

**FACTORS ASSOCIATED WITH DENTAL CARIES AMONG  
CHILDREN/YOUTH IN MBEERE DISTRICT**

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**A DISSERTATION SUBMITTED IN PARTIAL FULFILLMENT OF THE  
REQUIREMENTS FOR THE AWARD OF THE MASTER OF PUBLIC  
HEALTH DEGREE OF THE UNIVERSITY OF NAIROBI.**

**2020**

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## **DECLARATION**

I, Wamiti Catherine Wambui hereby declare that this is my original work and has not been submitted by any other person for research purpose, degree or otherwise in any other university or institution.

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## **SUPERVISORS' APPROVAL**

This dissertation has been submitted in partial fulfillment of the requirements for the award of Master of Public Health with our approval as supervisors.

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## **DEDICATION**

I dedicate this work to John, Ivana, Naima and Joanna.

## **ACKNOWLEDGEMENT**

I wish to acknowledge all that knew and supported me in making this study a success.

I am greatly indebted to my husband John Ndegwa for his support in my studies. His inspiration and encouragement to ensure I succeed is greatly valued. To our daughters, Ivana, Naima, and Joanna, thank you for your great understanding.

I am very grateful to my supervisors; Professor Wang'ombe and Dr. T. Olewe for their guidance, advice, support and positive criticism that enabled the success of this study.

I wish to thank the management of Compassion International, Kenya for the opportunity to conduct this study among the supported beneficiaries.

The support offered by the Partnership Facilitators, Project Management and Project Staff in mobilizing respondents for data collection is greatly appreciated.

Last but not the least, the contribution of the Project Children/ youth, and their caregivers, the Project Directors and County Health Official who participated in the study is greatly appreciated.

Above all, I thank God for His blessing and provision.

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## **ABBREVIATIONS AND ACRONYMS**

AIDS- Acquired Immunodeficiency Syndrome

ANUG-Acute necrotising ulcerative gingivitis

DFMT- Decayed, Missing, and Filled Teeth index

FY- Financial Year

HIV- Human Immunodeficiency Virus

IDJ- International Dental Journal

OR- Odds Ratio

PH- Power of hydrogen

PHC- Primary Health Care

SES- Socioeconomic status

USA- United States of America

WHO- World Health Organization

## **OPERATIONAL DEFINITIONS**

**Access-** comprises of four dimensions namely: availability, geographic accessibility, affordability and acceptability of dental health services

**Prevalence-** The proportion of individuals in a particular population suffering from a disease at a given time; in this case, dental caries.

**Risk Factors-** A variable associated with an increased risk of disease or infection; in this case, risk of acquiring dental caries.

**Project-** A child development centre of a local church that partners with Compassion where children/youth meet and participate in planned program activities.

**Beneficiary-** A child or youth aged between 4-22 years who is registered at a Compassion International assisted Project and participates in Compassions' program

**Clusters-** These are administrative units used by Compassion International. The partnering churches are organized in groups referred to as clusters using geographical proximity as the basis. One cluster is made up of 12-18 Projects, currently there exists 26 clusters.

**Caregiver-** An adult, male or female who provides care to the Compassion assisted beneficiary. He/she accompanied children/youth less than 18 years of age to the study sight and consented on behalf of the child.

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# **ABSTRACT**

## **Introduction**

Anecdotal reports from Compassion International assisted projects indicated that dental related conditions remained among the top five most prevalent conditions among the children/youth since 2009 despite implementation of interventions aimed at reducing their occurrence. Dental caries was the most reported dental condition. I sought out to establish the prevalence of dental caries among these children/youth and factors associated with dental caries occurrence.

## **Methods**

A descriptive cross-sectional study was conducted where dental caries prevalence was measured based on; World Health Organization (WHO) oral health assessment criteria which included a clinical examination. Socio-demographic factors, children/youth oral health behaviour, knowledge on dental caries prevention, caregiver's knowledge on their children's oral health behaviour and contextual/ system factors were assessed using structured open and closed ended interviewer administered questionnaires and key informant interview guides. The study population comprised of 280 children/youth aged 4- 22 years and their caregivers. Analysis for association was done using Chi square, Spearman's rank-order correlation, linear regression model, Analysis of Variance (ANOVA) and Fisher's exact test of association.

## **Results**

The overall prevalence of dental caries for both children and youth was 21.8% with children of age 6 – 12 years having a prevalence of 22.9% while youth of age  $\geq 13$  years having a

prevalence of 20.3%. The overall mean for decayed missing filled teeth (dmft) was  $0.58+1.24$  SD with children of age 6 – 12 years having a mean of  $0.74+1.45$  SD while the youth of age  $\geq 13$  years having a mean of  $0.38+0.86$  SD. An Independent-Samples t-test elicited a statistically significant difference in means of children's dental caries and age  $p = 0.011$ . A Curve Estimation Linear Regression model elicited a statistically significant association between age and decayed, missing, filled teeth (DMFT)  $p < 0.001$ . It means that as one progresses in age, the likelihood of decay is high. Knowledge and practice factors that elicited a statistically significant association with caries included; frequency of brushing  $p=0.029$ , caregiver's guidance during brushing  $p<0.001$ , knowledge of dental caries prevention  $p=0.015$  and knowledge on remnants of food particles on the mouthy  $p=0.020$ . The knowledge of the children/ youth on dental caries and its prevention was low at an average of 59.28%. Younger children aged 6-12 years had a higher understanding of oral hygiene than the older ones aged 13 years and above.

Contextual and health system factors cited to hamper oral health services delivery included; inaccessible oral health services due to limited facilities offering these services, the cost of oral health services was out of reach for most respondents, delay in accessing oral treatment related to distance from the facilities and congestion at the facilities. Additionally, inadequate number of trained personnel in dental care was also cited one of the major challenges in oral health care delivery. Lack of implementation of proper oral health care policy and inadequate budgetary allocations on dental care at the county level also hampers oral service delivery.

## **Conclusion**

The dental caries prevalence of the children/ youth was comparable with that of other studies within the country (21.8%) with boys recording a higher prevalence than girls. The younger children aged 6-12 years had a higher caries prevalence and DMFT than the older ones aged 13 years and above. Age was significantly associated with caries occurrence. Poor oral health practices that were statistically significantly associated with caries including not regularly brushing and brushing with the guidance of a caregiver. Some children/youth oral health knowledge factors were significantly associated with dental caries including; children/youth knowledge of preventability of dental caries and children/youth knowledge of remnants of food particles in the mouth. Younger children aged 6-12 years had a higher understanding of oral hygiene than the older ones aged 13 years and above. Caregiver factors were not statistically significantly associated with dental caries occurrence among their children. System factors of geographical access, affordability of services, inadequate oral health budgetary allocations at the county level, inadequate trained personnel, and slow implementation of the national policy on oral health hampers delivery of oral health services and are likely to contribute to high dental caries prevalence.

## **Recommendation**

Since dental caries prevalence has been shown to vary with age, age-graded oral health education curriculum needs to be developed and implemented. Older children and youth aged 13 years and above demonstrated lower knowledge of oral health hygiene, there should be special emphasis on oral health education for this age group including use of diverse methods to reach them with oral health messages. Oral health education in schools needs to be given



greater emphasis particularly focusing on oral practices such as, consistent brushing of teeth, use of fluoride toothpaste and visiting a dentist for check-up. Parents or guardians play a key role in guiding children on brushing their teeth, it is important to equip them with the correct information on brushing so that they pass accurate information to their children. The county government should increase the number of public facilities offering affordable oral health care and facilitate provision of oral health education to the communities and schools. Budgetary allocation for oral health care at the county level needs to be prioritized and increased. There is need to also fast track implementation of the oral health policy to mitigate oral diseases burden, facilitate equitable cost-effective quality oral health care and adoption of good oral health related lifestyles through engagement with public, private and community partnerships.

# **CHAPTER ONE:**

## ***1.1 BACKGROUND TO THE STUDY***

### **1.1.1 Oral health situation**

Oral health is the absence of disease and the optimal functioning of the mouth and its tissues, in a manner that preserves the highest level of self-esteem (WHO, 1999-2008). Oral health describes a standard which enables an individual to do various things including speaking and socializing without disease, discomfort or embarrassment. This has been shown to contribute to their general well-being. In spite of vast improvements globally, oral health challenges persist in many communities and populations around the world, predominantly among the disadvantaged and socially marginalized children (Petersen, 2003). The high occurrence of oral disease globally poses considerable public health problems including pain, impairment of function and, reduced quality of life (Locker, 1988).

Dental caries and periodontal diseases have in history been considered the most important global oral health burdens (Jamieson et al, 2004). The current pattern of dental caries reflects mainly distinct risk profiles across countries (i.e. living conditions, lifestyles and environmental factors) and the outcome of implementation of preventive oral health systems. Dental caries is still a major oral health problem in most industrialized countries, affecting 60–90% of school children and the vast majority of adults.

From most studies conducted in Kenya's capital city, Nairobi, the urban population under 18 years of age has a DFMT of 0.2-1.8; 12-15-year olds have a DMFT of 1.2-1.9 while handicapped children aged 5-15 years have a DMFT of 0.8. Information collected from the rural population has been scanty with the mean DMFT reported being below 2. Follow up

reports to these studies are lacking and subsequently there is no certainty whether dental caries in Kenya is on the decrease or not (Kaimenyi, 2004). Primary school going children ages 13-15 years in Nairobi were reported to have dental caries prevalence of 40-50%. (Ng'ang'a et al, 1992)

### **1.1.2. Dental Caries and associated factors**

Dental caries is defined as a disease of the teeth in which there is the demineralization of hard tissue of the teeth (enamel, dentin, and cementum) which eventually leads to cavitation. It is most common among children and continues to be a significant public health problem globally (Abdullah et al, 2008). It has harmful consequences on children's quality of life since it inflicts pain, causes premature tooth-loss, malnutrition and influences their overall growth and development (Stella et al, 2005). Children with poor oral health are 12 times more likely to have limited activity days compared to those who do not (Currie et al, 2000).

Children from low socioeconomic backgrounds bear a heavier brunt of the effects of dental diseases compared to their counterparts from high socioeconomic status. The effect of parent's socioeconomic status has been associated with the oral health of the children. Federal surveys report in the US found out that there were inequalities in the oral health of children and access to dental clinic for treatment of dental cavities; there were 60 % more untreated dental cases among the poor compared to those in the high-income group (Karjalainen et al, 2001). Factors like parent's low education and unemployment are also associated with the poor health of their children (Kidd, 2011).

Etiology of dental caries has been linked to four main factors namely; a susceptible tooth surface, specific bacteria in dental plaque (e.g, *Streptococcus mutans*, *Lactobacillus*), time and

a diet rich in fermentable carbohydrates, particularly refined sugars. 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).

### **1.1.3. DMFT**

According to WHO (1997) and the recording of dental caries using DMFT Index, a DMFT of: 0 – 1.1 is considered as very low; 1.1 – 2.77 as low; 2.78 – 4.4 moderate, while 6.6 or greater considered as severe. The mean DMF does not indicate what proportion of the population experiences the disease. The DMF count is irreversible; hence the index typically advances with age.

### **1.1.4. Compassion International Kenya**

Compassion International is a Christian child development organization founded in 1952. It supports poor children from resource limited settings in Kenya through partnership with local churches. Compassion Kenya partners with over 300 local churches spread throughout the country to support over 85,000 needy children. For purposes of administration, the churches are organized in groups referred to as Clusters using geographical proximity as the basis. One cluster is made up of 12-18 Projects, currently there exists 26 clusters.

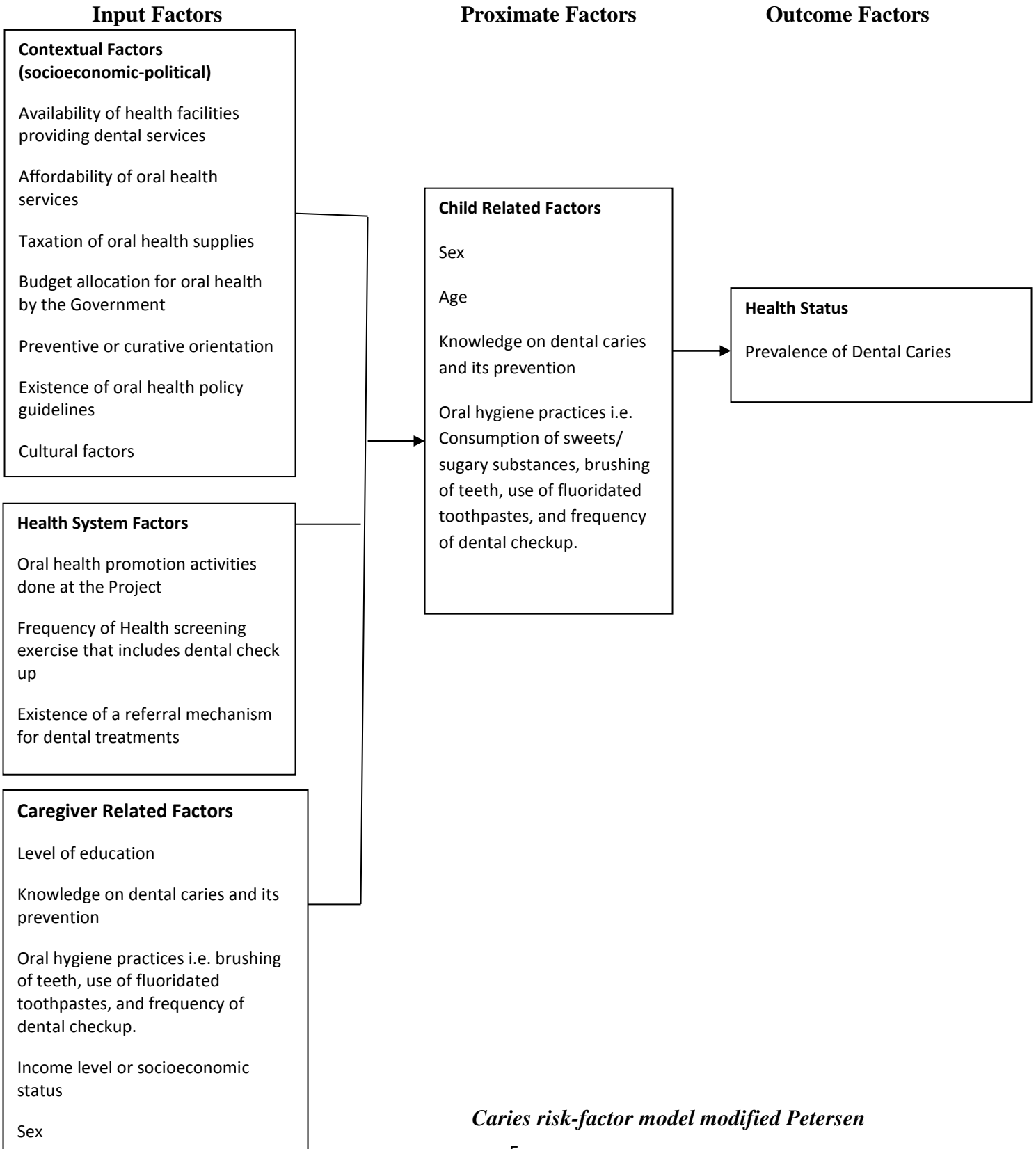
Physical development encompasses promoting the conditions that allow children/youth to reach and sustain their full physical capacity. One of the Physical development implementation standards stipulated in the Compassion Program Field Manual states that ‘At minimum, there will be annual health screening for all ages and prioritized additional medical treatment to follow-up on diagnosed conditions. All health screening will be conducted by a

qualified health professional, according to field office specifications; in a private space with an appropriate amount of individual time per young person. Health screenings should encompass a comprehensive examination to detect prevalent diseases, infections and conditions.

In the health screening exercise carried out in Financial Year 2013 between July and September 2012; a total of 75,901 children/youth were screened in 309 Projects. At the time of the screening, there were 85,437 children/youth and 333 Projects. The top five conditions reported included: Skin conditions (25.3%) followed by respiratory conditions (16.9%), digestive conditions (14.6%), dental conditions (14.2%) and Genito-urinary conditions at (8.1%), (CKE, 2013).

Dental conditions were common in Mwea-Kiambere cluster (14.9%), followed by Meru-Tharaka (12.5%) and Ndeiya (9.6%). Nairobi East and Ishiara were the fourth and fifth clusters burdened by dental conditions at 7.3% and 6.4% (CKE, 2013). Dental caries was reported as the most common dental disease affecting these children. This study sought to determine the prevalence and factors associated with dental caries among children from limited resource settings in Mbeere District's Compassion assisted Projects.

## 1.2 CONCEPTUAL FRAMEWORK FOR DENTAL CARIES, (Figure1)



*Caries risk-factor model modified Petersen*

## **Explanation on Conceptual Framework**

Dental caries is a result of interactions of an acid producing bacterium, a substrate that the bacteria can metabolize, and other host factors including teeth and saliva. Risk factors for dental caries include physical and biological factors (e.g., a high number of cariogenic bacteria and immunological components) and behavioral factors. Other risk factors include poverty, deprivation and social status.

Socioeconomic status, SES, has been recognized as a contributor to inequalities in oral health worldwide. Girls are often found to be more seriously affected with dental caries than boys however; numerous studies have reported no sex differences in dental caries experience.

Oral-health-related behaviors (sugar consumption, household-member smoking, dental visits, and irregular tooth brushing at night, insufficient access to topical fluoride and dental fear or anxiety) are important risk factors for dental caries in children. The role of sugars in caries etiology is well-known, and there is overwhelming evidence that both the amount and frequency of consumption of fermentable carbohydrates are associated with the development of caries. A low frequency of tooth brushing (once or less than once per day versus twice or more per day) has been found to be associated with a higher number of carious permanent teeth

Conceptually, oral-health-related behaviors might be considered as proximal risk factors, whereas socio-economic status might be considered a distal risk factor or an indicator of an individual's dental-caries experience. The dual relationship of oral-health related behaviors with socio-economic position on one hand and oral-health outcomes on the other suggests that oral-health-related behaviors play an important role when it comes to socio-economic

disparities in oral health. Several studies indicate that oral-health-related behaviors explain parts of the SES disparities in oral-health outcomes. Other studies have shown that the effects of SES on oral-health outcomes are not mediated by oral-health behaviors. Rather, SES has a direct effect on oral-health outcomes, independent of the proximal determinants of oral-health-related behaviors (Kijakazi, 2011)



## **1.3 LITERATURE REVIEW**

### **1.3.1 Dental Caries Burden**

Despite great achievements in oral health of populations globally, problems still remain in many communities all over the world - particularly among under-privileged groups in developed and developing countries. Dental caries and periodontal diseases have historically been considered the most important global oral health burdens (Peterson et al, 2005). These have been considered important mainly because almost everybody in the more affluent parts of the world, were affected by one or other of these conditions. In developing countries of Africa, these appear to be neither as common nor of the same order of severity as in the developed world (WHO, 2003). At present, the distribution and severity of oral diseases vary among different parts of the world and within the same country or region.

Dental caries is still a major oral health problem in most industrialised countries, affecting 60-90% of school children and the clear majority of adults. It is also a most prevalent oral disease in several Asian and Latin-American countries, while it appears to be less common and less severe in most African countries (Peterson et al, 2005). The most prominent oral health problems in Africa amongst low socio-economic communities include Noma, acute necrotising ulcerative gingivitis (ANUG), oral cancer, the oral manifestations of HIV and AIDS, oro-facial trauma, and dental caries (WHO, 2003).

Compared to other oral diseases, dental caries has been much more frequently recorded, despite most surveys indicating the prevalence of dental caries to be generally low and static. This mask the experience of certain, particularly deprived communities, where caries has increased (WHO, 2003).

Data from 39 African countries shows that 13 (33%) have at twelve years of age a very low Decayed Missing Filled Teeth index (DMFT) (0.0 -1.1), 19(44%) a low DMFT (1.2 - 2.6) and seven (23%) a moderate DMFT (2.7 - 4.4). Most of this represents untreated caries and the inadequacy of current oral health systems to address this problem. Unfortunately, such national and regional DMFT averages conceal the presence of those communities where caries is high in either prevalence or severity (WHO, 2003).

Currently, the disease level is high in the Americas but relatively low in Africa. Considering changing living conditions, however, it is expected that the incidence of dental caries will increase in many developing countries in Africa, particularly due to a growing consumption of sugars and inadequate exposure to fluorides (Peterson et al, 2005). In many developing countries, access to oral health services is limited and teeth are often left untreated or are extracted because of pain or discomfort (Peterson et al, 2005).

From most studies conducted in Kenya's capital city, Nairobi, the urban population under 18 years of age has a DFMT of 0.2-1.8; 12-15-year old have a DMFT of 1.2-1.9 while handicapped children aged 5-15 years have a DMFT of 0.8. From the rural population, information collected has been scanty with the mean DMFT reported being below 2. There are no follow up reports to these studies and consequently there is no certainty that dental caries in Kenya is on the decrease or not (Kaimenyi J.T., 2004). A study done in 1992 found the prevalence of dental caries to be 40% to 50 % among primary school children in Nairobi, Kenya aged 13-15 (Ng'ang'a et al, 1992). According to the Kenya National Oral Health Report, the prevalence of dental caries was 23.9% among the children. The number of teeth affected ranged from 1-14 teeth. A small proportion (3.4%) of the children had teeth missing

due to caries while 0.5% had filled teeth. The prevalence of dental caries was higher among the 5-year old (46.3%) when compared to the other age groups. The overall DMFT/dmft for the children was 0.8. The mean dmft for the 5-year-old children was 1.87, while the DMFT/dmft for 12 years old children was 0.42, children aged 15 years had a DMFT of 0.17. Females recorded a higher dmft/DMFT of 1.38 compared to 0.82 recorded for males. The dental caries experience was highest (0.86) among the peri urban children and lowest (0.65) among the urban children. The rural children had a dental caries experience of 0.76 (Kenya National Oral Health Survey Report, 2015).

### **1.3.2 Etiology of Dental Caries**

Dental caries is a multifactorial disease (Menaker, 1980). It is a localized, progressive demineralization of the hard tissues of the crown (coronal enamel, dentine) and root (cementum, dentine) surfaces of teeth. The demineralisation is caused by acids produced by bacteria, particularly mutans Streptococci and possibly Lactobacilli that ferment dietary carbohydrates. This process occurs within a bacteria-laden gelatinous material called dental plaque that adheres to tooth surfaces and becomes colonised by bacteria (Lewis et al, 1995). Thus, caries results from the interplay of three main factors over time: dietary carbohydrates, cariogenic bacteria within dental plaque, and susceptible hard tooth surfaces. It should be noted that for the disease process to be initiated, all three factors must exist simultaneously (Menaker, 1980). Dental caries is a dynamic process since periods of demineralization alternate with periods of remineralisation (Lewis et al, 1995).

The effect of untreated carries is to break down enamel and dentine and open the way for bacteria to infect the pulp. The ultimate consequences are inflammation of the pulp and later

of the periapical tissues. Acute pulpitis and periodontitis caused in this way are the most common causes of toothache. Infection can spread from the periapical region to the jaw and beyond (Lawson et al, 1998).

Dental caries is one of the most prevalent diseases of man; it is ubiquitous. It begins soon after teeth erupt, and its prevalence increases with age. It affects different tooth surfaces at different ages. In children and young adults, the pit-and-fissure (biting) surfaces are mainly affected (Graves et al, 1985). As people age, the smooth surfaces of their teeth become increasingly susceptible (Lewis et al, 1995).

### **1.3.3 Dental Caries Prevalence and associated factors**

Dental caries results from interactions over time between bacteria that produce acid, a substrate that the bacteria can metabolize, and many host factors that include teeth and saliva (status (Selwitz et al, 2007). Risk factors for dental caries include physical and biological factors (e.g., a high number of cariogenic bacteria and immunological components) and behavioral factors (poor oral hygiene, poor dietary habits, frequent use of oral medication containing sugars, insufficient exposure to fluoride and inadequate use of dental-health-care services). Other risk factors include poverty, deprivation and social status (Selwitz et al, 2007).

#### **1.3.3.1 Child related factors**

Girls are often found to be more seriously affected with dental caries than boys (Kallestal et al 2002); however, numerous studies have reported no sex differences in dental caries experience (Okullo, I., et al, 2003), (Nurelhuda, 2009), (Jamieson, 2009). In an oral health status survey of school children in Mbarara, Uganda, the mean decayed, missing, filled permanent teeth

(DMFT) was 1.5( $\pm$ 0.8 SD). Females had higher DMFT (1.6 $\pm$ 0.8SD) than males (1.3 $\pm$ 0.8SD). Decayed, filled milk teeth (dt) was 2.7( $\pm$ 1.8SD) but more in males 3.1( $\pm$ 2.1SD) than in females 2.4( $\pm$ 1.6SD) (Batwala et al,)

Oral-health-related behaviors (sugar consumption, household-member smoking, dental visits, and irregular tooth brushing at night, insufficient access to topical fluoride and dental fear or anxiety) are important risk factors for dental caries (Kinirons et al, 1998), (Juliñ et al, 2006), (Ayo-Yusuf et al, 2007). The role of sugars in caries etiology is well-known, and there is overwhelming evidence that both the amount and frequency of consumption of fermentable carbohydrates are associated with the development of caries (Sheiham, 2002), Zero, 2004).

Zhu and colleagues in their study in China found out that the risk of dental caries was high in the case of frequent consumption of sweets and dental caries risk was low for participants with use of fluoridated toothpaste (Zhu, 2003).

A study in Haiti revealed that the mean number of decayed, missing and filled teeth (DMFT index) was 0.93, which is low. However, a high-risk group was identified with a mean DMFT index of 3.8. Logistic regression analysis showed that dental hygiene and, to a lesser extent, sugar intake, were the principal risk factors for dental caries (Bedos et al, 2000).

Multiple logistic regression analysis showed that children had a higher risk of having dental caries if they, had not visited a dentist, did not use a toothbrush, or consumed sweets (Bedos et al, 2000). A low frequency of tooth brushing (once or less than once per day versus twice or more per day) has been found to be associated with a higher number of carious permanent teeth (Maserejian, et al., 2008)

In a study in Bangladesh Ullah et al found out the caries experience was low, with a mean DMFT score of experience of 0.97. Poor oral hygiene and bleeding gingiva were frequently detected. Dental caries associated with sex, oral hygiene (girls), and use of dental services (more caries among frequent users than non-users) (Ullah et al, 2002)

A review on the prevalence of dental caries in European children (0-18 years) and associated risk factors done by Rodrigo demonstrated variation in the prevalence of dental caries in different regions of Europe and it ranged from 1.0 dfmt (Scotland) to 5.8 dfmt (Kosovo). Although, the prevalence of dental caries had decreased in Western and Central Europe, Eastern Europe was still facing a high prevalence of dental caries. This is like the findings of Marthaler (2004). In this review, lower socio-economic status, sweets consumption and inadequate oral hygiene were reported as major risk factors. Other studies reported sugar consumption as a cause of dental caries. Similar association was reported by Cottrell (2005). Tooth brushing was also reported as protective factor in another study (Rodrigo et al, 2012).

In the study conducted by Gladwell (2012) in Mathira and Nairobi West Districts found that children who had visited a dentist in the past 12 months were more likely to have dental caries than those who had never visited a dentist. In Nairobi West district children who ate cakes/biscuits had significantly more caries than those who never ate cakes/biscuits. The risk of dental caries was significantly higher among children who drank sodas at a higher frequency compared to those who did not drink (OR=2.2) in Nairobi West District. There was no significant difference in the distribution of dental caries by sex, frequency of tooth brushing and presence of dental fluorosis.

### **1.3.3.2 Caregiver related factors**

The role of the parent's in dental education to their children is very important; children who are prone to caries often receive inadequate or no oral health guidance from their parents and in most cases the level of parent's education is usually low. (Mashoto, 2011, Christensen et al, 2010). Parents with more oral health knowledge have a positive impact on the oral health status of their family members (Isong et al, 2010). The perception among many parents is that doctors are responsible for providing all the information regarding oral health care to people. Therefore, the transfer of oral health knowledge from parents to their children is often delayed or absent leading to a delay in caries prevention (Saied-Moallemi et al, 2008).

The learning process of children starts from home under the supervision of the parents. One of the major factors which affect the behaviours of children in relation to oral hygiene is the oral health knowledge and attitude of their parents. Those children whose parents are aware of the oral health of their children have lower caries than those whose parents are unaware (Hallett et al, 2002). It has been seen in recent studies that children's who have dental caries are from a background where families have low income and their parents have low level of education (Wang et al, 2010). Children's with dental caries are completely dependent on their parents who decide whether to take them to dentist for dental caries treatment or not. Further research showed that children from lower socioeconomically backgrounds with younger parents with lower level of education were less likely to visit dental clinics although they had more dental diseases (Arora et al, 2011).

In a study on oral health knowledge of parents and relationship to dental caries of their children in Karachi, Pakistan found that, the DMFT index score increased as the father and mother education increased from lower to intermediate education level. However, the score

decreased among children whose parents had received higher education (Mohammad 2005). Other previous studies showed the same DMFT score in different education groups (Boyce et al, 2010).

Other findings of the Pakistan study revealed that children from high socio-economic status families had a higher DMFT score compared to those from the low socio-economic status group. The poor status was not a factor for the occurrence of dental diseases, but it was the high income that led to the occurrence of the disease and also enabled them to frequent dental clinics for dental filling treatment. It reflected that consumption of sugar and cariogenic food increased as the income rose causing more teeth decay as well as frequent dental clinic visits for restorative treatments (Mohammad, 2005). These results were dissimilar and contradictory from the study done in United States of America (USA) which had found that children from low SES had a higher DMFT than those from high SES (Al-Shalan, 2003).

In the study conducted by Gladwell (2012) in Mathira and Nairobi West Districts, it was found that; having a mother with no formal education was a significant risk factor for dental caries (OR=4.3).

Socioeconomic status has been recognized as a contributor to inequalities in oral health worldwide (Locker, 2000) The existence of a social gradient in dental caries prevalence as measured by the association between dental caries indicators and socioeconomic status has been documented across countries and oral-health systems, even in countries with a long tradition of oral-health promotion, preventive oral care, outreach dental-health services and high utilization rates (Petersen, 2005). A study of Tickle (1999) conducted on children who were registered to general dental clinics in north of London, found that children belonging to



low socioeconomic class experience a higher dental caries status and were less likely visit to dental clinics while those children from higher income class have lower experiences of dental disease and more treatments of dental diseases.

The effect of parent's socioeconomic status has also been associated with the oral health of their children. Federal surveys report of USA Surgeon General's workshop, Children and Oral Health, found out that there were disparities in oral health of children from low socioeconomic class compared to their peers from high socioeconomic class. They experienced higher caries and didn't easily access dental clinics for treatment. From the studied group, there were 60 % more untreated dental diseases among the low SES group compared to the high-income group (Karjalainen et al, 2001). Factors like low parental education, unemployment and low income are also associated with the poor health and chronic diseases (Figueiredo, 2011).

#### **1.3.3.3 System Related Factors**

In developing countries, oral health services are mostly offered at the regional or central hospitals of urban centres and little, if any, importance is given to preventive or restorative dental care. Many countries of Africa, Asia and Latin America have a shortage of oral health personnel and the capacity of health systems is generally limited to pain relief or emergency care. In Africa, the dentist to population ration is approximately 1: 150,000 compared with 1: 2,000 in most industrialized countries. In children and adults suffering from severe tooth decay, teeth are often left untreated or are extracted to relieve pain or discomfort. Public health problems related to tooth loss and impaired oral function are therefore expected to increase in many developing countries (Peterson, 2005).

Oral health services are mostly curative in the African countries. These services are mostly located in urban communities and are haphazardly established and poorly coordinated. This is aggravated by the capital-intensive nature of establishing curative dental services and the non-integration of oral health services with the mainstream Primary Health Care (PHC) delivery services. This results in the lopsided and non- equitable oral health care delivery in the region. (Danfillo, 2009)

In Kenya, most of the oral health personnel are dentists. The number of registered dentists in Kenya is 700. The dentist /population ratio is 1: 378,000 in the public sector. When all sectors are combined, the dentist/ population ratio is 1: 60,000, 20% are in the rural areas and 80% urban. There are few trained auxiliary dental personnel due to the late establishment of a National Oral Health Policy (Kaimenyi, 2004)

Further reports indicate that, basic oral health education is taught in Kenyan primary schools. Children are instructed 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 dental clinics, but access to these facilities is limited due to several barriers including poverty. A visit to a public dental clinic will require one to purchase a card, the cost of which is prohibitive to many people. Government facilities, of which 80% are situated in the urban areas, are also understaffed and are unable to provide dental education to visiting clients as demonstrated by the dentist- population ratio of 1: 60,000 (Enwonwu, 1995)

#### **1.3.4 Lessons from literature review**

Dental caries prevalence varies across age groups, social economic status, sex, geographical location (urban vs rural) among other factors. Factors associated with dental caries have also been shown to variably influence occurrence with some studies showing significant relationship while others reporting non-significant relationships. In his article on overview of oral health in Africa, Samuel Thorpe noted that oral health profile of Africa today was very different from how it was previously perceived. This profile of oral disease was not homogeneous across Africa thus, the oral diseases in each community need to be individually assessed in terms of the basic epidemiological criteria of prevalence, severity (morbidity and mortality), and age-adjusted distribution in the population (Samuel, 2003).

Important to note is that few studies have been conducted in regard to the association between parent/ caregiver related factors and the occurrence of dental caries among their children. System related factors that have been described generally relate to health facilities hence there is need to identify program specific factors that influence the occurrence of dental caries.

The findings of this study on prevalence of dental caries and associated factors among children in Mbeere cluster Compassion assisted Projects are expected to contribute to the existing body of knowledge on prevalence of dental caries among children from limited resource settings of different ages and their related oral health practices and caregiver's knowledge on oral health. Program specific factors were also studied.

## **1.4 RESEARCH QUESTIONS**

1. What is the prevalence of dental caries among Compassion assisted children/youth in Mbeere cluster Projects?
2. What are the child/youth related factors associated with dental caries occurrence?
3. What are the caregivers' related factors associated with dental caries occurrence?
4. What are the contextual and health system related factors associated with dental caries occurrence?

## **1.5 OBJECTIVES**

### **1.5.1 Main Objective:**

To determine the factors associated with dental caries among children/youth in Mbeere District.

### **1.5.2 Specific objectives:**

1. To determine the prevalence of dental caries among the children/youth
2. To determine the child/youth related factors associated with dental caries occurrence
3. To determine the caregiver related factors associated with dental caries occurrence among their children.
4. To determine the contextual and health system related factors associated with dental caries occurrence among the children/youth
5. To determine association between dental caries and child/youth factors and caregiver related factors.

### **1.5.3 Hypotheses:**

1. The prevalence of dental caries among the children/youth in Mbeere District is low.
2. There is no relationship between the child/youth factors and dental caries prevalence
3. There is no relationship between the caregiver factors and dental caries prevalence

4. There is no relationship between contextual and health system related factors and dental caries prevalence.

## **CHAPTER TWO:**

### ***2.1 STATEMENT OF THE RESEARCH PROBLEM***

Dental caries has been shown to affect a substantial number of children in Kenya, but there is inadequate current evidence about dental caries prevalence, oral health habits among poor children in Kenya and the caregiver's knowledge on oral health of their children (Kaimenyi, 2004)

Anecdotal reports from Compassion International assisted children indicated that dental related conditions were among the top five conditions affecting the children. Dental conditions remained among the top five most prevalent conditions among the children/youth since 2009. Interventions to reduce the high prevalence had been implemented including; oral health education to the children/youth, provision of toothpastes and toothbrushes, dental screening and dental treatments. Dental caries had also been reported as the most common dental disease affecting the children/youth. Children/youth from Mbeere Projects had been noted to suffer frequently from dental diseases compared to other children in the country despite benefitting from the aforementioned interventions. This pointed to existing gaps in knowledge of dental caries prevention as well as gaps in oral health practices among the children/youth. Factors suspected to be related to these gaps included: children/youth age, sex, susceptible tooth surface, consumption of sugary substances and poor access to dental services. Caregivers level of education, knowledge on caries prevention, level of income, sex and oral health care practices are also suspected to contribute to the high prevalence of dental caries.

There was therefore need to conduct a study to determine the prevalence of dental caries among these children/youths and also find out factors associated with dental caries occurrence.

## **2.2 JUSTIFICATION**

A study done in 1992 found the occurrence of dental caries to be 40% to 50 % among children aged 13-15 (Ng'ang'a et al, 1992). The International Dental Journal (IDJ) states that information on dental caries prevalence among the rural population in Kenya is scanty (IDJ, 2004). Additionally, according to World Health Organization report on Oral health in Africa, the profile of oral disease is not homogeneous across Africa. Thus, the oral diseases in each community need to be individually assessed in terms of the basic epidemiological criteria of prevalence, severity, and age-adjusted distribution in the population (Samuel, 2003).

This study sought to add to the existing body of knowledge information on dental caries prevalence among children/youth of varied ages and relate that to their oral hygiene practices and the caregiver's knowledge on children's oral health status.

## **CHAPTER THREE:**

### **3.1 Methodology**

This was a descriptive cross-sectional study aimed at assessing the prevalence of dental caries and investigating the associated factors among poor children and youth in Mbeere District's Compassion International Projects.

#### **3.1.1 Variables**

**Dependent variable-** The main outcome measure was the prevalence of dental caries

**Independent Variables-;**

- i. *Contextual Factors including:* Availability of health facilities providing dental services, affordability of oral health services, preventive or curative orientation of oral health services, budgetary allocations for oral health services, taxation of oral health supplies, existence of oral health policy guidelines and cultural factors.
- ii. *Health System Factors including;* oral health promotion activities done at the Project, frequency of health screening exercise that includes dental checkup and existence of a referral mechanism for dental treatments.
- iii. *Children factors including:* Sex, age, knowledge on dental caries and its prevention, oral hygiene practices i.e. Consumption of sweets/ sugary substances, brushing of teeth, use of fluoridated toothpastes, and frequency of dental checkup.
- iv. *Caregiver factors including;* sex, caregiver's level of education, family's level of income, oral hygiene practices i.e. dental visits, use of toothbrush, use of fluoridated toothpaste, consumption of sweets/ sugary substances, knowledge of dental caries and knowledge on dental caries and its prevention.



### **3.1.2 Study Area**

The study was conducted in Mbeere District- Projects assisted by Compassion International Kenya. The Projects are in Mbeere District, Embu County. The Projects are 16 in total with a total of 3959 registered children and youth aged 4 years to 21 years. Mbeere District, an administrative district in the Eastern Province of Kenya whose capital town is Siakago. The population totals to 170,950 and has an area of 2,093 km<sup>2</sup>. The district was split from Embu District in 1996. The district has two constituencies Mbeere South (previously known as Gachoka) and Mbeere North (previously known as Siakago). Most Ambeeres are small scale farmers who grow a variety of crops including mangoes, melons, pawpaws and passion fruits, maize, beans, cowpeas, pigeon peas, black peas, millet and sorghum.

### **3.1.3 Study Population**

Children and youth aged 4-22 years registered at the Compassion assisted Projects.

Caregivers to the children and youth will respond to the caregiver's interview questions

### **3.1.4 Study Subject Selection**

#### **Inclusion Criteria**

- i. All children/youth registered in the selected Project aged 4-22 years
- ii. Children/youth aged 12 years (mature minors) and above who assent to participate in the study and caregiver's consent for children less than 12 years of age.

#### **Exclusion Criteria**

- i. Non-registered children and youth present at the time of the interviews
- ii. Children/youth aged 12 years and above who dissent to participate in the study and failure of caregiver to give consent for children less than 12 years of age.

### **3.1.5 Sampling**

#### **Sample size determination**

Sample size was calculated using the formula;

$$n = \frac{z^2 p(1-p)}{d^2} \text{ (Fisher } et al, 1998)$$

Where n is the minimum sample size

Z is the standard normal deviate corresponding to 95% confidence interval.

p is the hypothesized prevalence of the factors (set at 0.24, Gladwell et al, 2012)

d is the level of precision which was set at 5%

Substituting the values in the above formula, the sample size was 280.

#### **Sampling Procedure**

Mbeere cluster has a total of 16 Projects. 8 Projects were randomly selected. For each of the 8 Projects selected, a listing of all the elements in each Project was obtained and systematic sampling procedure used to select 35 subjects per Project. The sampling interval was determined by: dividing the Population by the Sample size. The following Projects were included in the study; ACK Kathigagaceru, ACK Kogari, ACK St. John's Kanyuambora, ACK Karangare, EAPC Muthathara CDC, EAPC Thagiraini CDC, ACK St Philips Rwika CDC, and ACK Ngomola CDC.

### **3.1.6 Data collection (Instruments and Type of data)**

#### **Clinical examination**

Clinical examinations of teeth was carried out under field conditions in a classroom setting by one dentist using plane mouth mirrors, WHO periodontal probes and natural light as a source of illumination. A dental assistant was recording the observations. Subjects were examined

whilst seated on a chair. Dental health status was recorded using the DMFT index, following the WHO criteria for epidemiological studies (WHO, 1997). The child/youth were examined by a dentist trained to record the WHO oral health assessment data tool to avoid inter-examiner variations during the study. The age and sex of each child/youth was recorded. Inter- and intra-examiner consistency was assessed using the Kappa statistic which resulted to 1 meaning that there was almost perfect agreement between the two examiners.

An interviewer administered questionnaire was used to assess the children/youth's oral health practices, and knowledge on dental caries prevention. The questions were administered by an interviewer and children below 12 years were interviewed using the local language which enabled them to understand the questions.

### **Caregiver's interviews**

Another interviewer administered questionnaire was used to interview the caregivers of children/youth. Data on their knowledge on dental caries and its prevention was gathered through this questionnaire. The questionnaire included characteristics like, sex of caregiver, education level, source of income, and level of income.

Before data collection, the tools were pretested at P.C.E.A. Rironi in Kiambu County after which appropriate adjustments were made. The Kiambu Project is located in a rural set up just like the Mbeere Project and the beneficiaries are close in characteristics to those of the Mbeere Project.

### **Key Informant Interview**

Two key informant interview guides were used to obtain information on contextual factors and program factors. This information was obtained from one County Official of health and 8 Project Directors respectively.

### **3.1.7 Data Analysis**

Raw data was collected, coded, entered into the computer using Microsoft Excel, cleaned and analyzed using IBM Statistical Package for Social Sciences (SPSS) version 17.0 computer packages.

The same package was used to generate frequencies for sociodemographic factors, oral health knowledge and practices of the children and youth.

Relations between different variables were tested using chi-square, Spearman's rank-order correlation, linear regression model, Analysis of Variance (ANOVA) and Fisher's exact test of association. A P value of 0.05 was used throughout the analysis.

The open-ended questions were analyzed manually and summarized according to emerging themes.

### **3.1.8 Minimization of Errors and Biases Including Controlling For Confounding Variables**

1. One dentist examined the children/youth to avoid inter-examiner bias.
2. Pretesting of the study instruments was carried out for validation purposes.
3. Standardized data collection tools will be used.

### **3.1.9 Ethical considerations**

1. Approval to undertake this research was obtained from the Research and Ethical Committee and Compassion International Kenya Management.

2. All study participants were consented after providing them with relevant study information. Caregivers of participants below 12 years consented on their behalf and participants above 12 years (mature minors) assented.
3. Anonymity and confidentiality was maintained, codes were used for identification purposes.
4. The benefits of this study to the study participants included: free oral health checkup for the children/youth, advice on maintenance of proper oral hygiene and safe oral health practices for both children/youth and their caregivers.
5. The study participants who were found in need of further clinical management were referred to various health facilities for management. Children/youth's cost of further treatment has been catered for by Compassion International.
6. Only required data was obtained for the purposes of the study.
7. There was no coercion, psychological or physical harm to clients in course of the study.

### **3.2 STRENGTH AND LIMITATIONS OF THE STUDY**

The study had a high response rate of the children/ youth and the caregivers increasing the value of the results. The cross-sectional design allows for investigation of association between different factors, however, investigations for causality would require a longitudinal study. The study used an interviewer administered questionnaire which reduced the risk of no-response misconception and errors. Data collected was from a selected group and may not be generalized to the whole population

## CHAPTER FOUR: RESULTS

This chapter contains a presentation of the study results in two main sections:

- i) Section 4.1 which describe the respondent's social and demographic characteristics. The respondents were children / youth and their caregivers. A total of 280 respondents participated in the study drawn from 8 Compassion assisted Projects in Mbeere District and
- ii) Section 4.2 which contains the presentation of the results by objectives. The objectives included:
  - 1 To determine the prevalence of dental caries among the children/youth
  - 2 To determine the child/youth related factors associated with dental caries occurrence
  - 3 To determine the caregiver related factors associated with dental caries occurrence among their children.
  - 4 To determine the contextual and health system related factors associated with dental caries occurrence among the children/youth

### 4.1 SOCIAL DEMOGRAPHIC CHARACTERISTICS

**Table 1: Distribution by age and sex of Child/youth Respondents**

Characteristics		Age (Years) n=280	
		6 – 12 n (%)	>=13 n (%)
<b>Gender</b>	Female	74(47.1)	57(46.3)
	Male	83(52.9)	66(53.7)
<b>Total</b>		157 (56.07)	123 (43.93)

Out of the 280 examined children/youth, 157 (56.07%) were aged 6-12 years while 123 (43.93%) were aged 13 years and above. In the 6-12 years age bracket 74 (47.1%) were girls and 83 (52.9%) were boys while in the 13 years and above age bracket, 57 (46.3%) were girls and 66 (53.7%) were boys. The age range was 6- 22 years.

**Table 2: Distribution of caregiver respondents by sex, level of education, source of family income and monthly income (n=280)**

<b>Variable</b>	<b>Frequency</b>	<b>Percent</b>
<b>Sex</b>		
Male	47	16.8
Female	233	83.2
<b>Level of education</b>		
Primary	216	77.1
Secondary	45	16.1
Tertiary	3	1.1
None	16	5.7
<b>Source of family income</b>		
Formal employment	10	3.6
Non-formal employment	269	96.1
Other	1	0.4
<b>Monthly income</b>		
Less than Ksh 5000	246	87.9
Ksh 5000-10000	32	11.4
More than Ksh 10000	2	0.7
<b>Total (n)</b>	<b>280</b>	<b>100</b>

The 280 caregiver respondents comprised of females 233 (83.2%) and males 47 (16.8%). 77.1% had attained primary level education, 16.1% secondary, 1.1. % tertiary while 5.7% had not acquired any formal education. A large proportion of the caregivers, 269 (96.1%) earn their livelihood through non-formal employment with 246 (87.9%) earning less than Kes 5,000 per month. Only 3.6% were in formal employment and 1(0.4%) person reported not to

have any form of income. 32 (11.4%) caregivers earn between Kes 5,000 and Kes 10,000 and 2 (0.7%) earn more than Kes 10,000

## 4.2 RESULTS BY OBJECTIVES

### 4.2.1. To determine the caries experience among the children/youth

The overall prevalence of dental caries for both children and youth was 21.8% with children of age 6 – 12 years having a prevalence of 22.9% while youth of age  $\geq 13$  years having a prevalence of 20.3%. The overall mean dmft was  $0.58 \pm 1.24$  SD with children of age 6 – 12 years having a mean of  $0.74 \pm 1.45$  SD while the youth of age  $\geq 13$  years having a mean of  $0.38 \pm 0.86$  SD as illustrated in the table below:

**Table 3: Dental caries experience for permanent teeth and deciduous**

	dt Mean $\pm$ SD	mt Mean $\pm$ SD	ft Mean $\pm$ SD	dmft Mean $\pm$ SD
<b>Overall</b>	0.24 $\pm$ 0.70	0.01 $\pm$ 0.08	0.00 $\pm$ 0.06	0.58 $\pm$ 1.24
<b>Age</b>				
6 – 12 years	0.15 $\pm$ 0.55	0.00 $\pm$ 0.00	0.00 $\pm$ 0.00	0.74 $\pm$ 1.45
$\geq 13$ years	0.36 $\pm$ 0.85	0.02 $\pm$ 0.13	0.01 $\pm$ 0.09	0.38 $\pm$ 0.86

\*t- test = 2.557, df = 278, p= 0.011

### 4.2.2: To determine the child/youth factors associated with dental caries occurrence

#### 4.2.2.1: Dental caries experience and sociodemographic characteristics of children/ youth

An Independent-Samples t-test showed a statistically significant difference in means of children's dental caries and age ( $t = 2.557$ ,  $df = 278$ ,  $p = 0.011$ ) as illustrated in table 4 below.

**Table 4: The Association of various components of Dental Caries experience of children and their socio-demographic characteristics**

	dt Mean $\pm$ SD	mt Mean $\pm$ SD	ft Mean $\pm$ SD	dmft Mean $\pm$ SD
<b>Overall</b>	0.24 $\pm$ 0.70	0.01 $\pm$ 0.08	0.00 $\pm$ 0.06	0.58 $\pm$ 1.24
<b>Age</b>				
6 – 12 years	0.15 $\pm$ 0.55	0.00 $\pm$ 0.00	0.00 $\pm$ 0.00	0.74 $\pm$ 1.45
$\geq 13$ years	0.36 $\pm$ 0.85	0.02 $\pm$ 0.13	0.01 $\pm$ 0.09	0.38 $\pm$ 0.86

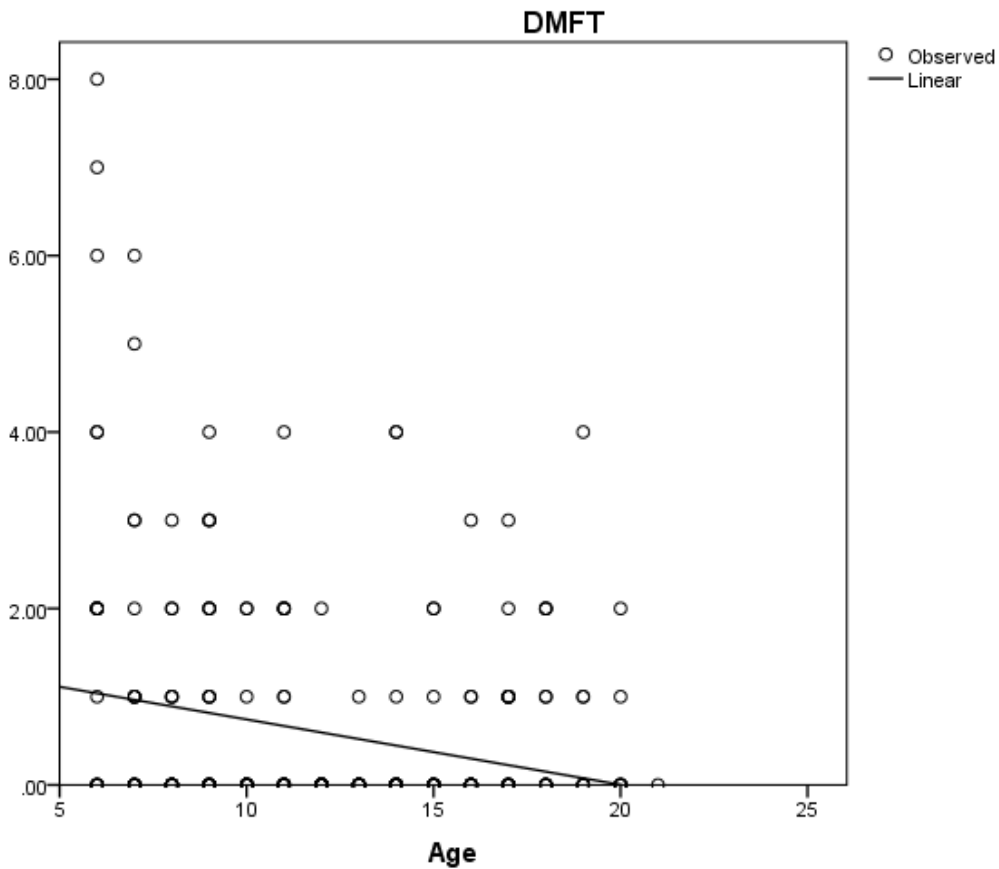
\*t- test = 2.557, df = 278, p= 0.011



Gender				
Male	0.21±0.68	0.01±0.12	0.00± 0.00	0.63±1.33
Female	0.28±0.73	0.00± 0.00	0.01± 0.09	0.53±1.13
t- test = 0.701, df = 278, p= 0.484				

A Curve Estimation Linear Regression model elicited a statistically significant association between age and decayed, missing, filled teeth (DMFT),  $F(1, 278) = 14.870$ ,  $R^2 = 0.041$ ,  $\beta = 0.225$ ,  $n = 280$ ,  $p < 0.001$ . The regression model positively predicted decay from age/prevalence of decay from age of children/ youth. Predictor variable is age. It means that as one progresses in age, the likelihood of decay is high. This is illustrated in the figure below:

**Figure 2: Plot model of age and decayed missing filled teeth (dmft)**



#### 4.2.2.2: Dental caries experience and oral health practices of children/ youth

An independent -Samples t-test showed a non-statistically significant difference in the means of children/youth dental caries and gender, brushing of teeth, frequency of brushing, what they use for brushing, use of fluoridated toothpaste, and if they have ever visited a dentist. An Analysis of Variance (ANOVA) showed a non-statistically significant difference in means of children/youth dental caries and the amount of time spent while brushing teeth, who guides them while brushing and when they last visited a dentist as shown in table 5 below.

**Table 5: The Association of various components of Dental Caries experience of children and their oral health practices**

	dt Mean + SD	mt Mean + SD	ft Mean + SD	dmft Mean + SD
<b>Overall</b>	0.24±0.70	0.01± 0.08	0.00 ±0.06	0.58±1.24
<b>Do you brush your teeth?</b>				
Yes	0.83± 0.37	0.00± 0.00	0.02± 0.15	0.20± 0.46
No	0.83± 0.86	0.17± 0.39	0.00 ± 0.00	0.40 ± 0.35
			t- test = 0.695, df = 278, p= 0.237	
<b>How often do you brush your teeth?</b>				
< Twice a day	0.20± 0.64	0.02± 0.13	0.00± 0.00	0.65± 1.41
>= Twice a day	0.22±0.60	0.00± 0.00	0.00± 0.00	0.46± 1.04
			t- test = 1.192, df = 278, p= 0.227	
<b>What do you use to brush your teeth?</b>				
Toothbrush	0.24±0.72	0.00±0.00	0.00± 0.00	0.62±1.35
Traditional sticks	0.27±0.73	0.02± 0.13	0.02± 0.13	0.55±0.93
			t- test = 0.323, df = 278, p= 0.747	
<b>Do you use fluoridated toothpaste while brushing your teeth?</b>				
Yes	0.22±0.66	0.01±0.07	0.00±0.00	0.61± 1.35
No	0.29±0.78	0.01±0.11	0.01±0.11	0.52± 0.93
			t- test = 0.575, df = 278, p= 0.566	
<b>How much time you spend brushing your teeth?</b>				
Less than 3 minutes	0.29±0.79	0.00±0.00	0.01±0.09	0.61± 1.30
3 minutes or more	0.22±0.68	0.02±0.14	0.00±0.00	0.52± 1.03
Don't know	0.12±0.33	0.00±0.00	0.00±0.00	0.67± 1.63
			ANOVA = 0.222, df = (2,272), p = 0.801	
<b>Who guides you to brush your teeth?</b>				
Mother	0.24±0.72	0.01± 0.11	0.01± 0.11	0.48±0.95
Father	0.05±0.23	0.00± 0.00	0.00± 0.00	0.47±0.84

Guardian	0.39±0.82	0.00± 0.00	0.00± 0.00	0.71±1.37
No one	0.24±0.70	0.01± 0.09	0.00± 0.00	0.63±1.41
ANOVA = 0.428, df = (3, 273), p = 0.733				
<b>Have you ever visited to dentist?</b>				
Yes	0.24±0.67	0.01±0.08	0.01± 0.08	0.58±1.20
No	0.26±0.76	0.01± 0.10	0.00± 0.00	0.61±1.32
t- test = 0.241, df = 278, p= 0.810				
<b>When did you last visit the dentist?</b>				
6 months ago,	0.46±1.10	0.00± 0.00	0.00± 0.00	1.00±1.74
1 year ago,	0.27±0.84	0.00± 0.00	0.00 ± 0.00	0.35±0.89
Never and Can't remember	0.22±0.62	0.01± 0.10	0.00± 0.07	0.59±1.23
ANOVA = 1.994, df = (2, 273), p = 0.138				

#### 4.2.2.3: Dental caries experience and oral health knowledge of children/ youth

An independent -Samples t-test showed a non-statistically significant difference in the means of children/youth dental caries and their oral health knowledge as shown in Table 6 below:

**Table 6: The Association of various components of Dental Caries experience of children and oral health knowledge characteristics**

	dt Mean ± SD	mt Mean ± SD	ft Mean ± SD	dmft Mean ± SD
<b>Overall</b>	0.24±0.70	0.01± 0.08	0.00 ±0.06	0.58±1.24
<b>Tooth decay is preventable</b>				
Yes	0.27±0.74	0.01±0.10	0.00± 0.00	0.59±1.31
No	0.17±0.54	0.00± 0.00	0.00± 0.00	0.56±0.99
t- test = 0.161, df = 278, p= 0.872				
<b>Dental Caries is-?</b>				
Correct definition	0.14±0.46	0.00± 0.00	0.00± 0.00	0.57±1.46
Incorrect definition	0.30±0.79	0.01± 0.10	0.01± 0.07	0.60±1.14
t- test = 0.206, df = 278, p= 0.837				
<b>Where does plaque stick to on the mouth?</b>				
Correct response	0.24±0.67	0.01± 0.07	0.01± 0.07	0.58±1.18
Incorrect response	0.26±0.76	0.01± 0.10	0.00± 0.00	0.59±1.35
t- test = 0.096, df = 278, p= 0.924				
<b>What cause dental caries?</b>				
Correct response	0.10±0.41	0.00± 0.00	0.00± 0.00	0.76± 1.64
Incorrect response	0.26± 0.73	0.01± 0.09	0.00 ± 0.00	0.56±1.19
t- test = 0.810, df = 278, p= 0.419				
<b>Do you brush your teeth after eating sweets or sugary substances?</b>				
Yes	0.29± 0.75	0.00± 0.00	0.00± 0.10	0.64± 1.31
No	0.21±0.67	0.01± 0.11	0.00± 0.00	0.55± 1.19
t- test = 0.566, df = 278, p= 0.572				

#### 4.2.2.4: Age and oral hygiene characteristics of children/ youth

Finding the age of children/ youth to have a statistically significant association with their dental caries experience necessitated a further analysis to determine association of age and various oral hygiene characteristics of the children/youth as follows:

A Chi-Square test of independence showed:

- i) A non-statistically significant association between children/youth gender and their age ( $\chi^2(1) = 0.017$ ,  $p = 0.905$ ).
- ii) A statistically significant association between children/youth frequency of brushing and their age ( $\chi^2(3) = 9.020$ ,  $*p = 0.029$ ).
- iii) A non-statistically significant association between children/youth type of toothbrush and their age ( $\chi^2(2) = 2.164$ ,  $p = 0.349$ ).
- iv) A non-statistically significant association between children/youth use of fluoridated toothpaste and their age ( $\chi^2(1) = 2.756$ ,  $p = 0.116$ ).
- v) A non-statistically significant association between children/youth duration of tooth brushing and their age ( $\chi^2(2) = 5.820$ ,  $p = 0.054$ ).

A Fisher's exact test of association showed a non-statistically significant association between children/youth brushing and their age (Fisher's Exact Test (1) = 0.424,  $p = 0.736$ ).

This is illustrated in table 7 below:

**Table 7: Socio-demographic and oral hygiene characteristics of children**

Characteristics		Age (Years)	
		6 – 12 n(%)	>=13 n(%)
<b>Gender</b>	Female	74(47.1)	57(46.3)
	Male	83(52.9)	66(53.7)
		$\chi^2(1) = 0.017, p = 0.905$	
<b>Do you brush your teeth?</b>	No	6(3.8)	3(2.4)
	Yes	151(96.2)	120(97.6)
		Fisher's Exact Test (1) =0.424, p = 0.736	
<b>How often do you brush your teeth?</b>	Once a day	63(40.1)	52(42.3)
	Twice a day	50(31.8)	49(39.8)
	Thrice a day	15(9.6)	14(11.4)
	Others	29(18.5)	8(6.5)
		* $\chi^2(3) = 9.020, p = 0.029$	
<b>What do you use to brush your teeth?</b>	Toothbrush	109(69.4)	95(77.2)
	Traditional sticks	35(22.3)	21(17.7)
	Others	13(8.3)	7(5.7)
		$\chi^2(2) = 2.164, p = 0.349$	
<b>Do you use fluoridated toothpaste while brushing your teeth?</b>	Yes	103(65.6)	92(74.8)
	No	54(34.4)	31(25.2)
		$\chi^2(1) = 2.756, p = 0.116$	
<b>How much time you spend brushing your teeth?</b>	Less than 3 minutes	74(47.1)	61(49.6)
	3 minutes or more	55(35.1)	52(42.3)
	Don't know	28(17.8)	10(8.1)
		$\chi^2(2) = 5.820, p = 0.054$	

A Chi-Square test of independence:

- i. Elicited a statistically significant association between caregiver's guidance of children/youth during tooth brushing and their age ( $\chi^2(3) = 25.391, *p < 0.001$ ).

- ii. Showed a non-statistically significant association between children/ youth dental visits and their age ( $\chi^2(1) = 0.008$ ,  $p = 0.929$ ).
- iii. Showed a non-statistically significant association between children/ youth last dental visit and their age ( $\chi^2(3) = 4.829$ ,  $p = 0.185$ ).
- iv. Showed a non-statistically significant association between children/youth brushing of teeth after eating sweets and sugary substance and their age ( $\chi^2(1) = 0.823$ ,  $p = 0.390$ ).
- v. Elicited a statistically significant association between children's knowledge of preventability of dental caries and their age ( $\chi^2(1) = 6.509$ ,  $*p = 0.015$ ).
- vi. Elicited a statistically significant association between children's knowledge of remnants of food particles in the mouth and their age ( $\chi^2(3) = 9.776$ ,  $*p = 0.020$ ).

This is illustrated in table 8 below:

**Table 8: Socio-demographic, oral health practice and knowledge characteristics of children**

Characteristics		Age (Years)	
		6 – 12 n (%)	>=13 n (%)
<b>Who guides you to brush your teeth?</b>	Mother	66(42.1)	19(15.4)
	Father	12(7.6)	7(5.7)
	Guardian	17(10.8)	21(17.1)
	No one	62(39.5)	76(61.8)
		*** $\chi^2(3) = 25.391$ , $p < 0.001$	
<b>Have you ever visited to dentist?</b>	Yes	63(40.1)	50(40.7)
	No	94(59.1)	73(59.3)
		$\chi^2(1) = 0.008$ , $p = 0.929$	
<b>When did you last visit the dentist?</b>	6 months ago,	15(9.6)	9(7.3)
	1 year ago,	16(10.2)	22(17.9)
	Never	89(56.6)	71(57.7)
	Can't remember	37(23.6)	21(17.1)
		$\chi^2(3) = 4.829$ , $p = 0.185$	
<b>Do you brush your teeth after eating sweets or</b>	Yes	58(36.9)	52(42.3)
	No	99(63.1)	71(57.7)

<b>sugary substances?</b>		$\chi^2(1) = 0.823, p = 0.390$	
<b>Tooth decay is preventable</b>	Yes	111(70.7)	103(83.7)
	No	46(29.3)	20(16.3)
		$*\chi^2(1) = 6.509, p = 0.015$	
<b>Remnants of food particles in the mouth are referred to as</b>	Calculus	19(12.1)	7(5.7)
	Plaques	55(35.0)	31(25.2)
	Stains	13(8.3)	8(6.5)
	Don't know	70(44.6)	77(62.6)
		$*\chi^2(3) = 9.776, p = 0.020$	

A Fisher's exact test of association showed a non-statistically significant association:

- i. Between children's knowledge of where plaque sticks to on the mouth and their age (Fisher's Exact Test (3) = 5.000,  $p = 0.172$ ).
- ii. Between children's knowledge of dental caries and their age (Fisher's Exact Test (2) = 5.310,  $p = 0.053$ ). This is shown in table 9 below:

**Table 9: Socio-demographic and oral health knowledge characteristics of children**

<b>Characteristics</b>		<b>Age (Years)</b>	
		<b>6 – 12 n (%)</b>	<b>&gt;=13 n (%)</b>
<b>Where does plaque stick to on the mouth?</b>	On the teeth	98(62.4)	84(68.3)
	On the gum	21(13.4)	21(17.1)
	On the tongue	6(3.8)	1(0.8)
	Do not know	32(20.4)	17(13.8)
		Fisher's Exact Test (3) = 5.000, $p = 0.172$	
<b>Dental Caries is-?</b>	Disease causing holes on the tooth surface	93(59.2)	89(72.4)
	Don't know	61(38.9)	33(26.8)
	Other	3(1.9)	1(0.8)
		Fisher's Exact Test (2) = 5.310, $p = 0.053$	

#### **4.2.3: To determine the caregiver factors associated with dental caries occurrence**

An Independent-Samples t test showed a non-statistically significant difference in means of:

- i. Children's dental caries and caregiver's knowledge of brushing as a prevention of dental caries in children ( $t = 1.423$ ,  $df = 278$ ,  $p = 0.158$ ).
- ii. Children's dental caries and caregiver's knowledge in guidance of children during tooth brushing ( $t = 0.667$ ,  $df = 278$ ,  $p = 0.505$ ).
- iii. Children's dental caries and caregiver's knowledge of use of toothpaste with fluoride in by children during tooth brushing ( $t = 0.141$ ,  $df = 278$ ,  $p = 0.888$ ).

An Analysis of Variance (ANOVA) showed a non-statistically significant difference in means of:

- i. Children's dental caries and the caregiver's knowledge of the type of toothbrush used for tooth brushing in children ( $F = 0.817$ ,  $df = (3, 270)$ ,  $p = 0.486$ ).
- ii. Children's dental caries and the caregiver's knowledge of toothpaste with fluoride as a prevention of dental caries in children ( $F = 0.259$ ,  $df = (2, 277)$ ,  $p = 0.772$ ).
- iii. Children's dental caries and the caregiver's knowledge of dental visits as a prevention of dental caries in children ( $F = 1.966$ ,  $df = (2, 277)$ ,  $p = 0.142$ ).
- iv. Children's dental caries and the caregiver's knowledge of tooth brushing by children after eating of sweets and sugary substance as a prevention of dental caries in children ( $F = 2.221$ ,  $df = (2, 277)$ ,  $p = 0.110$ ). This is illustrated in Table 10 below:



**Table 10: Caregiver's knowledge on children's oral health and dental caries occurrence amongst children/youth (n=280)**

Characteristics		n (%)	DT (Mean $\pm$ SD)	95% CI	
				Lower	Upper
<b>Does brushing of teeth prevent caries from occurring?</b>	Yes	237 (84.6)	0.26 $\pm$ 0.74	-0.0485	0.2926
	No	43 (15.4)	0.14 $\pm$ 0.47		
t = 1.423, df = 278, p = 0.158 rho = -0.058, p = 0.336					
<b>Do you guide your children on how to brush their teeth?</b>	Yes	238 (85.0)	0.23 $\pm$ 0.71	-0.3099	0.1531
	No	42 (15.0)	0.31 $\pm$ 0.64		
t = 0.667, df = 278, p = 0.505 rho = 0.087, p = 0.148					
<b>What do your children use for cleaning their teeth?</b>	Tooth brush	203 (74.1)	0.21 $\pm$ 0.65	0.1170	0.2968
	Traditional sticks	67 (24.5)	0.34 $\pm$ 0.81	0.1462	0.5404
	Fingers	1 (0.4)	0.00 $\pm$ .	.	.
	Any other (specify)	1 (1.1)	0.00 $\pm$ 0.00	0.0000	0.0000
F = 0.817, df = (3, 270), p = 0.486 rho = 0.056, p = 0.355					
<b>Does your child use fluoride toothpaste while brushing?</b>	Yes	207 (73.9)	0.25 $\pm$ 0.71	-0.1749	0.2019
	No	73 (26.1)	0.23 $\pm$ 0.68		
t = 0.141, df = 278, p = 0.888 rho = -0.004, p = 0.943					
<b>Does fluoride prevent teeth from decaying?</b>	Yes	212 (75.7)	0.23 $\pm$ 0.66	0.1374	0.3154
	No	36 (12.9)	0.28 $\pm$ 0.81	0.0022	0.5534
	Don't know	32 (11.4)	0.31 $\pm$ 0.86	0.0028	0.6222
F = 0.259, df = (2, 277), p = 0.772 rho = 0.019, p = 0.758					
<b>Has your child ever visited a Dentist?</b>	Yes	99 (35.4)	0.31 $\pm$ 0.80	0.1582	0.4734
	No	172 (61.4)	0.19 $\pm$ 0.62	0.0925	0.2796
	Don't know	9 (3.2)	0.56 $\pm$ 0.88	-0.1223	1.2335
F = 1.966, df = (2, 277), p = 0.142 rho = -0.043, p = 0.471					
<b>Do your child/youth brush his/her teeth after eating sweets or sugary substances?</b>	Yes	93 (33.2)	0.36 $\pm$ 0.89	0.1814	0.5498
	No	156 (55.7)	0.17 $\pm$ 0.57	0.0830	0.2632
	Don't eat sweets every day	31 (11.1)	0.23 $\pm$ 0.62	-0.0005	0.4521
F = 2.221, df = (2, 277), p = 0.110					

An Analysis of Variance (ANOVA) showed a non-statistically significant difference in means of:

- i. Children's dental caries and the caregiver's knowledge of remnants of food particles in mouth (F = 0.690, df = (3, 276), p = 0.559).
- ii. Children's dental caries and the caregiver's knowledge of where plaque stick to on the mouth (F = 0.603, df = (3, 276), p = 0.614).
- iii. Children's dental caries and the caregiver's knowledge of dental caries (F = 0.331, df = (2, 277), p = 0.718).
- iv. Children's dental caries and the caregiver's knowledge of causes of dental caries (F = 0.940, df = (5, 273), p = 0.456).
- v. Children's dental caries and the caregiver's knowledge of how dental caries can be prevented (F = 1.268, df = (5, 274), p = 0.278). This is shown in table 11 below:

**Table 11: Caregiver's knowledge on children's oral health and dental caries occurrence amongst children/youth (n=280)**

Characteristics		n (%)	DT (Mean $\pm$ SD)	95 % CI	
				Lower	Upper
<b>Remnants of food particles in mouth are referred to as?</b>	Plaques	142 (50.7)	0.22 $\pm$ 0.65	0.1099	0.3267
	Calculus	39 (13.9)	0.31 $\pm$ 0.89	0.0182	0.5972
	Stains	64 (22.9)	0.19 $\pm$ 0.53	0.0549	0.3201
	Don't know	35 (12.5)	0.37 $\pm$ 0.91	0.0587	0.6841
			F = 0.690, df = (3, 276), p = 0.559 rho = 0.035, p = 0.562		
<b>Where does plaque stick to on the mouth?</b>	On the tongue	9 (3.2)	0.33 $\pm$ 0.50	-0.0510	0.7177
	On the gum	68 (24.3)	0.32 $\pm$ 0.94	0.0966	0.5504
	On the teeth	199 (71.1)	0.22 $\pm$ 0.62	0.1296	0.3025
	Do not know	4 (1.4)	0.00 $\pm$ 0.00	0.0000	0.0000
			F = 0.603, df = (3, 276), p = 0.614 rho = -0.067, p = 0.263		
<b>Dental Caries is-?</b>	Disease causing holes on the tooth surface	173 (61.8)	0.27 $\pm$ 0.78		0.3836
				0.1482	

	Don't know	98 (35.0)	0.21 ± 0.56	0.1019	0.3267
	Any other (specify)	9 (3.2)	0.11 ± 0.33	-0.1451	0.3673
				F = 0.331, df = (2, 277), p = 0.718 rho = 0.011, p = 0.859	
<b>What causes dental caries?</b>	Micro-organisms	97 (34.8)	0.34 ± 0.85	0.1684	0.5120
	Eating too much sugary foods	82 (29.4)	0.26 ± 0.68	0.1064	0.4058
	Not having regular check-ups	6 (2.2)	0.00 ± 0.00	0.0000	0.0000
	Failure to brush teeth	82 (29.4)	0.13 ± 0.56	0.0108	0.2575
	Drinking dirty water	1 (0.4)	0.00 ± .	.	.
	Any other (specify)	11 (3.9)	0.27 ± 0.47	-0.0411	0.5865
				F = 0.940, df = (5, 273), p = 0.456 rho = -0.094, p = 0.119	
<b>How can dental caries be prevented?</b>	Limiting sugar consumption	31 (11.1)	0.39 ± 0.88	0.0635	0.7107
	Regular brushing with fluoride toothpaste	198 (70.7)	0.21 ± 0.66	0.1200	0.3042
	Regular dental check-ups	26 (9.3)	0.08 ± 0.39	-0.0815	0.2353
	Avoiding sweets	12 (4.3)	0.42 ± 0.10	-0.2163	1.0496
	Drinking fluoridated water	3 (1.1)	0.67 ± 1.15	-2.2018	3.5351
	Any other (specify)	10 (3.6)	0.50 ± 0.97	-0.1952	1.1952
				F = 1.268, df = (5, 274), p = 0.278 rho = -0.033, p = 0.578	

An Analysis of Variance (ANOVA) showed a non-statistically significant difference in means of:

- i. Children's dental caries and the caregiver's source of information on dental caries (F = 0.175, df = (3, 276), p = 0.913).
- ii. Children's dental caries and the caregiver's frequency of brushing (F = 0.341, df = (4, 275), p = 0.850).

iii. Children's dental caries and the caregiver's frequency of dental visits ( $F = 1.258$ ,  $df = (3, 276)$ ,  $p = 0.289$ ). This is shown in table 12 below:

**Table 12: Caregiver's knowledge on children's oral health and dental caries occurrence amongst children/youth (n=280)**

Characteristics		n (%)	DT (Mean $\pm$ SD)	95% CI	
				Lower	Upper
<b>Where did you get information on dental caries?</b>	School/Project teachers	186 (66.4)	0.25 $\pm$ 0.72	0.1439	0.3508
	Doctors/ Dentists	53 (18.9)	0.19 $\pm$ 0.59	0.0260	0.3514
	Advertisements	24 (8.6)	0.29 $\pm$ 0.91	-0.0917	0.6750
	Any other (specify)	17 (6.1)	0.29 $\pm$ 0.59	-0.0081	0.5964
				F = 0.175, df = (3, 276), p = 0.913 rho = 0.009, p = 0.876	
<b>How often do you brush your teeth?</b>	Once in a day	143 (51.1)	0.23 $\pm$ 0.65	0.1239	0.3377
	Twice in a day	95 (33.9)	0.28 $\pm$ 0.85	0.1118	0.4566
	Thrice in a day	21 (7.5)	0.10 $\pm$ 0.30	-0.0417	0.2322
	Do not brush	14 (5.0)	0.29 $\pm$ 0.61	-0.0672	0.6386
	Any other (specify)	7 (2.5)	0.28 $\pm$ 0.76	-0.4134	0.9848
				F = 0.341, df = (4, 275), p = 0.850 rho = 0.002, p = 0.974	
<b>How often do you visit a dentist?</b>	Once in a year	46 (16.4)	0.15 $\pm$ 0.51	-0.0008	0.3051
	More than once in a year	37 (13.2)	0.35 $\pm$ 0.82	0.0767	0.6260
	Can't remember	35 (12.5)	0.40 $\pm$ 0.91	0.0860	0.7140
	Never	162 (57.9)	0.21 $\pm$ 0.66	0.1069	0.3128
				F = 1.258, df = (3, 276), p = 0.289 rho = -0.045, p = 0.450	

#### **4.2.4: To determine the contextual and health system related factors associated with dental caries occurrence among the children/youth**

##### ***4.2.4.1 Contextual factors and prevalence of dental caries***

A key informant interview was done with the Embu County Health Officer and yielded the following information.

###### **4.2.4.1.1 Organization of oral health services in Embu County.**

There are only two public hospitals providing oral health services namely Embu level five and Ishiara level four. There is no office charged with the responsibility of running oral health just like there is a county pharmacist and a county medical director hence matters of co-ordination, regulation and acquisition of supplies is somewhat disorganized.

###### **4.2.4.1.2 Health facilities providing dental treatments in Embu County**

Two public hospitals; namely Embu level five and Ishiara level four provide dental treatments in Embu County. Several private clinics run by dental technicians and Community Oral Health Officers also offer oral health services.

###### **4.2.4.1.3 Dental services provided in Embu County**

Virtually all services are available in the hospitals mentioned above except for Ishiara level four that doesn't have a dental lab. The services include; dental check-up, teeth extraction, fillings, scaling, dentures, root canals, and braces provision.

###### **4.2.4.1.4 Accessibility of oral health services**

Since there are only two facilities offering oral health services, people have to travel far to access these services. This discourages a lot of people from seeking dental care (check -ups

and treatments). They resort to self-treatment and only visit the facility when the situation becomes unmanageable. If there is no pain, people learn to live with dental impairments.

Additionally, the cost of these services is seemingly unaffordable to most people.

#### **4.2.4.1.5 Cultural practices affecting utilization of services and other challenges experienced in providing oral health services**

Some religious sect discourages its members from seeking medical care so as not go against their faith; this causes its members who may have dental issues not to seek medical help. This sect has a small following of about 5% of the population.

Other challenges experienced in delivery of oral health services include: Lack of proper regulation and licensing hence you find too many unqualified people running private clinics, Lack of supplies and equipment's (inadequate funding), Very few public facilities offering dental services and Inadequate qualified personnel.

#### **4.2.4.1.6 Government policy and budget factors**

There exists a national policy on oral health aimed at ensuring Kenyans enjoy improved levels of oral health and function by considerably lowering the oral diseases burden, promoting equitable cost-effective quality oral health care and adoption of healthy lifestyles through promotion of public, private and community partnerships. However, the objectives envisaged in this policy are far from being realized since a county like Embu is still not able to provide equitable cost-effective quality oral health and effort has not been put in establishing partnerships that would promote adoption of healthy lifestyles. It also interesting to note that oral health supplies attract 16% tax (VAT); this contributes to an increase in the cost of oral

health services. No subsidies are available on dental treatments by the Government even for the poor people.

When asked if there was a county allocation on oral health, the response was ‘No. Dental supplies are bought with money slashed from other departmental budgets but sometimes the county has bought lignocaine (a local anesthesia drug)’.

#### **4.2.4.2: HEALTH SYSTEM FACTORS AND PREVALENCE OF DENTAL CARIES**

Key informant interviews done with the 8 Project Directors yielded the following information:

##### **4.2.4.2.1 What the Project exist to accomplish**

The cross-cutting response from the 8 Project Directors was that it exists to transform the lives of poor and needy children by improving their physical (health), social, spiritual and economic status and enable them to become responsible stewards within the community.

##### **4.2.4.2.2 Health interventions carried out at the Project**

The mentioned interventions included: annual general health screening of children, health seminars targeting children and other times their caregivers, dental campaigns, referral of sick children to hospitals, provision of a balance diet and provision of first aid services to children.

##### **4.2.4.2.3 Top five diseases affecting children at the Project**

The mentioned conditions included: Skin diseases, Eye diseases, Dental caries, Digestive conditions, Respiratory conditions and Malaria. Dental caries/ teeth decay was mentioned by all the 8 Projects.

#### **4.2.4.2.4 Magnitude of dental diseases at the Project**

The Project Directors indicated the burden to range from 30%- 60% and they said that dental cases are regularly reported by the children/ youth.

#### **4.2.4.2.5 Measures put in place to address dental diseases**

All the Projects reported to have organized dental campaigns for the children where they are taught on dental hygiene and those with dental issues are referred to health facilities for treatment.

#### **4.2.4.2.6 Accessibility of health facilities providing oral health services and services provided.**

All the PDs mentioned Embu Level five hospital and Ishiara level 4 hospitals where dental services are provided. They however indicated that the distance to these facilities was large, some children have to travel 24 kilometers to access dental care.

They mentioned a wide range of services provided in these facilities including; extractions, fillings, cleaning, root canal and dental check-up.

#### **4.2.4.2.7 Challenges experienced in supporting children/ youth access dental treatments.**

The challenges reported include:

- i. Distance- the two health facilities are far and children/ caregivers have to travel long distances to access dental care.
- ii. Long ques in the two health facilities' dental units which discourages many people from seeking care



- iii. Some dental procedures are expensive and beyond reach for most parents for example root canal treatment
- iv. Very few Dentists at the health facilities
- v. Some caregivers are ignorant on oral health and therefore they do not guide their children or even reinforce what has been taught at the project or school.
- vi. Lack of timely interventions due to delay in accessing care
- vii. Some services lack in Ishiara level four hospital causing subsequent referrals to Embu level five which is very far (some mentioned, 60-100 kms away).

#### **4.2.4.3 Summary of contextual and health system factors**

Contextual and health system factors contributing to high caries prevalence cited included; inaccessible oral health services due to limited facilities offering these services, the cost of oral health services was out of reach for most respondents, delay in accessing oral treatment related to distance from the facilities and congestion at the facilities. Additionally, inadequate number of trained personnel in dental care also contributes to high prevalence. Inadequate implementation of the oral health policy and inadequate budgetary allocations on dental care at the county level also hampers oral service delivery.

## DISCUSSION

The study has demonstrated that dental caries prevalence (21.8%) among rural school going children is comparable to that found in the Kenya National Oral Survey (Kenya National Oral Survey Report, 2015) (23.9%) and a study conducted in Mathira West District (24.0%) (Gladwell et al, 2012). It was also low in relation to that found in two studies done in Nairobi whose prevalence was found to be between 40-50% (Ng'ang'a et al, 1992) and 37.5% (Gladwell et al, 2012). The DMFT score was found to be 0.58 which is consistent with that of a report indicating that the mean DMFT of the rural children population is below 2 (Kaimenyi, 2004) but higher compared to the Mathira West District study (DMFT 0.36). Dental caries prevalence in this study was lower than other East African countries' prevalence where rural areas in Uganda recorded a prevalence of 29% (Wandera et al, 2003), and 41.5% among children living in urban areas in Tanzania (Mwakatobe et al, 2007). The prevalence was comparable to a study done in Burkina Faso where the rural area prevalence was 21.2% (Varenne et al, 2004).

In this study, boys (DMFT= 0.63) were found to have a higher prevalence than girls (DMFT=0.53). These findings differ with other studies which found girls to have a higher prevalence than boys as follows: Kallestal et al in a Swedish study found girls to be more seriously affected with dental caries than boys (Kallestal et al 2002). In an oral health status survey of school children in Mbarara, Uganda, the mean decayed, missing, filled permanent teeth (DMFT) was  $1.5(\pm 0.8 \text{ SD})$ . Females had higher DMFT ( $1.6\pm 0.8\text{SD}$ ) than males ( $1.3\pm 0.8\text{SD}$ ). Another study done among school going children in Bulawayo, Zimbabwe found girls to have a higher prevalence of 51.6% than boys, 48.4% (Notion, 2007).

Dental caries prevalence was found to be highest among children aged 6-12 years (22.9%, DMFT=0.74) and lower among children and youth aged 13-22 years (20.3%, DMFT=0.38). Age was found to be significantly associated with caries occurrence at p value (0.011). The 6-12 years old DMFT is lower compared to one recorded in a study done in India among orphaned children which was 1.37 (Rakesh, 2013). The DMFT for 13 years and above was lower than that of a study done among students in Nairobi whose DMFT was 1.2-1.9 (Ng'ang'a et al, 1992). Age influences caries occurrence in that when children are young, they tend to have poor oral health practices and level of knowledge on its prevention low hence high prevalence is recorded.

Children/youth oral hygiene practices and knowledge factors that showed significant statistical association included: frequency of brushing at p value 0.029, caregiver's guidance while brushing at p value 0.001, children/youth knowledge of preventability of dental caries at p value 0.015, and children/youth knowledge of remnants of food particles in the mouth at p value 0.02. In a similar manner, a study in Karachi, Pakistan found that poor oral hygiene (irregular brushing of teeth, failure to use toothpaste) was significantly associated with caries occurrence at p value 0.00 (Narender, 2012). In yet another study done in Karachi, Pakistan, never visited a dentist showed a strong statistical association with caries occurrence at p value 0.013(Mohammad, 2012), a similar association to the one revealed in this study. A low frequency of tooth brushing (once or less than once per day versus twice or more per day) was found to be associated with a higher number of carious permanent teeth (Maserejian, et al., 2008). It is therefore important to train children/ youth on; proper brushing of teeth, brushing of teeth more than once per day, and after eating sugary substances, use toothpaste while brushing and visit a Dentist for check-up at least once in a year.

The knowledge of the children/ youth on dental caries and its prevention was low at an average of 59.28%. 76.4% of the children/youth know that tooth decay is preventable of which 51.8% were aged six to twelve years and 48.1% aged thirteen years and above. 30.7% know that plaque sticks on the teeth of which 63.9% were aged six to twelve years and 36.04% aged 13 years and above. 65% know that dental caries causes holes on the teeth surface of which 51% were aged six to twelve years and 49% aged thirteen years and above. The observation made is that the younger children aged six to twelve years had a higher understanding of oral hygiene than the older ones aged thirteen years and above. This level of knowledge was lower compared to the study done among children in Zimbabwe ((Notion, 2007) and like the study done in Karachi, Pakistan ((Mohammad, 2012). It is important to diversify oral health education sources and include parents/guardians who are always with the children and therefore well placed to deliver proper education to their children. The teachers at Projects and Schools also need to be equipped with better training skills and aides so that they can effectively teach the children/ youth.

Brushing teeth under the guidance of a caregiver showed a significant association at p value 0.001. Since the mother is the main caregiver who guides children while brushing (30.4%), it is important to equip her with the correct information on brushing so that they pass accurate information to their children. Caregiver related factors showed a non-significant association with the children/youth oral health. These findings were comparable with those of other studies which did not find significant association but found that the odds of caries occurring was higher if ; the mother has no formal education (OR=4.3) (Gladwell et al, 2012), families have low income and their parents have low level of education (Wang et al, 2010). Other studies have shown that those children whose parents are aware of the oral health of their

children have lower caries than those whose parents are unaware (Hallett et al, 2002). It has been seen in recent studies that children's who have dental caries are from a background where families have low income and their parents have low level of education (Wang et al, 2010). A study of (Tickle,1999) conducted on children who were registered to general dental clinics in north of London, found that children belonging to low socioeconomic class experience a higher dental caries status and were less likely visit to dental clinics while those children from higher income class have lower experiences of dental disease and more treatments of dental diseases. Another study done in the USA found that children from low SES had a higher DMFT than those from high SES (Al-Shalan, 2003). Therefore, the caregiver's level of education, knowledge on caries and its prevention and socioeconomic status play a key role in caries occurrence.

Contextual and health system factors contributing to high caries prevalence cited by the County Official and Project Directors included; inaccessible oral health services due to limited facilities offering these services, the cost of oral health services was out of reach for most respondents, delay in accessing oral treatment related to distance from the facilities and congestion at the facilities. Additionally, inadequate number of trained personnel in dental care also contributes to high prevalence. Slow operationalization of the national oral health policy and inadequate budgetary allocations on dental care at the county level also hampers oral service delivery. There is also limited supply of oral health personnel in Africa, a situation that leaves children and even adults suffering from tooth decay untreated resulting to increasing level of oral malfunction (Peterson, 2005).

The factors reported in this study are also consistent with the report by Danfillo which states that oral health services are mostly curative in the African countries and these services are mostly located in urban communities and are haphazardly established and poorly coordinated. (Danfillo, 2009). Professor Kaimenyi also confirms that in Kenya, the majority of the oral health personnel are dentists. The dentist /population ratio is 1: 378,000 in the public sector and 1: 60,000 when all sectors are combined. There are few trained auxiliary dental personnel due to the late establishment of a National Oral Health Policy (Kaimenyi, 2004). Other reports also indicate that when one visits a public dental clinic in Kenya, they require to buy a card, the cost of which is prohibitive to many people. Most government facilities (80%) are situated in the urban areas, are often understaffed and are unable to provide dental education to visiting clients as demonstrated by the dentist- population ratio of 1: 60,000 (Enwonwu, 1995). All these factors contribute to increasing levels of impaired oral health.

## **CONCLUSION**

The dental caries prevalence of the children/ youth was comparable with that of other studies within the country (21.8%) with boys recording a higher prevalence than girls. The younger children aged 6-12 years had a higher caries prevalence and DMFT than the older ones aged 13 years and above. Age was significantly associated with caries occurrence.

Some children/youth oral health knowledge factors were significantly associated with dental caries including; children/youth knowledge of preventability of dental caries and children/youth knowledge of remnants of food particles in the mouth. Younger children aged 6-12 years had a higher understanding of oral hygiene than the older ones aged 13 years and above. Caregiver factors did not show statistically significant association with dental caries occurrence among their children.

Contextual and health system factors contributing to high caries prevalence cited by the County Official and Project Directors included; inaccessible oral health services due to limited facilities offering these services, the cost of oral health services was out of reach for most respondents, delay in accessing oral treatment related to distance from the facilities, congestion at the facilities and inadequate number of trained personnel in dental care. Slow implementation of the national oral health policy and inadequate budgetary allocations on dental care at the county level also hampers oral service delivery.

## **RECOMMENDATIONS**

1. Since dental caries prevalence has been shown to vary with age, age-graded oral health education curriculum needs to be developed and implemented.
2. Older children and youth aged 13 years and above demonstrated lower knowledge of oral health hygiene, there should be special emphasis on oral health education for this age group including use of diverse methods to reach them with oral health messages.
3. Oral health education in schools needs to be given greater emphasis particularly focusing on oral practices such as, consistent brushing of teeth, use of fluoride toothpaste and visiting a dentist for check-up.
4. Parents or guardians play a key role in guiding children on brushing their teeth, it is important to equip them with the correct information on brushing so that they pass accurate information to their children.
5. Since the school or Project is the main source of dental education, there is need to equip the teachers with better training skills and teaching aides so that they can effectively deliver education to the children/ youth.
6. The county governments need to put measures to encourage adult literacy and promote economic empowerment of the caregivers since these two have a potential of reducing caries prevalence.
7. The county government should increase the number of public facilities offering affordable oral health care and facilitate provision of oral health education to the communities and schools.
8. Oral health budgetary at the county level needs to be prioritized and increased.



9. County governments need to fast track implementation of the oral health policy to mitigate oral diseases burden, facilitate equitable cost-effective quality oral health care and adoption of good oral health related lifestyles through engagement with public, private and community partnerships

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## **APPENDICES**

### ***Appendix I: Participants' Consent form***

I, Catherine Wamiti, a postgraduate student pursuing a Master's degree in Public Health at the University of Nairobi, School of Public Health, am conducting a research study on **“Factors associated with dental caries among children/youth in Mbeere District”** The approval to carry out this study has been given by the Kenyatta National Hospital / University of Nairobi Ethics and Research Committee.

#### **Purpose of the Study & Procedure**

The purpose of this study is to determine Prevalence of dental caries and the associated factors among children/youth in Mbeere Cluster Compassion International Projects

If you agree to participate in this study, then you and your child/youth will be required to answer questions in an interviewer administered questionnaire which comprises of both close ended and open-ended questions. Your child/youth will also be examined by a dentist to check his/her oral health status and referred for further checkup and treatment as appropriate.

#### **Perceived benefits**

Your benefit from the study will include advice on maintenance of proper oral hygiene. Your child will benefit from dental checkup by a dentist and advised on appropriate treatment in case they are found to have issues. The results obtained from this study will provide information towards the development of effective oral health interventions aimed at reducing cases of dental caries.

#### **Risks**

There are no anticipated risks for participating in the study. The only risk is that some of required information is personal.

**Costs and payments:**

This study is strictly voluntary, and no monetary compensation will be given.

**Confidentiality:**

All the information that you provide will be strictly confidential. Your names will not appear anywhere on the data collection form. Only identification numbers will be used on the forms.

**Withdrawal privilege:**

If you decide to withdraw from the study, then you are free to do so at any time without penalty or prejudice.

**Contact**

In case you have any questions or issues regarding the study during or after the study, then you are free to contact me through P. O Box 55379-00200, Nairobi, Mobile: 0721563979 OR the Secretary, KNH-UoN Ethics and Research Committee, P.O Box 20723 - 00202, Nairobi, Tel. No. Tel: (254) 020 726300 EXT 44102, 44355

**Voluntary consent:**

I certify that I have read and understood all of this consent explanation and questions pertaining to the research have been answered to my satisfaction. My signature below means I freely agree to participate in this study.

**Signature of participant .....Date:.....**

**Investigators statement:**

I certify that I have explained to the above individual the nature and purpose of this study, potential benefits and possible risks associated with participation in this study. I have answered any questions that have been raised. I have also explained the above to the participant on the date on this consent form.

**Investigator.....Date:.....**

***Appendix II: Key Informant Interview Guide I- Project Director,  
Compassion International assisted Project in Mbeere District.***

**Guiding Questions**

1. What does this Project exist to accomplish?
2. Which health interventions are carried out in this Project?
3. Which are the top five diseases affecting children/youth in this Project
4. What is the magnitude of dental diseases in this Project
5. What measures have been put in place to address dental diseases?
6. What is the referral mechanism once a child/youth is diagnosed with a dental condition?
7. Are there health facilities providing dental treatments in your region of operation?
8. What are the dental services provided in these facilities?
9. What challenges do you experience in supporting children/youth access dental treatments?

## ***Appendix III: Key Informant Interview Guide II- Embu County Health Officer***

### **Guiding Questions**

- 1) Briefly explain the organization of oral health services in this county.
- 2) Are there health facilities providing dental treatments in your region of operation?
- 3) What are the dental services provided in these facilities
- 4) How accessible are oral health services in these facilities?
- 5) Are there some norms and cultural practices that affect utilization of oral health services in this county? Share more about them.
- 6) Is there a pro-poor dental policy by the Government? Share more about it and how it benefits people in this county.
- 7) How is the oral health policy implemented in this county?
- 8) Do oral health supplies attract any form of taxation?
- 9) Is there a budgetary allocation for oral health by the Government? Briefly explain this allocation.
- 10) What challenges are commonly experienced in provision of oral health services in this county?

**Appendix 1V: Interviewer administered questionnaire to the children /youth on knowledge of dental caries and their oral hygiene practices**

The interviewer will ask questions and tick where appropriate and give explanations where necessary.

Questionnaire No-----

Date completed ----- (dd/mm/yr)

Identification Code\_\_\_\_\_

**1. Demographic Characteristics**

1. Sex of the child/youth

Male

Female

**2. Oral Health Behaviour**

1. Do you brush your teeth?

Yes

No

2. If yes, how often do you brush your teeth?

Once in a day

Twice in a day

Thrice in a day

3. What do you use to brush your teeth?

Tooth brush

Traditional sticks

Fingers

Any other (specify) \_\_\_\_\_

4. Do you use fluoridated toothpaste while brushing your teeth?

Yes

No

5. How much time you spend brushing your teeth?

Less than 3 minutes

3 minutes or more

Don't know

6. Who guides you to brush your teeth?

Father

Mother

Guardian

No one

7. Have you ever visited to dentist?

Yes

No

8. When did you last visit the dentist?

6 months ago

1 year ago

Can't remember

Never

9. Do you brush your teeth after eating sweets or sugary substances?

Yes

No

3. **Knowledge on Caries and prevention**

10. Tooth decay is preventable

Yes

No



11. Remnants of food particles in mouth are referred to as?

Plaques

Calculus

Stains

Don't know

12. Where does plaque stick to on the mouth?

On the tongue

On the gum

On the teeth

Do not know

13. Dental Caries is-?

Disease causing holes on the tooth surface

Don't know

Any other (specify)\_\_\_\_\_

14. What causes dental caries?

- Micro-organisms
- Eating too much sugary foods
- Not having regular check-ups

Failure to brush teeth

Drinking dirty water

15. How can dental caries be prevented?

- Limiting sugar consumption
- Regular brushing with fluoride toothpaste
- Regular dental check-ups

Avoiding sweets

Drinking fluoridated water

16. Why should one visit a dentist?

- For regular dental check up
- When tooth/teeth are aching
- For dental treatment
- Do not know

17. Where did you get information on dental caries?

School/Project

Parents/ caregivers

Advertisements

Do not know

**Appendix V: Interviewer administered questionnaire to the caregivers on knowledge of dental caries and their children's/youth's oral hygiene practices**

The interviewer will ask questions and tick where appropriate and give explanations where necessary.

Questionnaire No-----

Date completed ----- (dd/mm/yr)

Identification Code (same as child's identification code)\_\_\_\_\_

**1. Demographic Characteristics**

1. Sex

Male

Female

2. Level of education

Primary

Secondary

Tertiary

None

3. Source of family income

Formal employment

Non formal employment

Any other (specify)\_\_\_\_\_

4. Level of family income per month

Less than Ksh 5,000.00

Ksh 5,000.00-10,000.00

More than Ksh 10,000.00

**Caregiver's knowledge on children's oral health and dental caries**

5. Does brushing of teeth prevent caries from occurring?

Yes

No

6. Do you guide your children on how to brush their teeth?

Yes

No

7. What do your children use for cleaning their teeth?

Tooth brush

Traditional sticks

Fingers

Any other (specify)\_\_\_\_\_

8. Does your child use fluoride toothpaste while brushing?

Yes

No

9. Does fluoride prevent teeth from decaying?

Yes

No

Don't know

10. Has your child ever visited a Dentist?

Yes

No

Don't know

11. Do your child/ youth brush his/her teeth after eating sweets or sugary substances?

Yes

No

Don't eat sweets every day

12. Remnants of food particles in mouth are referred to as?

Plaques

Calculus

Stains

Don't know

13. Where does plaque stick to on the mouth?

On the tongue

On the gum

On the teeth

Do not know

14. Dental Caries is-?

Disease causing holes on the tooth surface

Don't know

Any other (specify)\_\_\_\_\_

15. What causes dental caries?

Micro-organisms

Eating too much sugary foods

Not having regular check-ups

Failure to brush teeth

Drinking dirty water

16. How can dental caries be prevented?

Limiting sugar consumption

Regular brushing with fluoride toothpaste

Regular dental check-ups

Avoiding sweets

Drinking fluoridated water

17. Where did you get information on dental caries?

School/Project teachers

Doctors/ Dentists

Advertisements

18. How often do you brush your teeth?

Once in a day

Twice in a day

Thrice in a day

Do not brush

19. How often do you visit a dentist?

Once in a year

More than once in a year

Can't remember

Never

End

Thank you for participating



# Appendix VI WHO Oral Health Assessment Form

## WHO ORAL HEALTH ASSESSMENT FORM (1997)

Country .....

Leave blank (1) <input type="text"/> (4)	Year (5) <input type="text"/> (6) <input type="text"/> (8)	Day (9) <input type="text"/> (10) <input type="text"/> (14)	Identification number (11) <input type="text"/> (14)	Examiner <input type="text"/> (15)	Original/duplicate <input type="text"/> (16)
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**GENERAL INFORMATION**

Name ..... OTHER DATA (specify and provide codes)  (29)

Date of birth (17) Year  (20) Occupation  (25)

Age in years (21)  (22) Geographical location (26)  (27)

Sex (M = 1, F = 2)  (23) Location type:  (28)

Ethnic group  (24) 1 = Urban  
2 = Periurban  
3 = Rural

**CONTRAINDICATION TO EXAMINATION**  
Reason: .....  (31)

0 = No  
1 = Yes

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**CLINICAL ASSESSMENT**

**EXTRA-ORAL EXAMINATION**

0 = Normal extra-oral appearance  
1 = Ulceration, sores, erosions, fissures (head, neck, limbs)  
2 = Ulceration, sores, erosions, fissures (nose, cheeks, chin)  
3 = Ulceration, sores, erosions, fissures (commissures)  
4 = Ulceration, sores, erosions, fissures (vermillion border)  
5 = Cancrum oris  
6 = Abnormalities of upper and lower lips  
7 = Enlarged lymph nodes (head, neck)  
8 = Other swellings of face and jaws  
9 = Not recorded

**TEMPOROMANDIBULAR JOINT ASSESSMENT**

**SYMPTOMS**  
0 = No  
1 = Yes  
9 = Not recorded

**SIGNS**  
0 = No  
1 = Yes  
9 = Not recorded

Clicking  (34)  
Tenderness (on palpation)  (35)  
Reduced jaw mobility (< 30 mm opening)  (36)

(32)

<p><b>ORAL MUCOSA</b></p> <p><b>CONDITION</b></p> <p>0 = No abnormal condition  1 = Malignant tumour (oral cancer)  2 = Leukoplakia  3 = Lichen planus  4 = Ulceration (aphthous, herpetic, traumatic)  5 = Acute necrotizing gingivitis  6 = Candidiasis  7 = Abscess  8 = Other condition (specify if possible) .....  9 = Not recorded</p> <p><b>LOCATION</b></p> <p>0 = Vermilion border  1 = Commissures  2 = Lips  3 = Sulci  4 = Buccal mucosa  5 = Floor of mouth  6 = Tongue  7 = Hard and/or soft palate  8 = Alveolar ridges/gingiva  9 = Not recorded</p> <p>(37) <input type="checkbox"/> (40) <input type="checkbox"/>  (38) <input type="checkbox"/> (41) <input type="checkbox"/>  (39) <input type="checkbox"/> (42) <input type="checkbox"/></p>	<p><b>DENTAL FLUOROSIS</b></p> <p>0 = Normal  1 = Questionable  2 = Very mild  3 = Mild  4 = Moderate  5 = Severe  8 = Excluded  9 = Not recorded</p> <p>(53) <input type="checkbox"/></p>
<p><b>ENAMEL OPACITIES/HYPOPLASIA</b></p> <p>Permanent teeth</p> <p>0 = Normal  1 = Demarcated opacity  2 = Diffuse opacity  3 = Hypoplasia  4 = Other defects  5 = Demarcated and diffuse opacities  6 = Demarcated opacity and hypoplasia  7 = Diffuse opacity and hypoplasia  8 = All three conditions  9 = Not recorded</p> <p>14 13 12 11 21 22 23 24  (43) <input type="checkbox"/> (50) <input type="checkbox"/>  (51) <input type="checkbox"/> (52) <input type="checkbox"/>  46 <input type="checkbox"/> 36 <input type="checkbox"/></p>	<p><b>LOSS OF ATTACHMENT*</b></p> <p>0 = 0-3 mm  1 = 4-5 mm (cementoamel junction (CEJ) within black band)  2 = 6-8 mm (CEJ between upper limit of black band and 8.5-mm ring)  3 = 9-11 mm (CEJ between 8.5-mm and 11.5-mm rings)  4 = 12 mm or more (CEJ beyond 11.5-mm ring)  X = Excluded sextant  9 = Not recorded</p> <p>17/16 11 26/27  (60) <input type="checkbox"/> (62) <input type="checkbox"/>  (63) <input type="checkbox"/> (65) <input type="checkbox"/>  47/46 31 36/37</p> <p>*Not recorded under 15 years of age</p>
<p><b>COMMUNITY PERIODONTAL INDEX (CPI)</b></p> <p>0 = Healthy  1 = Bleeding  2 = Calculus  3* = Pocket 4-5 mm (black band on probe partially visible)  4* = Pocket 6 mm or more (black band on probe not visible)  X = Excluded sextant  9 = Not recorded</p> <p>17/16 11 26/27  (64) <input type="checkbox"/> (66) <input type="checkbox"/>  (67) <input type="checkbox"/> (69) <input type="checkbox"/>  47/46 31 36/37</p> <p>* Not recorded under 15 years of age</p>	

**DENTITION STATUS AND TREATMENT NEED**

Identification number

	Primary teeth										Permanent teeth										STATUS	TREATMENT																																																							
	Crown					Root					Crown					Root																																																													
Crown (86)	18	17	16	15	14	13	12	11	21	22	23	24	25	26	27	28	55	54	53	52	51	61	62	63	64	65	0	1	2	3	4	5	6	7	8	9	0 = None P = Preventive, caries-arresting care F = Fissure sealant 1 = One surface filling 2 = Two or more surface fillings 3 = Crown for any reason 4 = Veneer or laminate 5 = Pulp care and restoration 6 = Extraction 7 = Need for other care (specify)..... 8 = Need for other care (specify)..... 9 = Not recorded																																								
Foot (82)																																																																													
Treatment (88)																																																																													
Crown (114)	48	47	46	45	44	43	42	41	31	32	33	34	35	36	37	38	85	84	83	82	81	71	72	73	74	75																																																			
Foot (130)																																																																													
Treatment (146)																																																																													

**PROSTHETIC STATUS**

0 = No prosthesis  
1 = Bridge  
2 = More than one bridge  
3 = Partial denture  
4 = Both bridge(s) and partial denture(s)  
5 = Full removable denture  
9 = Not recorded

**PROSTHETIC NEED**

0 = No prosthesis needed  
1 = Need for one-unit prosthesis  
2 = Need for multi-unit prosthesis  
3 = Need for a combination of one- and/or multi-unit prostheses  
4 = Need for full prosthesis (replacement of all teeth)  
9 = Not recorded

Upper Lower (162)   (163)

Upper Lower (164)   (165)

DENTOFACIAL ANOMALIES	
<b>DENTITION</b> (166) <input type="checkbox"/> (167) <input type="checkbox"/> Missing incisor, canine and premolar teeth—maxillary and mandibular—enter number of teeth	
<b>SPACE</b> <input type="checkbox"/> (168) <input type="checkbox"/> (169) Spacing in the incisal segments: 0 = No spacing 1 = One segment spaced 2 = Two segments spaced	<input type="checkbox"/> (170) Diastema in mm <input type="checkbox"/> (171) Largest anterior maxillary irregularity in mm <input type="checkbox"/> (172) Largest anterior mandibular irregularity in mm
<b>OCCLUSION</b> <input type="checkbox"/> (173) Anterior maxillary overjet in mm <input type="checkbox"/> (174) Anterior mandibular overjet in mm	<input type="checkbox"/> (175) Vertical anterior openbite in mm <input type="checkbox"/> (176) Antero-posterior molar relation: 0 = Normal 1 = Half cusp 2 = Full cusp
<b>NEED FOR IMMEDIATE CARE AND REFERRAL</b> Life-threatening condition <input type="checkbox"/> (177) Pain or infection <input type="checkbox"/> (178) Other condition (specify)..... <input type="checkbox"/> (179)	Referral <input type="checkbox"/> (180) 0 = No 1 = Yes 9 = Not recorded
<b>NOTES</b>	

Appendix VII: Occurrence of Dental Conditions from FY '13

Figure 3: Kenya Health Screening Exercise: Cluster distribution of dental caries burden

