

A STUDY OF DIETARY PATTERNS, NUTRITIONAL  
STATUS AND DENTAL CARIES IN PRE-SCHOOL  
CHILDREN IN NAIROBI, KENYA.

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THIS THESIS SUBMITTED IN PARTIAL FULFILMENT OF THE  
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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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**DEDICATION**

I dedicate this work to my dear husband Stephen, and our children Alex, Bancy and John for their encouragement, support and prayers throughout the course.

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**ABSTRACT**

A cross-sectional study covering 16 pre-schools randomly selected from four divisions in the city of Nairobi was carried out between January and April 1997. A total of 304 children aged 3-5 years were covered by the study. The study aimed at determining the dietary patterns, prevalence of dental caries and the nutritional status of the children.

A semi-structured self administered questionnaire was sent to the parents/guardians of the children through the assistance of the teachers. The questionnaire was used to acquire information on the demographic characteristics of the families from which the children were drawn and the dietary patterns of the children. The nutritional status of the children was assessed through anthropometric measurements, while the prevalence of dental caries was assessed by physical examination of the teeth.

Majority of the mothers, 89.5% fell in the age group of 20 - 40 years. More than 50% of the parents had more than 8 years of schooling, and 86.2% of the fathers and 68.8% of the mothers had some form of occupation.

The mean breastfeeding duration of the children was 20.17 months (SD 10.39) and about 41% of the children had been bottlefed, for a mean duration of 13.58 months (SD 12.4). Majority of the children were weaned early, 61.5% of them at four months of age.

The study children consumed a wide variety of foods with over 70% consuming fruits, vegetables and fats daily, while 80.9% of them consumed milk daily. Tea with sugar was consumed by 84.9% of the children daily. Animal foods were rarely consumed.

The snacks mostly consumed in school included cereals by 62.5% of the children, and sweets and confectionaries by 30.9%, while the beverages consumed were mainly juices and sodas by 41.1% of the children and milk by 13.8%.

The rates of malnutrition were low with underweight at 1.6%, stunting at 4.3% and wasting at 1.0%. Some of the children were obese with 2.7% being overweight by weight for age and 3.3% overweight by weight for height, while 2.4% were taller than their expected height for age.

Up to 94.4% of the children brushed their teeth, with 90.1% using a commercial toothbrush and 4.3% a chewing stick. Of the total who brushed, 93.1% used toothpaste. A high proportion, (91%) of the children had bacterial plaque on the index teeth. The prevalence of dental caries was high at 63.5%, and a dmft of 2.95. Only 1.3% of the children had filled teeth.

The study shows that there was a relatively high consumption of sugar by the children, the rates of malnutrition were low and that the prevalence of dental caries was very high among the children studied. The high prevalence of dental caries raises a strong public health concern.

## DEFINITIONS

**Dental Caries** - Infectious microbiological disease that results in localized dissolution and destruction of the calcified tissues of the teeth.

**dmft** - Decayed(d), missing(m), filled (f) teeth(t). Index for measurement of dental caries (according to WHO criteria).

**Oral cavity** - The mouth with structures therein ie. teeth, tongue, palate, cheeks, etc.

**Caries experience** - Measured by determining the proportion of children with decayed, missing or filled teeth in the population.

**Oral hygiene** - Practice of cleaning the oral cavity through tooth-brushing or professional provision.

**Plaque** - soft white sticky material which forms on teeth surfaces. It is composed of a mass of different species of bacteria in a matrix of long-chain carbohydrates.

**Dietary Patterns** - Types and relative proportions and/or combinations of foods used in meals at particular times of the day.

**Food consumption** - Types of food or drink ingested by an individual. This includes timed meals and snacks.

**KOOL (Icebreaker)** - A home prepared iceblock consisting of water, sugar and food colouring sold packed in small polythene papers.

**Snack** - Foods or beverages eaten under other circumstances than as a regular meal.

**Socio-economic status** - In this study is based on fees structure of the pre- school the child attends.

**Occlusion** - Contact relationship of the maxillary and mandibular teeth, when the jaws are in a closed position.

**Centric Occlusion** - When the jaws are in a closed position with the maxillary and mandibular teeth in maximal interdigitated contact.

**Malocclusion** - Abnormal or malpositioned relationship of the maxillary teeth to the mandibular teeth when they are in centric occlusion.

**Infraocclusion** - Infraocclusion occurs when the molars have their occlusal surfaces below the occlusal plane of the neighbouring teeth.

**Anterior Open Bite** - Localized absence of occlusion in the anterior part of the mouth while the posterior teeth are in occlusion.

**Crossbite** - Indicates an abnormal buccolingual or labiolingual relationship of the teeth.

**Z-Score** - This is a measure of the standard deviation score from the median .It relates to the relative position of the individual height, weight etc to the distribution of the same measure in the reference population.

$$\text{Z-Score} = \frac{(\text{Observed Value}) - (\text{Median Reference Value})}{\text{Standard Deviation of Reference Population}}$$

**Height for Age (HAZ)** - Child's height(length) compared with the median height(length) of the reference children of the same age and sex. It is a measure of stunting.

**Weight for Height (WHZ)** - Child's weight compared with the weight of reference children of same height (length) and sex. It is a measure of wasting.

**Weight for Age (WAZ)** - Child's weight compared with the weight of reference children of the same age and sex. It is a measure of a combination of wasting and stunting.



## ABBREVIATIONS

NCC	-	Nairobi City Council
CBS	-	Central Bureau of Statistics
WHO	-	World Health Organization
UNICEF	-	United Nations Childrens Fund
GOK	-	Government of Kenya
KDHS	-	Kenya Demographic and Health Survey
UN	-	United Nations
UNESCO	-	United Nations Education and Scientific Organization
AMREF	-	African Medical and Research Foundation
IEC	-	Innovative Education Communication

## CHAPTER 1

### INTRODUCTION

Literature has shown that urban life styles influence dietary patterns of a community and that dietary patterns have an effect on the nutritional and dental status especially of children under the age of five years.

While the developing countries concern themselves with reducing undernutrition, diet related disorders have been sidelined with only few studies having examined the dental status and nutritional status in under five populations (Menaker, 1981).

A balanced diet that contains the essential nutrients at the required levels, within the recommended dietary allowances (RDA'S) consumed at correct intervals within a 24 hour period is necessary for maintenance of adequate nutrition and good health. However, dietary intake alone does not explain the high levels of malnutrition which exist in developing countries. Malnutrition has multiple causality with dietary intake and disease as the immediate causes (Appendix 1). In Kenya, personal hygiene which includes dental hygiene contributes to significant morbidity as evidenced by the high rates of dental caries, skin diseases and diarrhoeal disease. The latter two are among the top ten diseases in the country (WHO/UNICEF, 1985).

All primary teeth have normally erupted by the age of 3 years, and it is important that the child retains these teeth for the normal period of time to promote growth of the jaws, proper alignment of the permanent teeth, and also for proper mastication. The teeth are

designed for chewing, the anterior teeth (incisors and canines) providing a strong cutting action and the posterior teeth (premolars and molars) facilitating a grinding action.

In the 3 year old, proper care and maintenance of the primary teeth is important in the nutriture of the child who is now on the adult diet. Chewing of the food is important for digestion and absorption of all foods. It is most important especially for most fruits and raw vegetables which have undigestible cellulose membranes around their nutrient portions which must be broken before the food can be utilized in the body. Chewing aids in digestion of food by breaking it into small particles on which the digestive enzymes can act, the rate of digestion being highly dependent on the total surface area exposed to the intestinal secretions. Grinding the food to a fine particulate consistency increases the surface area and also the ease with which food is emptied from the stomach into the small intestine and thence into all succeeding segments of the gut (Guyton, 1976).

Maintenance of good oral hygiene is not a routine practice among Kenyan communities, especially among the 3-5 year old children. Dental caries is therefore a common condition within this age group as depicted in past studies (Masiga and Holt, 1993). Poor oral hygiene predisposes the teeth to caries which develops only in the presence of three interacting variables namely: bacterial plaque containing cariogenic bacteria, bacterial substrate especially sugar and susceptible tooth surfaces (Cawson, 1991).

Eating of refined carbohydrates and "snacking" in between meals

coupled with poor oral hygiene are good grounds for development of dental caries. In the oral cavity, the sugars and especially sticky ones, are acted on by bacteria to form acids. The acids cause demineralisation of the enamel, thus predisposing the tooth to decay.

### 1.1 STATEMENT OF THE PROBLEM

Dietary patterns have been changing with urbanization, modernization and industrialization. The changes have been towards more refined and convenient foods, which are quick and easy to prepare (den Hartog, 1985). There has been an invasion of western type sweet snacks in the Kenyan market which could contribute considerably to the nutritional and dental caries status of the preschool child.

High rates of malnutrition continue to persist in Nairobi despite the fact that the Government has set up growth monitoring units to advise mothers on the growth of their children, and to detect any growth faltering early enough for prompt intervention. From the recent national nutrition survey (CBS, 1996) in Nairobi, 22% of the children were underweight, 30.2% stunted while 5.5% were wasted. The prevalence of dental caries has also been reported to be high among the pre-school children in Nairobi. A survey carried out by Masiga and Holt (1993), revealed that 38% of the 3 year olds, 47% of the 4 year olds and 50% of the 5 year olds had dental caries, while the proportion of children who were caries free in the whole sample was 55%.

The relationship between dietary patterns, nutritional status and dental caries in children in Kenya needs to be investigated, in order to come up with a policy that will be effective in reducing malnutrition and dental caries.

## 1.2 JUSTIFICATION

The findings of the study will be useful to the relevant health planners by providing information that may be used to minimise the health problems that arise as a result of poor dietary patterns and its relationship to malnutrition and dental caries in children.

There is also need to provide information for development of Nutrition Education Packages. The study will also facilitate development of intervention programmes to curb both nutrition problems and dental caries.

## 1.3 BROAD OBJECTIVE

To study the dietary patterns, nutritional status and prevalence of dental caries in pre-school children in Nairobi.

## 1.4 SPECIFIC OBJECTIVES

1. To determine the dietary patterns of pre-school children.
2. To determine the nutritional status of pre-school children.

3. To assess the prevalence of dental caries in pre-school children.
4. To establish relationships between dietary patterns, nutritional status and dental caries in pre-school children.

#### 1.5 HYPOTHESIS

1. Dietary patterns of pre-school children predispose them to malnutrition.
2. Dietary patterns of pre-school children predispose them to dental caries.

## CHAPTER TWO

### LITERATURE REVIEW

The main function of food in a society is for survival, however, people also eat for social and psychological reasons. Knowledge on food consumption patterns is useful to understand the nutritional situation of a group of people. The ongoing modernization, industrialization and urbanization means inevitable change in diet, with increased consumption of sugars and convenience foods (den Hartog et al., 1985).

#### 2.1 DIETARY PATTERNS

Dietary patterns refer to type, relative proportions and/or combinations of foods used in meals by an individual.

Many nutrition studies are undertaken to investigate relationships of diet to nutritional status and the role of diet in the development of chronic diseases.

The choice of food consumed by an individual is dependent on several factors namely culture, availability, socioeconomic status, climatic conditions, occupation, meal pattern, household composition and size, physiological status, religion and political status (Fieldhouse, 1986). Information on food consumption is important for anthropometric assessment of the nutritional status of a population, and also the health situation assessment (den Hartog et al., 1995).

Studies done in Kenya have revealed that 81% of the pre-school

Studies done in Kenya have revealed that 81% of the pre-school children are fed on maize meal porridge with or without addition of millet, sorghum (Israel et al., 1983). Further studies in Kibera, Nairobi have revealed that after the age of three months, the children are mainly fed on milk, carrots, tomatoes, peas, bananas, maize meal porridge with or without millet flour, sugar, ugali and vegetables (Kogi-Makau et al., 1993).

Studies done in India have revealed that from the age of 2-3 years, the children's meal pattern and diet are on the lines of adults (Vanita et al., 1990).

Foods given to children are important determinants of their health and growth. These foods vary depending on availability, cost, culture and food prevalences (Hassary et al., 1984).

Studies in Nairobi revealed that most of the households consume three meals per day which include breakfast, lunch, and supper with most of the preschool children being fed on snacks in between the main meals (Kogi-Makau, 1993).

Majority of households depend on the market for their food supply, while a few of them obtain food from their gardens within or outside the city.

## **2.2. NUTRITIONAL STATUS**

The nutrition of the preschool child is of paramount importance because the foundation for life time health, strength and intellectual vitality is laid during that period.



The factors which have been found to contribute greatly towards the nutritional status of the preschool child include maternal education, parental occupation and income, household size, mother's age, food security and intrahousehold food distribution.

Lack of proper feeding leads to malnutrition in the preschool child. Malnutrition includes a wide range of clinical disorders that are the result of an unbalanced intake of energy, protein and micronutrients. The presentation can be excess as in obesity, or undernutrition. Undernutrition is the major problem in the least developed countries, where it accounts for more than 50% of under five deaths. The right to proper nutrition is expressed in the convention on the rights of the child (UNICEF, 1998).

#### **2.2.1 Causes and problems of malnutrition**

Malnutrition in preschool children is caused by several factors as shown in Appendix 1 (GOK/UNICEF, 1992). The immediate causes are dietary intake and morbidity. The underlying causes include food insecurity, inadequate maternal and childcare, insufficient health services and unhealthy environment. The basic causes are lack of adequate education, poor availability of resources and control, lack of good supportive political and ideological structure, poor economic structure and unavailability of potential resources.

The major problems of malnutrition in the preschool child are increased risk of death and increased incidence of chronic

infections. Malnutrition also lowers the physical and mental development of the child. Children who are malnourished are more prone to disease, and malnutrition can also result from disease (Macleod, 1977).

### 2.3 DENTAL CARIES

Dental caries is one of the commonest diseases afflicting man in the World today. Tooth decay is a pathological process which results in localized demineralization and dissolution of the calcified tissues, creating a defect in the tooth. Dental caries is a big contributing factor to tooth loss today, and a lot of time is wasted in seeking treatment let alone the finances involved. It is a disease with a multifactorial aetiology and it develops only in the presence of three interacting agents namely: bacterial plaque containing cariogenic bacteria, bacteria substrate especially sugar\carbohydrates and susceptible tooth surfaces (Cawson, 1991). In addition, there are other factors provided by the host which include genetics, behaviour, age, education and healthcare availability.

#### 2.3.1 The form of the human tooth .

Each tooth in man is composed of three calcified tissues namely enamel, dentine and cementum, and one delicate specialized

connective tissue, the pulp. Dentine forms the bulk of the calcified part of the tooth and is covered by enamel in the crown region and by cementum in the root region. The pulp is centrally situated and it forms the sensory and nutritive organ of the tooth. Cementum is similar to bone chemically and histologically, dentine is harder and shows considerable histological differences than these two. Enamel is a highly specialized tissue and the hardest and most densely calcified tissue in the body. It is therefore well suited to take the heavy wear of mastication. Unlike dentine, cementum or bone, enamel does not show a continuous formation throughout life, and once the proper thickness for the tooth has been laid down, no more is deposited. Therefore the calcified dental tissues cannot undergo repair in the areas that have been improperly formed or inadequately calcified during development, nor can they repair themselves after destruction. When teeth emerge into the oral cavity, blood supply to the enamel is severed, and the enamel comes into contact with saliva, micro-organisms, food and other substances in the mouth. Exchange and addition of ions can take place from saliva into the outer layers of the enamel by purely physico-chemical mechanisms. Each functioning tooth is implanted in a socket formed by the alveolar bone of the upper or lower jaw (Scott and Symons, 1982).

### **2.3.2 The dentitions**

In man there are two sets of teeth, the deciduous (milk) and the permanent dentitions. The deciduous dentition, made up of 20 teeth

begins to appear in the mouth about 6 months after birth and is complete at about 3 years. It is the functioning dentition up to about 6 years when the permanent dentition, made up of 32 teeth first appears in the mouth. The teeth making up each dentition are arranged in two dental arches, one in the lower jaw and one in the upper jaw. The teeth are arranged symmetrically on each arch. Each tooth has five surfaces namely:

1. Mesial - nearest to the midline of the dental arch.
2. Distal - furthest from the midline of the dental arch.
3. Labial(or buccal) - next to the lips or cheeks.
4. Lingual - next to the tongue for lower jaw.  
Palatal - next to the palate for upper jaw.
5. Occlusal- crushing surface in molars.  
Incisive edge- cutting margin in incisors and canines.

(Scott and Symons, 1982).

### **2.3.3 Tooth development and nutrition**

Nutrition is important in the development and continued integrity of all tissues and organs including the hard and soft tissues of the mouth. Nutritional shortcomings that occur during the period of tooth development may cause irreversible defects. This can be demonstrated by enamel fluorosis, fever induced enamel hypoplasia and tetracycline staining of teeth (Jolly and Levene, 1986; Cawson, 1991). The deciduous teeth start developing during the 4th week of intra-uterine life. Mineralization occurs during the 14th week of intra-uterine life, and is already complete by the time of birth of

the child. The development and final size of the teeth is genetically determined with environmental factors also playing a role. Studies by Ferne et al., (1990) have demonstrated that malnutrition of the mother while the foetus is in utero can result in enamel defects.

Enamel maturation, chemical composition, tooth morphology and size are all affected by pre-eruptive nutrient intake. An adequate intake of proteins, fats, carbohydrates, vitamins, minerals namely calcium, phosphorous and trace elements is important for building and maintenance of all the components of the teeth.

Calcium and phosphorous are the major constituents of the enamel and dentine, other constituents are magnesium, organic matter, water and the trace elements iron, lead, zinc and fluoride.

During tooth development, protein is essential for the proper formation of the enamel and dentine matrices and proper development of the salivary glands. Deficiencies occurring as part of malnutrition may cause a reduction in tooth size and an increase in enamel defects (Halloway et al., 1961). Only in cases of very severe deficiencies of minerals are teeth affected. Calcium and phosphorous are important in the mineralization of the dental tissues, and prolonged and severe dietary deficiencies of the minerals affects calcification resulting in hypoplastic teeth. Morphology of enamel and dentine tissues is influenced by dietary deficiencies of fluoride, vitamin A and calcium: phosphorous ratio imbalances during tooth development (Nizel, 1966). Magnesium acts

as a coenzyme in protein metabolism and its deficiency leads to disfiguration of ameloblasts (enamel forming cells) and odontoblasts (dentine forming cells) leading to deformation of the tooth due to failure of calcification process. The trace elements strontium, boron, molybdenum and fluoride if present during tooth development reduce the size of the pits and fissures of the teeth and thus reducing the chances of caries development. Developmental disturbances of the tooth germ in vitamin A deficiencies increases caries susceptibility (Lavelle, 1983).

Vitamin D deficiency leads to hypocalcification resulting in hypoplastic teeth, while vitamin C deficiency leads to failure in collagen maturation, blood vessels in the pulp become fragile leading to hyperaemia of the pulp and thus failure of the odontoblasts to lay down circumpulpal dentine (Shafer et al., 1988).

#### **2.3.4 Etiological agents of dental caries**

##### **2.3.4.1 Cariogenic bacteria**

Mutans streptococci and lactobacilli are the two micro-organisms which have been greatly associated with initiation of dental caries. These caries producing bacteria metabolize a range of sugars (fructose, glucose, maltose, lactose and sucrose) to generate acids e.g. lactic acid, which demineralize the teeth. Sucrose has a special ability to be converted by caries-forming bacteria into polysaccharides known as dextrans which stick to the tooth surface to form dental plaque (Guyton, 1976).

#### 2.3.4.2 Bacterial plaque

Bacterial plaque is a soft, translucent and tenaciously adherent material accumulating on the surface of teeth. Accumulation of plaque on teeth is a highly organised and ordered sequence of events. Survival of micro-organisms in the mouth depends on their ability to adhere to a surface or on initiation of plaque by pioneering organisms capable of surface adherence. Free floating organisms are rapidly cleared from the mouth by salivary flow and frequent swallowing. Streptococci are primarily the organisms which are able to adhere to oral surfaces. They have special receptors which help them to adhere to a clean tooth surface. Once attached they proliferate to form a matlike covering on the tooth surface.

This mat allows the adherence of other micro-organisms that are unable to adhere directly to the tooth surface. Thus formation of a mature plaque community involves a succession of changes. Mature plaque communities rapidly metabolize sucrose through glycolytic pathways to organic acids, primarily lactic acid. As the available carbohydrate is metabolized to acid, a severe drop in pH results, which increases the potential for enamel demineralization, which occurs from pH of 5.5 and below (Clifford et al., 1985).

#### 2.3.5 Diet and dental caries

The daily intake of food items may or may not play a role in caries development. The cariogenic role of the foods is determined by the

fermentable carbohydrate content, the retention of foods in the mouth and the frequency of food intake. The ongoing modernization, industrialization and urbanization results in inevitable changes in diets, with increased consumption of sugar and convenience foods (den Hartog et al., 1985).

Studies have shown that caries risk is still high in both developing and developed countries despite the increasing use of fluorides and improved oral hygiene, due to the increasing consumption of dietary sugar (Marthaler, 1990).

Intra-oral availability of free sugars, puddings, ice-creams, soft drinks, cakes, biscuits, cereals, rice, bread with sweet condiments through daily diets is an important factor in the aetiology of dental caries.

Studies done in India revealed that children who consumed snacks frequently had a higher prevalence of dental caries than those who consumed them occasionally. The most cariogenic snacks were found to be bread-bun, biscuits, mangoes and chocolate (Rajammal et al., 1986).

Analysis of the inter-relationship between diets, caries and salivary levels of mutans, streptococci and lactobacilli has revealed that consumption of vegetable stews, maize, ugali and tea with sugar are associated with low levels of salivary micro-organisms and absence of dental caries. High levels of the micro-organisms are associated with consumption of sweets, fruits, milk with sugar, buns, sugarcane and fish, while still being associated with absence of dental caries. High levels of these micro-



organisms are associated with caries only in the context of consumption of refined carbohydrates and processed foods. Lactobacilli are the most strongly associated with caries from consumption of soft drinks, while the mutans streptococci are most strongly associated with caries from consumption of ice-creams and puddings (Manji et al., 1988).

Dental caries is a significant public health problem in populations where the annual per capita consumption of sugar exceeds 20kg. Pre-eruptive influence of sugars on future caries susceptibility is improbable (Cutress, 1996).

Fluoride in diet exerts a significant anti-caries effect. However, although fluoride occurs naturally in many foods, the quantity obtained from diets may not be sufficient to give protection from tooth decay. To ensure adequate supply, it is therefore necessary to adjust levels in drinking water supplies, in areas where the fluoride level falls below the recommended level.

#### **2.3.6 Malnutrition and dental caries**

An adequate intake of proteins, fats, carbohydrates, minerals, vitamins and trace elements provides building and maintenance components for all tissues of the body including teeth. The way the teeth are formed has a bearing on their subsequent susceptibility to dental caries. During tooth development, protein is essential for the proper formation of the enamel and dentine matrix. Developmental defects have been recorded more frequently in primary

teeth of low birthweight and premature infants than in full term infants, and enhanced caries susceptibility has been associated with neo-natal enamel hypoplasia of prematurely born children (Rosenzweig et al., 1962; Drummond et al., 1992).

Epidemiological and animal studies have shown the existence of association between undernutrition during tooth development, with altered eruption patterns and increased susceptibility to dental caries. The studies further showed that protein plays an important role during the development of the teeth. Protein malnutrition is also believed to counteract the cariostatic action of fluoride which would affect preventive dental programs in developing countries where dental caries has become a public health concern (Menaker, 1981).

Nutrient deficiencies may result in enamel defects. Studies with animals have shown that protein deficiency is related to dental caries (Halloway et al., 1961). Moderate malnutrition, particularly lack of protein and certain micronutrients such as vitamins, zinc and iron can influence the amount and composition of saliva limiting the protective effects it has on the oral cavity, thus increasing caries susceptibility (Navia, 1996). The protective mechanism of saliva involves bacterial clearance, direct antibacterial activity, acting as a buffer and remineralization process.

In a longitudinal study of dental caries in the primary teeth of children who suffered from infant malnutrition (Alvarez et al., 1993), it was found that at age two, normal children had

significantly more teeth in the mouth than did stunted and wasted children. At age four, children who were stunted and wasted during infancy showed a significantly higher number of decayed, missing and filled teeth (dmft), whereas 17.2% of stunted and wasted children had a very high caries experience at age four.

Studies have demonstrated that one mild to moderate malnutrition episode occurring during the first year of life is associated with increased caries in both deciduous and permanent teeth many years later, hence the need for improved early childhood nutrition in order to reduce the proportion of dental caries occurring as a result of early childhood malnutrition (Alvarez, 1995).

### **2.3.7 Bottlefeeding and dental caries**

Bottlefeeding is believed to be a common cause of nursing caries in infants and preschool children. Studies have shown a strong parallel relationship between the prevalence of dental caries and increase in age among the bottle-fed children (Roberts et al., 1993). It has been suggested that salivary flow around maxillary anterior teeth is low and slow due to gravity, thus making them highly susceptible to colonization by bacteria. Sugars in the bottle act as substrate for the bacteria and especially when the bottle is used as a pacifier (Moss, 1996).

### **2.3.8 Breastfeeding and dental caries**

Breastfeeding where the child uses the breast as a pacifier has been associated with dental caries especially in the maxillary anterior teeth. Sugars in the breastmilk act as the substrate for bacteria (Moss, 1996). Studies have however shown a lower increase in dental caries prevalence with increase in age in breastfed children as compared to those bottlefed (Roberts et al., 1993).

### **2.3.9 Oral hygiene and dental caries**

Good oral hygiene, oral care availability and accessibility are important determinants of oral health. Careful cleaning of the teeth mechanically disrupts the bacterial plaque and leaves a clean enamel surface. This helps in the prevention of dental caries. Toothpaste aids the brush in cleaning the teeth and it also leaves a pleasant taste in the mouth. A toothpaste with fluoride is of value in the prevention of dental caries. Fluoride in tooth paste causes remineralization of enamel in incipient caries, leading to retarding or arresting of caries progression (Mellberg et al., 1983), calcium incorporated in tooth paste has been found to increase both fluoride uptake and remineralization (Mellberg, 1984).

The manual dexterity in children does not come easily and hence the need for them to be assisted in toothbrushing, to increase effectiveness. Regular toothbrushing coupled with regular professional cleaning results in removal of bacterial plaque which

plays an important role in caries formation (Konig and Navia, 1995).

The commercial toothbrush has been found to be more effective than the chewing stick in plaque control from studies carried out in Kenya (Ndung'u et al., 1990).

### 2.3.10 Occlusion

Occlusion refers to the contact relationships of the maxillary and mandibular teeth. Malocclusion refers to an abnormal or malpositioned relationship of the maxillary and mandibular teeth when they are in centric occlusion.

Functionally there are three segments of the dental arches namely the anterior, left posterior and the right posterior segment.

Infraocclusion occurs when the molars have their occlusal surfaces below the occlusal plane of the neighbouring teeth, this occurs due to a disturbance in growth. Malocclusions can occur in any one or more of these three segments above. They are caused by genetic and environmental factors. The environmental causes include premature extraction of deciduous teeth, nature of food, habits such as finger sucking, diseases and malnutrition. Several studies have shown environmental factors especially the chewing consistency of food as having a strong influence on the development of malocclusions (Corruccini et al., 1981, 1983). Malnutrition affects the quality of tissues being formed and the rate of calcification of dental tissues. Localized malocclusion is mainly caused by dental caries which are responsible for loss of deciduous

teeth leading to drifting and premature eruption of permanent teeth (Moyers, 1975).

#### **2.3.11 Interventions on dental caries**

Studies have shown that it is possible to reduce the prevalence of dental caries through intervention measures. Some of the interventions that have been carried out include fluoride and antimicrobial treatment, and fissure sealants in primary molars at risk (Holst et al., 1997). Topical fluoride in the form of mouthrinses has been found to prevent caries development partly in deciduous teeth and completely in permanent teeth (Sonju et al., 1997).

## CHAPTER THREE

### STUDY SETTING

#### 3.1 Study site

The study was based in Nairobi, which is bordered by Central province to the North, Rift Valley province to the South and Eastern Province to the East. The city covers an area of approximately 684 Km<sup>2</sup> and has a varied topography with an altitude of about 1700m above sea level.

The city is surrounded by urban trading centres which are growing rapidly such as Kiambu, Kajiado, Ngong and Ongata Rongai. These are major population centres which depend largely on Nairobi for services and employment.

The land is generally flat with a few valleys and rivers which are polluted by human activities. There is one dam, the Nairobi dam, which is also polluted. The only hills around Nairobi are the Ngong hills to the West.

Nairobi city has a few patches of natural forests at Dagoretti, Ngong, Karura and Western side of the Nairobi National Park. Some of the food crops grown in the city suburbs include: beans, maize, yams, green vegetables, sweet potatoes, irish potatoes, arrow roots. Cash crops grown include: coffee, vegetables and flowers. The fruits grown in Nairobi include mainly oranges, pawpaws, bananas, passion and apples.

The following livestock are kept in Nairobi suburbs: cattle, sheep, goats and pigs. Poultry is also kept for eggs and meat. Limited bee-keeping is carried out at Karen area.

Nairobi is the major industrial centre in Kenya. It has many modern industries which provide a large percentage of employment to the residents. It is also the main transit centre for tourists visiting various tourist sites and facilities in Kenya.

According to the 1989 census, Nairobi had a population of about 1.32 million people. Currently the population is estimated at 2.5 million (NCC, 1995). The population is composed of diverse ethnic and racial communities which are different in terms of social and economic status. There is a continuous influx of rural people to Nairobi in search of employment, business and education. About 55 % of the population live in unplanned, unserviced human settlements. Households in these areas have poor access to services such as safe drinking water, sanitation and waste disposal. These areas include Huruma, Mathare, Korogocho, Kariobangi, Kibera, Majengo, Gorofani and Bondeni.

The informal sector accounts for 27% of the total employment in Nairobi ( CBS, 1993 ). Women dominate the informal sector, while men dominate the formal sector. Men also engage in relatively higher paying activities than women eg car repairs, furniture making, masonry etc.

### **3.2 Schools and education in Nairobi**

Educationally and administratively, Nairobi is divided into eight divisions namely Dagoretti, Starehe, Lang'ata, Makadara, Kamukunji, Central, Embakasi and Westlands. Appendix 11 shows the administrative divisions of Nairobi. The divisions are further



divided into sixteen zones. Each division has three primary school advisors and one pre-school officer, whose main function is to ensure smooth running and sustenance of primary and pre-school education in the city.

Pre-school education caters for children aged between two and seven years. This early childhood education aims at educating, caring, socialization and total development of the child. The Government encourages participation of various parties such as associations, local authorities, religious organizations and individuals to establish, finance and manage pre-schools (CBS, 1996). According to the 1992 statistics (NCC, 1992), Nairobi had a total of 595 pre-schools of various categories, serving a population of 42987 children. The city council owns about 21 of these pre-schools, while the rest are privately owned by the other parties.

### **3.3 Dental services**

The four major hospitals in Nairobi which offer dental services include: Kenyatta National Hospital, Nairobi Hospital, Aga Khan, M.P. Shah and Mater Misericordie hospitals. In addition to these, the University of Nairobi Dental School, several nursing homes and private clinics both in the city centre and its environs also offer the services. There are two clinics which offer dental treatment specifically to children, the Lady Northey city council clinic and the Gertrudes Garden Childrens hospital.

The city council health personnel occasionally conduct dental checkups among pre-school children in the city and give appropriate advice to their parents and guardians.

There are several toothbrush and toothpaste manufacturing companies in Nairobi. Some of these companies e.g. Colgate Palmolive (EA) Ltd, occasionally offer dental health education and free dental kits to school children, as well as IEC materials to schools.

The cost of dental treatment in private hospitals and clinics is high and unaffordable to many people. The government hospitals offering similar services are usually very crowded with patients and often have inadequate staff and facilities. The introduction of cost-sharing in the government hospitals may be barring people from seeking dental treatment. Thus many people only seek dental treatment as an emergency when they are in pain.

## CHAPTER FOUR

### RESEARCH METHODOLOGY

#### 4.1 Research design

A cross-sectional study covering randomly selected pre-schools in the city of Nairobi was carried out from January to April, 1997.

#### 4.2 Sampling frame

The study population comprised 432 children aged between 3 and 5 years attending 16 pre-schools from four divisions in Nairobi.

#### 4.3 Sample size determination

In a previous study carried out in Nairobi to determine the prevalence of dental caries in children aged 3-5 years in nursery schools (Masiga and Holt, 1989), it was found that 55% of the children had dental caries. Taking the proportion of children with dental caries in this age group to be 55%, the following formula was used in sample size determination as follows:

$$n = \frac{Z^2Pq}{d^2}$$

Where:

n = the desired sample size (when population > 10,000)

z = the standard normal deviate, usually set at 1.96, which

corresponds to 95% confidence level.

$p$  = proportion in target population estimated to have a particular characteristic.

$q = (1 - p)$

$d$  = degree of accuracy desired, usually set at 0.05.

Then the sample size  $n$ , is calculated as

$$n = \frac{(1.96)^2(0.55)(0.45)}{(0.05)^2} = 380$$

$$10\% \text{ attrition} = 38$$

$$\text{Therefore } n = 380 + 38 = 418$$

#### 4 . 4     S a m p l i n g     m e t h o d

Multistage cluster sampling was used. In the first stage seven administrative divisions were selected out of the eight. One division was left out due to lack of statistics. Four divisions out of the seven were randomly selected using a table of random numbers. Stratified sampling was used to select city council and

private pre-schools. Only the city council schools offering pre-school education alone without the primary section were included in the study. One of the divisions, Dagoretti had no city council pre-schools. One city council school was randomly selected in each of the other three divisions. Proportionate sampling of the schools within each division was used in obtaining the number of schools to be included in the study by division. The private schools were randomly selected using a table of random numbers. A total of 16 pre-schools were sampled. Study children in each school were selected using the class register to include children of ages 3-5 years. The number of children included in the study was proportionately allocated among the schools. Where the calculated sample size was not achieved, the extra children were obtained proportionately from the other schools in the division. The sampling procedure is shown in Figure 1.

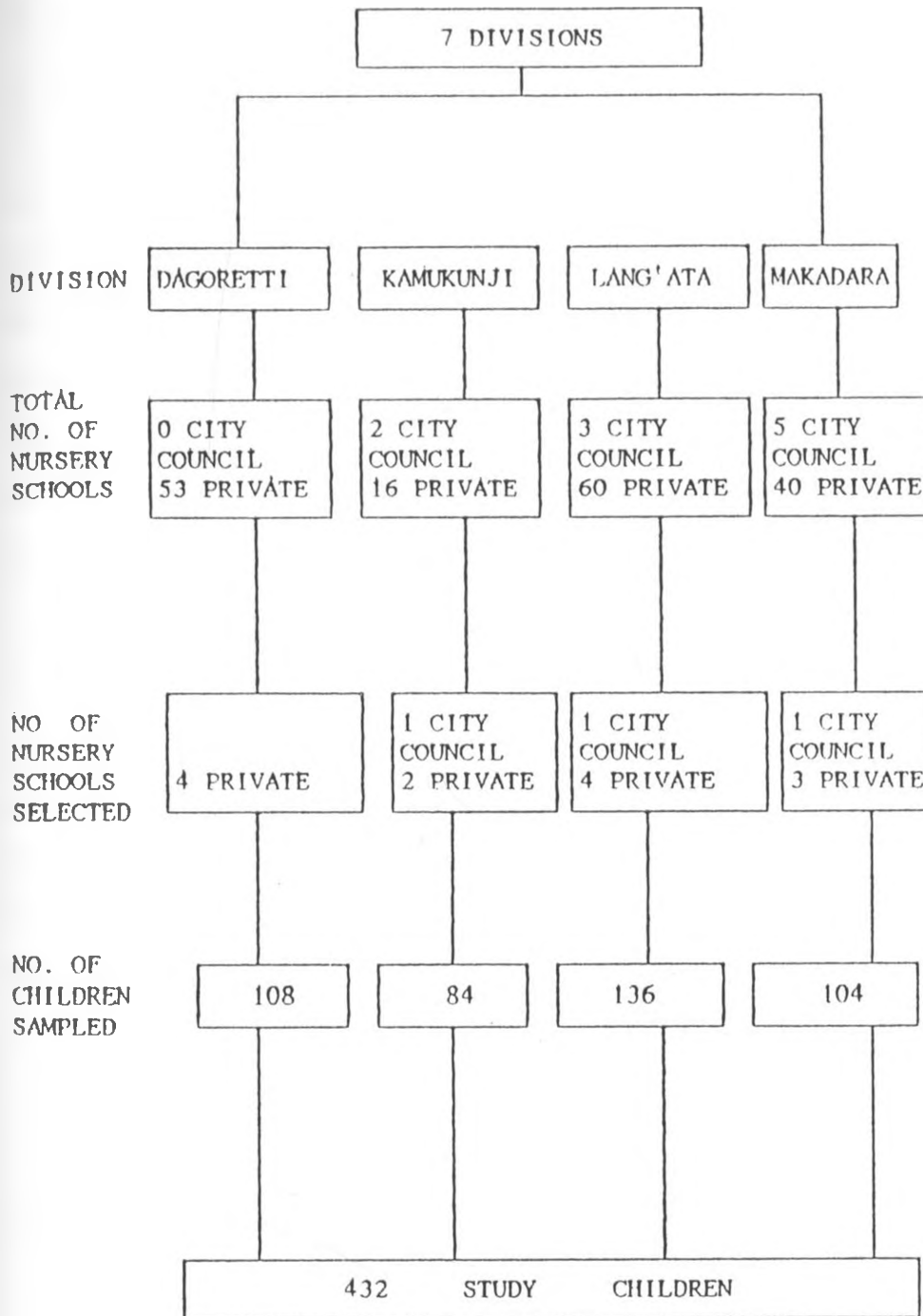


Figure 1 Schematic presentation of the sampling procedure

#### **4.5 Phase 1 of data collection**

##### **4.5.1 Mother's questionnaire**

A Structured-self administered questionnaire accompanied by an explanatory letter and a consent form were delivered to the parent/guardians of the study children through the teachers. The parents/guardians were to complete the questionnaire and return it together with the signed consent within a week of receipt.

The questionnaire collected information on:

1. Demography
2. Morbidity
3. Dietary patterns
4. Oral hygiene practices.

##### **4.5.2 Teacher's questionnaire**

A structured questionnaire was administered to the headmistresses.

The information obtained included:

1. General cleanliness of the children and the school.
2. Meals eaten at the school by the children.
3. Fees structure of the school.
4. Number of children in the school.

#### **4.6 Training of Research Assistants**

Two Research Assistants of secondary level of education were identified and trained. Emphasis was placed on:

1. Assisting the supervisor in taking of the heights and weights of the children.
2. Proper recording of anthropometric measurements and dental examination results.

#### **4.7 Pilot study**

A pilot study was conducted in one of the nursery schools which was not among those in the actual study. The purpose of the pilot study was to assess the research instruments as well as the skills of the research assistants. The results of the pilot study were used to modify the questionnaires before actual data collection.

#### **4.8 Phase II of data collection**

The second phase involved taking of weight and height measurements of the study children, as well as dental examination for oral hygiene status, dental caries and specific occlusal traits.

Oral hygiene education session was given to teachers and the children after the assessment. All children were issued with free dental kits consisting of a toothbrush and toothpaste, and oral hygiene education pamphlets donated by Colgate Palmolive.



#### 4.8.1 Anthropometric measurements

The heights of the children were taken using a standardized length board. Two readings were taken to the nearest 0.1cm and the average measurement was recorded.

The weights were taken using a Salter scale. The Salter scale was first adjusted to zero with the plastic pant before every reading. Weights were taken to the nearest 0.1kg, two readings were taken and the average of the, two recorded. Appendix 3 shows the procedure for anthropometry applied (UN, 1986).

#### 4.8.2 Dental examination

Dental examination was undertaken in a classroom near a window using natural light. A dental mirror and a dental probe, were the instruments used.

Plaque was scored as present or absent on buccal of upper molar and lingual of lower molar teeth surfaces.

Dental caries was scored as present when a lesion in a pit or fissure, or on a smooth tooth surface, had an unmistakable cavity, undermined enamel or a detectably softened floor or wall (WHO criteria, 1987).

All the deciduous teeth present in the mouth were assessed for dental caries. A tooth was recorded as missing only if it was clinically judged to have been lost due to dental caries and not natural shedding. Malocclusion was assessed by physical examination of the teeth, and the following occlusal traits were also

investigated: posterior crossbite, anterior open bite, lateral shift of the mandible and Infra occlusion of molar teeth.

#### **4.8.3 Data quality control**

All questionnaires were checked daily to ensure completeness, and missing information sort. The principal investigator participated in taking anthropometric measurements in order to ensure accuracy. All the dental examinations were carried out by the principal investigator.

#### **4.9 Data entry and analysis**

The data was entered in DBase III and was analysed using the SPSS/PC+ program except for anthropometric data which were analysed using the Centre for Disease Control (CDC) Anthropometric Computer program. The decayed, missing and filled teeth (dmft) index was calculated using SPSS program. Data cleaning was carried out prior to analysis.

The schools were classified by fee structure into three categories: low, middle and high cost. Schools with fees less than Ksh 2000 per term were classified as low-cost, those with fees between Ksh 2000 - 4000 as middle-cost while those with fees more than Ksh 4000 were classified as high-cost. The schools studied comprised of seven low-cost, three middle-cost and six high-cost. However, this classification has limitations as there is possibility of "cross-over" effects since it is based on school fees structure.

Dental caries experience was assessed using caries prevalence and the mean decayed, missing and filled teeth (dmft) index. Mean dmft was calculated using the following formula:

$$\text{mean dmft} = dt + mt + ft$$

Where:

$$\text{mean dt} = \frac{\text{Total number of decayed teeth in the study children}}{\text{Total number of children examined}}$$

$$\text{mean mt} = \frac{\text{Total number of missing teeth in the study children}}{\text{Total number of children examined}}$$

$$\text{mean ft} = \frac{\text{Total number of filled teeth in the study children}}{\text{Total number of children examined}}$$

Statistical analyses performed included:

1. Descriptive statistics, means and frequencies were carried out.
2. Chi square was used to determine whether associations between variables were significant or not.
3. Correlations were used to determine the strength of the associations between variables.

4. Analysis of variance was applied to test for differences between means in the dietary patterns.
5. T-test to test for significant differences between the variables.

## CHAPTER FIVE

### RESULTS

#### 5.1 DEMOGRAPHIC CHARACTERISTICS OF THE STUDY POPULATION

A total of 432 questionnaires were sent out, of which 325 were returned giving a response rate of 85.5%, twenty-one of the respondents were dropped due to incomplete information, leaving a sample size of 304. Of the respondents, 97.1% were biological parents of the study children while 2.9% were their guardians. The study children were from households with a mean size of 5.57 (SD 2.03). The mean number of brothers was 1.33 (SD 0.89), while the mean number of sisters was 1.40 (SD 1.17).

Of the mothers, 89.5% fell in the age range of 20 - 39 years, while 54.3% of the fathers were in the age range of 30 - 39 years. The distribution of the parents/guardians of the study children by their ages is shown in Table 1.

Table 1: Distribution of parents of study children by age and sex

AGE GROUP (YEARS)	FATHERS (%) (n=304)	MOTHERS (%) (n=304)
<20 years	2.3	1.0
20-29	12.2	48.4
30-39	54.3	41.1
40-75	16.8	4.9
No response	14.5	4.6

More than half of the mothers (81.9%) and fathers (70.4%) had more than 8 years of education. All the mothers gave a response about their schooling level while 14.8% of the fathers did not give their education level. Table 2 shows the distribution of the parents of the study children by level of education.

Table 2: Distribution of parents of the study children by sex and level of education.

NO. OF YEARS OF SCHOOLING	FATHERS (%) (n=304)	MOTHERS (%) (n=304)
<4 years	3.9	2.3
4 - 8	10.9	15.8
9 - 12	32.6	43.1
>12 years	37.8	38.8
No response	14.8	-

The wage-employees constituted the highest percentage of the occupation of the parents; which included 43.1% of the fathers, and 41.1% of the mothers. The wage-employees included typists, technicians, nurses, clerks, soldiers, secretaries, drivers and policemen. The professionals included lawyers, doctors, lecturers and accountants and these constituted 13.8% of fathers and 5.3% of the mothers.

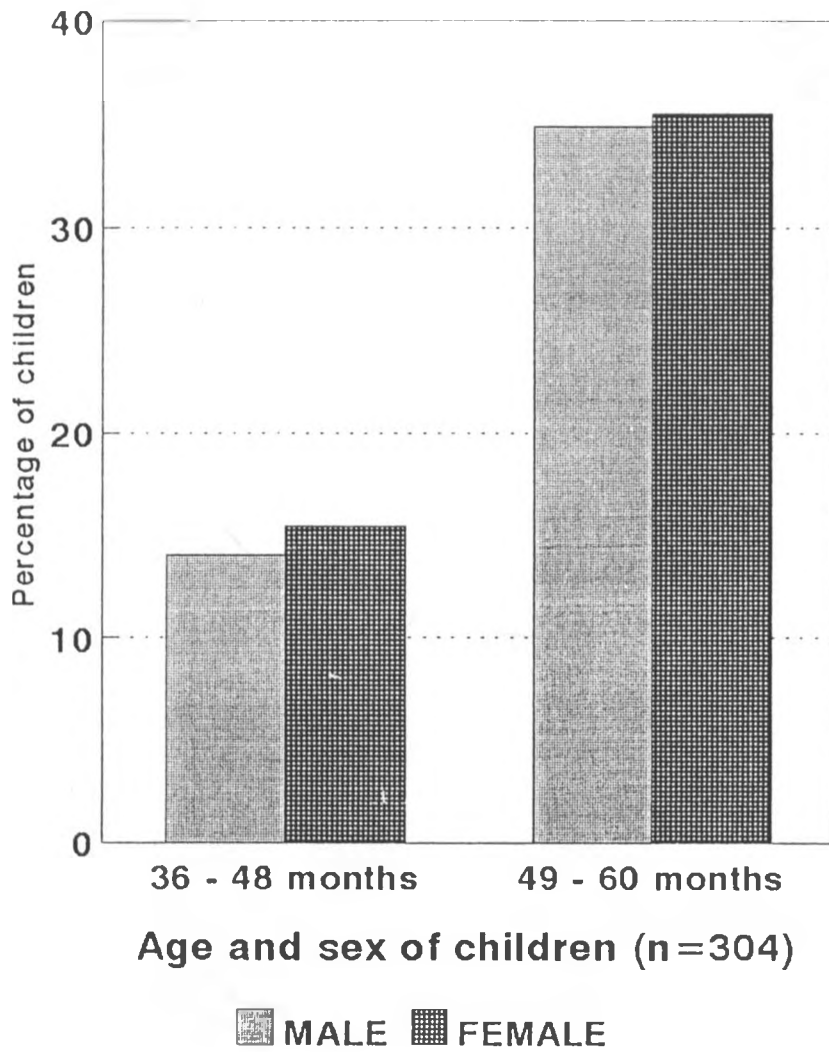
The artisans included hairdressers, mechanics, tailors, carpenters, machine operators of which the mothers were 5.6% and the fathers 8.9%. Those in business included the self-employed and traders with 14.1% of fathers and 16.4% of mothers, while 18.4% of the mothers were housewives. The distribution of the mothers and fathers of the study children by occupation is shown in Table 3.

Table 3: Distribution of the parents of the study children by occupation.

OCCUPATION	FATHERS (%) (n=304)	MOTHERS (%) (n=304)
Professionals	13.8	5.3
Wage Employees	43.1	41.1
Business	14.1	16.4
Artisans	8.9	5.6
Housewives	-	18.4
Others	0.3	9.2
No response	13.5	3.6

The study children had mean age of 50.9 months (SD 6.08) with a range of 36 - 60 months, and were composed of 49% males and 51% females. The lower age group of 36 - 48 months comprised 29.6% of which 47.8% were males and 52.2% females. The older age group of 48 - 60 months comprised 70.4% of which 49.5% were males and 50.5% females. A distribution of the study children by age and sex is shown in Figure 2.

**Figure 2**  
**Distribution of study children by age and sex**

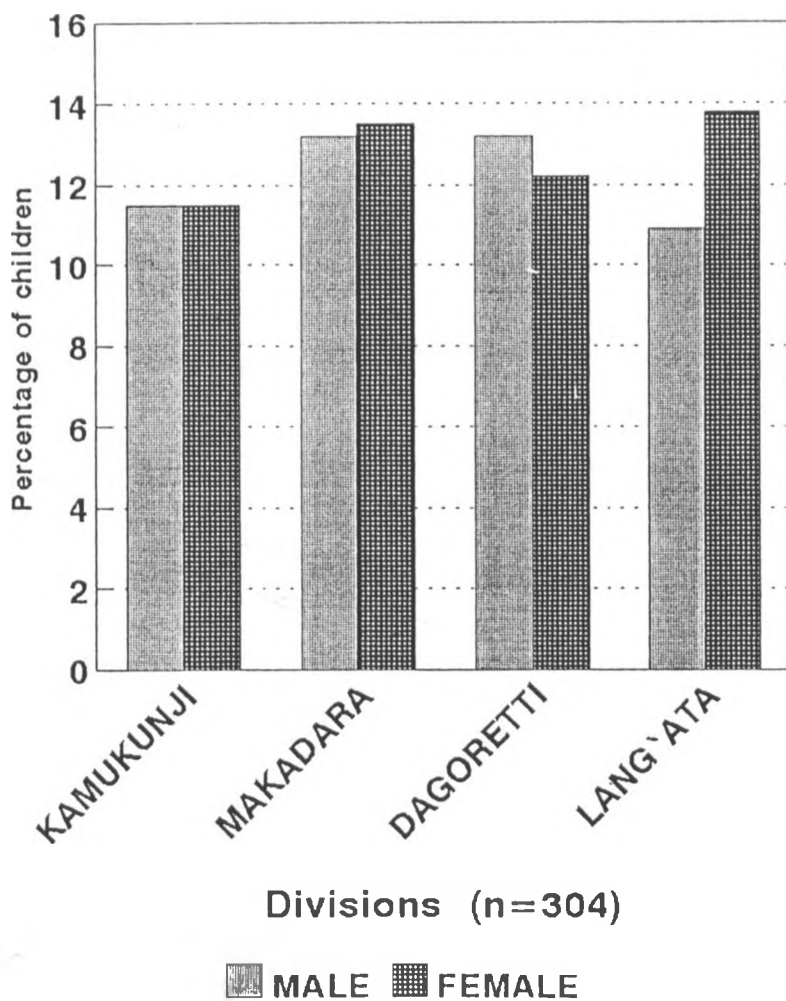




The distribution of the 304 study children by division was as follows: Kamukunji 23.0% with 50% males and 50% females, Makadara 26.6% with 49.4% males and 50.6% females, Dagoretti 25.7% with 52.6% males and 47.4% females, Lang'ata 24.7% with 44.0% males and 56.0% females. The distribution of the study children by sex and division is shown in Figure 3.

**Figure 3**

**Distribution of study children by sex and division**



## 5.2 MORBIDITY

The proportion of children who reported a history of sickness seven days prior to data collection was 50.7%. The commonest illness was cough/cold which accounted for 41.1% of the total, while diarrhoea accounted for 0.7% and malaria/fever for 2.0%. Other illnesses included dental, skin infections and wounds which comprised 6.9% of the illnesses. Kamukunji division reported the highest percentage of morbidity at 57.1%. The proportion of the children who had been fully immunized was 98.0%. The distribution of the illnesses suffered by the children by division is shown in Table 4.

Table 4: Distribution of the study children by the illnesses experienced in the seven days preceding data collection

ILLNESS	% OF CHILDREN				
	ALL (n=304)	KAMUKUNJI (n=70)	MAKADARA (n=81)	DAGORETTI (n=78)	LANG'AT A(n=75)
Diarrhoea	0.7	1.4	-	-	1.3
Cough/Cold	41.1	44.3	35.8	47.4	37.3
Malaria/ Fever	2.0	2.9	2.5	-	2.7
Others	6.9	8.6	4.9	7.7	10.7
Total	50.7	57.2	43.2	55.1	52.0

### 5.3 DIETARY PATTERNS

#### 5.3.1 Breastfeeding

The mean breastfeeding duration was 20.17 months (SD 10.39). The minimum duration was 0 months and the maximum was 53 months. Most of the children were breastfed for 12 - 24 months (46.7%), while 5% of the children had been breastfed for more than 36 months. These results are shown in Table 5.

Table 5: Breastfeeding duration by age group

BREASTFEEDING DURATION (MONTHS)	% OF CHILDREN (n=304)
< 6 months	10.2
6 - 12	17.4
13 - 24	46.7
25 - 36	16.8
> 36	4.9
No response	3.9

#### 5.3.2 Types of weaning milks used

The most commonly used weaning milk was cow's milk, which was fed to 77.6% of the children. Processed powder milk formulas were not very popular in weaning, with only 6% of the children having been fed on them alone. Both cow's milk and powder milk was given to 8.2% of the children. The brands of powder milk included nan, lactogen and S-26. The proportion of children who were not fed on

any milk supplement was 6.9%. These results are shown in Table 6.

Table 6: Frequency of milk consumption

TYPE OF MILK FORMULA	% OF CHILDREN FED (n=304)
Cow's milk	77.6
Powder milk	6.0
Powder and cow's milk	8.2
None	6.9
No response	1.3

More than half of the children (61.5%), started feeding on the milk supplements below the age of 4 months, while 14% were started at age 4 - 6 months. A number of children (6.9%), were not fed on any milk supplement.

Table 7 shows the distribution of the ages when milk supplements were started and the ages when they were stopped, by age group.

Table 7: Distribution of children by the age when milk was started and age when milk was stopped

AGE (MONTHS)	% OF CHILDREN (n=304)
Age milk started	
< 4 months	61.5
4 - 6	14.5
7 - 12	7.9
13 - 24	5.3
No response	10.9
Age milk stopped	
< 6 months	6.3
6 - 12	7.9
13 - 24	10.9
24 - 36	14.4
>36 months	79.5

### 5.3.3 Bottlefeeding

The proportion of children who were bottlefed was 40.8%, with 34.2% starting bottlefeeding below the age of 6 months. The mean age at which bottlefeeding was started was 1.59 months (SD 0.49). Only 1.3% of the children started bottlefeeding after 12 months of age. Table 8 shows the distribution of children by age when bottlefeeding was started.

Table 8: Distribution of children by age when bottlefeeding was started.

AGE GROUP (MONTHS)	% OF CHILDREN (n=304)
< 6 months	34.2
6 - 12	5.3
13 - 24	1.3

The mean bottlefeeding duration was 13.58 months (SD 12.40), with 5.6% of the children having been bottlefed for less than 6 months, 15.1% for 6 - 12 months, 16.1% for 13 - 24 months and 3.3% for 25 - 36 months. Two children were still bottlefeeding at 36.6 and 45 months of age respectively. Table 9 shows the distribution of children by bottlefeeding duration.

Table 9: Distribution of children by bottlefeeding duration

AGE GROUP (MONTHS)	% OF CHILDREN (n=304)
< 6 months	
6 - 12	5.6
13 - 24	15.1
25 - 36	16.1
>36 MONTHS	3.3
	0.7

The fluids used in bottlefeeding included milk, porridge and fruit juices. As shown in Table 10, a total of 27% of the children were bottlefed on milk with sugar, 36.3% on milk without sugar, 40.7% on fruit juices, 34.2% on porridge with sugar and 18.4% on porridge without sugar.

Table 10: Types of Fluids bottlefed and age of feeding

Age at which fed (months)	Milk with sugar %	Milk without sugar %	Fruit juices %	Porridge with sugar %	porridge without sugar %
< 6months	24.4	32.6	34.5	30.9	17.1
6 - 12	1.3	2.3	5.6	3.0	1.3
13 - 24	1.0	0.7	0.3	-	-
>24months	0.3	0.7	0.3	0.3	-
Total	27.0	36.3	40.7	34.2	18.4

(n=124)

#### 5.3.4 Snacks and drinks eaten in school by the children

Out of the 16 schools visited, 8 provided snacks and beverages to the children, 7 provided only beverages while 1 school did not provide any snacks or beverages at all. The snacks provided in school included bread, buns, fruits, cakes and sausages.

The beverages included milk, porridge, fruit juices, tea and drinking chocolate.

Fourteen of the schools provided lunch to the children, 12 of which had their lunch prepared in school, while the other 2 utilized outside catering services. One of the schools operated at half-day and therefore lunch was not necessary, while one of the schools had children bring lunch from home. All the schools that provided lunch to the children tried to provide a balanced meal of protein, carbohydrates and micronutrients (vitamins and minerals). Animal protein was not very common in the meals of most of the schools and 10 schools indicated giving meat products for lunch but on a few specific days only. In four of the schools the children pooled and shared the foods that they brought to school from their homes. The snacks carried by the children to school from home included bread, cakes, biscuits, sweets, crisps, popcorn, fruits, buns, chapati, pancakes, meat, eggs, sausages, ugali, potatoes, rice, porridge, groundnuts. These snacks were grouped into cereals, sweets and confectionaries, starchy staples, fruits, meat and meat products and groundnuts. Table 11 shows the distribution of the children by the snacks brought to school.



Table 11: Frequency distribution of children by types of snacks brought to school

TYPES OF SNACKS BROUGHT TO SCHOOL		% OF CHILDREN (n=304)
Cereals		62.5
Sweets and confectionaries		30.9
Starchy staples		19.7
Fruits		16.8
Meats and meat products		17.1
Groundnuts		0.02

The beverages brought to school by the children included milk, juice, soda, tea, cocoa and porridge, the commonest beverage being soda and fruit juices by 41.1% of the children, followed by milk (13.8%) as shown in Table 12.

Table 12: Frequency distribution of children by beverages brought to school

BEVERAGES BROUGHT TO SCHOOL		% OF CHILDREN (n=304)
Juices/Soda		41.1
Milk		13.8
Tea/Cocoa		10.9
Uji		3.6

### 5.3.5 Snacks given to the children as reward

The parents and guardians of the children indicated that they offered snacks to the children as rewards for achievements and good behaviour. This category of snacks comprised mainly biscuits which were given to 55.9% of the children, sweets to 36.2%, chocolate to 32.6% and icecream to 25.7% of the children. These results are shown in Table 13.

Table 13: Distribution of children by snacks given as reward

SNACK	% OF CHILDREN GIVEN SNACK (n=304)
Biscuits	55.9
Sweets	36.2
Chocolate	32.6
Icecream	25.7
Fruits	5.9
Juices/soda/dextrosol	3.6
Kool	3.3
chips and sausage	3.3

### 5.3.6 Consumption of sugar in foods

The study population consumed sugar in most of the beverages and breakfast cereals, with 88.5% consuming

Table 14: Distribution of sugar consumption with foods

FOOD WITH SUGAR	% OF CHILDREN (n=304)
Porridge	88.5
Beverages	86.2
Breakfast cereals	43.1
Milk	39.8

### 5.3.7 Meat and Meat products

The most commonly consumed meat was beef, by 27.7% of the children daily, while 47.4% consumed it weekly. Eggs were consumed by 18.4% of the children on daily basis, while 55% consumed them weekly. Pork and goat meats were not popular, 48.7% never consumed pork, while 35.9% had never consumed goatmeat. Consumption of other meats and meat products was not common as shown in Table 15.

Table 15: Distribution of the children by frequency of consumption of Meat and meat products

FOOD	FREQUENCY OF CONSUMPTION (%)					n=304
	DAILY	TWICE A WEEK	ONCE A WEEK	OCCASIONALLY	NEVER	
Beef	27.7	33.6	13.8	15.1	9.8	
Pork	1.0	1.6	9.5	39.1	48.7	
Fish	4.6	9.2	25.5	46.7	14.5	
Goat Meat	1.3	3.0	6.9	53.0	35.9	
Sausages	3.6	12.5	19.1	40.8	24.0	
Eggs	18.4	31.1	24.0	20.7	5.6	

### 5.3.8 Pulses

The consumption of pulses was not popular among the children with the highest percentage consuming the foods once a week or only occasionally. The daily consumption of pulses was very low with only 8.2% of the children consuming beans, 5.6% peas and 11.5% consuming greengram on daily basis. Table 16 shows the frequency distribution of consumption of pulses.

Table 16: Distribution of the children by frequency of consumption of pulses

FOOD	FREQUENCY OF CONSUMPTION (%)					n=304
	DAILY	TWICE A WEEK	ONCE A WEEK	OCCASIONALLY	NEVER	
Beans	8.2	26.3	37.5	24.3	3.6	
Peas	5.6	14.1	29.9	34.5	15.8	
Greengram	11.5	13.8	21.1	28.9	24.7	

### 5.3.9 Milk and milk products

There was a high consumption of milk with 80.9% of the children consuming it daily. Only 3.0% were not consuming milk. The consumption of milk products was not common as is seen in Table 17, with 67.4% of the children having never consumed yoghurt, while 74.7% never consumed cheese. Table 17 shows the distribution of the children on the basis of consumption of milk and milk products.

Table 17: Distribution of the children by frequency of consumption of milk and milk products

FOOD	FREQUENCY OF CONSUMPTION (%)					n=304
	DAILY	TWICE A WEEK	ONCE A WEEK	OCCASIONALLY	NEVER	
Milk	80.9	4.6	3.6	7.9	3.0	
Cheese	3.9	0.7	2.6	18.1	74.7	
Yoghurt	1.0	3.3	2.6	25.7	67.4	

### 5.3.10 Starchy Staples

A high percentage of children (90.1%), consumed bread daily, while 53.3% consumed porridge and 50.0% *ugali* daily. Breakfast cereals were consumed by 33.6% of the children daily. Rice was consumed by 48.7% of the children twice a week, while about 50% of the children were given chapati once a week (54.3%). Table 18 shows the distribution of consumption of starchy staples.

Table 18: Distribution of the children by frequency of consumption of starchy staples

FOOD	FREQUENCY OF CONSUMPTION (%)					n=304
	DAILY	TWICE A WEEK	ONCE A WEEK	OCCASIONAL LY	NEVER	
Bread	90.1	3.6	-	5.6	0.7	
Spagetti Macaroni	3.9	7.2	20.4	37.8	30.6	
Potato/ Chips	18.2	21.1	28.6	26.3	5.3	
Porridge	53.3	12.5	6.9	17.4	9.9	
Ugali	50.0	29.9	10.2	6.9	2.6	
Chapati	5.3	21.4	54.3	16.1	3.0	
Rice	19.7	48.7	19.7	10.2	1.6	
Break- fast Cereals	33.6	5.6	7.9	23.4	29.6	

### 5.3.11 Fats

There was a very high consumption of margarine with 71.1% of the children consuming it daily. Butter consumption was not common and most of the children (52%) never consumed it, while 29.6% only consumed it occasionally. Table 19 shows the frequency distribution for consumption of fats.

Table 19: Distribution of the children by frequency of consumption of fats

FOOD	FREQUENCY OF CONSUMPTION (%) n=304				
	DAILY	TWICE A WEEK	ONCE A WEEK	OCCASION ALLY	NEVER
Margarine	71.1	3.6	2.3	12.5	10.5
Butter	8.6	3.9	5.9	29.6	52.0

### 5.3.12 Fruits and Vegetables

The consumption of fruits and vegetables was fairly high among the children, with 75% and 78.3% consuming fruits and vegetables respectively, daily. Only 3.3% of the children never consumed fruits, while 2.3% never consumed vegetables. These results are shown in Table 20.

Table 20: Distribution of the children by frequency of consumption of fruits and vegetables

FOOD	FREQUENCY OF CONSUMPTION (%) n=304				
	DAILY	TWICE A WEEK	ONCE A WEEK	OCCASION ALLY	NEVER
Fruits	75.0	9.9	4.3	7.6	3.3
Vegetables	78.3	10.5	2.3	6.6	2.3

### 5.3.13 Sweets and Confectioneries

The most common food in this group was tea with sugar which was consumed by 84.9% of the children daily, followed by biscuits which were consumed by 12.8% of the children daily. The other food items in this group were commonly consumed on occasional basis, chocolate(47.7%), cookies (44.1%), soda (56.9%), icecream (52.0%), cakes (57.2%), sweets (55.9%) and biscuits (51.3%). Icebreakers were not popular, with 76.2% of the children not consuming them at all. These results are presented in Table 21.



Table 21: Distribution of the children by frequency of consumption of sweets and confectioneries

FOOD	FREQUENCY OF CONSUMPTION (%)					n=304
	DAILY	TWICE A WEEK	ONCE A WEEK	OCCASION ALLY	NEVER	
Chocolate	3.3	1.6	10.5	47.7	36.8	
Cookies	2.3	3.0	6.3	44.1	44.4	
Tea with sugar	84.9	1.3	0.7	7.6	5.6	
Soda	4.9	10.9	15.5	56.9	18.1	
Icebreaker	1.3	0.7	1.3	20.1	76.2	
Icecream	3.3	3.6	5.9	52.0	35.2	
Cakes	4.3	7.6	14.5	57.2	16.4	
Sweets	6.3	5.6	9.2	55.9	23.0	
Biscuits	12.8	11.2	10.9	51.3	13.8	

#### 5.3.14 Frequency of food consumption by food groups

The individual foods were then grouped into seven food groups, with fruit and vegetables, milk and milk products emerging as the foods commonly consumed by the children on daily basis. Meat and meat products, starchy staples and sweets and confectionaries were mostly consumed on occasional basis. Statistical analysis (ANOVA), on the consumption rate of individual food groups showed a significant difference between the mean

consumption of fruits and vegetables among Makadara division and the other three divisions ( $p < 0.05$ ), which did not show any significant differences among each other in their consumption of fruits and vegetables, Table 22. There was also a significant difference in the consumption of fats between Makadara and Dagoretti divisions ( $p < 0.05$ ). There was no significant statistical difference in the dietary patterns of the male and female children. The frequencies of consumption of the different food groups is shown in Table 23.

Table 22: Anova table for consumption of fruits and vegetables

Source of variation	df	Sum of squares	Mean squares	F-ratio	F-probability
Between groups	3	18.0049	6.0016	3.0226	0.0300
Within groups	300	595.6662	1.9856		
Total	303	613.6711			

Table 23: Distribution of the children by frequency of consumption of the food groups

FOOD	FREQUENCY OF CONSUMPTION (%) n=304				
	DAILY	TWICE A WEEK	ONCE A WEEK	OCCASIONALLY	NEVER
Meat and meat products	1.0	8.2	3.3	86.5	1.0
Pulses	3.6	21.1	19.4	53.9	2.0
Milk and milk products	47.0	6.9	4.9	38.5	2.6
Starchy Staples	2.0	24.3	6.9	66.4	0.3
Fruits and vegetables	65.8	17.8	5.3	9.9	1.3
Sweets & confectionaries	5.9	3.6	4.9	83.9	1.6
Fats	41.8	5.6	6.9	37.8	7.9

#### 5.4 NUTRITIONAL STATUS

The nutritional status of the children was assessed using the indicators WAZ, WHZ and HAZ according to the NCHS reference standards. The children were grouped into three categories, using the cut off point recommended by the WHO (1983). They were grouped into undernourished, normal and obese. Those below -2SD were classified as malnourished, those between -1.99 and +2SD as normal while those above +2SD were classified as obese.

The mean weight for age (WAZ), z-score was -0.04 (SD 1.07), the minimum WAZ was -2.6, while the maximum was 4.39, with 1.6% of the children below -2SD while 2.7% were above +2SD. The mean height for age (HAZ) z-score was -0.13 (SD 1.13), the maximum was 3.66 and the minimum -2.98. Stunting rate was low with 4.3% of the children below -2SD, while 2.4% were above +2SD. The mean weight for height (WHZ) was 0.14 (SD 0.98), the maximum value was 4.59, while the minimum was -2.50. Wasting was low with only 1% of the children being below -2SD, while 3.3% were above +2SD.

Table 24 shows the distribution of the children by their nutritional status.

Table 24: Distribution of study child by nutritional status

Nutritional Indicator	PERCENTAGE OF CHILDREN (n=304)		
	Malnourished (<-2SD)	Normal (-1.99 to +2SD)	Obese (>+2SD)
Weight for age	1.6	95.7	2.7
Height for age	4.3	93.3	2.4
Weight for height	1.0	95.7	3.3

The nutritional status deteriorated with increase in age as shown in Table 25.

Table 25: Distribution of child nutritional status by age

Age	Mean WAZ	Mean HAZ	Mean WHZ
36 - 47.99	0.12 (1.01)	0.10 (1.20)	0.23 (0.95)
48 - 59.99	-0.11 (1.09)	-0.23 (1.08)	0.10 (0.98)

Figures in parenthesis are mean(SD).

#### 5.4.1 Nutritional status and demographic factors

There was a significant positive correlation between the mother's age and child nutritional status in terms of weight for age ( $r=0.15$ ), and height for age ( $r=0.14$ ). The father's age positively correlated with the child's nutritional status in terms of height for age ( $r=0.15$ ). These results are shown in Table 26. The father's number of years of schooling was significantly positively correlated with weight for age ( $r=0.15$ ), and height for age ( $r=0.14$ ). However, there was no significant association between the mother's number of years of schooling and the child's nutritional status (Table 26).

There was no significant association between the child's weight for height and all demographic factors.

Table 26: Correlation between demographic factors and nutritional status of the study children

Factor	WAZ			HAZ		
	n	r	p	n	r	p
Mother's age	290	0.15	.013	290	0.14	.018
Father's age	-	-	-	260	0.15	.018
Father's years of schooling	259	0.15	.017	259	0.14	.020

#### 5.4.2 Nutritional status and morbidity

There was no significant association between immunization status or any sicknesses suffered the previous seven days prior to the data collection, and the nutritional status of the children.

#### 5.4.3 Nutritional Status and Dietary Patterns

The frequency of consumption of meat and meat products was significantly positively correlated with height for age and weight for age ( $p < 0.05$ ). There was no association between the freq

## 5.5 DENTAL STATUS

### 5.5.1 Oral hygiene

#### 5.5.1.1 Toothbrushing

All the schools indicated that they routinely checked the general hygiene status of the children and the school, with 13 of them paying attention to oral hygiene. Oral hygiene status in the study was based on toothbrushing habits and the presence of dental plaque on selected index teeth. A high proportion (94.4%) of the children indicated that they brushed their teeth. More than half of the children (59.5%) brushed once daily. About 71.1% were assisted to brush by their parents or guardians. Toothpaste usage was high by 93.1% of the children. Majority of the children (90.1%) used the commercial toothbrush, while 4% used a chewing stick. Table 27 shows the toothbrushing habits of the children.

Table 27: Toothbrushing habits of the study children

Brushing frequency	% of children (n=304)
Twice daily	23.7
Once daily	59.5
Once a week	10.9
Never	5.9

#### 5.5.1.2 Bacterial plaque

Majority of the children (91%), had plaque on the index teeth. These results are shown in Table 28.

Table 28: Distribution of study children by presence of plaque on the Index teeth

Index tooth	% of children with plaque (n=304)
Upper right first molar (54)	88.5
Upper right second molar (55)	95.4
Upper left first molar (64)	89.5
Upper left second molar (65)	98.0
Lower right first molar (74)	80.9
Lower right second molar (75)	97.4
Lower left first molar (84)	81.9
Lower left second molar (85)	97.0

#### 5.5.2 Finger and dummy sucking

A history of fingersucking was reported in 15.8% of the children. The mean fingersucking duration was 21.23 months (SD 33.09), with 4.3% of the children still fingersucking during the time of the study. Only 1% of the children had a history of dummiesucking. The mean dummiesucking duration was 1.2 months (SD 4.21). The maximum dummiesucking duration was 24 months.

#### 5.5.3 Dental caries

The proportion of children with dental caries was 63.5%. The mean decayed, missing and filled teeth (dmft) for the sample



lower age bracket which had a caries prevalence of 52.2%. Dental caries positively correlated with age ( $p < 0.05$ ), and stepwise logistic regression analysis showed older age as the main predictive factor in dental caries. The prevalence of dental caries, mean dmft and the values for components of the dmft are shown in Table 29.

Table 29: Caries experience in the study children  
( n = 3 0 4 )

No. (and %) with caries	193 (63.5)
Mean dmft	2.95
dt	2.82
mt	0.08
ft	0.05

The teeth mostly affected by caries included the maxillary incisors (254), the maxillary molars (167) and the mandibular molars (321). The caries experience by individual teeth is shown in Table 30.

The highest number of lesions (cavities) per child was 17, while the lowest was 1. The mode was two lesions (12.2%). Only one child had seventeen lesions. The distribution of the children by number of lesions is shown in Table 31.

Table 30: Caries experience by individual teeth

Teeth (n=6023)	No. Decayed	No. Missing	No. Filled
Lower Molars	321	5	9
Upper Incisors	254	12	-
Upper Molars	167	2	5
Lower Canines	69	3	-
Lower Incisors	25	1	-
Upper Canines	20	2	-
Total	856	25	14

Table 31: Distribution of children by number of lesions

Number of Lesions	Percentage of Children (n=304)
0	36.5
1	9.2
2	12.2
3	9.5
4	7.6
5	7.3
6	4.6
7	2.3
8	3.3
9	1.3
10	2.3
11	0.7
12	1.9
13	0.3
14	0.7
17	0.3

### 5.5.3.1 Caries experience by division

Lang'ata division had the lowest caries prevalence (48%), Kamukunji 65.7%, Dagoretti 69.2% and Makadara 70.4%. Lang'ata division had the lowest dmft. However, the values for the dmft were not statistically different across the divisions. The caries prevalence and mean dmft by division are shown in Table 32.

Table 32: Caries experience in study children by division

DIVISION	Percentage with caries	Mean dmft	dt	mt	ft
Makadara (n=70)	70.4	3.50	3.28	0.21	0.01
Dagoretti (n=78)	69.2	3.31	3.08	0.08	0.15
Kamukunji (n=81)	65.7	3.13	3.10	0.03	-
Lang'ata (n=75)	48.0	1.78	1.77	-	0.01
Total (n=304)	63.5	2.95	2.82	0.08	0.05

### 5.5.3.2 Caries experience by sex

The prevalence of dental caries was higher among the female children (66%), than among the male children (61%), though the difference was not statistically significant. However, the dmft for the male children was higher than that for the female children. The female children had a higher number of filled teeth than the males. The caries experience by sex in the study population is shown in Table 33.

Table 33: Caries experience in relation to sex

	Male Children (n=149)	Female Children (n=155)
No (and %) with caries	149 (61.1)	155 (65.8)
dmft	3.29	2.46
dt	3.19	2.46
mt	0.09	0.08
ft	0.01	0.08

#### 5.5.3.3 Caries experience by age

The prevalence of dental caries increased with the age of the child. Regression analysis showed age as the most predictive factor in dental caries.

Regression Equation: Caries = 0.11Age - 1.36Sex

The percentage of caries explained by the age of the child is 7.3, and is significant at  $F=82$  and  $p=0.0004$ .

#### 5.5.3.4 Caries experience by social class

The prevalence of dental caries and the mean dmft were higher among the children attending the middle cost schools than in the other groups. The caries experience by social class is shown in Table 34.

Table 34: Caries experience in relation to social class

	Low cost schools (n=143)	Middle cost schools (n=62)	High cost schools (n=99)
Percentage with caries	60.1	69.4	64.6
dmft	2.73	3.79	2.72
dt	2.54	3.71	2.66
mt	0.11	0.08	0.04
ft	0.08	-	0.02

#### 5.5.3.5 Dental caries and dietary patterns

The prevalence of dental caries was higher among the children consuming certain sugary snacks given as reward, as compared to the ones who did not consume them, as shown in Table 35. The prevalence of dental caries was also higher among the children consuming tea with sugar, cakes, sweets, biscuits and fruits daily, as compared to those who consumed them occasionally. These differences in caries prevalence were however not statistically significant. No significant association was apparent between the dietary patterns and dental caries in the study population. The prevalence of dental caries and the frequency of intake of certain foods is shown in Table 36.

Table 35: Intake of various snacks as reward by the children and the prevalence of dental caries (n=304)

SNACK	Percent caries prevalence in children consuming snack	Percent caries prevalence in children not consuming snack
Sweets	68.0	60.8
Biscuits	65.9	60.4
Icecream	67.9	61.9
Kool	70.0	63.3
Chocolate	64.6	62.9

Table 36: Frequency of intake of certain foods and the prevalence of dental caries (n=304)

SNACK	PERCENT CARIES PREVALENCE		
	CHILDREN CONSUMING SNACK DAILY	CHILDREN CONSUMING SNACK OCCASIONALLY	CHILDREN NOT CONSUMING SNACK
Bread	61.5	81.8	70.0
Chocolate	33.3	80.0	64.4
Cookies	83.3	77.8	63.1
Tea with sugar	68.9	50.0	57.0
Soda	60.0	78.8	63.6
Kool	100.0	100.0	63.1
Icecream	37.5	63.4	64.2
Cakes	75.0	65.2	63.0
Sweets	81.3	70.6	62.5
Biscuits	63.3	61.8	63.5
Fruits	64.8	48.5	61.3

### 5.5.3.6 Dental caries and nutritional status

The prevalence of dental caries was lower among children above +2 SD as compared to the normal and malnourished children. However, the differences in caries prevalence were not statistically significant. The prevalence of dental caries by nutritional status is shown in Table 37.

Table 37: Percent Prevalence of dental caries by nutritional status

INDICATOR	NUTRITIONAL STATUS (N=304)		
	< -2SD	-1.99 - +2SD	> +2SD
HAZ	66.7	63.7	50.0
WAZ	60.0	63.8	55.5
WHZ	66.7	64.5	36.4

### 5.5.4 Malocclusion

An anterior open bite was present in 7.2% of the children, a posterior crossbite in 7.6% and a lateral shift of the mandible in 10.9% of the children. There were no cases of infraocclusion in the whole sample. The mean intercanine width for the maxillary arch was 30.82 (SD 2.03) while the mandibular was 25.51 (SD 1.82). There was a significant positive association between anterior open bite and finger-sucking, ( $p < 0.05$ ). There was no significant association

between breastfeeding, bottlefeeding and malocclusion. There was no significant association between malocclusion and dental caries prevalence or nutritional status.



## CHAPTER SIX

### DISCUSSION

According to the 1992 statistics, Nairobi had a total of 595 pre-schools of various categories, serving a population of 42,987 children aged between 2 and 7 years (NCC, 1992).

This study was set out primarily to determine the dietary patterns, nutritional status and the prevalence of dental caries in children aged 36-60 months attending pre-schools in Nairobi. A total of 304 children from 16 pre-schools in four divisions were assessed.

#### 6.1 Sociodemographic characteristics of the study population

The study children were from relatively young mothers with 89.5% of the mothers falling in the age group 20-40 years. According to the National Demographic and Health Survey, 62.5% of women in Kenya fall within this age bracket, and 25% of males and 18% of females live in urban areas (KDHS, 1993).

Majority of parents of the children had formal education with 81.9% of the mothers and 70.4% of the fathers having obtained more than eight years of schooling. This is similar to the results of the National Demographic and Health Survey (KDHS, 1993), which showed that 90% of females and over 96% of the males in Nairobi had formal education. The education of the females was found to be inversely related to their age, with the older women having less

formal education than the younger women. Because some of the fathers declined to give their level of education, it was therefore difficult to compare the literacy levels of the fathers and mothers. Studies have however shown that the literacy level in males is generally higher than that of the females in Kenya (GOK/UNESCO, 1991). The average level of literacy in Kenya is 70% for females and 86% for males with 50.8% of males and 49.2% of females having completed the primary level of education, equivalent to eight years of formal schooling (UNICEF 1998, CBS 1997).

Of the parents, 79.9% of fathers and 68.4% of the mothers had some form of occupation, with wage employment taking up the highest percentage at 41.1% of the mothers and 43.1% of the fathers. Most of those who were not in employment engaged in some businesses.

## **6.2 Morbidity**

The immunization level of the children was very high with 98% of the children having been immunized against the common childhood diseases. The national level of immunization is 72% (CBS, 1996). However, the study was based on a select group of urban dwellers who were able to send their children to pre-school, which is not considered mandatory by the Kenyan school system. These parents had good income to afford the luxury. This coupled with the fact that most of them were considered literate by Kenyan standards explains their high degree of awareness with regard to child immunization.

About 50% of the children had a history of illness the previous seven days prior to the study, with the highest percentage of them suffering from colds and coughs (41.1%). These illnesses however did not seem to have had any significant effect on the nutritional status of the study children. The study was conducted at a time when the weather was very hot with a lot of dust and this could have contributed to the high prevalence of upper respiratory tract infections. There were no chronic illnesses reported among the study children.

### **6.3 Dietary patterns**

According to the national demographic health survey, almost all Kenyan children (97%) are breastfed for some period of time. Exclusive breastfeeding is not common, and there is early introduction of supplementary foods. Bottlefeeding is also common, with 1 out of every 6 infants below the age of 4 months being fed using a bottle. Use of infant formulas is not common (KDHS, 1993). The present study showed similar results to the trends indicated above with 40.8% of the children having been bottlefed, common cases of early weaning and a high percentage of children (96%) having been breastfed for some period of time. High rates of bottlefeeding and early termination of breastfeeding prompted by pressure on the mother to maintain regular employment have been reported in past studies (WHO, 1981). Majority of the mothers of the study children were in wage employment or business and this

could have contributed to the high rates of bottlefeeding and early weaning.

Although there were high frequencies of consumption from the main food groups especially milk, fruits, vegetables and starchy staples in form of bread, ugali and porridge on daily basis, there was a relatively high consumption of sugars and confectionaries by the children. The later group of foods could be contributing to dental caries. The dietary patterns of these children included consumption of high energy foods, which could explain the low rates of malnutrition and the presence of obese children in the study population.

There has been an influx of cheap selling sugary foods in the Kenyan market, both in shops and in the streets and these could also be contributing to the improvement of the nutritional status in terms of energy and the high prevalence of dental caries in pre-school children.

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#### 6.4 Nutritional status

The levels of malnutrition among the children were much lower than the levels obtained during the recent National Nutritional survey whereby 22% of the children in Nairobi were underweight, 30.2% stunted and 5.5% wasted (CBS, 1996). In the present study, 1.6% of the children were found to be underweight, 4.3% stunted and 1.0% wasted. A few of the children were obese, 2.7% for their weight for age and 3.3% for weight for height, while 2.4% were taller than their height for age. However, while the National Study dealt with

all the children in general, this study concentrated on children from the families that could be categorized as middle class. Also, the study population comprised school-going children who were taken care of in school. Their general hygiene status was routinely checked by their teachers and the city council occasionally carried out health checks and deworming of the children at school. This obviously reduced substantially the effect of poor hygiene on the nutritional status of these children. Finally most of these children (98%) were already fully immunized against early childhood diseases.

Demographic characteristics of the mother have been found to be the major determinants of child nutritional status (Sharmanov et al., 1997). In this study, the mother's age was positively correlated with the child's nutritional status in terms of weight for age (WAZ) and height for age (HAZ). There was also a significant positive correlation between father's age and child nutritional status in terms of height for age (HAZ). The study mothers were highly educated. Improved maternal education and literacy have been found to increase knowledge and skills in childcare practices, thus enhancing good nutritional status in children (WHO, 1992). The mothers of the children could also have had some exposure to nutrition education through such avenues as maternal and child health clinics.

Engagement of parents of the study children in employment and business meant improved incomes and hence food security, and therefore improved nutritional status of the children. This is in

keeping with past studies which have shown that children from lower socioeconomic classes have poorer nutritional status when compared to those from other classes (Hoorweg et al., 1984).

The relatively small household sizes (mean size 5.57) could also have contributed positively to the nutritional status of the children. The household size has been found to relate closely with the nutritional status of the household members especially the preschool children. Studies have shown that children under five years from large households are significantly shorter for their height and eat nutritionally poorer diets than those from smaller households (Pelto et al., 1991).

#### **6.5 Oral hygiene status**

Although 94.4% of the children reported brushing their teeth, this was inconsistent with the high percentages of plaque (91%), on the index teeth. These results could mean that the toothbrushing methods are ineffective or the claims of toothbrushing are not true. These results are in agreement with an earlier study on 6-8 year olds in Nairobi which showed that although 88% of the children indicated brushing their teeth, 75% of them had plaque on the index teeth (Ng, ang, a and Valderhaug, 1991).

It is important to stress the need for effective regular toothbrushing, which results in the removal of bacterial plaque, and thus minimise the dental caries prevalence. The 3-5 year old

children require parental assistance to achieve effective plaque removal. Studies have demonstrated that the combination of plaque removal and fluoride, was more effective at preventing caries than fluoride alone (Koch and Lindhe, 1970). In Kenya, promotion of dental health has not been a subject of major concern, and dental care was only recently added to primary healthcare. Training of community oral health workers was also started only recently.

#### **6.6 Dental caries**

The teeth are important for mastication, and dental caries is a common cause of loss of teeth in pre-school children. Early loss of deciduous teeth may interfere with proper mastication of food, alignment of the permanent teeth and jaw growth. Other problems associated with dental caries include abscesses, osteomyelitis, Lundwigs angina, cancrum oris, vincent's stomatitis and other infections and these can lead to disability and death. These problems can also compromise the dietary intake, and hence the nutritional status of the child (Jolly and Levene, 1986).

A study carried out among pre-school children in Nairobi previously reported a dental caries prevalence of 55% and a mean dmft of 1.72 (Masiga and Holt, 1993). The prevalence of dental caries seems to be still high among pre-school children as shown in this study, a dental caries prevalence of 63.5% and a dmft of 2.95. Only 1.3% of

the study children had filled teeth, with the filled component accounting for only 1.7% of the total dmft. Inadequate professional dental care for young children is common in many parts of the world (Winter GB, 1990, Hunter et al., 1997). This study has shown this to be so among the study children, where the number of filled teeth was found to be very low despite the high proportion of children with dental caries. The large percentage of children not seeking dental treatment could be due to lack of care, knowledge and financial resources. The dental caries prevalence seemed to increase with the age of child, and age was found to be the most predictive factor of dental caries, this is similar to findings in past studies (Marques and Messer, 1992).

The prevalence of dental caries was higher among children attending the middle-cost schools, compared to those in the other classes. This might imply that this is the class where children are more exposed to cariogenic foods, which the lower socioeconomic class might not afford to buy. In the high socioeconomic class, it would be expected that these are children who are less exposed to the cariogenic foods in the streets and kiosks, and hence reduced frequency of their consumption. Previous studies have found a lower dental caries prevalence in the higher socioeconomic class than in the lower socioeconomic class (Schou, 1991), which agrees with the results of this study. Studies have further shown that consumption of cariogenic foods and snacks, mainly carbohydrates, refined foods and processed foods leads to a higher prevalence of dental caries, the prevalence being directly related to the frequency of



consumption (Manji et al., 1988, Freeman et al., 1997). In this study, the prevalence of dental caries was higher among children consuming cariogenic snacks as a reward, compared to those who did not consume. The role of diet in the occurrence of dental caries has long been established in the consumption of carbohydrates which provide the substrate for bacteria to act on. There has been a big influx of cariogenic foods in the Kenyan market which sell at relatively low prices. Some of these snacks especially sweets, biscuits, chocolates and icebreakers are sold in streets and kiosks, and are therefore easily accessible. This encourages snacking which is detrimental to the oral hygiene status and hence caries susceptibility. Studies have shown frequency of exposure to sugar as the most important factor in the development of dental caries (Hascke, 1992).

There did not seem to be a correlation between the high prevalence of dental caries and the nutritional status of the children, maybe because severity of caries was not enough to affect food mastication and intake. It is also possible that the children with rampant caries were feeding on soft diets that did not require much chewing, and therefore little compromise on the nutritional status of the children. The low rates of malnutrition could also have made it difficult to detect the statistical association between the nutritional status of the children and dental caries prevalence, even if it existed.

## 6.7 Malocclusion

Difficulty in chewing resulting from malocclusions may result in improper digestion and absorption of food, and this has nutritional implications. Other effects include increased risk of dental caries due to difficulty in cleaning malaligned teeth, interference with esthetics and speech, social and emotional stress.

Finger-sucking and dummy-sucking are predisposing factors to malocclusion in children usually leading to anterior openbite and posterior crossbite. Studies have shown increased prevalence of posterior crossbite among finger- and dummy-suckers in relation to non-suckers (Larsson, 1975). However, in the present study finger- and dummy-sucking had no significant influence in the development of posterior crossbite.

It has been suggested that breastfeeding is superior to bottlefeeding as far as development of occlusion is concerned (Labbok et al., 1987). In the present study where 15.8% of the children had a history of finger-sucking, and 1% dummy-sucking, there was no significant relationship observed between either bottlefeeding or breastfeeding and malocclusions. The presence of posterior crossbite in 7.6% of the children could have been due to other factors. The prevalence of an anterior openbite of 7.2% was lower in this study compared to previous studies which reported a prevalence of 12% (Kabue et al., 1995).

## CHAPTER 7

### CONCLUSIONS AND RECOMMENDATIONS

#### 7.1 CONCLUSIONS

The children were consuming a wide variety of foods and the different food groups were catered for. There was however a very low consumption of animal foods. There was a high consumption of dietary sugar in beverages and breakfast cereals, and also a relatively high consumption of cariogenic snacks given as reward. There was no difference in the dietary patterns of the children across the different divisions.

The rates of malnutrition were low in the study population, with some overweight children. The factors which correlated positively with nutritional status were mother's and father's age and the father's number of years of schooling.

The prevalence of dental caries was relatively high in this population with 63.5% of the children having dental caries. The prevalence was higher in females than males although the males had a higher dmft.

The study was unable to demonstrate any relationship between dental caries and nutritional status.

## 7.2 RECOMMENDATIONS

Inorder to reduce the high consumption of dietary sugar and the high prevalence of dental caries in the pre-school children, the following recommendations are made:

Preventive oral health education programs are needed inorder to increase knowledge, modify attitudes and hence improve oral health care practices. These programs could be incorporated in maternal and child health clinics, and also in the pre-school education curriculum. Preventive community approach to dental care in primary oral health programmes is recommended.

Dietary counselling and advice is required inorder to educate the population on the cariogenicity of dietary sugar, and its detrimental effects.

Intervention measures are needed inorder to reduce the prevalence of dental caries and associated problems.

Further research is recommended in the area of dental caries and nutrition, inorder to come up with likely associations between the two.

## REFERENCES

- Alvarez, J.O.; Caceda, J.; Woolley, T.W.; Carley, K.W.; Baiocchi, N.; Caravedo, L.; Navia, J.M. (1993). A longitudinal study of dental caries in the primary teeth of children who suffered from infant malnutrition. *Journal of Dental Research*: 72 (12): 1573-6.
- Alvarez, J.O. (1995). Nutrition, tooth development and dental caries: *American Journal of clinical Nutrition*: 410s - 416s.
- Bernard, F.e.; Marangu, L.T.; Hammond, M. (1989). Childhood Protein Energy Malnutrition, Meru district. (Unpublished).
- Cawson, R.A. (1991). *Essentials of Dental Surgery and Pathology*, pp 15-16: Churchill Livingstone, London.
- Central Bureau of Statistics, (1993). Kenya Demographic and Health Survey, pp 11-15: Macro International Inc., Maryland, USA.
- Central Bureau of Statistics, (1996). National Development Plan. Office of the Vice-President and Ministry of Planning and National Development.
- Central Bureau of Statistics, (1996). National Nutrition Survey. Office of the Vice-President and Ministry of Planning and National Development.
- Central Bureau of Statistics, (1997). National Economic Survey. Office of the Vice-President and Ministry of Planning and National Development.
- Cholton, R. and Moneti, M. (1989). Improving child survival and nutrition. The joint WHO/UNICEF nutrition support programme in Iringa, Tanzania. Dar es salaam - Tanzania - UNICEF, (6):20p.
- Corrucini, R.S.; Whitley, L.D. (1981). Occlusal variation in a rural Kentucky community: *American Journal of Orthodontics*, 79:250-62.
- Corruccini, R.S.; Kaul, S.S.; Chopra, S.R.K.; Larsen, M.D.; Marrow, C. (1983). Epidemiology survey of occlusion in north India. *British Journal of Orthodontics*, 10:44-7.

**Cutress, T.W. (1996).** Nutrition and dental caries in pacific RIM countries. International Dental Journal vol. 46, supplement 1:388 - 392.

**Drummond, B.K.; Ryan, S.; O'Sullivan, E.A.; Congdon, P.; Curzon, M.E.J. (1992).** Enamel defects of the primary dentition and osteopenia of prematurity. Paediatric Dental Journal 14:119 - 121.

**Falkner, F. and Tanner, J.M. (1986).** Human growth: A comprehensive treatise, 2nd edition, volume 3. Methodology: Ecological, Genetic and Nutritional effects on growth. Plenum press.

**Ferne, J.M.; Bryan, E.M.; Elliman, A.M.; Brook, A.H.; Williams, D.M. (1990).** Enamel defects in the primary dentition of children born weighing less than 2000gm. British Dental Journal:168:433 - 437.

**Fieldhouse, P. (1986).** Nutrition, Customs and Culture. Croomhelm, London.

**Freeman R.;Breistein B;McQueen A.;Stewart M. (1997).** The dental health status of 5 year old children in north and west Belfast. Community-Dent-Health. Dec;14(4):253-7.

**GOK/UNESCO, (1991).** National planning workshop on "Child Health, Nutrition and School Participation". Paris.

**GOK/UNICEF, (1992).** Children and women in Kenya - a situation analysis. Regal Press Limited, Nairobi.

**Guyton, A.C. (1976).** Textbook of Medical Physiology, pg 854 - 855, 1070. W.B. Saunders company, Philadelphia.

**Halloway, P.J.; Shaw, J.H.; Sweeny, E.A. (1961).** Effects of various sucrose-casein ratios in purified diets on the teeth and supporting structures of rats. Arch Oral Biol 3:185.

**Harrison's Principals of internal medicine.** Ninth edition; pp 1989-90. McGraw-Hill, Tokyo.

den Hartog, A.P. and Wija, A. ran S. (1985). Manual for social surveys on food habits and consumption in developing countries, pg 3-7.

Haschke, F. (1992). The nutrition commission of the Austrian Society of Paediatrics and Adolescent medicine. Prevention of caries. Paediatr- Padol 1992:27(5):109-11.

Hassary, N. and Ahmed, K. (1984). Studies on food and nutrient intake by rural population of Bangladesh, comparison between intakes of 1962 - 64, 1975 - 6 and 1981 - 82. J Ecol Food and Nutri. United Kingdom: pp 15.

Holst, A.; Martensson, I.; Laurin, M. (1997). Identification of caries risk children and prevention of caries in pre-school children. Swed-Dent-J.21(5):185-91.

Hoorweg, J. and Niemjer, G. (1990). The nutritional impact of the preschool health program at three clinics in central province. Kenya research report no.11, African studies centre Leiden, Netherlands.

Hoorweg, J. and Niemeijer, G. (1991). Intervention in child nutrition. Evaluation studies in Kenya, pp 7-12: AMREF, Nairobi.

Hunter, M.L.; Hood, C.A.; Hunter, B.; Kingdom, A. (1997). Reported infant feeding, oral hygiene and dental attendance patterns in children aged 5 years and under referred for extraction of teeth under general anaesthesia. Int-J-Paediatr-Dent. Dec;7(4):243-8.

Israel, R.; Tighe, J.W.; Wirtz, S.; Taylor, B.E.; Tognetti, J. (1993). Maternal and infant nutrition reviews, Kenya. An international nutrition communication service publication, Newton USA, pg 5 - 25.

Jolly, H. and Levene, M.I. (1986). Diseases of children. Fifth edition, pp 270-272, 267: ELBS, London.

Kabue, M.M.; Moracha, J.K.; Ng'ang'a, P.M. (1995). Malocclusion in children aged 3-6 years in Nairobi, Kenya. East African Medical Journal Vol 72 No 4.

**Koch, G. and Lindhe, J. (1970).** The state of gingivae and caries increment in school children during and after withdrawal of various prophylactic measures, pp 271-281. In:McHugh WD (ed.). Dental plaque. Livingstone, Edinburgh.

**Kogi-Makau W. (1993).** A socio-economic study of Kibera, baseline Survey. Publication for institutional capacity building/child survival and development(NCB/CSD). Unpublished.

**Konig, K.G.; Navia, J.M. (1995).** American Journal of Clinical Nutrition: 62(1 suppl.) 2755-2825.

**Labbok, M.H. and Hendershot, G.E. (1987).** Does breastfeeding protect against malocclusion? An analysis of child health supplement to the national health interview survey. American Journal of preventive medicine:3:227 - 32.

**Larsson, E. (1975).** Dummy- and finger-sucking in 4 year olds. Swed Dent J;68:219-24

**Lavelle, C.L.B. (1983).** Applied Oral Physiology. Second edition, pp 111-112. ELBS, London.

**Lockshin, M.F. (1994).** Preventive oral healthcare, a review for family physicians. American-Family-Physician: 50(8): 1677-84,87.

**Macleod, J. (1977).** Davidson's principles and practice of medicine; pp 111; Churchill Livingstone, Edinburgh.

**Manji, F.; Beighton, D.; Fegerskov, O.; Nagelkerke, N. (1988).** Inter-relationship between diet, salivary mutans streptococci and lactobacilli, and dental caries; Caries Res paper No. 17/88 pp 155-165; Rural Kenya.

**Marques, A.P. and Messer, L.B. (1992).** Nutrient intake and dental caries in the primary dentation. Pediatr-Dent;Sept-Oct;14(5):314-21.

**Marthaler, T.M. (1990).** Changes in the prevalence of dental caries: How much can be attributed to changes in diet? Caries research 24:3-15



**Masiga, M.A. and Holt, R.D. (1993).** The prevalence of dental caries and gingivitis and their relationship to social class amongst nursery school children in Nairobi, Kenya. *International Journal of Paediatric Dentistry*:3:135-140.

**Mellberg, J. and Ripa, L.W. (1983).** Fluoride in Preventive Dentistry: Theory and Clinical Applications, 7/1983; Quintessence International, Chicago.

**Mellberg, J. and Mallon, D.E. (1984).** Soluble calcium-enhanced remineralization of artificial carious lesions with monofluorophosphate. *Caries Res.*18:416-420.

**Menaker, L. (1981).** Effect of undernutrition during the time of tooth development on susceptibility to dental caries. *Journal of infant and child feeding*: pp 349-62.

**Moss, S. (1996).** The relationship between diet, saliva and baby bottle decay. *International Dental Journal*, Vol. 46/No.4 (Supplement 1)

**Navia J.M. (1996).** Nutrition and dental caries. *International Dental Journal* vol.46, No.4 (Supplement 1), pp 381-87.

**Nairobi City Council, (1992).** Centre for Early Childhood Education, pp 1-2. Pre-school Statistics; Education Department.

**Nairobi City Council, (1995).** The Nairobi we want; Nairobi City Council.

**Ndung'u, F.L.; Kaimenyi, J.T.; Arneberg, P.; Muthami, L.N. (1990).** A comparative study on the efficacy of plaque control by a chewing stick and a toothbrush. *East African Medical Journal* 67:907-11.

**Ng'ang'a, P.M. and Valderhaug, J. (1991).** Oral hygiene practices and periodontal health in primary school children in Nairobi, Kenya. *Acta Odontol Scand*; 49:303-309.

**Nizel, (1966).** Science of nutrition and its application in clinical dentistry, pp 8-11.

**Pelto, G.H.; Urgello, J.; Allen, L.H.; Chavez, A.; Martinez, H.; Meneses, L.; Capacchione, C.; Backstrand, J. (1991).**

Household size, food intake and anthropometric status of school age children in a highland in Mexico.

*Social Science and Medicine* 33:1135-40.

**Pradpasen, M.; Charoenpong, R.; Temcharoen; Porapakham, Y.; (1995).** Nangrong dietary survey. University Institute for Population and Social Research, IV, 88p. IPSR publication No. 95.

**Rajammal, P.D. and Nirmala, K.M. (1986).** Incidence of dental caries in children of age 5-12 years in Coimbatore. *The Ind. J. Nutri. Dietet*, 23, 183.

**Rao, K.V. and Gopalan, C. (1969).** Nutrition and family size: *Journal of Nutrition and Dietetics* 6:258-266.

**Roberts, G.J.; Cleaton-Jones, P.E.; Fatti, L.P.; Richardson, B.D.; Sinwel, R.E.; Hargreaves, J.A.; Williams, S. (1993).**

Patterns of breast and bottle feeding and their association with dental caries in 1 to 4 year olds: South Africa.

*Community Dental Health* 10(4):405-13.

**Rozenzweig, K.A. and Sahar, M. (1962).** Enamel hypoplasia and dental caries in the primary dentition of premature infants. *British Dental Journal* 113:279-280.

**Rugg-Gunn A.J. (1993).** *Community Dental Health*, 10 suppl. 2:47-56.

**Schou L. (1991).** Social and behavioural aspects of caries prediction. In: Johnson NW(ed.); *Risk markers for oral disease*, vol. 1, Dental caries, pp 172-197; Cambridge University Press, Cambridge.

**Scott, J.H. and Symons, N.B.B. (1982).** *Introduction to Dental Anatomy*, eighth edition; Churchill Livingstone, Edinburgh.

**Shafer; Hine; Levy, (1988).** *A Textbook of Oral Pathology*. Fourth edition, pp 53-7.

**Sharmanov, Tsh.; Karsybekova, N.M.; Bekbocynov, T.K.; Sarse, A.P.; Kudalbergenova, Z.K. (1997).** Nutritional status of early age children in Kazakhstan. *Vopr-Pitan.* (4):23-5.

Shellar, B.; Williams, B.J.; Lombardi, S.M. (1997). Diagnosis and treatment of dental caries-related emergencies in a children's hospital. Paediatr-Dent. Nov-Dec;19(8):470-5.

Sonju, C.A.B.; Ogaard, B.; Duschner, H.; Ruben, J.; Arends, J.; Sonju, T. (1997). Caries development in fluoridated and non-fluoridated deciduous and permanent enamel in situ examined by microradiography and confocal laser scanning microscopy. Adv-Dent-Res. Nov;11(4):442-7).

United Nations, (1986). How to weigh and measure children: Assessing the nutritional status of young children in Household Surveys, Annex 1; New York.

UNICEF, (1998). The state of the world's children, pp 19-21; Oxford University Press, New York.

Vanita, T. and Patil, J.A. (1990). A study on the nutritional status of children in the Anganwadis of Nagpur city. The Ind. J. Nutri. Dietet. 27,82.

WHO, (1981). Contemporary patterns of breastfeeding. Report on WHO collaborative study in breastfeeding; Geneva.

WHO, (1983). Measuring changes in nutritional status. Guidelines for assessing the nutritional impact for vulnerable groups, pp 12-13; Geneva.

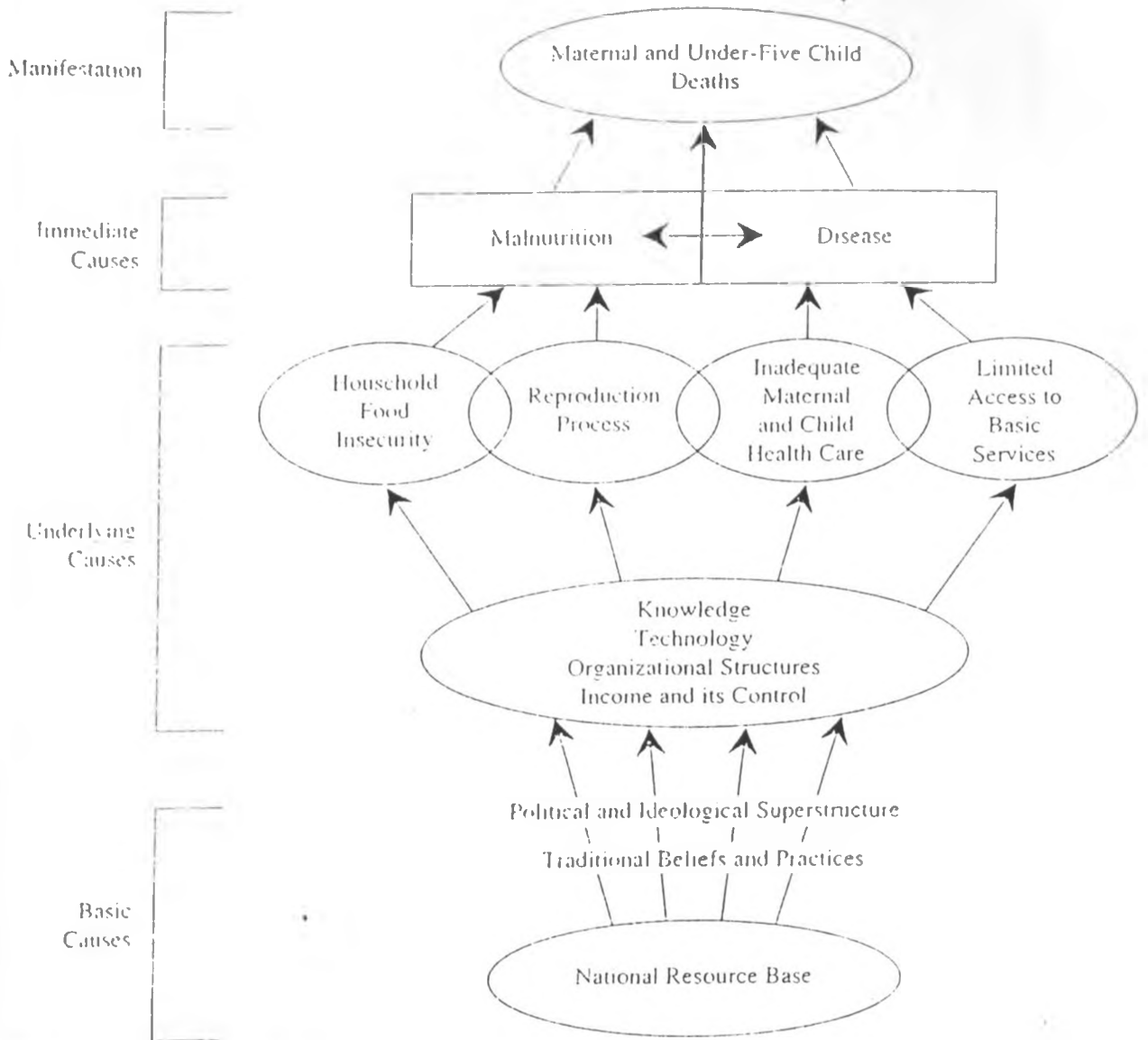
WHO, (1987). Oral Health Surveys. Basic Methods, 3rd edition pp 41; Geneva.

WHO, (1992). Nutrition and Development, a global assessment. International conference on nutrition pp xvi-xvii; Rome.

WHO/UNICEF, (1985). International Conference on Primary Health Care - Alma Alta.

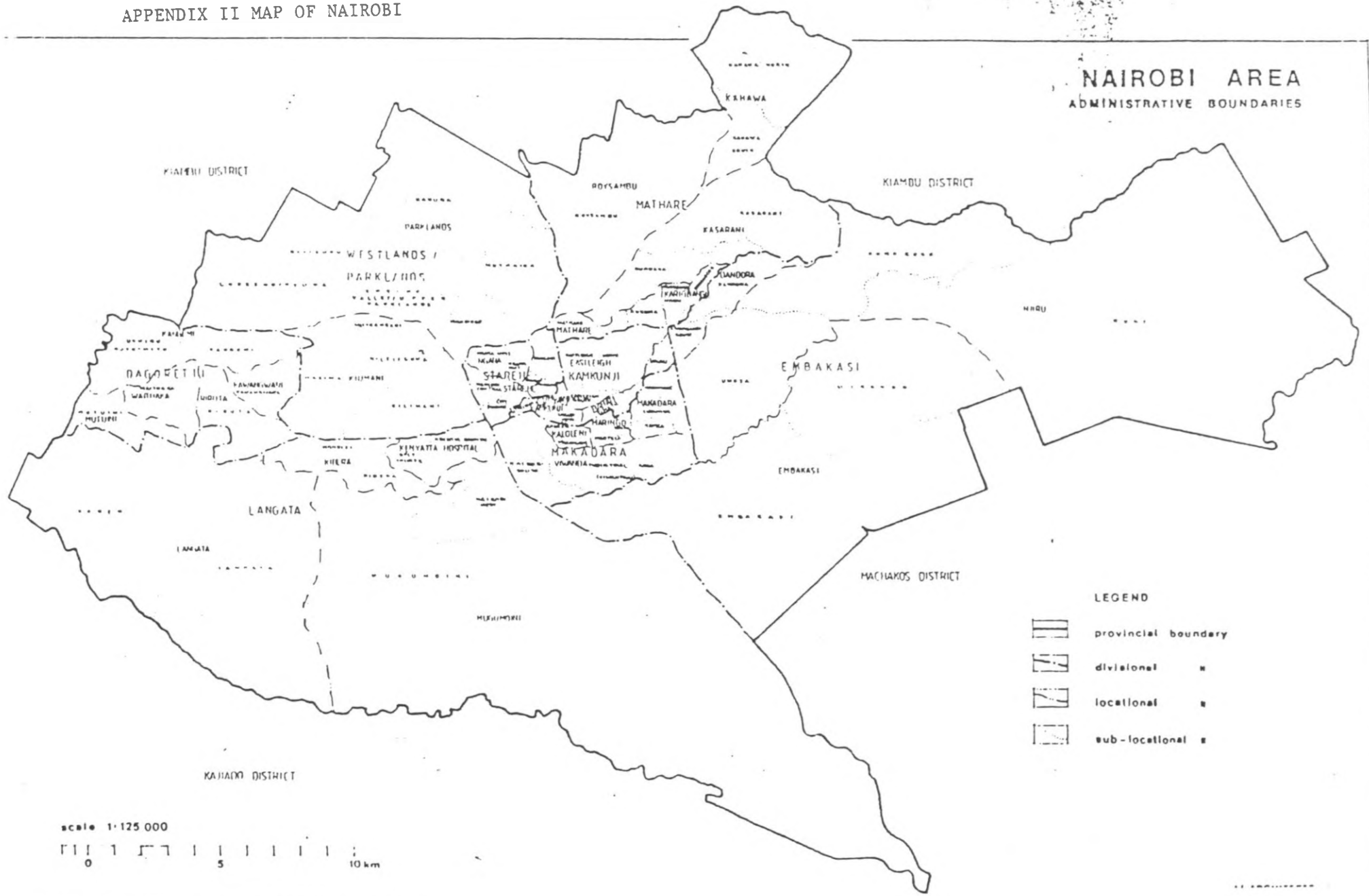
Winter, G.B. (1990). Caries in the preschool child. Journal of Dentistry. 18:322-323

APPENDIX 1 THE MULTIPLE CAUSES OF MALNUTRITION



Source: Children and Women in Kenya  
A situation Analysis 1992





NAIROBI AREA  
ADMINISTRATIVE BOUNDARIES



scale 1:125 000



LEGEND

-  provincial boundary
-  divisional "
-  locational "
-  sub-locational "

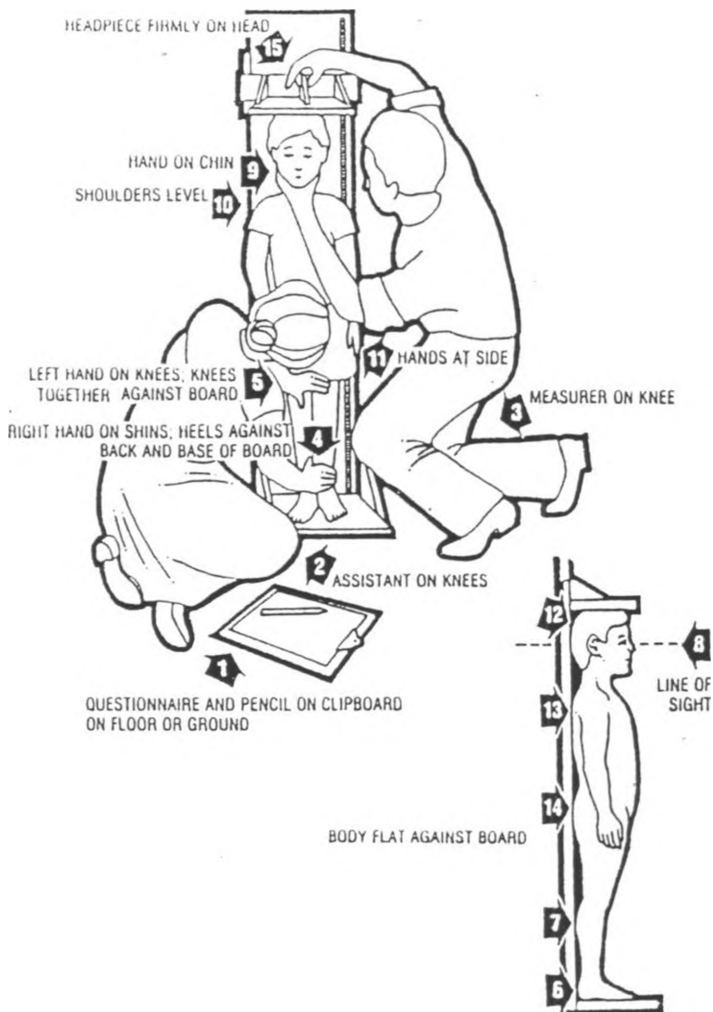
## II. Nutritional Status Measurement Summary Procedures

### A. Child Height Summary Procedure (Illustration 1)\*

1. **Measurer or Assistant:** Place the measuring board on a hard flat surface against a wall, table, tree, staircase, etc. Make sure the board is stable.
  2. **Measurer or Assistant:** Ask the mother to remove the child's shoes and unbraided any hair that would interfere with the height measurement. Ask her to walk the child to the board and to kneel in front of the child (if she is not the assistant).
  3. **Assistant:** Place the questionnaire and pencil on the ground (Arrow 1). Kneel with both knees on the right side of the child (Arrow 2).
  4. **Measurer:** Kneel on your right knee only, for maximum mobility, on the child's left side (Arrow 3).
  5. **Assistant:** Place the child's feet flat and together in the centre of and against the back and base of the board. Place your right hand just above the child's ankles on the shins (Arrow 4), your left hand on the child's knees (Arrow 5) and push against the board. Make sure the child's legs are straight and the heels and calves are against the board (Arrows 6 and 7). Tell the measurer when you have completed positioning the feet and legs.
  6. **Measurer:** Tell the child to look straight ahead at the mother if she is in front of the child. Make sure the child's line of sight is level with the ground (Arrow 8). Place your open left hand on the child's chin. Gradually close your hand (Arrow 9). Do not cover the child's mouth or ears. Make sure the shoulders are level (Arrow 10), the hands are at the child's side (Arrow 11), and the head, shoulder blades and buttocks are against the board (Arrows 12, 13, and 14). With your right hand, lower the headpiece on top of the child's head. Make sure you push through the child's hair (Arrow 15).
  7. **Measurer and Assistant:** Check the child's position (Arrows 1-15). Repeat any steps as necessary.
  8. **Measurer:** When the child's position is correct, read and call out the measurement to the nearest 0.1 cm. Remove the headpiece from the child's head, your left hand from the child's chin and support the child during the recording.
  9. **Assistant:** Immediately record the measurement and show it to the measurer.
- NOTE:** If the assistant is untrained, the measurer records the height.
10. **Measurer:** Check the recorded measurement on the questionnaire for accuracy and legibility. Instruct the assistant to erase and correct any errors.

\* If the assistant is untrained, e.g. the mother, then the measurer should help the assistant with the height procedure.

Illustration 1  
Child Height Measurement



### Child Weight Summary Procedure (Illustration 3)\* (

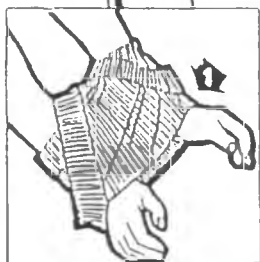
1. **Measurer or Assistant:** Hang the scale from a tree branch, ceiling beam, tripod or pole held by two people. You may need a piece of rope to hang the scale at eye level. Ask the mother to undress the child.
2. **Measurer:** Attach a pair of the empty weighing pants, infant sling or basket to the hook of the scale and adjust the scale to zero, then remove from the scale.
3. **Measurer:** Have the mother hold the child. Put your arms through the leg holes of the pants (Arrow 1). Grasp the child's feet and pull the legs through the leg holes (Arrow 2). Make certain the strap of the pants is in front of the child.
4. **Measurer:** Attach the strap of the pants to the hook of the scale. **DO NOT CARRY THE CHILD BY THE STRAP ONLY.** Gently lower the child and allow the child to hang freely (Arrow 3).
6. **Assistant:** Stand behind and to one side of the measurer ready to record the measurement. Have the questionnaire ready (Arrow 4).
6. **Measurer and Assistant:** Check the child's position. Make sure the child is hanging freely and not touching anything. Repeat any steps as necessary.
7. **Measurer:** Hold the scale and read the weight to the nearest 0.1 kg (Arrow 5). Call out the measurement when the child is still and the scale needle is stationary. Even children who are very active, which causes the needle to wobble greatly, will become still long enough to take a reading. **WAIT FOR THE NEEDLE TO STOP MOVING.**
8. **Assistant:** Immediately record the measurement and show it to the measurer.
9. **Measurer:** As the assistant records the measurement, hold the child in one arm and gently lift the child by the body. **DO NOT LIFT THE CHILD BY THE STRAP OF THE WEIGHING PANTS.** Release the strap from the hook of the scale with your free hand.
10. **Measurer:** Check the recorded measurement on the questionnaire for accuracy and legibility. Instruct the assistant to erase and correct any errors.

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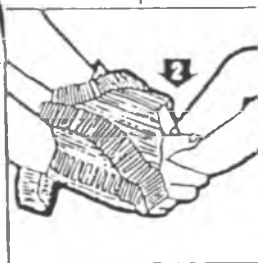
\* If the assistant is untrained, e.g. the mother, then weight should be taken by one person only, the trained measurer, who should also record the measurement on the questionnaire.



Illustration 3  
Child Weight



PUT HANDS THROUGH LEG HOLES



GRASP FEET





21. Which type of toothbrush does this child use to brush his / her teeth (please tick)

1. Chewing stick (mswaki) \_\_\_\_\_

2. Commercial (bought) \_\_\_\_\_

#### DIETARY PATTERNS

22. How long did you breastfeed this child  
(please indicate age in months)

\_\_\_\_\_

23. Did you feed this child on any of these types of milk  
( please tick below )

1. Nan \_\_\_\_\_

2. Lactogen \_\_\_\_\_

3. S - 26 \_\_\_\_\_

4. Cows milk \_\_\_\_\_

5. Other (which one) \_\_\_\_\_

6. None \_\_\_\_\_

24. At what age did you start feeding this child on the above  
types of milk ( Please indicate age in months )

\_\_\_\_\_

25. At what age did you stop giving this child the types of milk  
mentioned above (please indicate age in months)

\_\_\_\_\_

**BOTTLEFEEDING**

26. Did you feed this child using a bottle \_\_\_\_\_

1=yes

2=no

(If your answer to question number 26 is NO, please go to question number 30)

27. At what age did you start feeding this child on a bottle

( Please write how many months) \_\_\_\_\_

28. For how long did you feed this child on a bottle

( Please write in months) \_\_\_\_\_

29. For the fluids listed below, please indicate which ones you used to bottlefeed this child, and at what age you started feeding your child on them. (please indicate age in months)

FLUIDS	FED = YES NOT FED = NO	AGE IN MONTHS AT WHICH FED
Milk with sugar		
Milk without sugar		
Fruit juices (e.g. ribena, orange, banana, pawpaw, lucozade etc).		
Porridge with sugar		
Porridge without sugar		
Other (which ones)		

30. What foods/snacks do you usually pack for this child to carry to school

Foods / snacks	How many times in a week
1. _____	_____
2. _____	_____
3. _____	_____
4. _____	_____
5. _____	_____

31. What drinks do you pack for this child to carry to school

Drinks	How many times in a week
1. _____	_____
2. _____	_____
3. _____	_____
4. _____	_____
5. _____	_____

32. Which of the following snacks do you give to this child as a reward (please tick)

1. sweets \_\_\_\_\_
2. chocolate \_\_\_\_\_
3. biscuits \_\_\_\_\_
4. ice cream \_\_\_\_\_
5. kool \_\_\_\_\_
6. other (which ones) \_\_\_\_\_

33. Do you add sugar to these foods when you give them to this child (Please answer yes or no )

1. Breakfast cereals e.g. weetabix, golden morn etc \_\_\_\_\_

2. Beverages e.g. tea, coffee, milo \_\_\_\_\_

3. Porridge \_\_\_\_\_

4. Milk \_\_\_\_\_

34. Has this child ever sucked his/her finger \_\_\_\_\_

1=yes

2=no

35. If yes, for how long has this child sucked his/her finger

(Please write whether years or months )

\_\_\_\_\_

36. Has this child ever sucked a dummy (pacifier) \_\_\_\_\_

1=yes

2=no

37. If yes, for how long did this child suck the dummy

(Please write whether years or months)

\_\_\_\_\_





	FOOD	ONCE DAILY	TWICE DAILY	ONCE A WEEK	TWICE A WEEK	OCCASSI ONALLY	NEVE R
	Margarine						
	Butter						
	Sausage						
	Fruits						
	Vegetable s						
	chocolate						
	Cookies						
	Tea with sugar						
	Soda						
	Kool						
	Ice cream						
	Cakes						
	Sweets						
	Biscuits						

PLEASE SIGN THE FORM BELOW

I agree to have my child take part in this study.

\_\_\_\_\_ (sign here).



8. Which Of the following do you pay attention to when checking the hygiene status of the children in your school (please tick)

1. Body cleanliness \_\_\_\_\_

2. Clothes \_\_\_\_\_

3. Hair \_\_\_\_\_

4. Nails \_\_\_\_\_

5. Teeth \_\_\_\_\_

6. Other (Specify) \_\_\_\_\_

9. How can you rate the hygiene status of the children in your school (Please tick )

1. Satisfactory \_\_\_\_\_

2. Good \_\_\_\_\_

3. Fair \_\_\_\_\_

4. Poor \_\_\_\_\_

ANTHROPOMETRY AND DENTAL EXAMINATION

1. Date of interview \_\_\_\_\_

2. Anthropometry

	First	Second	Average
Weight (Kg)			
Height (Cm)			

Dental examination

3. Plaque present (on D/E)

(Buccal surface of upper and lingual surface of lower)

2=No soft deposits visible to the naked eye

1=Soft deposits visible to the naked eye

55	54	64	65
85	84	74	75

4. Number of teeth examined \_\_\_\_\_  
( only deciduous)

5. DMF

d=decayed m=missing f=filled

		55	54	53	52	51	61	62	63	64	65
		85	84	83	82	81	71	72	73	74	75

6. Number of teeth:

Decayed =

Missing =

Filled =

Total =

7. Anterior open bite present

1=yes

2=no

8. Posterior cross-bite present

1=yes

2=no

9. Crossbite

Unilateral:

Right \_\_\_\_\_

Left \_\_\_\_\_

Bilateral: \_\_\_\_\_

Unilateral edge to edge: Right \_\_\_\_\_

Left \_\_\_\_\_

Bilateral edge to edge: \_\_\_\_\_

10. Lateral shift of mandible present

1= Yes

2=No

11. Inter canine width

53 - 63 = mm

73 - 83 = mm

12. Infraocclusion

1= Yes

2=No

55	54	64	65
85	84	74	75



Total Number of teeth in infraocclusion =

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