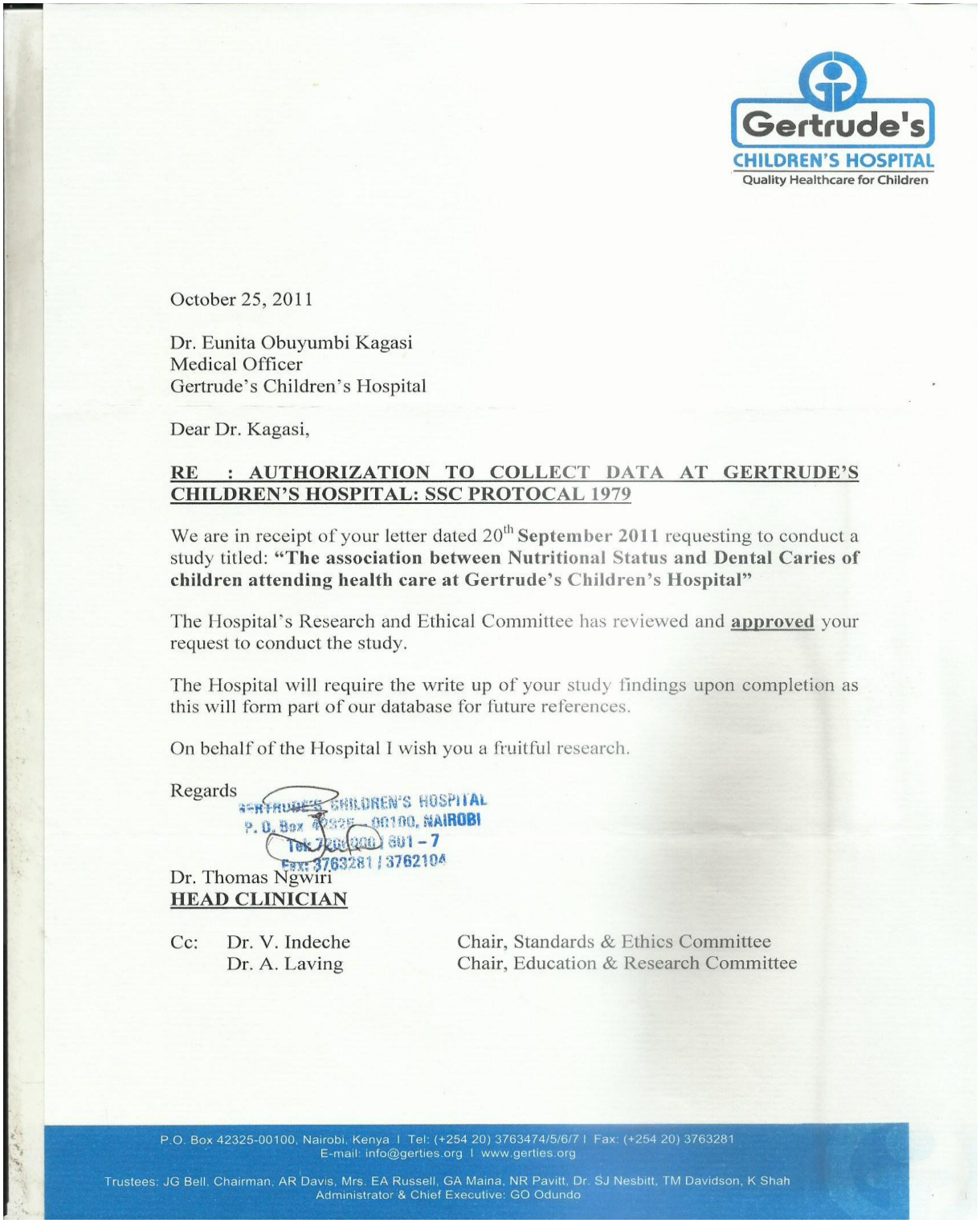
Any unanticipated problems resulting from the implementation of this protocol should be brought to the attention of the ERC.
You are also required to submit any proposed changes to this protocol to the ERC to initiation and advise the ERC when the study is completed or discontinued.
You may embark on the study.

Sincerely,

Caroline Kithinji,
FOR: SECRETARY,
KEMRI/NATIONAL ETHICS REVIEW COMMITTEE

In Search of Better Health

Appendix VIII: GCH Ethical Clearance Letter



Gertrude's
CHILDREN'S HOSPITAL
Quality Healthcare for Children

October 25, 2011

Dr. Eunita Obuyumbi Kagasi
Medical Officer
Gertrude's Children's Hospital

Dear Dr. Kagasi,

RE : AUTHORIZATION TO COLLECT DATA AT GERTRUDE'S CHILDREN'S HOSPITAL: SSC PROTOCAL 1979

We are in receipt of your letter dated 20th **September 2011** requesting to conduct a study titled: **"The association between Nutritional Status and Dental Caries of children attending health care at Gertrude's Children's Hospital"**

The Hospital's Research and Ethical Committee has reviewed and **approved** your request to conduct the study.

The Hospital will require the write up of your study findings upon completion as this will form part of our database for future references.

On behalf of the Hospital I wish you a fruitful research.

Regards

GERTRUDE'S CHILDREN'S HOSPITAL
P. O. Box 42325 - 00100, NAIROBI
Tel: 3763474/5/6/7 - 7
Fax: 3763281 / 3762104

Dr. Thomas Ngwiri
HEAD CLINICIAN

Cc: Dr. V. Indeche — Chair, Standards & Ethics Committee
Dr. A. Laving — Chair, Education & Research Committee

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Trustees: JG Bell, Chairman, AR Davis, Mrs. EA Russell, GA Maina, NR Pavitt, Dr. SJ Nesbitt, TM Davidson, K Shah
Administrator & Chief Executive: GO Odundo

Appendix IX: Map of the study area

Appendix X: Proof of publication

KENYA MEDICAL RESEARCH INSTITUTE

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KEMRI/AJHS/2014/396

26th August, 2014

Eunita O Kagasi
Institute of Tropical Medicine and Infectious Diseases,
Jomo Kenyatta University of Agriculture and Technology,
Box 62000-00200
NAIROBI

Dear Madam,

AJHS/2014/396 – ASSOCIATION BETWEEN NUTRITIONAL STATUS AND DENTAL CARRIES AMONG CHILDREN ATTENDING HOSPITAL IN NAIROBI,KENYA.

This is to inform you that the above manuscript has been approved for publication in the African Journal of Health Sciences.

It was noted that your study was on the association between nutritional status and dental carries among children attending Hospital in Nairobi, Kenya.

Thank you for taking interest in the journal.

Yours faithfully,

For:

DR. HUDSON LODENYO
EDITOR-IN-CHIEF
AFRICAN JOURNAL OF HEALTH SCIENCES

In Search of Better Health