ORAL HEALTH STATUS AND TREATMENT NEEDS AMONG 3-6 YEAR-OLD CHILDREN ATTENDING LADY NORTHEY DENTAL CLINIC, NAIROBI CITY COUNTY

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DECLARATION

I, Fredah Chepkwony, hereby declare that this thesis is my original work and it has not been presented for the award of any degree in any other institution.

Signed: _____ Date: _____

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APPROVAL

This thesis has been submitted for examination with our approval as the university's supervisors.

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DEDICATION

This thesis is dedicated to my loving and supportive mother, Ceciliah Cheptanui Chepkwony.

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ABBREVIATIONS

ANUG	Acute Necrotizing Ulcerative Gingivitis
AU	Aphthous Ulcer
COML	Common Oral Mucosal Lesions
dmft	decayed, missing, filled teeth
ECC	Early Childhood Caries
HG	Herpetic gingivostomatitis
HIV	Human Immunodeficiency Virus
HSV	Herpes Simplex Virus
KNH	Kenyatta National Hospital
PI	Principal investigator
SPSS	Statistical Package for Social Sciences
TN	Treatment Need
UoN	University of Nairobi

DEFINITION OF TERMS

Age: Child's age as at their last birthday.

Child: For the purpose of this study, a child is an individual between 3 to 6 years of age.

Oral Health: A state of being free from chronic mouth and facial pain, oral and throat cancer, oral sores, birth defects, periodontal disease, tooth decay and tooth loss and other diseases and disorders that affect the oral cavity.

Oral Health Status: For the purpose of this study, oral health status was measured by the WHO criteria, dmft index, simplified debri index, gingival index, Foster and Hamilton criteria.

Oral Hygiene: Principles of hygiene as applied to the mouth, to ensure cleanliness and promotion of healthy teeth and gingiva.

ABSTRACT

Background: Oral health is an integral part of the general health of children and it has been defined as "a state of being free from chronic mouth and facial pain, oral and throat cancer, oral sores, birth defects such as cleft lip and palate, periodontal disease, tooth decay and tooth loss, and other diseases and disorders that affect the oral cavity". Although there has been a great global success in improving the oral health of children, the problem still exists in many communities around the world; particularly among the under-privileged in both developed and developing countries. Dental caries and periodontal diseases, which are associated with poor oral hygiene and dietary factors, have been considered as important components of the global disease burden. These two diseases can effectively be prevented and controlled through a combination of community, professional and individual oral health prevention and promotion strategies.

Setting: Lady Northey Dental Clinic, Nairobi City County, Kenya.

Objectives: The main objective of the present study was to assess the oral health status and treatment needs of 3 to 6-year-olds attending Lady Northey dental clinic.

Study Design and Methodology: This was a descriptive cross-sectional study with a minimal analytic component. The study population comprised of 3 to 6 year-old children, who attended Lady Northey dental clinic during the months of September to November, 2014. A structured interview with the child's parent/caregiver was used to collect data on the socio-demographic profile, oral hygiene and dietary practices. A clinical examination was then carried out by the principal investigator and a record made of oral mucosal lesions, dental caries, plaque deposits, gingival status, malocclusion and the corresponding treatment needs for each of these variables.

Data analysis and presentation: The data collected was coded, entered, cleaned and analysed using the Statistical Package for Social Sciences (SPSS) version 20. Univariate analyses were performed using Chi-square, ANOVA and t-tests. Adjusted odds ratios from multivariate logistic regression was also computed to obtain the association between different variables. The results of the analysis were presented in the form of charts and tables.

Results: The 272 children who participated in the current study had a high dietary sugar intake and poor oral hygiene status. The prevalence of oral mucosal lesions in this study group was 40.4%, with dental abscess being the most common lesion. A total of 95% of the children had dental caries with a mean dmft of 8.53 (± 5.52 SD). The prevalence of gingivitis and malocclusion was 44.1% and 55% respectively. With regards to the treatment needs, 60% of those who had oral mucosal lesions required prompt treatment in the form of incision and drainage. Most of the children in the study required restorations (87.5%), pulp therapy and stainless steel crowns (62.5%) and extraction (60.3%). Approximately 44% of the children required oral prophylaxis and scaling for the management of gingivitis. In relation to malocclusion, the majority (87.9%) of the children who participated in the study required preventive orthodontic treatment, while 8.8% and 2.6% required interceptive treatment and referral to an orthodontist respectively.

Conclusion: The majority of the children had poor oral health status, poor oral hygiene practices and high sugar intake. Most of the children were from a low socioeconomic background with the caregivers having poor knowledge and attitude towards oral health and the perception that deciduous teeth were not important. The prevalence of dental caries was 95.5% with moderate prevalence rates for oral mucosal lesions, gingivitis and malocclusion. The treatment needs included prompt incision and drainage, extraction, dental restorations, pulp treatment, stainless steel crowns, oral prophylaxis and preventive orthodontic treatment. The only treatment available at the time the study was conducted was dental extraction.

Recommendations: These results indicate a need to lobby county authorities to consider ways of improving dental health among children, human resource and capacity building, and a need to spread dental services to the periphery of Nairobi county.

1.0 CHAPTER ONE: INTRODUCTION AND LITERATURE REVIEW

1.1 INTRODUCTION

Oral health is an integral part of the general health of children and it has been defined as 'a state of being free from chronic mouth and facial pain, oral and throat cancer, oral sores, birth defects such as cleft lip and palate, periodontal disease, tooth decay and tooth loss, and other diseases and disorders that affect the oral cavity'[1]. Oral health has often been neglected in many developing countries and given low priority due to budgetary constraints and a number of other more pressing health problems like malaria, pneumonia and HIV/AIDS. In Kenya, the allocation to oral health by The Ministry of Health for the year 2014/2015 financial year was 392,400 Kenya Shillings [2]. There is a need to ensure that these limited resources are used efficiently and effectively.

The Constitution of Kenya, 2010 provided for the creation of 47 counties with their own devolved County Governments, to replace the former 8 provinces. Nairobi City County Government came into existence in 2013 with the same boundaries as the former Nairobi Province. Nairobi City County Government is composed of 17 Parliamentary constituencies. Under the devolved government structure, healthcare falls under the County government. The impact of devolution on health care delivery is yet to be determined in Kenya.

Generally, the most common paediatric oral mucosal lesions in children include candidiasis, herpes simplex infection, aphthous stomatitis, erythema migrans and angular cheilitis[3]. Plaque-induced chronic gingivitis forms the most common periodontal disease among children and adolescents[3]. In Nairobi, the prevalence of acute necrotizing ulcerative gingivitis among school children has been reported to be 0.06%[4]. Dental caries is a major oral health problem in Kenya. Hospital based studies conducted in Nairobi have reported high prevalence rates for dental caries of 89.4%[5] and 93.6%[6] among 3-5 year old children. A community-based study conducted in 1997 by Ngatia et al[7] reported a lower prevalence of dental caries (63.5%) with a mean dmft of 2.95 among nursery school children aged 3-5 years in Nairobi. Few local studies have assessed malocclusion in the primary dentition[8]. Malocclusion can predispose the child to unfavourable sequelae such as tooth mal-alignment and impaction, which may require complex orthodontic treatment in the permanent dentition[9].

Oral health status assessment is key in planning oral health services for children who attend oral health care facilities. The findings on oral diseases that these children present with and their respective treatment needs can then be utilized in the interim to recommend treatment measures that are preventive, promotive and curative for children attending oral health care facilities in Kenya.

1.2 LITERATURE REVIEW

1.2.1 Oral Hygiene

In order to achieve adequate plaque removal, 3 to 6 year old children require caregiver's assistance, with emphasis on at least once daily tooth cleaning using toothbrush[10]. Tooth brushing with fluoridated toothpaste twice daily has been thought to be beneficial against the development of dental caries[10]. Kibosia et al[11] reported that urban children practiced daily tooth brushing with some of the children using fluoridated toothpaste due to accessibility of toothbrushes, awareness and media influence. Frequent consumption of foods containing fermentable carbohydrates without good oral hygiene increases the risk of caries due to prolonged contact between the sugar in the drink/food and the cariogenic bacteria on the tooth surface[12].

1.2.2 Oral Mucosal Lesions

Epidemiology of childhood oral mucosal lesions has received less attention when compared to dental caries and periodontal disease. Most of the previous studies on oral mucosal lesions have been done among adults in populations at high risk for specific lesions of interest[3]. A wide variability in the prevalence of oral mucosal lesions among children has been reported in different regions of the world[13]. This wide difference could be attributed to differences in the criteria used in the diagnosis of these lesions. Lower prevalence rates of oral mucosal lesions have been reported in Lesotho (4.9%) among children under five years[3] and South Africa (32.9%) among black pre-school children from a low socio-economic area[14]. A Brazilian study by Bessa et al[15] reported a prevalence of 24·9% among children under the age of 4 years and this particular study excluded lesions caused by dental caries, endodontic and inflammatory periodontal lesions. Some of the most prevalent oral mucosa lesions reported include geographical tongue[15], coated tongue[16], lip/cheek bite[17], candidiasis [3] and angular cheilitis [18].

The geographic tongue, also known as benign migratory glossitis or erythema migrans, is the most commonly studied lesions in children globally and the most common tongue disease reported in almost all studies[15]. This condition is predominant among females and sometimes presents at a very early age[19]. It appears as multiple areas of papillary scaling, well circumscribed by tenuous white borders spread on the dorsum of the tongue. It is highly prevalent in children with chronic disease, suggesting that an underlying pathophysiologic disorder(s) or the use of drugs by these children could be associated with this disorder[20].

Aphthous stomatitis (AS) is another common childhood or adolescence oral mucosal condition, characterized by multiple, recurrent, small, round or ovoid ulcers with circumscribed margins, erythematous halos and yellow or gray floors. The etiology of AS is unknown but genetic, immunologic, microbial, socioeconomic/environmental and nutritional factors have been implicated[15]. In a research by Majorana et al[20], it was reported that AS was more common among children affected by systemic disease (immunodeficiency, nutritional deficiencies, malabsorption, celiac disease) than in healthy children.

Herpetic gingivostomatitis (HG), a viral infection of the oral cavity, is another condition found in children and it is caused by the herpes simplex virus (HSV). It is highly contagious, typically affects children and has a high rate of recurrence of infection[21]. Epidemiologically, there are two peaks with respect to the age at which primary herpetic gingivostomatitis occurs, the first peak occurs among children aged 6 months to 5 years of age, the second peak occurs among young adults in their early twenties. Individuals in developing countries with a lower socio-economic status are more susceptible to HSV-1 at an earlier age than their counterparts in developed countries. The recurrent form of herpes simplex viral infection is Herpes labialis, which presents on the lip as small blisters or sores on or around the mouth. A study by Crivelli et al[22] reported that Herpetic lesions appeared in 10% of the low socioeconomic group compared to the 1% of in the high socioeconomic group.

Oral candidiasis is the most prevalent mycotic infection of the oral mucosa. It is caused by an overgrowth of *Candida albicans*, an opportunistic fungus found in the oral cavity, gastro-intestinal tract and vagina. Clinically, it appears as diffuse, curdy or velvety white mucosal plaques that can be wiped off. Oral candidiasis results in discomfort and sometimes pain in the oral cavity and in extreme cases it may spread to neighbouring regions resulting in pain on swallowing. In their study on HIV-infected children, Anver, et al [23] reported that candidiasis was the most prevalent HIV related oral manifestation among the children in Nairobi and Mombasa. Whereas the study by Majorana et al[20] observed that oral candidiasis was more likely to occur among children with systemic diseases, owing to local and systemic predisposing factors in the children.

1.2.3 Dental Caries

Dental caries is a chronic infectious disease of the dental hard tissues that causes tooth demineralization. Four factors contribute to the initiation and progression of dental caries: a susceptible tooth surface, specific bacteria in dental plaque, time and a diet rich in

fermentable carbohydrates, particularly refined sugars. Dental caries can result in oro-facial pain that may interfere with speech, eating, sleeping, swallowing and breathing. This can result in low self-esteem and undermine social acceptance among children[24]. World Health Organisation reports[25] indicate that dental caries is more prevalent in developing countries than in most developed countries where its prevalence and severity has declined due to implementation of preventive oral health care programmes and changes in living conditions and lifestyles. In developing countries, especially Sub-Saharan Africa, the prevalence of dental caries has been reported to vary according to the population group and their socio-economic status[26]. The consequences of dental caries include pain and subsequent irreversible pulp damage that may lead to premature loss of teeth. This may predispose the child to malocclusion in the succeeding permanent dentition, increased risk of developing caries in the permanent dentition and a reduced oral-health related quality of life[27].

1.2.3.1 Early childhood caries

Early childhood caries (ECC) is the presence of one or more decayed, missing (due to caries) or filled tooth surfaces in any primary tooth in a child aged 71 months or younger[28]. ECC has also been described as nursing caries, nursing bottle syndrome, nursing bottle caries, night bottle mouth, baby bottle tooth decay, milk bottle caries, labial caries and caries of the incisors[29]. Nursing caries and rampant caries are the two variants of ECC. The difference between the two variants of ECC is the involvement of mandibular incisors in rampant caries as opposed to nursing caries[27]. Some of the predisposing factors include prolonged and night-time bottle feeding of milk or sweetened water or juice, “on-demand” breastfeeding, prolonged use of a pacifier coated with sugar or other sweetened foods and linear hypoplasia of primary teeth associated with malnutrition. ECC affects the quality of life of young children and it has been implicated in the contribution of other health problems. Children with ECC have been shown to weigh less than 80% of their ideal weight and to be in the lowest 10th percentile for weight[30].

In developing countries the prevalence rate of ECC has been reported to be as high as 70% unlike in developed countries where it ranges from 1-12%[31]. In Nairobi, hospital based studies have reported higher dental caries prevalence rates of 89.4%[5], with a mean dmft of 8.52 ($\pm$ 5.27 SD) and 93.6%[6], with a mean dmft of 8.14 ($\pm$5.34 SD) among 3-5 year old children. Lower prevalence rates have been reported in community based studies by Njoroge et al (59.5%)[27] and Ngatia et al (63.5%)[7] among 3-5 year preschool children in

Kiambaa and Nairobi respectively. Masiga and Holt[39] and Ngatia et al[7] have reported mean dmf-t scores of 1.27 and 2.95 respectively among preschool children in Nairobi. School-based studies conducted in Uganda[31] and South Africa[32] have reported mean dmft values of 2.6 and 2.9 respectively among 3-5 year old children. A prevalence of ECC of 47% has been reported among school-based children aged 2 to 5 years in Accra, Ghana[40].

1.2.3.2 Diet and Dietary Habits

An oral environment enriched with dietary sugars is a major factor in the initiation and progression of dental caries. Sucrose is a widely used dietary sugar in most of the consumable food products making it a common available and accessible substance to a majority of the Kenyan children population[11]. The features unique to sucrose as a cariogenic carbohydrate includes; the production of extracellular glucan, that enables *Mutan Streptococcus (MS)* to adhere firmly to teeth[33] and acid production that causes a change of the oral microflora from non-cariogenic to a cariogenic[34].

1.2.3.3 Socio-demographic and economic factors

Socio-demographic and economic factors such as parental level of education, number of children and family income are important determinants of dental caries. A relationship exists between ECC and socio-economic backgrounds with children from the lower socio-demographic classes having a higher caries experience as compared to those from the higher socio-demographic classes[35]. Children born to single parent families and young mothers have been shown to have a higher caries experience. A Kenyan study by Masiga and Holt in 1993[39] reported a high caries prevalence among single parent families and families having an unemployed father probably due to their low socioeconomic status. A Brazilian study found that caries was prevalent among children whose mothers were either illiterate or had less than 4 years of education[36], this was probably due to the inadequate knowledge on oral health.

1.2.4 Gingivitis

Gingivitis refers to inflammatory lesions confined to the marginal gingiva with the principal local factor being dental plaque. Dental plaque is defined as an oral biofilm comprising of bacteria, saliva and food residues. The bacteria within the dental plaque initiates gingivitis[37]. Gingivitis in children is reported to be less severe than in adults, this may be as a result of differences in bacterial plaque composition, morphology of the gingiva and

predominance of lymphocytic infiltrate in gingival tissues in children[38]. Oh et al[18] reported that plaque-induced chronic gingivitis was the most common periodontal infection among children. Marginal gingivitis usually commences in early childhood and its incidence and degree of severity worsens in adolescence[38]. The prevalence of gingivitis reported in Kenya by Masiga and Holt[39] among nursery school children was 37% among 3-5 year old children. This was lower than the 95% prevalence reported by Kassami et al[5] in a hospital-based study among 3-12 year-old children. A hospital-based study in Lesotho[3] among children under five reported a prevalence of gingivitis of 5.4% and another the one in Accra, Ghana[40] had a prevalence of 4.2% among 4-5 year old peri-urban schoolchildren. Another study by Olga and Ismael[41] reported a prevalence of 39% among Mexican preschool children aged 4-5 years.

Acute necrotizing ulcerative gingivitis (ANUG) is a severe painful form of gingivitis characterized by necrotizing inflammation of the marginal interdental gingiva with minimal or no osseous involvement[42]. The disease begins at the interdental papillae with red and oedematous gingiva, spontaneous bleeding and sore mouth as some of the presenting signs and symptoms. The predisposing factors for ANUG includes poor oral hygiene, pre-existing gingivitis, emotional stress, low socio-economic status and malnutrition. In sub-Saharan Africa, the disease has been seen almost exclusively among economically underprivileged children[43]. If untreated, ANUG may progress to the life-threatening disease cancrum oris[44]. In Kenya, the prevalence of acute necrotizing ulcerative gingivitis among school children has been reported to be 0.06%[6].

1.2.5 Malocclusion

Malocclusion is a common occurrence in children and it may be unnoticed during the early years of life, yet it may predispose the child to unfavourable sequelae, requiring complex orthodontic treatment[9]. Malocclusion has its aetiology relating to genetic or environmental factors like digit sucking, lip biting and tongue thrusting. Rop and Ng'ang'a[9] studied malocclusion among school going children in public pre-schools aged 3-5 year in Nairobi and reported a prevalence of 60.94%, with mesial step being the most prevalent terminal plane relationship (70.1%), followed by flush terminal (27.1%). Class I canine relationship was found in 78.9% and majority of the children had a Class I incisor relationship with 50.7% having an ideal overbite. Spacing was prevalent (80.3%). Kabue et al[46] also conducted a study among 221, 3-6 year olds, in Nairobi from six randomly selected pre-primary schools and reported that 53% of the children had straight terminal plane, 43% had

mesial step and 1% had distal step molar relationship. Anthropoid spaces were observed in 85% of the children with over 60% spacing in the anterior region. A study conducted in Tanzania[47] reported that flush terminal plane accounted for 93.8%, bilateral mild mesial step in 1.6% and severe mesial step in 1.6%. Otuyemi et al[48] carried out a study of 525 Nigerian children and found that the flush terminal plane to be prevalent (74.5%) followed by mesial step in 20.9% and 1.9% with distal step. Determination of terminal plane in the primary dentition stage is important because the erupting molars are guided by the distal surfaces of the second primary molars[49].

The canine relationship has been used as a second reference for occlusal status[50]. Class I canine relationship has been reported as the norm[48]. Some malocclusions like a full Class II malocclusion in the primary dentition and maxillary protrusion are more prone to persist during the development of the occlusion than others. Rwakatema and Ng'ang'a[47] found excessive overjet (5.1%), deep bite (21.5%), anterior crossbite (1.9%) frontal open bite (1.6%), lateral open bite (0.8%) and posterior crossbite (0.3%) in 3-5 year old Tanzanian children.

1.2.6 Oral Health Education

Oral health education has been reported to produce positive results in the overall oral health of a child. In schools, children are instructed to reduce the intake of sugary foods and brush their teeth at least twice in day, however this does not cover the entire aspects of oral disease and its prevention[51]. Additional information on oral disease prevention is taught in dental clinics, however access to these facilities is limited due to several barriers including poverty. Availability and accessibility of professional dental care for children in deciduous dentition in Nairobi has been reported to be inadequate[11].

1.2.7 Treatment Needs and Treatment seeking behavior

Oral health treatment needs refers to the demands for oral healthcare among a population[37]. A school based study done in Uganda by Nalweyiso et al[51] indicated that the treatment burden of dental caries among children in primary dentition was mainly centred in fillings (56%) and extractions (44%). Yee et al[52] conducted a study on the burden of restorative dental treatment in third world countries and concluded that in many low-income countries the cost of treating dental caries in children alone would exceed the total health care budget for children. Kabue et al[46] in their study on malocclusion among 3-6 year old children in Nairobi reported that some of the children required interceptive orthodontic treatment. Downer[53] in his study reported that children with poor oral health seeking

tendency had the highest dft values as compared to regular attendees and occasional attendee.

1.3 Statement of the Problem

Epidemiological studies on childhood oral mucosal lesions are scarce in Kenya. From the aforegoing review, limited Kenyan studies have been conducted on gingivitis and dental caries among children in the deciduous dentition. Changes in the dietary patterns have also been reported hence the reported prevalence rates for oral diseases may not reflect the current situation[37]. Studies on malocclusion in the deciduous dentition are scanty with the few studies conducted previously being community-based[9,46], no hospital or clinic-based study has been reported. It would be important to have data on the common oral health issues presenting at the oral health facilities, oral health seeking behaviour and the oral health treatment needs of the Kenyan children. There is therefore a need to profile the children attending Lady Northey dental clinic and to determine the pattern of the common oral diseases and conditions that these children present with. The treatment needs of these children are unknown and therefore the information could be vital in planning of quality dental services for these children.

1.4 Justification

Oral diseases have been reported to restrict activities both in school and at home among children because they tend to cause pain that leads to absenteeism and poor performance in school[54]. Children in the deciduous dentition are vulnerable to high incidence of oral diseases, as they do not have sufficiently developed manual dexterity and cognitive skills to perform oral health care practices independently. They also depend on their caregivers for proper dietary habits.

Lady Northey dental clinic is a public paediatric dental clinic in Kenya and, as at the time the study was conducted, was referring patients to Kenyatta National Hospital and The University of Nairobi, Dental school for comprehensive management. There were only two dental operatories and the only curative treatment offered at the time the study was conducted was dental extraction. No comprehensive study had been conducted at Lady Northey dental clinic to determine the oral health status, pattern of oral diseases and treatment needs of these children. The previous studies done on the prevalence of malocclusion[9], dental caries[7], gingivitis[39] may not reflect the current state due to changes in lifestyles, dietary and oral practices.

It was anticipated that data collected from this study could provide an important baseline for possible planning and acquisition of resources for preventive, promotive and curative oral health care for the children attending the clinic. The institution could also use the data to lobby for more resources from the county government and other well wishers.

1.5 Study Objectives

1.5.1 Broad Objective

To establish the oral health status and treatment needs of 3 to 6 year old children attending Lady Northey dental clinic, Nairobi City County.

1.5.2 Specific Objectives

1. To determine the oral hygiene and dietary practices among 3 to 6 year old children attending Lady Northey dental clinic.

2. To determine the occurrence of oral mucosal lesions, dental caries, gingivitis and malocclusion among 3 to 6 year old children attending Lady Northey dental clinic.

3. To determine the treatment needs of children aged 3 to 6 years attending Lady Northey dental clinic.

1.6 Null Hypotheses

1. The occurrence of dental caries is not dependant on the tooth brushing frequency among children attending Lady Northey dental clinic.

2. The occurrence of gingivitis is not dependant on the tooth brushing frequency among children attending Lady Northey dental clinic.

1.7 Alternative Hypotheses

1. The occurrence of dental caries is dependant on the tooth brushing frequency among children attending Lady Northey dental clinic

2. The occurrence of gingivitis is dependant on the tooth brushing frequency among children attending Lady Northey dental clinic.

1.8 Study Variables

1.8.1 Dependent Variables

Dependent Variable	Measurement
1. Oral mucosal condition	WHO, 2013 criteria
2. Dental Caries	dmft index, Klein, Palmer & Knutson,1938
3. Oral Hygiene Status	Simplified Debri Index, Rodrigues C. R,1990
4. Gingivitis	Gingival Index, Loe & Silness,1963
5. Malocclusion	Foster & Hamilton criteria, 1969

1.8.2 Independent variables

1. Age of child
2. Gender of child
3. Socio-demographic data
4. Dietary practices
5. Oral hygiene practices

2.0 CHAPTER TWO: MATERIALS AND METHODS

2.1 Study Area and Population

2.1.1 Study Area

The study was carried out in Nairobi, which is a metropolitan city with a population of approximately 3 million people. Nairobi City County is composed of 17 Parliamentary constituencies: Westlands, Langata, Kibra, Makadara, Kamukunji, Starehe, Dagoretti North, Dagoretti South, Roysambu, Kasarani, Ruaraka, Embakasi South, Embakasi North, Embakasi Central, Embakasi East, Embakasi West, and Mathare. The central government, the Nairobi City County and several private and non-governmental institutions provide health services to children and the general public. Due to the high cost of dental treatment, most of the children population seek treatment in major government-run institutions such as the Kenyatta National Hospital, The University of Nairobi, School of Dental Sciences and Lady Northey Dental Clinic.

The study was conducted at Lady Northey Dental Clinic, located along State House Avenue in Westlands constituency of Nairobi City County. Lady Northey dental clinic was initially set up in 1978 to offer preventive and curative dental services to children attending city council primary schools. At the time of the study, the clinic offered free oral health education, diagnosis and extractions to children in the urban and peri-urban Nairobi. Children in need of specialized treatment were referred to The University of Nairobi, School of Dental Sciences or Kenyatta National Hospital dental clinic.

2.1.2 Study Population

All the patients aged 3-6 years in primary dentition who attended Lady Northey dental clinic from September to November 2014, were eligible for inclusion into the study. The choice of the age group was made as the study required children in full primary dentition. Among the Kenyan population, the second deciduous molar erupts at 24 to 30 months and the lower central incisors exfoliate at the age of 5 to 6 years. This age bracket therefore captured the children in full deciduous dentition. Accordingly, for the child to be included into the study, he or she had to fulfill the inclusion criteria.

2.1.3 Inclusion Criteria

1. Children aged 3-6 years in full primary dentition.

2. Children who were accompanied by parents/caregivers.
3. Children whose parents/caregivers gave consent.
4. Children who assented to take part in the study.

2.1.4 Exclusion Criteria

1. Children below 3 and above 6 years.
2. Children who were accompanied by persons who were not parents/caregivers
3. Children who did not assent and those whose parents/guardians had not given a written informed consent to participate in the study.
4. Children in mixed dentition.
5. Children with incomplete eruption of deciduous teeth.
6. Uncooperative children.

2.2 Methodology

2.2.1 Study Design

A descriptive cross-sectional study design with an analytical component was used to collect relevant data in order to evaluate the oral health status and treatment needs of children aged 3-6 years attending Lady Northey dental clinic.

2.2.2 Sample Size Determination

The desired sample size was calculated using the following formula:

$$n = \frac{z^2 p(1-p)}{d^2}$$

Where:

z is the standard normal deviate at required confidence level, set at 1.96, which corresponds to 95% confidence interval.

p is the proportion of children with poor oral health, set at 80%[1].

d is the degree of precision, set at 5%.

Thus the sample size calculated was:

$$n = \frac{1.96^2\ 0.8(1-0.8)}{0.05^2} = \mathbf{246}.$$

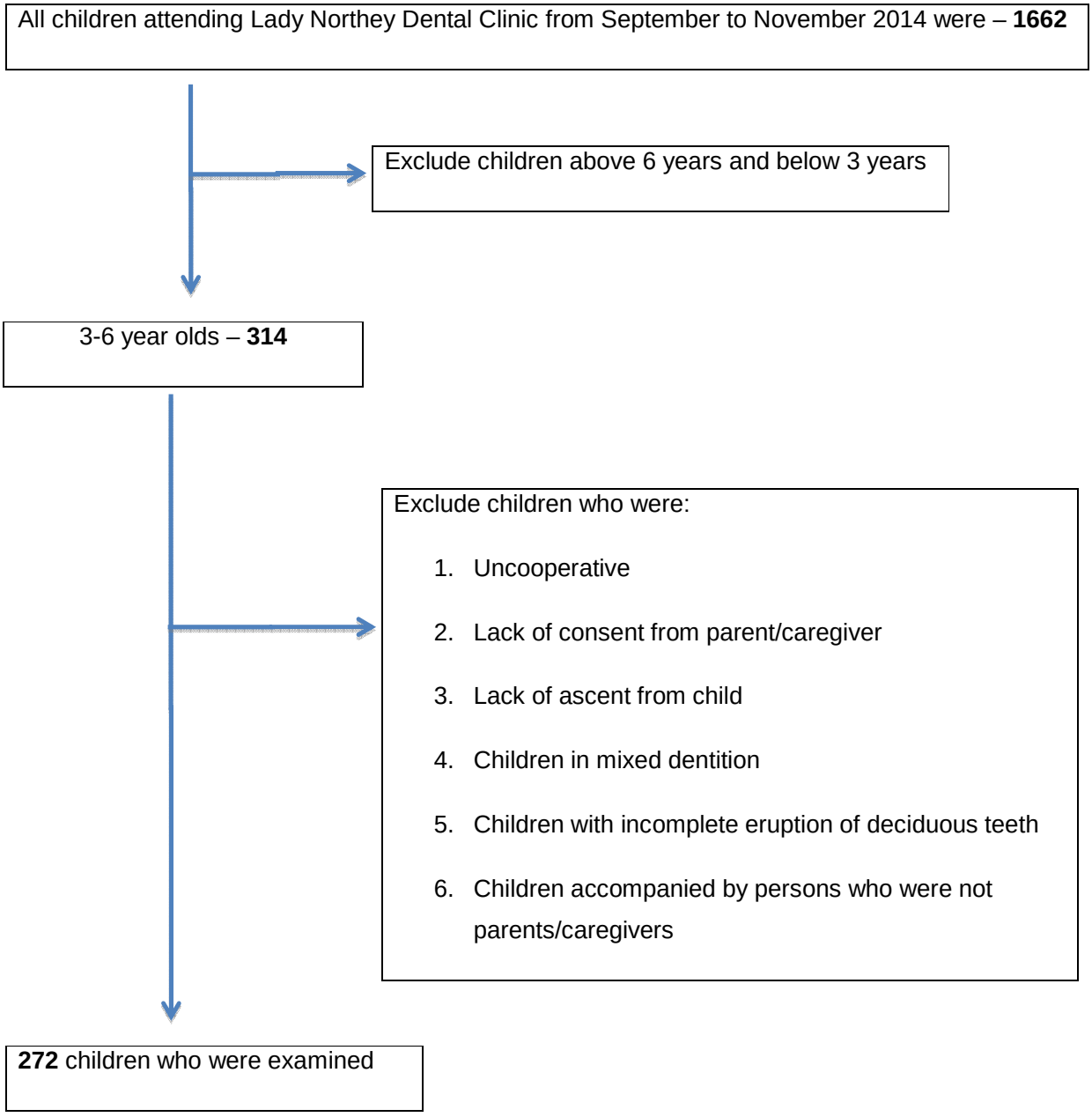
Accounting for non-response rate of 10% [55] was obtained.

n = 246 + 25 = **271** (Minimum children to be examined)

272 children were examined.

2.2.3 Sampling procedure

Purposive sampling was used. All the children attending the Lady Northey dental clinic during the period of the study and those who met the inclusion criteria, were consecutively examined.



2.3 Data Collection Instruments and Techniques

2.3.1 Questionnaire

A semi-structured questionnaire (Appendix V) was used to collect data, in a face-to-face interview with the parent/caregiver, to obtain the socio-demographic characteristics, oral hygiene practices and dietary practices of the children. The parents/caregivers were interviewed by a research assistant. The research assistant was trained and calibrated by the principal investigator prior to the time of data collection. Where necessary, explanation and interpretation in Swahili language was provided.

2.3.2 Oral clinical examination

The oral cavity was examined by the principal investigator under natural daylight, with the child seated on a bench or on the parents' lap, using clean disposable gloves, mask, sterile dental mirror, an explorer and WHO probe. The WHO 2013[56] criteria for field studies was used. The oral health status components that were assessed included oral mucosal lesions, dental caries, plaque score, gingivitis and malocclusion. A recording clerk recorded the findings as reported by the principal investigator. All the instruments used for clinical examination were heat-sterilized before re-use.

2.3.2.1 Oral mucosal lesions and treatment need

Examination procedure

Clinical diagnostic criteria for oral mucosal alterations, proposed by the World Health Organization[56] was used. The lips were examined with the mouth in an open and closed position. The colour, texture and any surface abnormalities of the vermillion border were noted. The mandibular vestibule was examined visually with the mouth partially opened. The colour and any swelling of the vestibular mucosa was observed. With the mouth partially open, the maxillary vestibule and frenulum was examined. Using a dental mirror as retractors and the mouth wide open, the entire buccal mucosa extending from the commissures to the anterior tonsillar pillar was examined. Any changes in colour, texture and mobility of the mucosa was noted. Alveolar ridges were examined from all sides (bucally, palatally, lingually).

With the tongue at rest and the mouth partially opened, the dorsum of the tongue was inspected for any ulceration, coating, swelling or variation in colour or texture. The margins of the tongue were inspected with the aid of a dental mirror. The tongue was elevated and

the ventral surface and floor of mouth observed for swellings or any other abnormalities. With the mouth wide open and the subject's head tilted backwards, the base of the tongue was gently depressed. The hard palate was inspected first followed by the soft palate. The treatment need was recorded for any lesion identified.

2.3.2.2 Oral hygiene status

The criterion used to ascertain oral hygiene was the plaque component of the simplified oral hygiene index as described by Rodrigues C. R in 1990[57] among for 4-6 years-olds. The labial surfaces of **54, 61, 82** and lingual surface of **75** were used. Only the Simplified debri index was used and scored as:

0 - No debris observed on the tooth surface.
1 - Soft debris covering not more than one third of the tooth surface or presence of stains without other debris regardless of surface area covered.
2 - Soft debris covering more than one third, but not more than two thirds of the exposed tooth surface.
3 - Soft debris covering more than two thirds of the tooth surface.

2.3.2.3 Gingival Status and treatment need

Bleeding on gentle probing is an early sign of gingival inflammation and precedes colour changes and enlargement of the gingival tissues. Modification of the gingival index of Loe & Silness, 1963[58] was used and six sites were probed:

Buccal/Labial of 55, 51, 65, 71 and lingual aspect of 75 and 85

The teeth were dried and examined visually using a mouth mirror and a WHO periodontal probe. The probe was run along the soft tissue wall near the entrance to the gingival sulcus to evaluate bleeding. Thirty seconds was allowed for re-inspection of an area that did not show bleeding immediately. Bleeding was recorded as present or absent. Gingivitis was recorded when there was a slight change in colour, edema (score 1), bleeding on probing (score 2) or when spontaneous bleeding occurred (score 3). Healthy gingiva was scored as 0. The treatment need for each tooth was recorded.

2.3.2.4 Dental Caries and treatment need

All the teeth were cleaned using sterile gauze. Caries was diagnosed according to the criteria recommended by WHO for oral health surveys[56]. Caries was recorded when a detectable softened floor, undermined enamel or softening of the walls was present. Missing teeth were scored as such only when they were as a consequence of caries. The dmf(t) index by Klein, Palmer & Knutson (1938) was used to determine the caries experience. Any restored tooth was recorded as a filled tooth. The treatment need for each tooth was recorded in the questionnaire form.

2.3.2.5 Malocclusion and treatment need

The occlusion was assessed with the child biting on his/her back teeth with the jaws in centric relation. The cheek was retracted on each side using a dental mirror and occlusion was registered according to the modified guidelines of Foster and Hamilton, 1969 [59] while looking at right angles to the buccal surfaces on each side. The treatment need for each child was recorded in the questionnaire form.

Evaluation criteria

1. Terminal plane relationship

Flush terminal plane: The distal surfaces of maxillary and mandibular primary second molars lie in the same vertical plane in centric occlusion.

Mesial step: The distal surface of the mandibular primary second molar is mesial to that of the maxillary primary second molar in centric occlusion.

Distal step: The distal surface of the mandibular primary second molar is distal to the distal surface of the maxillary primary second molar in centric occlusion.

2. Primary canine relationship

Class I: The cusp tip of the maxillary primary canine tooth is in the same vertical plane as the distal surface of the mandibular primary canine.

Class II: The cusp tip of the maxillary primary canine tooth is mesial to the distal surface of the mandibular primary canine.

Class III: The cusp tip of the maxillary primary canine tooth is distal to the distal surface of the mandibular primary canine.

In the determination of primary second molar relationship, if one side ends with distal or mesial step while the other side ends with flush terminal plane, it was recorded as flush terminal plane. In the determination of canine relationship, if there was a Class II or Class III relationship on one side and a Class I on the other, it will be recorded as a Class I relationship. In the determination of the occlusal relationship of both primary second molars and primary canines, the children with mesial step on one side and distal step on the other were left out of assessment.

3. Overbite

Normal: The upper primary central incisors covering of less than or equal to 50% of lower primary incisors in centric occlusion.

Increased: The upper primary central incisors covering of more than 50% of lower primary incisors in centric occlusion.

Edge-to-edge: The upper and lower primary incisors in relation.

Anterior open bite: There is no vertical overlap between the upper and lower primary incisors in centric occlusion.

4. Overjet

Amount of overjet was measured from the lingual surface of the mesial corner of the most protruded maxillary incisor to the facial surface of the corresponding mandibular incisor recorded in millimeters using boley gauge. Normal overjet was 0-2 mm.

5. **Anterior crossbite**

One or more of the maxillary incisors occluded lingual to the opposing mandibular incisors in centric occlusion.

6. **Posterior crossbite**

One or more of the maxillary primary canine or molars occluded palatally to the buccal cusps of the opposing mandibular teeth in centric occlusion (either unilateral or bilateral).

Normal occlusion

1. Flush terminal/mesial step molar relationship
2. Class I canine relationship
3. Ideal overjet of 0-2 mm
4. Ideal overbite of $>0^0$ to $\leq 50^0$
5. Absence of crossbites

Malocclusion

A set of inter-arch and intra-arch dental deviations from the normal, in the sagittal, vertical and transverse planes.

2.4 Validity

The principal investigator trained and calibrated the two research assistants. Training of the research assistants included:

- Providing an overview of the study
- Interviewing techniques
- Data recording into questionnaires
- Disinfection and sterilization of instruments and infection control.

The principal investigator examined all the participants following calibration by one of the supervisors. All the questionnaires were reviewed by the principal investigator before the end of each day and any discrepancies corrected before releasing the participants.

2.5 Reliability

2.5.1 Pretesting of data collection tool

A pilot study was conducted in March 2014 on thirty two subjects at Lady Northey dental clinic prior to the main study. This enabled vital adjustments of the data collection tool.

2.5.2 Results from Calibration Exercise

Calibration was done to measure both intra-agreement between two measures from the same dental examiner (the principal investigator) and inter-agreement between the dental

examiner and an experienced dental examiner (the principal supervisor). Dental examiner or examiner was used to refer to the principal investigator, whereas the term gold standard was used to refer to the principal supervisor. The scores of interest for calibration analyses were dmft, simplified debris index, gingival index and Foster & Hamilton criteria.

For *intra-calibration* exercise, every 10th child was re-examined to establish intra-examiner consistency, a total of 27 children. The aim of this exercise was to validate examiner scores against itself in order to assess the propensity of obtaining the same score. On the other hand, for *inter-calibration* exercise, the examiner and gold standard measured the same child. A total of 23 children were examined. The aim of this exercise was to validate the scores of the examiner against a gold standard and to determine how well or accurate the two scores agreed. The results of the calibration obtained were Cohen's Kappa of 1.00,1.00,0.80,0.85 for intra-examiner and 1.00,1.00,0.85,0.80 for inter-examiner values in relation to dental caries, gingivitis, oral hygiene and malocclusion respectively, representing almost perfect agreement.

2.6 Data Quality and Control

The quality of data was ensured during the entire study process. At data collection point, completeness of questionnaires, legibility of data collected and validity of responses was determined. At the data processing, quality control included data cleaning and validation. All information collected was coded and password protected and the questionnaires arranged in folders and properly kept in lockable drawers for confidentiality.

2.7 Data Analysis

Data entry and cleaning was done using Statistical Package for Social Sciences (SPSS) version 20. Descriptive statistics and frequency distribution were determined for all the oral diseases/conditions. Appropriate statistical tests were used to determine the association between two or more variables. The data was presented using charts and tables to provide an overview of the study findings.

2.8 Ethical Considerations

Approval for the study was sought from the Kenyatta National Hospital and the University of Nairobi ethics, research and standards committee (Appendix IX) and Nairobi City County (Appendix X). The Principal Investigator guided the parents/caregivers of eligible children through the consent seeking protocol (Appendix III/IV), in a language that they understood. For those who did not understand English, Swahili was used. The children

whose parents/caregivers gave consent by use of either a signature or thumbprint and those who met the selection criteria were enrolled into the study.

Questionnaires (Appendix V) were administered in a private area. Codes were used instead of the participant's names for identification. Oral examination was conducted using sterile instruments. Study subjects and their parents/ caregivers were counselled on preventive measures and treatment options available with regard to their oral health status. Children in need of treatment were treated at Lady Northey dental clinic and those requiring comprehensive treatment were referred to Kenyatta National Hospital and University of Nairobi Dental School.

All the information that was obtained was kept confidential; codes were used to identify the participants. All data collected was entered in password-protected computers.

3.0 CHAPTER THREE: RESULTS

3.1 Socio-Demographic Characteristics

A total of 272 children aged 3 to 6 years and their parents/caregivers participated in the study. One hundred and thirty seven (50.4%) children were males and 135 (49.6%) were females. The mean age of the children was 4.5 years (± 0.8 SD) with the mean ages of the males and females being 4.4 and 4.5 years respectively. Nine children (3.3%) came from single parent families (mothers). Nearly half of the fathers of the children, who formed 48.2% (n=131) and mothers, who formed 41.9% (n=114), had completed secondary school education. With regard to father's employment status, 73.2% (n=199) were in non-formal employment, while 20.2% (n=55) were in formal employment. A comprehensive summary of the socio-demographic characteristics of the children is as shown in table 1.

Table 1: Socio-demographic characteristics of the children by gender.

Age (years)	**Male N (%)**	**Female N (%)**	**Total N (%)**
Overall	137 (50.4)	135 (49.6)	272 (100.0)
3	26 (61.9)	16 (38.1)	42 (100.0)
4	37 (50.0)	37 (50.0)	74 (100.0)
5	66 (45.8)	78 (54.2)	144 (100.0)
6	8 (66.7)	4 (33.3)	12 (100.0)
Highest Level of education by Father			
No formal schooling/Primary school	34 (65.4)	18 (34.6)	52 (100.0)
Secondary school	61 (46.6)	70 (53.4)	131 (100.0)
College/University	33 (44.0)	42 (56.0)	75 (100.0)
No father	6 (66.7)	3 (33.3)	9 (100.0)
Not known	3 (60.0)	2 (40.0)	5 (100.0)
Fisher's Exact = 8.353, p= 0.018			
Highest Level of education by Mother			
Primary school	45 (50.6)	44 (49.4)	89 (100.0)
Secondary school	58 (50.9)	56 (49.1)	114 (100.0)
College/University	34 (49.3)	35 (50.7)	69 (100.0)
Pearson Chi X^2= 0.368, df = 2, p = 0.947			
Employment Status of father			
Unemployed	11 (64.7)	6 (35.3)	17 (100.0)
Non-Formal employment	99 (49.7)	100 (50.3)	199 (100.0)
Formal employment	27 (49.1)	28 (50.9)	55 (100.0)
Pearson Chi X^2= 0.482, df = 2, p = 0.497			

3.2 Geographical site of residence of the children

Most of the children resided in Dagorretti South (11.4%), Dagorretti North (11.0%), Kibra (11.0%) and Kasarani (11.0%) constituencies. Only 6.3% came from Westlands

constituency, where the Lady Northey dental clinic is located. A considerable number of children (9.6%) were from the neighbouring counties (see Figure 1).

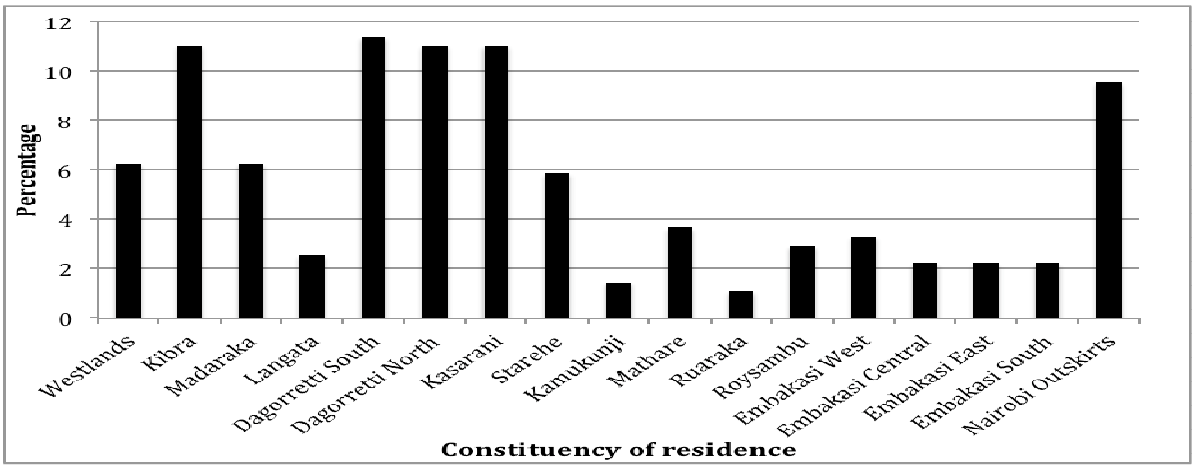


Figure 1: Residence of the children

3.3 Brushing habits

3.3.1 Brushing frequency

The majority of the children in the study, 97.1% (n=264) brushed their teeth. Out of these, 77.2% (n=210) brushed once a day, 12.9% (n=35) brushed two or more times a day while 2.9% (n=8) never brushed at all as shown in table 2.

Table 2: Frequency Distribution of tooth brushing by gender.

	Male	**Female**	**Total**
Brushing frequency	**N (%)**	**N (%)**	**N (%)**
Never	6 (4.4)	2 (1.5)	**8 (2.9)**
*Occasionally	14 (10.2)	5 (3.7)	**19 (7.0)**
Once a day	101 (73.7)	109 (80.7)	**210 (77.2)**
Two or more time a day	16 (11.7)	19 (14.1)	**35 (12.9)**
Total	**137(100.0)**	**135 (100.0)**	**272 (100.0)**
Fisher's Exact = 8.469, p= 0.100			

* Occasionally = Several times a month, once a week, several times a week.

3.3.2 The Person brushing the child's teeth

Out of those children who brushed their teeth, 58.5% (n=159) brushed on their own, 5.9% (n=16) had their teeth brushed by the caregiver and 32.7% (n=89) were assisted by their

caregiver (See Table 3). Generally the number of children who brushed their teeth increased with increasing age as opposed to those assisted by their caregivers.

Table 3: Distribution of the person who brushes the child's teeth by the child's age

	Who brushes child's teeth				
Age	**Child**	**Caregiver**	**Child assisted by caregiver**	**None**	**Total**
	N (%)	N (%)	N (%)	N (%)	**N (%)**
3 yrs	14 (33.3)	7 (16.7)	18 (42.9)	3 (7.1)	**42 (100.0)**
4 yrs	39 (52.7)	3 (4.1)	31(41.9)	1(1.3)	**74 (100.0)**
5 yrs	98 (68.1)	6 (4.2)	37 (25.7)	3 (2.0)	**144 (100.0)**
6 yrs	8 (66.7)	0 (0.0)	3 (25.0)	1 (8.3)	**12 (100.0)**
Total	**159 (58.5)**	**16 (5.9)**	**89 (32.7)**	**8 (2.9)**	**272 (100.0)**

3.3.3 The Brushing aids used by the children in the study.

A majority of the children in the study brushed their teeth using toothbrush and toothpaste. Figure 2 shows the distribution of brushing aids used by the male and female children.

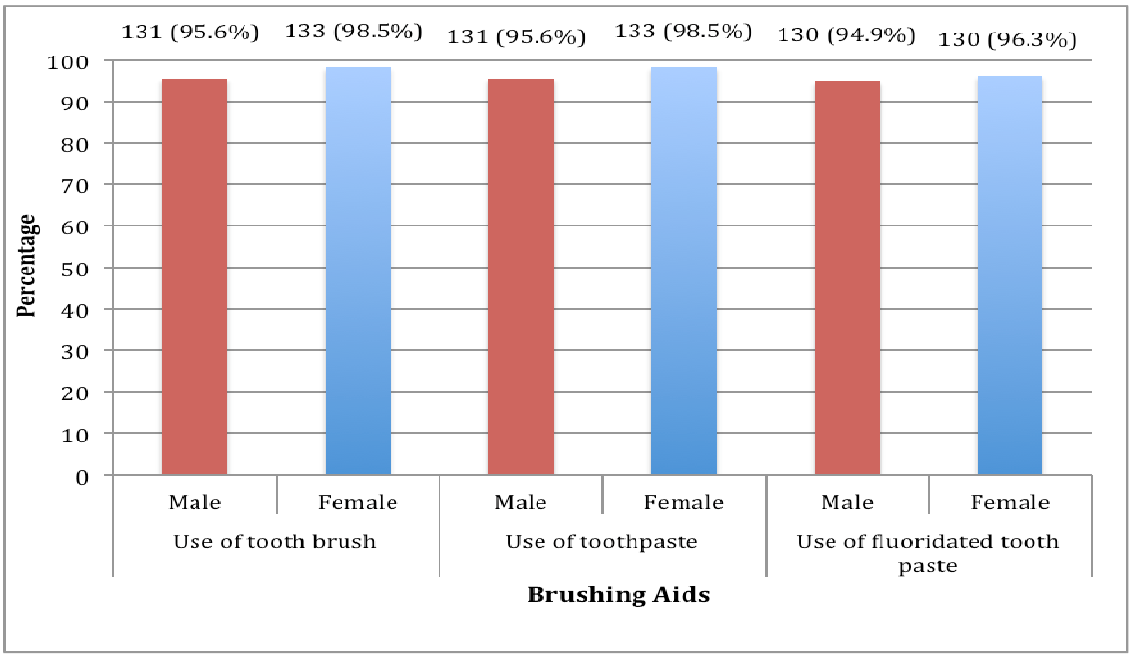


Figure 2: Use of oral hygiene aids used by gender

3.4 Dietary habits

In the present study, the most frequently consumed cariogenic food/drink was tea containing sugar, 93.7%(n=255) followed by jam/honey, 37.2%(n=101). Soft drinks, 76.5%(n=208) and fruit juice, 65.0%(n=177) formed the group of the most occasionally taken food/drink. A complete list of the commonly consumed cariogenic food/drinks is as shown in table 4.

Table 4: Distribution of the frequency of cariogenic food and drinks consumed by the children.

Food/Drink	*Frequently N (%)	**Occasionally N (%)	Never N (%)	Total N (%)
Fresh juice	32 (11.8)	177 (65.0)	63 (23.2)	272 (100)
Biscuits, Cakes	88 (32.4)	149 (54.8)	35 (12.8)	272 (100)
Soft drinks	20 (7.3)	208 (76.5)	44 (16.2)	272 (100)
Jam/Honey	101 (37.2)	81 (29.8)	90 (33.0)	272 (100)
Chewing gum	79 (29.0)	135 (49.7)	58 (21.3)	272 (100)
Sweets/Chocolates	82 (30.2)	128 (47.1)	62 (22.7)	272 (100)
Tea with sugar	255 (93.7)	5 (1.8)	12 (4.5)	272 (100)

* Frequently - Several times a day/every day.

**Occasionally - Several times a week, Once a week, Several times a month.

3.5 Oral health seeking behaviour of the children in the study

Most of the children, n=160 (59%), had never visited a dentist before the current study as shown in Figure 3.

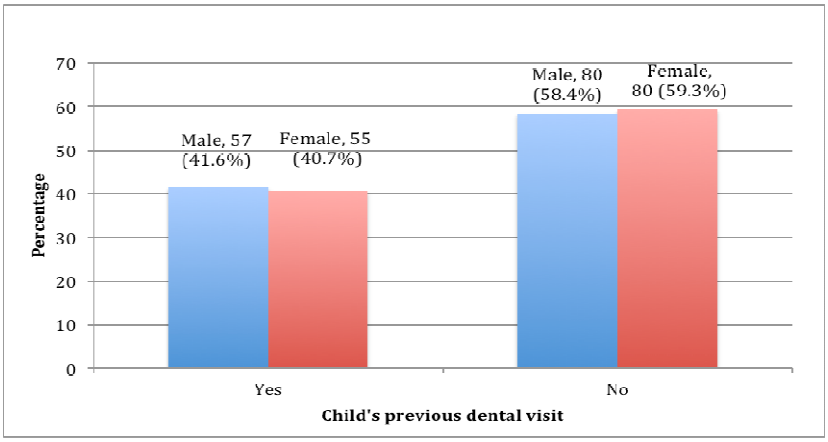


Figure 3: The distribution of oral health seeking behaviour of the children by their gender.

A majority of the children, 95.5%(n=106), had previously visited a dentist due to pain. None of the children had visited a dentist for routine check-up (The full results of the reason for the child's previous dental visit is as shown in Table 5).

Table 5: Distribution of the reason for the child's previous dental visit by gender

Gender	**Reason for dental visit**							
	Signs/symptom of oral disease		Follow up treatment		Routine checkup		**Total**	
	N	**(%)**	**N**	**(%)**	**N**	**(%)**	**N**	**(%)**
Male	54	(94.7)	3	(5.3)	0	(0.0)	**57**	**(100.0)**
Female	52	(94.5)	3	(5.5)	0	(0.0)	**55**	**(100.0)**
Total	**106**	**(94.6)**	**6**	**(5.4)**	**0**	**(0.0)**	**112**	**(100.0)**

3.6 Parent's Sources of Oral Health knowledge

The parent's sources of oral health knowledge in the present study were varied. Most of the parents obtained their knowledge from friends while the least number of parents obtained the knowledge from schools. The distribution of these results is shown in Figure 4.

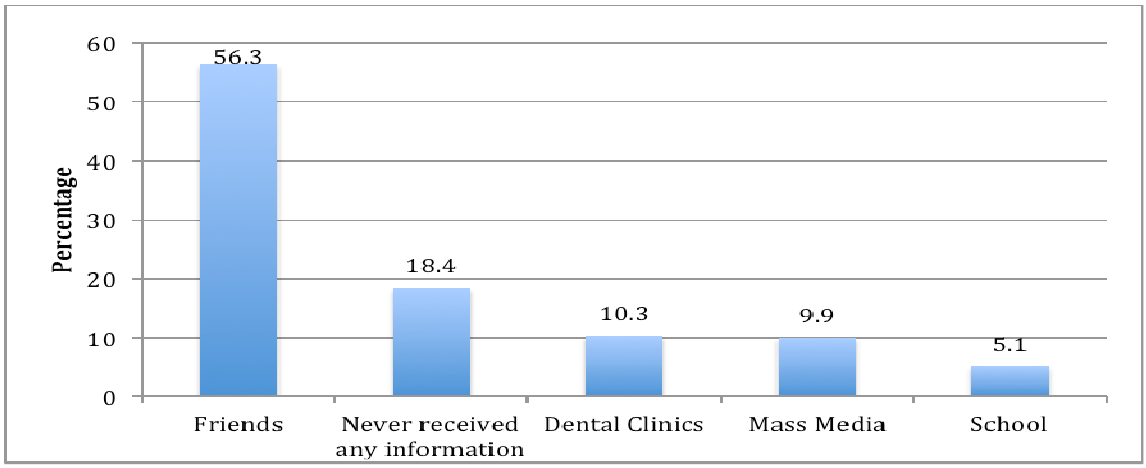


Figure 4: The distribution of parents' sources of Oral Health Education

3.7 Oral Hygiene Status of the children

All the children examined had plaque, with more than half, 55% (n=149) having plaque covering more than one third but less than two thirds of tooth surface. The highest plaque scores were reported among children whose fathers, 48.2%(n=131) and mothers, 42.0%(n=114) had completed secondary. With regards to employment status, children

whose fathers were in non-formal employment had the highest plaque scores, 73.2%(n=199). The oral hygiene status of the children in relation to their parent's socio-demographic status is as shown in table 6.

Table 6: Oral hygiene status by socio-demographic characteristics among the children in the study.

	Plaque deposits on tooth surface			
	Mild N (%)	**Moderate N (%)**	**Severe N (%)**	**Total N (%)**
Overall	93 (34.0)	149 (55.0)	30 (11.0)	272 (100)
Gender				
Male	42 (30.7)	75 (54.7)	20 (14.6)	137 (100.0)
Female	51 (37.8)	74 (54.8)	10 (7.4)	135 (100.0)
	Pearson Chi X^2= 4.197, df= 2, p = 0.123			
Age				
3 years	12 (28.6)	21 (50.0)	9 (21.4)	42 (100.0)
4 years	25 (33.8)	40 (54.1)	9 (12.1)	74 (100.0)
5 years	53 (36.8)	80 (55.6)	11 (7.6)	144 (100.0)
6 years	3 (25.0)	8 (66.7)	1 (8.3)	12 (100.0)
	Fisher's Exact = 6.643, p= 0.336			
Highest Level of education of the Father				
Less than primary school	15 (28.8)	32 (61.6)	5 (9.6)	52 (100.0)
Secondary school completed	41 (31.3)	75 (57.2)	15 (11.5)	131 (100.0)
College/University	33 (44.0)	33 (44.0)	9 (12.0)	75 (100.0)
No father/legal guardian	1 (11.1)	7 (77.8)	1 (11.1)	9 (100.0)
	Fisher's Exact = 8.637, p = 0.327			
Highest Level of education of the Mother				
Primary school	27 (30.3)	56 (62.9)	6 (6.8)	89 (100.0)
Secondary school	37 (32.4)	62 (54.4)	15 (13.2)	114 (100.0)
College/University	29 (42.1)	31 (44.9)	9 (13.0)	69 (100.0)
	Fisher's Exact = 6.289, p = 0.176			
Employment Status of father/Male guardian				
Unemployed	7(41.2)	9(52.9)	1(5.9)	17(100.0)
Non Formal employment	61(30.5)	115 (57.5)	24(12.0)	199(100.0)
Formal employment	25(46.3)	24(44.4)	5(9.3)	55(100.0)
	Fisher's Exact = 5.046, p = 0.268			

- Mild plaque deposits – Plaque covering less than $^1/_3{}^{rd}$ of tooth surface.
- Moderate plaque deposits – Plaque covering more than $^1/_3{}^{rd}$ but less than $^2/_3{}^{rds}$ of tooth surface.
- Severe plaque deposits – Plaque covering more than $^2/_3{}^{rds}$ of tooth surface.

3.8 Oral mucosal lesions

3.8.1 Prevalence, Location and Treatment needs of oral mucosal lesions

The study shows that the prevalence of the oral mucosal lesions was 40.4% with dental abscess (23.5%) being the most common lesion, followed by geographical tongue, (8.5%). Candidiasis was the least common lesion being reported in only 0.7% (n=2) of the children. Most of the lesions (68.2%) were located on the gingiva/alveolar ridges followed by the tongue (20.9%) with the lowest number of lesions located on the lips (2.7%). About half of the oral mucosal lesions required no treatment 21.8% (n=34). Sixty percent (n=66) of the lesions required prompt/emergency treatment. Comprehensive results on the prevalence, location and treatment needs of oral mucosal lesions are as shown in Table 7.

Table 7: Distribution of the Prevalence, Location and Treatment needs of Oral Mucosal lesions by gender

Oral mucosal lesion	**Male**	**Female**	**Total**
	N (%)	**N (%)**	**N (%)**
Overall	63 (23.2)	47 (17.2)	110 (40.4)
Abscess	35 (25.5)	29 (21.5)	64 (23.5)
Geographical tongue	14 (10.2)	9 (6.7)	23 (8.5)
Ulceration	6 (4.4)	7 (5.2)	13(4.8)
Other conditions	3 (2.2)	2 (1.5)	5 (1.8)
ANUG	3 (2.2)	0 (0.0)	3 (1.1)
Candidiasis	2 (1.5)	0 (0.0)	2 (0.7)
Location			
Alveolar ridges/Gingiva	42 (66.7)	33(70.2)	75(68.2)
Tongue	14 (22.2)	9(19.1)	23(20.9)
Buccal mucosa	2 (3.2)	3(6.4)	5(4.6)
Palate	2 (3.2)	2(4.3)	4(3.6)
Lips	3 (4.7)	0(0.0)	3(2.7)
Treatment need			
No treatment need	15 (23.8)	9 (19.1)	34(21.8)
Prompt treatment	37 (58.7)	29 (61.7)	66(60.0)
Preventive/Routine treatment	7(11.1)	6(12.8)	13(11.9)
Immediate/Urgent treatment	2(3.2)	2(4.3)	4(3.6)
Need for referral	2(3.2)	1(2.1)	3(2.7)

- Other conditions included Oral warts (n=1), Herpes labialis (n=2), Angular Cheilitis (n=2).

3.9 Dental Caries

3.9.1 Dental caries prevalence and experience in the study population

The overall prevalence of dental caries was 95.5%. The mean decayed missing filled teeth (dmft) was 8.53 (± 5.52 SD). The mean dmft scores by age are illustrated in figure 5.

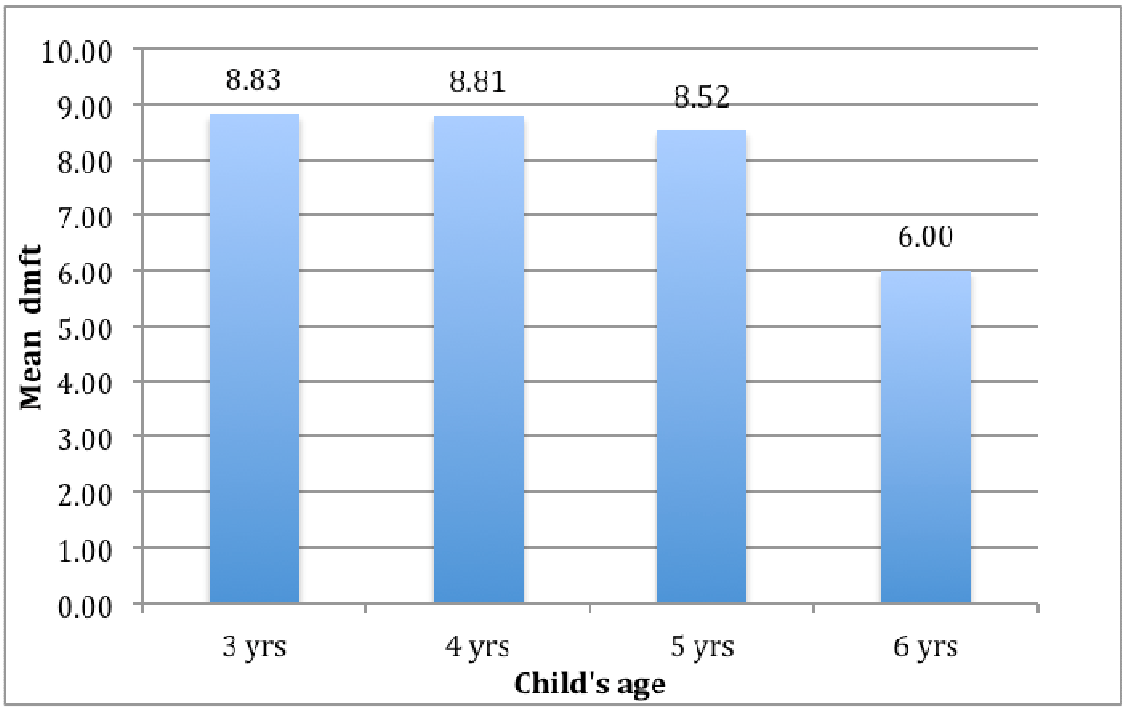


Figure 5: Mean dmft by child's age

3.9.2 The children's dental caries experience and their socio-demographic characteristics

The mean decayed component was highest of the dmft index with the values being higher among the males at 8.65 (SD±5.54) as compared to females at 8.37 (SD± 5.50). The mean missing component increased with increasing age of the children. The highest dmft scores were obtained from children whose fathers had no formal schooling, mothers who had less than primary education and fathers whose employment status was not known or were unemployed. Table 8 shows a detailed description of the association between the dental caries experience of the children and their socio-demographic characteristics.

Table 8: Association of various components of Dental Caries experience of children and the parent's socio-demographic characteristics

	dt	mt	ft	dmft
	Mean ± SD	**Mean ± SD**	**Mean ± SD**	**Mean ± SD**
Overall	8.51 ± 5.52	0.02 ± 0.12	0.00 ± 0.06	8.53 ± 5.52
Gender				
Male	8.65 ± 5.54	0.02 ± 1.15	0.00 ± 0.00	8.67 ± 5.56
Female	8.37 ± 5.50	0.01 ± 0.08	0.01 ± 0.08	8.38 ± 5.49
			t- test = 0.426, df = 263, p= 0.670	
Age				
3 yrs	8.83 ± 5.37	0.00 ± 0.00	0.02 ± 0.15	9.2 ± 5.46
4 yrs	8.81 ± 5.59	0.00 ± 0.00	0.03 ± 0.16	8.9 ± 5.73
5 yrs	8.50 ± 5.38	0.01 ± 1.20	0.02 ± 0.14	9.1 ± 5.59
6 yrs	5.83 ± 4.86	0.17 ± 0.39	0.00 ± 0.00	6.4 ± 5.35
			ANOVA = 0.943, df = 3, p = 0.420	
Highest Level of education by Father				
College/University	7.95 ± 5.58	0.03 ± 1.64	0.00 ± 0.00	7.97 ± 5.60
Secondary school completed	8.64 ± 5.15	0.01 ± 0.09	0.01 ± 0.09	8.66 ± 5.15
Primary school completed	8.34 ± 6.01	0.02 ± 0.15	0.00 ± 0.00	8.36 ± 6.03
Less than primary school	9.75 ± 7.97	0.00 ± 0.00	0.00 ± 0.00	9.75 ± 7.97
No formal schooling	15.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00	15.00 ± 0.00
No father/legal guardian	8.78 ± 5.33	0.00 ± 0.00	0.00 ± 0.00	8.78 ± 5.33
Not known	12.40 ± 7.44	0.00 ± 0.00	0.00 ± 0.00	12.40 ± 7.44
			ANOVA = 0.815, df = 6, p = 0.559	
Highest Level of education by Mother				
College/University	8.1 ± 4.96	0.58 ± 1.09	0.03 ± 0.17	8.7 ± 5.2
Secondary school completed	8.1 ± 5.39	0.43 ± 0.89	0.01 ± 0.94	8.5 ± 5.7
Primary school completed	9.2 ± 5.46	0.42 ± 0.80	0.03 ± 0.19	9.6 ± 5.6
Less than primary school	8.7 ± 8.62	2.33 ± 3.22	0.00 ± 0.00	11.0 ± 9.2
			ANOVA = 1.097, df = 3, p = 0.351	
Employment Status of father/Male				
Formal employment	7.26 ± 5.29	0.00 ± 0.00	0.00 ± 0.00	7.26 ± 5.29
Non Formal employment	8.74 ± 5.56	0.02 ± 0.14	0.01 ± 0.07	8.76 ± 5.56
Unemployed	9.65 ± 5.48	0.00 ± 0.00	0.00 ± 0.00	9.65 ± 5.47
Not known	12.00 ± 0.00	0.0 ± 0.00	0.00 ± 0.00	12.00 ± 0.00
			ANOVA = 1.416, df = 3, p = 0.238	

3.9.3 Pattern of tooth decay

In the maxillary arch, the second deciduous molars on the right and left were the teeth with the highest caries prevalence of 66.2% and 64.0% respectively. The prevalence of decayed central incisors was 52.9% and 54.4% on the right and left respectively (Figure 6). In the mandibular jaw, the second deciduous molars on the left and right were the teeth with the highest caries prevalence at 68% and 66.9% respectively (Figure 7).

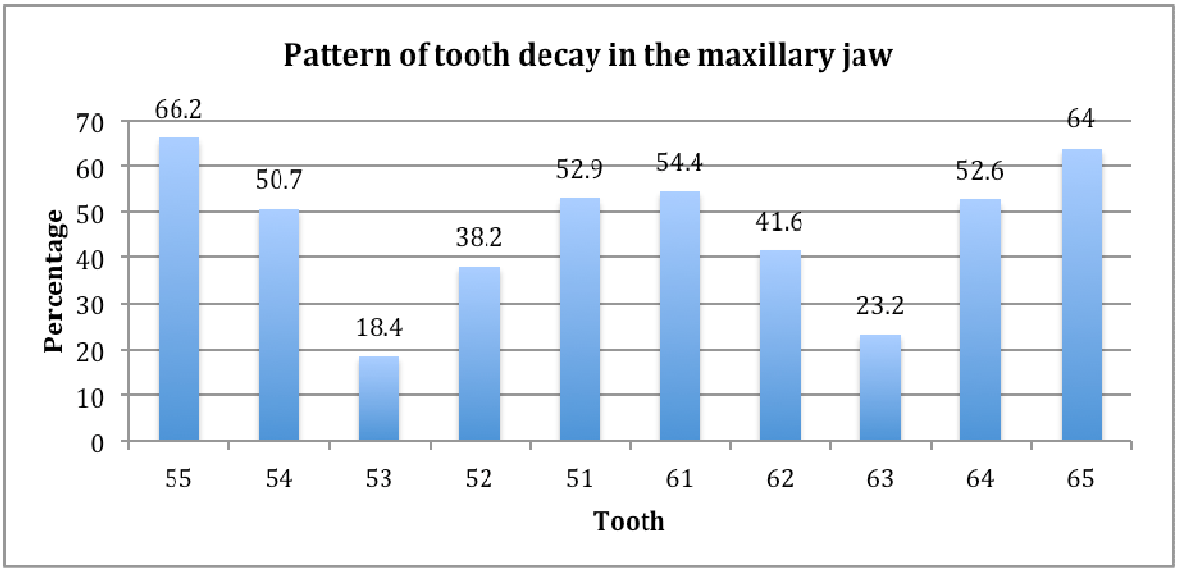


Figure 6: Pattern of tooth decay in the maxillary jaw according to tooth type

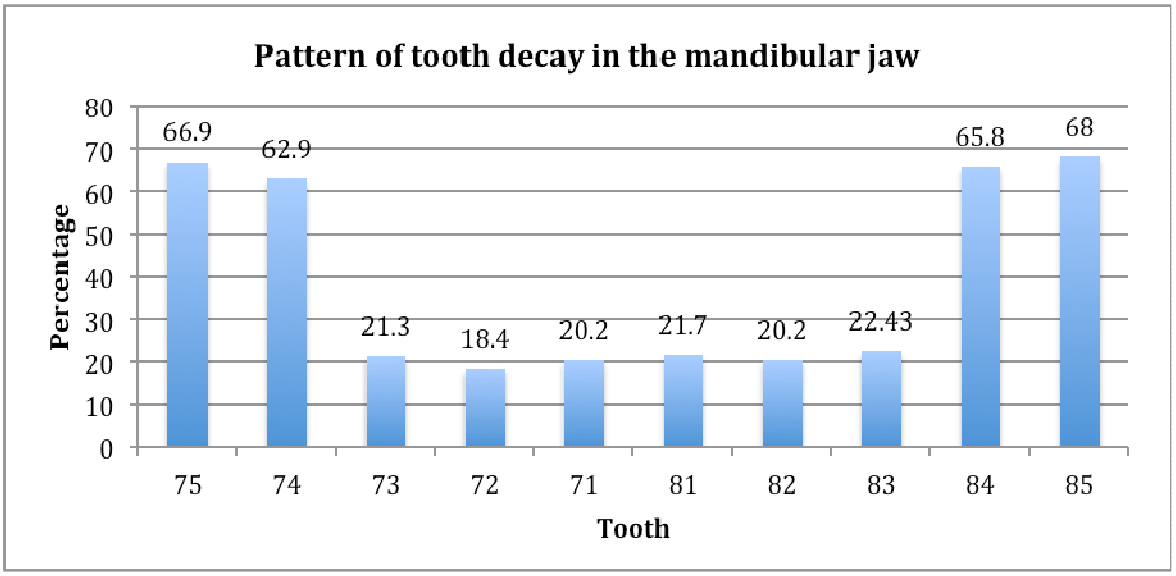


Figure 7: Pattern of tooth decay in the mandibular jaw according to tooth type

The results also showed that the occurrence of dental caries was higher in the maxillary jaw (Mean score of 4.65, SD ± 3.19) when related to the mandibular jaw (Mean score of 3.86, SD ± 2.89).

3.9.4 Dental Caries experience and tooth brushing frequency

Children who brushed their teeth several times a month had a mean dmft of 13.00 (SD ± 8.49) while the dmft of those who never brushed was 11.38 (SD ± 6.87). The children who brushed atleast twice daily had a lower mean dmft score of 7.86 (SD ± 5.97). A comprehensive association is illustrated in Table 9. The results were however not statistically significant (ANOVA = 0.837, df = 5, p = 0.524).

Based on these findings, the null hypothesis stating that the occurrence of dental caries is not dependent on the tooth brushing frequency among children attending Lady Northey dental clinic is therefore accepted.

Table 9: Association between brushing frequency and dental caries experience among the children

	dt	mt	ft	dmft
	Mean ± SD	**Mean ± SD**	**Mean ± SD**	**Mean ± SD**
Frequency of Brushing teeth				
Several times a month	13.00 ± 8.49	0.00 + 0.00	0.00 + 0.00	13.00 ± 8.49
Never	11.38 + 6.87	0.00 + 0.00	0.00 + 0.00	11.38 + 6.87
Once a day	8.51 + 5.35	0.02 + 0.14	0.00 + 0.00	8.53 ± 5.35
Two or more time a day	7.83 + 5.97	0.00 + 0.00	0.03 + 0.17	7.86 ± 5.97
Several times a week	8.31 + 5.66	0.00 + 0.00	0.00 + 0.00	8.31 ± 5.66
Once a week	7.25 + 6.34	0.00 + 0.00	0.00 + 0.00	7.25 ± 6.34
Total	8.51 + 5.51	0.02 + 0.12	0.00 + 0.06	8.53 ± 5.52
			ANOVA = 0.837, df = 5, p = 0.524	

3.9.5 Dental Caries experience in the children by the person who brushed the child's teeth

High dmft scores were reported for the children who never brushed their teeth (11.38, SD ± 6.87) and those whose teeth were brushed by the caregiver (11.25, SD ± 5.37) as compared to those brushed by the child (8.22, SD ± 5.45), (Table 10). There was a

statistically significant difference in the dental caries experience among the persons brushing the children's teeth (ANOVA = 4.635, df = 3, p = 0.03).

Table 10: Distribution of Dental Caries experience in children by the person who brushed child's teeth

Who brushes child's teeth	**Age**				
	3 yrs	**4 yrs**	**5 yrs**	**6 yrs**	**Total**
1. Child					
Mean dmft	7.36	9.18	8.04	7.25	8.22
SD	5.94	5.77	5.26	5.73	5.45
N	14	39	98	8	159
2. Caregiver					
Mean dmft	11.71	14.33	9.17	0.00	11.25
SD	5.02	0.58	6.71	0.00	5.37
N	7	3	6	0.00	16
3. Child assisted by caregiver					
Mean dmft	8.67	7.40	9.38	3.67	8.33
SD	4.81	5.77	5.39	2.31	5.41
N	18	31	37	3	89
4. None					
Mean dmft	10.00	20.00	12.67	3.00	11.38
SD	6.56	0.00	6.66	0.00	6.87
N	3	1	3	1	8
Total					
Mean dmft	8.83	8.81	8.52	6.00	8.53
SD	5.37	5.91	5.39	5.03	5.52
N	39	73	141	11	264
ANOVA = 4.635, df = 3, p = 0.03					

3.9.6 Dental Caries experience and the cariogenic dietary intake

High dmft scores were reported for children consuming Juice (11.40, SD + 4.51) and Soft drinks (10.00, SD + 0.00) several times a day. The results of the children's dental caries experience in relation to the dietary intake were as shown in Table 11, the results were not statistically significant.

Table 11: Association between Dental Caries experience of the children by the cariogenic dietary intake

Cariogenic Food/Drink	N	Mean dmft (SD)
Biscuits, Cakes		
Several times a day	13	8.54 (5.62)
Every day	75	8.00 (5.24)
Several times a week	50	8.08 (4.92)
Once a week	42	8.21 (6.21)
Several time a month	56	9.51 (5.57)
Never	35	9.00 (6.02)
ANOVA = 0.606, df = 5, p = 0.695		
Chewing gum	**N**	**Mean dmft (SD)**
Several times a day	37	8.26 (4.85)
Every day	42	7.19 (4.76)
Several times a week	53	7.86 (5.87)
Once a week	45	9.47 (4.94)
Several time a month	37	9.44 (5.78)
Never	58	9.00 (6.22)
ANOVA = 1.195, df = 5, p = 0.312		
Jam, Honey	**N**	**Mean dmft (SD)**
Several times a day	16	6.86 (5.53)
Every day	85	8.64 (5.38)
Several times a week	26	7.81 (5.04)
Once a week	19	10.21 (4.02)
Several time a month	36	9.77 (6.49)
Never	90	8.07 (5.60)
ANOVA = 1.192, df = 5, p = 0.314		
Juice	**N**	**Mean dmft (SD)**
Several times a day	5	11.40 (4.51)
Every day	27	8.78 (6.45)
Several times a week	48	8.20 (5.02)
Once a week	47	8.18 (5.61)
Several time a month	82	8.32 (5.14)
Never	63	8.97 (5.99)
ANOVA = 0.451, df = 5, p = 0.813		
Soft drinks	**N**	**Mean dmft (SD)**
Several times a day	1	10.00 (0.00)
Every day	18	8.89 (5.38)
Several times a week	79	7.48 (5.30)
Once a week	57	10.36 (5.60)
Several time a month	72	8.52 (5.60)
Never	44	7.79 (5.42)
ANOVA = 2.00, df = 5, p = 0.079		
Sweets, Chocolates	**N**	**Mean dmft (SD)**
Several times a day	44	7.64 (5.02)
Every day	38	8.29 (4.67)
Several times a week	38	7.89 (5.03)
Once a week	50	8.29 (6.21)
Several time a month	40	10.39 (5.43)
Never	62	8.71 (5.98)
ANOVA = 1.235, df = 5, p = 0.293		
Tea with sugar	**N**	**Mean dmft (SD)**
Several times a day	217	8.90 (5.64)
Every day	38	6.63 (4.51)
Several times a week	4	10.50 (4.36)
Once a week	1	16.00 (0.00)
Never	12	6.83 (5.20)
ANOVA = 2.274, df = 4, p = 0.062		

3.9.7 Dental Caries experience and the parent's source of oral health education

Children whose parents obtained information on oral health from friends had the highest dmft scores (9.09, SD ± 5.57) compared to those whose sources were schools (6.85, SD ± 5.19) and dental clinics (7.86, SD ± 4.40). The other association between parent's source of oral health education and dmft is shown in Table 12.

Table 12: Distribution of Dental Caries experience by the parent's source of oral health education.

Source of Oral Health Education	N	Mean dmft (SD)
Friends	153	9.09 (5.57)
Never received any information	50	7.94 (6.11)
Schools	14	6.85 (5.19)
Dental Clinics	28	7.86 (4.40)
Mass Media	27	8.00 (5.27)
Total	**272**	**8.53 (5.52)**
ANOVA = 0.997, df = 4, p = 0.410		

3.9.8 Dental Caries experience and Oral Hygiene status of the children

The children with the least mean dmft score (7.24, SD ± 5.07) had the least amount of plaque deposits (as shown in Table 13).

Table 13: Oral Hygiene Status and Dental Caries experience

Simplified Debri Index	Mean dmft	SD
Debri covering less than $^{1}/_{3}$rds of tooth surface	7.24	5.07
Debri covering more than $^{1}/_{3}$rds but less than $^{2}/_{3}$rds of tooth	9.24	5.57
Debri covering more than $^{2}/_{3}$rds of tooth surface	8.83	6.02
Total	**8.53**	**5.52**
ANOVA = 3.768, df = 2, p = 0.024		

Poor oral hygiene was found to be associated with a high occurrence of dental caries with the results being statistically significant. (ANOVA = 3.768, df = 2, p = 0.024).

3.9.9 Dental caries treatment needs

Majority of the children required fillings, 87.5%(n=238) and pulp treatment and stainless steel crowns, 62.5%(n=170). Other forms of treatment required are as shown in Table 14.

Table 14: Dental caries treatment needs by gender

Treatment need	Male	Female	Total
	N (%)	N (%)	N (%)
Filling	120 (50.4)	118 (49.6)	238 (100.0)
Pulp therapy and Stainless steel crown	88 (51.8)	82 (48.2)	170 (100.0)
Extraction	86 (52.4)	78 (47.6)	164 (100.0)
Extraction/Space maintainers	53 (57.0)	40 (43.0)	93 (100.0)
Stainless steel crown/ Crowns	3 (75.0)	1 (25.0)	4 (100.0)

3.10 Gingivitis

3.10.1 Prevalence of gingivitis

The prevalence of gingivitis among the children was 44.1% (n=120) with most of these children having mild gingivitis, 28.3%(n=77). The prevalence of gingivitis among boys (54.7%) was higher than that of girls (33.3%). The severity of gingivitis among the children by gender is as shown in figure 8. There was a statistically significant difference in occurrence of gingivitis among the males and females children with the males having higher gingival scores as compared to females (Pearson Chi X^2 = 14.2608, df = 3, p = 0.003).

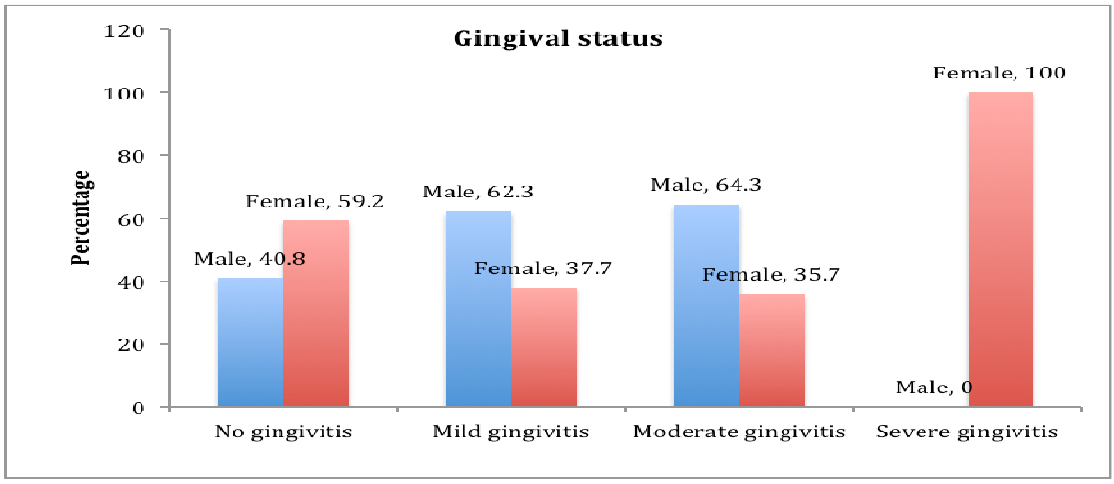


Figure 8: Prevalence of gingivitis according to gender

3.10.2 Occurrence of Gingivitis in the study population in relation to the parents' socio-demographic characteristics

The highest scores of gingivitis were reported among the children whose parents had the least form of education; fathers (less than primary education (50.0%,n=2) and primary education (51.1%,n=24), mothers (less than primary education (66.7%,n=2) and primary education (48.8%,n=42) and those whose fathers were unemployed (47.1%,n=8). This is illustrated in Table 15. Of the children who participated in the study, 3.3% (n=9) did not have a male guardian.

Table 15: Association between gingivitis in relation to the parents' socio-demographic characteristics

	Healthy Gingiva N (%)	**Gingivitis N (%)**	**Total N (%)**
Overall	152 (55.9)	120 (44.1)	272 (100.0)
Father's Education Level			
Less than primary	2 (50.0)	2 (50.0)	4 (100.0)
Primary	23 (48.9)	24 (51.1)	47 (100.0)
Secondary	80 (61.1)	51 (38.9)	131 (100.0)
Tertiary/ University	39 (52.0)	36 (48.0)	75 (100.0)
Not known	3 (60.0)	2 (40.0)	5 (100.0)
Fisher's Exact = 22.030, p = 0.632			
Mother's Education Level			
Less than primary	1 (33.3)	2 (66.7)	3 (100.0)
Primary	44 (51.2)	42 (48.8)	86 (100.0)
Secondary	72 (63.2)	42 (36.9)	114 (100.0)
Tertiary/ University	35 (50.7)	34 (49.3)	69 (100.0)
Fisher's Exact = 13.102, p = 0.175			
Father's Employment Status			
Unemployed	9 (52.9)	8 (47.1)	17 (100.0)
Non Formal employment	111 (55.5)	89 (44.5)	200 (100.0)
Formal employment	31 (57.4)	23 (42.6)	54 (100.0)
Fisher's Exact = 7.318, p = 0.983			

3.10.3 Occurrence of Gingivitisin relation to the oral hygiene status of children

Generally more than half the children who had mild (60%) and moderate (56%) plaque deposits had healthy gingiva, however majority of those who had severe plaque deposits (60%) had gingivitis. The association between the occurrence of gingivitis and the oral hygiene status of the children is as shown in Table 16. Children who had poor oral hygiene had a significantly higher occurrence of gingivitis. (Pearson Chi X^2= 14.175, df = 6, p = 0.023).

Table 16: Occurrence of Gingivitis in the study population in relation to the oral hygiene status of the children.

	Healthy gingiva	**Gingivitis**	**Total**
Simplified Debri Index	**N (%)**	**N (%)**	**N (%)**
1. Debri covering less than $^1/_3^{rds}$ of tooth surface (Mild deposits)	56 (60.0)	37 (40.0)	93 (100.0)
2. Debri covering more than $^1/_3^{rds}$ but less than $^2/_3$rds of tooth surface (Moderate deposits)	84 (56.0)	65 (44.0)	149 (100.0)
3. Debri covering more than $^2/_3^{rds}$ of tooth surface (Severe deposits)	12 (40.0)	18 (60.0)	30 (100.0)
Total	**152 (55.9)**	**120 (44.1)**	**272 (100.0)**

Pearson Chi X^2= 14.175, df = 6, p = 0.023

3.10.4 Occurrence of Gingivitis in the study population in relation to the brushing habits

The highest occurrence of gingivitis was reported among children who never brushed 60% (n=6). The highest score of gingivitis was reported for children whose teeth were brushed by their caregivers, 56.2% (n=9) as compared to the children who brushed on their own 42.8% (n=68). The brushing frequency in relation to the occurrence of gingivitis is as shown in Table 17.

Table 17: Association between the occurrence of Gingivitis among 3-6 year old children and their brushing habits

Brushing frequency	Healthy gingiva	Gingivitis	Total
	N (%)	N (%)	N (%)
Overall	152 (55.9)	120 (44.1)	272 (100.0)
Never	4 (40.0)	6 (60.0)	10(100.0)
Several times a month	3 (75.0)	1(25.0)	4(100.0)
Several time a week	6 (46.1)	7 (53.9)	13(100.0)
Once a day	119 (56.7)	91 (43.3)	210(100.0)
Two or more time a day	20 (57.2)	15 (42.8)	35(100.0)
	Fisher's Exact = 11.814, p= 0.735		
Who brushes teeth			
Child	91 (57.2)	68 (42.8)	159 (58.5)
Caregiver	7 (43.8)	9 (56.2)	16 (5.9)
Child/Caregiver	50 (56.2)	39(43.8)	89 (32.7)
None	4 (50.0)	4 (50.0)	8 (2.9)
	Fisher's Exact = 8.418, p= 0.651		

3.10.5 Gingivitis treatment needs

Slightly lower than half of the children, 44.5%(n=121) required treatment in the form of oral hygiene instructions and motivation, oral prophylaxis and scaling (Table 18).

Table 18: Treatment needs for gingivitis according to age

	Gingivitis Treatment need		
Age	**No treatment**	**Treatment required**	**Total**
	N %	**N %**	**N %**
3 yrs	24(57.1)	18(42.9)	42 (100.0)
4 yrs	39(52.7)	35(47.3)	74 (100.0)
5 yrs	81(56.2)	63(43.8)	144 (100.0)
6 yrs	7(58.3)	5 (41.7)	12 (100.0)
Total	**151(55.5)**	**121 (44.5)**	**272 (100.0)**
	Pearson Chi X^2 = 0.352, df = 3, p = 0.955		

3.11 Malocclusion

Occlusion was assessed with the child biting on his/her back teeth with the jaws in centric relation. The cheek was retracted on each side using a dental mirror and occlusion was registered according to the guidelines of Foster and Hamilton, 1969[58] while looking at right angles to the buccal surfaces on each side.

3.11.1 Prevalence of malocclusion

Malocclusion was reported with presence of either of the following:

1. Distal step terminal plane relationship
2. Canine class II or III relationship
3. Increased overbite or Anterior open bite
4. Increased overjet
5. Presence of anterior or posterior crossbite

The prevalence of malocclusion among the children was **55%.**

3.11.2 Occlusal relationship of the 3-6 year old children

Of all the children who were examined, majority had mesial step, 51.5% (n=140) and flush terminal plane 28.3% (n=77). A majority of the children, 66.5% (n=181) had a Class I and minority had Class III canine relationship, 11.4% (n=31). The antero-posterior incisor relationship showed that most of the children 75% (n=204) had normal overjet of 0-2 mm. The overjet of 12.2% (n=33) children could not be determined due to missing anterior teeth or presence of retained roots.

About two thirds of the children had normal overbite, 61%(n=166) by age. The overbite of 13.6%(n=37) of the children could not be determined due to missing anterior teeth or presence of retained roots. Only 2.9% (n=8) children had posterior crossbite. One hundred and fifty two children (55.9%) had primate spaces in at least one of the jaws. The presence of primate spaces could not be determined in 0.7% (n=2) of the children due to the premature loss of teeth anterior or posterior to the deciduous canines.

Table 19: Occlusal relationship among the 3-6 year old children by age.

Age	3 years N (%)	4 years N (%)	5 years N (%)	6 years N (%)	Total N (%)
Overall	42 (15.4)	74 (27.2)	144 (52.9)	12 (4.4)	272 (100.0)
Molar relationship					
1. Flush terminal	11 (26.2)	15 (20.3)	47 (32.6)	4 (33.3)	77 (28.3)
2. Mesial step	26 (62.0)	48 (64.9)	62 (43.1)	4 (33.3)	140 (51.5)
3. Distal step	3 (7.0)	8 (10.8)	13 (9.0)	1 (8.4)	25 (9.2)
4. Undeterminable	2 (4.8)	3 (4.0)	22 (15.3)	3 (25.0)	30 (11.0)
Canine relationship					
1. Class I	28 (66.6)	51 (68.9)	97 (67.4)	5 (41.7)	181 (66.5)
2. Class II	6 (14.3)	14 (18.9)	34 (23.6)	5 (41.7)	59 (21.7)
3. Class III	8 (19.1)	9 (12.2)	12 (8.3)	2 (16.6)	31 (11.4)
4. Undeterminable	0 (0.0)	0 (0.0)	1 (0.7)	0 (0.0)	1 (0.4)
Overjet					
1. Normal	29 (69.0)	54 (73.0)	113 (78.5)	8 (66.7)	204 (75.0)
2. Increased	5 (11.9)	7 (9.5)	15 (10.4)	3 (25.0)	30 (11.0)
3. Reverse	1 (2.4)	2 (2.7)	1 (0.7)	1 (8.3)	5 (1.8)
4. Undeterminable	7 (16.7)	11 (14.8)	15 (10.4)	0 (0.0)	33 (12.2)
Overbite					
1. Normal	24 (57.1)	42 (56.8)	94 (65.3)	6 (50.0)	166 (61.0)
2. Increased	5 (11.9)	8 (10.8)	13 (9.0)	5 (41.7)	31 (11.4)
3. Edge to edge*	5 (11.9)	7 (9.5)	13 (9.0)	0 (0.0)	25 (9.2)
4. Anterior open bite	2 (4.8)	2 (2.7)	4 (2.8)	0 (0.0)	8 (3.0)
5. Anterior crossbite	1 (2.4)	2 (2.7)	1 (0.7)	1 (0.7)	5 (1.8)
6. Undeterminable	5 (11.9)	13 (17.5)	19 (13.2)	0 (0.0)	37 (13.6)
Posterior Crossbite					
1. Present	1 (2.4)	3 (4.1)	2 (1.4)	2(16.7)	8 (2.9)
2. Absent	41 (97.6)	71 (95.9)	142 (98.6)	10 (83.3)	264 (97.1)
Primate spaces					
1. Present	24 (57.1)	48(64.9)	70 (48.6)	10 (83.3)	152(55.9)
2. Absent	18 (42.9)	26 (35.1)	72(50.0)	2 (16.7)	118 (43.4)
3. Undeterminable	0 (0.0)	0(0.0)	2 (1.4)	0 (0.0)	2 (0.7)

Table 20: Occlusal relationship among the 3-6 year old children by gender.

	Gender		
	Male	**Female**	**Total**
	N (%)	**N (%)**	**N (%)**
Overall	137 (50.4)	135 (49.6)	272 (100.0)
Molar relationship			
1. Flush terminal	37 (27.0)	40 (29.6)	77 (28.3)
2. Mesial step	66 (48.2)	74 (54.8)	140 (51.5)
3. Distal step	16 (11.7)	9 (6.7)	25 (9.2)
4. Undeterminable	18 (13.1)	12 (8.9)	30 (11.0)
Canine relationship			
1. Class I	84 (61.3)	97 (71.9)	181 (66.5)
2. Class II	36 (26.3)	23 (17.0)	59 (21.7)
3. Class III	16 (11.7)	15 (11.1)	31 (11.4))
4. Undeterminable	1 (0.7)	0 (0.0)	1 (0.4)
Overjet			
1. Normal	95 (69.2)	100 (74.1)	195 (71.7)
2. Increased	17 (12.4)	13 (9.6)	30 (11.1)
3. Reverse	6 (4.4)	14 (10.4)	33 (12.1)
4. Undeterminable	19 (14.0)	8 (5.9)	14 (5.1)
Overbite			
1. Normal	84 (61.3)	82 (60.7)	166 (61.0)
2. Increased	18 (13.1)	13 (9.6)	31 (11.4)
3. Edge to edge	11 (8.0)	14 (10.4)	25 (9.2)
4. Anterior open bite	6 (4.4)	2 (1.5)	8 (2.9)
5. Anterior crossbite	1 (0.7)	4 (3.0)	5 (1.8)
6. Undeterminable	17 (12.4)	20 (14.8)	37 (13.6)
Posterior Crossbite			
1. Present	2 (1.5)	6 (4.4)	8 (2.9)
2. Absent	135 (98.5)	129 (95.6)	264 (97.1)
Primate spaces			
1. Present	81 (59.1)	71 (52.6)	152 (55.9)
2. Absent	54 (39.4)	64 (47.4)	118 (43.4)
3. Undeterminable	2 (1.5)	0 (0.0)	2 (0.7)

3.11.3 Orthodontic treatment need

Most of the children required preventive treatment, 87.9% (n=239), 8.8% (n=24) required interceptive treatment and 2.6% (n=7) needed referral to an orthodontist (Figure 9). Preventive orthodontics included measures put in place to prevent premature loss of teeth and its subsequent effects. Interceptive orthodontics included placement of fixed and removable appliances to intercept an already developed malocclusion.

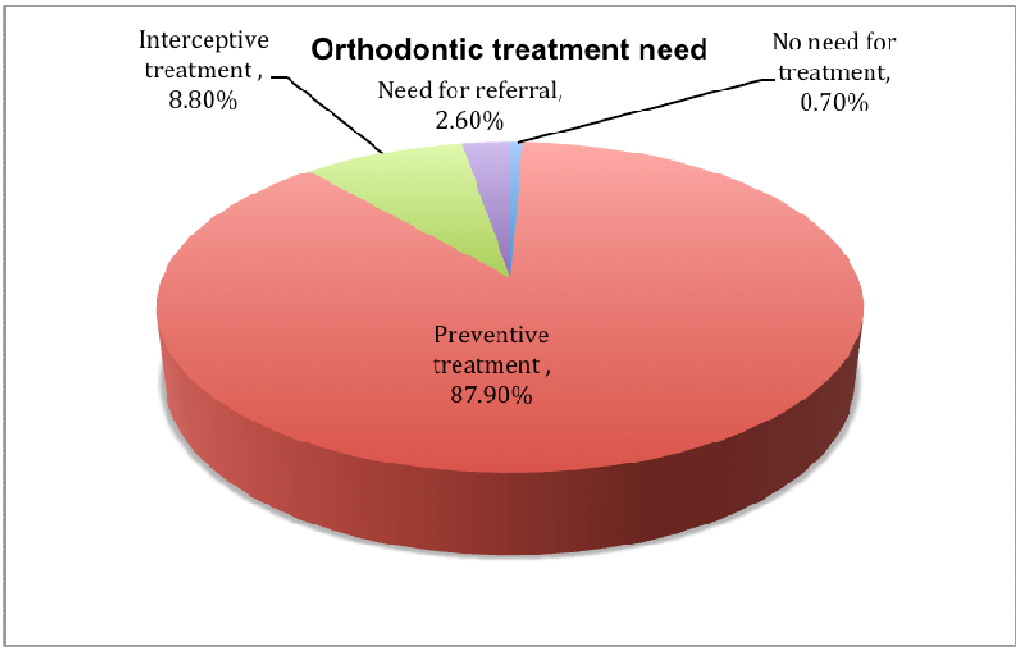


Figure 9: Distribution of orthodontic treatment need of the children

3.12 Adjusted odds ratio from multivariate logistic regression

3.12.1 Linear Regression Analysis of dmft index

A linear regression model was appropriate for analysis of dmft index due to the wide range of values of dmft (y) and its unimodal distribution.

The linear regression model derived was:

$$y = \alpha_1 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \varepsilon$$

Where

Y= The outcome (y) is the dmft index which takes the values between 0 to 20

X_1 = 1 if male, 0 if female

X_2 = 1 if age is 4 years, else 0

X_3 = 1 if age is 5 years, else 0

X_4 = 1 if age is 6 years , else 0

ε = Error term

Table 21 shows the linear regression analysis relating the dmft index to the age and gender of the children.

Table 21: Parameter estimates from logistic regression of dichotomized dmft index

Covariate	B	SE	WALD	P value (X^2)
Gender				
Male	0.35	0.69	0.26	0.612
Female#	-	-	-	-
Age				
3	2.85	1.81	2.48	0.116
4	2.86	1.73	2.75	0.098
5	2.59	1.67	2.41	0.122
6#	-	-	-	-

- # - Baseline
- Analysis of the socio-demographic variables could not be estimated due to the high prevalence of dental caries reported.

3.12.2 Logistic Regression Model of Occurrence of Gingivitis

Table 22 shows the results of logistic regression of gingivitis (y=1 if gingivitis is present and y=0 if gingivitis if absent). The independent variables were Age, Gender, Employment status of the father and the Highest level of education of the mother.

The logistic regression model:

$$\textbf{Logit (Pr(y=1)) = } \alpha_1 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + + \beta_5 X_5 + \beta_6 X_6 + \beta_7 X_7 + \beta_8 X_8 + \beta_9 X_9 + \varepsilon$$

Where

Y= The outcome (y) is the occurrence of gingivitis which takes the values y=1 if gingivitis is present and y=0 if gingivitis if absent

X_1 = 1 if male, 0 if female

X_2 = 1 if age is 4 years, 0 otherwise

X_3 = 1 if age is 5 years, 0 otherwise

X_4 = 1 if age is 6 years, 0 otherwise

X_5 = 1 if non formal employment, 0 otherwise

X_6 = 1 if Fomal employment, 0 otherwise

X_7 = 1 if Primary school completed, 0 otherwise

X_8 = 1 if Secondary school completed, 0 otherwise

X_9 = 1 if College/University completed, 0 otherwise

ε = Error term

Table 22: Parameter estimates from logistic regression of dichotomized gingivitis index

Covariate	B	SE	WALD	Adjusted OR	95% Confidence Interval	P value (X^2)
Gender						
Male	0.92	0.26	12.62	2.5	1.51,4.15	0.001
Female[#]	-	-	-	1	-	-
Age						
3 years[#]	-	-	-	1	-	-
4 years	0.41	0.41	0.97	1.5	0.67,3.36	0.324
5 years	0.34	0.38	0.80	1.4	0.67,2.92	0.370
6 years	0.34	0.68	0.25	1.4	0.38,5.42	0.620
Employment Status of father/Male						
Unemployed [#]	-	-	-	1	-	-
Non Formal employment	0.26	0.61	0.18	1.30	0.39,4.29	0.668
Formal employment	0.22	0.35	0.41	1.25	0.63,2.46	0.521
Unknown*	-	-	-	-	-	-
Highest Level of education by Mother						
No formal schooling [#]	-	-	-	1	-	-
Primary school completed	-0.76	1.28	0.35	0.47	0.14,20.77	0.554
Secondary school completed	-1.20	0.36	11.13	0.30	0.43,1.77	0.001
College/University	-0.78	0.34	5.10	0.46	0.27,1.04	0.024

- # - Baseline
- * - Logistic regression not computed as some cell values were too small.
- Analysis of the highest level of education by the father/male could not be estimated.

Males appeared to be 2.5 times more likely to get gingivitis than females. The children whose fathers were in non-formal employment appeared to be 1.02 times more likely to get gingivitis than those whose fathers were unemployed. Children whose fathers were in formal employment appeared to be 0.7 times more likely to get gingivitis than those whose fathers were unemployed. The children whose mothers had received formal education appeared to be less likely to get gingivitis than those whose had not (Table 22).

3.12.3 Logistic Regression Model of Malocclusion

Table 23 shows the results of logistic regression of malocclusion (y=1 if malocclusion is present and y=0 if malocclusion if absent). The independent variables were Age, Gender, Employment status of the father and the Highest level of education of the mother.

The logistic regression model:

$$\textbf{Logit (Pr(y=1)) = } \alpha_1 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + + \beta_5 X_5 + \beta_6 X_6 + \beta_7 X_7 + \beta_8 X_8 + \varepsilon$$

Where

Y = The outcome (y) is the occurrence of malocclusion which takes the values y=1 if malocclusion is present and y=0 if malocclusion if absent

X_1 = 1 if male, 0 if female
X_2 = 1 if age is 4 years, 0 otherwise
X_3 = 1 if age is 5 years, 0 otherwise
X_4 = 1 if age is 6 years, 0 otherwise
X_5 = 1 if Unemployed, 0 otherwise
X_6 = 1 if Non Formal employment, 0 otherwise
X_7 = 1 if Primary school completed, 0 otherwise
X_8 = 1 if Secondary school completed, 0 otherwise
ε = Error term

Table 23: Parameter estimates from logistic regression of Malocclusion

Covariate	B	SE	WALD	Adjusted OR	95% Confidence Interval	P value (X^2)
Gender						
Male	0.07	0.26	0.07	1.07	0.65,1.77	0.791
Female[#]	-	-	-	1	-	-
Age						
3[#]	-	-	-	1	-	-
4	0.29	0.40	0.53	1.34	0.61,2.93	0.465
5	0.16	0.36	0.19	1.17	0.58,2.39	0.664
6	0.91	0.75	1.47	2.48	0.57,10.78	0.226
Employment Status of father/Male						
Unemployed	0.02	0.59	0.01	1.02	0.32,3.23	0.973
Non Formal employment	0.10	0.34	0.09	1.11	0.57,2.15	0.758
Formal employment[#]	-	-	-	1	-	-
Unknown*	-	-	-	-	-	-
Highest Level of education by Mother						
Primary school completed	-0.19	0.35	0.28	0.83	0.42,1.67	0.597
Secondary school completed	0.09	0.33	0.07	1.09	0.57,2.09	0.795
College/University[#]	-	-	-	1	-	-

- # - Baseline
- * - Not included in test
- Analysis of the highest level of education by the father/male could not be estimated.

Males appeared to be 1.07 times more likely to get malocclusion than females. Malocclusion experience among the children appears to increase with age, however the results are not statistically significant. This is as shown in Table 23.

4.0 CHAPTER FOUR

4.1 Discussion

4.1.1 Socio-demographic Characteristics of the Study Population and the Study Method

The broad objective of the current study was to determine the oral health status, practices and treatment needs among the 3 to 6 year-old children attending Lady Northey dental clinic in Nairobi City County. A total of 314 children and their parents/caregivers were enrolled to participate in the study; out of whom 42 participants were excluded from the study due to failure to obtain assent from the child or consent from the parent/caregiver. The current study based the diagnosis of oral diseases on clinical examination only; without x-ray or histological report hence the possibility of under-reporting cannot be ruled out. The dependence of parents/caregivers in the determination of the study participant's oral health practices may have influenced the validity of the parents/caregivers answers in the present study. There was also the possibility that socially desired and undesired habits and practices may have been over or underestimated by the parents/caregivers in the current study.

The mean age of the 272 children who participated in the study was 4.5 years (± 0.8 SD), which correlated to a previous study done at Lady Northey dental clinic among 3-5 year olds that had a mean age of 4.4 years (± 0.7 SD)[6]. The age distribution in the present study was skewed towards the 5 year olds who comprised 52.9% of the study population, just as reported by Ngatia et al[7], Gichu et al[6] in Nairobi and Njoroge et al[27] in Kiambaa among 3 to 5 year olds. The greater number of the 5 year-olds could be as a result of the longer presence of the teeth in the mouth, which can predispose to development of dental caries that was found to be prevalent in the current study. The present study had included 6 year-old children in deciduous dentition (4.4%) unlike other previous studies, which excluded 6 year-olds [4,7,31]. In the present study, the male to female ratio was 1:1. This was similar to previous Kenyan studies done by Ngatia et al[7], Njoroge et al[27], Kassami et al[5] and Gichu et al[6]. This could be a reflection of the Kenyan population where the male to female ratio is 1:1 as is reflected in the 2011 Kenya Bureau of Statistics report[60].

This study reports a moderate literacy rate among the parents of the study population with the majority of the parents having attained secondary education. This finding is similar to a previous study conducted by Gichu et al[6] at Lady Northey dental clinic. The parents

however had a higher level of education than that reported by the 2008-09 Kenya Demographic and Health Survey[61]**.** Most of the fathers of the children were in non-formal employment, which could be a reflection of the level of education as only 27.6% of the fathers had completed tertiary education.

4.1.2 Oral Health Practices of the children

4.1.2.1 Dietary Habits

Sugar intake was found to be high in the current study population; particularly in the form of sugar in tea, soft drinks, fruit juices, biscuits, cakes, sweets, chocolates, jam, honey and chewing gum. The role of diet in the acquisition of dental caries is considered critical with frequent and prolonged intake of sucrose, glucose and fructose having been reported to result in high prevalence of dental caries among children[62]. Urban lifestyles have also been found to have an influence on the dietary patterns of children in Kenya with high consumption of snacks being reported at home and school[7]. Tea containing sugar was found to be the most frequently consumed drink by the children in the study (93.7%), just as reported in a previous community-based Kenyan study among 3-5 year-olds where 84.9% of the children consumed tea-containing sugar[7]. The high sugar intake could have been as a result of its availability and accessibility by majority of the Kenyan population[11].

4.1.2.2 Brushing Habits

Oral hygiene plays an important role in the prevention of oral diseases. The reduction or elimination of dental plaque from tooth surfaces is therefore important, with the most effective way of achieving this being through mechanical means[63]. A majority of the children (97.%) in the current study brushed their teeth using toothbrush and toothpaste. This was similar to what was reported in previous Kenyan studies by Kibosia[11], Ngatia et al[7] and Njoroge et al[27] where most of the children brushed their teeth using toothbrush and toothpaste. Similarly in Uganda, Kiwanuka et al[31] reported toothpaste use in 99% of the preschool children.

Slightly more than half (58.5%) of the children in the study brushed their teeth without the help of the caregiver. This findings differed with what Ngatia et al[7] reported where 71% of the children received assistance from the caregivers during tooth brushing. Children below the age of six years have poor manual dexterity and require the caregiver's assistance

during tooth brushing due to their physical and cognitive immaturity[27]. This might have been as a result of the caregivers' ignorance on the need to assist the during tooth brushing. These findings could have contributed to the high prevalence of dental caries despite the reported tooth brushing.

4.1.3 Parent's oral health knowledge and the children's previous dental visits

The parent's sources of oral health knowledge in the present study appeared to be limited with slightly more than half of the parents (56.3%) obtaining information on oral health from friends. The oral health knowledge of the friends was unknown and was not the subject of the present study, but it could have been limited or misleading. Oral health knowledge and practices of the caregiver are likely to have an important role in influencing the development of healthy dental habits in a child[27]. Parents/caregivers who obtained knowledge on oral health from the more reliable sources (dental clinics) accounted for a small percentage (10.3%). Of importance is that none of the children in the current study had visited the facility for dental check-up. A majority of them had visited the facility due to dental pain (95.4%). The number of the children who were on follow-up treatment were few despite the high dental caries prevalence reported. This could have been as a result of poor attitude towards oral health and perception that primary teeth are not important, poverty and inadequate parent/caregiver's oral health knowledge.

4.1.4 Oral hygiene status of the children in the study

The oral hygiene status of the children in the present study was poor with all the children having plaque. This compares to a Kenyan study by Kassami et al[5] among 3-12 year olds where all the children in that study had dental plaque deposits. This may have been as a result of inadequate oral hygiene measures, which was worsened by the presence of dental pain. The severity of plaque deposits appeared to increase with increasing age of the children in the study. Children whose fathers were in non-formal employment had the highest plaque scores. Interestingly children whose parents had completed secondary education also had the highest plaque scores as compared to those with lower education levels. This could be as a result of the high number of parents who has completed secondary education in the current study.

4.1.5 Oral mucosal lesions and treatment needs

The frequency and prevalence of oral mucosal lesions shows a wide range in literature. This could be as a result of the differences in geographical areas, sociodemographic characteristics, methodology and clinical diagnosis criteria of the different studies. Some authors have excluded ANUG[15,16] and dentoalveolar abscess[15] in the diagnosis of oral mucosal lesions, which may influence the overall prevalence of oral mucosal alterations. The current study included dental abscess and acute necrotizing gingivitis in the diagnosis of oral mucosal lesions.

The results of the present study showed that 40.4% of the children examined had one or more oral mucosal lesions. This was higher than in a school-based study among South African preschool children (2.9%) aged 1.5-6 years[14] and a hospital-based study in Lesotho (4.9%) among 0-5 year-olds attending a Mother and child health clinic[3]. The variation in the prevalence rates could be explained by the different study settings and the study population age bracket. A higher prevalence rate of 50.7% has been reported in Brazil among 2-5 year-olds[64]. Dental abscesses constituted the highest percentage of the Oral Mucosal Lesions in the current study. This was lower than a South African school-based study, which reported a prevalence of 1.1% for dentoalveolar abscess[14]. This difference may have been due to the high prevalence of dental caries reported in the current study that could result in dentoalveolar abscess if left untreated. Another possible explanation of this difference is that we report a hospital-based study where the prevalence of oral mucosal diseases could be higher than that in a school setting. Viera-Andrade et al[64] reported that fistula associated with dentoalveolar abscess was the only oral mucosal lesion associated with a negative impact on the quality of life of Brazilian preschool children. The treatment required for dentoalveolar abscess was prompt incision and drainage and commencement of pulp treatment, which was not offered at Lady Northey dental clinic.

The second most prevalent oral mucosal lesion in the current study was geographic tongue (8.5%). This was higher than the prevalence previously reported in other studies: 1.1% among children under 5 years in Lesotho[3], 1.6% among black pre-school South African population[14], 2.3% among 0-5 year-old children and 5.2% among 2-5 year-olds in Brazil[64]. The presence of a geographical tongue can predispose one to plaque retention, due to the anatomy of the dorsal surface of the tongue. This could have contributed to the

poor oral hygiene reported among the children.

Candidiasis was the least reported lesion in the present study (0.7%). A Kenyan study by Anver et al[23] on HIV-infected children, reported that the most prevalent oral manifestation among these children was candidiasis possibly due to immunosuppression.

4.1.6 Dental Caries experience and treatment needs

The prevalence of caries in the current study population was high (95.5%). These results were closely similar to two Kenyan hospital-based studies by Kassami et al[5] (89.4%) and Gichu et al[6] (93.6%). High prevalence of dental caries has been reported in less developed nations, especially with urbanization and increased availability and access to processed foods and sweet drinks by the children[62]. Lack of adequate and accessible public dental facilities and dental surgeons in Nairobi could be partly contributing to the high prevalence in these studies. The high cost of dental treatment in private clinics and other government referral hospitals were paediatric dentists are available may also be limiting access to dental services by children from low socioeconomic backgrounds.

Some previous Kenyan school-based studies have reported lower dental caries prevalence rates of 45%[39], 63.5%[7] and 59.5%[27] among preschool children. In Uganda, Kiwanuka et al[31] reported a dental caries prevalence of 64% among 3-5 year olds in Nakawa, a peri-urban location. In Asia, Singh et al[65] reported a dental caries prevalence rate of 40% among 3-5 year old children. The high prevalence in the current study could be a reflection of the differences in the study settings as the current study setup was in a paediatric dental clinic with most of the children presenting with dental caries and its sequelae. Lower dental caries prevalence rates have also been reported among 0-59 month-olds in Lesotho (2.7%)[3] and 2-5 year-olds in Accra (47%)[40]. The age distribution in the studies could explain the difference in caries prevalence, with the teeth of the older children having been exposed for a longer period to the oral environment and so having a higher probability of developing dental caries**.** Thus increasing age of the child seemed to be a risk factor of caries development in deciduous dentition in the present study population.

Dental caries experience was assessed using the dmft index, which is universally used to measure caries. In the present study, mean dmft reported was 8.53 (± 5.52 SD). Other clinical based Kenyan studies have reported mean dmft scores of 7.87 (± 5.29 SD)[5] and 8.14 (± 5.34 SD)[6] among 3-5 year old children. The decayed component was the highest

of the three scores, 8.51(± 5.52 SD) as compared to the missing, 0.02 (± 1.12 SD) and filled, 0.00 (± 0.06 SD) components. The mean dmft was higher among males, 8.67 (± 5.56 SD) than females, 8.38 (± 5.49 SD), this was similar to what Ngatia et al 2007 [7] and Gichu et al 2009[6] observed. In the current study, males appeared to be 1.8 times more likely to get dental caries than females. The difference in caries experience between males and females may have been as a result of the meticulous nature of girls in their personal hygiene and thus better tooth brushing as compared to the boys[27].

There was a significantly higher prevalence of caries among children from low socioeconomic background. The highest dmft scores were reported for children whose parents had the least or no formal education and those whose father's were unemployed. This could be explained by the fact that the parents might have had inadequate knowledge on the preventive and curative measures of oral disease, secondly due to low income, they may not afford to seek treatment for already existing dental decay. These findings compare to a Kenyan study by Masiga and Holt in 1993[39] which reported a high caries prevalence among single parent families and families having an unemployed father probably due to their low socioeconomic status. Another Brazilian study found that caries was prevalent among children whose mothers were either illiterate or had less than 4 years of education[36], this was probably due to the inadequate knowledge on oral health.

Inadequate tooth brushing among the children was associated with high scores of dental decay. The children who never brushed their teeth or those who brushed several times in month reported the highest dmft scores. Interestingly, the highest caries experience was reported among children who had their teeth brushed by their caregivers. This could have been as a result of improper tooth brushing technique by the caregiver. The results further showed that children with the lowest dmft scores had the least amounts of plaque deposits on teeth. The children whose parents obtained oral health education from friends had the highest caries experience as opposed to those whose sources were schools and dental clinics. Friends may have offered misleading or inadequate information on oral health to the caregivers possibly due to deficiency in their oral health knowledge.

The carious teeth were not evenly distributed by tooth type; the most affected teeth by dental caries were the deciduous molars and the maxillary incisors. The maxillary jaw reported a higher prevalence of dental caries (46.5%) as compared to the mandibular jaw (38.6%). This pattern seems to mimic nursing caries, however the dietary history of the children from birth was not reported, as it was beyond the scope of the current study.

These findings were similar to those reported by Njoroge et al[27] and Ngatia et al[7] among 3-5 year olds in Kiambaa and Nairobi respectively. Consequently, with regards to treatment needs for dental caries, the current study reported that a majority of the children required fillings (87.5%), pulp treatment and stainless steel crowns (62.5%) and extractions (60.3%).

Dental Caries Treatment needs of the current study population was fillings (35%), pulp therapy and stainless steel crowns (25%), extraction (24%), extraction and space maintainers (13%) and Stainless Steel crowns (0.5%). However the only treatment that was available at the time of the study was extraction, which was ranked third in order of treatment need. A school-based Ugandan study[51] reported that the treatment burden of dental caries among children in deciduous dentition was mainly centred on fillings (56%) and extractions (44%).

4.1.7 Gingivitis and treatment needs

The prevalence of gingivitis reported in the current study was moderate (44.1%). This was higher when related to previous school-based studies done among preschool children in Kenya (37%)[39], Ghana (12.9%)[40] and Mexico (39%)[41]. The explanation for this difference could be that the children who presented at Lady Northey dental clinic were already experiencing pain or discomfort hence oral hygiene practices could have been inadequate as compared to the school-based studies where the children may not have been in any pain or discomfort. Another hospital-based study in Lesotho among children under five[3] reported a prevalence of gingivitis of 5.4%. The age difference between these two studies could explain the apparent difference in prevalence. The majority of the Lesotho study sample comprised of 0-11 months olds with no teeth or with newly erupted teeth, whereas in the present study, the majority of children were 5 year olds. Additionally, different indices were used in these studies hence making direct comparison difficult. Marginal gingivitis usually commences in early childhood and its incidence and degree of severity worsens in adolescence[38], this is further supported by the findings by Kassami et al[5] of a high prevalence of gingivitis (95%) among older children in Nairobi.

The current study reported that males were 2.5 times more likely to get gingivitis than females. This finding could be as a result of the significantly higher proportion of males that had severe plaque deposits as compared to females. Females are probably more meticulous in performing tooth brushing and attain maturity before boys hence the poor

oral hygiene status and higher occurrence of gingivitis among the males. The occurrence of gingivitis in the present study was also reported to be higher among children whose parents had the least form of formal education and those whose fathers were unemployed. Oral disease preventive measures like tooth brushing is taught in schools and the parents may have been deficient in the same hence not relaying it to their children. The subsequent treatment need among the children was centred on plaque removal, which included oral hygiene instructions/motivation and oral prophylaxis.

4.1.8 Malocclusion and treatment needs

Malocclusion is a common occurrence in children and it may be unnoticed during the early years of life. It may predispose the child to unfavourable sequelae, which may require complex orthodontic treatment in the permanent dentition[9]. Studies of malocclusion in the deciduous dentition are problematic due to the different concepts that are used to define malocclusion[66]. The Foster and Hamilton criteria, 1969[59] were used in this study as it defines the occlusal characteristics in the anteroposterior, vertical and transverse dimensions. In the current study malocclusion was reported when either distal step terminal plane, canine class II or III, increased overjet, anterior open bite increased overbite or presence of crossbites.

The prevalence of malocclusion in this study was 55%. This was within the range of other previous school-based Kenyan studies, which have reported prevalence rates of 60.9%[9] and 51%[46]. In the current study, mesial step was the most prevalent terminal plane relationship (51.5%), just as reported in a previous Kenyan study, though with a slightly higher percentage of 70.1%[9]. Bishara et al[67] reported that the most prevalent terminal plane relationship among 5 year-old Iowa children was mesial step (61%) and that the presence of mesial step indicates a greater probability for Class I molar relationship in the permanent dentition. The high prevalence of mesial step is further supported by the findings that most of Kenyan adolescents (93%) have been found to be in neutral occlusion[68]. However, contrasting results have also been reported in Kenya[46], Tanzania[47] and Nigeria[48]; where straight terminal plane was found to be the most prevalent. The current study did not show any differences of the anteroposterior molar relationship across the ages (Table 20) and this was similar to the Kenyan study by Rop and Ng'ang'a[9]. This supports the finding by Baume[50] that terminal planes remain constant during the deciduous dentition.

The most common canine relationship in the present study was class I, which was similar to other Kenyan[9] and Nigerian[48] studies. A high prevalence of normal overjet and overbite was also observed in the current study just as has been reported in other previous Kenyan studies[9,46]. The prevalence of primate spaces (55.9%) was lower than other previous Kenyan studies, which reported prevalence rates of 85%[46] and 80.3%[9], this may indicate a greater possibility of crowding in the subsequent dentition. The prevalence of posterior crossbite in the present study was 2.9% (Table 20), this was similar to a Kenyan study [9] which reported a prevalence of 2.5%. Other Kenyan[46] and Nigerian[48] studies have reported similar findings.

A few of the children (8.8%) required interceptive orthodontic treatment. A previous Kenyan study[46] also reported that some of the children needed interceptive orthodontic treatment. A small percentage (2.6%) of complex cases required referral to an orthodontist. The participant's orthodontic treatment needs were not based on the data on the prevalence of malocclusion alone. The need for the orthodontic treatment was governed by the dental health component of malocclusion, which is measured in terms of its effect on the longevity dentition and function of the occlusion[69]. The existence of a dental irregularity may not have warranted orthodontic treatment like some transient cases of Class II malocclusion and anterior open bite, which required close monitoring and possible intervention during the mixed dentition as opposed to intervention during the primary dentition.

4.2 Conclusion

1) In general, the oral health status of the children attending Lady Northey dental clinic was poor in spite of the majority of the children brushing at least once daily using fluoridated tooth paste, additionally their dietary intake of sugar was reported to be high.

2) The prevalence of dental caries of 95.5% was very high while the prevalence rates of gingivitis (44.1%), oral mucosal lesions (40.4%) and malocclusion (55%) were moderate.

3) The majority of the children's treatment needs included prompt incision and drainage, dental restorations, pulp treatment, stainless steel crowns, oral prophylaxis and preventive orthodontic treatment.

4.3 Recommendations

1. The results indicate that The Nairobi City County needs to take urgent steps to improve the oral health of the children within the county and to build human resource and facility capacities to mitigate oral health diseases.
2. There is also a need to conduct another study aimed at determining other oral diseases causative factors such as nursing habits that were not studied in the present study.

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APPENDICES

Appendix I: Time Schedule

Activity	**2013**	**2014**		**2014/15**	
Proposal Writing	Dec–May				
Submission to Ethical Committee and BPS UON & Approval		May-June			
Pre-testing questionnaire		July			
Data Collection			Sept-Oct		
Data Entry/Analysis			November		
Thesis Writing				Dec-March	
Thesis Submission				Apr-May	
Thesis Defence					Aug

Appendix II: Budget

Item	Unit	Unit Cost (Kshs)	Total Cost (Kshs)	Justification
Stationery				
Files	300	30.00	9,000.00	For storing questionnaires and consent forms
Printing Paper	10	1,000.00	10,000.00	To be used in printing and xeroxing documents - Questionnaires - Proposal - Thesis
Pens	10	20.00	200.00	
Pencils	20	10.00	200.00	
Rubbers	5	10.00	50.00	
Sharpeners	5	10.00	50.00	
Flash disk	1	3000	3,000.00	
Internet access	60 per hour	960 hours	57,600.00	Literature review
Printing	20 per page	1000 pages	20,000.00	
Binding	150	20 copies	3,000.00	
Clinical examination materials				
Latex Gloves (pkts)	10	400.00	4,000.00	
Masks	4	600.00	2,400.00	
Wooden spatulas	5 pkts	400.00	2,000.00	
Disclosing tablets	500 pcs		5,000.00	
Sterilising poaches/Tape	300pcs		2,000.00	
Personnel				
Research assistants	40 days	1,000.00	40,000.00	
Supervisors	3	5,000.00 x 6 days	90,000.00	
Statistician	1	40,000.00	40,000.00	
Secretarial services	30 days	300	9,000.00	
Sub-Total			**297,500.00**	
10% Contingency	-	-	**29,750.00**	To mitigate for any unforeseen costs
Grand Total			**327,250.00**	

Appendix III: Consent Information Document

Date: .....

Participant code:.....

Project Title:

Oral health status and treatment needs among 3-6 years attending Lady Northey Dental clinic in Nairobi.

Objective of the study

The objective of the study is to determine the oral health status and treatment needs of children aged 3-6 attending Lady Northey Dental clinic.

Procedure to be followed

You shall be interviewed on the child's dietary and oral health practices. Your child will be examined by trained and qualified health professionals. At the end of the study you shall be informed of the results. The results will also be communicated to the community and sponsors, and both in local and international scientific conferences.

Risks

There are no risks in this study since no invasive procedures will be performed on your child.

Benefits

This study seeks to determine the type of conditions that the children present with at Lady Northey dental clinic. This will help in allocation of the available resources on the same based on the treatment needs of these children. We shall use the results to advice policy makers and health care professionals on the best interventions in the provision of oral health care to the children seeking treatment at Lady Northey dental clinic.

Confidentiality

All the information that will be obtained from your child will be confidential to protect their privacy. This will be done by giving codes hence avoiding the use of their name.

The identity of any participant will not be disclosed in any public conferences, reports or publications.

Period of study

The study will be conducted in September and October 2014 and the participants will be interviewed and examined only once during the period of the study.

Role of Ethics Research Committee

The role of the Kenyatta National Hospital/University of Nairobi Ethics and Research Review Committee (KNH/UON-ERRC) is to review biomedical research in order to help safeguard the dignity, rights, safety and well being of all actual or potential research participants. A cardinal principle of research involving human participants is “respect for dignity of persons”. The goals of research, while important, should never be permitted to over-ride the health, well-being and care of research participants. KHN/UON-ERRC shall take into consideration the principles of justice. Justice requires that the benefits and burdens of research be distributed fairly among all groups and classes in society, taking into account age, gender, socio-economic status, culture, and ethnic consideration.

Your co-operation will be highly appreciated.

Yours sincerely,

Dr. Fredah Chepkwony, 0722- 295106 (Principal Investigator)

Dr. Arthur Kemoli, 0722- 436481 (Lead supervisor)

Kenyatta National Hospital/University of Nairobi - Ethics, research and standards committee.

Email: uonknh_erc@uonbi.ac.ke

Tel: 726300-9

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P O Box 20723-00202 Nairobi.

Maelezo ya kutafuta idhini kutoka kwa wazazi wa watoto watokaoshiriki katika utafiti

Kiini cha utafiti

UTAFITI UNAOBAINI HALI YA MENO NA MDOMO NA MATIBABU YANAYOHITAJIKA KWA WATOTO WA MIAKA 3-6 WANAOHUDHURIA KLINIKI YA LADY NORTHEY, NAIROBI.

Kanuni za utafiti

Utahojiwa kuhusu chakula ambacho mtoto wako huwa anakula na mbinu anazotumia kusafisha meno. Mtoto wako atapimwa na picha ya mdomo yake kuchukuliwa na daktari wa meno aliyehitimu kwa kazi hiyo. Utafiti utakapokamilika utajulishwa matokeo yake pamoja na kuyawasilisha kwa jamii zenu, wadhamini wa utafiti huu na wanasayansi wa hapa nchini na wa kimataifa. Kama mtoto atakua na mahitaji ya dharura ya kimatibabu pia atatumwa kwa mtaalamu katika hospitali kuu.

Madhara na manufaa ya utafiti huu

Hakuna madhara yeyote yanayotarajiwa katika utafiti huu kwa mtoto wako. Matokeo ya utafiti huu yatatumika katika kuboresha huduma ya afya ya meno ya watoto kwa jumla. Ningependa kukueleza kuwa haitakugharimu chochote kushiriki katika utafiti huu.

Hifadhi ya nakala ya habari utakayotoa

Habari zote nitazokusanywa kutoka kwa mtoto wako zitahifadhiwa kwa siri na kutumiwa tu katika utafiti huu. Majina ya watoto binafsi watakaoshiriki hayataandikwa mahali popote wakati wowote. Nakala zote za habari kuhusu mtoto wako zitafungiwa katika makabati maalum wakati wote wa utafiti huu. Habari hizi zitapowekwa kwenye komputa zitatumiwa na mimi peke yangu kwa kutumia kitambulisho cha siri ili kufikia habari hizi.

Tunasistiza usiri huu katika kusimamia habari tutakazopewa ili kuzuia kujulikana kwa watakaoshirki katika utafiti huu. Hakuna majina yatakayotumika katika vikao vya sayansi kwa umma na ripoti zitakazochapishwa katia mijarida za sayansi.

Asante kwa kushiriki katika utafitii huu.

..... Dr. Fredah Chepkwony, 0722- 295106 (Principal Investigator)

Appendix IV: Consent Form

....., ID No.: ..... the *Parent / Guardian* of ..... I understand the aims and the content of the study. I *Agree/Disagree* to let my child and I participate in the study. I understand that this study is totally voluntary, and the child can decide to withdraw from the study without any victimization.

Signature of the *Parent / Guardian* : .....
Date: ……

Idhini yako na sahihi

Nimesoma maelezo yaliyoko hapa juu na nimekubali kwa hiari ya mtoto wangu kushiriki katika utafiti huu

…… ……

Jina la Mshiriki Sahihi ya Mshiriki na Tarehe

Mimi niliyepewa jukumu la kupeana maelezo kuhusu utafiti huu kwa mshiriki aliyetajwa hapa juu, nimepeana maelezo kamili kulingana na masomo na ujuzi wangu katika kazi hii. Kwa hivyo ninahitimu kufanya jukumu hili.

…… ……

Jina la mtafiti ya aliyetoa maelezo Sahihi ya Mtafiti na Tarehe

Contacts

1. Dr. Fredah Chepkwony, 0722- 295106 (Principal Investigator)
2. Dr. Arthur Kemoli, 0722- 436481 (Lead supervisor)
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Appendix V: Study Questionnaire (WHO 2013 Criteria) and Indices

Participants' No. (Code): ……

Section A: Socio-Demographic Data

1. Date of birth : …… (DD/MM/YY)

2. Age in years : ……..

3. Gender (1) Male (2) Female

4. Constituency {Geographical location}:

1. Westlands 2. Dagoretti North 3. Dagoretti South 4. Langata
5. Kibra 6. Roysambu 7. Kasarani 8. Ruaraka
9. Embakasi South 10. Embakasi North 11. Embakasi Central
12. Embakasi East 13. Embakasi West 14. Makadara
15. Kamukunji 16. Starehe 17. Mathare
18. Other (Specify) ……..

5. What is the highest level of school completed by the father? (stepfather, legal guardian):

1. No formal schooling
2. Less than primary school
3. Primary school completed
4. Secondary school completed
5. College/University completed
6. No father/legal guardian in household
7. I don't know

6. What is the highest level of school completed by the mother?

1. No formal schooling
2. Less than primary school
3. Primary school completed
4. Secondary school completed
5. College/University completed

6. No female adult in household
7. I don't know

7. What is the employment status of the head of the household?

1. Unemployed
2. Non formal employment
3. Formal employment

Section B: Oral Hygiene and Dietary Practices

8. Feeding Habits:

How often does the child eat or drink any of the following foods, even in small quantities?

Snack/Drink	Several times in a day	Every day	Several times a week	Once a week	Several times a month	Never
	6	5	4	3	2	1
Fresh fruit						
Biscuits, Cookies, Cakes, sweet buns, bread etc.						
Soda, Ribena, afya or other soft drinks						
Jam/Honey						
Chewing gum containing sugar						
Sweets/Chocolates						
Milk with sugar						
Tea with sugar						

9. Brushing Habits

Does the child brush his/her teeth after meals?

(1) Never

(2) Several times a month (2-3 times)

(3) Once a week

(4) Several times a week {2-6 times}

(5) Once a day

(6) 2 or more times a day

Does the child use any of the following to clean his/her teeth or gums?

Yes (1) No (2)

(1) Tooth brush
(2) Chewing Stick/Mswaki
(3) Wooden toothpicks
(4) Thread {dental floss}
(5) Charcoal
(6) Other .....

Does the child use toothpaste to clean teeth 1. Yes 2. No

Does the child use fluoridated toothpaste?

(1) Yes
(2) No
(3) Don't know

Who brushes the child's teeth?

(1) Child (2) Caregiver (3) Child assisted by caregiver

10. Dental Visits

How often has the child visited a dentist during the last 12 months? {One answer only}

1. Once
2. Twice
3. Three times
4. Four times
5. More than four times
6. Never received dental care/visited a dentist
7. Never visited dentist in the last 12 months.

If the child has never visited a dentist go to question 12

11. What was the reason of your last visit to the dentist?

1. Pain or trouble with teeth, gums or mouth
2. Routine check-up of teeth/treatment
3. Treatment/follow-up treatment
4. Can't remember/ don't know

12. Oral health education

Where do you obtain information of oral diseases, its prevention and treatment options?

(1) Mass media
(2) Dental clinics
(3) Friends
(4) Others (Specify).....

Modified WHO oral health assessment form (2013)

Section C: Clinical Evaluation

12. Oral Mucosa

CONDITION (C)	**LOCATION (L)**	**Treatment need (TN)**
0 = Normal	0 = Vermilion border	TN-0= No treatment required

1 = Ulceration {aphthous, herpetic, traumatic}	1 = Commissures	TN-1= Preventive/ Routine treatment required
2 = Geographical tongue	2 = Lips	TN-2= Prompt treatment required
3 = Acute Necrotizing Ulcerative Gingivitis	3 = Sulci	TN-3 = Immediate/Urgent treatment required
4 = Candidiasis	4 = Buccal Mucosa	TN-4= Need for referral
5 = Abscess	5 = Floor of Mouth	
6 = Other condition	6 = Tongue	
7 = Not recorded	7 = Palate	
	8 = Alveolar ridges/ Gingiva	

Condition	Location	Treatment Need

13. Oral hygiene:

Simplified debris index (Rodriges et al 1990)

Score {Debri}

0- No debris

1- Soft debris covering not more than one third of the tooth surface or presence of stains without other debris regardless of surface area covered.

2- Soft debris covering more than one third, but not more than two thirds of the exposed tooth surface.

3- Soft debris covering more than two thirds.

54 61 82

Score of Labial surfaces of			

75

Score of lingual surfaces of	

Calculation = Total score

No of surfaces scored.

14. Gingivitis (Gingival Index, Loe & Silness,1963)

Score Criteria

Gingival bleeding score		**Gingivitis**
0	Normal gingiva, no inflammation	Absent
1	Mild inflammation, no bleeding on probing	Mild gingivitis (0.1-1)
2	Moderate inflammation, bleeding on probing	Moderate gingivitis (1.1-2)
3	Severe inflammation, spontaneous bleeding	Severe gingivitis (2.1-3)

	55	51	65	71
Score of Buccal surfaces of				

	75	85
Score of lingual surfaces of		

Calculation of GI = $\frac{\text{Total scores}}{\text{Number of surfaces examined}}$

15. Treatment need for periodontal disease

Treatment Needs (TN)	**Status**
TN-0	A recording of code 0 or code Y (missing) all six sextants will indicate that there is no treatment need
TN-1	Need to improve personal oral hygiene
TN-2	A code of 2 or 3 will indicate the need for professional cleaning and removal of plaque retentive factors/Prompt treatment

23. Dentition status and Treatment need

	55	54	53	52	51	61	62	63	64	65
Status										

Treatment need										

	75	74	73	72	71	81	82	83	84	85
Status										
Treatment need										

Status

0 = Sound

1 = Caries

2 = Filled & Decayed

4 = Filled no caries

5 = Missing

6 = Fissure sealant

7 = Dental prosthesis/Crown, abutment, veneer

8 = Unerupted

9 = Not recorded

Treatment Need (TN)

None = 0

Extraction = 1

Filling = 2

Stainless Steel Crown = 6

Pulp Therapy and SSC = 7

Crown/Veneers = 5

Need for other care = 6

dmft =

24. Malocclusion (Foster and Hamilton,1969)

A. Terminal plane relationship

1. Flush terminal plane
2. Mesial step
3. Distal step

B. Primary canine relationship

1. Class I
2. Class II
3. Class III

C. Overbite

1. Normal
2. Increased
3. Edge-to edge
4. Anterior open bite

D. Overjet

1. 0 – 2 mm - Normal
2. > 2mm - Increased

E. Anterior crossbite*:*

1. Present
2. Absent

F. Posterior crossbite*:*

1. Present
2. Absent

Malocclusion was reported with presence of either of the following:

1. Distal step terminal plane relationship
2. Canine class II or III relationship
3. Increased overbite or Anterior open bite
4. Increased overjet
5. Presence of anterior or posterior crossbite

25. Orthodontic Treatment need (WHO, 2013)

TN-0 = No need for treatment

TN-1 = Preventive treatment required

TN-2 = Interceptive treatment required

TN-3 = Need for referral

OTHER FINDINGS/ SPECIAL COMMENTS

.....

.....

Appendix VI: Criteria used for diagnosis of oral mucosal lesions

Lesion	Criteria
Candidiasis	Creamy white patches, wipeable leaving red patches May incorporate erythematous areas
Cheek and lip biting	Oral mucosa shows a rough, grey-white, macerated surface with irregular, flaky desquamation. Lesion is located self-infliction by chewing is possible.
Angular cheilitis	Bilateral folds in the skin of the labial commissures, surface tissue appears wrinkled, fissured or cracked with no tendency to bleeding, although a crusted exudate may be present
Tongue lesions (a) Fissured tongue	Shallow or deep fissures on the dorsum of the tongue; most common pattern is a marked central fissure, from which smaller fissures radiate laterally. Often association with geographic tongue
(b) Geographic tongue	Lo Localized absence of filiform papillae. Affected areas are irregularly shaped. Areas change location over time
Ulcers (a) ANUG	"Punched-out" papillae Pseudomembranous exudate. Bleeding upon slight palpation. Pain, distinctive oral odour
(b) Herpetic gingivostomatitis (primary herpes)	Severe gingival inflammation. Whitish, serofibrinous exudates
(c) Herpes labialis (secondary herpes)	Clusters of vesicles or crusts. Found on vermillion border. Duration: less than three weeks with history of recurrence
(d) Recurrent aphthous ulceration	- Well-defined, greyish-white ulcer(s) - Ulcers surrounded by red halo - Pain; duration: 10-21 days; history of recurrence
(e) Ulcer (non-specific)	- Traumatic ulcers - Idiopathic ulcers - Tooth brushing-induced ulcers
(f) Mucocele	- Well-defined, fluid-filled swelling - Normal pink or bluish colour - Commonly found on labial mucosa and floor of the mouth (ranula)

Appendix VII: Codes and criteria for diagnosing dental caries

0 **Sound crown.**

A crown will be recorded as sound if it shows no evidence of treated or untreated clinical caries. In addition, a crown with the following defects will also coded as sound: white or chalky spots, discoloured or rough spots that were not soft to touch with the metal CPI probe, stained pits or fissures in the enamel that do not have visual signs of undermined enamel, or softening of the floor or walls detectable with a CPI probe, dark, shiny, hard, pitted areas of enamel in a tooth showing signs of moderate to severe fluorosis, lesions that, on the basis of distribution or history, appeared to be due to abrasion.

1 **Decayed tooth.**

Caries will be recorded as present if a lesion in a pit or fissure, or on a smooth tooth surface, had an unmistakable cavity, undermined enamel, or a detectable softened floor or wall. A tooth with a temporary filling, or one, which is sealed but also decayed, will also included in this category.

2 **Filled tooth, with decay**.

A tooth will be considered filled, with decay, if it has one or more permanent restorations and one or more areas that were decayed.

3 **Filled tooth, no decay**.

A tooth will be considered filled, without decay, when one or more permanent restorations is/are present and there was no caries anywhere on the crown. A tooth that had been crowned because of previous decay will be recorded in this category.

4 **Missing tooth**

This code will be used for teeth that that are not present in the oral cavity.

5 **Not recorded**.

This code will be used for any tooth that cannot be examined for any reason.

Appendix VIII: Nairobi City County Authority - Pretesting

Appendix IX: Ethics Approval Letter, Process number P356/06/2014

Appendix X: Nairobi City County Authority – Main study