MALOCCLUSION TRAITS AND ORTHODONTIC TREATMENT NEEDS AMONG 7–12-YEAR-OLD CHILDREN WITH ADENOTONSILLAR HYPERTROPHY IN THREE REFERRAL HOSPITALS

CHEGE JACKLINE WANGARI

V60/36700/2020

A Dissertation Submitted in Partial Fulfilment of the Master of Dental Surgery Degree in Paediatric Dentistry, The University of Nairobi

DECLARATION

I, **Chege Jackline Wangari**, declare that this dissertation is my work and that it has not been submitted for any award in any Institution of higher learning. To the best of my knowledge, the thesis contains no material previously published or written by another person except where due reference is made.

Chege Jackline Wangari
V60/36700/2020

Signature: ..... Date: 21/11/2023

APPROVAL

This dissertation is submitted with the approval of my supervisors:

Dr. Richard Owino, BDS (Nbi), MDS (Nbi)
Lecturer, Unit of Pediatric Dentistry and Orthodontics,
Department of Dental Sciences,
University of Nairobi.

Signature: ..... Date: 17.11.2023

Dr. Peter Mugwe, MBChB (Nbi), MMed (Nbi)
Senior Lecturer, Department of Surgery,
University of Nairobi.

Signature: ..... Date: 17-11-2023

This dissertation has been submitted with the approval of the Chair of the Department of Dental Sciences:

Dr: Walter A. Odhiambo, BDS (UON), MDS-OMFS (UON), FRCS (PRIME-K)
Chairman, Department of Dental Sciences.
Senior Lecturer, Unit of Oral and Maxillofacial Surgery
Faculty of Health Sciences, University of Nairobi.

Signature: ..... Date: 20/11/2023

CHAIRMAN
DEPARTMENT OF DENTAL SCIENCES
UNIVERSITY OF NAIROBI
P.O. Box 19676, NAIROBI

DEDICATION

To my entire family, you have been the wind beneath my wings. This is for you.

ACKNOWLEDGEMENTS

I wish to extend my immeasurable gratitude to my supervisors **Dr. Richard Owino and Dr. Peter Mugwe** for their wisdom, time and constant support, **Dr.James Ngesa** for going out of his way to give invaluable input during the research. The academic staff in the Unit of Paediatric Dentistry for their contribution during this research and in my training.

I appreciate the University of Nairobi for granting me a full scholarship for my study duration. I also extend my gratitude to the Kenyatta National Hospital, Gertrude's Children Hospital and Mbagathi Hospital administration for permitting me to access their facilities for the entire duration of my study. Gratitude to the parents, guardians, and children for cooperation during the study period. Special gratitude goes to the nursing team at the study sites who coordinated this activity with the uttermost dedication, notably Sr. Leah Asami.

My gratitude also goes to **Magdalene Wairimu** who helped in data collection and **Mr. Owino** for data analysis as well as my friends and classmates who walked this path with me to the very end.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF ABBREVIATIONS

AC	Aesthetic Component
ANR	Adenoid Nasopharyngeal Ratio
COCSTOC	Commission on Classification and Statistics for Oral Conditions
ENT	Ear Nose and Throat
ENT/HN	Ear Nose and Throat / Head and Neck surgery
FDI	Fédération Dentaire Internationale (World Dental Federation)
IOTN	Index of Orthodontic Treatment Need
KNH	Kenyatta National Hospital
OSA	Obstructive Sleep Apnea
PSQ	Paediatric Sleep Questionnaire
SPSS	Statistical Product and Service Solutions
UoN	University of Nairobi
WHO	World Health Organization

ABSTRACT

Background: The relationship between adenotonsillar hypertrophy, chronic mouth breathing and its associated pattern of malocclusion has been a subject of intense research as well as controversy. Various authors have reported that children with mouth breathing develop an array of morphological disorders during the growth phase which manifests as both dental and skeletal malocclusion. Malocclusion has been associated with several unfavorable consequences which comprise dental caries, traumatic dental injuries, periodontal diseases and impaired oral function. In recent years, there has been increasing interest in the early detection and treatment of malocclusion with emphasis on preventive and interceptive procedures that seek to modify skeletal, muscular and dentoalveolar abnormalities in the mixed dentition stage.

Study Objectives: The study aim was to determine malocclusion traits and Orthodontic treatment needs in 7–12-year-old children with adenotonsillar hypertrophy in three referral hospitals.

Materials and Methods: This was a cross-sectional study with hospital-based participants at the Kenyatta National Hospital, Mbagathi Hospital and Gertrude's Children Hospital ENT clinics. A total of 162 children aged 7-12 years diagnosed to have adenotonsillar hypertrophy and who fulfilled the inclusion and exclusion criteria were recruited into the study. Data collection was carried out using a data collection form and clinical examination. Malocclusion traits were registered following the WHO/FDI malocclusion registration index and the Orthodontic treatment needs assessed via the modified aesthetic scale of the Index of Orthodontic Treatment Need.

Data Analysis and Presentation: Analysis was carried out using SPSS version 25.0 for Windows. The data was subjected to descriptive statistics. Thereafter, data was subjected to Chi-square test, Fischer's exact test and Spearman's correlation to compare and relate the variables. A p-value of ≤ 0.05 was considered statistically significant. The results obtained are presented using tables and figures.

Results: A total of 162 participants comprising of 82 (50.6%) boys and 80 (49.4%) girls participated in the study. The mean age was 8.85 ± 1.77 years. Majority of the participants (n=

132, 81.4%) were in mixed dentition while 30(18.4%) were in permanent dentition. The most common anteroposterior molar relationship was an Angles class I molar relationship in 72.8% of the participants. Angles Class II molar relationship was present in 22.8% of the participants. An increased overjet was detected in 21.0% of the participants. Posterior cross bite was present in 14.8% of the participants and occurred significantly more in participants aged 9-12 years (*Fisher's* = 26.874, $p < .001$). With regards to orthodontic treatment needs, majority of the participants in permanent dentition had moderate to great Orthodontic Treatment Needs.

Conclusions: Majority of the participants were in mixed dentition and there was a statistically significant positive correlation between the overjet measurements, occurrence of posterior crossbite and tonsillar hypertrophy grade. Most of the participants in permanent dentition had moderate to great Orthodontic Treatment Needs.

CHAPTER 1: INTRODUCTION

1.1 Introduction

The World Health Organization defined malocclusion as a dentofacial anomaly. A handicapping dentofacial anomaly has been termed as one that causes disfigurement or which impedes function and requires treatment if it is likely to be an obstacle to the patient's physical or emotional well-being. Malocclusion is a multifactorial condition with the two major determinants of growth and development in the craniofacial region being hereditary and environmental factors.[1] Malocclusion not only affects the smile, aesthetics and function but also the social and psychological status of the patient.[2,3]

The relationship between adenotonsillar hypertrophy, mouthbreathing and its associated pattern of malocclusion has been a topic of intense research and controversy.[4-6] Moss stated that 'bones do not grow, bones are grown'. Moss theorized that the size and shape of the maxillaries are determined by the functional matrices, concluding that nasal breathing leads to optimal growth of the nasomaxillary complex, with close interaction with other functions such as chewing and deglutition.[7]

Adenotonsillar hypertrophy is the commonest cause of pharyngeal obstruction and sleep-related breathing disorders in children. It has been demonstrated that the size and the position of the palatine tonsils influence not only the symptoms experienced but the diagnosis of upper airway obstruction as well.[8] Snoring during sleep, apnea, and chronic mouth breathing are the commonest signs of pharyngeal obstruction in children.[9,10] Chronic nasal obstruction in children with adenotonsillar hypertrophy has been associated with mouth breathing.[9-11] Mouth breathing is a parafunctional habit and has been described as the exclusive or partial passage of air through the mouth instead of the nose.[1] Young children with chronic mouth breathing develop an array of peculiar anatomical disorders during the growth phase. These manifest as both dental and skeletal Class II alterations and include reduced width of the maxilla, high arched palate, posterior crossbite, anterior open bite and buccal inclination of the incisors.[12] The disharmony in the growth and development of orofacial structures in these patients results in characteristic facial features termed 'adenoid facies'.[13]

These distinct facial features may have an impact on their perceived dental appearance as it has been shown that discontent with dental aesthetics is directly proportional to the malocclusion severity.[14] In recent years, concern over dental appearance has been on the rise and a high correlation has been reported between dental aesthetics, the need for orthodontic treatment and severity of malocclusion in clinical evaluations.[15] The aim of this study, therefore, is to determine the malocclusion traits and orthodontic treatment needs amongst 7–12-year-old children with adenotonsillar hypertrophy in three referral hospitals.

CHAPTER 2: LITERATURE REVIEW

2.1 Adenotonsillar Hypertrophy

2.1.1 Anatomy of the Adenoids and Palatine Tonsils

The adenoids (nasopharyngeal tonsils) and the palatine tonsils constitute a major part of the Waldeyers ring. The lingual tonsils, posterior and lateral pharyngeal tonsils forming only a minor part of the ring.[16] These lymphoepithelial tissues are located at the entrance of the aerodigestive tract and they increase substantially in size between the first three years of life, with peaks between 3 – 7 years. From adolescent to adulthood years, the adenoids progressively reduce in size.[17]

The palatine tonsils are paired structures located between the palatoglossal arch anteriorly and the palatopharyngeal arch posteriorly. The free medial surface of the palatine tonsils extends into the pharynx.[18] Brodsky[19] demonstrated that the size and the position of the palatine tonsils affect the symptoms and diagnosis of upper airway obstruction. Brodsky further formulated a classification that is widely used and accepted as a grading system of tonsillar size. The tonsillar grade ranges from 0 to 4. 0: the tonsils don't extend beyond the tonsillar pillar. 1: the tonsillar tissues occupy < 25% of the oropharynx, 2: the tonsillar tissues occupy 25% - 50% of the oropharynx, 3: the tonsillar tissues occupy 50% - 75% of the oropharynx, 4: the tonsillar tissues occupy >75% of the oropharynx (Figure 2.1).

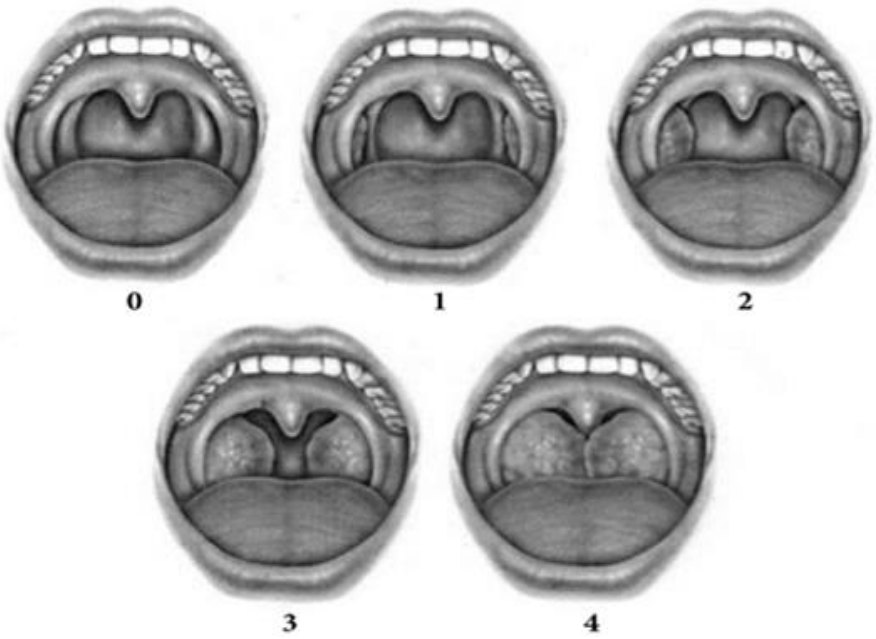


Figure 2.1: Brodsky grading for tonsillar size[19]

The adenoids are an aggregation of pyramidal lymphoid tissue whose base lies on the posterior nasopharyngeal wall and the apex pointed towards the nasal septum. Using a method first described by Fujioka et al[21], the severity of adenoid hypertrophy can be determined by assessing the adenoid – nasopharyngeal ratio (ANR) from lateral skull radiographs. The adenoid size (A) is obtained by measuring the distance of a perpendicular line from the spheno-basiocciput to the most convex area of the adenoid shadow. The size of the nasopharynx (N) is obtained by measuring the distance from the spheno-basiocciput to the posterior aspect of the hard palate. Dividing the value, A by the value N provides the ANR ratio. (Figure 2.2)

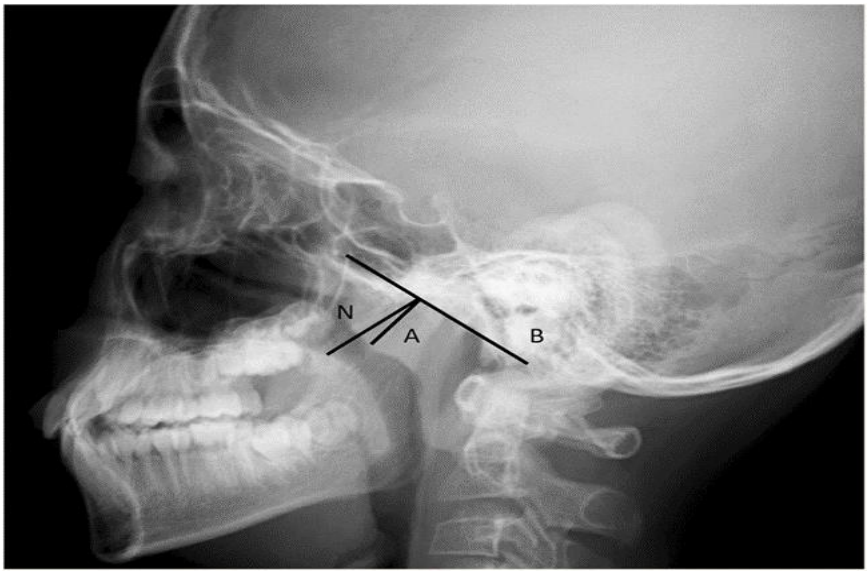


Figure 2.2: Lateral aspect of the nasopharynx showing how the ANR is calculated[21]

2.1.2 Role of the Adenotonsillar Tissues and Aetiology of Adenotonsillar Hypertrophy

Adenoids play a vital immunological role in host defense against viral and bacterial infections. B-lymphocytes are the main cellular component of these lymphoid tissues while T-cell lymphocytes constitute approximately 40% of their volume. The lymphoid tissues are central in inducing cellular immunity through the production of immunoglobulins and proinflammatory mediators.[23, 24] Adenotonsillar disease is a common paediatric and otorhinolaryngological disorder worldwide.[25] The causes of adenotonsillar hypertrophy are not fully understood. Repeated bacterial and viral upper airway infections, however, have been implicated in the pathophysiology of adenotonsillar hypertrophy.[26] Aggravating factors include environmental factors such as allergic rhinitis, pollution and gastroesophageal reflux disease.[27, 28]

2.1.3 Prevalence of Adenotonsillar Hypertrophy

The prevalence of obstructive palatine tonsils in Korean children was reported to be 28% at 6 years and 22.9 % at 7 years. The prevalence was noted to decrease to below 10 % amongst children aged 10 years and above.[29] In Turkey, Kara et al.[30] reported the prevalence of tonsillar hypertrophy as 11% in school-going children. There was a positive correlation between tonsillar hypertrophy and the frequency of upper respiratory tract infections. Habitual mouth breathing was reported in 21.8% of the study subjects and 37.6 % of children with obstructive tonsils. In addition, an association was demonstrated between obstructive tonsillar hypertrophy, snoring and mouth breathing while asleep. In Nigeria, the prevalence of adenoid and tonsillar hypertrophy was reported to range between 1.3% - 27%.[10,31] This disparity in prevalence could be attributed to different instruments used in diagnosis, sample sizes, racial as well as geographical variables. There is an absence of reported data on the prevalence of adenotonsillar hypertrophy in Kenya. However, adenotonsillectomy was the most frequent (48.2%) Ear, Nose and Throat/Head and Neck (ENT/HN) operation carried out in three major hospitals within Nairobi.[32]

2.1.4 Management of Adenotonsillar Hypertrophy

The mainstay treatment for adenotonsillar hypertrophy is adenotonsillectomy and has been shown to reduce the patients' presenting symptoms. However, a 13% - 29% chance of persistent symptoms after surgery still exists.[33] Various researchers have confirmed that adenotonsillectomy results in a significant change from chronic mouth breathing to nasal breathing. However, dentofacial growth in snoring and mouth breathing children is not modified by adenotonsillectomy despite the symptom relief. Best results, concerning dentofacial growth and dental arch morphology, are observed in children that had undergone tonsillectomy when aged six years and below.[34, 35] An alternative treatment for adenotonsillar hypertrophy is non-surgical therapy. Several researchers have indicated the benefits and success of broad-spectrum antibiotics and nasal corticosteroids in the treatment of mild and moderate cases of adenotonsillar hypertrophy.[36, 37]

2.2 Malocclusion

Efforts to describe disorders and deformities of the dentition date back to the 18th century where Fauchard, in 1728 discussed 'tortured teeth, badly arranged and out of position teeth' in literature. It was not until the late 19th century that the term malocclusion was adopted by

Edward Angle. 'Malocclusion' is an indistinct concept that can only be described with normal occlusion as the point of reference. Normal occlusion can be defined as occlusion that is within the acceptable variation from the ideal that does not comprise any functional or aesthetic problems.[38] There are no clear limits describing the range of normal occlusion and consequently, the dental profession is faced with the problem of not knowing how far from the norm the occlusion must deviate to be termed a malocclusion.

2.2.1 Aetiology of Malocclusion

Orthodontists worldwide have held different views concerning the aetiology of malocclusion with most incidences attributed to a complex interaction between inherited and environmental factors. A small proportion of malocclusions, however, could be attributed to a specific known cause such as genetic syndromes, embryologic defects and trauma.[1]

Malocclusion develops gradually, providing ample opportunity for several environmental factors such as mouth breathing to have an effect. These environmental factors affect the developing dentofacial structures through forces that alter tooth position or alter jaw growth.[39] Moss stated that 'bones do not grow, bones are grown'. He theorized that the size and shape of the maxillaries are determined by the functional matrices and as such the soft tissue morphology, position and breathing will condition the craniofacial morphology.[7] In theory, the anteroinferior tongue position required for oral respiration leads to the downward displacement of the mandible and an increased vertical dimension. These morphological changes in mouth breathing children could also be attributed to the effects of soft tissue stretching that occurs when they overextend their heads to make up for the compromised nasal respiration.[5]

2.2.2 Prevalence of Malocclusion

Malocclusion features as the third-highest prevalent condition after caries and periodontal disease, consequently ranking third in the public health dental disease priorities worldwide.[39] Several authors have reported the prevalence of malocclusion to range from 39% - 98%.[41-43] The reasons for this disparity in prevalence could be attributed to the different age groups, ethnicity, size of the study population as well as the malocclusion registration method used. Mugonzibwa et al.[44] in a descriptive cross sectional study amongst Tanzanian children, reported the prevalence of malocclusion to be 51%. In Kenya, 72% of 13 -14-year-olds in Nairobi, were

found to have malocclusion. The prevalence of crowding was reported as 19%, rotated teeth 10%, posterior crossbite 10%, increased overjet 10% and anterior open bite as 8%.[45]

2.2.3 Malocclusion and its Relationship to Adenotonsillar Hypertrophy

Mouth breathing as an etiologic factor in the development of malocclusion has been debated widely. In the early 20th century, this aetiology was considered important but was however rejected mid-century and has only recently been re-emphasized. Experimental studies in animals and isolated human experiments have denoted that total nasal obstruction causes consequential alterations in the pattern of craniofacial growth leading to malocclusion. Absolute airway obstruction in humans is however rare and that leaves the question as to whether partial airway obstruction frequently seen in patients with adenotonsillar hypertrophy has a significant effect.[13, 46, 47]

A positive correlation between dentofacial alterations and adenotonsillar hypertrophy has been demonstrated in studies conducted by several authors.[48-51] On the other hand, there have been studies that failed to demonstrate an association between adenotonsillar hypertrophy and dentofacial disharmony.[52, 53]

Osiatuma[50] carried out a case-control study to assess the occlusal characteristics of children with adenoid hypertrophy in Nigeria. The total sample size was 180 subjects with an equal number of cases and controls. The participants' average age was 6.89 +/- 2.43 years with 93 (51.7%) males and 87(48.3%) girls. The most prevalent occlusion in the cases and controls was a Class I molar relationship (55.6% and 72.2 % respectively). However, the prevalence of class II division 1 malocclusion was more in the cases than in the controls (38.8 % vs 18.9% respectively). A posterior crossbite was present in 11.1% of the cases and 7.8% of the controls and was significantly associated with the cases aged 9-12 years. This finding could be explained by the fact that adenotonsillar hypertrophy has a time-dependent relationship with the occurrence of occlusal discrepancies.

In a cross sectional study amongst 114 children aged between 3-12 years in Brazil by Nunes et al.,[51] obstructive enlargement of the adenoids and tonsils was reported in 64.9% of the participants. Posterior crossbite was the most prevalent malocclusion trait observed in the participants and a significant association between the sagittal occlusion and the site of lymphoid tissue obstruction was also reported. The occurrence of a class II relationship was

significantly higher when both the tonsils and the adenoids were hypertrophied. Anterior displacement of the maxilla or the downward and backward posture of the mandible to permit airflow through the oropharynx may be a plausible explanation for these findings.

In an Italian case-control study looking at children aged 2 -10 years with obstructive sleep apnea (OSA) secondary to adenotonsillar hypertrophy, the prevalence of malocclusion amongst the cases was 89.9% and 60.6% in the control group. Increased overjet, overbite as well as posterior crossbite were strongly associated with the OSA group.[48] The authors reported that increased overbite had a significant association with OSA, in contrast to various researchers.[52] A crucial shortcoming of this study is that dental casts were not utilized in the analysis of the orthodontic variables hence an increased possibility of overestimation/underestimation of the variables. Direct orthodontic examination was favoured because of the young children examined.

In Brazil, Souki et al.[53] reported the occurrence of a posterior crossbite to be higher in mouth-breathing children aged 2-12 years old compared to the general population. The likelihood of an anterior open bite and a class II malocclusion occurring was higher in the mouth breathers. However, most mouth breathing children included in the study did not match the expected dental stereotype. In addition, the obstructive size of adenotonsillar tissues was not a risk factor in the occurrence of anterior open bite, posterior crossbite or class II malocclusion.

2.2.4 Effects of Malocclusion on Dental Health

Several studies have considered a causal relationship between malocclusion, caries and periodontal disease. In mouth breathers, the complaint of xerostomia is common due to increased evaporation of saliva. This lack of mechanical cleansing from saliva results in the build-up of plaque and food debris that promotes cariogenic bacteria leading to the development of caries and halitosis.[54] A higher occurrence of caries has been observed in certain malocclusions. In addition, it's assumed that the mechanical removal of plaque from mal-aligned teeth demands greater patient dexterity which may not be easily achieved in children.[55,56]

The presence of an increased overjet, as well as an anterior open bite, are malocclusion traits that have been reported as predisposing factors in the occurrence of traumatic dental injuries.[57] Among school-going children in Nairobi, Muasya[58] concluded that traumatic dental injuries

occurred more in children with an overjet of greater than 3mm than those with 3mm and less. These findings corroborated those of Järvinen and Shulman et al.[59,60] Alterations in speech, mastication, deglutition and dysfunction of the temporomandibular joint have also been observed amongst patients with malocclusion in addition to its impact on their social and psychological status.[2,3]

2.3 Orthodontic Treatment Needs and Orthodontic Indices

'Orthodontic treatment need' has been described as the extent to which one requires orthodontic intervention due to pertinent characteristics of the malocclusion or the impairments the malocclusion gives rise to. There has been a lack of consensus on what is considered malocclusion and what isn't among different populations. Similarly, there has been debate on what determines the orthodontic treatment need. Efforts to classify malocclusion can be traced to the early 19th century when various scholars such as Edward Angle developed a simple, widely accepted and used index. Angle's classification was followed by several other indices that were mostly qualitative and only served to describe and classify a patients' malocclusion. Recently, there have been major strides made in the development of indices that measure malocclusion as well as objectively determine the orthodontic treatment need.[61,62]

The FDI index was originally developed for COCSTOC and later evaluated by the WHO to obtain a fundamental classification of malocclusions that would allow more objective epidemiological comparisons between sample groups. This index was formulated for the assessment of patients in permanent dentition and focused on the following occlusal characteristics; dentition, inter-arch and intra-arch relationships. The indications for treatment in this index are categorized as either: treatment not needed, doubtful, necessary and urgent. However, the assessment of treatment needs is largely dependent on one's clinical judgment thus undermining its objectivity.[63]

The Index of Orthodontic Treatment Need (IOTN), developed by Brook and Shaw[64], is an index that categorizes malocclusion based on select occlusal traits as well as aesthetic impairment. It is comprised of the dental health component (DHC) and the aesthetic component (AC). The AC of the IOTN has often been utilized in the determination of the orthodontic treatment needs on aesthetic grounds both by the dental practitioners and the patients. The conventional AC is a collection of 10 numbered colour intra-oral photographs that represent

different treatment categories: ‘no treatment needs’ (numbers 1–4), ‘borderline treatment needs’ (numbers 5–7), and ‘great treatment needs’ (numbers 8–10). Regrettably, this conventional AC scale has a few disadvantages in that it does not include features common to the Black and Asian communities such as anterior open bite, midline diastemas and reverse overjet.[65] Consequently, a modified aesthetic scale of the IOTN was formulated and consists of 16 photographs that cover a wider scope of malocclusions thus increasing the sensitivity of the scale.[66]

2.4 Problem Statement

Adenotonsillectomy has been reported to be the most common ENT/HN surgical procedure in Nairobi [32], suggesting that adenotonsillar hypertrophy is a common problem in Kenya. Upper airway obstruction secondary to adenotonsillar hypertrophy leads to chronic mouth breathing which in turn leads to an array of morphological disorders during the growth of the craniofacial structures that may manifest as both dental and skeletal Class II malocclusions. There is increasing interest in the early detection and treatment of malocclusion as well as the corresponding emphasis on preventive and interceptive procedures that seek to modify skeletal, muscular and dentoalveolar abnormalities in the mixed dentition stage. In addition, due to the increasing importance of aesthetics and dental appearance, patients nowadays are strongly driven to seek orthodontic treatment. Children with adenotonsillar hypertrophy may present to the general dental and specialist practitioner for correction of malocclusion associated with adenotonsillar hypertrophy yet there is no information on the occurrence of malocclusion and orthodontic treatment needs of children with adenotonsillar hypertrophy in Kenya.

2.5 Justification

Orthodontic need assessment is of importance to the clinician and patient to adequately prioritize treatment on time. The proposed study provides baseline information on the malocclusion traits present in children with adenotonsillar hypertrophy as well as their orthodontic treatment needs. Further, the information gathered in the present study will help promote an interdisciplinary approach by the general Dental practitioner, Paediatric Dentists, ENT specialists and Orthodontists in the management of patients with adenotonsillar

hypertrophy. As such, the negative effects of chronic mouth breathing can be intercepted early and its untoward effects on dentofacial growth, oral health status and associated social problems reduced or prevented. There has been no study has been done in Kenya to evaluate malocclusion traits and orthodontic treatment needs amongst 7-12 year old children with adenotonsillar hypertrophy and there is, therefore, a need to carry out a study in this area.

2.6 Objectives

2.6.1 Broad Objective

To determine the malocclusion traits and Orthodontic treatment needs in 7–12-year-old children with adenotonsillar hypertrophy.

2.6.2 Specific Objectives

a) To describe the malocclusion traits in 7–12-year-old children with adenotonsillar hypertrophy.
b) To determine the Orthodontic treatment needs of 7–12-year-old children with adenotonsillar hypertrophy using the modified aesthetic component of the IOTN.
c) To determine the association between the overjet, overbite, posterior crossbite and adenotonsillar hypertrophy and in 7–12-year-old patients with adenotonsillar hypertrophy.

2.7 Hypotheses

2.7.1 Null Hypotheses

1. There is no association between the overjet and tonsillar hypertrophy and in 7-12 year old patients with adenotonsillar hypertrophy.
2. There is no association between the overbite and tonsillar hypertrophy and in 7-12 year old patients with adenotonsillar hypertrophy.
3. There is no association between posterior crossbite and tonsillar hypertrophy and in 7-12 year old patients with adenotonsillar hypertrophy.

2.8 Variables

Sociodemographic Variables	1. Age (Years) 2. Sex (Male/Female)
Independent Variables	1. Adenotonsillar Hypertrophy
Dependent Variables	1. Crowding 2. Overjet 3. Crossbite 4. Overbite 5. Openbite 6. Scissor bite 7. Anteroposterior molar relationship 8. Orthodontic treatment needs

CHAPTER 3: MATERIALS AND METHODS

3.1 Study Design

This was a descriptive cross-sectional study with hospital-based participants.

3.2 Study Area

The study was conducted at the Kenyatta National Hospital (KNH), Mbagathi Hospital and Gertrude's Children's Hospital ENT clinics located in Nairobi, Kenya which were selected using purposive sampling.

Nairobi City County is the smallest yet most populous of 47 counties of Kenya, with an area of 69491 Km^2 and a population of 3,138,369. Nairobi City County hosts Kenyatta National Hospital and several referral hospitals. KNH is located in Upperhill area, 3.5 Km West of the central business district. It is a level 6 public healthcare facility and the largest referral hospital in the country. In addition, it is utilized as a teaching hospital by the University of Nairobi Faculty of Health Sciences. Mbagathi hospital, a level 4 public hospital, is located in Dagoretti Division. It borders the Kenyatta National Hospital, Defence Forces Hospital, the Kenya Medical Research Institute and the Kibera slums. With a large catchment area comprising mainly of the underprivileged, it has been relied on to decongest KNH. Gertrude's Children's hospital is a level 5 private Referral and Teaching facility that provides healthcare services to children and teenagers up to 21 years of age. It provides the full range of outpatient and inpatient healthcare services as well as specialist services to over 300000 patients annually through a network of medical centres in Nairobi. The main hospital is located in Muthaiga area, 5 Km North-East of the central business district.

3.3 Study Population

The study population was 7–12-year-old children who had been diagnosed to have adenotonsillar hypertrophy with adenotonsillectomy recommended at the KNH, Mbagathi Hospital and Gertrude's Children's Hospital. The 7–12-year age group was chosen due to the time-dependent relationship between adenotonsillar hypertrophy and the occurrence of malocclusion traits.

3.4 Sample Size Calculation

Considering the study design and prevalence of malocclusion amongst 2-10-year-old children with adenotonsillar hypertrophy as 89.9%,[48] the sample size was determined using Cochran's formula and computed as follows:

$$n = \frac{\left(Z_{1-\frac{\alpha}{2}}\right)^2 p(1-p)}{d^2}$$

Where:

n = sample size

Z = value from the standard normal distribution for 95% confidence level = 1.96

p = prevalence of malocclusion amongst children with adenotonsillar hypertrophy = 0.89

d = allowable error (absolute) = 0.05

Therefore:

$$n = \frac{(1.96)^2 0.89(1-0.89)}{0.05^2}$$

$$n = 150.4 \sim 150$$

The minimum number of children to be recruited into the study was **150**. However, **162** children were recruited during the period of data collection.

3.5 Sampling Procedure

The sampling frame was patients being managed at the ENT outpatient clinics and those recommended for adenotonsillectomy. Children who met the inclusion criteria and whose parents consented were recruited in the study using consecutive sampling until the required sample size was obtained (Figure 3.1).

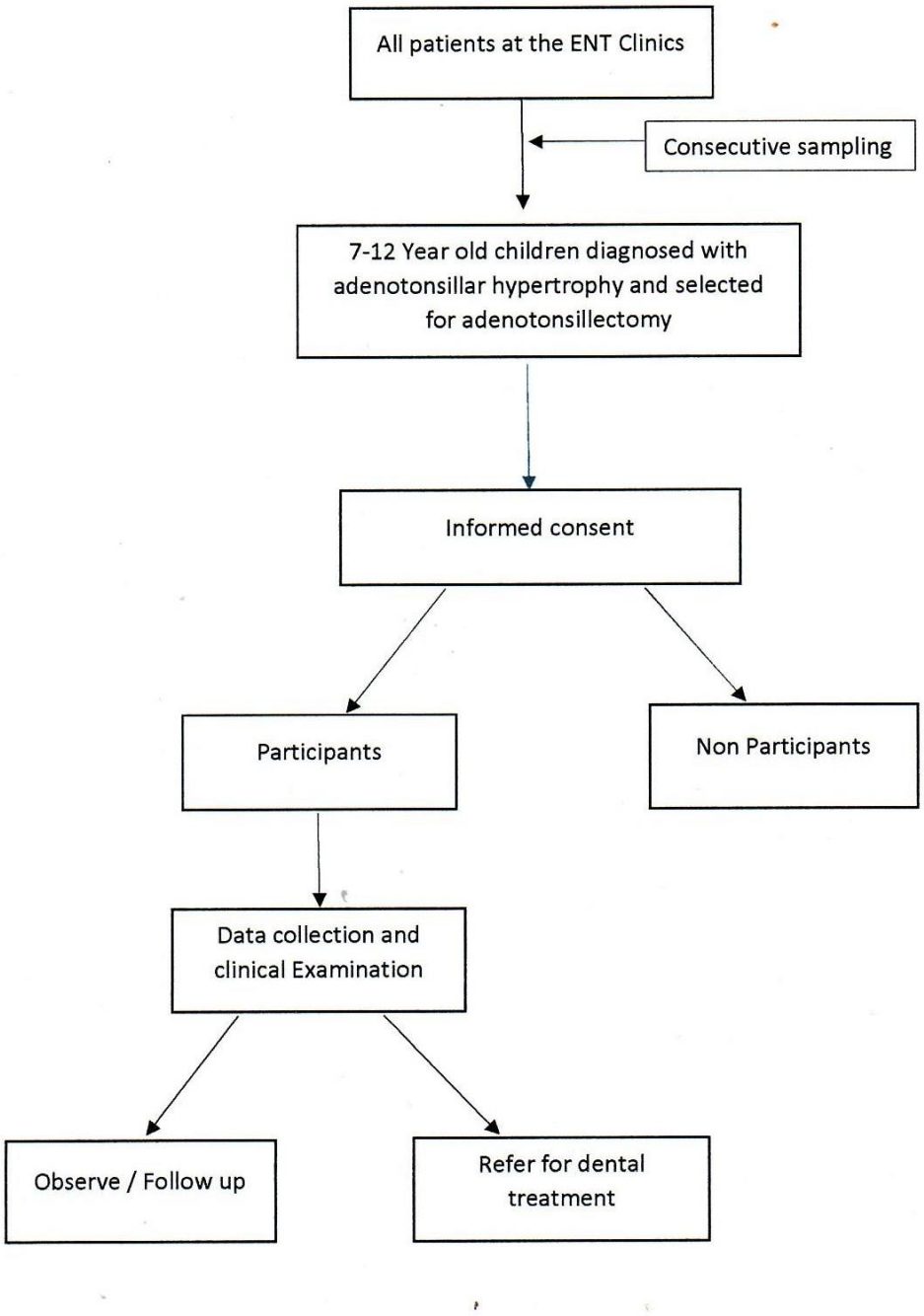


Figure 3. 1: A Flowchart showing the sampling procedure

3.5 Inclusion and Exclusion Criteria

3.5.1 Inclusion Criteria

a) 7–12-year-old children who had been diagnosed to have adenotonsillar hypertrophy by an ENT specialist and due for adenotonsillectomy.
b) 7–12-year-old children who assented and whose parents or guardians consented to participate in the study

3.5.2 Exclusion Criteria

a) Children with craniofacial deformities e.g., cleft lip and palate
b) Children that had undergone orthodontic treatment, adenoidectomy and or tonsillectomy
c) Children with a history of trauma to the Head and Neck region

3.6 Data Collection

A data collection form (Appendix I and II) with four sections was used to record the sociodemographic variables, medical history, malocclusion traits as well as Orthodontic treatment needs. All the sections were completed by the principal investigator.

3.6.1 Data Collection Tool

Section 1 of the data collection form was used to record the patient's sociodemographic variables. Section 2 consisted of a structured questionnaire to record the medical history with questions adapted from the Obstructive Sleep Apnea (OSA-18) Questionnaire and the Paediatric Sleep Questionnaire (PSQ).[67,68] In Section 3, malocclusion traits were recorded mainly following the registration method provided by WHO/FDI [63] Orthodontic treatment needs were assessed via the modified aesthetic component of the Index of Orthodontic Treatment Need in Section 4 of the data collection form.

3.6.2 Clinical Examination

Clean and sterile instruments which consisted of gloves, intraoral mirrors, an orthodontic ruler, a sharp pencil and a marquis periodontal probe were used to carry out the intraoral examination (Figure 3.2).

Figure 3.2: Clinical examination materials

The intraoral examination was carried out by the principal investigator with the participants seated upright on a chair facing the principal investigator under natural light. The variables were recorded as follows:

Dentition status

a) Any tooth that, considering the patient's dental development, should have erupted but was not visible in the mouth was recorded as congenitally missing. Missing permanent teeth due to extraction or trauma were also recorded.

b) Tooth malformations were recorded under the following categories: supernumerary, size and shape anomalies.

Intra-arch measurements

a) A space of 2 mm or more, measured horizontally from the mesial aspect of one maxillary central incisor to the mesial aspect of the other maxillary central incisor was recorded as a diastema.

b) Crowding and spacing were recorded as either present or absent. The maxillary and mandibular incisal segments were examined for crowding and spacing. A space deficiency of 2mm or more was regarded as the presence of crowding while a space excess of 2mm or more was regarded as spacing.

Inter-arch measurements

a) With the subject in centric occlusion, the midlines were assessed relative to the mid-sagittal plane. The measurements were documented to the nearest whole millimeter.
b) Overjet was measured (to the nearest mm) from the labio-incisal edge of the most prominent maxillary incisor to the labial surface of the corresponding mandibular central incisor parallel to the occlusal plane. A reverse overjet was recorded only when all four maxillary teeth occluded lingually to the lower incisors.
c) Anterior crossbite was assessed for presence or absence with the presence as three or fewer maxillary incisors in crossbite.
d) Overbite was approximated as the maximum overlap of either maxillary central incisor in relation to the mandibular incisor and documented. An anterior open bite was recorded when all four maxillary incisors do not overlap any mandibular incisor when viewed in the occlusal plane.
e) A posterior crossbite was recorded if the buccal cusp of the maxillary tooth was positioned lingual to the maximum height of a buccal cusp of the opposing mandibular tooth.
f) A scissor-bite was recorded if the lingual cusp of the upper tooth was positioned buccal to the maximum height of a buccal cusp of an opposing lower tooth.
g) The anteroposterior assessment was based on the first permanent molars on each side. No attempt was made to compensate for any drift of these teeth. Where the first molars were missing, the assessment was carried out based on the canine relationship.
h) To assess the treatment need, the principal investigator rated the appearance of the participants' anterior teeth to the modified aesthetic component of the IOTN and identified the photo that closely resembled the appearance of their front teeth.

3.7 Covid-19 Precautions

Due to Covid-19, extra infection control precautions were taken to safeguard the safety of the researcher, assistant and the participants. Both the researcher and the assistant were wearing personal protective equipment and ensured that the masks are on at all times. Additionally, the gloves were changed and disposed properly after each child was examined, and hand sanitizers were available and used efficiently.

3.8 Calibration

The principal investigator (PI) was calibrated by an experienced orthodontist before data collection. Calibration was carried out at the University of Nairobi Dental Hospital. Cohen's Kappa coefficient (k) statistic was used to measure the inter-examiner and intra-examiner reliability of the study. The Cohen Kappa statistic value of 0.82 for the clinical examination and 0.90 for orthodontic treatment need was obtained. During the data collection period, every 10th child was re-examined by the PI to determine intra-examiner consistency. The intra-examiner Cohen Kappa statistic value was 0.90 for the clinical examination and 0.96 for the orthodontic treatment need. A research assistant to aid in data recording was trained and calibrated by the principal investigator to ensure that there were minimal errors while recording the data.

3.9 Quality Assurance and Data Security

a) The filled data collection forms were checked for completeness and accuracy before data entry.
b) Once data entry was done, 15% of the questionnaires were sampled for double entry to check that the entry had been done accurately.
c) Additionally, the data was checked for any logical or typographical errors.
d) All the information collected was password protected whereas the coded and filled questionnaires were kept in folders under lock and key for confidentiality.

3.10 Data Analysis and Presentation

The data was analyzed using Windows IBM SPSS version 25. Descriptive statistics such as mean and standard deviation were applied to all continuous data variables. Thereafter, data was subjected to statistical tests such as Pearson's Chi-square test, Fischer's exact test and linear regression model to compare and relate variables. All statistical tests and hypotheses testing was determined at a significance level of 0.05 ($p<0.05$) and a 95% Confidence interval. The results were presented in tabular format and in text.

3.11 Ethical Considerations

a) Ethical clearance was sought and obtained from Kenyatta National Hospital and UoN Ethical and Research Committee (KNH-UoN ERC) – P979/12/2021
b) Permission to conduct the study was also sought and obtained from Kenyatta National Hospital, Mbagathi Hospital as well as the Gertrude's Children's Hospital Ethical Review Board.
c) Participation in the study was voluntary.
d) Informed consent was obtained from the parents/guardians accompanying the children. (Appendix III and IV) Assent was also obtained from the children. (Appendix V and VI)
e) Patient confidentiality was ensured by the provision of identification numbers, which were indicated on each page of the data collection form. No names were included in the data collection forms.
f) Oral health education was given during data collection and all children found to require further dental treatment were referred to relevant dental facilities for management.
g) No incentives were given to the participants.
h) Information obtained was only used for the study and dissemination of the study findings will be done through conferences, workshops and scientific publications.

CHAPTER 4: RESULTS

4.1 Socio-Demographic Characteristics

The children were enrolled from Kenyatta National Hospital (80, 49.4%), Gertrude's Hospital (47,29.0%) and Mbagathi Hospital (35, 21.6%). There were 82 (50.6%) boys and 80 (49.4%) girls, with a male to female ratio of 1.03:1.

The age of the children ranged from 7 to 12 years, with a mean $\pm$ SD age of 8.85 $\pm$ 1.77 years. The study participants were thereafter, grouped into three age groups: 7 – 8 years (n = 83, 51.2%), 9 – 10 years (n = 43, 26.5%) and 11 – 12 years (n = 36, 22.2%) as presented in Figure 1.

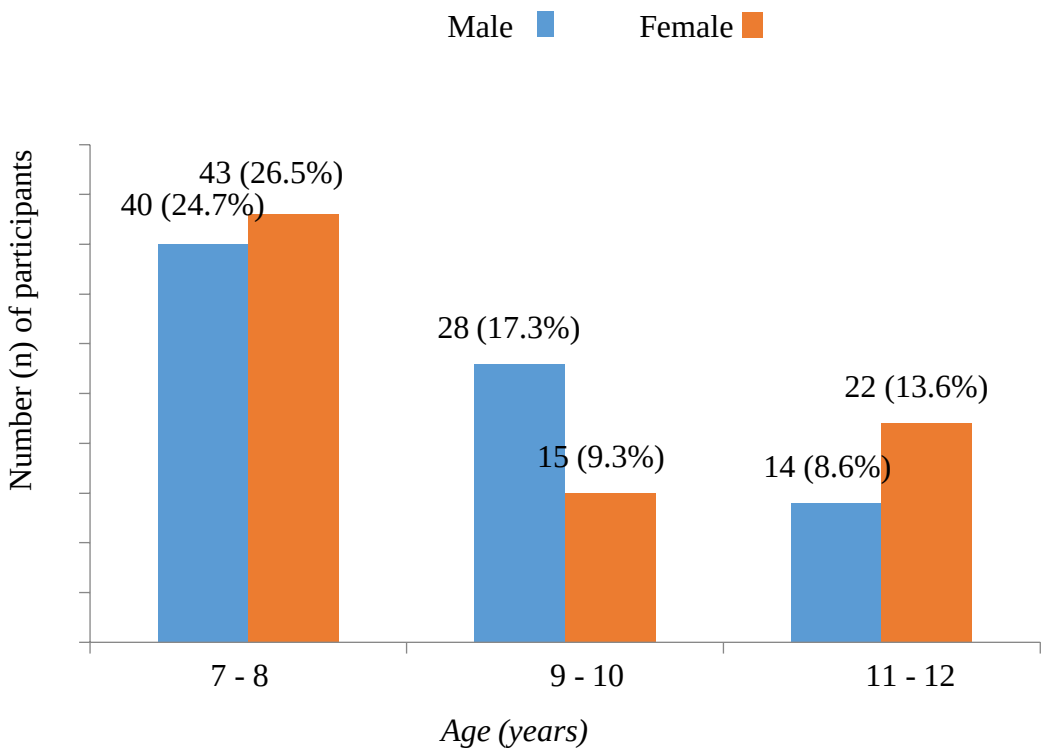


Figure 4.1: Distribution of participants by age groups and gender.

4.2 Medical History

Concerning the participants past dental history, majority of the participants 111 (68.5%) had never been to a dentist as shown in Figure 4.2.

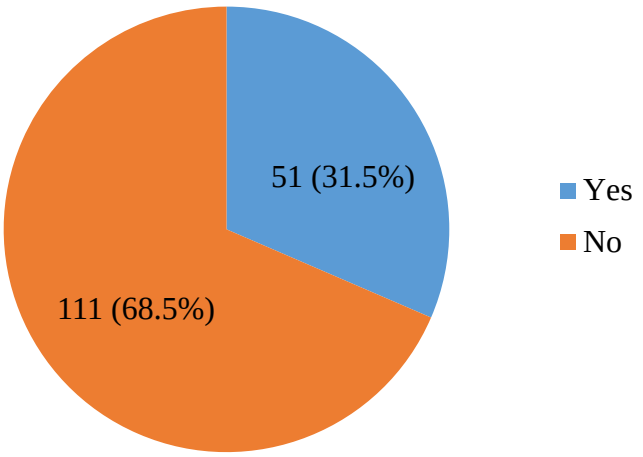


Figure 4.2: Dental visits among the children (n = 162).

The medical history regarding the symptoms experienced by the participants was obtained using a structured questionnaire with questions adapted from the Obstructive Sleep Apnea (OSA-18) Questionnaire and the Paediatric Sleep Questionnaire (PSQ).

Majority (n=111, 68.5%) of the participants reported snoring more than half the time they were asleep. Participants with chronic mouth breathing accounted for 47.5% and all the children reported having frequent colds and upper respiratory infections.

With regards to age, the distribution of participants who reported snoring while sleeping was variable with majority 53(32.7%), aged between 7-8 years. Similarly, chronic mouth breathing was more prevalent in the 7-8 years age group (n= 32, 19.8%) and there was a statistically significant association between chronic mouth breathing and age (Fisher's = 11.439, p = .021). This is comprehensively presented in Table 4.1.

Table 4.1: Distribution of participants' symptoms (n = 162).

			Gender		Age (years)		
			Male	Female	7 – 8	9 – 10	11 – 12
Medical History and Habits		n (%)	n (%)	n (%)	n (%)	n (%)	n (%)
Snoring	Yes	111(68.5)	58(35.8)	53(32.7)	53(32.7)	29(17.9)	29(17.9)
	No	51(31.5)	24(14.8)	27(16.7)	30(18.5)	14(18.6)	7(4.3)
Statistical test(95% CI)			X2 = 0.377 p = .539		X2 = 3.278 p = .194		
Breathe through mouth	Yes	77(47.5)	41(25.3)	36(22.2)	32(19.8)	19(11.7)	26(16.0)
	No	47(29.0)	23(14.2)	24(14.8)	28(17.3)	13(8.0)	6(3.7)
	Don't know	38(23.5)	18(11.1)	20(12.3)	23(14.2)	11(6.8)	4(2.5)
Statistical test(95% CI)			$\chi 2$= 0.427 p = .808		**Fisher's = 11.439 p = .021***		
	Total	162(100)	82(50.6)	80(49.4)	83(51.3)	43(26.5)	36(22.2)

**p< .05*

4.3 Tonsillar Hypertrophy Grade

The tonsillar hypertrophy grade of each study participant was recorded from the medical records as registered by the Otolaryngologist. The most common grade amongst the participants was tonsillar hypertrophy grade 3, at 58.7% (n = 95).

Most (n=54, 33.3%) of the children with obstructive tonsils (tonsillar hypertrophy grade 3 and 4) were aged between 7-8 years. Fischer's exact test showed no significant association between the tonsillar grades, gender (Fisher's = 0.258, p = .963) and age (Fisher's = 3.121, p = .549). A comprehensive distribution of the tonsillar hypertrophy grade of the study participants is presented in Table 4.2.

Table 4.2: Distribution of tonsillar hypertrophy grades of the study participants (n = 162).

		Gender		Age (years)		
		Male	Female	7 – 8	9 – 10	11 – 12
Tonsillar grade	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)
Grade 2	60(37.0)	31(19.1)	29(17.9)	29(17.9)	20(12.3)	11(6.8)
Grade 3	95(58.7)	47(29.0)	48(29.6)	49(30.2)	22(13.6)	24(14.8)
Grade 4	7(4.3)	4(2.5)	3(1.9)	5(3.1)	1(0.6)	1(0.6)
Statistical test(95% CI)		Fisher's = 0.258 p = .963		Fisher's = 3.121 p = .549		
Total	162(100)	82(50.6)	80(49.4)	83(51.3)	43(26.5)	36(22.2)

4.4 Dentition Status

Majority of the participants (n= 132, 81.4%) were in mixed dentition while 30(18.4%) were in permanent dentition. Most of the participants had missing permanent teeth secondary to extraction and the most common dental anomaly was anomaly in size as presented in Figure 4.3.

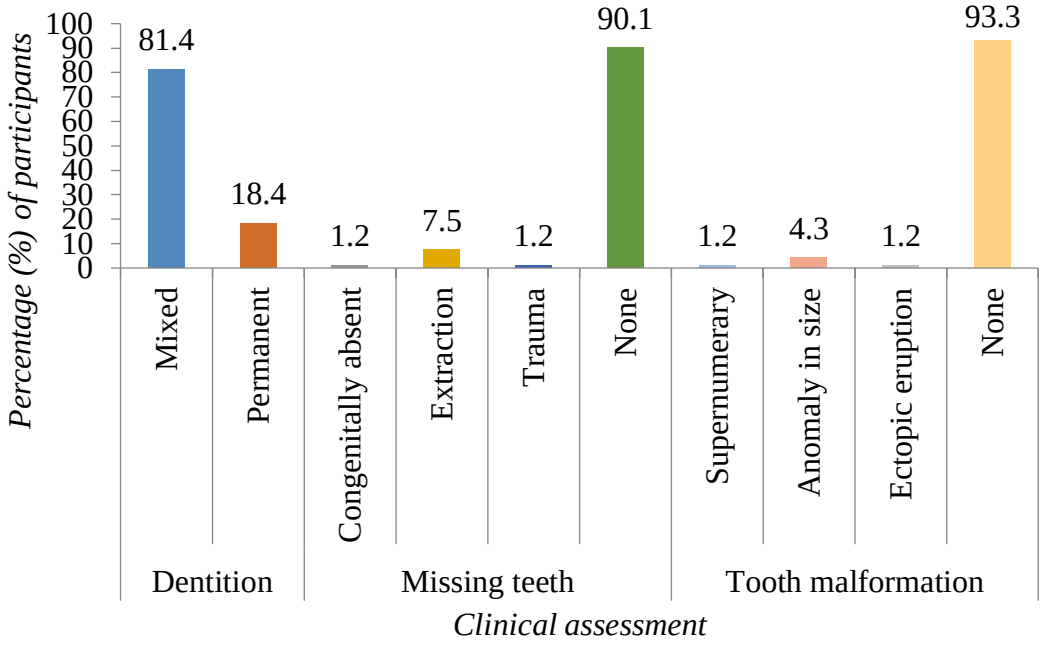


Figure 4.3: Dentition status of the participants (n = 162).

4.5 Intra-Arch Assessment

In the maxillary anterior segment, 35.8% of the participants (n = 58) had crowding and 8.0% (n=13) had spacing. In the mandibular anterior segment, 39.5% (39.5%) had crowding and 2.5% of the participants (n=4, 2.5%) had spacing. Majority of the participants neither had crowding nor spacing in both the maxillary and mandibular anterior segments as shown in Table 4.3 below.

Table 4.3: Distribution of participants anterior arch crowding/spacing (n = 162).

Intra-Arch Measurements			**Gender**		**Age (years)**		
			Male	Female	7 – 8	9 – 10	11 – 12
		n (%)	n (%)	n (%)	n (%)	n (%)	n (%)
Anterior arch: Maxillary	Crowding	58(35.8)	34(21.0)	24(14.8)	27(16.7)	17(10.5)	14(8.6)
	Spacing	13(8.0)	6(3.7)	7(4.3)	2(1.2)	6(3.7)	5(3.1)
	None	91(56.2)	42(25.9)	49(30.2)	54(33.3)	20(12.3)	17(10.5)
Statistical test(95% CI)			$\chi 2 = 2.315$ p = .314		Fisher's = 10.171 p = .131		
Anterior arch: Mandibular	Crowding	64(39.5)	34(21.0)	30(18.5)	38(23.5)	18(11.1)	8(4.9)
	Spacing	4(2.5)	2(1.2)	2(1.2)	2(1.2)	1(0.6)	1(0.6)
	None	94(58.0)	46(28.4)	48(29.6)	43(26.5)	24(14.8)	27(16.7)
Statistical test(95% CI)			Fisher's = 0.398 p = .860		Fisher's = 6.520 p = .124		
	Total	162(100)	82(50.6)	80(49.4)	83(51.3)	43(26.5)	36(22.2)

With regards to tonsillar hypertrophy grade, majority of the participants with crowding in the maxillary and mandibular anterior segments had grade 3 tonsillar hypertrophy. Nevertheless, these findings were not statistically significant as shown in Table 4.4.

Table 4.4: Comparison of participants anterior arch crowding/spacing and tonsillar hypertrophy grade (n = 162).

Anterior Arch Crowding/Spacing			**Tonsillar Hypertrophy Grade**			**Statistical test(95% CI)**
			Grade 2	Grade 3	Grade 4	
		n (%)	n (%)	n (%)	n (%)	
	Crowding	58(35.8)	19(11.7)	34(21.0)	5(3.1)	Fisher's = 6.221 p = .159
Maxillary	Spacing	13(8.0)	4(2.5)	8(4.9)	1(0.6)	
	Normal	91(56.2)	37(22.8)	53(32.7)	1(0.6)	
	Crowding	64(39.5)	20(12.3)	41(25.3)	3(1.9)	Fisher's = 5.567 p = .204
Mandibular	Spacing	4(2.5)	2(1.2)	1(0.6)	1(0.6)	
	Normal	94(58.0)	38(23.5)	52(32.1)	4(2.5)	
	Total	162(100)	60(37.0)	94(58.0)	8(4.9)	

4.6 Inter Arch Assessment

4.6.1 Antero Posterior Molar Relationship

The anteroposterior molar relationship according to Angle was assessed; 72.8% of the participants had a class I molar relationship and 22.8% had a class II molar relationship. Although not statistically significant, more male participants (14.8%) have a class II molar relationship compared to the female participants (8.0%). There were no cases with class III anteroposterior molar relationship as shown in Table 4.5.

Table 4.5: Distribution of participants anteroposterior molar relationship (n = 162).

Antero-Posterior Molar Relationship			**Gender**		**Age (years)**		
			Male	Female	7 – 8	9 – 10	11 – 12
		n (%)	n (%)	n (%)	n (%)	n (%)	n (%)
	Class I	118(72.8)	55(34.0)	63(38.9)	76(46.9)	28(17.3)	14(8.6)
	Class II	37(22.8)	24(14.8)	13(8.0)	5(3.1)	13(8.0)	19(11.7)
	Cannot be assessed	7(4.3)	3(1.9)	4(2.5)	2(1.2)	2(1.2)	3(1.9)
	Statistical test(95% CI)		Fisher's = 3.954 p = .136		Fisher's = 38.299 p = .101		
	Total	162(100)	82(50.6)	80(49.4)	83(51.3)	43(26.5)	36(22.2)

There was no statistically significant association between the anteroposterior molar relationship and tonsillar hypertrophy grades of the participants as shown in Table 4.6.

Table 4.6: Comparison of participants anteroposterior molar relationship by tonsillar hypertrophy grade (n = 162).

Antero-Posterior Molar Relationship			Tonsillar Hypertrophy Grade			Statistical test (95% CI)
			Grade 2	Grade 3	Grade 4	
		n (%)	n (%)	n (%)	n (%)	
	Class I	118(72.8)	47(29.0)	64(39.5)	7(4.3)	Fisher's = 3.041 p = .535
	Class II	37(22.8)	10(6.2)	26(16.0)	1(0.6)	
	Cannot be assessed	7(4.3)	3(1.9)	4(2.5)	0	
	Total	162(100)	60(37.0)	94(58.0)	8(4.9)	

4.6.2 Overjet Measurements

Majority of the participants (n= 128,79.0%), had an overjet between 0mm to 3mm while 34 (21.0%) had an overjet greater than 3mm to 6mm. The likelihood of having an overjet greater than 3mm increased with age as most (n=16, 9.9%) of the participants with an overjet greater than 3mm were aged between 11-12 years. Chi-square test of association showed a statistically significant difference in the overjet measurements among the age groups ($\chi 2$= 15.815, p = .001) as shown in Table 4.7.

Table 4.7: Distribution of the overjet measurements of the participants (n = 162).

			Gender		Age (years)		
Inter-arch measurements			Male	Female	7 – 8	9 – 10	11 – 12
		n (%)	n (%)	n (%)	n (%)	n (%)	n (%)
Overjet	0 to 3mm	128(79.0)	64(39.5)	64(39.5)	74(45.7)	34(21.0)	20(12.3)
	>3mm to 6mm	34(21.0)	18(11.1)	16(9.9)	9(5.6)	9(5.6)	16(9.9)
Statistical test(95% CI)			$\chi 2$= 0.093 p = .760		**$\chi 2$= 15.815 p < .001***		
	Total	162(100)	82(50.6)	80(49.4)	83(51.3)	43(26.5)	36(22.2)

**p< .05*

There was a statistically significant association in the overjet measurements among the tonsillar hypertrophy grades (Fisher's = 9.999, p = .005). Moreover, majority of the participants with an overjet greater than 3mm had grade 3 tonsillar hypertrophy as shown in Table 4.8. Spearman's correlation test between the overjet measurements and tonsillar hypertrophy grade showed a statistically significant but weak correlation (rs = 0.237, p=0.002).

Table 4.8: Comparison of participants overjet measurement by tonsillar hypertrophy grade (n = 162).

		Tonsillar Hypertrophy Grade				Statistical test (95% CI)
Inter-arch measurements			Grade 2	Grade 3	Grade 4	
		n (%)	n (%)	n (%)	n (%)	**Fisher's = 9.999 p = .005***
Overjet	0 to <3mm	128(79.0)	55(34.0)	67(41.4)	6(3.7)	
	>3mm to 6mm	34(21.0)	5(3.1)	27(16.7)	2(1.2)	
	Total	162(100)	60(37.0)	94(58.0)	8(4.9)	

**p< .05*

4.6.3 Anterior Cross Bite

An anterior cross bite was present in only 8 (4.9%) of the participants. With regards to gender, male participants had a slightly higher prevalence of anterior open bite (n=5, 3.1%). However, neither gender nor age was significantly associated with the occurrence of an anterior cross bite as shown in Table 4.9.

Table 4.9: Distribution of anterior cross bite amongst the participants (n = 162).

			Gender		Age (years)		
Inter-arch measurements			Male	Female	7 – 8	9 – 10	11 – 12
		n (%)	n (%)	n (%)	n (%)	n (%)	n (%)
Anterior cross bite	Present	8(4.9)	5(3.1)	3(1.9)	4(2.5)	3(1.9)	1(0.6)
	Absent	154(95.1)	77(47.5)	77(47.5)	79(48.8)	40(24.7)	35(21.6)
Statistical test(95% CI)			Fisher's = 0.475 p = .720		Fisher's = 0.751 p = .798		
	Total	162(100)	82(50.6)	80(49.4)	83(51.3)	43(26.5)	36(22.2)

4.6.4 Overbite Measurements

For the overbite measurements, an anterior open bite was present in 13.0% (n=21) and was most common in those aged 7-8 years. Majority (113, 69.8%) of the children had edge to edge to 1/3 rd overlap. With regards to gender, there were no significant differences in the overbite measurements (Fisher's = 2.975, p = .386) as shown in Table 4.10.

Table 4.10: Overbite measurement amongst the study participants (n = 162).

		Gender			Age (years)		
Inter-arch measurements			Male	Female	7 – 8	9 – 10	11 – 12
		n (%)	n (%)	n (%)	n (%)	n (%)	n (%)
	Edge to edge to 1/3rd overlap	113(69.7)	55(34.0)	58(35.8)	65(40.1)	26(16.0)	22(13.6)
Overbite	>1/3rd overlap to 2/3rd overlap	21(13.0)	14(8.6)	7(4.3)	4(2.5)	10(6.2)	7(4.3)
	>2/3rd overlap	7(4.3)	4(2.5)	3(1.9)	1(0.6)	5(3.1)	1(0.6)
	Anterior open bite	21(13.0)	9(5.6)	12(7.4)	13(8.0)	2(1.2)	6(3.7)
Statistical test (95% CI)			Fisher's = 2.975 p = .386		Fisher's = 20.600 p = .151		
	Total	162(100)	82(50.6)	80(49.4)	83(51.3)	43(26.5)	36(22.2)

4.6.5 Posterior Cross Bite

The inter arch measurements of the participants for the posterior cross bite was assessed as either present or absent. With regards to gender, male participants had a higher prevalence of posterior cross bite, although not statistically significant ($\chi 2 = 0.671$, $p = 0.136$).

The likelihood of having a cross bite increased with age as presented in Table 4.11 which shows 8(4.9%) participants were aged between 9-10 years and 14(8.6%) participants were aged 11-12 years (Fisher's = 26.874, $p < .001$). Spearman's correlation test between the posterior cross bite and age showed a statistically significant but weak correlation ($rs = 0.284$, $p=<0.001$)

Table 4.11: Distribution of posterior cross bite amongst the study participants (n = 162).

Characteristic			**Gender**		**Age (years)**		
			Male	Female	7 – 8	9 – 10	11 – 12
		n (%)	n (%)	n (%)	n (%)	n (%)	n (%)
Posterior Crossbite	Present	24(14.8)	14(8.6)	10(6.2)	2(1.2)	8(4.9)	14(8.6)
	Absent	138(85.2)	68(42.0)	70(43.2)	81(50.0)	35(21.6)	22(13.6)
Statistical test (95 % CI)			$\chi 2$= 0.671 p = .136		**Fisher's = 26.874** **p < .001***		
	Total	162(100)	82(50.6)	80(49.4)	83(51.3)	43(26.5)	36(22.2)

**p< .05*

There was a statistically significant association (*Fisher's* = 11.392, *p* = .002) between the participants posterior cross bite measurements and tonsillar hypertrophy grades. Majority of the study participants with posterior cross bite had grade 3 tonsillar hypertrophy (Table 4.12). Spearman's correlation test between the posterior cross bite and tonsillar hypertrophy grade showed a statistically significant but weak correlation (rs = 0.234, p=0.003).

Table 4.12: Comparison of participants posterior cross bite by tonsillar hypertrophy grades (n =162).

Intra-arch measurements			**Tonsillar Hypertrophy Grade**			**Statistical test (95% CI)**
			Grade 2	Grade 3	Grade 4	
		n (%)	n (%)	n (%)	n (%)	
Crossbite	Present	24(14.8)	2(1.2)	21(13.0)	1(0.6)	**Fisher's = 11.392** **p = .002***
	Absent	138(85.2)	58(35.8)	75(46.3)	5(3.1)	
	Total	162(100)	60(37.0)	96(59.3)	6(3.7)	

**p< .05*

4.6.6 Scissor Bite

Only 1(0.6 %) of the children examined had a scissor bite (Table 4.13).

Table 4.13: Occurrence of scissor bite amongst the study participants (n = 162).

			Gender		Age (years)		
Scissor bite			Male	Female	7 – 8	9 – 10	11 – 12
		n (%)	n (%)	n (%)	n (%)	n (%)	n (%)
	Present	1(0.6)	0(0.0)	1(0.6)	1(0.6)	0(0.0)	0(0.0)
	Absent	161(98.1)	82(50.6)	79(48.8)	82(50.6)	43(26.6)	36(22.2)
Statistical test (95% CI)			Fisher's = 0.315 p = .999		Fisher's = 1.041 p = .790		
Total		162(100)	82(50.6)	80(49.4)	83(51.2)	43(26.6)	36(22.2)

4.6.7 Orthodontic Treatment Need

Orthodontic treatment need was assessed using the modified aesthetic component of the IOTN for only those in permanent dentition (n=30). Most of the children required moderate or borderline need for treatment (*n* = 16, 53.3%) followed by no or slight need for treatment (*n* = 8, 26.7%) and great need for treatment (*n* = 6, 20.0%) (Figure 6).

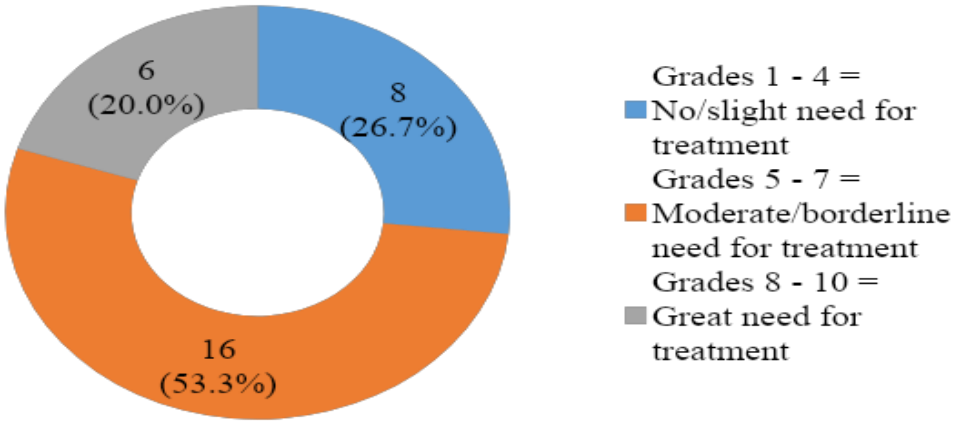


Figure 4.4: Orthodontic Treatment Need

CHAPTER 5: DISCUSSION, CONCLUSION AND RECOMMENDATIONS

5.1 Discussion

The present study was a cross sectional hospital based study carried out to evaluate the malocclusion traits of and orthodontic treatment needs amongst 7–12-year-old children with adenotonsillar hypertrophy and recommended to have adenotonsillectomy in three referral hospitals in Nairobi.

The relationship between adenotonsillar hypertrophy, mouth breathing and its associated pattern of malocclusion has been a topic of intense research and controversies. [4-6] However, it has been accepted that respiratory needs are a key determinant in the posture of the jaws and associated soft tissues. [5] Chronic nasal obstruction associated with mouth breathing can be due to several factors however, adenotonsillar hypertrophy is the commonest cause of pharyngeal obstruction in children. [8] The dental inter-arch relationship in the three planes of space is a fundamental parameter in assessing occlusion as well as the effects of unbalanced muscular activity in growing children.

In the present study, there was an equal number of female and male participants with the majority (68.5%) reporting to have never been to a dentist, findings which were similar to those of a Turkish study that evaluated the effects of adenotonsillar hypertrophy on the oral health of children.[69] The findings of the present study, however, were higher than those reported in the Kenya National Oral Health Survey in 2015.[70] The survey demonstrated that 46.7% of the children participating had never visited a dental clinic in their life time. A subjective inference can thus be made that utilization of dental care amongst patients with adenotonsillar hypertrophy is lower compared to the general population.

The present study confirmed the findings about the most common symptoms experienced by children with adenotonsillar hypertrophy as reported by various African and International authors.[71-73] All the participants reported experiencing frequent colds and upper respiratory infections. An explanation for this may be supported by literature. The lymphoid tissues are central in inducing cellular immunity through the production of immunoglobulins and proinflammatory mediators thus chronic persistent inflammation due to frequent upper airway infections has been postulated to be a key factor in hypertrophy of the adenotonsillar tissues. [26] Snoring was the second most common symptom reported followed by mouth breathing. It was

found out that snoring ($\chi 2$= 3.278, p = .194) and chronic mouth breathing (Fisher's = 11.439, p = .021) were more prevalent in the participants aged between 7-8 years. Similarly, a majority (n=54, 33.3%) of the children with obstructive tonsils (grade 3 and 4 tonsillar hypertrophy) were also aged between 7-8 years (Fisher's = 3.121, p = .549). These findings could be explained by the fact that the adenotonsillar tissues proliferate and reach their peak size between the ages of 3-7 years and progressively reduce in size from adolescent to adulthood years.[16-18] This physiological proliferation coupled with chronic inflammation may lead to the proliferation of the adenotonsillar tissues causing sufficient airflow obstruction and inducing chronic mouth breathing. It should however be noted that the present study did not assess adenoidal hypertrophy.

The distribution of participants with regards to the stage of dental development of the participants showed that the majority of participants (81.4%) were in mixed dentition while 18.4% were in permanent dentition. Overall, the finding that the majority of participants were in mixed dentition is in accordance with findings reported by Souki et al. [53] Nevertheless, in the study carried out by Souki et al, only 6.5% of the children were in permanent dentition with a similar pattern of results obtained by Ballikaya et al. [74] These differences could be attributed to the age group included in the different studies. The present study looked at participants aged 7-12 years while Souki et al and Ballikaya et al included participants aged 2-12 years and 3-15 years respectively. This is an important finding given the increasing interest in the early detection and treatment of malocclusion as well as the corresponding emphasis on preventive procedures with some malocclusions benefitting from treatment in the mixed dentition stage.[75]

In the sagittal plane, the most common Anteroposterior molar relationship was Class I (71.6%) whilst a Class II molar relationship was registered in 23.5% of the participants. This finding is in agreement with various authors. [51, 52, 76] The present study, however, did not establish any statistically significant correlation between the anteroposterior molar relationship and tonsillar hypertrophy. It is generally agreed that the sagittal dental inter-arch relationship is largely determined by heredity. Although chronic mouth breathing is implicated in prolonged head extension, it only acts as a secondary factor and these unbalanced muscular activities may not be sufficient to alter a class I growth pattern into a class II pattern.[77] It is also important to note that, Anteroposterior molar relationship may not be a good indicator of a patient's skeletal type as the molar relationship can be influenced by other factors such as early loss of primary teeth.

The present study revealed that 21% of the participants had an increased overjet with majority aged between 11-12 years ($\chi 2=15.815$, $p<.001$). The increased overjet could be due to altered craniofacial growth pattern that is particularly during high potential growth spurts such as the preadolescent growth spurt. Impaired growth hormone secretion in children with obstructive sleep apnea secondary to adenotonsillar hypertrophy may be a contributory factor in the altered craniofacial growth pattern. In addition, children with chronic mouth breathing may have excessive postural responses of the head, mandible and tongue which results in a predominantly vertical growth pattern that is associated with a retrognathic mandible an increased overjet.[78, 79] Spearman's correlation test between the overjet measurements and tonsillar hypertrophy grade showed a statistically significant but weak correlation ($rs = 0.237$, $p=0.002$). The weak correlation between the two variables could be explained by the findings of various authors [52, 80] that hypertrophic tonsils are not always obstructive and thus future studies should examine the correlation between overjet measurements and hypertrophic adenoids as well. In contrast, Carvalho [76] did not find a statistically significant association between sleep-disordered breathing and overjet in a pilot study amongst 7–9-year-olds. The findings by Carvalho are in agreement with those of Valera [81] who did not register any alterations in overjet amongst 3–6-year-old preschool children with adenotonsillar hypertrophy.

In the vertical dental relationship, the present study did not demonstrate a significant association between the overbite measurements or anterior open bite and tonsillar hypertrophy which is in agreement with the findings in previous clinical studies. [53] However, Galeotti et al [48] reported an association between increased overbite and obstructive sleep apnea, findings contradictory to those reported by various authors. [53, 76] A plausible explanation for these conflicting findings is that the degree of overbite and open bite can be influenced by multiple factors such as the stage of dental development, oral habits and heredity. [82]

Regarding the presence of posterior crossbite, the findings of the present study demonstrate some similarity with the aforementioned studies carried out by various authors.[48,50,53] Children with adenotonsillar hypertrophy have been shown to have a reduced intermaxillary width than those without in various case control studies. [52, 79] In a case control study utilizing dental casts for the linear measurements, Parkkinen et al [52] demonstrated that the maxillary arch width measured at the level of the canines and the molars was reduced in the snoring and obstructive sleep apnea groups when compared with the control group. This could be due to the lower tongue posture adopted by children with chronic mouth breathing that changes the muscular

balance between the tongue and the cheeks favouring the development of a posterior crossbite.[79] It may be justified to say that adenotonsillar hypertrophy has a time-dependent relationship with the occurrence of transverse discrepancies as the findings of the present study showed likelihood of having a posterior crossbite increased with age with most of the participants with a posterior crossbite were aged between 9-12 years. In the present study, most of the participants with a posterior crossbite had grade 3 or 4 tonsillar hypertrophy and Spearman's correlation test between the posterior cross bite and tonsillar hypertrophy grade showed a statistically significant but weak correlation ($r_s = 0.234$, $p=0.003$) meaning the higher the tonsillar grade, the higher the odds of a posterior cross bite.

A high correlation has been reported between the need for orthodontic treatment and the severity of malocclusion in clinical evaluations.[15] There are no studies that have assessed the concept of orthodontic treatment needs in children with adenotonsillar hypertrophy. In the general population, however, various authors have looked at orthodontic treatment needs amongst children of different ages utilizing the aesthetic component of the IOTN.[83-85] In the present study, the orthodontic treatment needs were assessed for only those children in permanent dentition and 53.3% of the children required moderate or borderline need for treatment and 20% had great need for treatment. These figures are higher than those of Tanzanian, Nigerian and Turkish children. [83-86] In the study carried out by Mugonzibwa amongst 9-18 year old children in Tanzania, about 11% of the participants were found to have great need for orthodontic treatment.[83] A similar pattern of results was observed amongst Turkish children aged 11-14 years and Nigerian children aged 12-18 where 4.8% and 7% of the were found to have great orthodontic treatment needs respectively.[85,86] A possible explanation for this could be that the malocclusion traits observed in children with adenotonsillar hypertrophy, in accordance with the aesthetic component of the IOTN could be more severe than those of children in the general population. A limitation, however, when comparing results of the present study with previous studies is the different age groups assessed in the various studies as well as the lack of published studies assessing orthodontic treatment needs in children with adenotonsillar hypertrophy.

5.2 Limitations

a) The study population was relatively small and only looked at participants aged 7-12 years hence the results may not be generalized to all children with adenotonsillar hypertrophy.
b) The study did not assess the degree of nasal obstruction, duration of obstruction and size of the airway in relation to the size of the adenotonsillar tissues as each of these could influence the degree to which the occlusion could be altered.
c) The study measured the outcome and exposure variables at the same time hence it was relatively difficult to establish a causal relationship.

5.3 Conclusion

This study showed the following:

a) The likelihood of increased overjet and posterior crossbite was more in participants aged 9-12 years.
b) There was a statistically significant positive correlation between the overjet measurements, occurrence of posterior crossbite and tonsillar hypertrophy grade.
c) Majority of the participants in permanent dentition had moderate to great Orthodontic Treatment Needs.

5.4 Recommendations

There is need to encourage dental evaluation for children aged 7-12 years with adenotonsillar hypertrophy as it makes it possible to better intercept or prevent developmental alterations when they are approached at the appropriate age before the growth spurt. Further research, with a case control design could add important information on the causal relationship between adenotonsillar hypertrophy and malocclusion traits

REFERENCES

1. Proffit WR, Fields HW, Sarver DM. The etiology of orthodontic problems. Contemporary Orthodontic. 3ed. St. Louis: Mosby. 2000:13-44.
2. Grimm S, Frazão P, Antunes JL, Castellanos RA, Narvai PC. Dental injury among Brazilian schoolchildren in the state of São Paulo. Dental traumatology. 2004 Jun;20(3):134-8.
3. Muasya MK, Opinya GN, Macigo FG. Malocclusion and orthodontic treatment need among 12-15-year-old children in Nairobi. East African Medical Journal. 2012;89(2):39-44.
4. Bresolin D, Shapiro PA, Shapiro GG, Chapko MK, Dassel S. Mouth breathing in allergic children: its relationship to dentofacial development. American Journal of Orthodontics. 1983 Apr 1;83(4):334-40.
5. Linder-Aronson S. Adenoids. Their effect on mode of breathing and nasal airflow and their relationship to characteristics of the facial skeleton and the dentition. A biometric, rhino-manometric and cephalometro-radiographic study on children with and without adenoids. Acta oto-laryngologica. Supplementum. 1970; 265:1-132.
6. McNamara Jr JA. Influence of respiratory pattern on craniofacial growth. The Angle Orthodontist. 1981 Oct;51(4):269-300.
7. Moss M. A theoretical analysis of the Functional matrix. Acta Biotheoretica. 1968;18(1-4):195-202.
8. Brodsky L, Moore L, Stanievich JF. A comparison of tonsillar size and oropharyngeal dimensions in children with obstructive adenotonsillar hypertrophy. International journal of pediatric otorhinolaryngology. 1987 Aug 1;13(2):149-56.
9. Kara CO, Ergin H, Koçak G, Kılıç İ, Yurdakul M. Prevalence of tonsillar hypertrophy and associated oropharyngeal symptoms in primary school children in Denizli, Turkey. International journal of pediatric otorhinolaryngology. 2002 Nov 11;66(2):175-9.
10. Chinawa JM, Akpeh JO, Chinawa AT. Clinical profile and pattern of adenoid hypertrophy among children attending a private hospital in Enugu, South East Nigeria. Pan African Medical Journal. 2015;21(1).
11. Lee SY, Guilleminault C, Chiu HY, Sullivan SS. Mouth breathing,"nasal disuse," and pediatric sleep-disordered breathing. Sleep and Breathing. 2015 Dec;19(4):1257-64.
12. Zicari AM, Albani F, Ntrekou P, Rugiano A, Duse M, Mattei A, Marzo G. Oral breathing and dental malocclusions. Eur J Paediatr Dent. 2009 Jun 1;10(2):59-64.

13. McNamara Jr JA. Influence of respiratory pattern on craniofacial growth. The Angle Orthodontist. 1981 Oct;51(4):269-300.
14. Espeland LV, Stenvik A. Perception of personal dental appearance in young adults: relationship between occlusion, awareness, and satisfaction. American Journal of Orthodontics and Dentofacial Orthopedics. 1991 Sep 1;100(3):234-41.
15. Lewis EA, Albino JE, Cunat JJ, Tedesco LA. Reliability and validity of clinical assessments of malocclusion. American Journal of Orthodontics. 1982 Jun 1;81(6):473-7.
16. Hellings P, Jorissen M, Ceuppens J. The Waldeyer's ring. Acta Otorhinolaryngol Belg. 2000;54(3):237-241.
17. Chang SJ, Chae KY. Obstructive sleep apnea syndrome in children: Epidemiology, pathophysiology, diagnosis and sequelae. Korean journal of pediatrics. 2010 Oct;53(10):863.
18. Nave H, Gebert A, Pabst R. Morphology and immunology of the human palatine tonsil. Anatomy and embryology. 2001 Nov;204(5):367-73.
19. Brodsky L, Moore L, Stanievich JF. A comparison of tonsillar size and oropharyngeal dimensions in children with obstructive adenotonsillar hypertrophy. International journal of pediatric otorhinolaryngology. 1987 Aug 1;13(2):149-56.
20. Lu X, Zhang J, Xiao S. Correlation between Brodsky tonsil scale and tonsil volume in adult patients. BioMed Research International. 2018 Oct 24;2018. Figure 1, Brodsky grading scale for tonsils.
21. Fujioka M, Young LW, Girdany BR. Radiographic evaluation of adenoidal size in children: adenoidal-nasopharyngeal ratio. American Journal of Roentgenology. 1979 Sep 1;133(3):401-4.
22. Wang J, Zhao Y, Yang W, Shen T, Xue P, Yan X, Chen D, Qiao Y, Chen M, Ren R, Ren J. Correlations between obstructive sleep apnea and adenotonsillar hypertrophy in children of different weight status. Scientific Reports. 2019 Aug 7;9(1):1-7. Figure 1, Measurement of the adenoidal/nasopharyngeal (A/N) ratio on lateral cephalometric radiographs; p. 2.
23. Yuko EA. Intereukin 6 levels in adenotonsillar hyperplasia and chronic recurrent tonsillits (Masters dissertation, University of Nairobi, Kenya). 2012.
24. Serpero LD, Kheirandish-Gozal L, Dayyat E, Goldman JL, Kim J, Gozal D. A mixed cell culture model for assessment of proliferation in tonsillar tissues from children with

obstructive sleep apnea or recurrent tonsillitis. The Laryngoscope. 2009 May;119(5):1005-10.

25. Nikakhlagh S, Rahim F, Boostani H, Shirazi ST, Saki N. The effect of adenotonsillectomy on quality of life in adults and pediatric patients. Indian Journal of Otolaryngology and Head & Neck Surgery. 2012 Jun;64(2):181-3.
26. Demain JG, Goetz DW. Pediatric adenoidal hypertrophy and nasal airway obstruction: reduction with aqueous nasal beclomethasone. Pediatrics. 1995 Mar;95(3):355-64.
27. Sadeghi-Shabestari M, Moghaddam YJ, Ghaharri H. Is there any correlation between allergy and adenotonsillar tissue hypertrophy?. International journal of pediatric otorhinolaryngology. 2011 Apr 1;75(4):589-91.
28. Niu X, Wu ZH, Xiao XY, Chen X. The relationship between adenoid hypertrophy and gastroesophageal reflux disease: A meta-analysis. Medicine. 2018 Oct;97(41).
29. Chae SW, Choi G, Hwang KS, Lee DJ, Choi CS, Hwang SJ. The Incidence and Clinical Symptoms of Palatine Tonsillar Hypertrophy in Elementary School Children. Korean Journal of Otorhinolaryngology-Head and Neck Surgery. 2000 Dec 1;43(12):1342-5.
30. Kara CO, Ergin H, Koçak G, Kılıç İ, Yurdakul M. Prevalence of tonsillar hypertrophy and associated oropharyngeal symptoms in primary school children in Denizli, Turkey. International journal of pediatric otorhinolaryngology. 2002 Nov 11;66(2):175-9.
31. Eniolaa EJ, Bolaa AY, Clementx N. The prevalence of nasal diseases in Nigerian school children. J Med Sci. 2014 Apr;5(4):71-7.
32. Oburra HO, Idenya M. Frequency of adenotonsillectomy in some Nairobi hospitals. East African medical journal. 2001;78(7):338-42.
33. Marcus CL, Brooks LJ, Ward SD, Draper KA, Gozal D, Halbower AC, Jones J, Lehmann C, Schechter MS, Sheldon S, Shiffman RN. Diagnosis and management of childhood obstructive sleep apnea syndrome. Pediatrics. 2012 Sep 1;130(3):e714-55.
34. Hultcrantz E, Löfstrand-Tidestföm B, Ahlquist-Rastad J. The epidemiology of sleep related breathing disorder in children. International journal of pediatric otorhinolaryngology. 1995 Jun 1;32:S63-6.
35. Löfstrand-Tideström B, Hultcrantz E. Development of craniofacial and dental arch morphology in relation to sleep disordered breathing from 4 to 12 years. Effects of adenotonsillar surgery. International journal of pediatric otorhinolaryngology. 2010 Feb 1;74(2):137-43.
36. Ciprandi G, Varricchio A, Capasso M, Varricchio AM, De Lucia A, Ascione E, Avvisati F, Capristo C, Marseglia GL, Barillari U. Intranasal flunisolide treatment in

children with adenoidal hypertrophy. International journal of immunopathology and pharmacology. 2007 Oct;20(4):833-6.

37. Don DM, Goldstein NA, Crockett DM, Ward SD. Antimicrobial therapy for children with adenotonsillar hypertrophy and obstructive sleep apnea: a prospective randomized trial comparing azithromycin vs placebo. Otolaryngology-Head and Neck Surgery. 2005 Oct 1;133(4):562-8.
38. Houston WJ, Stephens CD, Tulley WJ, Foster ME. A textbook of orthodontics. Wright; 1992.
39. Moimaz SA, Garbin AJ, Lima AM, Lolli LF, Saliba O, Garbin CA. Longitudinal study of habits leading to malocclusion development in childhood. BMC oral health. 2014 Dec;14(1):1-6.
40. Brito DI, Dias PF, Gleiser R. Prevalence of malocclusion in children aged 9 to 12 years old in the city of nova friburgo, rio de Janeiro State, Brazil. Revista Dental Press de Ortodontia e Ortopedia Facial. 2009;14:118-24.
41. Dhar V, Jain A, Van Dyke TE, Kohli A. Prevalence of gingival diseases, malocclusion and fluorosis in school-going children of rural areas in Udaipur district. Journal of Indian Society of Pedodontics and Preventive Dentistry. 2007 Apr 1;25(2):103.
42. Rwakatema DS, Nganga PM. Prevalence of malocclusion among 12-15-year-olds in Moshi, Tanzania, using Bjork's criteria. East African Medical Journal. 2006;83(7).
43. Thilander B, Myrberg N. The prevalence of malocclusion in Swedish schoolchildren. European Journal of Oral Sciences. 1973 Feb;81(1):12-20.
44. Mugonzibwa EA, Eskeli R, Kuijpers-Jagtman AM, Laine-Alava MT, Van't Hof MA. Occlusal characteristics during different emergence stages of the permanent dentition in Tanzanian Bantu and Finnish children. The European Journal of Orthodontics. 2004 Jun 1;26(3):251-60.
45. Ng'ang'a PM, Ohito F, Øgaard B, Valderhaug J. The prevalence of malocclusion in 13- to 15-year-old children in Nairobi, Kenya. Acta Odontologica Scandinavica. 1996 Jan 1;54(2):126-30.
46. Harvold EP, Tomer BS, Vargervik K, Chierici G. Primate experiments on oral respiration. American journal of orthodontics. 1981 Apr 1;79(4):359-72.
47. Miller AJ, Vargervik K, Chierici G. Experimentally induced neuromuscular changes during and after nasal airway obstruction. American journal of orthodontics. 1984 May 1;85(5):385-92.

48. Galeotti A, Festa P, Viarani V, D'Anto V, Sitzia E, Piga S et al. Prevalence of malocclusion in children with obstructive sleep apnoea. Orthod Craniofac Res . 2018;21(4):242-247.
49. Kim DK, Rhee CS, Yun PY, Kim JW. Adenotonsillar hypertrophy as a risk factor of dentofacial abnormality in Korean children. European Archives of Oto-Rhino-Laryngology. 2015 Nov;272(11):3311-6.
50. Osiatuma VI, Otuyemi OD, Kolawole KA, Ogunbanjo BO, Amusa YB. Occlusal characteristics of children with hypertrophied adenoids in Nigeria. International Orthodontics. 2015 Mar 1;13(1):26-42.
51. Nunes WR, Di Francesco RC. Variation of patterns of malocclusion by site of pharyngeal obstruction in children. Archives of otolaryngology–head & neck surgery. 2010 Nov 15;136(11):1116-20.
52. Pirilä-Parkkinen K, Pirttiniemi P, Nieminen P, Tolonen U, Pelttari U, Löppönen H. Dental arch morphology in children with sleep-disordered breathing. The European Journal of Orthodontics. 2009 Apr 1;31(2):160-7.
53. Souki BQ, Pimenta GB, Souki MQ, Franco LP, Becker HM, Pinto JA. Prevalence of malocclusion among mouth breathing children: do expectations meet reality?. International journal of pediatric otorhinolaryngology. 2009 May 1;73(5):767-73.
54. Kanehira T, Takehara J, Takahashi D, Honda O, Morita M. Prevalence of oral malodor and the relationship with habitual mouth breathing in children. Journal of Clinical Pediatric Dentistry. 2004 Jul 1;28(4):285-8.
55. Adler P. The incidence of dental caries in adolescents with different occlusion. Journal of Dental Research. 1956 Jun;35(3):344-9.
56. Sá-Pinto AC, Rego TM, Marques LS, Martins CC, Ramos-Jorge ML, Ramos-Jorge J. Association between malocclusion and dental caries in adolescents: a systematic review and meta-analysis. European Archives of Paediatric Dentistry. 2018 Apr;19(2):73-82.
57. Nguyen QV, Bezemer PD, Habets LL, Prahl-Andersen B. A systematic review of the relationship between overjet size and traumatic dental injuries. European Journal of Orthodontics. 1999 Oct 1;21(5):503-15.
58. Muasya MK. Malocclusion and traumatic dental injuries in relation to over-jet and lip posture in 12-15 year old in Nairobi (Masters dissertation, University of Nairobi, Kenya). 2009.
59. Järvinen S. Incisal overjet and traumatic injuries to upper permanent incisors: A retrospective study. Acta Odontologica Scandinavica. 1978 Jan 1;36(5-6):359-62.

60. Shulman JD, Peterson J. The association between incisor trauma and occlusal characteristics in individuals 8–50 years of age. Dental traumatology. 2004 Apr;20(2):67-74.
61. Borzabadi-Farahani A. An insight into four orthodontic treatment need indices. Progress in orthodontics. 2011 Nov 1;12(2):132-42.
62. Hassan R, Rahimah AK. Occlusion, malocclusion and method of measurements-an overview. Archives of orofacial sciences. 2007;2:3-9.
63. Bezroukov V, Freer TJ, Helm S, Kalamkarov H, Infirri JS, Solow B. Basic method for recording occlusal traits. Bulletin of the World Health Organization. 1979;57(6):955.
64. Brook PH, Shaw WC. The development of an index of orthodontic treatment priority. The European Journal of Orthodontics. 1989 Aug 1;11(3):309-20.
65. Trottman A, Elsbach HG. Comparison of malocclusion in preschool black and white children. American Journal of Orthodontics and Dentofacial Orthopedics. 1996 Jul 1;110(1):69-72.
66. Khasim S, Abdullah AA, Wahab RM, Yahya NA. Assessment of orthodontic treatment needs using a modified aesthetic scale. Sains Malaysiana. 2013;42:759-64.
67. Franco Jr RA, Rosenfeld RM, Rao M. First Place—Resident Clinical Science Award 1999 Quality of life for children with obstructive sleep apnea. Otolaryngology-Head and Neck Surgery. 2000 Jul 1;123(1):9-16.
68. Chervin RD, Hedger K, Dillon JE, Pituch KJ. Pediatric sleep questionnaire (PSQ): validity and reliability of scales for sleep-disordered breathing, snoring, sleepiness, and behavioral problems. Sleep medicine. 2000 Feb 1;1(1):21-32.
69. İnönü-Sakallı N, Sakallı C, Tosun Ö, Akşit-Bıçak D. Comparative evaluation of the effects of adenotonsillar hypertrophy on oral health in children. BioMed Research International. 2021 Apr 2;2021:1-3.
70. Kenya MO. Kenya National Oral Health Survey Report 2015. Nairobi: 2015.
71. De Lira AD, de Moraes Izquierdo A, Prado S, Souza MM, Torres SR. Adenoid hypertrophy and open bite. Brazilian Journal of Oral Sciences. 2011;10(1):17-21.
72. Agarwal L, Tandon R, Kulshrestha R, Gupta A. Adenoid facies and its management: an orthodontic perspective. Indian J Orthodontics and Dentofacial Research. 2016 Apr;2(2):50-5.
73. Adegbiji WA, Aremu SK, Nwawolo CC, Asoegwu CN. Current trends of adenotonsillar hypertrophy presentation in a developing country, Nigeria. International Journal of Otorhinolaryngology and Head and Neck Surgery. 2017;3(3):501-5.

74. Ballikaya E, Dogan BG, Onay O, Tekcicek MU. Oral health status of children with mouth breathing due to adenotonsillar hypertrophy. International Journal of Pediatric Otorhinolaryngology. 2018 Oct 1;113:11-5.
75. Proffit W R 2006 The timing of early treatment: an overview . American Journal of Orthodontics and Dentofacial Orthopedics 120 : S47 – S49
76. Carvalho FR, Lentini-Oliveira DA, Carvalho GM, Prado LB, Prado GF, Carvalho LB. Sleep-disordered breathing and orthodontic variables in children—pilot study. International journal of pediatric otorhinolaryngology. 2014 Nov 1;78(11):1965-9.
77. Mossey PA. The heritability of malocclusion: part 2. The influence of genetics in malocclusion. British journal of orthodontics. 1999 Aug;26(3):195-203.
78. Lyle KC. Airway compromise and dentofacial abnormalities. Journal of General Orthodontics. 2000 Jan 1;11(4):9-18.
79. Behlfelt K, Linder-Aronson S, McWilliam J, Neander P, Laage-Hellman J. Dentition in children with enlarged tonsils compared to control children. The European Journal of Orthodontics. 1989 Nov 1;11(4):416-29.
80. Boudewyns AN, Van de Heyning PH. Obstructive sleep apnea syndrome in children: an overview. Acta oto-rhino-laryngologica Belgica. 1995 Jan 1;49(3):275-9.
81. Valera FC, Travitzki LV, Mattar SE, Matsumoto MA, Elias AM, Anselmo-Lima WT. Muscular, functional and orthodontic changes in pre school children with enlarged adenoids and tonsils. International journal of pediatric otorhinolaryngology. 2003 Jul 1;67(7):761-70.
82. Wanjau J, Sethusa MP. Etiology and pathogenesis of anterior open bite: a review. East African Medical Journal. 2010;87(11).
83. Mugonzibwa EA, Kuijpers-Jagtman AM, Van't Hof MA, Kikwilu EN. Perceptions of dental attractiveness and orthodontic treatment need among Tanzanian children. American Journal of Orthodontics and Dentofacial Orthopedics. 2004 Apr 1;125(4):426-34.
84. Rwakatema DS, Kemoli AM. Orthodontic treatment needs amont 12-15 year-olds in Moshi, Tanzania. East African medical journal. 2007;84(5):226-32.
85. Ucuncu N, Ertugay E. The use of the index of orthodontic treatment need (IOTN) in a school population and referred population. J Orthod 2001;28:45-52.
86. Otuyemi OD, Ugboko VI, Adekoya-Sofowora CA, Ndukwe KC. Unmet orthodontic treatment need in rural Nigerian adolescents. Community dentistry and oral epidemiology. 1997 Oct;25(5):363-6

APPENDICES

Appendix I: Data Collection Form (English)

Section 1: Sociodemographic Information

1. Location ( ) KNH ( ) Gertrude's Hospital ( ) Mbagathi Hospital
2. Sex ( ) Male ( ) Female
3. Date of birth

Day	Month	Year

Section 2: Medical History

1. Has your child had a dental visit before?
   ( ) Yes
   ( ) No
2. When sleeping, does your child snore more than half the time?
   ( ) Yes
   ( ) No
   ( ) I don't know
3. When sleeping does your child snore loudly?
   ( ) Yes
   ( ) No
   ( ) I don't know
4. Does your child tend to breathe through the mouth during the day?
   ( ) Yes
   ( ) No
   ( ) I don't know
5. Does your child have frequent colds or upper respiratory infections?
   ( ) Yes
   ( ) No
   ( ) I don't know
6. Tonsillar grade

   Grade 0 Grade 1 Grade 2 Grade 3 Grade 4

Section 3: Clinical Assessment

A: Dental Measurements

1. **Dentition**

   Mixed dentition ☐ Permanent dentition ☐

2. **Missing teeth** *(Tick where appropriate and indicate the tooth number)*

   Congenitally absent ☐

   Extraction ☐

   Trauma ☐

   None ☐

3. **Tooth malformation**

   (Tick where appropriate and indicate tooth number)

   Supernumerary ☐

   Anomaly in size ☐

   Ectopic eruption ☐

   None ☐

B: Intra-Arch Measurements

1. **Diastema**

Present ☐ Absent ☐ Unrecordable ☐

2. **Anterior arch crowding / spacing**

   Maxillary

   Crowding ☐ Spacing ☐ None ☐

   Mandibular

   Crowding ☐ Spacing ☐ None ☐

C: Inter-Arch Measurements

1. **Midline shift**

   Maxillary

   Right ☐…….mm Left ☐ ……mm None ☐

   Mandibular

   Right ☐…….mm Left ☐ ……mm None ☐

2. **Overjet (mm)**

Edge to edge <3mm ☐

>3mm to <6mm ☐

> 6mm ☐

3. **Mandibular overjet** *(more than 3 teeth in crossbite)*

Present ☐ Absent ☐ Unrecordable ☐

4. **Anterior crossbite** *(three or fewer teeth in crossbite)*

Present ☐ Absent ☐ Unrecordable ☐

5. **Overbite**

Edge to edge to < one thirds overlap ☐

One thirds to < two thirds overlap ☐

>Two thirds overlap ☐

Anterior open bite ☐

6. **Posterior crossbite**

L Present ☐ Absent ☐ Unrecordable ☐

R Present ☐ Absent ☐ Unrecordable ☐

7. **Scissorbite**

L Present ☐ Absent ☐ Unrecordable ☐

R Present ☐ Absent ☐ Unrecordable ☐

8. **Antero-posterior molar relationship**

R		**L**	
Class I	☐	Class I	☐
Class II	☐	Class II	☐
Class III	☐	Class III	☐
Cannot be assessed	☐	Cannot be assessed	☐

<u>Section 4: Orthodontic Treatment Need</u>

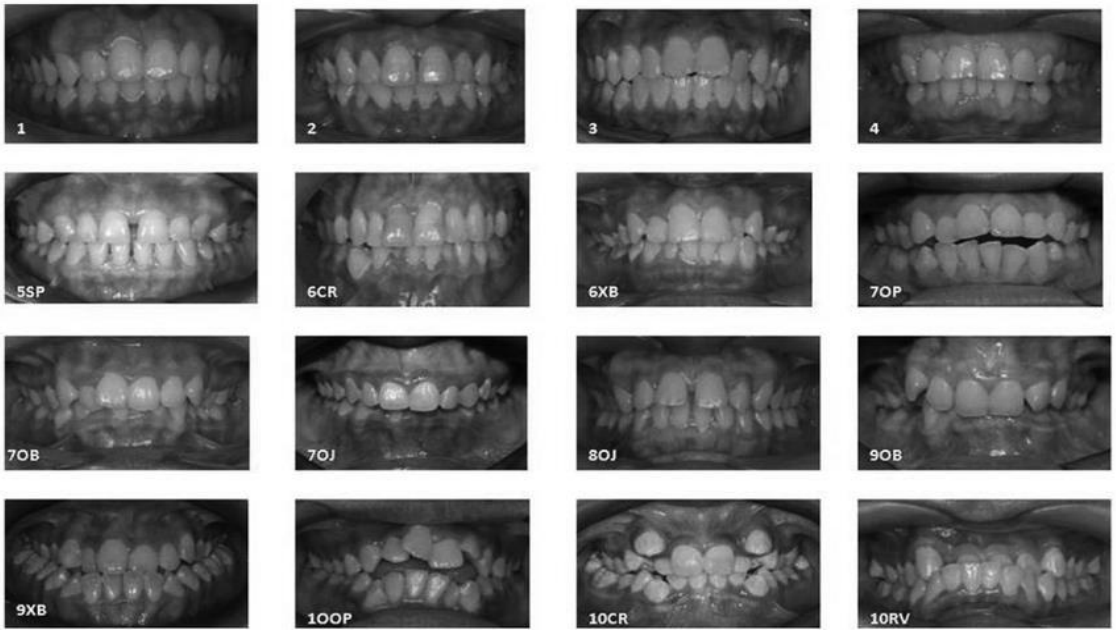
Modified Aesthetic component of the Index of Orthodontic Treatment Need (IOTN)

(Tick where appropriate for participants in permanent dentition)

( ) Grades 1 – 4 = No/slight need for treatment

( ) Grades 5 – 7 = Moderate/borderline need for treatment

( ) Grades 8– 10 = Great need for treatment



Appendix II: Data Collection Form (Kiswahili)

Fomu ya Kukusanya Data

Sehemu ya Kwanza: Demografia

1. Nambari ya usajili: [ ]
2. Jinsia: ( ) Mwanaume ( ) Kike
3. Tarehe ya Kuzaliwa: [ ]

Sehemu ya Pili: Historia ya Matibabu

1. Je, mtoto wako amewahi kumtembelea daktari wa meno?
   ( ) Ndio
   ( ) La
2. Wakati wa kulala, je, mtoto wako anakoroma zaidi ya nusu wakati?
   ( ) Ndio
   ( ) La
   ( ) Sijui
3. Wakati wa kulala,je, mtoto wako anakoroma kwa sauti kubwa?
   ( ) Ndio
   ( ) La
   ( ) Sijui
4. Je, mtoto wako huwa anapumua kwa mdomo?
   ( ) Ndio
   ( ) La
   ( ) Sijui
5. Je, mtoto wako hupata mafua ya mara kwa mara au maambukizi ya njia ya juu ya kupumua?
   ( ) Ndio
   ( ) La
   ( ) Sijui.
6. Tonsillar grade

   Gredi 0 Gredi 1 Gredi 2 Gredi 3 Gredi 4

Sehemu ya Tatu: Uchunguzi wa Meno

A. Dental Measurements

1. Dentition

Mixed dentition ☐ Permanent dentition ☐

2. Missing teeth *(Tick where appropriate and indicate the tooth number)*

Congenitally absent ☐

Extraction ☐

Trauma ☐

None ☐

3. Tooth malformation

(Tick where appropriate and indicate tooth number)

Supernumerary ☐

Anomaly in size ☐

Ectopic eruption ☐

None ☐

B: Intra-Arch Measurements

1. Diastema

Present ☐ Absent ☐ Unrecordable ☐

2. Anterior arch crowding / spacing

Maxillary

Crowding ☐ Spacing ☐ None ☐

Mandibular

Crowding ☐ Spacing ☐ None ☐

C: Inter-Arch Measurements

1. Midline shift

Maxillary

Right ☐…….mm Left ☐ ……mm None ☐

Mandibular

Right ☐…….mm Left ☐ ……mm None ☐

2. **Overjet (mm)**

Edge to edge <3mm ☐

>3mm to <6mm ☐

> 6mm ☐

3. **Mandibular overjet** *(more than 3 teeth in crossbite)*

Present ☐ Absent ☐ Unrecordable ☐

4. **Anterior crossbite** *(three or fewer teeth in crossbite)*

Present ☐ Absent ☐ Unrecordable ☐

5. **Overbite**

Edge to edge to < one thirds overlap ☐

One thirds to < two thirds overlap ☐

>Two thirds overlap ☐

Anterior open bite ☐

6. **Posterior crossbite**

L Present ☐ Absent ☐ Unrecordable ☐

R Present ☐ Absent ☐ Unrecordable ☐

7. **Scissorbite**

L Present ☐ Absent ☐ Unrecordable ☐

R Present ☐ Absent ☐ Unrecordable ☐

8. **Antero-posterior molar relationship**

R		**L**	
Class I	☐	Class I	☐
Class II	☐	Class II	☐
Class III	☐	Class III	☐
Cannot be assessed	☐	Cannot be assessed	☐

Sehemu ya Nne

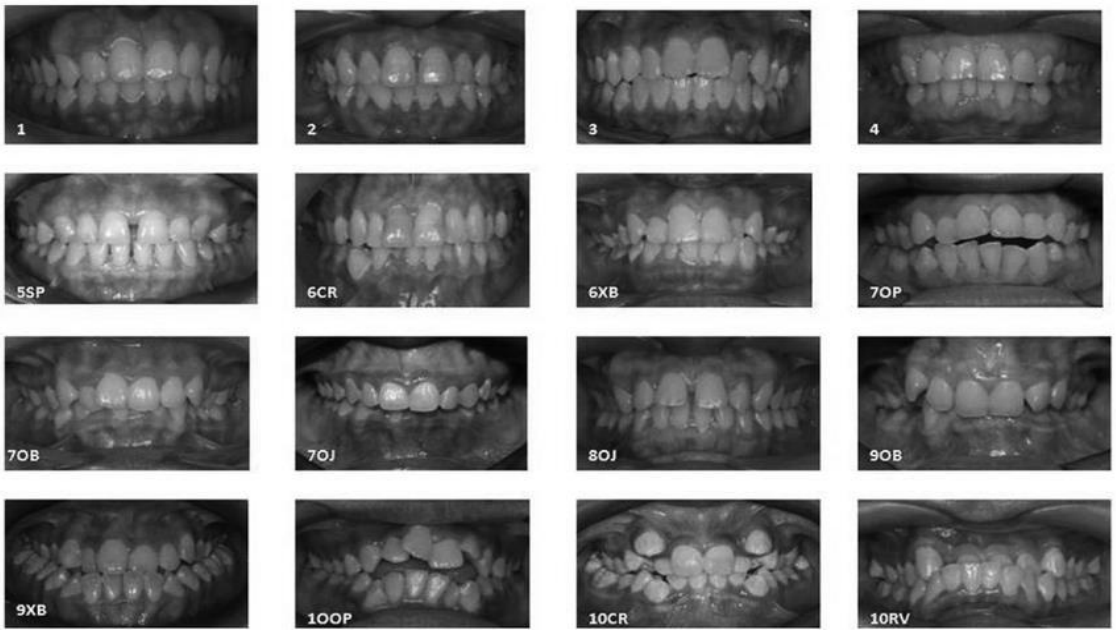
Modified Aesthetic component of the Index of Orthodontic Treatment Need (IOTN)

(Tick where appropriate)

( ) Grades 1 – 4 = No/slight need for treatment

( ) Grades 5 – 7 = Moderate/borderline need for treatment

( ) Grades 8– 10 = Great need for treatment



Appendix III: Consent Form (English)

Project Title: Malocclusion Traits and Orthodontic Treatment Needs in 7–12-Year-Old Children with Adenotonsillar Hypertrophy in Three Referral Hospitals

Dear Parent/Guardian of……..

I am Dr. Chege Jackline Wangari currently pursuing a Master's degree in Paediatric Dentistry at the University of Nairobi, Kenya.

Purpose of the Study: In partial fulfillment of my degree, I am working on a dissertation entitled: Malocclusion traits and Orthodontic treatment needs in 7–12-year-old children with adenotonsillar hypertrophy in Three Referral Hospitals. This study will provide baseline information on malocclusion traits present in children with adenotonsillar hypertrophy as well as their Orthodontic treatment needs.

Procedure: You (parent/guardian) will be interviewed on the date of birth of the child, sociodemographic information as well as the medical history of the child. Your child will then have a dental examination to assess the malocclusion traits and orthodontic treatment need. This will be carried out by myself. The dental examination will be carried out using sterile instruments and materials.

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

Benefits:

1. The parent/guardian will obtain free oral health education for the child, on the day of data collection.
2. The results of this study shall help enrich the available knowledge on the occlusal characteristics and pattern of malocclusion in children with adenotonsillar hypertrophy as well as treatment options.

Assent process: Your child will not be forced to participate in the study if they are unwilling or unable to.

Referral: Children with dental problems and in need of elective and emergency care will be referred to the University of Nairobi Dental School Hospital. The parents/guardian will however bear the cost of treatment.

Confidentiality: All the information that will be obtained about your child will be confidential to protect their privacy. This shall be done by giving codes to their questionnaire and examination form thereby avoiding using their name when gathering information. The information shall only be accessed by authorized professionals involved in the study but they

will not recognize your child's identity. There is no identity of any participant that shall be disclosed in any public conferences, reports or publications.

The right of withdrawal: You may withdraw your child from participating at any time without suffering any consequences.

This letter is to kindly request you to accept and allow your child to participate in the study. Read it and make sure you have understood it before signing if you agree to your child's participation in this study.

Participation

I…….parent/guardian of...…… do hereby freely consent/do not consent to my child participation in the said study.

Signature/Thumb Print: ..... Signature of investigator……

Date: ..... Date…….....

For further information or inquiries please contact:-

Dr. Chege Jackline Wangari
Tel: 0728084088
Email: wangarichege088@gmail.com

Lead supervisor:

Dr. Richard Owino
Lecturer, Department of Paediatric Dentistry and Orthodontics,
Tel: 0722 758247
Email: owinorichie@yahoo.com

The chairperson,
Kenyatta hospital/ University of Nairobi Ethics and Research Committee,
Email: uonknherc@uonbi.ac.ke
Tel: 00202 726300

Appendix IV: Consent Form (Kiswahili)

Fomu la kukubali: Maelezo ya kutafuta idhini kutoka kwa watoto watakaoshiriki katika utafiti.

Kichwa cha mradi: Sura ya Msongamano wa Meno na Haja ya Tiba Katika Watoto wa Miaka 7-12 Wenye Hypertrophy ya Adenotonsillar Katika Hospitali Tatu za Rufaa.

Kwa mlezi wa …….

Mimi, Daktari Chege Jackline Wangari, mwanafunzi wa shahada ya uzamili wa masuala ya meno ya watoto katika chuo kikuu cha Nairobi.

Sababu kuu ya utafiti: Katika hali ya kutaka kutimiza mahitaji ya shahada yangu, ninafanya kazi katika tasnifu inayohusu: sura ya msongamano wa meno kwa watoto wa miaka 7-12 wenye hypertrophy ya adeno-tonsillar katika hospitali tatu za rufaa.

Utafiti huu utaweza kutoa msingi wa habari kuhusu msongamano wa meno kwa watoto wa miaka 3-12 wenye hypertrophy ya adeno-tonsillar.

Utaratibu: Mzazi / mlezi atahojiwa juu ya tarehe ya kuzaliwa kwa mtoto. Mtoto wako atafuatiwa uchunguzi wa meno kutathmini sifa za msongamano wa meno. Hii itafanywa na mimi mwenyewe. Hakuna matibabu yatakayopewa watoto japo wale ambao watapatikana na matatizo yatakayohitaji usaidizi wa dharura wataweza kuelekezwa katika hospitali ya kaunti.

Hatari: Hakuna hatari katika utafiti huu kwa sababu utaratibu wa upasuaji hautafanywa kwa mtoto wako.

Manufaa: Matokeo ya utafiti huu yatasaidia katika kukuhamasisha wewe na wakenya wengine kuhusu hali ya msongamano wa meno kwa watoto wa miaka 7-12 wenye hypertrophy ya adeno-tonsillar. Licha ya hayo matokeo haya yatasaidia katika kutoa ushauri kwa wapangaji husika wa shughuli za matibabu katika matibabu yanayofaa kwa watoto hawa

Siri: Habari yote itakayochukuliwa kutoka kwa mtoto wako itakuwa siri ili kukinga hali yao yasiri. Hii itawezekana kwa kutoa nambari maalumu katika rekodi zao za matibabu na vijikaratasi vya maswali hivyo basi kuepuka kutumia majina yao habari inapokusanywa kutoka kwao. Habari itakaguliwa na wataalamu waliohusika katika uchunguzi na wale ambao wameruhusiwa kufanya hivyo lakini hawawezi kutambua jina la mtoto au kijana. Hakuna kitambulisho cha mshiriki yeyote ambacho kitatolewa katika mikutano ya umma, ripoti au chapa.

Hifadhi ya nakala ya habari utakayotoa: Habari yote itakayokusanywa kutoka kwa mtoto wako zitahifadhiwa kwa siri na kutumiwa katika utafiti huu. Majina ya watoto binafsi watakaoshiriki hayataandikwa mahali popote. Nakala zote za habari kuhusu mtoto wako zitafungiwa katika makabati maalum wakati wote wa utafiti huu. Tutasistiza usiri huu katika kusimamia habari tutakazopewa ili kuzuia kujulikana kwa watakaoshiriki katika utafiti huu. Hakuna majina yatakayotumika katika vikao vya sayansi ama ripoti zitakazochapishwa katika majarida haya.

Nafasi ya kujiondoa: unaweza ondoa mtoto kutoka utafiti bila vikwazo zozote.

Idhini yako na sahihi: Nimesoma maelezo yaliyomo hapo juu na nimekubali kwa hiari yangu kuwa mtoto wangu ashiriki katika utafiti huu;

Mimi ……. mzazi wa ……..nakubali / nakosa kukubali mtoto wangu kuhusishwa katika huu utafiti.

Sahihi/Alama ya kidole: ..... Sahihi ya mtafiti……..

Tarehe: ..... Tarehe……...

Kwa maswali zaidi tafadhali wasiliana na: -

Dkt. Chege Jackline Wangari

Namba ya simu: 0728084088

wangarichege088@gmail.com

Msimamizi mkuu:

Dkt. Richard Owino

Nambari ya simu: 0722 758247

owinorichie@yahoo.com

Mwenyekiti, Kenyatta Hospital/University of Nairobi Ethics and Research Committee

uonknh_erc@uonbi.ac.ke

Namba ya simu: 00202 726300-9

Appendix V: Assent Form (English)

Project Title: Malocclusion Traits and Orthodontic Treatment Needs in 7–12-year-old Children with Adenotonsillar Hypertrophy in Three Referral Hospitals.

Investigator(s): Dr. Jackline Wangari Chege.

We are doing a research study about how your teeth are arranged in your mouth and if you need any dental treatment to align them. This research study is a way to learn more about people. At least 150 children will be participating in this research study with you. If you decide that you want to be part of this study, you will be asked to let the examiner look at your teeth to see how they are aligned and if you need any treatment. The examiner will show you all the instruments to be used and there will be no pain at all.

There are some things about this study you should know. Not everyone who takes part in this study will benefit. A benefit means that something good happens to you. We think these benefits might be helping us know what to expect when children like you come to the dentist with teeth that are not aligned properly.

When we are done with this study we will write a report about what was learned. This report will not include your name or that you were in the study. You do not have to be in this study if you do not want to be. If you decide to stop after we begin, that's okay too. Your parents know about the study too. If you decide you want to be in this study, please sign your name. I, _____, want to be in this research study. _____ (Signature/Thumb stamp) _____ (Date)

Appendix VI: Assent Form (Kiswahili)

Kichwa Cha Mradi: Sura Ya Msongamano Wa Meno Na Haja Ya Tiba Katika Watoto Wa Miaka 7-12 Wenye Hypertrophy Ya Adenotonsillar Jijini Nairobi, Kenya.

Mtafiti: Dkt. Jackline Wangari Chege

Tunafanya utafiti kuhusu jinsi meno yako yamepangwa mdomoni mwako na ikiwa unahitaji matibabu yoyote ya meno ili kuyapanga vizuri. Utafiti huu ni njia ya kujifunza zaidi kuhusu watu. Angalau watoto 150 watashiriki nawe katika utafiti huu. Ukiamua kuwa ungependa kuwa sehemu ya utafiti huu, utaombwa kuruhusu mkaguzi aangalie meno yako ili kuona jinsi yalivyo na ikiwa unahitaji matibabu yoyote. Mkaguzi atakuonyesha vyombo vyote vya kutumika na hakutakuwa na maumivu hata kidogo.

Kuna baadhi ya mambo kuhusu utafiti huu unapaswa kujua. Sio kila mtu atakayeshiriki katika utafiti huu atafaidika. Faida inamaanisha kuwa kitu kizuri kinatokea kwako. Tunafikiri manufaa haya yanaweza kuwa yanatusaidia kujua nini cha kutarajia wakati watoto kama wewe wanakuja kwa daktari wa meno wakiwa na meno ambayo hayajapangiliwa ipasavyo.

Tukimaliza utafiti huu, tutaandika ripoti kuhusu yale tuliyojifunza. Ripoti hii haitajumuisha jina lako au kwamba ulikuwa kwenye utafiti. Si lazima uwe katika utafiti huu ikiwa hutaki kuwa. Ukiamua kuacha baada ya sisi kuanza, hiyo ni sawa pia. Wazazi wako wanajua kuhusu utafiti pia.

Ukiamua ungependa kuwa katika utafiti huu, tafadhali saini jina lako. Mimi, _____, nataka kuwa katika utafiti huu. _____ (Sahihi/Muhuri wa kidole) _____ (Tarehe)

Appendix VII: Kenyatta National Hospital and UoN Ethical and Research Committee Approval.

UNIVERSITY OF NAIROBI
FACULTY OF HEALTH SCIENCES
P O BOX 19676 Code 00202
Telegrams: varsity
Tel:(254-020) 2726300 Ext 44355

KNH-UON ERC
Email: uonknh_erc@uonbi.ac.ke
Website: http://www.erc.uonbi.ac.ke
Facebook: https://www.facebook.com/uonknh.erc
Twitter: @UONKNH_ERC https://twitter.com/UONKNH_ERC

KENYATTA NATIONAL HOSPITAL
P O BOX 20723 Code 00202
Tel: 726300-9
Fax: 725272
Telegrams: MEDSUP, Nairobi

Ref: KNH-ERC/A/126

29th March, 2022

Dr. Jackline Wangari Chege
Reg. No.V60/36700/2020
Dept. of Dental Sciences
Faculty of Health Sciences
University of Nairobi

29 MAR 2022

Dear Dr. Chege,

RESEARCH PROPOSAL: MALOCCLUSION TRAITS AND ORTHODONTIC TREATMENT NEEDS IN 7-12 YEAR OLD CHILDREN WITH ADENOTONSILLAR HYPERTROPHY IN NAIROBI, KENYA (P979/12/2021

This is to inform you that KNH-UoN ERC has reviewed and approved your above research proposal. Your application approval number is **P979/12/2021.** The approval period is 29th March 2022 – 28th March 2023.

This approval is subject to compliance with the following requirements;

i. Only approved documents including (informed consents, study instruments, MTA) will be used.
ii. All changes including (amendments, deviations, and violations) are submitted for review and approval by KNH-UoN ERC.
iii. Death and life threatening problems and serious adverse events or unexpected adverse events whether related or unrelated to the study must be reported to KNH-UoN ERC 72 hours of notification.
iv. Any changes, anticipated or otherwise that may increase the risks or affected safety or welfare of study participants and others or affect the integrity of the research must be reported to KNH-UoN ERC within 72 hours.
v. Clearance for export of biological specimens must be obtained from relevant institutions.
vi. Submission of a request for renewal of approval at least 60 days prior to expiry of the approval period. Attach a comprehensive progress report to support the renewal.
vii. Submission of an executive summary report within 90 days upon completion of the study to KNH-UoN ERC.

Appendix VIII: National Commission For Science, Technology & Innovation (NACOSTI) Permit

REPUBLIC OF KENYA

NATIONAL COMMISSION FOR SCIENCE,TECHNOLOGY & INNOVATION

Ref No: **396796**

Date of Issue: **22/April/2022**

RESEARCH LICENSE

This is to Certify that Dr.. JACKLINE WANGARI CHEGE of University of Nairobi, has been licensed to conduct research in Nairobi on the topic: MALOCCLUSION TRAITS AND ORTHODONTIC TREATMENT NEEDS IN 7-12 YEAR-OLD CHILDREN WITH ADENOTONSILLAR HYPERTROPHY IN NAIROBI, KENYA for the period ending : 22/April/2023.

License No: **NACOSTI/P/22/16984**

396796

Applicant Identification Number

Director General
NATIONAL COMMISSION FOR SCIENCE,TECHNOLOGY & INNOVATION

Verification QR Code

NOTE: This is a computer generated License. To verify the authenticity of this document, Scan the QR Code using QR scanner application.