DENTAL CARIES AND ITS RELATIONSHIP TO ORAL HEALTH KNOWLEDGE AND PRACTICE AMONG 12 YEAR OLD CHILDREN IN NAIROBI WEST DISTRICT, KENYA

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Dental caries and its relationship to oral health knowledge and practice among 12 year old children in Nairobi West District, Kenya

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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

This thesis is dedicated to my husband, Henry Nyaga and daughter Clarice who have greatly supported me throughout this whole process and have been a constant source of inspiration.

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

LIST OF ABBREVIATIONS

CDC	Centers for Disease Control and Prevention
CI	Confidence interval
DMFT	Decayed, missing and filled teeth
FELTP	Field epidemiology and laboratory training programme
JKUAT	Jomo Kenyatta University of Agriculture and Technology
KEMRI	Kenya Medical Research Institute
NCC	Nairobi City Council
OR	Odds Ratio
pH	Power of Hydrogen
USA	United States of America
W	West
WHO	World Health Organization

DEFINITION OF OPERATIONAL TERMS

Approximal surface	The two side where teeth come into contact with each other
Buccal surface	Surface adjacent to and facing the cheek
Cariogenic	Causing caries usually used to describe sugary foods
Dental fluorosis	Health condition caused by a child receiving too much fluoride during development of teeth
Enamel	The outer covering of a tooth
Flossing	The use of specially made thread (dental floss) to clean in between teeth
Occlusal Surface	Broad chewing surface found on posterior teeth
Palatal surface	Surface adjacent and facing the palate

ABSTRACT

Dental caries is a chronic infectious disease that causes demineralization of dental hard tissues. Dental caries was declared a pandemic by World Health Organization (WHO) in 2005 because of its high global prevalence and severe consequences. The prevalence of dental caries varies worldwide between 60% and 90%. In Kenya approximately 50% of children aged between 13-15 years have dental caries. The main objective of the study was to determine the association between dental caries and oral health knowledge and practice among children in Nairobi West and Mathira West Districts. A cross-sectional study was conducted among 639 children aged 12 years attending public primary schools in Nairobi West and Mathira West districts. A semi-structured questionnaire was used to determine the level of knowledge and practices employed. Oral screening was performed using WHO recommended methods. Dental caries was measured using the Decayed, Missing, Filled Teeth (DMFT) index. Nairobi West District had significantly higher caries prevalence of 37.5% than Mathira West District which had a prevalence of 24% ($p<0.05$). The mean DMFT in Nairobi West District was 0.76 ± 1.2 while in Mathira West District it was 0.36 ± 0.7. On multivariate analysis knowing that a toothbrush should be changed after three months (OR 3.2) and high consumption of soda (OR 3.0) were found to be significant risk factors for dental caries in Nairobi West District. In Mathira West District having a caregiver with no formal education (OR 4.3) was a significant risk factor for dental caries. The study shows the need for intensive oral health promotion in urban areas to reduce the higher prevalence of dental caries. The school

health policy should be used to promote oral health by provision of oral health instructions and educating on harmful dietary practices particularly soft drinks. Caregivers should be encouraged to take their children for regular dental check-ups.

CHAPTER ONE: INTRODUCTION

1.1 Background

Dental caries is a chronic infectious disease that causes demineralization of dental hard tissues. The interaction of four factors allows this to happen: a susceptible tooth surface, specific bacteria in dental plaque (e.g., *Streptococcus mutans* and *lactobacillus spp.*), time and a diet rich in fermentable carbohydrates, particularly sugars (Weir, 2002). The impact of dental caries includes oral pain which may affect speech, eating, sleeping, swallowing and breathing. The altered appearance it causes can lead to low self esteem and undermine social acceptance (Weir, 2002).

The burden of oral disease is carried mainly by medically compromised individuals, physically and mentally challenged people and HIV positive patients. The World Health Organization recognizes dental caries as a pandemic and reports that the prevalence of dental caries among school aged children as being 60% to 90% (Petersen *et al.*, 2005). In several industrialized countries the prevalence and severity of dental caries have declined substantially because of preventive oral care programmes and changes in living conditions and lifestyles (Petterson and Brathall, 1996). In developing countries especially sub-Saharan Africa the prevalence differs according to country, population group and social economic status (Fejerskov *et al.*, 1994; Cleaton-Jones and Fatti, 1999).

There is no oral national survey that has been carried out to determine the prevalence of dental caries in Kenya. A study done in 1992 found the prevalence of dental caries to be 40% to 50 % among children in Nairobi even though dental caries is a preventable disease

(Ng'ang'a and Valderhaugh, 1992). Preventive measures include good oral hygiene practices such as regular tooth brushing, restriction of sugary diet intake and oral hygiene education.

Basic oral health education is taught in Kenyan primary schools. However it is mentioned in the curriculum but not much emphasis is placed on it. Children are told to avoid sugary foods because they cause dental caries. They are also taught that they should brush their teeth three times a day. The two messages are important but do not cover the entire aspects of dental caries and its prevention. Another source of dental education is in dental clinics but access to these facilities is limited due to poverty. A visit to a public dental clinic will require one to purchase a card which some people find to be expensive. Government facilities are also understaffed and are unable to provide dental education to visiting clients as demonstrated by the dentists: population ratio of 1:60,000 (Kaimenyi, 2004).

1.2 Problem Statement

Children continue to suffer from the dental caries and its effects despite the fact that this is a preventable problem that has been inflicting our society for a long time. Childhood tooth decay is a rare example of a very common and consequential health problem that can be solved through public interventions without incurring much cost (Eldestein, 2006).

Dental caries needs to be addressed as soon as possible in children because this dental problem is carried on to the adult life where suffering continues or will start at this point (Eldestein, 2006). If left untreated caries could progress through the dentine to the pulp, which becomes inflamed. Within the rigid confines of the pulp chamber, this

inflammation process produces severe persistent pain. Necrosis of the pulp eventually occurs. Inflammation can spread around the tooth apex going on to the soft tissues eventually forming an abscess, granuloma, or cyst (Holt *et al.*, 2001). It could in addition lead to systemic infection (Weir, 2002).

1.3 Justification of the study

Though the prevalence of dental caries among children is generally high 50% (Ng'ang'a and Valderhaugh, 1992), there is limited data about the dental caries status among specific communities, including schools, and the status of oral health knowledge and practice among children. Children aged 12 years were used in this study because it is an index age recommended by WHO (WHO, 1987). This age is comparable with earlier Kenyan studies and with studies conducted internationally. It is also the age at which most permanent teeth have erupted.

1.4 Research Questions

- Do children aged 12 years old in Nairobi West and Mathira West districts who are knowledgeable about oral health have less dental caries?
- Do children aged 12 years old in Nairobi West and Mathira West districts who have good oral health practices have less dental caries?

1.5 Null Hypothesis

There is no association between dental caries and oral health knowledge and practice among children in both Nairobi West and Mathira West Districts, Kenya.

1.6 Objectives

1.6.1 General Objective

To determine the dental caries status and oral health knowledge and practice among 12 year old children in Nairobi West and Mathira West Districts, Kenya.

1.6.2 Specific Objectives

The specific objectives were to determine:

1. The dental caries status of 12 year old children in Nairobi West and Mathira West districts, Kenya.
2. The level knowledge and practices on oral health among 12 year old children in Nairobi West and Mathira West districts, Kenya.
3. The factors associated with dental caries in Nairobi West and Mathira West districts, Kenya.

1.7 Limitations

The study uses school going children who are twelve years old thereby leaving out children who are not attending school. The children in this study are therefore not representative of the general population. Children aged twelve can also not be used to generalize the finding to all children. However, due to the social and economic situation of the country, general population studies are almost impossible to conduct.

This study is collecting data at one point for a disease that has a long term pathogenic history therefore it is difficult to adequately discern the process. A longitudinal study is more appropriate but due to time constraints a cross-sectional design was used. In addition, other studies have done a cross-sectional study hence comparison is possible.

The use of a questionnaire may have led to potential information bias like over-reporting in favor of socially accepted behavior such as tooth brushing while under-reporting could be the case for less accepted behavior such as consumption cariogenic food. Despite this limitation, self reporting has been used as an approximation for various behavior patterns in other studies.

Samples of water that were collected for fluoride analysis were only collected once in each site and the also quantity collected varied. Fluoride content in water usually varies according to the climatic conditions therefore it would have been necessary to collect the water samples at various time intervals. However the results obtained can be used as a guide to estimate the fluoride content at the various sites.

CHAPTER TWO: LITERATURE REVIEW

2.1 Etiology of dental caries

Dental caries etiology is multi-factorial and the main causative agents include diet, plaque, tooth surface and time (Holt *et al.*, 2001). Plaque is a biofilm entity formed by sequential colonization of microorganisms such as *streptococcus mutans* and other bacteria on the tooth surface. It continually forms in between and on the surface of the teeth. It can develop on teeth above the gum line, below the gum line on the roots of teeth and along the gum line. After eating a meal or snack, the bacteria in plaque release acids that attack the enamel surfaces of teeth, especially above and below the gum line and in between the teeth. Repeated acid attacks increasingly erode the enamel, eventually causing tooth decay (DiMatt, 2009**).**

Susceptible tooth surfaces are areas in the teeth that tend to be plaque retentive and have little fluoride contact. Studies have shown that the susceptible tooth surfaces include; Occlusal surfaces, buccal pits and approximal surfaces of molars, occlusal surfaces of 1st premolar and palatal surfaces of upper lateral incisors (Batchelor and Sheiham, 2004).

Diet exerts its effects locally by provision of a substrate which is readily fermented thus providing an acidic pH. The acid attacks the tooth enamel and gradually dissolves it (demineralization). Repeated acid attacks which do not give teeth the time to recover increase risk of caries, therefore small amounts of sugar and other fermentable carbohydrates eaten frequently during the day will increase caries risk more than large amounts eaten infrequently. Sticky foods stay in the mouth much longer, and increase the

potential for decay. Calcium-rich foods like cheese, eaten immediately after sugar, can help protect against demineralization (Burt *et al.,* 1988)

Adequate time is necessary to allow the fermentable carbohydrates to be metabolized by the oral bacteria to produce acid (Holt *et al.,* 2001). The longer the tooth is in contact with the fermentable carbohydrates the higher the chances are of the tooth getting decayed.

Saliva production and composition also plays a role in caries formation (Featherstone *et al.*, 2003). Saliva is the primary resource of calcium, phosphate and fluoride, the materials used to re-mineralise the enamel. Saliva also acts quickly to clear away food debris from the mouth and to buffer the organic acids that are produced by the bacteria. Saliva is therefore a very vital and complex material in the prevention of dental caries. Thus, salivary dysfunction can lead to rapid deterioration of dental enamel. Salivary dysfunction can occur whenever certain medications are taken or medical treatments such as radiotherapy are undergone.

2.2 Prevalence and Incidence of dental caries

WHO reports that prevalence of dental caries in school age children globally to be 60-90% (Petersen *et al.*, 2005) with the DMFT index among 12 year olds being 2.5 (Petersen, 2003). It further reports that developed countries have lower rates than developing countries and the difference is attributed to availability of simple sugars in diet, to fluoride, and to dental treatment. There has been increased consumption of sugary foods in developing countries as increased industrialization takes place leading to higher dental caries prevalence. The developed countries that have fluoride level below the optimum

recommended levels have implemented water fluoridation projects and this has helped to reduce the prevalence of dental caries (Petersen *et al.*, 2005).

In Europe variations in prevalence levels of dental caries do exist with countries such as Spain recording a prevalence of 61% and mean DMFT 1.52 (Smyth *et al*., 2007) while in Italy prevalence was 45% and mean DMFT was 1.44 (Ferro *et al.,* 2007). In Asia a study done on Saudi Arabia found the prevalence of dental caries among 12 year olds to be 68.9% (Amin and Al-Abad, 2008) while in Thailand the prevalence was 70% with a DMFT of 2.4 (Petersen *et al*., 2001).

In Africa the situation shows significant regional variations. In South Africa the prevalence of dental caries among 12 year olds is 22% with a DMFT of 0.7 (Addo-Yobo *et al.,* 1991). In Zimbabwe a study done in 1985 revealed that 27.6% of 12 year old children in urban and 20.9% of children in the rural area had dental caries (Chironga and Manji, 1989). In Uganda the results of a baseline survey showed that 40% of school going children had caries with a mean DMFT of 0.7 (Wandera and Twa-Twa, 2003). In Dar- es- salaam, Tanzania 42% of 12 year old children had dental caries with a DMF of 0.7 (Mwakatobe and Mumghamba, 2007).

In Kenya a study done by Frencken *et al* revealed that the mean DMFT of 12 year old children in Nairobi to be 0.51 (Frencken *et al.*, 1986). This falls within the WHO target of mean DMFT of less than two for developing countries (WHO, 1987). Among nursery school children the prevalence is even higher at 63.5% (Ngatia *et al*., 2001). Among children aged 13 to 15 the prevalence is 50% with a mean DMFT of 1.8 (Ng'ang'a and

Valderhaug, 1992). This implies an increase in dental caries experience from the study in 1987 by Frencken *et al.*

2.3 Risk factors for dental caries

An unhygienic status of oral cavity is a predisposing factor to dental caries. An unhygienic mouth harbors plaque which is one of the etiological factors for dental caries (Khamadeeva *et al.*, 2008).

Nocturnal eating of sweat foods has been associated with increased caries incidence. This is due to the fact that overnight there is less salivary stimulation due to reduced activity in the mouth. As a result of less saliva production the pH of the mouth cannot be buffered to less acidic one hence caries process is activated (Zhang *et al.,* 2007).

An important predictor of dental caries is the educational level of the parents. Children with parents that have a low level of education tend to have more caries than those with higher education. This is because the more educated parents are aware of the various forms of dental caries prevention (Zhang *et al.,* 2007).

Another caries risk factor is low social economic status. Children from low social economic status tend to have limited access to tooth cleaning agents such as toothpaste and toothbrushes. In addition such children also have limited access to oral health care givers where oral health instructions can be given and also where early carious lesions can be detected (Tinanoff, 1995). It has also been suggested that mothers in deprived areas are more likely to give their children sweets after nursery school, to use sweets as comforters, spend more money on sweets and allow continued sweet consumption during the day (Kiwanuka *et al.,* 2004**).**

Medicinal syrups have long been hypothesized to be a source of hidden fermentable sugars such as glucose, and therefore, have the potential to independently increase the risk of having caries if taken for long periods and/or frequently (Kiwanuka et *al.,* 2004). Antibiotic syrups particularly independently increased the risk that a child would have a number of carious lesions, especially if taken frequently ((McMahon *et al.,* 1993)

A study done among preschool children in the USA found one of the predictors for dental caries to be familial caries pattern. It was likely that children who had caries also had siblings or parents who had dental caries. Dental caries has a hereditary aspect though its mechanism is not well understood (Tinanoff, 1995).

2.4 Knowledge on oral health

The prevalence of dental caries can be markedly reduced if children are informed about its causes and methods of prevention**.** Studies have revealed that children with inadequate oral health knowledge are twice as likely to have caries as children with adequate knowledge (Oliveira *et al.,* 2000). In China nearly half (47.2%) of 12 year olds interviewed had never received any oral health care instruction (Zhu *et al.,* 2003).

More than half of the children interviewed in study conducted in Tanzania knew that dental caries can be caused by frequent consumption of sugary substances (Msolla and Carneiro, 2009). The same study revealed that 64% of children knew that proper tooth brushing can prevent dental caries. A Study done among adults in North Eastern province in Kenya reveal that there is a low level of oral health awareness as 43% of study participants did not know any cause of dental disease (Kassim *et al.,* 2006).

In Myanmar (formerly Burma) there was found to be difference between level of knowledge pertaining to oral health between children residing in rural areas and those in urban areas. Children in the rural areas had a higher DMFT than those in urban areas. There were statistically significant correlations between the correct/incorrect responses to knowledge and attitude questionnaires on oral health and the mean number of DMFT (Ogawa *et al.*, 2003). However a study done by Kaimenyi *et al.* (1993) in Kenyan children aged 9 to 15 found that there were no consistent differences in oral hygiene habits and dental health awareness between peri-urban and urban children.

2.5 Dietary habits and dental caries

Dietary habits are key factors that determine the occurrence of dental caries. Sugary foods are a favorite commodity among children and they are the main causative agents for dental caries. People are aware about the foods that have obvious sugar such as sweets and cakes but are unaware about foods with hidden sugar such as soft drinks. In Thailand, children who reported having soft drinks and tea with sugar were 24% and 26% respectively (Petersen *et al.*, 2001).

Consumption of sugary foods in between meals is considered a risk factor for dental caries (Burt *et al.*, 1988). There is less risk of dental caries when sugary foods are consumed together with the main meal due to increased salivary activity that helps to neutralize the acidic effect and wash away the food.

Proper dietary habits should be commenced early enough during infant feeding and weaning. The use of sweetened milk formula is a risk factor for the development of dental

caries. Furthermore when a child is left to sleep with a feeding bottle he will be more susceptible to dental caries (Robke, 2008).

Dietary practices in children are influenced by the caregivers because they are the ones who purchase and prepare the foods. Factors that influence what food the caregivers provide include level of education and social economic status. Evidence suggests that caregivers of 0–23-month-old infants from low social economic status add sugar to complementary foods and drinks more frequently than oils and milk (McMahon *et al.*, 1993)

Parents/guardians are known to give sugary snacks to their children as a form of reward or for comfort. A study done in Kenya by Ngatia *et al*. (2001) revealed that mothers of children aged between 3-5 years reported that they gave their children biscuits, sweets and chocolates as a form of reward. This has led to an increase in the amount of sugar that is taken by the children

In the recent past it has been documented that carbonated soft drinks are a major risk for caries development in children (Sohn *et al.,* 2006, Cook *et al.,* 2008). Studies done in the past tended to concentrate on cariogenic foods hence undermining the role of sugared beverages. Of particular concern are soft drinks which are popular among children.

Eating of sweet food just before sleeping has been associated with increased caries prevalence (Zhang *et al*., 2007). This is because of reduced salivary production that occurs at night hence the buffering effect saliva is not present.

2.6 Dental visits and dental caries

Lack of awareness, cost implications and fear of the dentist are some of the factors that contribute to poor dental visit habits (Bajomo *et al.,* 2004). In Ukraine 90% of the children had visited a dentist within the past one year despite the fact that each school has a dentist who provides routine oral health care to all enrolled children. However the study revealed that children only sought dental services when they were in pain (Spivak *et al.,* 2004).

Elsewhere in Africa dental visit behavior of the schoolchildren in both public and private schools was found to be poor. Studies conducted in Lagos, Nigeria found 86% of the children had never visited a dentist (Adekoya-Sofowora *et al.,* 2006) while in Tanzania 76% of the children had never visited a dentist (Mwakatobe, and Mumghamba, 2007). In contrast a higher number of children visit dentists in developing countries. For example 71% of 12 year olds in Poland had made dental visits (Wierzbicka *et al.,* 2002). Dentists are considered key agents in provision of oral education and preventive services that improve oral status.

2.7 Tooth brushing habits and dental caries

Although children are taught the importance of tooth brushing, they also need to be taught the importance of frequency and the proper methods of brushing their teeth (Umesi-Koleoso and Ayanbadejo, 2007). Children were found to be inadequate when their tooth brushing techniques were examined. A survey done among 12 year old Children in Sudan revealed that 64% brushed their teeth once, 25% brushed twice and 5% brushed more than twice per day. Three percent reported to have used dental floss (Nurelhuda *et al.,* 2009).

A study done in Burkina Faso revealed that only 9% of the 12 year old reported the use of fluoridated tooth paste (Varenne *et al.*, 2004). Fluoridated toothpastes are advocated because of their preventive properties.

An alternative to these two is use of the chewing stick '*mswaki'* which has been shown to be as effective (Ndungu *et al.*, 1990; Van Palenstein Helderman *et al.*, 1992). However, children from poor families do not use chewing sticks because they are unaware of its effectiveness. In Kenya, 21.1% of peri-urban children and 2% of the urban children use chewing sticks to brush their teeth (Kaimenyi *et al.*, 1993).

2.8 Prevention of dental caries

2.8.1 Primary Prevention of dental caries

Primary prevention is done before the disease process has started. Primary prevention protects individuals against disease, often by placing barriers between the etiological agent and the host. There are various ways of primary prevention of dental caries. These include health education which involves offering detailed explanation on the causes of dental caries and methods of prevention to communities and individuals. This helps reduce the prevalence of dental caries. A systematic review has demonstrated that dental health education carried out by a professional at the chair side is more often effective than other types of oral health promotion interventions (Evans and Dennison, 2009). Other methods however are also effective especially in resource poor settings. Results of a two year study done in China indicate that oral health education offered in schools had some positive effect in improving the oral hygiene of children (Peng *et al.*, 2004)

Another method is maintenance of good oral hygiene. The removal of plaque by adequate oral hygiene practices such as appropriate tooth brushing and flossing helps prevent dental caries. It is recommended that one should brush their teeth at least twice a day with a toothpaste containing fluoride (Holt *et al.*, 2001).

Dietary control is a method of primary prevention achieved by restriction of sugary foods and drinks. Sucrose and refined carbohydrates are the main causes of caries and so should be avoided (*Holt et al.*, 2001). Non sugary substitutes such as xylitol (Twetman, 2009) can be used instead and these reduce the incidence of dental caries. Fibrous foods have been shown to stimulate salivary flow which in turn prevents tooth decay in addition food containing calcium aid in re-mineralization of teeth (Burt *et al.*, 1988)

A fourth method of primary prevention is the use of fluorides. This can be done in two ways. The first method is topical application via use of fluoridated toothpastes and professional application. Children who brush their teeth at least once a day with toothpaste that contains fluoride have less tooth decay (Marinho *et al.*, 2003). Secondly, via systemic ingestion of fluoride tablets or fluoridated water in areas with low fluoride concentration (Evans and Dennison, 2009).

2.8.2 Secondary prevention of dental caries

Secondary prevention targets patients early in the disease process to arrest or reverse the process and to improve the prognosis. This includes early detection of caries by assessing risks for every individual at regular intervals. The following factors should be considered when assessing caries risk: clinical evidence of previous disease, dietary habits, especially

frequency of sugary food and drink consumption, social history, especially socio-economic status, use of fluoride, plaque control, saliva and medical history (Evans and Dennison, 2009).

For carious lesions that are only confined to the enamel, preventive measures rather than operative care is recommended. This includes topical fluoride varnish, twice daily, use of a toothpaste containing at least 1000 ppm fluoride, flossing and dietary advice (Evans and Dennison, 2009**).**

Another method is the use of fissure sealants applied in pits and fissures that are likely to become carious. A fissure sealant is a plastic coating placed on pits and fissures of teeth. Fissure sealants can also be used to restore small to moderate sized cavities (Ahovuo-Saloranta *et al.*, 2008).

2.8.3 Tertiary prevention of dental caries

The aim of tertiary prevention is to reduce complications that may arise because of dental caries such as pain. The aim is to limit disability and complications of treatment (Whitaker, 2006**).** This involves rehabilitation of carious teeth by permanent fillings, root canal treatment, crowns, extractions and provision of dentures.

Fillings are used to fill holes (cavities) that have formed, usually as a result of decay or tooth wear. There are many types of filling, each suitable for different cavities. Amalgam fillings are made of a combination of metals including silver, tin, copper and mercury. Amalgam is extremely durable and able to withstand the grinding and chewing of molars

over long periods of time. Tooth-coloured fillings match the colour of teeth, making them a natural-looking alternative to amalgam fillings. They are often used in teeth are anteriory placed. They are less durable than amalgam. Root canal treatment involves the removal of blood vessels and nerves that are present at the center of the tooth. A material is then placed inside the canal to replace the blood vessels and nerves and afterward the tooth is either filled using amalgam or tooth-coloured filling. If a tooth has been weakened by a lot of decay or a large filling, a crown (or cap) can fitted to strengthen it and improve its appearance. Crowns are shaped like natural teeth and fit over the prepared tooth (Kidd *et al.*, 1996)

For the teeth that are extensively damaged due to dental caries, extraction is done since the tooth cannot withstand any filling material. The extracted tooth/teeth can then be replaced using partial or complete dentures to prevent loss of function (Sailer and Pajarola, 1999**).**

CHAPTER THREE: MATERIALS AND METHODS

3.1Study design

This was a cross-sectional study. The study described the current dental caries situation of children in Nairobi West and Mathira West districts and related it to the oral health knowledge and practices employed. The statistical design used in this study includes measures of association and measures of statistical significance.

3.2 Study Site

The study was conducted in two districts. Nairobi West District is predominantly an urban area while Mathira West District is predominantly a rural area.

These two areas are different socio-demographically. Nairobi West District is one of the three districts in Nairobi province. Nairobi West District is located between Latitude 01^0 17' South and 36^0 50' East and rises 1795 m above sea level. It has three administrative divisions. It is a cosmopolitan district with economic activities ranging from casual labourers, business people and those that are permanently employed. Drinking water in Nairobi is supplied by pipes to homes by the Nairobi Water Company.

Mathira West District is in Central Province and is located between Latitudes $1^0$00 South and Longitudes 36^0 46' East. It is located approximately 2000 m above sea level. The main economic activity is farming, particularly coffee. In Mathira West District the main source of drinking water are boreholes, rivers and streams. The climate is tropical while the pattern of rainfall is equatorial. It is comprised of three locations; though administrative divisions have not been created yet.

3.3 Study Population

The study population consisted of 12 year old children attending public primary schools. Children aged 12 years were used as the study population as this is an index age recommended by WHO (WHO, 1987). WHO recommends this age because it is the age at which children leave primary school, and thus is the last age at which a reliable sample may be obtained through the school system. This age is comparable with earlier Kenyan studies and with studies conducted internationally. It is also the age at which most permanent teeth have erupted.

3.3.1 Inclusion Criteria

- Children who assented to the study
- Children whose parents/guardians gave consent
- Children who were 12 years old as indicated by the class register

3.3.2 Exclusion Criteria

- Children who did not assent to the study
- Children whose parents/guardians did not give consent
- Children who were not 12 years old as determined by the class register.

3.4 Sampling

A two stage sampling technique was used in the study. Stratified sampling system was used to sample the primary schools. Nairobi West District was stratified into the three administrative divisions and two schools two randomly selected from each of the three divisions. Mathira West District was stratified into the three administrative locations and

then two schools were randomly selected from each of the three locations. Administrative divisions have not yet been created in Mathira West District.

A list of all the schools in the district was obtained from the Nairobi City Council and the District Education Office in Mathira West District. Information about the approximate number of 12 year old was also obtained. The school with the least number of pupils was used to determine the sampling scheme. The number of pupils in that school was used as the sampling scheme (K). The number of schools to be sampled was determined by dividing the sample size for each district by (K). Six schools from each of the two districts were identified.

Once in the schools a register was obtained containing all the 12 year old then random sampling was used to select the 12 year old children in each district. A unique number was assigned to each child and then a list of random numbers was generated using the computer via Microsoft Excel software.

3.5 Sample Size

The Cochran's formula (Cochran, 1963) was used to calculate the sample size.

$n = (z^2pq)/d^2$

n= Sample size

z = (1-α)/2 percentage of standard normal distribution

d=Absolute precision (5%)

p = Expected proportion

q = 1-p

Two sample sizes were computed for Nairobi West and Mathira West districts using an expected proportion of 33.8% and 21.2% respectively (Varenne *et al.*, 2004)

Nairobi West District	Mathira West District
$n=1.96^2*0.338*0.662/0.05^2$	$n=1.96^2*0.212*0.788/0.05^2$
n=343	n=256

3.6 Data collection

3.6.1 Questionnaire

An interviewer administered pre-tested semi-structured questionnaire (Appendix 1) was used to collect data from the children.

Pre-testing of questionnaire was done two schools, one in Nairobi East District and one in Muranga North District. Question four was added to the questionnaire as a follow-up to question three. One question was deleted from the questionnaire because they children did not seem to understand it and seem to interpret it in various ways. They way in which question ten and eleven was asked was harmonized as the different interviewers were interpreting it differently.

3.6.2 Variables

Dependent variables

The data collected included:

Demographic variables such as sex, location, presence of dental fluorosis

Proximal factors: direct lifestyle factors e.g. tooth brushing, drinking water dental visits and consumption of cariogenic foods (frequency and type). Consumption of cariogenic food was classified as high (consumes at least three times a week), low (consumes twice times per week or less) and never consumes.

Distal factors: indirect lifestyle factors e.g. Mothers education, level of knowledge

Independent variable

Dental caries

3.6.3 Clinical examination

Two trained examiners were used to conduct oral screening of the selected pupils. Dental caries status was determined by oral screening using the WHO caries diagnostic criteria; DMFT (WHO, 1987). The children were examined while seated in a straight chair using natural day light. All examinations were done in the classrooms. A calibration exercise was conducted to assess the consistency of the two examiners and the variations between the two. Differences between the two examiners were discussed and a consensus reached upon.

Dean's index was used to record the prevalence of dental fluorosis (Rozier, 1994). Results were reported as either sound (score 0) or fluorosed (score 1-4) very mild to severe.

3.6.4 Fluoride content in water

Six water samples from the piped taps inside the six schools in Nairobi West District were collected for analysis of fluoride content. In Mathira West District six water samples were collected from three rivers, one water tank, one boreholes and one piped tap. Water was

collected in clean 500 ml plastic bottles.The fluoride analysis was done at Kenya Water Institute Laboratory. Fluoride concentration was determined using photometric analysis (Nollet, 2007).

3.7 Study Duration

The study was conducted between August 2009 and February 2010.

3.8 Data Management and analysis

Data was entered, cleaned and stored using *Epi info* version 3.3.2. Data protection was done by using a password protected computer to limit unauthorized access to data. Protection from loss was achieved by backing up the data both in the internet and in two flash disks.

Descriptive analysis was done for basic variables that describe the children to show the total number of responses and frequency of distributions.

Bivariate analysis was done to compare two variables to each other in contingency tables to show Odds Ratio as a measure of association and confidence intervals. Multivariate analysis was done using logistic regression.

Measures of statistical significance were done using T-test for continuous variables and Chi-square for categorical variables to determine significant differences and the corresponding P- values. P- Value of less than 0.05 was considered significant.

3.9 Ethical considerations

- Approval was sought from JKUAT, NCC and National Council of Science and Technology.
- Approval was also sought from the Ministry of Public Health and Sanitation.
- Written informed consent was obtained from the children's guardian/parents.
- Assent was sought from the Children.
- All children examined were given oral health education, advice and referral instructions if necessary.
- The information obtained was treated confidentially.

CHAPTER FOUR: RESULTS

4.1 Social demographic characteristics

A total of 639 children participated in the study. Of these, 347 (54%) were from Nairobi West District while 292 (46%) were from Mathira West District.

More females (55%) than males participated in the study as shown in Table 1. In Nairobi West District females were 199 (57%) while in Mathira West District the females were 152 (52%).

Table 1: Distribution of children by sex

	Nairobi West n= 347	Mathira West n=292	Total n=639
Female	199 (57%)	152 (52%)	351 (55%)
Male	148 (43%)	140 (48%)	288 (45%)

Results showed in Figure 1 indicate that only 2% and 3% of the children's caregivers had no formal education in Nairobi West and Mathira West districts respectively as reported by the children. Secondary level and above constituted the majority in the two districts.

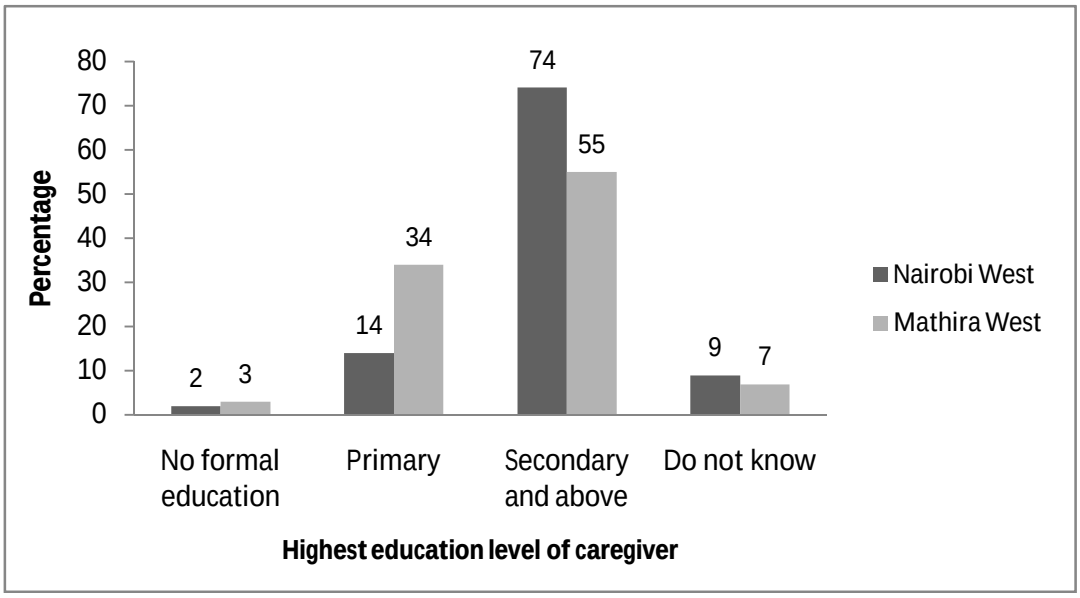

Figure 1: Highest education level of caregiver as reported by the children

4.2 Dental caries status

In Nairobi West District the prevalence of dental caries was 37.5%, DMFT was 0.76 while in Mathira West District the prevalence was 24% and DMFT was 0.36 as shown in Table 2. Overall, 31.5% of the children had dental caries.

Table 2: Dental caries status

	Prevalence of dental caries	DMFT	Standard Deviation
Nairobi West n=347	37.5%	0.76	±1.2
Mathira West n=292	24.0%	0.36	±0.7
Total n=639	31.5%	0.58	±1.1

The decayed component (D) of the DMFT accounted for 87% and 97% in Nairobi West District and Mathira West Districts respectively (Figure 2). None of the children in Mathira West had their teeth filled.

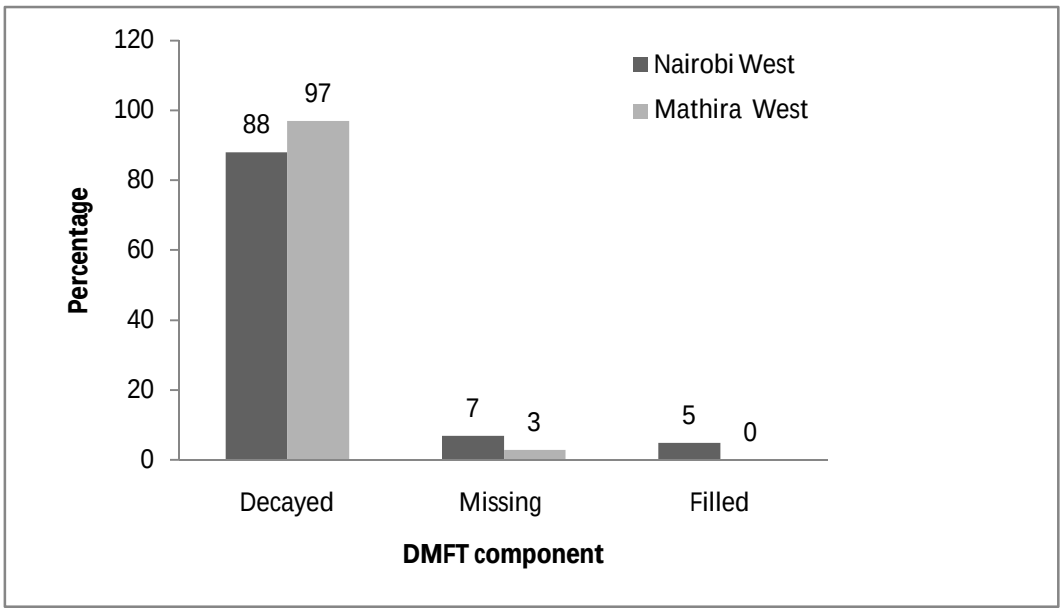

Figure 2: Distribution of decayed, missing and filled teeth

4.3 Oral health knowledge

Table 3 highlights the oral health knowledge of the children. Ninety one percent and 86% of children in Nairobi West and Mathira West districts knew the correct causes of dental caries respectively. Sixty nine percent of children in both districts responded correctly when asked about the frequency of changing toothbrush.

Table 3: Percentage distribution of correct responses on oral health knowledge

Knowledge items	Correct Responses Nairobi W n=347	Mathira W n=292	Total n=649
What causes tooth decay	315 (91%)	251 (86%)	566 (89%)
A person can prevent tooth decay by brushing their teeth daily	310 (89%)	237 (81%)	547 (86%)
A toothbrush should be changed regularly	255 (74%)	211 (72%)	466 (73%)
Frequency of changing toothbrush	179 (69%)	111 (69%)	290 (61%)
Visiting a dentist after 6 months is important	326 (94%)	206 (71%)	532 (83%)
Rinsing of mouth after meals helps in preventing tooth decay	208 (71%)	234 (67%)	442 (69%)
Do you know what dental floss is	21 (4%)	1 (0.3%)	22 (4%)

4.4 Dental hygiene practices

Sixty one percent and 54% of the children in Nairobi West and Mathira West districts brush their teeth twice or more times per day as indicated in Table 4. Chewing sticks were reported to have been used by 14% and out of these 1.2% and 30% were from Nairobi West and Mathira West districts respectively. In all, 77% of the children admitted to brushing each of their teeth carefully. Twenty nine percent of children in Nairobi West District had received instructions on tooth brushing while in Mathira West District 40% had received instructions.

Table 4: Oral hygiene practices

	Nairobi West n=347	Mathira West n=292	Total n=649
Frequency of tooth brushing			
Less often than daily	12 (4.0%)	10 (3.0%)	22 (3.0%)
Once /day	122 (35.0%)	152 (52.0%)	274 (43.0%)
Twice or more/day	213 (61.0%)	130 (45.0%)	343 (54.0%)
Tooth cleaning aids			
Toothbrush and toothpaste	322 (96.0%)	192 (66.0%)	514 (80.0%)
Chewing stick	4 (1.2%)	88 (30.0%)	92 (14.0%)
Others	21 (2.8%)	12 (4.0%)	33 (6.0%)
Brush every tooth very carefully	320 (93.0%)	168 (58.0%)	488 (77.0%)
Has received instructions on tooth brushing	100 (29.0%)	116 (40.0%)	216 (34.0%)

Table 5 demonstrates that the proportion of those who had ever visited the dentist was more than twice for Nairobi West District children in comparison to Mathira West District.

Table 5: Dental visits

	Nairobi West n=347	Mathira West n=292	Total n=639
Has ever visited a dentist	132 (38%)	51 (18%)	183 (29%)
Visited dentist within the past 12 months	70 (20%)	34 (12%)	104 (16%)

Results shown in Figure 3 demonstrate various reasons for visiting the dentist. Only 17% and 12% of the children in Nairobi West and Mathira West districts respectively had visited the dentist because they wanted a checkup.

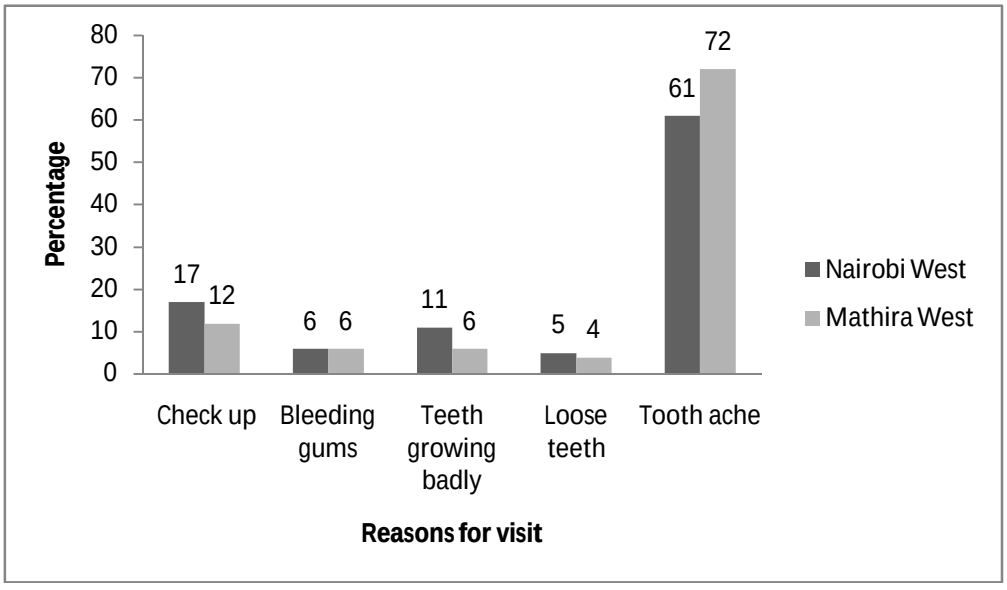

Figure 3: Reasons for visiting the dentist

4.5 Consumption of cariogenic foods

More than half of the children in Nairobi West District reported that they consume sweets at a high frequency as compared to 37% in Mathira West District as shown in Table 6. Cakes/biscuits were consumed at a high frequency by 43% and 32% of the children in Nairobi West and Mathira West districts respectively. The number of children eating chocolates at a high frequency was low in both districts; 18% in Nairobi West and 6% in Mathira West. High consumption of soda was more than eight times as high among the Nairobi west children in comparison to the Mathira West children.

Table 6: Distribution of cariogenic food consumption

	Frequency of consumption		
	High	Low	Never
Sweets			
Nairobi W.	200 (55%)	114 (33%)	43 (12%)
Mathira W.	108 (37%)	175 (60%)	9 (3%)
Total	298 (47%)	289 (45%)	52 (8%)
Cakes/biscuits			
Nairobi W.	148 (43%)	136 (39%)	63 (18%)
Mathira W.	92 (32%)	161 (55%)	39 (13%)
Total.	240 (38%)	297 (46%)	102 (16%)
Chewing gum			
Nairobi W.	207 (60%)	87 (25%)	53 (15%)
Mathira W.	76 (26%)	153 (52%)	63 (22%)
Total.	283 (44%)	240 (38%)	116 (18%)
Chocolate			
Nairobi W.	61 (18%)	114 (33%)	172 (49%)
Mathira W.	16 (6%)	69 (23%)	207 (71%)
Total.	77 (12%)	183 (29%)	379 (59%)
Sodas			
Nairobi W.	117 (34%)	177 (51%)	53 (15%)
Mathira W.	13 (4%)	203 (70%)	76 (26%)
Total.	130 (20%)	380 (60%)	129 (20%)
Tea/cocoa with sugar			
Nairobi W.	331 (95%)	9 (3%)	7 (2%)
Mathira W	228 (78%)	44 (15%)	20 (7%)
Total.	559 (87%)	53 (9%)	27 (4%)

4.6 Fluorosis and fluoride levels in water

The prevalence of dental fluorosis was 8% in Nairobi West District and 1% in Mathira West District.

Table 7 illustrates that the mean Fluoride water content for the selected water sources in Nairobi West District was 0.59mg/L while for Mathira West District was 0.77mg/L.

Table 7: Fluoride content in water sample collected

	Nairobi West (mg/L)	Mathira West (mg/L)
Mean	0.59±0.17	0.77±0.27
Minimum	0.35	0.4
Maximum	0.85	1.05

Table 8 indicates that two of the rivers sampled had fluoride levels of above 1mg/L. Water sample collected from the tap had the lowest fluoride concentration.

Table 8: Distribution of Fluoride according to Source in Mathira West District

Source	Fluoride Level mg/L
River Rui Riuru	1.0
River Sagana	1.05
River Hombe	1.05
Borehole (Kahiraini Primary School)	0.6
Water tank (Gatondo primary school)	0.5
Tap (Kabiruini center)	0.4

4.7 Bivariate analysis

4.7.1 Social demographic variables

Table 9 shows that Nairobi West District had a significantly higher dental caries prevalence than Mathira West District (OR= 1.9 p=0.0003).

Table 9: Dental caries distribution according to location of children

	% Dental caries present	OR (95%CI)	p-value
Location			
Nairobi West	37.5%	1.9 (1.3-2.7)	0.0003
Mathira West	24%	ref	

ref = reference group

There was no significant difference in the distribution of dental caries by sex in both districts as illustrated by Table 10. In Nairobi West District having a caregiver who had no formal education (OR=0.9) or primary education (OR=0.7) compared to those who had secondary education and above was protective of dental caries. This association was however not significant. In Mathira West District having a caregiver who had no formal education was a significant risk factor for dental caries (OR=4.3). In the same district having a caregiver with primary education reduced the risk though it was not significant. Children who had dental fluorosis were 1.1 times more likely to have dental caries than those who did not have in Nairobi West District.

Table 10: Dental caries distribution according to social-demographic variable

Socio-demographics	Nairobi West % Dental caries present	OR (95%CI)	Mathira West % Dental caries present	OR (95%CI)
Sex				
Female	39	1.2 (0.8-1.9)	25	1.1 (0.6-1.9)
Male	35	ref	23	ref
Caregivers education				
No formal education	38	0.9 (0.2-3.9)	56	4.3 (1.1-16.7)*
Primary	33	0.7 (0.4-1.4)	21	0.9 (0.5-1.7)
Secondary and above	40	ref	23	ref
Dental fluorosis				
Yes	40	1.1 (0.5-2.4)	0	0
No	38	ref	24	ref

*p<0.05

ref = reference group

4.7.2 Knowledge about dental caries

Table 11 illustrates that in Nairobi West District, children who knew the causes of dental caries (OR= 1.4) and that a toothbrush had to be changed regularly (OR=1.2) had a higher caries prevalence than those who did not know. In Mathira West District, children who knew the causes of dental caries (OR= 0.6) and that a toothbrush had to be changed regularly (OR=0.8) had a lower caries prevalence than those who did not know. In Nairobi West District those who knew the correct frequency of changing toothbrush had significantly higher caries prevalence than those who did not know (OR 2.3).

Table 11: Knowledge distribution in relation to dental caries

	Nairobi West		Mathira West	
	% Dental caries present	OR (95%CI)	% Dental caries present	OR (95%CI)
Causes of dental caries				
correct	38	1.4 (0.6-3.00)	22	0.6 (0.3-1.1)
incorrect	31	ref	34	ref
Tooth brushing prevents caries				
correct	37	0.7 (0.3-1.3)	24	0.9 (0.5-1.7)
incorrect	36	ref	26	ref
Toothbrush should be changed regularly				
correct	38	1.2 (0.7-1.9)	26	0.8 (0.8-2.9)
incorrect	35	ref	19	ref
Frequency of changing toothbrush				
correct	45	2.3 (1.3-4.1)*	26	1.0 (0.6-2.0)
incorrect	26	ref	23	ref
Visiting dentist after 6 months is important				
correct	37	0.8 (0.3-2.0)	24	1.0 (0.6-1.9)
incorrect	43	ref	24	ref
Rinsing of mouth after meals prevents tooth decay				
correct	39	1.2 (0.8-1.9)	24	1.1 (0.6-1.8)
incorrect	35	ref	24	ref

4.7.5Dental hygiene practices

The risk of having dental caries among those who brushed their teeth less than twice a day was more than those who brushed at least twice or more per day in both districts as shown in Table 12. Children who brushed each of their teeth carefully had higher caries

prevalence than those who did not brush carefully. Receiving instructions on how to brush was preventive of dental caries in the two districts.

Table 12: Teeth brushing practice in relation to dental caries

	Nairobi West		Mathira West	
	% Dental caries present	OR(95%CI)	% Dental caries present	OR(95%CI)
Frequency of tooth brushing				
Less often than daily	33	1.1 (0.3-3.1)	20	1.2 (0.1-4.3)
Once /day	31	1.3 (0.8-2.0)	20	1.2 (0.6-2.0)
Twice or more/day	35	ref	22	ref
Brush each tooth carefully				
Yes	38	2.2 (0.8-6.1)	24	1.0 (0.6-1.8)
No	22	ref	24	ref
Has received instructions on how to brush teeth				
Yes	37	0.9 (0.6-1.6)	18	0.6 (0.3-1.0)
No	38	ref	28	ref

ref = reference group

Children who had ever visited a dentist were 2.1 and 1.7 times more likely to have dental caries in Nairobi West and Mathira West districts respectively (Table 13). Notably this relationship was only statistically significant in Nairobi. Children who had visited a dentist within the last 12 months had higher caries prevalence than those who had not.

Table 13: Dental visits in relation to dental caries

	Nairobi West		Mathira West	
	% Dental caries present	OR (95%CI)	% Dental caries present	OR (95%CI)
Has ever visited dentist				
Yes	49	2.1 (1.4-3.3)*	33	1.7 (0.9-3.4)
no	31	ref	22	ref
Visited dentist in past 12 months				
yes	57	2.7 (1.6-4.8)*	38	2.1 (1.0-4.6)*
no	33	ref	22	ref

ref = reference group

*p<0.05

4.7.4 Consumption of cariogenic foods

Table 14 illustrates association between frequency of self-reported cariogenic food consumption and dental caries. In Nairobi West District children who ate cakes/biscuits had significantly more caries than those who never ate cakes/biscuits. Children who drank sodas at a higher frequency were more likely to have dental caries compared to those who did not drink (OR=2.2).

Table 14: Dental caries in relation to consumption of cariogenic food.

	Nairobi West		Mathira West	
	% Dental caries present	OR (95%CI)	% Dental caries present	OR (95%CI)
Sweets				
High	38	1.5 (0.7-3.1)	22	1.0 (0.2-5.1)
Low	41	1.8 (0.8-3.9)	25	1.2 (0.2-5.9)
Never	28	ref	22	ref
Cakes/biscuits				
High	42	2.3 (1.2-4.6)*	25	0. 6 (0.3-1.6)
Low	38	2.0 (1.0-3.9)*	21	0.5 (0.2-1.5)
Never	24	ref	33	ref
Chewing gum				
High	37	1.0 (0.5-1.9)	25	1.4 (0.6-3.2)
Low	37	0.9 (0.5-2.0)	26	1.6 (0.7-3.0)
Never	38	ref	19	ref
Chocolate				
High	34	1.0 (0.5-1.8)	31	1.1 (0.2-5.6)
Low	43	1.4 (0.9-2.3)	25	1.5 (0.4-4.5)
Never	35	ref	23	ref
Soda				
High	47	2.2 (1.1-4.5)*	23	0.9 (0.2-3.6)
Low	34	1.3 (0.7-2.5)	24	0.9 (0.5-1.7)
Never	28	ref	25	ref
Tea/cocoa with sugar				
High	38	0.2 (0.0-1.3)	25	1.3 (0.4-4.1)
Low	11	0.1 (0.0-0.7)	23	1.2 (0.3-4.3)
Never	71	ref	20	ref

ref = reference group

*P<0.05

4.8 Multivariate analysis

Logistic regression analysis revealed that knowing that a toothbrush should be changed after three months and high consumption of soda were significant risk factors for dental caries Nairobi West District. In Mathira West District having a caregiver with no formal education was a significant risk factor for dental caries (Table 15)

Table 15: Logistic regression analysis of significant independent variables

	P-value	OR	95% CI	
Nairobi West				
Knowing that a toothbrush should be changed after three months	0.01	3.2	1.3	8.0
High consumption of soda	0.02	3.0	1.2	7.6
Mathira West				
Caregiver with no formal education	0.04	4.3	1.1	16.7

CHAPTER FIVE: DISCUSSION

This study provides information on prevalence of dental caries, oral health knowledge and practice in a representative sample (n = 639) of children from Nairobi West District (347) and a Mathira West District (292) in Kenya.

The prevalence of dental caries was significantly higher in Nairobi West District (37.5%, DMFT 0.76) than in Mathira West District (24%, DMFT 0.36). Other studies have found similar results that indicate that the urban region had higher caries prevalence than the rural region (David *et al.*, 2005, Wandera and Twa-Twa, 2003). Living in urban areas has implications for lifestyle, including dietary pattern and has been shown to be associated with an increased prevalence of dental caries (Ismail *et al.*, 1997). In contrast to the results found in this study a study done in India showed urban children did not have a higher caries prevalence compared with rural children (Christian and Evans, 2009). This may be because of similar oral hygiene practices that exist between children residing in urban and rural areas.

Children in Nairobi West District had a DMFT of 0.76 which is higher than the DMFT of 0.51 that was found among 12 year olds in Nairobi (Frencken *et al.*, 1986). This shows that there is a general increase in the trend of dental caries that is also being experienced in Uganda (Wandera and Twa-Twa, 2003**).** This increase may be attributed to increased availability and accessibility of cariogenic foods in the market over the years. However the difference may also be attributed different criteria for inclusion and caries diagnosis,

dentition included (deciduous/permanent), and different field conditions (Assaf *et al., 2004).*

Other East African counties have recorded a prevalence of 41% in urban area and 29% in rural areas in Uganda (Wandera and Twa-Twa, 2003) and in Tanzania the prevalence among urban children was 41.5% (Mwakatobe and Mumghamba, 2007). Some African countries are also experiencing a similar status of dental caries as seen in a study done in Burkina Faso where the urban area prevalence was 33.8% while the rural area prevalence was 21.2% (Varenne *et al.*, 2004). Globally, in India the prevalence of dental caries was shown to be 33% and 25% in urban and rural areas respectively (David *et al.,* 2005) which are close to the results found in this study.

The decayed component of DMFT formed the major component in both districts: Nairobi West District 88% and Mathira West District 97%. These high numbers of untreated teeth may be as a result of a low perception of the need for treatment and the low priority placed on oral health care compared with other needs (David *et al.,* 2005). None of the children in Mathira West District had any of their tooth filled as opposed to their counterparts in Nairobi West District where 13 fillings were found. This can be explained by the reduced number of dental clinics both private and public and lack of resources in the few clinics that are available. Other studies have also shown results that indicate that no filled teeth were found in the rural population (Bajomo *et al.*, 2004**;** Varenne *et al.*, 2004).

Dental caries prevalence was higher in the females (39%) and (25%) than in the males (35%) and (23%) in Nairobi West and Mathira West districts respectively. This difference

was however not significant. These findings are in agreement with the findings of other studies (Nurelhuda *et al.*, 2009; Varenne *et al.*, 2004). The earlier eruption time of the permanent teeth in the females and the higher consumption of cariogenic foods may have been responsible for the higher caries experience.

Ninety one percent of children in Nairobi West District and 86% of the children in Mathira West District knew the causes of dental caries, which is higher than 72% that was found in Tanzania (Mwakatobe and Mumghamba, 2007). Awar**e**ness of the importance of tooth brushing to prevent dental caries was high (89%) in Nairobi West District and (81%) in Mathira West District. This finding is similar to a study by Varenne *et al.*, (2004) where majority of the children in urban areas reported that regular tooth cleaning may prevent oral disease. Sixty nine percent of the children in both districts correctly identified the frequency of changing toothbrush to be three months which was higher than what was found in Saudi Arabia (50%) (Amin and Al-Abad, 2008).

Sixty one percent of children in Nairobi West District and 45% of children in Mathira West district brush their teeth at least twice per day. These figures are higher than what has been reported in Sudan (Nurelhuda *et al.*, 2009). This indicates a moderate level of oral awareness among the children. A previous study conducted in Kenya found that 2% of children in urban areas used chewing sticks while in this study only 1.2% of the children in the urban region used chewing sticks (Kaimenyi *et al.*, 1993). This decrease may be attributed to increased use of toothbrush and toothpaste due to increased oral health awareness. There may also have been a feeling of embarrassment associated to owning up

to using chewing sticks. In spite of this, children whose parents cannot afford toothbrushes should be encouraged to use chewing sticks and health promotions done to make the chewing sticks socially acceptable. There was high reporting of careful tooth brushing among children in Nairobi West District (93%) compared to Mathira West District (53%). In Isreal 50% of the children reported that they brush each of their teeth carefully (Levin and Shenkman, 2004). The results in Nairobi West District imply that there was over-reporting.

Sixty two percent of the children in Nairobi West District and 82% in Mathira West District had never visited a dentist compared to 76% in Tanzania (Mwakatobe and Mumghamba, 2007) and 29% in Poland (Wierzbicka *et al.*, 2002). The low figures of dental attendance seen in developing countries may be due to poor dental health awareness, cost implication and fear of the dentist in the general population (Bajomo *et al.*, 2004)

Children who had caregivers with no formal education had higher caries prevalence than children whose caregivers had secondary and above level of education in Mathira West District. Similar finding have been reported in Uganda (Kiwanuka *et al.*, 2004). The study in Uganda demonstrated that, sugar consumption was significantly higher among those children who had mothers with a lower level of education, as compared to children of their more highly educated counterparts. Additionally caregivers with no formal education may lack access to literature on caries prevention and oral health in general.

Results of this study indicate that children whose caregivers had primary education tended to have lower dental caries prevalence than those with secondary education and above in both districts. Similar findings were found in Saudi Arabia where children whose mothers had university education had more caries than those with primary education (Amin and Al-Abad, 2008). This could be due to differences in economic status brought about by having better employment due to higher level of education. Better economic status has an effect on dietary practices in this case leading to increased consumption of cariogenic foods (Okullo *et al*., 2003**).**

Children who knew that a toothbrush should be changed after three months had significantly higher caries prevalence than those who did not know in Nairobi West District. This can be explained by the fact that the knowledge may not have been necessarily translated to practice considering the economic situation in the county where not many people can afford to change their toothbrush after three months. The knowledge may also have been acquired after having experienced dental caries. This is in contrast to other studies that have demonstrated that children with good oral health knowledge tended to be carious free (Amin and Al-Abad, 2008).

Children who brushed their teeth twice or more times per day had less caries prevalence than those who brushed either once or less frequently in both Nairobi West and Mathira West districts. These findings are consistent with other studies (Petersen *et al.*, 2001; Amin and Al-Abad., 2008). Surprisingly, children who brushed each of their teeth carefully had higher caries prevalence than those who did not. It would have been

expected that those who brushed their teeth carefully would have had less dental caries. Similar findings were found in a study conducted among young Israeli adults (Levin and Shenkman, 2004). This inconsistency could be explained by either over reporting on careful brushing or differences in interpretation of brushing carefully. In both districts having received instructions on how to correctly brush teeth was found to be protective of dental caries.

Although children who had ever visited a dentist were found to have lower caries prevalence than those who had visited in prior studies, this was not supported here (Adekoya–Sofowora *et al.*, 2006; Nurelhuda *et al.*, 2009). This study revealed that children who had visited a dentist had significantly higher caries prevalence than those who had not in Nairobi West District. The same results applied to those who had visited a dentist within the past 12 months though the association was slightly more for both districts. This mirrors the pattern observed in low-resource communities where dental visits are often prompted by pain and discomfort rather than regular preventive attendance (Christian and Evans, 2009; Petersen *et al.*, 2001). This is reflected in the reasons they gave for visiting the dentist as only 15% had gone for a checkup. Reasons for visiting were curative rather than preventive.

In accordance with other studies (Amin and Al-Abad, 2008; Adekoya–Sofowora *et al.*, 2006) the results found in Nairobi West District showed that children who consumed sugary foods had higher caries prevalence than children who did not consume sugary foods. Children who ate cakes/biscuits had significantly higher dental caries prevalence

than those who never ate cakes/biscuits. In addition high consumption of sodas was a significant risk factor for dental caries. A study done in Mexico revealed that drinking of sodas particularly between meals was significantly associated with dental caries (Cook *et al.*, 2008).

The prevalence of dental caries was lower in Mathira West District where mean Fluoride content was higher (0.77mg/L) as compared to Nairobi West where the mean Fluoride content (0.59mg/L). The optimum level of fluoride in drinking water associated with the maximum level of dental caries protection and minimum level of dental fluorosis, is considered to be approximately 1 mg/L (Dean and Elvove, 1936**).** These results are supported by a study that revealed a dose dependant relationship between fluoride levels and dental caries experience. Water fluoridation in Auckland was shown to reduce the risk of dental caries (Kanagaratnam *et al.,* 2009). In conflict is a study done in Mexico that revealed that fluoride exposure did not reduce the prevalence of dental caries (Pontigo-Loyola *et al.,* 2007).

Multiple regression analysis revealed that knowing the correct response to frequency of changing toothbrush and high consumption of soda were risk factors for dental caries in Nairobi West. In Mathira West District having a caregiver with no formal education was a significant risk factor.

CHAPTER SIX: CONCLUSIONS AND RECOMMENDATIONS

6.1 Conclusions

The prevalence of dental caries among 12 year old children in Nairobi West District (37.5%) an urban area was significantly higher than Mathira West District (24%) a rural area. Mean DMFT was 0.76 in Nairobi West District and 0.36 in Mathira West District.

Ninety one percent of children in Nairobi West District and 86% of the children in Mathira West District know what causes of dental caries.

Sixty one percent of children in Nairobi West District and 45% of children in Mathira West district brush their teeth at least twice per day.

Curative services were more prevalent than preventive services as seen from the reasons for visiting the dentist. Children tended to go to the dentist because they had a problem.

Significant risk factors for dental caries in Nairobi West District include: knowing that a toothbrush should be changed after three months, having ever visited a dentist, having visited the dentist within the past 12 months, eating cakes/biscuits and drinking sodas at a high frequency.

In Mathira West District having a caregiver with no formal education and visiting a dentist within the past 12 months were risk factors for dental caries.

.

6.2 Recommendations

Intensive oral health promotion should be done in urban area to reduce the higher prevalence of dental caries.

The school health policy should be used to promote oral health by provision of oral health instructions and educating on harmful dietary practices in particular soft drinks.

Caregivers should be encouraged to take their children for regular dental check-ups

Further studies conducted to determine the relationship between dental caries and fluoride content in drinking water.

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APPENDICES

Appendix 1: Interview questionnaire (Administered to the children)

Questionnaire number ……

Date……

Name of Interviewer…….

School……..

District……

Sex Female ☐ Male ☐

Mothers highest level of education
1. None
2. Primary
3. Secondary
4. Tertiary
5. I don't know

1) What causes tooth decay?
1. Sugary foods
2. Bacteria
3. Cold weather
4. Bacteria and sugary foods
5. I don't know

2) A person can prevent tooth decay by brushing their teeth daily
1. Yes
2. No
3. I don't know

3) A toothbrush should be changed regularly
1. Yes
2. No
3. I don't know

4) After how long should you change your tooth brush?
1. 3 months
2. 6 months
3. 1 year
4. 2 years
5. I don't know

5) Visiting a dentist after 6 months is important

1. Yes
2. No
3. I don't know

6) Rinsing of mouth after meals helps in preventing tooth decay

1. Yes
2. No
3. I don't know

7) Do you know what dental floss is?

1. Yes
2. No

8) How many times do you brush your teeth?

1. Once
2. Twice
3. Thrice
4. Never

9) I use the following to brush my teeth

1. Toothbrush
2. Toothpaste
3. Chewing stick
4. Salty water
5. Charcoal
6. Others specify…….

10) I usually brush each of my teeth very carefully

1. Yes
2. No

11) Has anybody ever taught you how to brush your teeth? (Apart from the very first time)

1. Yes
2. No

12) Who taught you?

1. Father
2. Mother
3. Elder sibling
4. Relatives
5. Teacher
6. Dentist

13) Have you ever visited a dentist?

1. Yes
2. No

14) If answer is yes did you visit within the last 12 months?

1. Yes
2. No

15) If yes what was the reason for visiting?

1. My tooth was aching
2. My gums were bleeding

3. For a check up
4. My teeth were growing badly
5. Others specify……..

How often do you eat the following foods?

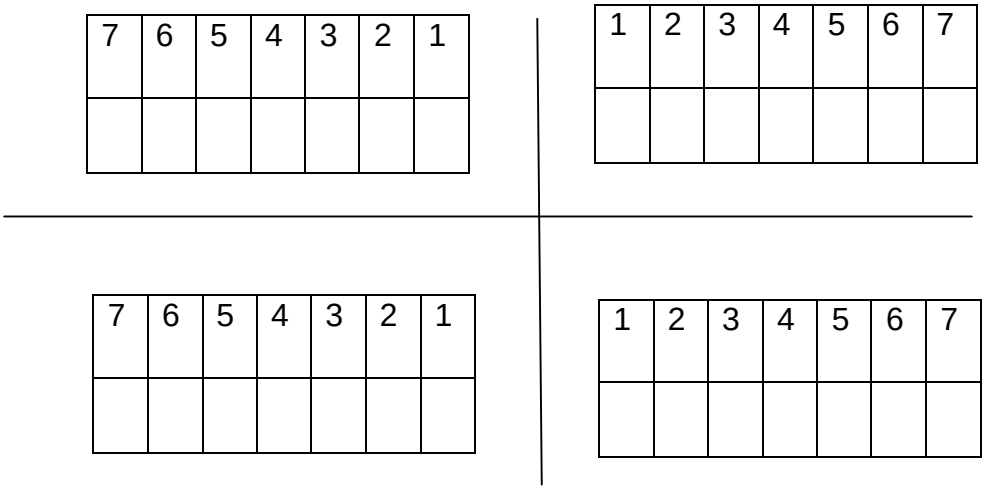
Food/Drink	Daily	3-6 times /week	≤twice/week	Never
Sweets				
Cakes/biscuits				
Chewing gum				
Chocolate				
Sodas				
Tea/cocoa with sugar				

D-Decayed

M- Missing

F- Filled

Fluorosis score ☐



Total DMFT= ☐

Appendix 2: Consent form

Title of Study: Dental Caries and Oral Health Knowledge and Practice among Children in Nairobi West and Mathira West Districts, Kenya

Investigator: Dr. Gladwell Gathecha

Institution: Jomo Kenyatta University of Agriculture and Technology

Dear Parent

Your child's school has been selected to take part in a survey to determine dental caries (rotten teeth) and its relationship to oral health knowledge and practices.

Purpose of the study

This study will help us to know the situation of dental caries among 12 year old children in Nairobi West and Mathira West districts. It will also help us know the level of oral health knowledge held by the children and the oral health practices they employ. This study may help to improve our understanding on prevention and treatment of dental caries in future.

Procedure

With your permission, a dentist will screen your child's teeth to check for dental caries and other dental problems. Please be assured that the dental screening will be carried out in a hygienic manner. If we find that your child has a dental problem requiring attention we will give him/her a letter to take home .This letter can be used when going to see the dentist. The children will also be asked some questions using a questionnaire.

Benefits

Your child will be able to have their teeth checked. Appropriate advice will be given to your child at the end of the interview.

Risk

The study will not pose any risk to your children. There will be no costs to you for taking part in this study.

Confidentiality: Information obtained about your child for this study will be kept confidential and will be used only for the purposes of the study

Consent: Both you and your child have to agree to take part in this study. Your child is allowed to withdraw from the study at any time without incurring any penalty

If you have any questions regarding this survey please contact me at 0728991164 or via e-mail ggkoku@yahoo.com

Please sign the form attached and give your child to return to school.

Thank you

Childs Name……..

Tick where appropriate

☐ Yes I give permission for my child to have his/her teeth checked

☐ No, I do not give permission for my child to have his/her teeth checked

……

Signature of Parent or Guardian

Date……

Appendix 3: Referral letter

Dear Parent/Guardian

I have found that your Child……..

has the following dental problem(s)

……..

…….

……

I recommend that you take him/her to dental clinic as soon as possible.

Sign…….. Date……

REPUBLIC OF KENYA

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Date: **28th July 2009**

Dr. Gladwell K. Gathecha
Jomo Kenyatta University of Agriculture and Technology,
P. O. Box 62000,
NAIROBI

Dear Madam
RE: RESEARCH AUTHORIZATION

Following your application for authority to carry out research on "**Dental caries and oral health knowledge and practice among children in Nairobi West and Mathira Districts, Kenya**", I am pleased to inform you that you have been authorized to undertake your research in **Nairobi West and Mathira Districts** for a period ending **31st December 2009.**

You are advised to report to the **District Commissioners and the District Education Officers, Nairobi West and Mathira Districts** before embarking on your research project.

Upon completion of your research project, you are expected to submit two copies of your research report/thesis to our office.

PROF. S. A. ABDULRAZAK Ph.D, MBS
SECRETARY

CITY COUNCIL OF NAIROBI

TELEGRAM "SCHOOLING"
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CITY EDUCATION DEPARTMENT

GL/NC/141 VOL III/94

17th July, 2009

HEADTEACHERS
PUBLIC PRIMARY SCHOOLS
NAIROBI WEST DISTRICT
NAIROBI.

RE: RESEARCH AUTHORIZATION

I write to certify that *Gladwell Gathecha,* a student at Jomo Kenyatta University of Agriculture and Technology pursuing an Msc in Applied Epidemiology has been granted permission to visit City Council Primary Schools in Nairobi West District for the purpose of collecting research data.

The research title is on; **"Dental Caries, Oral Health knowledge and practice among children in Nairobi West District, Kenya".**

You are requested to facilitate this activity to enable her complete her studies.

JECINTA A. CHARLES
Ag. DEPUTY CHIEF ADVISOR TO SCHOOLS
FOR: DIRECTOR OF CITY EDUCATION

cc. - M.E.O. - Nairobi West.