DENTAL CARIES, GINGIVITIS, ORAL HEALTH KNOWLEDGE AND PRACTICES AMONG 10-12 YEAR OLD URBAN AND RURAL CHILDREN IN KENYA.

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DECLARATION

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

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DEDICATION

This Thesis is humbly dedicated to the memory of my late husband Aggrey A. Musera. Those who walk uprightly enter into peace; they find rest as they lie in death.

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ACRONYMS

- SMS - Mutans streptococcus
- DMFT – Decayed, Missing, Filled teeth for permanent dentition
- dmft- decayed, missing, filled teeth for deciduous dentition.
- SD – Standard Deviation
- Sq –square
- Mt – Mount
- WHO – World Health Organisation
- Pg – page
- Int Dental J – International Dental Journal
- Scand J Dent Res – Scandinavian Journal of Dental Research
- Braz Dent J - Brazilian Dental Journal
- Caries Res – Caries Research
- Saudi Dent J. – Saudi Dental Journal
- E Afri Med J – East African Medical Journal
- J Clin Dent – The Journal of Clinical Dentistry
- Odontostomatol Trop – Odontostomatologie Tropicale
- Int Journ of paediatric Dentistry – International Journal of Paediatric
- Brit Dent J – British Dental Journal
- Afr. Hlth – African Health
- Community Dent Oral Epidemiol- Community Dentistry and Oral Ep
- Acta Odontol Scand- Acta Odontologica Scandinavica
- JADA- Journal of American Dental Association
- Pediatr Dent- Paediatric Dental Journal
- J Dent Res- Journal of Dental Research
- Annals Hum.Biol- Annals of Human Biology
- J Clin Periodontol- Journal of Clinical Periodontology

ABSTRACT

Introduction: The need for epidemiological studies on oral diseases will give recent disease trends especially with comparison of a rural and urban setting.

Objective: To assess the prevalence of dental caries and gingivitis in 10-12-year-old rural and urban children in Kenya. To determine the oral health knowledge and practices of the children in both populations.

Design: Cross sectional comparative study.

Setting: Nairobi for urban and Meru South District for rural.

Subjects and methods: Two hundred and forty four children aged 10-12 years from 4 public primary schools in Nairobi and two hundred and forty six children from 5 public primary schools in Meru South District were examined for dental caries and gingivitis using the WHO Criteria. A questionnaire was employed to determine their oral health knowledge and practices prior to the examination.

Data analysis was done using a computer. Mann Whitney Rank, Kruskal Wallis one way ANOVA statistical tests were used to determine differences in levels of disease between urban and rural areas, male and female and the different age groups. Pearson Chi-Square test was used to test differences in the responses to the questionnaire on oral health knowledge and practices.

Results: The prevalence of dental caries in the permanent dentition was significantly higher for rural (74%) compared to urban (50%) children ($p<0.001$). The mean DMFT was 1.25(SD1.68) for urban and 2.72(SD2.64) for the rural population. 31% and 32% of urban and rural children respectively had caries in the deciduous dentition. The difference was not significant ($p=0.580$). The mean dmft was 0.91(SD1.86) for urban and 0.99(SD1.88) for rural children.

The prevalence of gingivitis was 99.2% for urban and 98.4% for rural children ($p=0.377$). The levels of knowledge in oral health was fair with 56% of urban and 69% of rural children getting 3 to 5 out of 9 correct answers.

Significantly fewer rural children brushed their teeth ($p<0.001$); 95% of urban children brushed compared to 72% of rural ones. Toothpaste was used by 96% of urban children and 35% of rural children ($p<0.000$). About half of urban children had visited a dentist before the study while only 19% of rural ones had done so ($p<0.001$). In general, the study found that females had better oral hygiene practices than the males. The oral health knowledge was found to improve with age.

There was no correlation between oral health knowledge and oral health practices and levels of the diseases examined. However, positive correlations were found in children who brushed ($p<0.05$) and used toothpaste ($p<0.001$); they had relatively less dental caries in the permanent dentition. There was no relationship between frequency of tooth brushing and gingivitis.

Conclusion: The rural children had significantly higher prevalence of dental caries compared to rural children however the disease levels are still low.

CHAPTER 1

INTRODUCTION

1.1 Dental caries

Dental caries can be defined as a bacterial disease of the calcified tissues of the teeth characterized by demineralization of the inorganic and destruction (dissolution) of the organic substance of the tooth [1].

It is a complex and dynamic process involving a physicochemical process associated with the movement of ions across the interface between the tooth and the external environment as well as the biological process associated with the interaction of bacteria in dental plaque with host defense mechanisms [1]. Dental caries is a major contributing factor to tooth loss [2].

Caries is initiated in the enamel as a result of acid challenge that is brought about by low pH (<5.5). The low pH results from acid producing bacteria believed to be mostly *Mutans Streptococcus*. The bacteria act on fermentable carbohydrates like sucrose to produce this organic acid [1,3,4,5]. This results in enamel crystal collapse and hence cavitation. When the cariogenic challenge is persistent the rate of demineralization exceeds remineralization and subsequently the enamel breaks down.

The etiological factors associated with dental caries are multiple. They include a susceptible tooth surface, bacterial plaque, a sugar substrate and time. Other factors such as presence of fluorides, dietary habits, oral hygiene practices, salivary flow rates and anatomy of the teeth may alter the rate of demineralization as well as produce specific patterns of destruction found in different subjects.

Tooth susceptibility to dental caries is also related to factors such as enamel composition, structure, tooth morphology and position, chemical composition of saliva and immunity [1]. Developmental disturbances of the dental tissues due to poor nutrition, excessive fluoride (greater than 1 ppm) may result in anomalies like enamel hypoplasia and fluorosis. Social, economic and environmental factors will influence other issues such as residence and nutrition and this may increase susceptibility to dental caries.

The consumption of refined sugars and carbohydrates may be high in certain communities because of easy accessibility to confectioneries and changing dietary habits like frequent snacking [6,7,8,9]. This may be coupled with ignorance on preventive dentistry making the child or parent make a poor choice of food consumed in as far as oral health is concerned [9].

Certain studies have been carried out world wide that support the role of salivary *Mutans Streptococcus (SMS)* in caries attack. In a longitudinal study in Connecticut USA, children with high colonization of SMS at 3 years as shown by Thibodeau and O'Sullivan showed a higher caries index at 8 years [10]. SMS was used to predict the caries outcome in an individual and related it to the DMFS [11]. The study proved that the *Mutans Streptococci* changes the dental plaque matrix to lower the salivary PH in a high sucrose diet resulting in enamel mineral loss [4].

Analysis of disease trends done in epidemiological studies in the population is important for judging shifts in disease patterns and the efficacy of oral health care systems.

This is an epidemiological study on dental caries and gingivitis in children aged 10-12 years who are in their late mixed dentition or early permanent dentition with particular reference to urban and rural comparisons.

1.2.1 Gingivitis

The term gingivitis is used to designate inflammatory lesions confined to the marginal gingival and interdental papilla[1]. Gingivitis is caused by micro-organisms colonizing the teeth and gingival resulting in destruction of collagenous gingival fibres, ulceration and proliferation of the epithelium. Primary herpetic gingivostomatitis and necrotizing gingivitis are acute gingival diseases conditions that result from specific viral and bacterial infection. Chronic plaque induced gingivitis is common in children seen as a non-specific inflammatory lesion with complex micro flora . In children the dominant cell is B lymphocytes unlike in adults where plasma cell is abundant hence the gingivitis in children is quiescent and does not progress inexorably to involve the deeper periodontal tissues [61].

Clinical trials have provided confirming evidence that optimal control of supragingival plaque is a prerequisite for gingival heath hence the importance of good oral hygiene [2].

1.2.2 Oral health knowledge and practices

Oral hygiene practices entail the mechanical or chemical removal of the bacterial plaque from the tooth surfaces by tooth brushing, flossing, and use of mouth rinses or professional cleaning. Tooth brushing and other mechanical procedures are considered to be the most reliable means of controlling plaque, provided the cleaning is sufficient, thorough and performed daily [2]

It is advisable that children begin brushing their teeth as soon as they erupt. A piece of gauze or cotton wool may be used at this early age. The children should be assisted with the cleaning of their teeth up to the age of 5-6 years when they are expected to have the dexterity to remove plaque effectively on their own [12]. Flossing is also advised to keep the interdental areas clean. The commercial toothbrush is often used for brushing, however, the use of traditional means of brushing such as a chewing stick (mswaki) is also popular in this part of the world [6,8,13,14] . Use of different dentifrices has different efficiency in removing plaque and conferring topical fluoride [15,16,17]. Antiseptic mouth rinses help reduce the amount of micro flora in the mouth. Professional mechanical tooth cleaning at time intervals tailored to the needs of an individual is helpful in maintaining oral health [2]

Ignorance and a casual attitude towards teeth in a community make dental care be given a low priority as a health need. In a study conducted in a rural community in South Africa [18] one adult participant stated that 'most of the time we don't mind about our teeth as long as we feed our stomach." This may sum up the general attitude to oral health in developing countries. In the same study the participants indicated that dental services be ranked last behind baby clinics, immunization and clinics for minor injuries [18]. Oral health is also not considered a priority by individuals in a restrained economy. Intervention is only sought in the event of pain or extreme discomfort like swelling [13,18,19].

In conclusion it can be said that caries is not inevitable but it can be prevented and controlled since its etiological factors are known [20]. However, this is not so easy because the control of sugar and plaque involves behavior change from one that is detrimental to

oral health to one that promotes good health[21]. It would be logical to say that removing plaque from tooth surfaces by brushing can prevent caries, however, studies have shown that tooth brushing alone does not bring about caries reduction. Tooth brushing with fluoride toothpaste is important in conveying fluoride to the tooth surface hence prevention of dental caries[21]. The major property of fluoride seems to be its ability to increase remineralization of dental enamel but it also increases enamel resistance to demineralization and decreases acid production in plaque [21].

This study also assesses the prevalence of dental caries and the oral health knowledge and practices of 10-12 year old children from an urban and a rural population in Kenya.

RESEARCH PROBLEM

Although epidemiological studies on oral health have been carried out in Kenya, the availability of recent trends on dental caries and gingivitis in different age groups is lacking especially as trends in Africa seem to suggest a higher prevalence of dental caries [6,8,22-26]. The present study will seek to establish the current situation in 10-12 -year-old children, an age group that has not been studied more recently, the last reported study in Kenya having been undertaken more than 13 years ago [8,22,23]. The prevalence of dental caries has been demonstrated to be related to the age of the child hence the need to be age specific [8,27,28]. Most of the studies done on caries prevalence in Kenya were based in Nairobi. This investigation will therefore be comparative one between children in urban and rural areas.

No studies have strictly compared oral health awareness of rural and urban children. Kaimenyi et al (1993) [13] studied this issue in children living in a peri-urban and urban areas and showed that there were no significant differences between the two groups [13]. Both groups, however, had had previous contact with an oral health officer; furthermore the oral health status in these groups was not investigated. Although the awareness was reported to be fairly good, the prevalence of dental diseases was not necessarily low. Evaluating the oral health knowledge, attitudes and practices and at the same time ascertaining the prevalence of dental caries and gingivitis may reveal a relationship in the variables.

In conclusion, it is important to know the prevalence of dental caries and gingivitis in order to establish the current levels of diseases and also be able to plan for the provision of dental services to children in this age group. These are children who are in the early permanent dentition, which is most susceptible to dental caries. Knowledge of the practices of oral hygiene would hopefully also assist in planning health education.

1.4 JUSTIFICATION OF THE STUDY

Although there is a lot of data on epidemiology of dental diseases for most developed countries, it is not so in Kenya. Hence more current information is required to establish the current levels of disease.

One of the World Health Organisation's goals was ' Health for all' by the year 2000 was that 12-year-old children should have a DMFT of 3 or less. This study encompasses this age group (10-12 year-olds) of children hence will compare our levels of disease to the stipulated recommendation.

The study of 12-year-olds is an important one in making international comparisons.

The results of a study carried out in both the urban and rural communities will give a view of the burden of the parameters under investigation in Kenya. This will show to what extent differences exist (if any) in the prevalence of caries, gingivitis, knowledge and practices of oral health between urban children and a rural community. This is especially so in regard to incorporating dental health as an element of primary health care [29].

1.5 OBJECTIVES

1.5.1 Broad Objectives

To obtain epidemiological data on dental caries in children aged 10-12 years in an urban (Nairobi) and rural (Meru South District) community in Kenya and to determine their knowledge and practices regarding oral health.

1.5.2 Specific Objectives

- Determine prevalence of dental caries in 10-12- year- olds in an urban and a rural population.
- Determine the prevalence of gingivitis in 10-12-year old schoolchildren in an urban and a rural population.
- Establish the knowledge and practices in regard to oral health for an urban and a rural population.
- Compare the prevalence of dental caries in an urban and a rural community in Kenya.
- Compare the knowledge and practices to oral health between urban children and those in rural area.
- To compare the prevalence of gingivitis in an urban and rural community in Kenya.
- Ascertain if a relationship exists between the oral health knowledge and practices with the prevalence of dental caries and gingivitis.
- Compare the prevalence of dental caries, gingivitis, oral health knowledge and practices between males and females.

1.6 HYPOTHESES

- There is no difference between the prevalence of dental caries and gingivitis in an urban (Nairobi) and a rural (Meru South) group of children aged 10-12 years in Kenya.
- There is no difference between oral hygiene practices and oral health knowledge in children from an urban and a rural area.
- The knowledge and practices of both communities in regard to oral health is adequate.
- There is no relationship between the knowledge and practices on oral health and the prevalence of dental caries and gingivitis in these populations.

1.7 VARIABLES

Independent variables: Location (urban or rural);, Sex

Age; Oral health knowledge; Oral health practices.

Dependent variables: Dental caries; Gingivitis

CHAPTER 2

LITERATURE REVIEW.

2.1 Epidemiology of Dental Caries

The prevalence of dental caries is reported to have increased over the years in the developing countries because of increased urbanization due mostly to rural urban migration [30,31]. These have led to changes in dietary habits, from the traditional type of foods to consumption of more refined foods [21]. This is unlike developed countries where National Surveys have generally shown decrease in prevalence of dental caries although caries amongst children continues to be a public health concern [32,33,34].

There have been several epidemiological studies on dental caries in Kenya. These date as far back as the 1950's, when a study carried out by Neville and Brass on European children residing in Kenya reported that 40% of them had filled or decayed teeth[35]. The study did not include African children.

In 1960 Williamson commented in the East African Medical Journal on the deterioration of African teeth due to contact with European civilization especially those in the urban centers [36]. In later years Manji (1983) reported a DMFT at age 12 of 0.2 (SD 0.9), whilst the dmft at 5 years was 1.5(SD 2.2). About 56.4 % of the 5-year olds and 90.4% of the 14 –year-olds were caries free . The oral hygiene amongst all the children was poor with 90% of them with having gingivitis [22]. Manji (1982) in a different study compared the prevalence of caries among the Asian and African children in Nairobi. There were more decayed and filled teeth in Asians and more missing teeth in Africans. The DMFT in Asians was 1.1 and that in Africans 0.6 [23]. Mosha[37] did not find a significant increase in dental caries in comparative studies that he carried out in 1979 and 1983 in Tanzania. In the 7- year- olds the prevalence of dental caries had increased, the average dfs was 2.6 in 1979 and 4.5 in 1983 for deciduous dentition. The prevalence remained at the same level among the 11-year-olds. Among the 14-year-olds a decrease of 50% was observed, the average number of decayed teeth were 5.3 in 1979 and 3.1 in 1983. This unusual trend was attributed to decline in sugar consumption due to a worsened economy in Tanzania between 1979 and 1983[37].

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Dental caries patterns have been fairly similar in children in East Africa. A comparative study reported in 1988 by Manji, Mosha and Frenken among 12-year-old children in rural Kenya and Tanzania found that 87.4% of Kenyan, and 74.8% of Tanzanian children were caries free. The differences in caries levels between the populations were primarily accounted for by the differences in the number of occlusal surfaces affected [24].

A more recent longitudinal study in Dar es salaam, Tanzania, showed that the progress of carious lesions was low amongst children aged 8-16 years. Less than 5% of occlusal surfaces that were sound at the beginning of the study developed caries over a 3 year period [38].

In 1987 Ng'ang'a and Valderhaug[8] investigated 6-8 and 13-15- year-old children in Nairobi. The 6-8- year-olds were reported to have a dmft of 1.7 (SD 2.4) and 44% of them were caries free. The 13-15-year-olds had DMFT of 1.8(SD 2.2) and only 50% were caries free. The decayed component of the DMFT was the major contributor to the DMFT.

Very few studies have been undertaken in Kenya to determine the caries status of pre-school children. Masiga and Holt [25] reported that 62% of 3-year old children and 50% of 5-year-olds were caries free. The dmft for the 3 and 5-year-old was 1.35 and 1.88 respectively. More recent studies have suggested an increase of dental caries among preschool children in Nairobi. A study conducted in 1998 by Ngatia [6] reported the prevalence of dental caries as 63.5% with a mean dmft of 2.95. Only 1.3% of the children had filled teeth [6].

The distribution of caries in children may depend on their age and whether the child has deciduous or permanent dentitions [8,27,28]. Differences in caries distribution in mandibular and maxillary teeth have also been demonstrated[24]. A study conducted in Saudi Arabia [27] showed that the dmft was higher in the age group 6-9 years which ranged between 3.27– 6.83. The average for 6-13 year-olds was relatively low at 2.16 [27]. The same study showed that mandibular primary molars were affected more than the maxillary molars. Manji (1983) reported a decline in dmft from 1.5 (SD 2.2) at age 5 years to 0.3 (SD 0.9) at 10 years. Only 56.8% of 5-year-olds were caries free compared to 99.4% of 14 year olds [22]. Some studies in Kenya showed no difference between males and

females, while a study conducted in Zambia showed that females have a higher prevalence of the disease [6,8,39].

Recently erupted teeth are more susceptible to caries because of the immaturity of the enamel and favourable conditions for plaque accumulation due to partial lack of functional usage hence preventive programs should target such teeth [40].

Caries in relation to age is important as a predictor of early fissure caries in permanent molars as demonstrated by Radliar and Espelid (1991). Children with a higher dmft generally showed a positive correlation with the incidence of fissure caries in permanent first molars [41]. The incidence of caries on the mesial surface of the first permanent molar was demonstrated by Mejare et al (2000) to be related to the incidence of approximal caries in the primary molars [42].

There have also been studies done on prevalence of dental caries on children residing in social welfare institute. In Saudi Arabia a study by Al-Malik and Holt [46] showed dental caries prevalence of 30%. The mean dmft was 0.95 (SD 2.03) in 4-5-year-old children living in an institution [46]. The lower prevalence compared to other children in Saudi Arabia was attributed to the strict dietary control and regular supervised oral hygiene measures taken in the institution. In a comparative study by Mansour et al [47] of 6-7-year-old girls attending public and armed forces schools in Saudi Arabia, the mean dmft was 6.0 (SD 3.7) for public and 8.1 (SD4.1) for armed forces while the caries free dentitions were 7.1% and 3.0% respectively. This was a statistically significant difference[47]. The results obtained may have been due to differences in social economic status of the two schools. In Kenya Ohito et al (1988) [26] examined 5-15-year-old handicapped children attending special schools in Nairobi and found the highest mean dft was 0.6 among the 5-7-year-old group after which the dft declined inversely with increase with age. The highest DMFT of 1.1 was experienced among the 14-15-year-olds.

2.2 Dental caries and diet

The strong relationship between sugar consumption and caries has been debated and documented since the Vipeholm in 1949.

Many other studies have shown that caries experience is positively related to dietary factors with consumption of sugar playing a major role[9]. Recently Ngatia et al (1998) found that the prevalence of dental caries was higher among children consuming cariogenic snacks as a reward compared to those who did not [6]. In their study they found no significant correlation between the high prevalence (63.5%) of dental caries and nutritional status of the children, which was found to be adequate, perhaps because the severity of caries was not enough to affect food mastication and intake [6].

2.3 Dental caries in urban and rural areas.

In general, epidemiological studies in the world report a higher prevalence of dental caries among urban than among rural children [7,24,28,39,43]. In Kenya a recent study by Dattani et al (1997), reported a mean DMFT score of 1.34 for urban and 0.71 for rural children in Kenya[33]. However there were many shortcomings in this study. Sample size was small and since random sampling was not done, the population was unlikely representative.

In 1984 Frenken et al [7] reported that average dmft scores of 7, 8 and 9- year-old urban and rural children in Tanzania were 0.2, 0.33, 0.35 and 0.04, 0.23, 0.23 respectively. The permanent dentition was caries free in 80% of the urban and 89% of the rural children. This difference was thought to have been contributed by the higher intake of candy, meals and sweetened beverages in urban and the higher fluoride content of drinking water in the rural areas [7].

A comparative study of two rural areas in East Africa revealed low caries prevalence. The mean DMFT amongst 12-year-old rural Kenyan and Tanzanian children was found to be 0.21 (s.d. 0.65) and 0.5 (s.d. 1.07) respectively. 87.4% of Kenyan and 74.8% of Tanzanian children were caries free [24].

Outside Africa, a study by Irigoyen et al [44] in Mexico showed a prevalence of 91.0% in urban and 54.4% in the rural areas. The mean DMFT in the 10-year-olds was 1.93 (SD1.72) and 0.4 (SD0.070) in urban and rural areas respectively [44]. In this study there

was a large difference in the prevalence and distribution of dental caries between rural and urban Mexican children aged 9 to 10 years. The authors explanation was that the rural children consumed traditional foods based on corn, beans and vegetables while the urban ones had access to snacks and processed food products.

However this trend is not always the case, caries in five year-old Finnish children was reportedly higher in those living in a rural environment compared to those in urban; 38% of rural children had a dmft>0 while the urban ones were 26% ($p=0.008$)[45]. This was attributed to less frequent brushing by the rural children. Dental health may not be as positive and important value for the rural population as it is for the urban populations.

2.4 Dental caries and socioeconomic status.

Dental caries like many other medical conditions has been shown to be related to socio-economic factors. In Kenya Ngatia et al found that pre-school children in the middle class had higher caries prevalence compared to those in the low and higher socio-economic groups [6]. The mean dmft for children in the middle cost schools was 3.79 and those in the low and high cost schools were 2.73 and 2.72 respectively. However, these findings should be interpreted cautiously since the social class was school based.

Manji [48] found higher caries prevalence in the higher social groups although the relationship was not strong. However Masiga and Holt (1993) [25] found no evidence of either caries or gingivitis being significantly related to social class [25]. All these studies found more filling in the higher social groups compared to the low ones. In all these studies, however, the categorization of the children according to social class was not based on strict criteria. Elsewhere, in a high socio-economic group in Iceland caries has remained high. At 6 years mean dmfs was 4.1 with 48% caries free and mean DMFS at 12 years of 4.7 with 22 % caries free while at 16 years DMFS was 11.6 and none were caries free [3].

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2.5 Gingivitis in children

Gingivitis in children has been reported in young preschool children [25]. Manji (1983) reported that 90% of children aged 4-16 years old had gingivitis with poor oral hygiene. The same study showed a pattern of proportional increase of gingivitis with age. 79.2% of 5-year-olds had gingivitis which increased to 90% at 7 years [22]. Similarly, Ng'ang'a and Valderhaug [22] reported high levels of gingivitis amongst Nairobi children who, although most reported brushing their teeth, had high plaque accumulation. 71% and 72.6% of 6-8 year-old males and females respectively had gingivitis. At 13-15 years 85.6% of boys and 65.7% girls had gingivitis.

In Tanzania Frenken et al [7] reported small differences in prevalence of gingivitis among rural and urban children .The prevalence of the disease in rural areas was 61% and in urban areas 55%. Mosha [37] showed that higher over 90% of his sample prevalence had gingivitis.

The gingival health of handicapped children improved after treatment during a interventional programme demonstrating the reversible nature of gingivitis in children [26].

2.6 Oral health knowledge and practices among children

Studies on knowledge, attitudes and oral health practices in Kenya are scanty. Kaimenyi et al (1993) [13] found that the oral health knowledge of urban and peri-urban schoolchildren around Nairobi and Ruai were about the same. Both groups had reasonable knowledge of reasons for brushing and the causes of dental caries and gingivitis [13]. Ng'ang'a and Valderhaug in enquiring about tooth brushing habits in 6-8 and 13-15-year-old children, 88% of the children said they brushed; of these 83% brushed daily and 17% occasionally. Ninety per cent used a commercial toothbrush and 8% used the "mswaki". Children in the higher socio- economic class had better oral hygiene than those in lower class [49]. In a study of pre-school children by Ngatia et al (1998) 94.4% of the children indicated that they brushed, with more than half of them doing so daily; 71.7% were assisted by their parents or guardians[6]. In many studies the majority of children reported brushing but most of them had plaque deposits on their teeth and subsequently gingivitis [6,7,8,22,37,39].

Due to the different socioeconomic classes children in Kenya, different methods of brushing are utilized. Studies in Nairobi report that the majority use the commercial toothbrush and less than 10% use a chewing stick [6,49]. Kaimenyi et al [13] found that 1.1% of peri-urban and only 2% of urban children used a chewing stick to brush. The same author demonstrated in a different study that the traditional chewing had a comparable ability to that of a commercial toothbrush in removing moderate plaque deposits [14].

Maina and Lesan (1988) examined mentally handicapped children who had supervised brushing at least once daily and found that 88.5% of the sites examined had gingivitis and 100% had dental plaque[64] .

In one study by Hodge et al [50] it was apparent that tooth brushing was not necessarily related to pursuit of good health in children and adolescents but other social factors like personal hygiene, fresh breath and grooming which may play a stronger role [50]. In a study by Tucker et al (1976) [51] British children with good oral hygiene and those who brushed their teeth at least twice a day developed less dental caries than those who brushed less frequently. This was a 3-year clinical trial study. Good oral habits developed early tend to be retained to adulthood, hence the need for early learning [21].

The aims of the study were to determine the prevalence of dental caries and gingivitis in 10-12- year-old public schoolchildren living in urban and rural areas. The investigation also determined their oral health knowledge and practices and examined the variations in caries experience and gingivitis against levels of knowledge and practices.

CHAPTER 3

DESCRIPTION OF STUDY AREAS

The study of 10 -12-year-olds schoolchildren was done in Nairobi and in Meru South District (Appendix 3). Nairobi was chosen because being the capital city of Kenya, it is representative of an urban center. Meru South District was favoured as a rural community to study because it was familiar to the researcher. This eased the general logistical handling of the study.

3.1 NAIROBI

Demography

Nairobi is a metropolitan city with a total estimated population of about 3 million people. The population was 2,143,254 in the 1999 population and housing census with a inter censal growth rate of 4.8% (1987-1999). The growth rate is contributed to by rural- urban migration and population increase.

Density of the population is estimated at 10,000 persons per sq mile. 1.5 million of the population is under 18 years of age.

Nairobi covers an area of 684 sq kilometers and is located on latitude 36 50' East and longitude 1 7' South, 140 km south of the equator. Altitude is 1670 feet above sea levels.

Most Nairobi residents live in the peri-urban area. The city is surrounded by trade centers/towns that include Kiambu, Kajiado, Ngong' and Ongata Rongai. Nairobi is the main industial center in Kenya. These industries provide a large percentage of employment to the residents. It is also a main transient center for tourists.

About 55% of the population are thought to live in unplanned, temporary houses. These households have inadequate access to services like clean drinking water, sanitation and waste disposal. The rest of the population live in permanent houses and more affluent planned estates.

According to the 1999 population census, children aged 10-14 years totaled 170,731 with 79,683 males and 91,048 females.

3.1.1 Schools in Nairobi City.

The city has private schools which are managed by individual entrepreneurs, churches or other non governmental organizations and public schools, which are managed by the City Council. The city council education department has divided Nairobi into 7 administrative divisions namely Kasarani, Westlands, Embakasi, Dagoretti, Makadara, Langata and Starehe (Appendix 1). Each division is further subdivided into 2 zones. There are a total of 182 schools (Table1).

Table 1. Nairobi City council primary schools.

Division	zones	no. of primary schools
Kasarani	Ruaraka	12
	Kahawa	14
Westlands	Kilimani	12
	Parklands	13
Embakasi	Kayole	16
	Dandora	13
Dagoretti	Riruta	12
	Waithaka	12
Makadara	Buruburu	14
	Viwanda	12
Langata	Karen	6
	Nairobi West	9
Starehe	Juja Road	16
	Central	15
Total		176

The study included only the city council schools. Consideration was made during the categorisation of schools into high, medium and low classes such that all classes were included in the study.

According to the 1999 census 83.3% of children in the age-group 10-14 years were at school, 9.6% had left and 7.1% had never attended school.

3.2 MERU SOUTH DISTRICT

Demography

Meru South District is in Eastern province and is one of the 13 districts in the province. It was demarcated in 1997 when Tharaka-Nithi District was divided into Meru South and Tharaka districts.

To the North it borders Meru Central, Tharaka to the North East, Embu and Mbeere to the South, Kirinyaga and Nyeri to the West where one also finds the peak of Mount Kenya (Appendix 2). The district covers a total area of 1092.9 sq kilometers.

It has 5 administrative divisions, 25 locations and 76 sub-locations. The divisions include Chuka, Igambang'ombe, Magumoni, Muthambi and Mwimbi.

In the 1999 census, the total population was 205,951 persons of whom 40% were below 15 years of age. The population growth rate is 1.16% and the projected population in 2001 was 366,000 persons. The population density is 188 persons per square kilometer.

Mt Kenya, a snow-capped mountain in the equator is a major topographical feature in the region and serves as a tourist attraction. It makes climatic conditions experienced in the district vary from cold-humid alpine type to hot semi-arid conditions down the slopes and plains. The altitude range from 5200m at the peak of Mt Kenya to 300 meters in the dry lowlands of Tharaka divisions.

The main economic activity in the district is both small and large scale farming, livestock rearing and entrepreneurship . Coffee and tea are grown as cash crops in the upper zones while cotton and tobacco in the lower zones. The cash crops are grown at a small scale and marketed through cooperatives. Due to the current poor economic yield of the crops, the standard of living has remained low. The rainfall is also favourable for maize, beans, cowpeas, pigeon peas, bananas, potatoes, yams, millet, sorghum and fruits such as mangoes and oranges. Horticulture is practiced mainly along riverbeds. The diet is sometimes supplemented with foods that are purchased from shops and markets such as rice, wheat products like bread, sugar and confectionery.

The lower zones experience unreliable and poorly distributed rainfall and hence suffer food insecurity.

3.2.1 Schools in Meru South District.

The primary schools can be divided into those that are managed by the government (public schools), those managed by organizations like churches and those owned by individuals (private schools).

The population (1999 census) of children aged 10-14 years was 29,675 with 14,881 males and 14,794 females. Of these 88.2% attended school, 8.3% dropped from school and 3.5% had never attended school.

The primary school Education Department has divided the district into 5 administrative divisions namely Magumoni, Igamban'gombe, Chuka, Muthambi and Mwimbi. They are further subdivided into 2 zones each but Mwimbi has 3 zones (Table 2).

There are a total of 238 primary schools . The public schools are managed by the District Education Department which is under the Ministry of Education.

Table 2 Organization of Meru South District primary schools

Division	Zones	No of primary school
Chuka	Mugwe-Kithangari	32
	Kiang'ondu-Karingani	24
Magumoni	Mwonge-Rubate	19
	Magumoni	22
Igambang'ombe	Kajuki-Mutino	28
	Kamwimbi	12
Mwimbi	Chogoria-Murugi	24
	Kiera	21
	Ganga	17
Muthambi	Muthambi	20
	Kiini	19
Total		238

CHAPTER 4

RESEARCH METHODOLOGY

4.1 STUDY POPULATION

Children aged 10-12 years from public primary schools from Nairobi and Meru South District representing urban and rural populations respectively.

4.2 STUDY DESIGN

This was a cross-sectional urban and rural comparative study.

4.3 SAMPLE SIZE DETERMINATION AND SAMPLING PROCEDURE

4.3.1 Sample size determination

A sample size was computed using EPI Infor version Computer package utilizing a confidence level of 95% and a Power of 80%. The prevalence of dental caries utilized was 57% for the urban population and 44% for rural [52] . A sample of 246 was computed for each of the study areas giving a total of 492 children for the two study groups.

4.3.2 Sampling procedure

The study population comprised of 10-12-year-old primary school children from schools that were randomly selected. Sampling was done by multistage cluster method to determine the schools that would be involved in the study. For each area the school zones were listed and using table of random numbers the zones were selected. The schools were then selected using the random numbers again.

For Nairobi (urban) 14 zones were listed and numbered 1 to 14. Using the table of random numbers (Appendix 4) 4 zones were then selected. These included Kilimani, Kayole, Viwanda and Kahawa. Next the schools were listed in each zone and using table of random numbers once more one school was selected from each zone. The schools selected were St Georges from Kilimani zone, Embakasi from Kayole, Nairobi South from Viwanda and Murema from Kahawa zones. These were representative of the different socioeconomic categories of schools. St Georges is in the higher socioeconomic, Nairobi South in middle while Embakasi and Murema primary schools are in the lower category.

The same procedure was followed for the Meru South District schools. A total of 10 zones were listed and the following zones were randomly selected Mwonge-Rubate,

Kajuki, Kiangondu, Chogoria and Kiera. Kajuki is found in the lowlands while Chogoria in the highlands. The schools selected were Kagaani, Makanyaga, Kiangondu, Wiru and Makengi.

The distance from the main tarmac road to the schools was varied. Wiru is about 2 kilometers from the main road hence it was the nearest. Makanyaga which is furthest is about 30 kilometers from Chuka town. Kiangondu was nearest to the Chuka Municipality (about 5 kilometers away).

The procedure for selecting the children to participate in the study was similar for both the urban and rural schools. In the urban schools class registers from Standard four, five and six were used to randomly select about 30 children per age group who were then given consent forms to take to their parents or guardians (Appendix 7). The selection of males and females was 15 each. Those with a positive response hence consent from parent or guardian participated in the study. All the rural children aged 10-12 years from Class three to six were issued with the consent forms and those whose parent or guardian consented participated in the investigation. The children were advised that they should be within the stipulated age groups before taking the consent forms.

4.3.3 Inclusion/ exclusion criteria

All children of the age group 10-12 years inclusive (those born in 1990 to 1992) who had consent from parents or guardians were included in the study. The children volunteered their ages and the class teacher clarified through the school registers. Those included were the children who attended school on the day of the examination. Those without consent were excluded.

4.4 DATA COLLECTION INSTRUMENTS AND PROCEDURE

Prior to commencement of data collection, the two field assistants underwent training. The author explained to them about how to record during the oral examinations and also how to disinfect and sterilize the instruments to be used.

They were also given the responsibility of recalling every 10^{th} child for re examination without making the author aware of this at the particular point.

The principal investigator administered a pre-prepared structured questionnaire (Appendix 6). The questions were designed to evaluate oral health knowledge and practices of the children. The questions were also designed to suit the level of cognitive development of the children.

The children answered the questionnaires in a classroom by themselves. The author explained that the questionnaires were not a test hence they needed to be truthful in their answers. The class teachers assisted in explaining some of the questions whenever necessary. In Meru South District the questions sometimes had to be interpreted to the vernacular language by the teachers and sometimes by the author.

Intraoral examination was carried out in a well-lit room (natural daylight) with the child seated on an ordinary classroom chair. The author did all the examinations assisted by one trained assistant who did the recording.

WHO criteria[53] was used to assess for dental caries. Each tooth was recorded as either decayed (D/d), Missing (M/m) or filled (F/f) i.e (DMFT or dmft) [53] (Appendix 5B).

Those that were missing were verified by inquiring from the child whether they had been extracted due to decay. Those missing due to caries were recorded as Missing (M/ m).

The teeth were isolated and dried using gauze subsequent to which examination was done using the standard dental mouth mirror. Presence of caries was determined by gentle probing. In addition, clinical judgement was used to determine if the caries extended to the enamel, dentine or the pulp.

Gingival Index (GI) by Loe and Silness [53] 1963 was used to determine the gingival status. The gingiva was examined and a periodontal probe was used to determine the gingival status of 6 teeth i.e Nos: 16, 12, 24, 36, 31, 44 (Appendix 5C). The most affected surface was recorded for the tooth as suggested in WHO criteria. Where the tooth was missing the adjacent mesial tooth was examined. Since many of the children had a mixed dentition, the deciduous first molar was examined instead of the premolar.

During the visit to the first school, one of the supervisors assessed the data collection methods of the author which were found to be satisfactory.

During the data collection, 39 children were re-examined to determine intra examiner variability. The kappa values obtained were between 0.80 and 1.00 which show good consistency or minimal variability. For gingival index the Kappa value was 0.803, for

caries in permanent dentition, Kappa was 0.805 while for assessment of caries in deciduous teeth it was 0.941.

4.5 DATA ANALYSIS

Data was entered into a computer and SPSS computer software used for analysis.

Data validation done by checking the frequencies and reentering missing data.

For each variable frequencies were run. The mean, mode and median values were computed for decayed, missing, filled teeth and oral health knowledge scores. Computation were done to calculate the DMFT, dmft, mean Gingival Index and mean oral health knowledge scores.

The following statistical tests were done:

1. Mann Whitney Rank test used to test differences in:-
    - Urban and rural as well as male female comparison on the prevalence of dental caries, mean decayed , mean DMFT, mean dmft , mean Gingival Index scores and mean oral health knowledge scores.
    - Compared the mean scores of oral health knowledge for the children with tooth brushing habits, use of toothpaste and whether they had previous visit to the dentist or not.
    - Compared the mean Gingival Index scores and the percentage of children with dental caries and the oral health practices.
2. Kruskall Wallis one way ANOVA was used to test the differences in :-

    Prevalence of caries, mean DMFT, mean dmft, mean Gingival scores and mean oral health knowledge scores in the different age groups.
3. Pearson Chisquare was used for:-
    - Differences in urban and rural responses to the questionnaires on oral health knowledge.
    - Differences in oral hygiene practices like frequency of brushing, use of toothpaste, brushing aids for urban and rural groups . Also used for male female differences for frequency of tooth brushing.
    - To determine the urban and rural significance in those who visited or did not visit the dentist prior to the study.

4.6 ETHICAL CONSIDERATIONS

1. The oral health research was approved by the Kenyatta National Hospital Ethical and Research committee.
2. The Education departments and heads of schools were consulted before study. In Nairobi, the City Council Education Department gave consent and the head teachers. In Meru South, the District Education Department office ga authority.
3. Consent was obtained from the parent/ guardian. They were assured of complete confidentiality.
4. Participation in the study was voluntary and had no financial implication.
5. Advice and referral to the nearest oral health facility was done for tho who were found to require treatment.
6. The principal investigator was under the guidance of two experienced an competent faculty supervisors who had undertaken these types o epidemiological studies previously.

4.7 LIMITATIONS OF THE STUDY

- Diagnosis of caries using a probe and natural light though used in epidemiological studies is not entirely accurate in terms of locating all the carious lesions. Improved visual aids and complete drying of the tooth is required in order to include initial lesions. The constraints of wet, plaque covered teeth also make accurate diagnosis difficult. Further other diagnostic aids are not readily available for the epidemiologist include radiography, electronic caries detector, ultrasonic detector and laser fluorescence systems [62,63].
- Although the author was calibrated by the supervisors, errors in oral examination could occur during examination or recording. The intra-examiner reproducibility was within acceptable limits with Kappa values 0.8-1.0.

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- The questionnaire used was structured hence limiting the expressions of the children. Further there are possibility of errors in answering the questions with some of them guessing the answers so that they do not appear not to know.
- The exact age in terms of years and months of the children could not be reliably established because some of the children were not sure of their exact date of birth. Hence there are possibilities of inaccuracies in the age recorded from the class registers.
- The study did not establish whether the children used a fluoridated or non fluoridated toothpaste.
- The amount of fluoride in the drinking water was not determined hence its influence in the study was not accounted for.
- The influence of diet was not investigated hence its influence to disease was not ascertained.
- The socio economic differences in the two study group was not determined.

CHAPTER 5

RESULTS

5.1: Socio-demographic characteristics

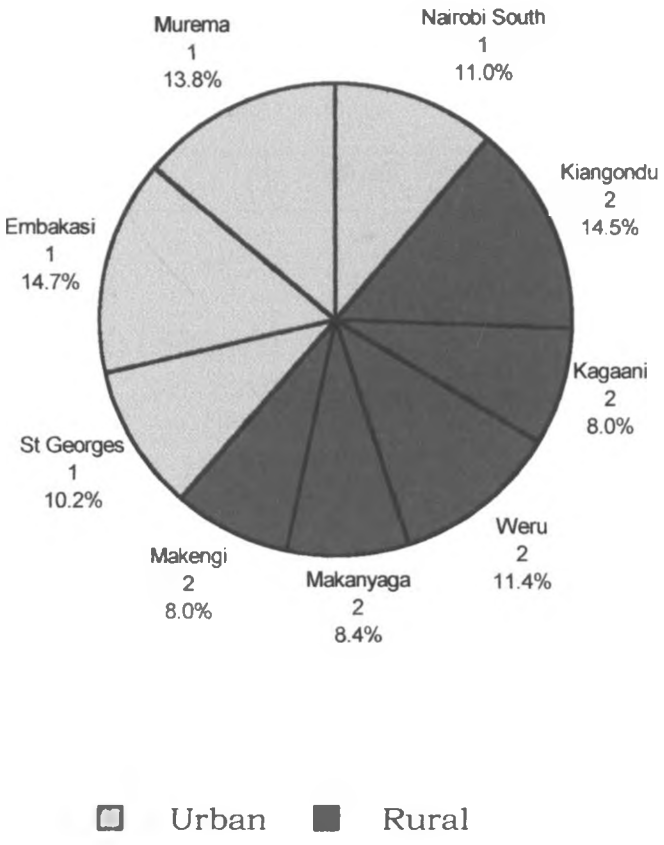
A total of 490 primary school children aged 10-12 years were included in the study. There were 250 (51%) males and 240 (49%) females. 244 (49.8%) children were from urban (Nairobi) and 246(50.2%) were from rural (Meru South District). The distribution of children according to age and sex is shown on Table 3. The distribution of males and females were about the same in both areas of the study.

Table 3. Distribution of children examined according to age and gender in urban and rural areas.

	Urban				Rural				
Age (years)	Male		Female		Male		Female		**Total**
	No.	%	No.	%	No.	%	No.	%	
10	42	8.6	41	8.4	39	8.0	40	8.2	**162**
11	40	8.2	37	7.6	43	8.8	43	8.8	**163**
12	44	9.0	40	8.2	42	8.6	39	8.0	**165**
Total	**126**	**25.7**	**118**	**24.1**	**124**	**25.3**	**122**	**24.9**	**490**

The children from Nairobi were from 4 city council schools while those from the rural area were from 5 public schools from Meru South District (Figure 1)

Figure 1. Distribution of children in the different primary schools



5.2. Dental caries

5.2.1 Dental caries Prevalence and experience - urban and rural comparison .

The overall prevalence of dental caries among both the urban and rural 10-12 year old children was 62.0% for the permanent dentition with a Mean DMFT of 1.918. The prevalence was lower in the deciduous dentition with about a third (31.2%) of the children having caries and mean dmft of 0.851.

Table 4. Dental caries prevalence and experience in 10-12 year-olds from urban and rural locations.

Dentition	Urban	Rural	*pvalue
Permanent			
Prevalence	49.2%	74.8%	p<0.001
Mean Decayed	1.156(±1.566)	2.675(±2.565)	
Deciduous			
Prevalence	30.7%	31.7%	p=0.580
Mean decayed	0.770(±1.552)	0.931(±1.798)	

*Mann Whitney rank test

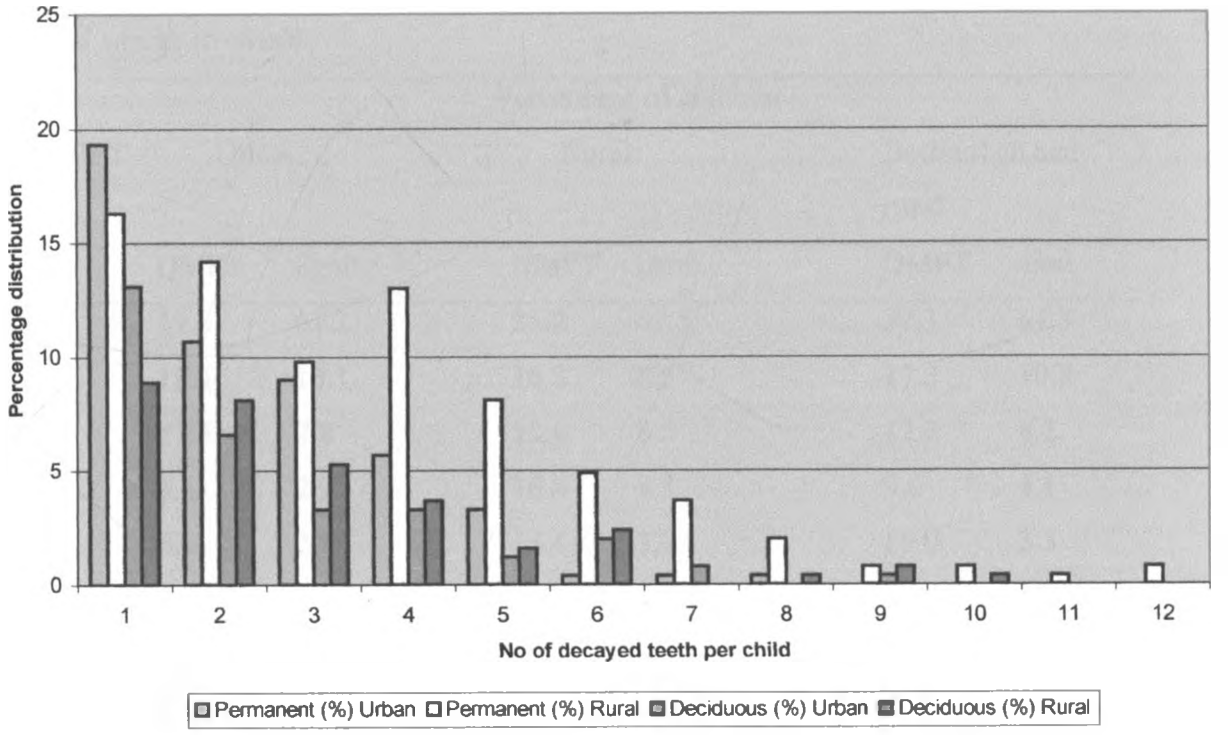
The urban children who had caries-free permanent dentition were 50.8% and 69.3% of them had caries-free deciduous dentition. For the rural children only 25.2% had caries-free permanent dentition while 68.3% had no caries in the deciduous dentition.

The rural children had significantly higher prevalence of caries in the permanent dentition compared to urban children ($p<0.001$). For the deciduous dentition there was no significant difference ($p>0.05$) in prevalence of caries between urban and rural children (Table 4).

Figure 2 shows that the rural children had a range of 1-12 decayed permanent teeth per child. A third (34.5%) of them had 4 or more decayed teeth. About 10.2% of urban children had 4 to 8 permanent decayed teeth per child.

The distribution in the deciduous dentition was similar for both urban (range 0-9) and rural (range 0-10) children.

Figure 2. Distribution of number of decayed teeth per child for permanent and deciduous dentition among urban and rural children (n=490).



Dental caries experience for all the children

About 62.7% of both the urban and rural children had a DMFT greater than 0. Those with DMFT greater than 3 were 33.1%. The mean DMFT was 1.988.

For the deciduous dentition the mean dmft was 0.951. Children with dmft greater than 0 were 32.7%. The decayed component accounted more than the teeth missing due to caries or filled teeth. 1% of the children had fillings in the permanent dentition while only 0.8% had restoration in the primary teeth (Table 5).

Table 5. Distribution(%) of DMFT and dmft in 10-12 year-old children in urban and rural areas (n=490)

The DMFT or dmft	Percentage of children					
	Urban		Rural		Both urban and rural	
	DMFT	Dmft	DMFT	Dmft	DMFT	dmft
0	49.6	67.2	25.2	67.5	37.3	67.3
1	18.4	13.1	16.3	8.5	17.3	10.8
2	11.5	7.8	13.0	8.5	12.2	8.2
3	8.6	2.9	10.6	5.3	9.6	4.1
4	6.6	2.9	13.4	3.7	10.0	3.3
5	2.9	2.0	7.7	1.6	5.3	1.8
6	1.2	1.2	4.9	2.4	3.1	1.8
7	0.8	0.8	3.7	0.8	2.2	0.8
8	0.0	0.4	1.6	0.4	0.8	0.4
9	0.4	1.2	0.8	0.8	0.6	1.0
10	0.0	0.0	1.6	0.4	0.8	0.2
11	0.0	0.4	0.4	0.0	0.2	0.2
12	-	-	0.4	-	0.2	-
13	-	-	0.4	-	0.2	-
Total	100.0	100.0	100.0	100.0	100.0	100.0

The mean DMFT for the rural children was significantly higher than that of the urban children ($p<0.001$). The difference was in the decayed component and not due to missing or filled teeth. For the deciduous dentition the two populations had similar caries experience($p>0.05$) (Table 6)

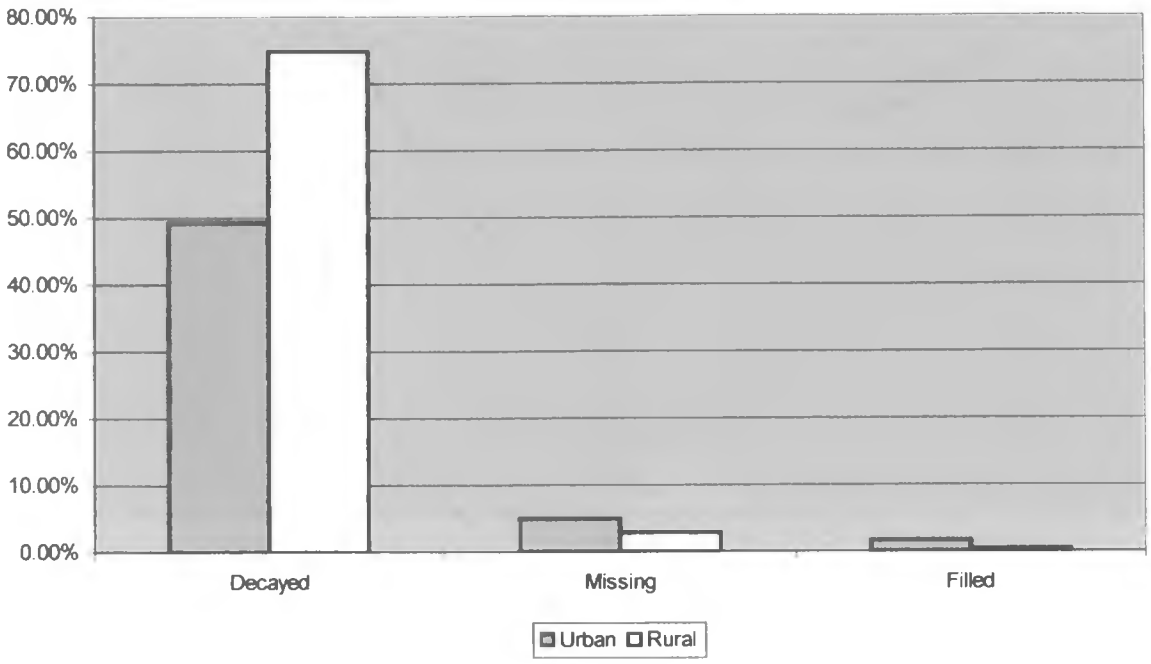
Table 6. Comparison of the mean DMFT and dmft in urban and rural children (n=490).

	Urban	Rural	p value
Permanent dentition			
Mean Decayed	1.156(± 0.100)	2.675(±2.675)	p<0.001
Mean Missing	0.057(± 0.017)	0.041(±0.041)	p>0.05
Mean Filled	0.033(± 0.017)	0.008(±0.008)	p>0.05
Mean DMFT	1.246(± 1.679)	2.724(± 2.638)	p<0.001
Deciduous dentition			
decayed	0.770(± 0.099)	0.931(±0.115)	p>0.05
missing	0.127(± 0.034)	0.057(±0.020)	p>0.05
filled	0.012(± 0.007)	0.004(±0.004)	p>0.05
Mean dmft	0.910(± 1.859)	0.992(±1.878)	p>0.05

**Mann Whitney Rank Test was used to test for significance difference

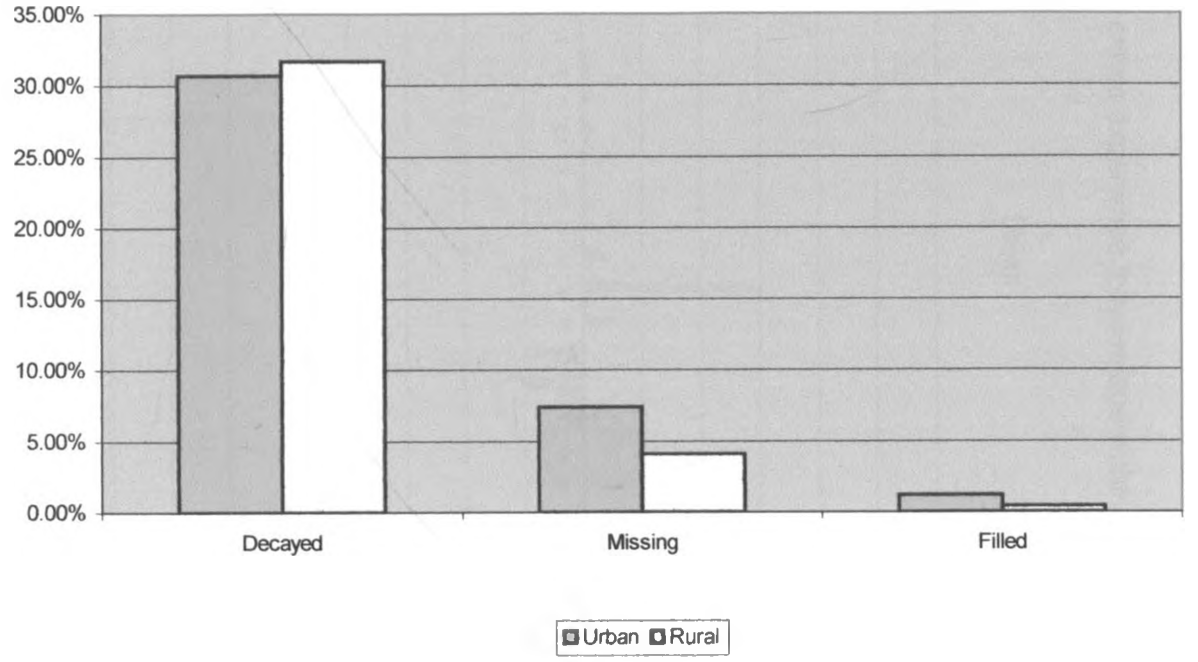
p value indicates rural and urban differences

Figure 3. Percentage distribution of DMFT among urban and rural children



For the urban children the mean DMFT was 1.246 (±1.679) with 50.4% having a DMFT of 1 while the caries experience in rural children showed that those with DMFT of one or more were 74.8%. A negligible number of children had filled or teeth missing due to caries (figure 3).

Figure 4. Percentage distribution of dmft among urban and rural children



About a third of both urban and rural children had decayed deciduous teeth. More urban children(5.9%) had teeth extracted due to caries compared to 2.8% in rural children. (figure 4)

5.2.2 Dental caries and tooth type

In the permanent dentition, the first and second molars had the highest incidence of caries. A higher percentage of mandibular teeth were carious compared to the maxillary teeth. In the rural population the second molar was more involved compared to second molars in the urban children. The extent of caries was mostly into dentine. There was no caries experienced in the lower anterior teeth. (Figure 5)

The pattern of caries involvement in the deciduous dentition was similar for urban and rural children. The caries extended mostly into the pulp and dentine in the deciduous dentition. The distribution of caries was similar for the mandibular and maxillary teeth. Caries was mostly in the molars. (figure 6).

Figure 5. Dental caries experience (percentage within location) according to tooth type among urban and rural children in the permanent dentition.

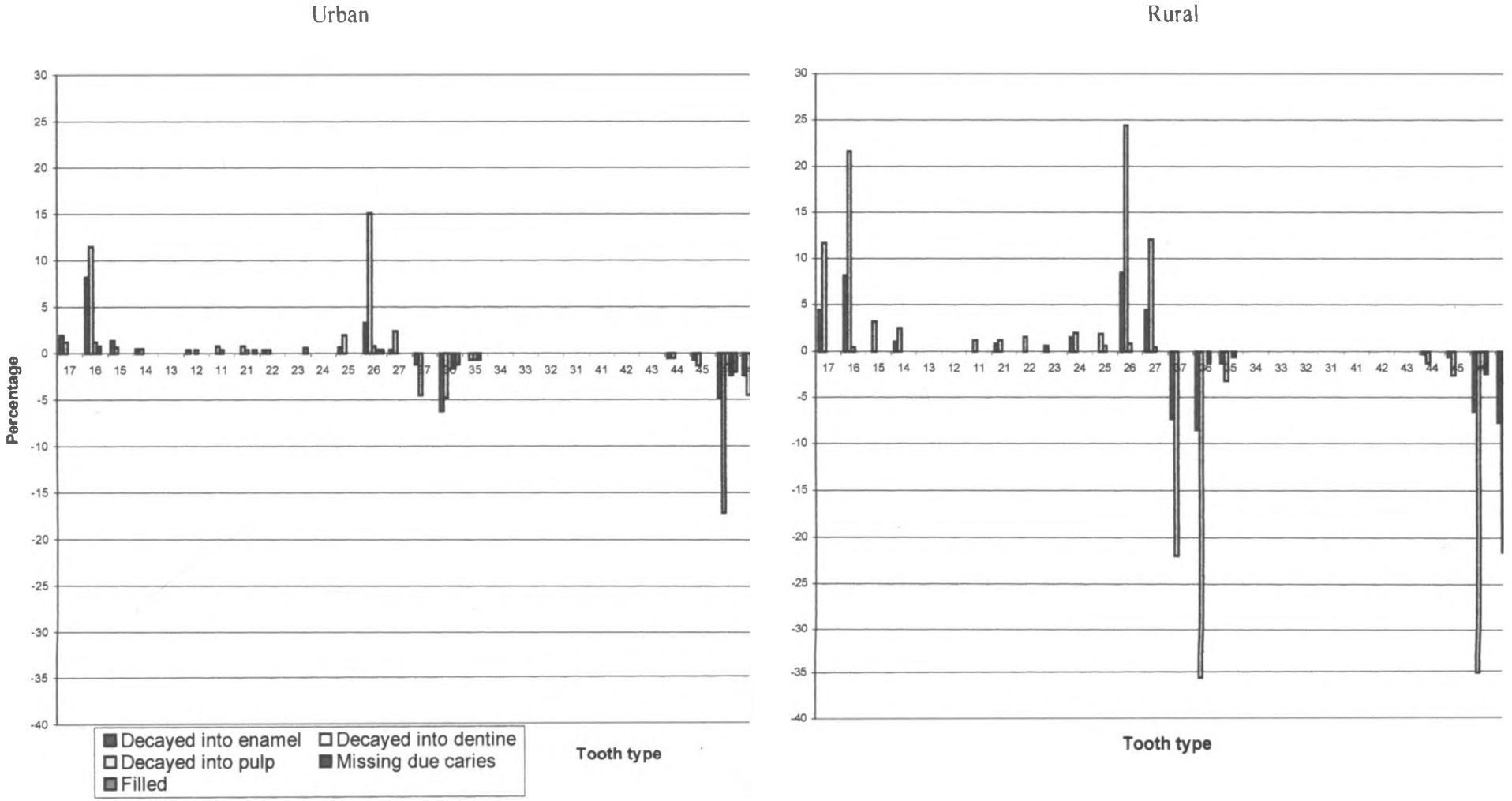
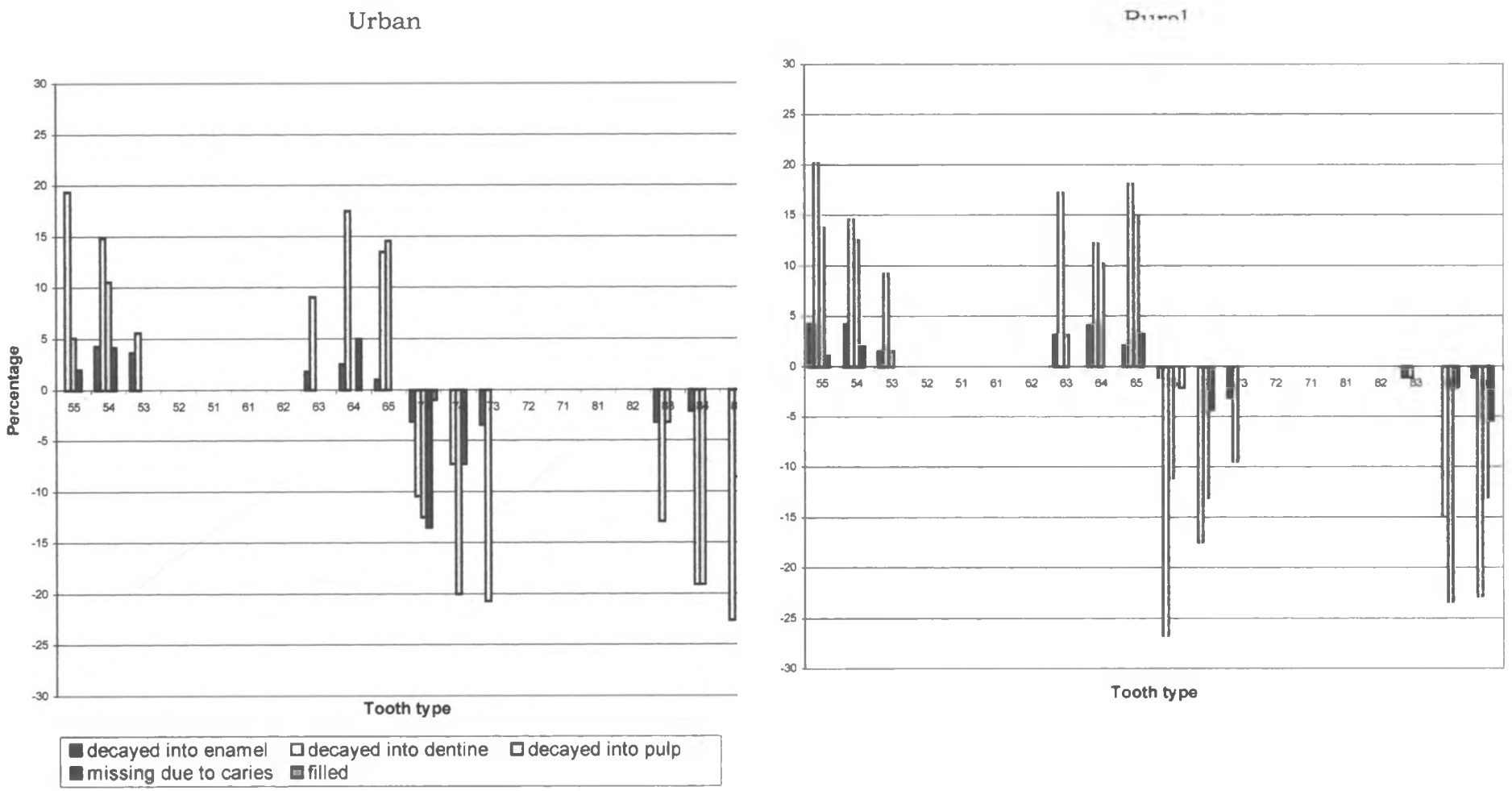


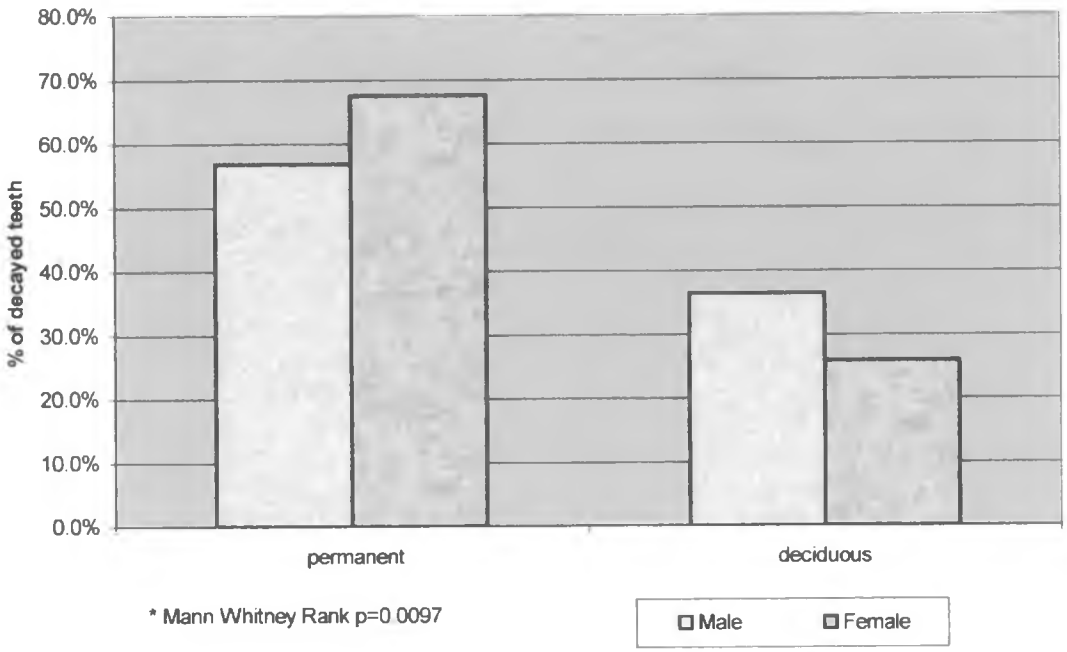
Figure 6. Dental caries experience (percentage within location) according to tooth type among urban and rural children in the deciduous dentition



5.2.3 Dental caries prevalence and experience in both urban and rural areas according to gender.

The prevalence of caries for boys was 56.8% and 67.5% for girls for the permanent dentition. The difference was statistically significant ($p<0.05$). The reverse was true for the deciduous teeth, 36.4% of the boys had decayed teeth while 25.8% of the girls had caries ($p<0.05$) (figure7).

Figure 7. Prevalence of dental caries of all the children according to gender.



For both the permanent and deciduous dentition the significant differences in the caries experience for males and females was in the decayed component and not in the filled and missing teeth (Table 7).

Table 7. Mean decayed teeth, DMFT and dmft according to gender for all the children (n=490)

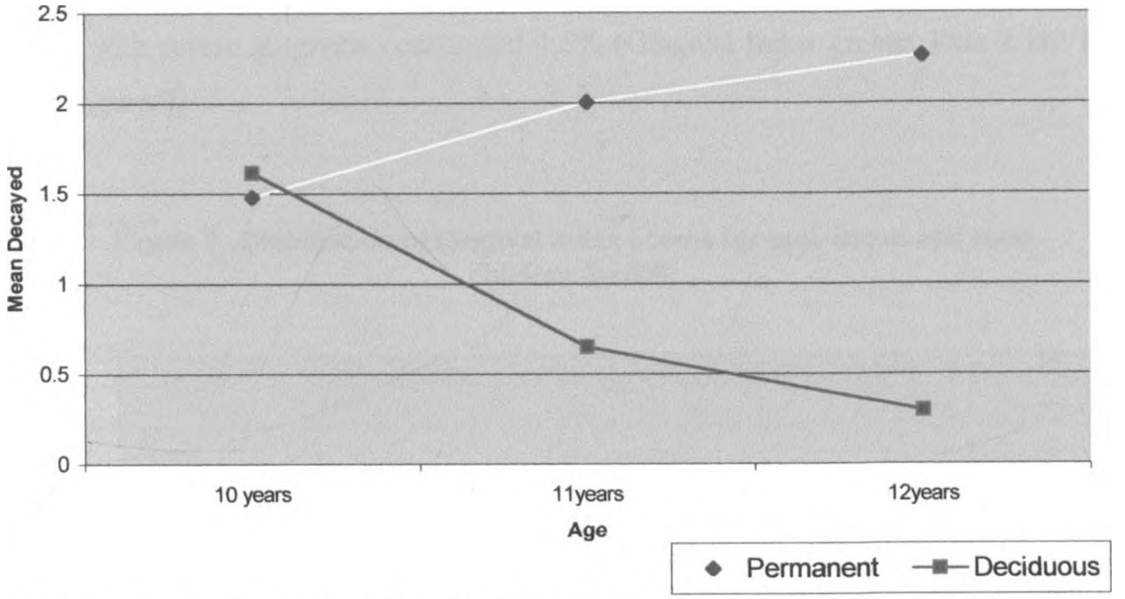
Dentition	Mean (Male)	Mean(Female)	p value
Permanent-Decayed	1.672(SD±0.134)	2.175(±0.153)	P<0.05
DMFT	1.720(±2.151)	2.267(± 2.479)	P<0.05
Deciduous- decayed	1.076(SD±0.123)	0.617(±0.084)	p<0.05
dmft	1.160(± .057)	0.733 (± 1.622)	p<0.05

* Mann Whitney test used to test for significant differences

5.2.4 Dental caries and prevalence experience according to age.

There was an increase in the mean number of decayed teeth per child for the permanent teeth in the older children but not significantly ($p>0.05$). For the deciduous dentition the percentage of mean decayed teeth was inversely related to the age significantly ($p<0.001$) (figure 8).

Figure 8. Mean number of decayed teeth per child in the different age groups.



Kruskal-Wallis 1-way ANOVA test used.Permanet $p>0.05$,deciduous $p<0.001$

The mean DMFT increased with age but not significantly ($p>0.05$).

For deciduous dentition the dmft decreased with age significantly ($p<0.001$) (Table 8).

Table 8. Prevalence of dental caries and the mean DMFT and dmft according to the age of the children.

Dentition	10 years	11 years	12 years	P value
Permanent				
Prevalence	62.3%	63.2%	60.6%	p>0.05
Mean DMFT	1.543 (± 1.756)	2.055 (± 2.307)	2.358 (± 2.754)	
Deciduous				
Prevalence	51.2%	28.2%	14.5%	p<0.001
Mean dmft	1.809(±2.476)	0.755(±1.572)	0.303(±0.865)	

** Test used Kruskal-Wallis 1 way Anova for significant differences.

5.3. Gingivitis

Overall the prevalence of gingivitis amongst the 10-12 year old children was 98.8%. Those with mild gingivitis i.e Gingival Index of 1(inflammation but no bleeding on probing) or less were 38.6%.

Those with bleeding gingiva on probing had moderate gingivitis (G.I of 2 or less) were 55.7%.

Children with severe gingivitis constituted 4.5% (Gingival Index greater than 2 but less than 3. (figure 9)

Figure 9. Distribution of Gingival Index scores for both urban and rural children (n=490)

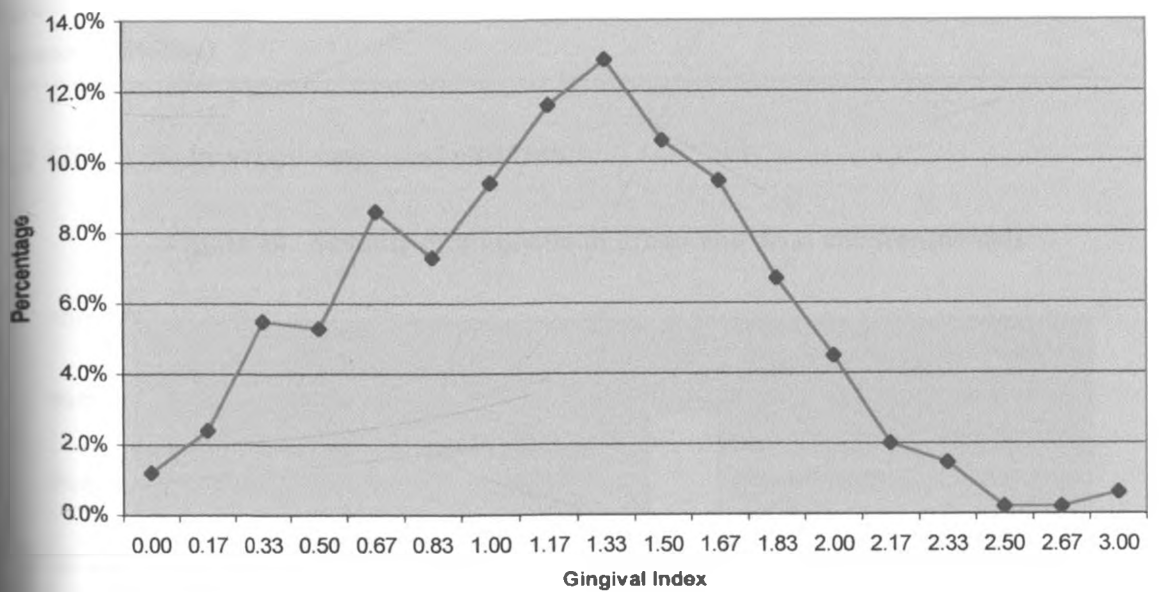


Table 9 shows the distribution of gingivitis in the teeth examined. The posterior teeth had more severe inflammation compared to the anterior teeth. 50.4% of lower first molars had bleeding gingiva on probing.

Table 9. Severity (%) of gingival inflammation in the different index teeth for 10-12-year old children.

	Percentage					
Tooth Type	16	12	24	36	32	44
Gingival status						
No Inflammation	10.8	26.6	28.3	8.5	26.0	32.7
Mild inflammation (no bleeding on probing)	48.1	35.2	33.5	38.8	43.9	33.7
Moderate inflammation (bleeding on probing)	39.6	34.1	35.2	50.4	26.0	31.9
Severe inflammation (oedema, spontaneous bleeding)	3.5	4.1	3.0	2.2	4.1	1.6

5.3.1 Gingivitis in urban and rural children.

Figure 10. Severity of gingivitis in urban and rural children(n=490).

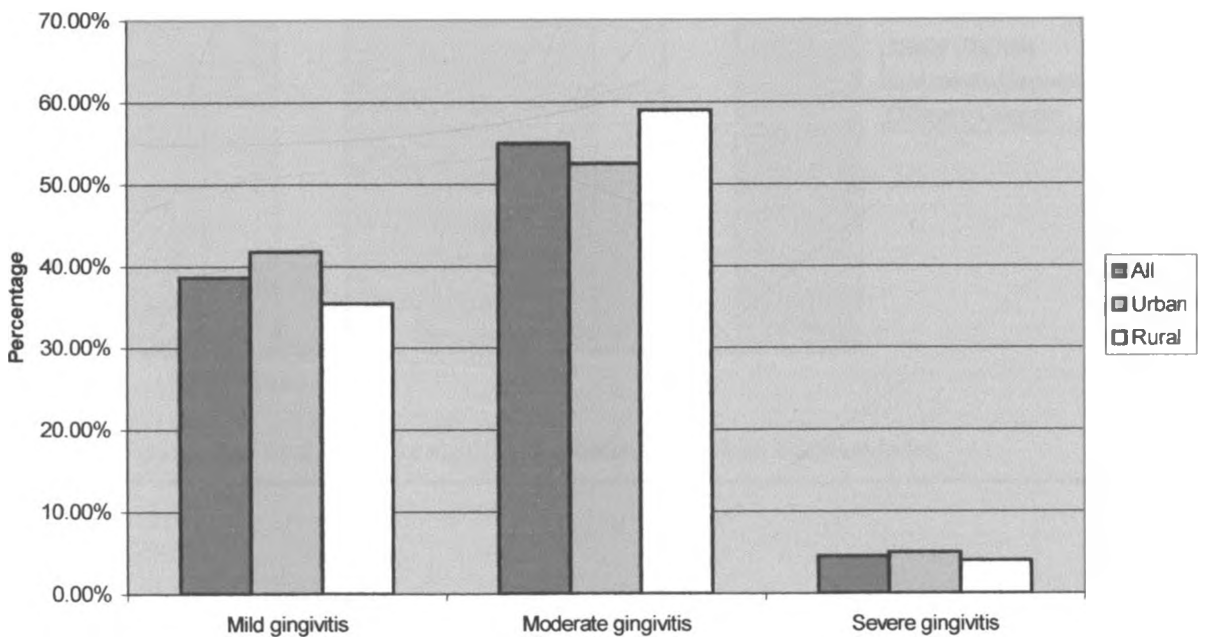


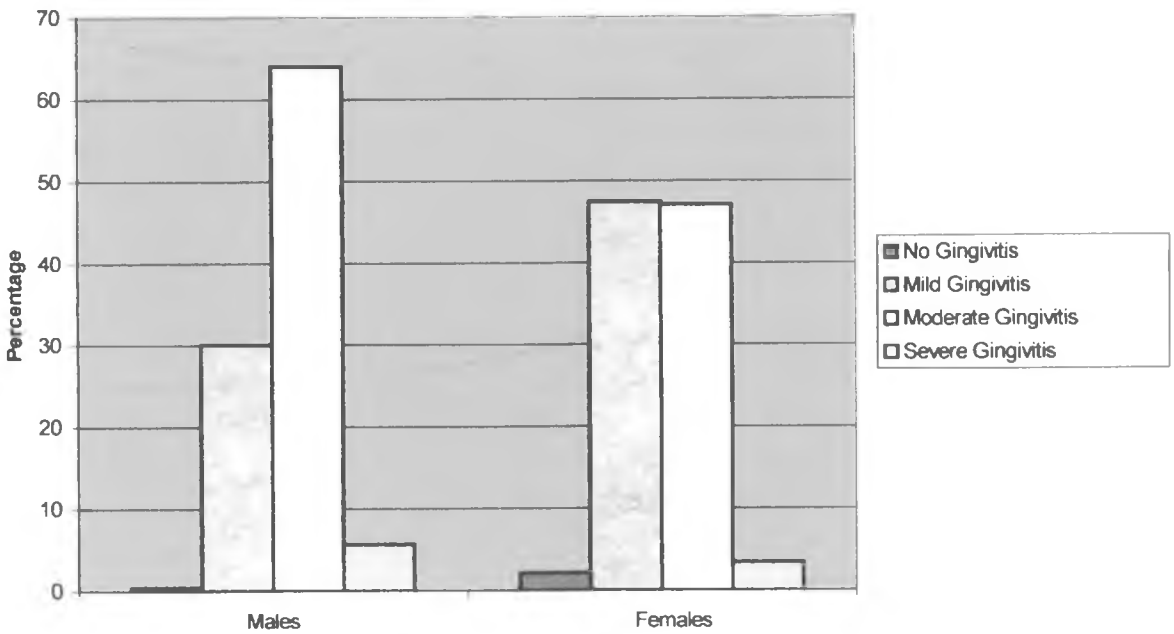
Figure 10 shows the distribution of gingivitis all the children and an urban and rural comparison.

The mean Gingival Index for urban and rural school children were 1.176 (SD 0.571) and 1.231 (SD 0.529) respectively however the differences were not significant ($p > 0.05$) using the Mann Whitney Rank test .

5.3.2 Gingivitis according to gender

Males had significantly worse gingival inflammation compared to the females ($p<0.001$), the mean Gingival Index for boys was 1.329(± 0.034) while that for girls was 1.073(±0.035) (Figure 11).

Figure 11. Distribution(%) of children with gingivitis according to gender



* Mann Whitney rank test used to test for significant differences in Mean Gingival Index

5.3.3 Gingivitis according to age of the children.

The severity of gingivitis increased with the age of the child but not significantly (p= 0.2211) (Table 10).

Table 10 Gingivitis according to the different age-groups (n=490)

Age in years	10	11	12
Prevalence	97.5%	99.4%	97%
Mild Gingivitis	40.1%	38.7%	34.6%
Moderate Gingivitis	53.1%	56.4%	57.6%
Severe Gingivitis	4.3%	4.3%	4.8%
Mean Gingival Index	1.166(±0.535)	1.195(±0.517)	1.249(±0.595)

* Kruskal-Wallis 1 way ANOVA used to test for significant differences in Gingival index (p>0.05)

5.4 Oral Health Knowledge

5.4.1 Levels of oral health knowledge

The children were required to answer nine questions which were administered to them to establish their knowledge regarding oral health (Appendix 5D).

Those who scored 0 to 2 correct answers were considered to have poor knowledge of oral health while those with 3 to 5 correct answers out of the 9 were considered to have fair knowledge. Those who scored 6 to 9 correct answers were regarded as having good understanding of oral health issues.

Two thirds of the children scored fairly (62.7%), a third (31.4%) had good understanding of oral health while 5.9% scored poorly. (Table 11).

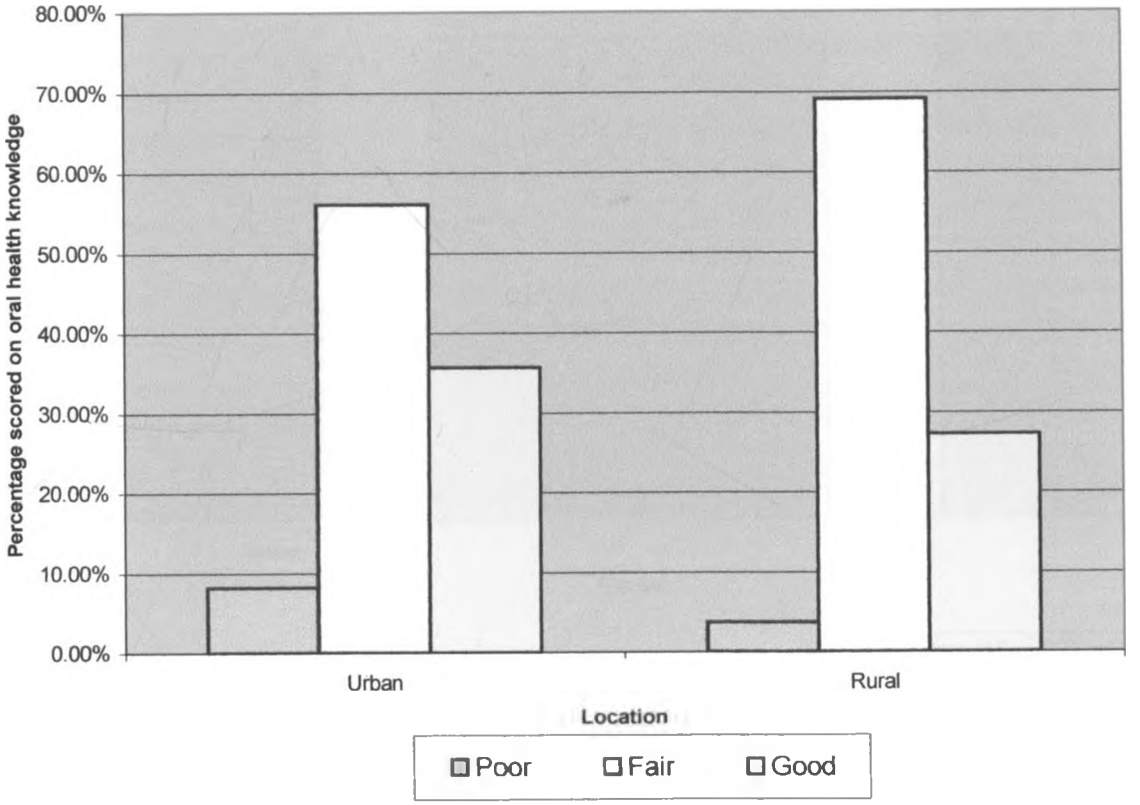
Table 11. Levels of oral health knowledge for both urban and rural children (n=490).

Score	Knowledge	Scores
0-2	Poor	5.9%
3-5	Fair	62.7%
6-9	Good	31.4%

The difference between the mean scores on oral health knowledge for urban and rural children was not significant ($p>0.05$) using Mann Whitney rank test. The mean score for urban children was 4.930(± 0.099) and that for rural ones was 4.817(±0.082).

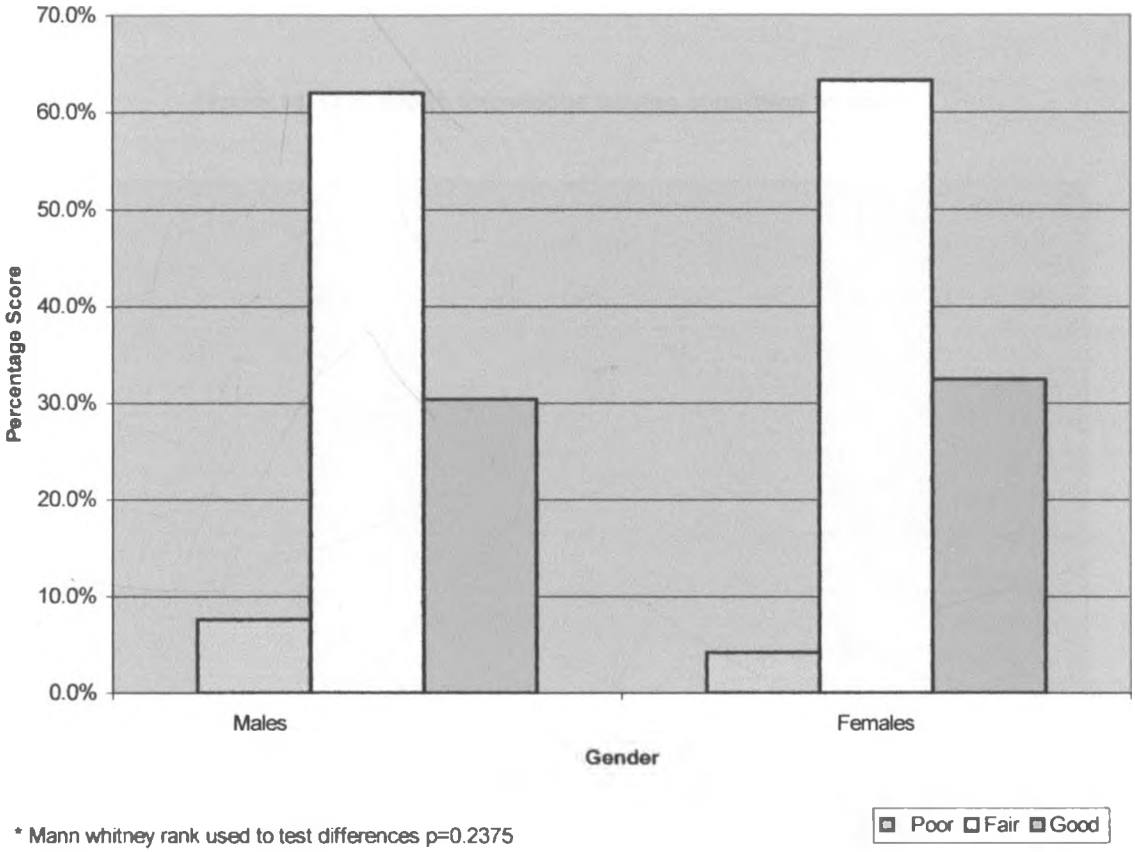
For both urban and rural children, more than half scored fairly to the questions on the oral health knowledge (figure 12).

Figure 12. Levels of oral health knowledge according to urban rural location



The levels of understanding on oral issues were similar between the males and females ($p>0.05$) (Figure 13).

Figure 13. Levels of oral health knowledge according to gender

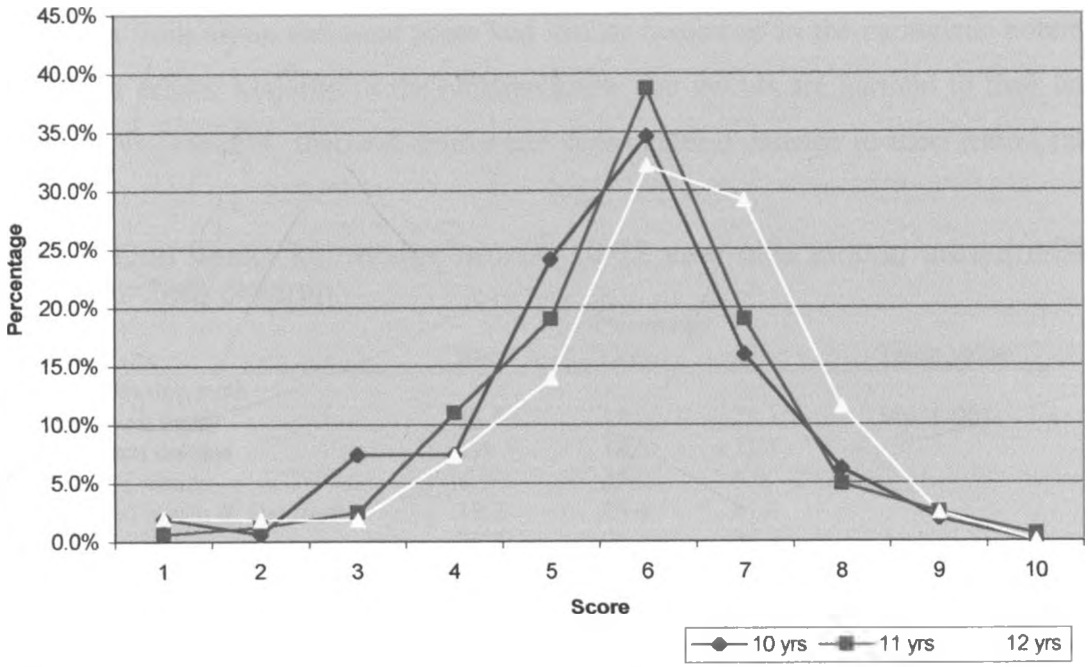


* Mann whitney rank used to test differences p=0.2375

The oral health knowledge increased significantly (p=0.003) in the older children hence the scores were higher in the 12 year-old children (Figure 14)

The mean score for the 10 year-olds was 4.611(± 0.117), 11year-olds 4.822 (± 0.108) and 12 year-olds 5.182 (± 0.105).

Figure 14. Oral health knowledge scores according to age



Kruskal Wallis 1 way ANOVA tested differences mean scores p=0.003

5.4.2 Urban and rural comparison on responses of the children to oral health knowledge questionnaires .

The two groups of children had different reasons for brushing their teeth. 27.2% of the rural and 25.4% of the urban children had the correct response. 8.4% of rural children brushed to prevent periodontal disease compared to 18.3% of urban children . The responses were significantly different ($p<0.001$) (Table 12).

The children from urban and rural areas had similar responses to the cariogenic potential of foods and drinks. Majority of the children knew that sweets are harmful to their teeth but only 20.4% thought that soft drinks like sodas caused damage to their teeth (Table 12)

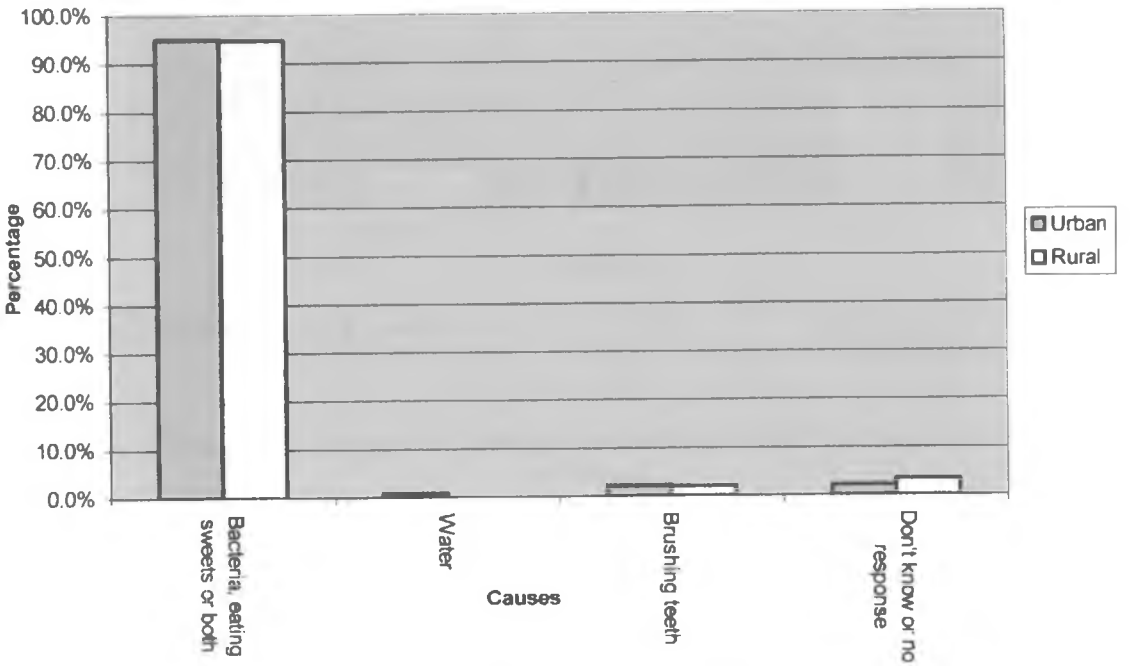
Table 12. Oral health knowledge among 10-12 year-olds among urban(n=244) and rural (n=246) children.

	Percentage			
Question/response	Rural	Urban	All	Test/p.value
Reasons for brushing teeth				
- Prevent tooth decay	33.5	18.3	25.1	**p<0.001
- Prevent gum disease	8.4	18.3	13.1	
- Make teeth whiter	6.3	10.0	8.0	
- Prevent bad breath & feel fresh	19.2	25.4	21.4	
- Reasons 1,2,4	27.2	25.4	25.7	
- Does not know	5.4	2.5	6.7	
The following are harmful to teeth				
- Sweets/biscuits Yes	91.5	89.7	90.6	*P=0.465
No	6.1	8.7	7.4	
Don't know	2.4	1.7	2.0	
- Meat Yes	12.1	8.7	10.4	*P=0.452
No	81.0	83.9	82.4	
Don't know	6.9	7.4	7.2	
- Mangoes Yes	11.7	12.8	12.3	*P=0.895
No	76.5	76.4	76.5	
Don't know	11.7	10.7	11.2	
- Sodas Yes	21.1	20.2	20.7	*P=0.975
No	64.4	64.9	64.6	
Don't know	14.6	14.9	14.7	
- 'Sukuma wiki' Yes	6.5	10.7	8.6	*P=0.178
No	84.6	82.6	83.6	
Don't know	8.9	6.6	7.8	

* Pearson Chi-square $p>0.05$ hence no significance, ** significant

Both the urban and rural children knew the causes of tooth decay hence no difference in their response ($p>0.05$). Majority (94.1%) of the children knew that tooth decay can be caused by either eating sweets or germs or both. Only 2.4% admitted to not knowing the cause of dental caries (figure 15).

Figure 15. Response to 'causes of tooth decay' among urban and rural children



*Pearson Chisquare tested for differences, p=0.426 hence not significant

There was significant difference ($p<0.001$) in urban and rural children response on whether tooth decay was preventable with 32.1% or rural and 11.3% of urban indicating that tooth decay cannot be prevented (figure 16)

Figure 16. Response to "Can tooth decay be prevented"according to urban and rural location

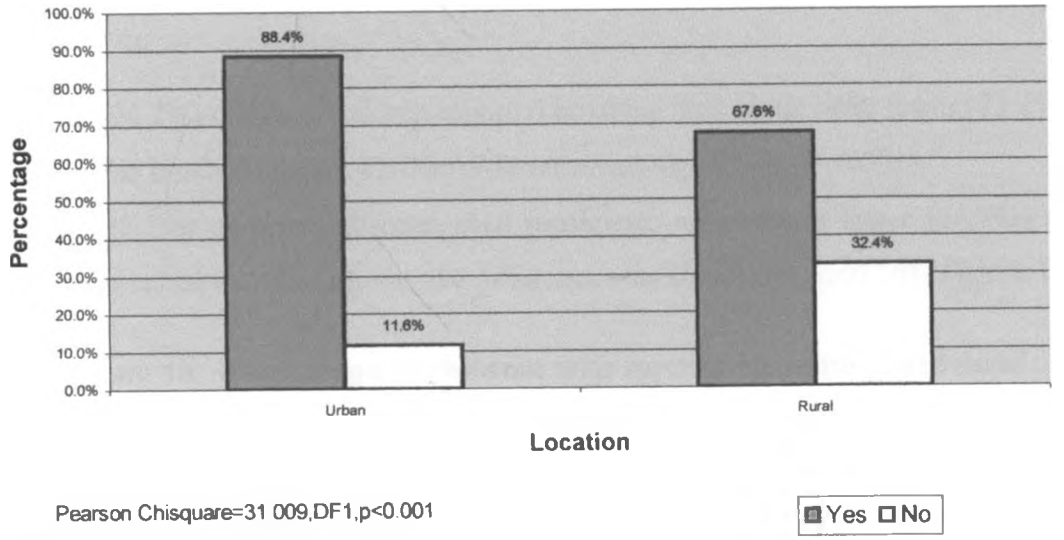
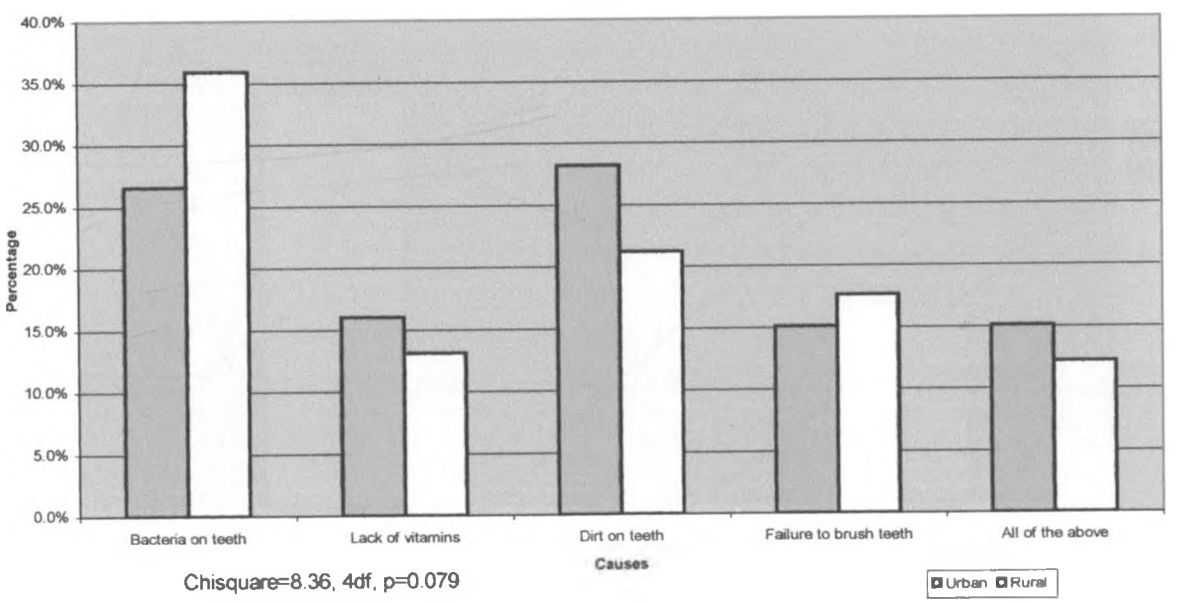


Figure 17. Response to' causes of bleeding gums' by urban and rural children



Both the urban and rural children knew the causes of bleeding gums. The different response of the two group had no significance difference ($p<0.05$) (Figure 17).

5.5. Oral Health Practices

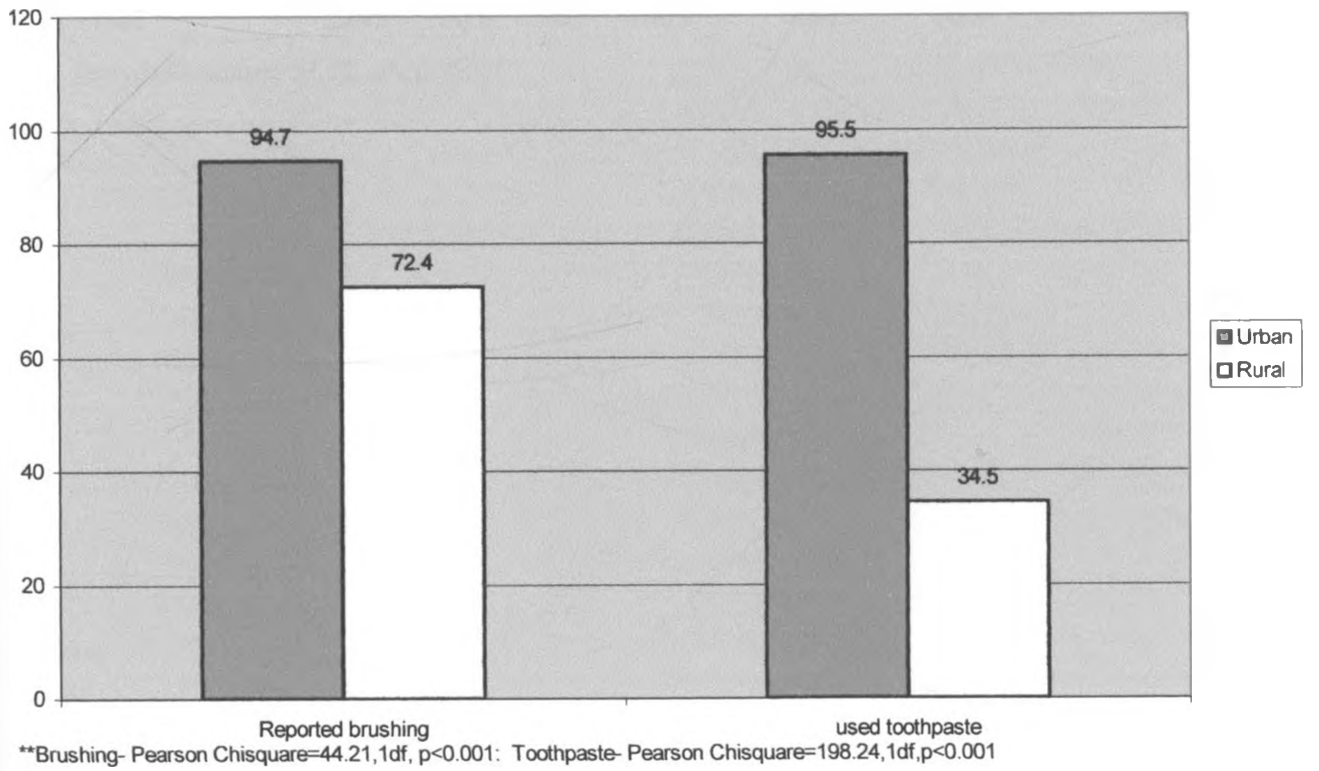
5.5.1 Tooth brushing habits.

In both rural and urban areas the majority of children (83.5%) reported that they brushed their teeth. 9.8% said they never brushed while 15.3% brushed rarely and 1% did not respond.

Nearly all (94.7%) of urban children reported brushing their teeth while fewer (72.4%) of the rural ones brushed (Figure 8). The difference was significant ($p<0.001$).

Majority (95.5%) of urban children used toothpaste while much fewer (34.5%) of the rural ones brushed with toothpaste, the difference was significant ($p<0.001$) (figure 18).

figure 18. Percentage of children who reported brushing and used toothpaste among urban and rural children (n=490)



**Brushing- Pearson Chisquare=44.21,1df, p<0.001: Toothpaste- Pearson Chisquare=198.24,1df,p<0.001

The urban children brushed more frequently than the rural ones. The difference in the frequencies was significant ($p<0.001$) (Table 13).

Table 13. Frequency of tooth brushing for urban and rural children

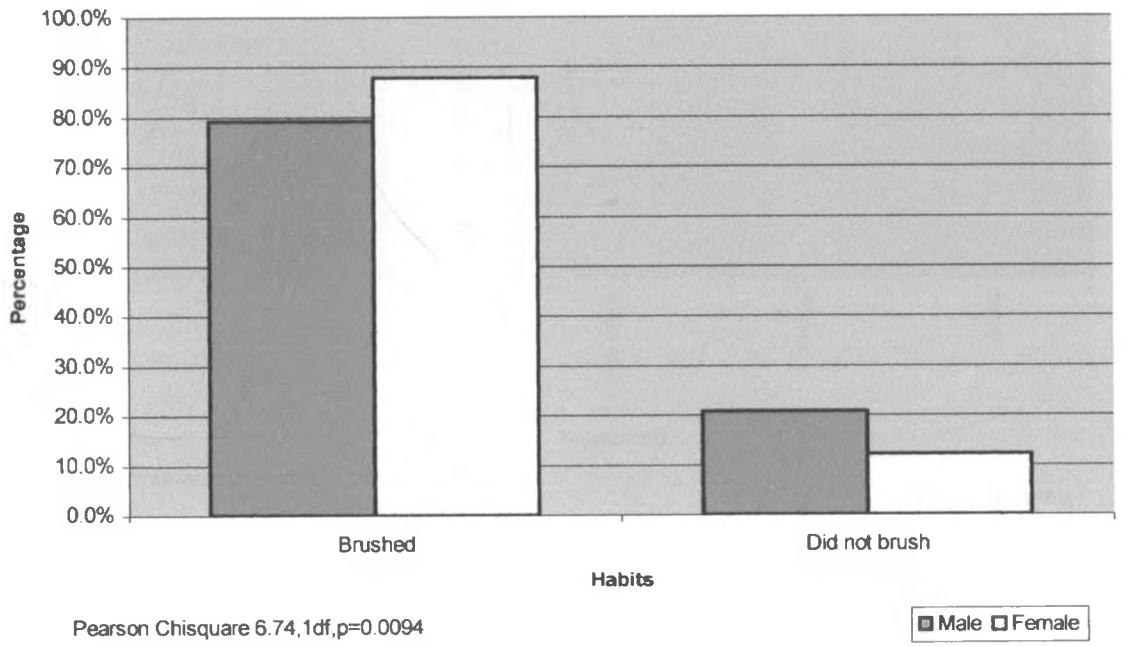
Frequency	Urban		Rural		Total		p value
	No	%	No	%	No	%	
Three times daily	40	16.3	27	11.2	67	13.8	p<0.001
Twice daily	99	40.4	56	23.1	155	31.8	
Once daily	90	36.7	51	21.1	141	29.0	
Rarely	11	4.5	65	26.9	76	15.6	
Never	5	2.0	43	17.8	48	9.9	
Total	245	100.0	242	100.0	487	100	

Pearson Chisquare=93.68, df4, p<0.001

A significantly larger percentage of girls brushed their teeth (87.9%) compared to boys (79.2%) ($p<0.05$).

The use of toothpaste was almost equally distributed between the sexes with 66.4% of males and 64.3% of females having reported to have used toothpaste(figure 19)..

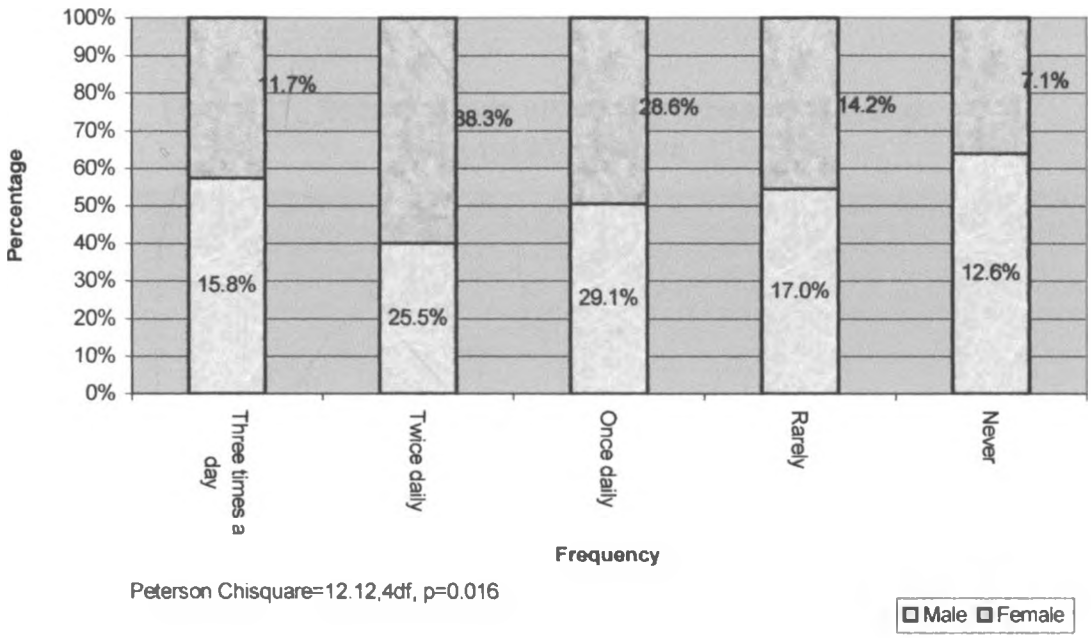
Figure 19. Distribution of brushing habits according to the gender



Pearson Chisquare 6.74,1df,p=0.0094

For both populations more females reported brushing at least twice daily (38.3%) compared to 25.5% of males. About 12.6% of males said that they never brushed while only 7.1% females had never brushed (figure 20).

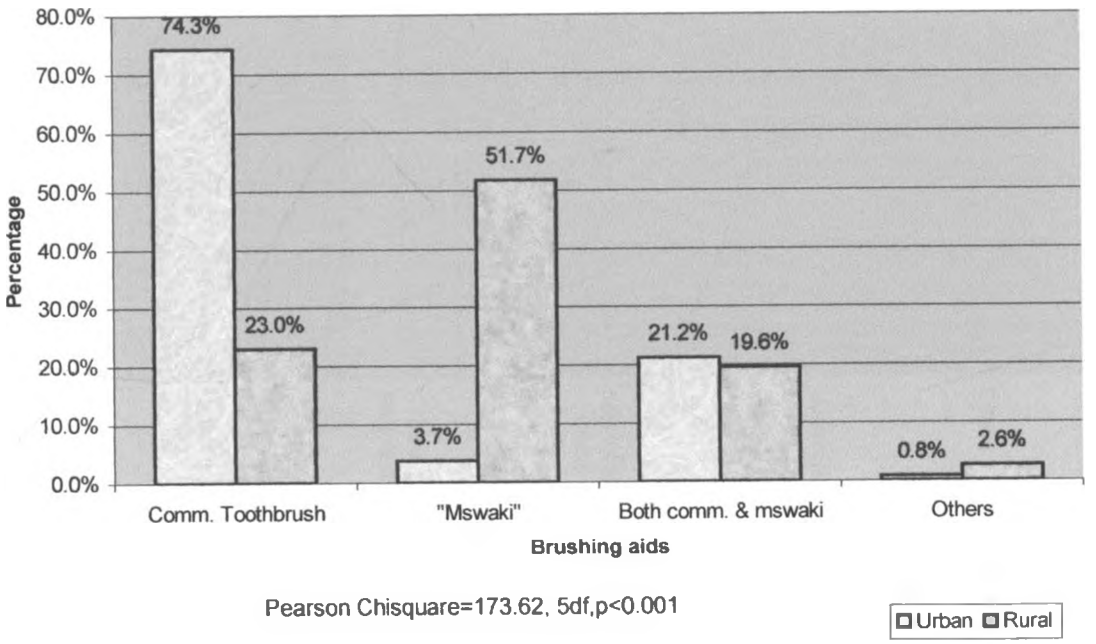
Figure 20. Frequency of brushing according to gender



5.5.2 Brushing aids used by the urban and rural children.

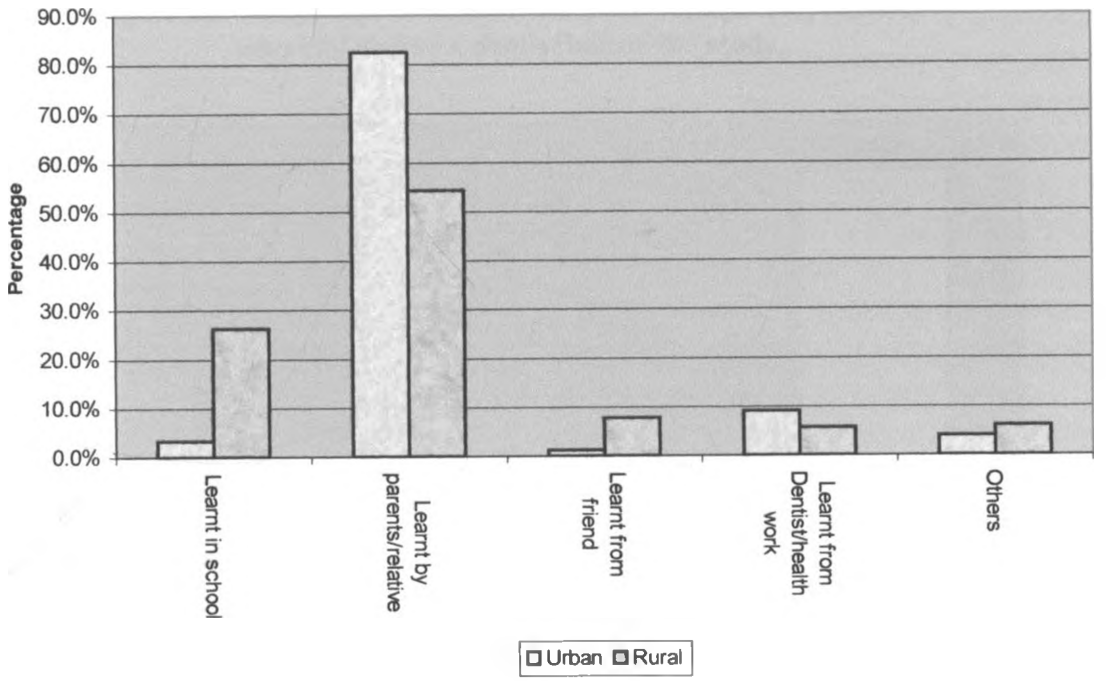
Of interest also was the use of brushing aids, 'mswaki' which was used mostly by rural children 52.4% compared to 3.7% of the urban children. The urban children (74.3%) mostly utilized the commercial toothbrush. The differences in the two populations was significant(Figure 21).

Figure 21. Brushing aids utilised by urban(n=244) and rural(n=230) children



Most children from both urban (82.5%) and rural (54.3%) areas learnt about brushing from parents or relatives that lived with. About 20% of rural children and less than 10% of urban children learnt from schools (figure 22).

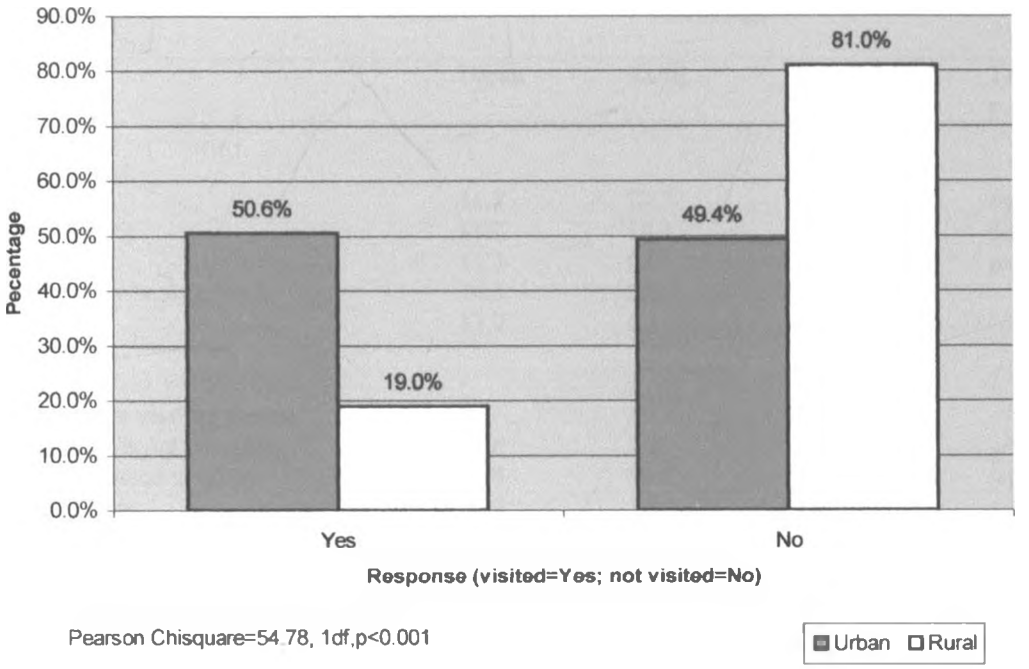
Figure 22. Distribution of source of information regarding brushng in urban(n=244) and rural(n=246) children.



5.5.3 Oral health seeking behaviour and experience for urban and rural children.

About two thirds (65.2%) of the children from both populations had never visited a dentist while 34.8% had done so. About half of the urban (50.6%) and 19.1% of rural children had visited a dentist, the difference was significant ($p<0.001$) (figure23).

Figure 23. Percentage of urban(n=243) and rural(n=246) children who had visited a dentist before the study.



Pearson Chisquare=54.78, 1df,p<0.001

For those who had visited a dentist most reported having had tooth extraction during their visit. No child in the rural community reported having had fillings (Table 14).

About half of urban and rural children who had not visited a dentist said that they had not done so because they did not have a need.

Those who feared a dentist were less than 10% (Table 14).

Table 14. Treatment rendered for urban (n=124) and rural (n=49) children who had visited a dentist.

Reasons given by urban (n=135) and rural (n=207) children who had not visited a dentist before the study.

Question/response	Percentage			
	Urban	Rural	Total	Test, p.value
Treatment done:-				
Extraction	46.8	73.5	54.3	*χ^2=17.93, 5df, p=0.003
Teeth cleaning	13.7	18.4	15.0	
Fillings	11.3	0.0	8.1	
Treatment for broken tooth	14.5	2.0	11.0	
Check-up	13.7	6.1	11.5	
Reasons for not visiting dentist:-				
Think that it is not necessary	12.6	8.2	9.9	χ^2 =10.88, 5df, p=0.055
Never had a need to do so	59.3	59.9	59.6	
Lack of money	11.9	17.4	15.2	
Fear of the dentist	9.6	3.4	5.8	
Don't know where to find one	5.9	8.7	7.6	
Dentist will spoil my teeth	0.7	2.4	1.8	

*significant,

Those who had been to the dentists reported that they had a painless first experience (13.9%) while 16.9% said that they endured a lot of pain (figure 24).

Figure 24. The first experience at the dentist for both urban and rural children (n=174).

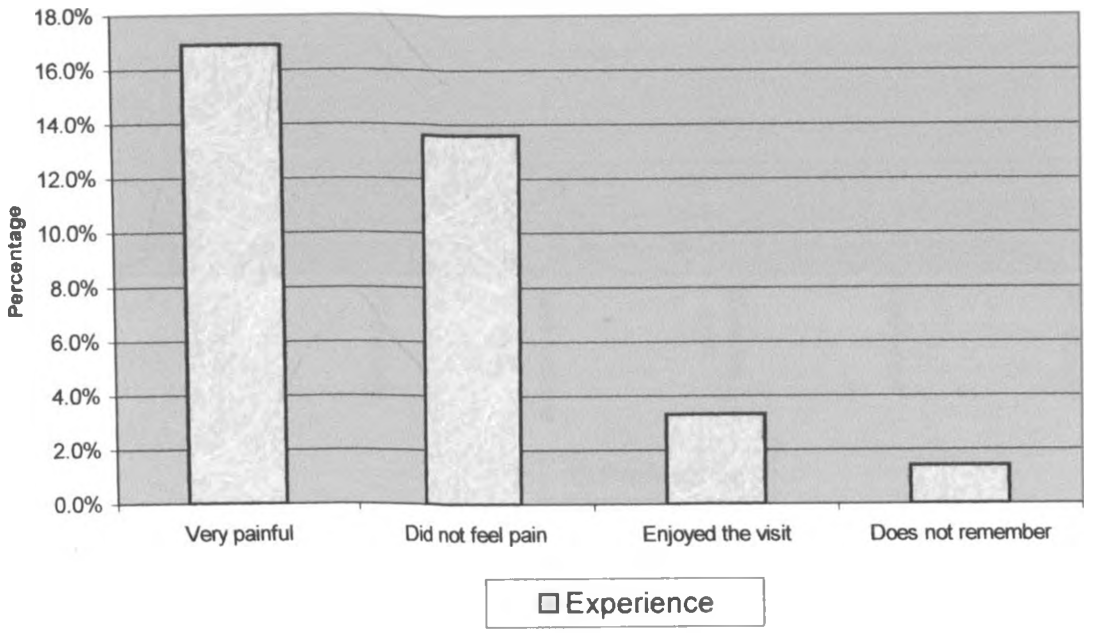
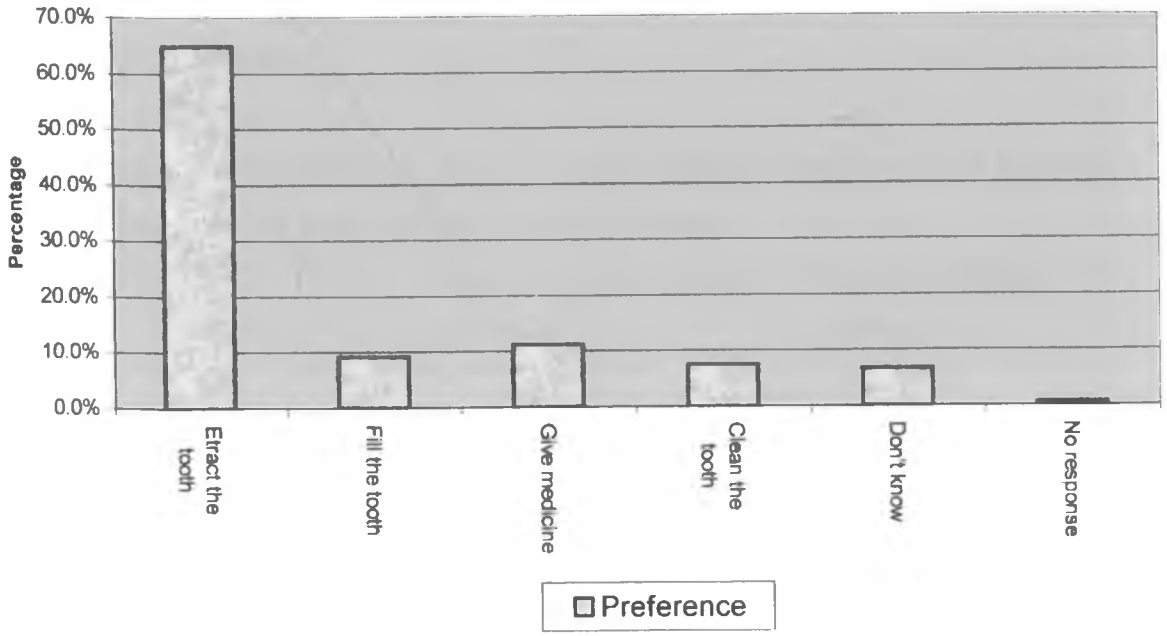


Figure 25. What the children said they would prefer the dentist to do if they had a toothache



Majority (64.8%) of the children would have preferred to have a tooth extracted if they had toothache and only 9.1% would have preferred to have a filling done (figure 25).

5.6 Relationship between oral health knowledge and practices and dental caries experience.

Table 15. Relationship between levels of oral health knowledge, oral hygiene practices, dental caries and previous visit to a dentist.

Variable	Mean scores of oral health knowledge	Test Mann Whitney Rank test
Brushed teeth	4.883 (SD±1.430)	
Did not brush	4.827 (SD±1.386)	p = 0.2358
Used toothpaste	4.918 (SD±1.478)	
Did not use toothpaste	4.820 (SD±1.309)	p = 0.1069
Had visited a dentist	4.906 (±1.464)	
Had not visited a dentist	4.852 (±1.401)	p = 0.3772
Had caries in permanent dentition	4.900 (SD±1.367)	
Caries free perm dentition	4.831 (SD±1.511)	p =0.8745
Had caries in deciduous teeth		
Caries free deciduous teeth	4.694 (SD±1.471)	p* = 0.0866
	4.901 (SD±1.391)	

Mann Whitney Rank test p>0.05

The table above shows the mean scores for oral health knowledge obtained for different groups of children. There were no differences in the levels of oral health knowledge for those children who brushed or did not, those who used toothpaste or not, those who had visited a dentist prior to the study or not and those who had caries or were caries free.

5.6.1 Relationship between oral health practices and dental caries and gingivitis

There was a higher percentage of children with dental caries in the permanent dentition amongst those who did not brush or use toothpaste ($p<0.05$). There was no significant relationship between tooth brushing, use of toothpaste or visiting the dentist with gingivitis or decay in deciduous dentition. Those who had visited a dentist before the study had a significantly lower gingival index compared to those who had not $p<0.05$) (Table 16).

Table 16. Relationship between oral health practices and dental caries and gingivitis.

	Mean Gingival	Presence of caries Permanent (%)	Presence of caries Deciduous (%)
Brushed teeth	1.190 (SD 0.565)	60.6%	33.0%
Did not brush	1.274(SD 0.467)	72.8%	30.9%
Test	p = 0.1398	*p = 0.0380	p = 0.7071
Used toothpaste	1.184(SD 0.518)	55.6%	33.7%
Did not use toothpaste	1.236 (SD 0.518)	75.4%	31.1%
Test	p = 0.2570	**p = 0.0000	p = 0.5760
Had visited a dentist	1.102 (SD 0.514)	62.6%	38.0%
Had not visited a dentist	1.255 (SD 0.560)	62.9%	29.9%
Test	**p = 0.0081	p = 0.9444	p = 0.0674

Mann Whitney rank test used to test for significant differences

* significant, ** highly significant

CHAPTER 6

DISCUSSION

6.1 Social-demographic characteristics

In this study there was a lower enrolment of children in the rural schools compared to urban ones. Hence it was necessary to include more schools in the rural district in order to achieve the stipulated sample size.

It was not possible to ascertain the exact date of birth because many children especially those in rural areas were not certain of their birthdays. The ages were recorded in years only and were obtained mostly from the class registers.

The percentage of females and males selected for the study was about equal suggesting a comparable enrolment in schools for boys and girls for both the urban and rural population.

The sampling method employed in the study (multistage cluster) was such that the children were representative of the communities under investigation.

6.2 Dental caries.

The WHO criteria [53]was used as a guide for recording the findings (Appendix 5A).

The children examined were in their late mixed dentition or early permanent dentition with either the first permanent molars erupted or both the first and second permanent molars hence the first molar had a higher prevalence of caries. For most of them the second permanent molars were recently erupted therefore had less time for exposure to cariogenic environment. None of the children had the third molars.

The rural children had distinctly higher prevalence (74.8%) of dental caries in the permanent dentition compared to the urban 10-12 year-olds who had a prevalence of 49.2%.

The present study demonstrated a higher mean DMFT (1.246) in urban children compared to that of a 1983 study by Manji[22] where the DMFT for 12 year-olds was reported as 0.2. A study by Ng'ang'a and Valderhaug [8] reported a higher DMFT (mean 1.8) amongst 13-15 year-olds Nairobi. The prevalence of dental caries in their study was 50% which is similar to this study for the urban population.

The rural children reported a higher prevalence (74.8%) when compared to a another study by Manji et al [24] in 1988 on 12 year-olds in a rural area in Kenya where 87.4% of the children were caries free where the prevalence was reported as 12.6%.

Past studies involving preschool children [6,25] showed a higher prevalence and increased dmft amongst the Nairobi children compared to this study. This can be explained by the fact that 10-12 year-old children are in the late mixed dentition hence have fewer deciduous teeth because of exfoliation compared to the 3-5 year-old preschool children.

This study found a significant increase in dental caries prevalence and experience in the permanent dentition among rural children compared to the urban ones. The mean DMFT for rural children was 2.724 and for urban 1.246. These findings are in contrast to others where caries in urban areas tend to be higher than that in rural areas [7,24,28,39,43,44]. In these studies the explanation given was that the urban children consumed more cariogenic foods and snacks and the rural children used more traditional unrefined foods and also used naturally fluoridated water [7,28].

However, the prevalence in the deciduous dentition were similar, rural 31.7% and urban 30.7% probably explained by the poor oral hygiene in both groups of children and similar dietary factors. The caries experience reported in a late mixed dentition does not consider previous experience of the exfoliated teeth which may have been carious. Similarly a Finnish study [45] showed a higher caries prevalence in rural children compared to urban ones in the deciduous dentition of five year-olds.

In this study the urban and rural caries disparities were related to tooth brushing and the use of toothpaste. 27.6% of rural children compared to a lower percentage (5.3%) of urban reported not brushing or rarely doing so. Those who did not brush had a higher prevalence of dental caries. This difference in prevalence of caries for those who brushed and those who did not was tested using the Mann Whitney rank test and was found to be significant ($p<0.05$).

Of greater contrast was the use of toothpaste, 65.5% of rural children did not use toothpaste compared to 4.5% of urban ones. Those who used toothpaste had less caries experience compared to those who did not. These findings were highly significant ($p<0.001$) when Mann Whitney rank test was applied.

The role that toothpaste may have played in reduction of caries in this study was shown by the larger percentage of caries free children who brushed with toothpaste compared to those who did not. It can be assumed that fluoridated toothpaste was used since such toothpastes are more readily available in Kenya. This finding is in agreement with other research findings on the ability of fluoride containing dentifrice to contribute to caries control when used regularly[15,16,20,56]. The effects of topical fluoride will depend on the frequency of application. The calcium fluoride ions from a fluoridated dentifrice provide free fluoride reservoir that releases the ions when pH drops in the dental plaque. This mobilized fluoride participates in the beneficial effects of enamel re-mineralization hence its cariostatic effect. Studies have shown that when fluoride is present small amounts of plaque are acceptable. However when hygiene is poor hence thick plaque accumulation fluoride cannot inhibit caries[56,65].

The contribution of brushing towards reduction of dental caries in this study should be cautiously interpreted because the gingival index scores were similar for both the urban and rural children despite their different brushing habits. Other studies have shown that teeth that were frequently brushed were less likely to experience caries than children who brushed irregularly [2,51,57].

For both the urban and rural children the relatively inexpensive cariogenic items such as sweets, chewing gum and biscuits were readily available to the children in 'canteens or kiosks' near schools or homes. Although the rural population is generally consindered to consume more traditional foods more frequently, there may be growing changes in the dietary habits with increased use of refined foods that are conveniently purchased.

The amount of fluoride in the water was not assessed in both the populations in this study. The rural children sourced their drinking water either from the river or bore-holes while those in Nairobi got their water mainly from the City Council supplies and some bore-holes.

The decayed component accounted more to the levels of DMFT or dmft. The teeth most affected by the caries in the permanent dentition were the first and second molars. A larger proportion of second permanent molars in the rural children were decayed compared the urban ones. The higher percentage of mandibular molars than maxillary ones with decay is similar to the pattern of caries reported by Manji et al [24] although no explanation was given. Caries in permanent anterior teeth was found only in the maxilla and none in the mandible. For the deciduous dentition there were no differences between the mandibular and maxillary teeth.

The extent of caries as judged clinically showed that the majority of carious lesions were into dentine and less than 2% had invaded the pulp for each tooth type. This implies that a very large proportion of the dentinal lesions can treated using the ART (atraumatic restorative treatment) especially in the rural communities where amenities such as electricity is scarce [66]. For the deciduous dentition more teeth (15%) had caries involving the pulp. Teeth missing due to caries were less than 2.5% for each tooth type. Those which were missing due to other reasons like orthodontic problems were either canines or premolars. Only a negligible number of children (13 children) had any form of restorative treatment amongst both the urban and rural population. Other studies in Kenya have also reported a minimum amount of dental treatment for children[6,26,49]. This may be explained by the unfavourable dentist/population ratio, inadequate facilities necessary to render curative services, lack of resources, affordability and casual attitude towards dental health in the general population [19,44]. The National Oral Health Policy that was recently launched hopes to offer a comprehensive oral health care system based on primary health care with emphasis on promotion of oral health and prevention of oral disease. The policy has addressed issues such as prevention and promotion of oral health care, curative and rehabilitative care and development of oral health services that are accessible to all the population [67].

There were gender disparities in the caries experience of the present populations. Females had more teeth involved in caries in the permanent dentition and conversely males had a higher dmft compared to the females. These trends differ with previous studies [6,8] where there were no gender differences. In this study where a mixed dentition was investigated, the females had their permanent teeth erupt earlier compared to the males hence had more

caries experienced [59]. The males had more deciduous teeth than females hence higher caries prevalence in the deciduous dentition.

There were differences in mean DMFT recorded in the different age groups (Table 8). The higher DMFT for the permanent teeth in the 12 year-olds may have been a reflection of accumulated disease. At 12 years you have more missing teeth i.e the prevalence of dental caries is less than at 10 and 11 years yet DMFT is higher at 12 years. The extracted teeth are recorded as missing (M) component hence the mean DMFT is higher. Conversely the mean dmft decreased with increased age probably due physiological exfoliation of the deciduous teeth. This is supported by the pattern of tooth decay where the deciduous canine and molars were involved.

Generally both the urban and rural children showed low mean DMFT values compared to the WHO goals of 2000 of DMFT of 3 or less for 12-year-old children.

The problem of caries in children especially dentinal caries could be solved with use of less expensive methods like atraumatic restorative treatment (ART)[66]. This is a combined preventive and restorative procedure and has been shown in a Zimbabwen study [68] to have a 85-88% three year survival for one surface ART restoration.

6.3 Gingivitis

The gingival status of the children was determined using the Loe and Silness Index (1963) which includes the six index teeth. The prevalence of gingivitis was 98.8% among the children. More than half of the children had bleeding gingiva on gentle probing or spontaneous bleeding. There were no significant differences between the urban and rural children. High prevalence of gingivitis has been reported in other studies done locally[7,22,26,49].

Most of the children had plaque induced chronic gingivitis that is mostly associated with children and adolescents [61]. Some of the children with severe gingivitis were noted to be from the lowlands of the rural areas where there is food insecurity. These children were observed to be poorly nourished and may have had signs of acute gingival disease like acute ulcerative gingivitis.

The males had significantly higher gingival index scores compared to the females, probably explained by their poorer oral hygiene practices since they brushed less frequently.

The brushing habits of the children did not correlate with the gingival health implying that even when the children claimed that they brushed they may not have done so effectively. The mean gingival index scores in those who brushed their teeth were similar to those who did not. Mann Whitney rank test in the two groups showed no significant differences.

The children who had visited a dentist had significantly less gingivitis than those who had not probably because they had received individualized oral hygiene instructions were hence more motivated to control plaque.

6.4 Oral health Knowledge and practices

The oral health knowledge and practices were assessed using pre-prepared questionnaires. The short comings of close-ended questionnaires like the ones used in this study is that the study group does not express their views on the issues hence the researcher may miss vital information. The children may have given an answer without necessarily understanding the question since the answer options were available. For the questions on oral hygiene practices, they may answer what they deem is the correct answer instead of what they actually practice. The validity of information obtained from questionnaires has been shown to be influenced by the wording of the questions and the individuals interpretation of the questions [69]. The levels of cognitive development of the children influenced their ability to comprehend the question. In this study, any clarification were made whenever necessary and for the rural children interpretation to the vernacular language was done by a teacher or the author. The questionnaires may not be extremely accurate in assessing the levels of knowledge and oral health practices of the study group hence the findings should be interpreted with caution.

Both the urban and rural children had a fair understanding of oral health issues based on the questionnaire used in the study. Majority knew the causes of dental caries and periodontal diseases. This is similar to other studies in Kenya where dental awareness

among urban and peri-urban children was assessed and found that both populations had fair oral health awareness [13,14].

Majority of the children knew that cariogenic snacks such as sweets, biscuits and cakes were harmful to teeth. However about two thirds thought that carbonated drinks were 'not bad' for their teeth. A significantly larger percentage of rural children thought that tooth decay cannot be prevented while those in the urban areas knew that tooth decay is preventable.

The children may have acquired the knowledge from the school as provided in the school curriculum or through visits by dental and other health officers [13,18]. The media may also have played an important role especially amongst the urban children who have more access to radio, newspapers, magazines and to television. Other sources of information demonstrated strongly in this study include parents, guardians and relatives (figure 22).

Majority of children from urban schoools said they learnt how to brush from their parents or guardians while a large percentage of rural children learnt from school. Hence the teachers, parents and guardians played an important role in oral health education[45].

The level of knowledge improved in the older children, hence the 12 year-olds had higher scores in the questionnaires compared to the 10 year-olds. This can be explained by the improvement in understanding of issues as the children mature.

The urban and rural children had different patterns of tooth brushing habits. A significant percentage of rural children never brushed their teeth or rarely did so. The majority (77.1%) of urban children brushed once or twice daily. About 16% of the urban children reported brushing three times a day. This may have been exaggerated or it may have been the case only in schools where the children were allowed to go home for their midday break. For the urban children the oral hygiene practice claims compared to previous studies where over 90% of children of different age groups reported similar brushing habits [6,13,14,49]. These claims were inconsistent with plaque scores or gingivitis implying that some of them may not have brushed or may have done so ineffectively.

The lack of brushing reported by the rural children (44.7%) may be explained by the unavailability of the commercial toothbrush and the ignorance to the effectiveness of the traditional chewing stick. Only about half (51.7%) of them reported using the traditional chewing stick (mswaki). A much smaller percentage (23.0%) of urban children used the

'mswaki'. The tooth brushing aids used depended on its availability to the child. Other studies associated urban children who used the 'mswaki' with lower socio-economic class [13,49]. Hence the use of the traditional chewing stick by the rural children may be a reflection of their poorer economic status[17]. Studies by Kaimenyi et al showed that the commercial toothbrush is as efficacious as the 'mswaki' in controlling mild to moderate gingival disease [14]. Hence this means of oral hygiene should be encouraged especially in communities that cannot afford the commercial toothbrush.

A significantly smaller percentage of the rural children used toothpaste compared to the urban children. The rural children were either not able to afford toothpaste or it may not have been considered to be an essential household commodity. The type of toothpaste used were likely to contain fluoride since the brands commonly available and marketed in Kenya are fluoridated toothpastes. Toothpaste forms an important component of application of topical fluoride hence its significance in this study [2,15,51].

As has been reported in other studies the girls brushed more frequently than the boys [49-51]. This may due to the concern that the girls have towards personal grooming and cleanliness. Tooth brushing during adolescence is strongly related to cleanliness and appearance rather than motives related to dental hygiene or health[50]. The girls had significantly lower gingival inflammation compared to the boys probably because of better oral hygiene practices.

About 50% of the urban children and only 19% of rural ones had ever visited a dentist before the study. A higher percentage of rural children compared to urban ones said that they had not visited a dentist due to financial constraints or poor accessibility (they did not know where to find a dentist). Majority of the dentists in Kenya work in urban centers where amenities like electricity and water are available hence the rural children may not have access to them.

Majority of those who had visited a dentist had had tooth extraction and hardly any restorative treatment. This trend has been seen in the past epidemiological studies where there is a high prevalence of untreated dental disease. This had a negative influence on the children because when questioned about what they prefer the dentist to do for them if they had a toothache, majority responded that they would rather have an extraction. The children did not seem to understand the scope of a dentists work.

About half of urban and a third of rural children felt that they did not have a need to visit a dentist. About 6.9% felt that it was not necessary to do so hence had no previous dental visits. The question asked in the study may have been difficult for the 10-12 year- old children because they were required to give reasons for a decision that they were not in control of. For the age group studied, the parents or guardians have the responsibility towards the health of the children hence decisions on regular dental care lies with the parents. The question may have been more appropriate to the parents or guardians and not the child. The family influence on health seeking behaviour is important and is related to the family's dental health habits and lifestyle. The children came from families where concern for basic needs like food and schooling may have been the priority. Preventive dentistry and oral health education which concentrates only on the child only may be inadequate instead the parents and guardians should be involved.

More children in the urban area feared the dentist compared to rural ones. This may be explained by the fact that more of them or their peers had previous contact with a dentist and majority said that they had had a painful experience at the dentists. Similar findings among University students served to keep the patient away from seeking regular dental care [19]. Helping children cope with pain and dental anxiety helps them accept dental procedures in the future therefore this needs to be addressed [54].

The good knowledge on oral health issues that the children depicted did not translate to good oral hygiene habits. Good oral health practices involve behaviour change and availability of oral hygiene aids [18,21,49]. Although the children may have understood the importance and benefits of looking after their teeth, the parental participation in the oral health of the children may have been minimal hence no emphasis on good oral hygiene was placed at home. A study of the attitudes of the parents to oral health may give a better explanation as to the lack of tooth brushing aids especially of the rural children.

This study showed no relationship between the knowledge the children had regarding oral health and levels of dental disease. There was also no correlation between the knowledge and practices such as tooth brushing, use of toothpaste or visiting a dentist and levels of disease.

6.5 Conclusion

Differences in the two group of children was seen in the prevalence of caries in the permanent dentition. 75% of rural children had caries in permanent teeth compared to 50% of urban children. Similar dental caries prevalence was found in the deciduous dentition. The lower dental caries prevalence among the urban children was thought to be attributed to the use of fluoridated toothpaste in the urban children.

Majority of the children had poor gingival health with 60% having bleeding on probing. There was no correlation between oral health knowledge and practices and gingival health.

The oral health knowledge of both the urban and rural children appeared adequate since most of them showed a good understanding of the causes of dental caries and periodontal disease. Unfortunately this did not seem to translate to good oral hygiene practices. Oral health practices are usually influenced by other factors such as socio-economics, resources and family influences. The urban children had relatively better oral hygiene practices compared to the rural ones in which a smaller percentage brushed their teeth and less than 40% used toothpaste.

6.6 Recommendations

In order for the oral health of the children to improve, oral health workers need to set up programmes that can motivate the children and the families to care for their dental health.

These programmes should not focus on knowledge only but should aim at motivating the child and the family he/she lives in so that oral hygiene practices may be modified and hopefully improved.

They should focus on both the urban and rural children as both populations are affected by dental diseases.

That preventive oral health programmes should be instituted now while the levels of disease is still low.

Attempts should be made to make the availability of dental care more accessible to the population of Kenya. For instance, in the treatment of dental caries, it may be worthwhile to consider the use of relatively inexpensive curative measures like ART (atraumatic restorative technique). Middle cadre personnel like the community oral health officers

may be used for these procedures. This will hopefully decrease the levels of untreated dental diseases.

In conclusion a National Oral Health Survey should be undertaken so that disease levels can be monitored.

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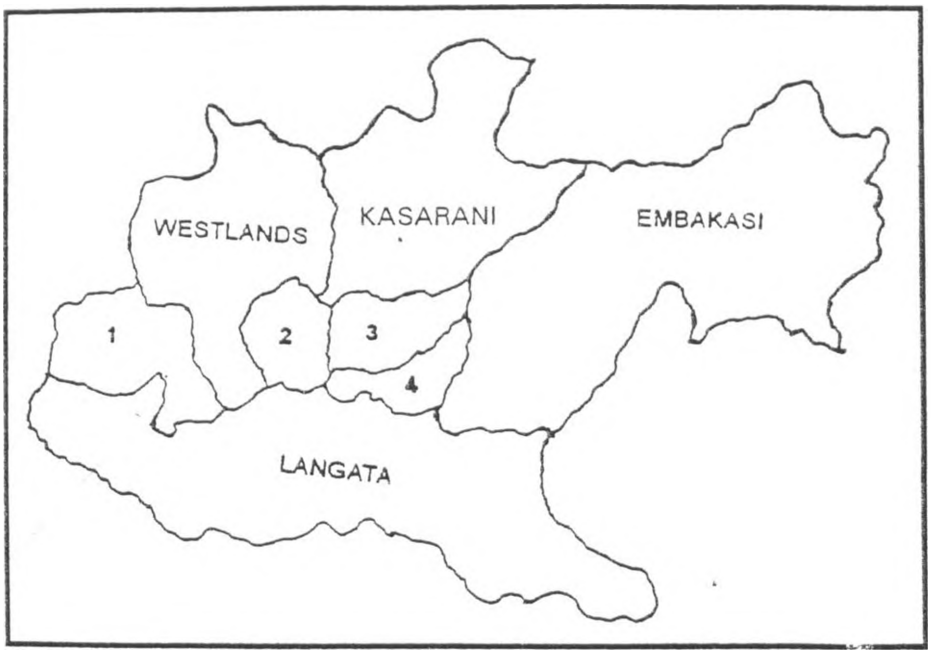
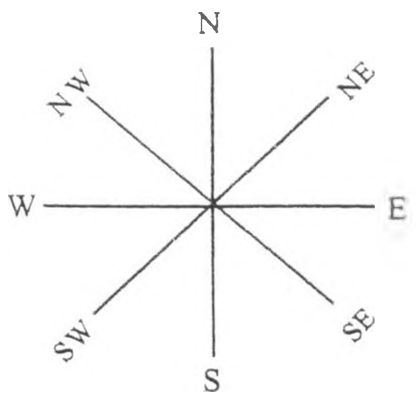
APPENDIX 1: MAP OF NAIROBI SHOWING DIVISIONS





KEY

1. DAGORETTI
2. STAREHE
3. KAMUKUNJI
4. MAKANDARA

APPENDIX 2: MAP OF MERU SOUTH DISTRICT (ADMINISTRATIVE BOUNDARIES)

APPENDIX 3: LOCATION OF MERU SOUTH IN KENYA

APPENDIX 4: TABLE OF RANDOM NUMBERS

12	67	73	29	44	54	12	73	97	48	79	91	20	20	17	31	83	20	85	66
06	24	89	57	11	27	43	03	14	29	84	52	86	13	51	70	65	88	60	88
29	15	84	77	17	86	64	87	06	55	36	44	92	58	64	91	94	48	64	65
49	56	97	93	91	59	41	21	98	03	70	95	31	99	74	45	67	94	47	79
50	77	60	28	58	75	70	96	70	07	60	66	05	95	58	39	20	25	96	89
00	31	32	48	23	12	31	08	51	06	23	44	26	43	56	34	78	65	50	80
01	67	45	57	55	98	93	69	07	81	62	35	22	03	89	22	54	94	83	31
24	00	48	34	15	45	34	50	02	37	43	57	36	13	76	71	95	40	34	10
77	52	60	27	64	16	06	88	38	73	51	32	62	85	24	58	54	29	64	56
36	29	93	93	10	00	51	34	81	26	13	53	26	29	16	94	19	01	40	45
94	82	03	96	49	78	32	61	17	78	70	12	91	69	99	62	75	16	30	69
23	12	21	19	67	27	86	47	43	25	25	05	76	17	50	55	70	32	83	36
77	58	90	38	66	53	45	85	13	93	00	65	30	59	39	44	86	75	90	73
92	37	51	97	83	78	12	70	41	42	01	72	10	48	88	95	05	24	44	21
28	93	48	44	13	02	49	32	07	95	26	47	67	70	72	71	08	47	16	018
09	68	01	98	80	27	49	78	56	67	49	22	13	66	61	33	53	18	36	03
61	73	92	33	89	48	20	42	32	33	79	37	68	88	44	59	35	17	97	61
82	35	37	33	53	42	52	04	16	54	08	25	48	89	57	87	59	89	96	76
39	20	77	72	55	19	66	58	57	91	38	43	67	97	52	66	45	29	74	67
51	90	71	05	82	38	37	40	94	52	24	09	35	44	37	33	35	20	65	89
97	49	53	79	17	25	02	65	77	70	88	45	53	51	63	30	89	66	42	03
73	18	91	38	25	82	29	71	56	89	86	74	68	58	75	36	93	13	33	31
17	79	34	97	25	89	01	17	67	92	62	25	54	70	52	88	28	05	61	17
97	27	26	86	17	67	59	56	95	07	49	05	70	06	70	35	21	35	26	18
56	06	63	00	07	40	65	87	09	49	70	34	67	02	33	39	04	40	01	51

APPENDIX 5: DATA COLLECTION SHEET

A: DEMOGRAPHIC DATA

1. Full Names_____ 2. Registration No ☐☐☐

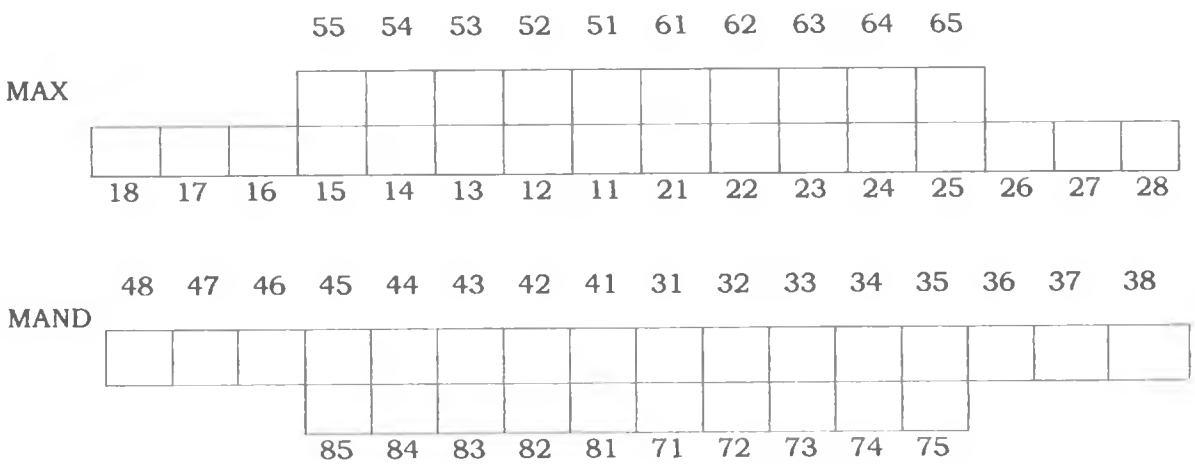
3. Sex M 1 ☐ F 2 ☐

4. Age in years ☐☐

5. Name of School _____

6. Location Urban 1 ☐ Rural 2 ☐

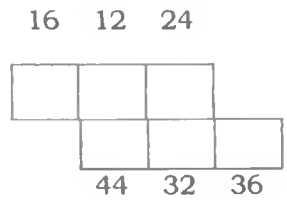
B: EXAMINATION FOR CARIES



Tooth Status	Code for Permanent Teeth	Code For Deciduous Teeth
• Sound	0	11
• Decayed –caries into enamel	1	12
• Decayed – caries into dentine	2	13
• Decayed – caries into pulp	3	14
• Filled with 1° or 2° Caries	4	15
• Filled with no decay	5	16
• Missing due to caries	6	17
• Missing due to other reasons e.g. extracted for orthodontic reason or trauma	7	

- Sealant or varnish 8
- Bridge abutment or special crown 9
- Unerupted tooth (Permanent tooth) 10

C: GINGIVAL INDEX (G.I)



Each of the surfaces of the teeth will be examined separately and the gingival status will be recorded according to Gingival Index by Loe & Silness (1963).

Criteria

- Absence of inflammation. 0
- Mild inflammation, slight change in colour, no bleeding on probing. 1
- Moderate inflammation, redness and oedema, bleeding on gentle probing. 2
- Severe inflammation, marked redness and oedema. spontaneous bleeding. 3

APPENDIX 6: QUESTIONNAIRE 0N ORAL HEALTH KNOWLEDGE AND PRACTICES.

PRACTICES

1. Do you brush your teeth

   1.Yes
   2.No

2. How often do you brush your teeth
   1. Three times a day
   2. Twice a day
   3. Once a day
   4. Rarely
   5. Never

3. When did you start brushing your teeth?
   1. Before primary school
   2. In primary school
   3. This year
   4. I don't remember

4. What do you use to brush your teeth
   1. Mswaki (traditional chewing stick)
   2. Commercial toothbrush
   3. Toothbrush and mswaki
   4. Finger
   5. Charcoal
   6. Others (specify) _____

5. Do you use toothpaste
   1.Yes
   2.No

6. Who taught you how to brush
   1. At school
   2. By a friend
   3. By parent/relative
   4. By a dentist /other health worker
   5. Other [specify] _____

7. Have you ever visited a dentist
   1. Yes
   2. No

If yes answer question 8 and 9 and skip no 11.
If No go to question 10.

8. What treatment was done during your visit
   1. Extractions (tooth removal)
   2. Tooth cleaning
   3. Filling
   4. Broken tooth treatment
   5. Check-up
   6. Other (specify) _____

9. What can you say about your first experience with the dentist
   1. It was a painful experience
   2. I did not feel pain
   3. I enjoyed it
   4. I don't remember

KNOWLEDGE

10. Why do you brush your teeth
    1.To prevent tooth decay (rotting teeth)
    2.To prevent gum disease (bad gums)
    3.To make my teeth whiter
    4.To prevent bad breath and feel fresh
    5.Because of a, b and d
    6.I don't know
    7.Others (specify) _____

11. Why have you never visited a dentist
    1. I don't think it is necessary
    2. I have never had a need to
    3. Lack of money
    4. I fear dentists
    5. I don't know where to find one
    6. The dentist will spoil my teeth

12. What would you prefer the dentist to do if you had a toothache
    1. Remove the tooth (extraction)
    2. Fill the tooth
    3. Give medicines
    4. Clean the tooth
    5. I don't know

13. What causes tooth decay (rotten teeth)
    1. Germs (bacteria)
    2. Eating sweets
    3. Water
    4. Brushing teeth
    5. 1 and 2
    6. I don't know

14. Do you think tooth decay can be prevented
    1. Yes
    2. No

15. Can any of the following be harmful(bad) to teeth when consumed (tick into the correct box)

Item	1.Yes	2.No	3. Don't know
Sweets, biscuits,cakes			
Meat			
Mangoes			
Sodas			
Sukuma Wiki			

16. What causes bleeding gums
    1. Bacteria on teeth
    2. Lack of Vitamins
    3. Dirt on teeth
    4. Failure to brush teeth
    5. Other (Specify) _____

APPENDIX 7

CONSENT FORM.

Dear Parent/ Guardian,

I am a postgraduate student at the University of Nairobi Dental School. I am pursuing studies specializing in children's dentistry.

I wish to request for your permission for your child to participate in a study that will form part of my degree work.

The study will involve examination of your Child's teeth and gums, which will be done by myself. I will also ask them questions regarding their brushing habits. All this will then be recorded and later analyzed for research purposes only. Should any problem be detected in your child then they will be referred to a dentist or advised accordingly. No invasive procedure will be performed on your child during the study.

I would therefore appreciate your consent by signing below.

Dr Dorcas K. Musera.

I, ...,Parent/ Guardian of .....of .....P.O.Box .....do hereby freely consent / do not consent to my child/ward to participate in the current oral health study.

Dr..... has explained what is required of my child/ward. I understand that consenting to my child/ward to participate in the programme will not affect any planned oral health care and, further, the child can withdraw at any time without any adverse consequences to him/her. I am also informed and understand that all information about my child/ward shall be treated in the strictest confidence.

Signed: .....
(Parent or guardian)

Witnessed by: .....

Date:.....