MALOCCLUSION AND ORTHODONTIC TREATMENT NEED AMONG 12–15-YEAR-OLD TANZANIAN SCHOOLCHILDREN USING THE DENTAL AESTHETIC INDEX

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By

Makala Yesaya, DDS

A Dissertation Submitted in Partial Fulfilment of the Requirement for the Degree of Master of Dentistry in Orthodontics at

Muhimbili University of Health and Allied Sciences

October 2024

CERTIFICATION

The undersigned certify that they have read and hereby recommend for acceptance by the Muhimbili University of Health and Allied Sciences a dissertation entitled **"Malocclusion and orthodontic treatment need among 12–15-year-old Tanzanian schoolchildren using the Dental Aesthetic Index''** in (partial) fulfilment of the requirements for the degree of Master of Dentistry (Orthodontics) of Muhimbili University of Health and Allied Sciences.

_____

Dr. Matilda Mtaya Mlangwa

(Supervisor)

Date: _____

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Date: _____

DECLARATION AND COPYRIGHT

I, Makala Yesaya, declare that this dissertation is my original work and that it has not been presented and will not be presented to any other University for a similar or any other degree award.

Signature…… Date…….

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DEDICATION

This work is dedicated

to my dear friend and wife Luciana Albert

and our beloved sons and daughter Bricius, David, and Elyana, respectively

ABSTRACT

Background: Prevalence of malocclusion in children and adolescents varies significantly in different geographical regions ranging from 39% to 93%, and its severity ranges from what is considered as a normal deviation to severe malocclusion or handicapping malocclusion. Normally, deciding if one should undergo orthodontic treatment or not, greatly depends on the severity of the malocclusion. Recently, dental appearance has been something of a great concern among members of the community. Perceived orthodontic treatment need differ correspondingly with social, cultural as well as geographical locations. It was therefore important to highlight the extent of malocclusion, the orthodontic treatment need and its related factors, in a Tanzanian community.

Objective: To assess the prevalence of malocclusion and orthodontic treatment need among 12–15-year-old Tanzanian schoolchildren using the Dental Aesthetic Index (DAI).

Material and Methods: This was a school-based cross-sectional analytical study which involved 12-15-year-old schoolchildren from Kinondoni District. Participants were obtained through a multistage random sampling method. Data collection was done by using a questionnaire, and a clinical examination was performed utilizing the Dental Aesthetic Index (DAI). Data was processed by using SPSS software, version 29.0. A comparison of proportions was done through a Chi-square test, whereas, the Modified Poisson Regression under Stata MP-17.0 was used to confirm the bivariate associations. The level of statistical significance was set at $p<0.05$, with 95% confidence interval.

Results: A total of 483 12-15-year-old schoolchildren in Kinondoni Municipal-Dar es Salaam were enrolled, majority (43.3%) being 12-year-olds. The distribution of the participants by sex and residence, showed a slight predominance of girls and those from Northern wards of the Kinondoni Municipal (56.9% and 54.7%, respectively). The overall prevalence of malocclusion in schoolchildren was 55.9%. The most common malocclusion trait was crowding, and majority had normal molar relationship (39% and 85%) respectively. Also, a number of participants (52%) showed a subjective orthodontic treatment need. Schoolchildren who perceived to have malocclusion and those who had normative malocclusion, were more likely to demonstrate orthodontic treatment need than

their counterparts (aOR 1.736, CI 1.509-1.998; *p<0.001* and (aOR 1.252, CI 1.051-1.492; *p=0.012,* respectively)**.** Furthermore, class seven pupils were less likely to express need for orthodontic treatment as compared to those in class six (aOR 0.712, CI 0.567-0.892; *p =0.003*).

Conclusion: Majority of the schoolchildren (55.9%) had malocclusion with the severity ranging from definite to handicapping malocclusion, as per the DAI scores and orthodontic treatment needs ranged from elective to mandatory. The perceived orthodontic treatment needs were more likely to be influenced by the perceived malocclusion and presence of normative malocclusion. Also, most children belonging to a younger age group were found with subjective orthodontic treatment need, with majority of them belonging to class six.

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ABBREVIATIONS

AC	Aesthetic Component
CRAC	Child-Related Aesthetic Component
DAI	Dental Aesthetic Index
DHC	Dental Health Component
ERAC	Examiner Related Aesthetic Component
IOTN	Index of Orthodontic Treatment Need
MPEO	Municipal Primary Education Officer
MUHAS	Muhimbili University of Health and Allied Science
SDC	Sociodemographic Characteristics
SES	Social Economic Status
SPSS	Statistical Package for Social Sciences
WHO	World Health Organization

DEFINITION OF TERMS

Malocclusion: This is the term used to describe dental irregularities and occlusal traits that represent an aberration from the ideal occlusion (1).

Normative need is a need that is defined according to a norm or set of standards and is an objective need defined by experts (2)**.**

Orthodontics: This is the subdivision of dentistry that deals with the diagnosis, prevention, interception, and treatment of occlusal anomalies (1).

Subjective need/felt need is an experienced or perceived need that is defined by the client, this kind of need is not necessarily expressed by the client (2).

CHAPTER ONE

1 INTRODUCTION

1.1 Background

Malocclusion is an anomaly of the teeth or a mal-relationship of the dental arches that describes dental irregularities and occlusal traits with an aberration from the ideal occlusion (1), and its occurrence varies significantly in different geographical regions, ranging from 39% to 93% in children and adolescents (3,4). Malocclusion can occur as a result of genetic or environmental factors. It is usually associated with psycho-social problems, impaired oral functions, increased susceptibility to trauma and predisposition to dental diseases, mainly dental caries and periodontal diseases (5). However, the effects of malocclusion differ from one individual to another, bringing disparities in objective and subjective assessment results. Although malocclusion may not have a direct threat to one's life, it is capable of imparting severe negative psychosocial and functional limitations to individuals (6). Malocclusion severity ranges from what is considered as a normal deviation to severe malocclusion, this may determine whether or not someone will undergo orthodontic treatment (7).

Dental appearance has recently received increased concerns. In a study which was done in 2022, it was stated that people believed that well-aligned teeth bring about a more appealing facial appearance (8). Additionally, previous studies have shown an association between good dental appearance and high SES, with more concerns about dental appearance being expressed among children from high SES group (9).

Geographical location has also been considered as a determinant of the treatment need. Whereby, more children in urban areas were considered by their parents and peers to need treatment than children in rural areas (5). An individual with good dental appearance is further considered to be more prestigious in terms of his/her social position and occupation. Thus, high socio-economic status also seems to determine one’s orthodontic treatment need (5). The higher the aspiration of a child, the more likely the parents will seek orthodontic treatment for him or her (5).

Nevertheless, what is considered as normal to the orthodontist, may not necessarily be considered so by the general public, and vice versa. In earlier studies, there was a substantial difference between the patients' perception of their dental appearance and their orthodontic treatment needs, and how the clinician perceived them (10). Most people with normative occlusal irregularities do not perceive them as problems, unless they interfere with function, cause pain, affect self-esteem or appearance (11). Principally, the majority of patients tend to seek orthodontic treatment primarily due to aesthetic concerns (12), with anterior teeth malalignment being their most common complaints (13). Notably, orthodontic treatment may bring about positive effects, with respect to achieving good appearances and improving self-esteem (12). Furthermore, a patient's perception of oneself usually plays a great role in determining orthodontic treatment demand, compared to the need which is determined by the clinician. Importantly, it is how much of the functions and aesthetics are affected (14). Despite these facts, in Tanzanian settings, there are few or no retrievable studies which made such observations and comparisons.

Accordingly, in order to objectively determine occlusal irregularities that warrant orthodontic treatment; a number of indices have been developed. In this study, the Dental Aesthetic Index (DAI) was chosen instead of other indices because it is a measurable index which is simple to use, reliable, valid, objective, universally accepted and it does not need to be adapted or modified to different cultural and ethnic settings (15). The DAI is also recommended by the World Health Organization (WHO) for evaluating dentofacial abnormalities in people with permanent dentition (16). In addition, DAI is an orthodontic index that links clinical and aesthetic components mathematically to produce a single score. So, it is an epidemiological index used to identify orthodontic treatment needs, and used as a screening tool to determine treatment priority in resource-constrained countries (7,17,18).

Prior to this study, it was not known whether the proportion of people with malocclusion has increased or not, in the country. Recently, a high influx of clients demanding orthodontic treatment has been observed in the dental clinics in Tanzania. Due to the variation in the prevalence of malocclusion reported in earlier studies, and owing to an anticipated increase in the expressed need for orthodontic treatment, it was necessary to conduct this study in order to avail data on children's orthodontic treatment needs. This

can be used to plan an oral health related treatment, in Kinondoni District. Clearly, the studies on how children view their dental mal-alignment and their need for orthodontic treatment in Tanzania are few.

It is important to further note that, orthodontic treatment is not always covered by health insurance companies, leaving socioeconomically underprivileged persons unable to have the health benefits (19). Mostly, health insurances largely reduce the direct cost implications to the parents/guardians. Nonetheless, there were no retrievable studies that have reported about the health insurance effect, on the demand for orthodontic treatment in Tanzanian settings. To address these matters and appropriately plan orthodontic services, the present study was conducted. It thus aimed to assess malocclusion and orthodontic treatment need among 12-15-year-old Tanzanian schoolchildren using the Dental Aesthetic Index.

1.2 Problem Statement

From a global view, a great variation has been noted in the magnitude and severity of malocclusion over the years. The way people react to teeth malalignment differs greatly (11,20). Significant differences also exist between patients' perception of malocclusion and the related treatment need, and that of a clinician's (10). However, the severity of malocclusion is one of the significant factors in determining the orthodontic treatment needs of patients/clients (14). Furthermore, there are other factors like socioeconomic and sociodemographic factors, that have been shown to have a great influence on orthodontic treatment needs (12,19). The few earlier Tanzanian studies did not specifically assess the association of the perceived malocclusion, malocclusion severity, perceived orthodontic treatment need and their associated factors. Thus, there were no retrievable studies from the existing Tanzanian data on such matter.

1.3 Conceptual Framework

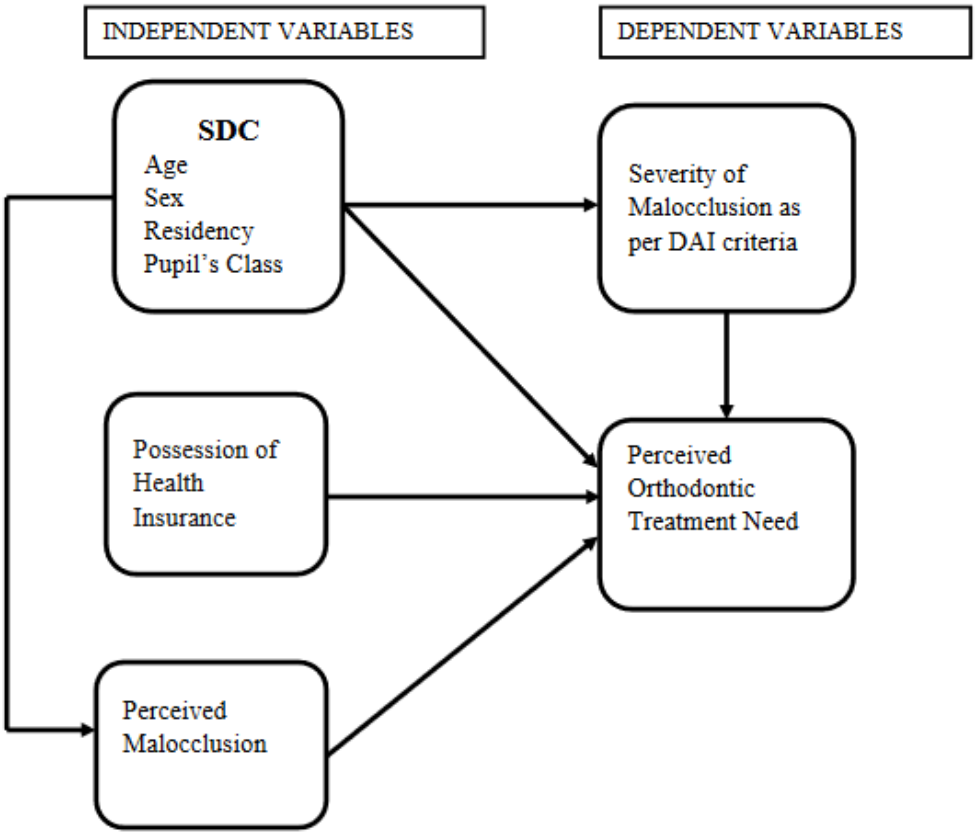


Figure 1: Theoretical illustration of the relationship between orthodontic treatment need and associated factors. Source: Yesaya, 2024.

Description:

From the illustration (Figure 1), one side consists of factors that are thought to be important in determining the normative treatment need or in influencing the severity of malocclusion. Also, they are important determinants of the perception of orthodontic treatment need (perceived/subjective treatment need). In addition, the severity of malocclusion directly determines orthodontic treatment need of a person. In the diagram, malocclusion severity level may also influence subjective or perceived orthodontic treatment need of an individual. The more severe the malocclusion is, the more negative impacts it poses to that particular person in terms of aesthetics, psychosocial, and function, and therefore, the greater the subjective orthodontic treatment.

On the other hand, age of the child, sex and socio-economics as well as socio-demographics, are considered as important associated factors. This in turn tend to influence self-perception of malocclusion, and therefore, the subjective need for orthodontic treatment. In addition, people with the health insurance coverages compared to those without, incline towards having concerns about their general and oral health. Likewise, most of those who perceive their occlusal status as unsatisfactory, are likely to express their subjective need for orthodontic treatment than their counterparts.

1.4 The Rationale of the Study

Most people have acceptable occlusion, despite having some occlusal deviations. Therefore, they may not need treatment. Treating mild cases without indication, can be a waste of one's and the public's resources. Data on the magnitude of malocclusion, severity, and orthodontic treatment need, have provided some information which will help dental practitioners and other stakeholders in making rational treatment decisions. Data obtained from this research can be utilized by the Kinondoni Municipality, in planning oral health services, including orthodontic interventions.

This also serves as a partial fulfilment of the researcher's Master degree, MDent-Orthodontics, of MUHAS.

1.5 Research Questions

1.5.1 General Research Question

What is the prevalence of malocclusion and orthodontic treatment need among 12–15-year-old schoolchildren in Kinondoni District, using the Dental Aesthetic Index?

1.5.2 Specific Research Question

(i) What is the prevalence of malocclusion among schoolchildren in Kinondoni District, as per the DAI criteria?

(ii) What is the magnitude of the perceived malocclusion among schoolchildren in the Kinondoni District?

(iii) What is the magnitude of perceived orthodontic treatment need among schoolchildren in the Kinondoni District?

(iv) What is the relationship between perceived orthodontic treatment need and associated factors?

1.6 Objectives

1.6.1 Broad Objective

To assess the prevalence of malocclusion and orthodontic treatment need among 12–15-year-old schoolchildren in Kinondoni District, using the Dental Aesthetic Index.

1.6.2 Specific Objective

(i) To determine the proportion of schoolchildren in Kinondoni District with malocclusion, by using the DAI criteria.

(ii) To determine the magnitude of perceived malocclusion among schoolchildren in the Kinondoni District, by using the IOTN-AC.

(iii) To determine the magnitude of perceived orthodontic treatment need among schoolchildren in the Kinondoni District.

(iv) To assess the relationship between perceived orthodontic treatment need and the associated factors.

CHAPTER TWO

2 LITERATURE REVIEW

Proportion of malocclusion among children

Globally, malocclusion is considered as one of the most important oral health problems, following dental caries and periodontal diseases (21). Irrespective of gender, the universal prevalence of malocclusion among children and adolescents is estimated to be over fifty percent (22). However, this varies significantly in different geographical regions, ranging from 39% to 93% in children and adolescents (3,4). In the year 2020, a systematic review and meta-analysis study in China among other observed findings, results showed that 47.92% of Chinese schoolchildren presented with one or several types of anomalies (23).

In the studies that have been done in the African continent, a high prevalence of malocclusion (above 75%) was reported (24). In Kenya, a study which involved 12 to 15 year-old children, had a high proportion of children with malocclusion, whereby, 11.3% of the participants exhibited handicapping malocclusion (25). In Tanzania, in the few studies that were done between 2009 to 2018, a wide range of malocclusion ranging from 32.5 % to 94.4%, was shown (3,26,27).

For specific malocclusion traits, a high proportion of Class I molar relationship has been reported in several studies. In a study which was done among adolescents in Northeast Italy, Angel's Class I molar relationship, had the highest proportion (75.5%) (28). In Africa, most of the studied participants had Class I, followed by Class II, and then Class III malocclusion, in the permanent dentition (24,29).

In the assessments which were conducted in Dar es Salaam involving Tanzanian children, in the years 2009 and 2017, a high prevalence of Class I malocclusion compared to those of Class II and Class III malocclusion was shown (3,26). Additionally, another study was conducted in Kilimanjaro region, Class I malocclusion was also the most prevalent trait (30).

In Nigeria, one study showed a high proportion of individuals with an increased overjet and spacing, whereas, anterior open bite was the least reported malocclusion (29). A recent study in Egypt, reported deep bite to be the leading trait tailed by increased overjet, while open bite had a lesser proportion (31). In a Tanzanian study by Mtaya *et al.,* it was revealed that, apart from Angle's malocclusion, the most frequently recorded anomalies in their participants were spacing of at least 2 mm (19.8%) and open bite (18.6%) (26). The other Tanzanian study was done among a group of primary schoolchildren from Kilimanjaro, crowding was found to be the most common dental disorder (32).

Perceived malocclusion

Perceived malocclusion varies among different populations, as a result of different factors (33,34). A similar pattern was seen in studies which were conducted in Nigeria, South Africa and England. In which, less than thirty percent of the children and adolescents, rated themselves as having moderate to severe malocclusion (35–39). On the contrary, nearly three-quarters of the Brazilian schoolchildren were unhappy with the appearance of their front teeth, mainly due to the alignment of their teeth (40).

In Tanzania, Mugonzibwa *et al.* reported about the perception of dental attractiveness and orthodontic treatment needs among Tanzanian children. In their study, they reported that, just above 30% of the children were unhappy with the arrangement and the appearance of their teeth (41). Similar results were seen in a later study by Rwakatema *et al.,* which showed that thirty percent of the respondents in their study, were dissatisfied with the way their teeth appeared (42). Correspondingly, in a most recent study by Protas *et al.,* about 70% of the secondary school children in Iringa, were satisfied with the arrangement of their teeth (43).

Perceived orthodontic treatment need

Literature have also shown that the subjective orthodontic treatment varied significantly. Whereby, some studies reported a greater proportion of the need for orthodontic treatment than others. The results which were reported in Netherlands and Poland, it was shown that nearly half of the population had moderate to severe need for orthodontic treatment (44,45). In a study from the United Kingdom, more than half of the girls (52%) perceived

the need for orthodontic treatment, while fewer boys (40%) perceived the need for orthodontic treatment (46).

In a Nigerian study, it was shown that 3.9% of the children perceived a definite need for orthodontic treatment, while the rest didn't perceive the need (35). In addition, a Namibian study reported subjective orthodontic treatment need was found in 17.7% of their participants (47). In South Africa, a study on the perceived and normative orthodontic treatment needs of a group of children aged 11-14 years, showed that about one third of the children reported a self-perceived need for orthodontic treatment (36). Moreover, in Kenya, 30% of the children aged 12-14 years reported a self-perceived need for orthodontic treatment (48). Similarly, in Tanzania, a study by Mugonzibwa *et al.* among 9-18 year-old children reported a 38% expressed perception of orthodontic treatment need (41) among their participants. Meanwhile, Rwakatema *et al.* reported a higher proportion (69.1%) of children with subjective need for orthodontic treatment (30). Generally, studies that have assessed the perception of the need for orthodontic treatment, as they relate to other factors, are scarce in Tanzania.

Relationship between perceived orthodontic treatment needs and associated factors

Perceived orthodontic treatment need has been shown to be influenced by a number of factors. These include, SDC, SES, perceived malocclusion and objective malocclusion. In a number of studies, gender has been shown to be significantly associated with the perceived orthodontic treatment need. In the United States, a study by Simon *et al.* showed that, being a female was the strongest predictor of utilizing an orthodontic service among adults and children (49). In Tanzania, a study which was done by Rwakatema *et al.,* reported no significant association between the desire for orthodontic treatment and gender (30).

As regards, age has also been associated with the subjective need for orthodontic treatment. Researchers like Yilmaz *et al.,* reported that most of their younger participants expressed subjective need for orthodontic treatment than the older ones (50). Conversely, Shaw *et al.* observed that many older study participants expressed subjective orthodontic treatment need, compared to the younger ones (51).

The objectively determined severity of malocclusion, which in turn determines the normative orthodontic treatment need according to the DAI criteria, may also influence subjective orthodontic treatment needs. Several studies have shown a strong significant association between perceived orthodontic treatment need among people with severe malocclusion (52). Also, another study concluded that perceived orthodontic treatment need was statistically significantly influenced by the DAI scores (53).

The assessment of orthodontic treatment needs in Namibian schoolchildren aged 12-15 years showed that, more than 80% of those who had orthodontic treatment needs as per Dental Health Component (DHC), they also had the perceived self-need according to the Child-Related Aesthetic Component (CRAC). On the other hand, about 90% of the children who objectively had no need for orthodontic treatment according to the Examiner Related Aesthetic Component (ERAC), were in agreement with the subjective assessment scores according to the CRAC (47).

In Tanzania, there was only one retrievable study which was done by Mugonzibwa *et al.,* which reported that Tanzanian children with higher objective need of treatment, also had a higher subjective need for treatment (41). Regarding the perception of malocclusion, Feldens *et al.* reported that majority of the adolescents who were dissatisfied with their dental appearance, also desired orthodontic treatment (52). However, the report that was provided by Schroeder *et al.,* concluded that, motivation to seek orthodontic treatment is not related to the perception of malocclusion severity (53).

Regarding the relationship between SES and perceived orthodontic treatment need, studies reported that significantly many of the subjects from high socioeconomic status group perceived that they do not need orthodontic treatment, as compared with their counterparts (54). Yet, other studies denied any association between SES and perceived orthodontic treatment needs (55). Contrariwise, the other study reported that subjects from low SES group have more subjective need for orthodontic treatment than their counterparts (56).

As regards the place of residence, this may also influence the perception of orthodontic treatment need of individuals. The variations may be attributed to the differences in their locations, which may also affect the availability and accessibility of orthodontic care,

awareness about orthodontic treatment and social classes. In a study by Kerosuo *et al.* in Kuwait, it was suggested that subjects from rural areas of Kuwait had lower perception of orthodontic treatment than those in the urban Kuwaiti areas. It was further observed that the urban communities had access to free orthodontic treatment, while this was not the case for rural communities (57). The availability of orthodontic treatment have also been associated with an increased orthodontic awareness, and therefore the uptake (58). Additionally, Burden *et al.* noted a statistically significant association between the perceived need for treatment and the participants' geographical location (59). Existing Tanzanian literature could not avail information about the relationship between perceived orthodontic treatment needs and associated factors.

CHAPTER THREE

3 MATERIAL AND METHODS

3.1 Study Design

A school-based analytical cross-sectional study assessing malocclusion and orthodontic treatment need among schoolchildren in selected public primary schools.

3.2 Study Area

The study was conducted in Kinondoni District of the Dar es Salaam region in Tanzania. Kinondoni has a population of 982,318 people (Census 2023) and it has a total of 82 public primary schools which are distributed in 20 wards. Seven public primary schools from randomly selected five wards, were finally sampled. Among these schools, four (4) were from northern wards, while three (3) were from southern wards.

Figure 2 shows the map of Dar es Salaam region, Kinondoni District and wards within Kinondoni District.

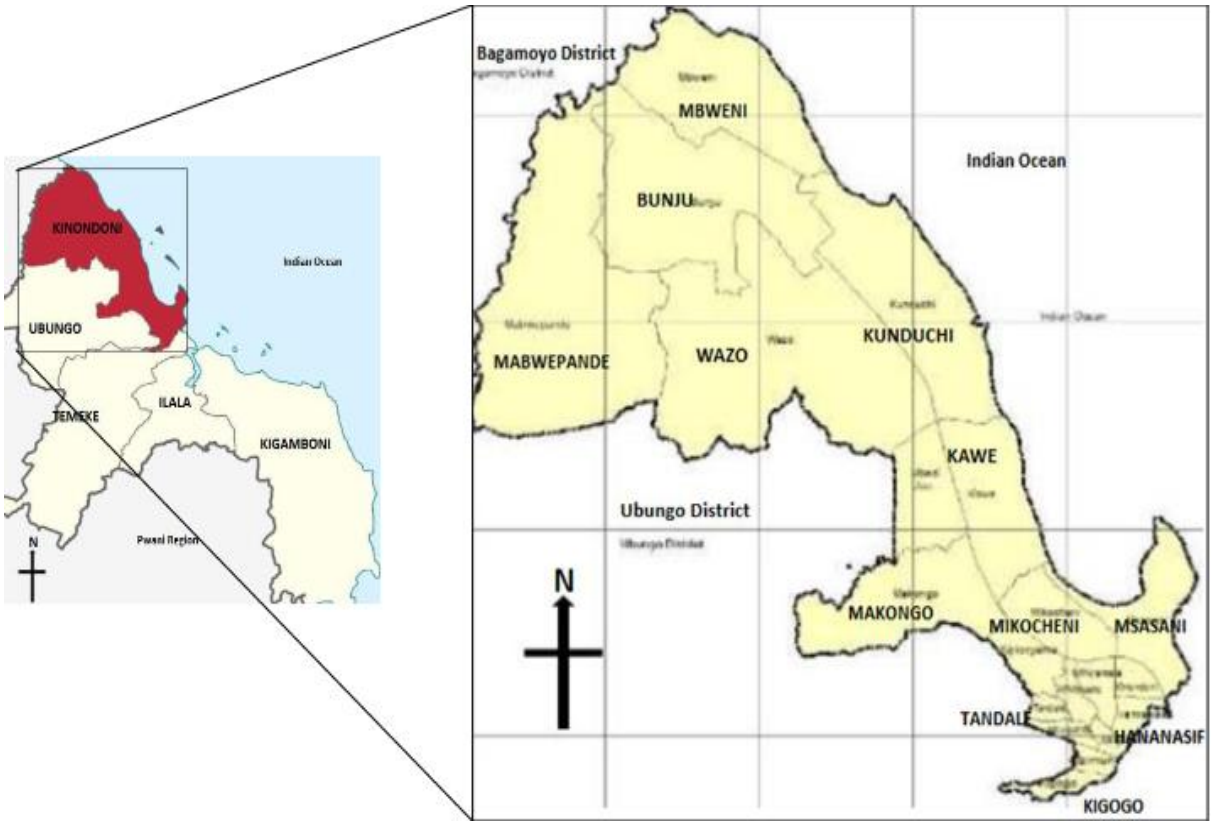


Figure 2: Dar es Salaam region map, showing Kinondoni District and its wards.

3.3 Study Population

Consisted of schoolchildren aged 12-15 years, attending public primary schools in Kinondoni Municipal of the Dar es Salaam region, during data collection time. The total number of public primary schoolchildren in the district was 90,115, which is equivalent to 9.2% of the total population in the district.

3.4 Sampling Method and Sample Size Estimation

3.4.1 Sample Size Estimation

With the help of a biostatistician, the sample size was calculated from the following formula:

$$n = [Z^2P (1-P) / e^2] DE$$

Whereby;

n = Sample size.

Z = Standard normal deviation, set at 95% (1.96).

P = Proportion (estimated) of children with malocclusion that meet objective treatment need as reported in Moshi in 2007: P=35.3% (32).

e = Desired level of precision (marginal error), set at 6%.

DE= Design effect = 2 since a multistage cluster sampling method was used.

n = [1.962 x 35.3 (100- 35.3) / 62] x 2

n = [8770.21/36] x 2

n = 487.24 ≈ 487

n = 487

Therefore, the sample size is estimated was 487 schoolchildren.

3.5 Sampling Technique

Kinondoni District has a total of eighty-two (82) public primary schools which are distributed within twenty (20) wards. The sample was obtained through a multistage cluster random sampling method. In stage one; the twenty wards were randomly sampled to get the five participating wards; Kunduchi, Tandale, Ndugumbi, Hananasif, and Kawe which had 9, 4, 3, 2, and 7 public primary schools each, respectively. Afterwards, 2 public primary schools were randomly picked from wards with more than 6 schools and 1 public primary school was randomly picked from wards with less than 5 schools. In this case, two wards (Kawe and Kunduchi) gave two primary schools each, and the remaining three wards (Tandale, Ndugumbi, and Hananasif) gave one primary school each, to make a total of seven (7) selected schools.

Each school provided seventy (70) schoolchildren of the age group 12-15 years. In the schools' settings, a sampling frame of all schoolchildren with the required age group was used, from which, schoolchildren who participated were randomly picked to obtain the required number. Finally, a sample size of 490 schoolchildren was expected from the seven schools. However, due to some reasons such as the absence of the sampled pupil on the day of data collection, and the refusal of some parents to allow their children to participate in the study, the study ended up with 483 schoolchildren. This is equivalent to 98.6%, as the response rate. The following flow chart (Figure 3) summarises the sampling technique.

DIAGRAMMATIC FORMAT TO ILLUSTRATE THE SAMPLING TECHNIQUE

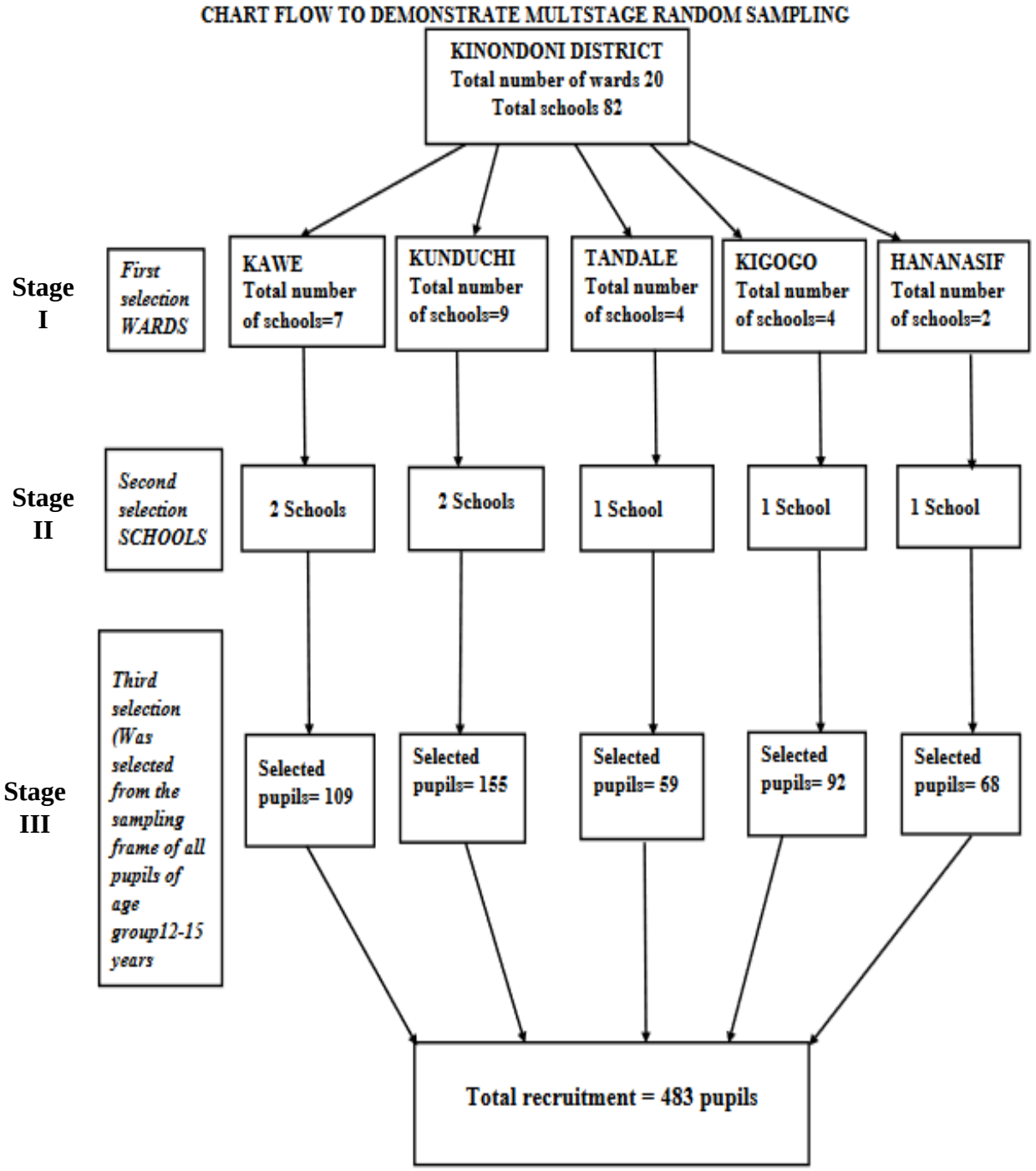


Figure 3: Recruitment flow chart

3.6 Inclusion and Exclusion Criteria

3.6.1 Inclusion Criteria

i) Children aged 12-15 years.

3.6.2 Exclusion Criteria

i) Mentally retarded children *(due to poor cognitive ability)*

ii) Currently on orthodontic treatment *(to avoid bias in terms of perceived treatment need and objective presence of malocclusion)*

iii) Children with mixed dentition *(WHO proposes DAI to be used for assessment of malocclusion in permanent dentition)*

3.7 Study Variables

A. Independent variables

a) Socio-demographic variables was determined in the following categories:

- Sex: 1 = male, 2 = female
- Age: In years
- Level of education: (grade/class)
- Address (Residency): In wards from which they reside

b) Socio-economic variables

- Parent or guardian occupation: 1= Business man/woman, 2= Employed, 3= Self-employed, 4= No formal work
- Health insurance: Do you have health insurance? 1= Yes, 2= No

B. Dependent variables

a) For specific objectives (i), proportion of malocclusion, severity of malocclusion and orthodontic treatment need was measured by using the DAI; *Total DAI score of ≤25* = normal occlusion or negligible malocclusion, hence no orthodontic treatment need, *total DAI score of 26 to 30* = definite malocclusion with elective treatment need, *total DAI score of 31 to 35* = severe malocclusion with highly desirable treatment need, and *a total DAI score of ≥36* = handicapping malocclusion with mandatory orthodontic treatment need (appendix 2).

b) For specific objective (ii), the perceived malocclusion (subjective or self-assessment and rating of the malocclusion by the participants) was measured by using ten occlusion photographs as per IOTN-AC; 1= Picture 1-4 (Grade 1-Normal

occlusion), 2= Picture 5-7 (Grade 2- Moderate malocclusion), 3= Picture 8-10 (Grade 3- Severe malocclusion) (appendix 2).

c) For specific objective (iii), perceived orthodontic treatment need (subjective or self-determined orthodontic treatment need by the participants regardless of their normative malocclusion) was determined by using a structured questionnaire, where a pupil was to respond to a question that assessed perceived orthodontic treatment need during an interview "Do you think that you need orthodontic treatment?" and the responses were; 1 =yes; 2 =no; 3 =I don't know.

3.8 Data Collection

Data collection was by interview using a structured questionnaire for sociodemographic variables, perception of malocclusion and perceived orthodontic treatment need. Clinical examination was done by the Principal Investigator (PI) to assess malocclusion with an assistant (Intern Dentist) recording the observations and measurements. Dental aesthetic index (DAI) was used in the assessment of the severity of malocclusion and orthodontic treatment need. Participants who were recognized with malocclusion, were refered to the nearest hospital, or to the MUHAS, School of Dentistry clinics.

3.9 Data Collection Procedure

As soon as consent and assent were obtained from the participants, data were collected using structured questionnaires by interviewing the participants, followed by clinical examinations.

Demographic information variables were collected in an interview schedule, using a structured questionnaire (appendix 2).

The perceived malocclusion status of the participants was obtained by using IOTN-AC criteria, where participants rated themselves on how they perceived their occlusal status, by selecting one among the ten pictures of different occlusal statuses, provided that they think it corresponds to how their teeth look like (Attachment 1). A score of 1 meant selecting pictures 1-4, indicating Grade 1- normal occlusion, a score of 2 meant selecting pictures 5-7, indicating Grade 2- Moderate malocclusion, and a score of 3 meant selecting pictures 8-10, indicating Grade 3- Severe malocclusion (appendix 2).

Clinical variables were obtained through a clinical examination. This was conducted by the PI with participants seated on chairs under suitable natural light. Mouth mirror, periodontal

probe (with a stopper), a pair of deviders and an endodontic ruler for linear measurements were used. Findings were scored on the pre-prepared clinical assessment form, according to DAI criteria (attachment 2). A DAI score of (</=25) indicates normal occlusion or negligible malocclusion, hence no orthodontic treatment need, a DAI score of (26 to 30) indicates definite malocclusion with elective treatment need, a DAI score of (31 to 35) indicates severe malocclusion with high desirable treatment need, and a DAI score of (>/=36) indicates handicapping malocclusion with mandatory orthodontic treatment need.

3.10 Validity and Reliability of Research Tools

Validity

The questionnaire was developed by a Dentist (PI) and later reviewed by Orthodontists and oral health research specialists (supervisors), and it was then translated into Swahili by the PI who is fluent in speaking and writing in Swahili and English languages. The question for assessment of perception of orthodontic treatment need was set as it was used in previous studies (30,41).

For clinical examination, the Dental Aesthetic Index (DAI) was used to collect data on the assessment of malocclusion, severity, and normative orthodontic treatment needs. Calibration of the examiner (PI) versus an experienced researcher (MM) was conducted in a sample of six (6) subjects at the MUHAS dental clinic. Measurement of agreement of the various scores for each individual was compared and revealed Kappa coefficient statistics of 76% to 100%, which, according to Landis and Koch shows substantial to perfect agreement (60).

Reliability

Data reliability was checked for clinical indices as per the DAI tool and questionnaire, by conducting intra-examiner reliability, by re-interviewing and re-examining every 10^{th} participant. For quick and easy reliability test in the field, continuous clinical data (e.g. diastema, largest maxillary irregularity, largest mandibular irregularity, maxillary overjet, mandibular overjet, and anterior open bite) of the participants were transformed to categorical data, in which malocclusion was accorded as “present” or “absent”. By Using Kappa test, 84% to 100% intra-examiner agreement for all categorical variables was obtained for each of the 46 re-examined schoolchildren.

3.11 Data Management

The data was handled only by the researcher, under the MUHAS authority. There was no information from the data which was used against what was stated in the consent form. None of the information that identifies the participant was recorded.

3.12 Data Entry, Transformation and Analysis

On each working day, data from completed questionnaires and clinical examination forms were fed into a computer. Later, at the end of data collection, data cleaning and analysis using the software for Statistical Package for Social Sciences (SPSS, version 29.0) followed. The level of significance was set at $p<0.005$, with 95% confidence interval.

Data transformation to facilitate analysis was done. Age of the schoolchildren was recoded as 1=12-year-olds and 2= above 12-years. Residence of the participants was recoded as 1=Southern wards of Kinondoni (Tandale, Hananasif and Kigogo) and 2=Northern wards of Kinondoni (Kunduchi and Kawe). Perceived malocclusion was recoded as 1=Normal occlusion (Grade 1) and 2= Malocclusion present (moderate to severe malocclusion; Grade 2-3). Perceived orthodontic treatment need was recoded as 1=Need treatment (Those who responded "Yes") and 2= Do not need treatment (Those who responded "No" and "I don't know"). Objective malocclusion was recoded as 0=Normal occlusion (DAI score ≤ 25) and 1=Malocclusion present (DAI score ≥ 26; Definite to handicapping malocclusion).

Univariate analysis was done to generate frequencies. These were then dichotomised before cross tabulation and Chi-square computations. Bivariate analysis using Pearson's Chi-square test, was done to assess the association between dependent and independent variables. Factors that were statistically significantly associated with subjective orthodontic treatment need in bivariate analysis, plus those with *p-value* of <0.2 were taken into multivariate analysis to take care of the confounding factors (if any), and their role in influencing perception of orthodontic treatment need was determined. Since the outcome was noted to be common (>10%) and hence tend to overestimate the odds ratios (OR's), an alternative type of regression under Stata MP-17.0 version was used, and a Modified Poisson Regression was applied. The following table summarises the analysis done per each specific objective.

Summary of the analysis for each specific objective

S/No.	Specific Objective	Analysis Plan
1	Assess the proportion of malocclusion among schoolchildren in the Kinondoni district by using DAI criteria.	Descriptive statistics
2	Determine the magnitude of perceived malocclusion among schoolchildren in the Kinondoni district by using IOTN-AC.	Descriptive statistics
3	Determine the magnitude of perceived orthodontic treatment needs among schoolchildren in the Kinondoni district by using a self-administered questionnaire.	Descriptive statistics
4	Determine the relationship between perceived orthodontic treatment need and associated factors.	In bivariate analysis, a *p-value* of < 0.05 was set to be statistically significant Multivariate analysis by Modified Poisson Regression

3.13 Ethical Issues

Ethical clearance was granted by the Research and Ethics Committee of Muhimbili University of Health and Allied Sciences (MUHAS), and the study was conducted per the ethical standards. Permission to conduct the study in Kinondoni Municipal public primary schools was sought from the Municipal Director of Kinondoni District. Written informed consent was obtained from all participants' parents/guardians and assent from the participants (children), before they participated in the study. Before filling out the consent/assent form (appendix III), each participant received a detailed verbal clarification of the nature and aim of the study.

Prior to data collection day, each participant was given the consent form to take it home for their parents/guardians to fill in whether or not they allow their children to participate in the study. Then schoolchildren were asked to return back with the filled consent forms on the planned day, for further data collection. The participants were guaranteed

confidentiality, and had the right to withdraw from the study without penalty. They were also informed that the information obtained was only used for the planned purpose. After clinical examination, each participant was given oral health information. The participants who were found with oral health problems, were reffered to the nearest hospital, or to the MUHAS, School of Dentistry clinics, for intense care.

3.14 Dissemination of Findings

This study report will be submitted to the Department of Orthodontics Paedodontics and Community Dentistry, as a requirement for partial fulfilment of the Master degree offered at the Muhimbili University of Health and Allied Sciences (MUHAS). A copy will be provided to the MUHAS library repository. Also, the findings will be disseminated through presentations at scientific conferences and will later be submitted for publication in scientific journals.

CHAPTER FOUR

4 RESULTS

The socio-demographic characteristics of the study participants

A total of 483 schoolchildren from Kinondoni Municipal in Dar es Salaam city were enrolled for this study. The age ranged from 12-15 years, with 43.3% of the participants being 12 years old. The distribution of the participants by sex showed a slight predominance of girls (56.9%) and on residence-Kunduchi ward (32.1%). Fewer schoolchildren (24.0%) had health insurance (Table 1).

Table 1: Distribution of participants by sociodemographic characteristics.

Socio-demographic characteristics		***n***	**%**
Sex	Boys	208	43.1
	Girls	275	56.9
Age (years)	12 years	209	43.3
	13 years	179	37.1
	14 years	83	17.2
	15 years	12	2.5
Schoolchildren class	Six (6)	236	48.9
	Seven (7)	247	51.1
Health Insurance Possession	Yes	116	24.0
	No	367	76.0
Place of residency	Hananasif	68	14.1
	Kawe	109	22.6
	Kigogo	92	19.0
	Kunduchi	155	32.1
	Tandale	59	12.2

Objective 1: Proportion of schoolchildren with malocclusion using the DAI criteria

Table 2 shows the distribution of malocclusion and orthodontic treatment need among the study population according to the DAI scores. Schoolchildren with significant malocclusion which ranges from definite to handicapping malocclusion were (55.9%).

Table 3 shows the frequency distribution of different malocclusion traits as per DAI components. The most common recorded malocclusion was crowding (39%) followed by, increased maxillary overjet (35.6%) and spacing (35%). On the other hand, 6.8% had at least one permanent tooth missing and mandibular overjet was seen in 2.9% of the participants.

Proportions of schoolchildren with malocclusion by socio-demographic characteristics are presented in Table 4. Malocclusion prevalence was slightly higher among girls (56.7%), class seven (57.9%) and those above 12 years of age (57.7%) compared to their counterparts. However, all these findings were not statistically significant in the bivariate analysis.

Table 2: Distribution of the participants' malocclusion status and orthodontic treatment need according to the DAI scores.

No. of children affected *n* (%)	**DAI Scores**	**Severity of Malocclusion**	**Treatment need**
213 (44.1)	≤ 25	Normal or Negligible Malocclusion	No need
145 (30.0)	26 - 30	Definite Malocclusion	Elective need
47 (9.7)	31 - 35	Severe Malocclusion	Highly desirable need
78 (16.1)	≥ 36	Handicapping Malocclusion	Mandatory need
483 (100)			

Table 3: Frequency distribution of participants' individual malocclusion traits as per the DAI criteria.

DAI components		***n***	**%**
Number of visibly missing teeth	None	450	93.2
	At least one tooth is missing	33	6.8
Crowding in the anterior segment	No crowding	296	61.3
	Crowding present at least in one segment	187	38.7
Spacing in the anterior segment	No spacing	314	65
	Spacing present at least in one segment	169	35
Maxillary diastema	No diastema	369	76.4
	Diastema present	114	23.6
Largest maxillary irregularity	No irregularity	368	76.2
	Irregularity present	115	23.8
Largest mandibular irregularity	No irregularity	376	77.8
	Irregularity present	107	22.2
Maxillary overjet	Normal overjet	311	64.4
	Increased overjet	172	35.6
Mandibular overjet	No mandibular overjet	469	97.1
	Mandibular overjet present	14	2.9
Anterior open bite	No anterior open bite	411	85.1
	Anterior open bite present	72	14.9
Molar relationship	Normal relationship	411	85.1
	Deviation from normal relationship present	72	14.9

Table 4: Distribution of the participants' occlusion status using the DAI criteria by sociodemographic characteristics.

Sociodemographic characteristics		**Malocclusion (n=483)**			**Statistics (*p-value*)**
		Normal occlusion *n* (%)	**Malocclusion present *n* (%)**	**Total**	
Sex	Boys	94 (45.2)	114 (54.8)	208	*0.674*^{ns}
	Girls	119 (43.3)	156 (56.7)	275	
Class	Six (6)	109 (46.2)	127 (53.8)	236	*0.367* ^{ns}
	Seven (7)	104 (42.1)	143 (57.9)	247	
Age (years)	12 years	97 (46.4)	112 (53.6)	209	*0.371*^{ns}
	Above 12 years	116 (42.3)	158 (57.7)	274	
Place of residency	Southern Kinondoni Wards	97 (44.3)	122 (55.7)	219	*0.938*^{ns}
	Northern Kinondoni Wards	116 (43.9)	148 (56.1)	264	

Key: Chi-Square test, *$p<0.05$ significant, **$p<0.001$ highly significant, and ns not statistically significant

Objective 2: Distribution of the participants by perceived malocclusion using the IOTN-AC index

Proportion of perceived malocclusion according to the IOTN-AC criteria is presented in Table 5. Majority of the schoolchildren (84.5%) considered themselves as having "normal occlusion". The proportion of children with perceived malocclusion by socio-demographic characteristics is presented in Table 6. However, there was no statistically significant differences that was found in these findings.

Table 5: Distribution of the participants by perceived malocclusion status using the IOTN – AC.

No. of children affected *n* (%)	IOTN – AC picture selected	Grade of occlusions Status	Severity of Subjective Malocclusion by IOTN – AC
408 (84.5)	1 - 4	Grade 1	Normal occlusion
41 (8.5)	5 - 7	Grade 2	Moderate malocclusion
34 (7)	8 - 10	Grade 3	Severe malocclusion
483 (100)			

Table 6: Participants' perceived malocclusion assessed using the IOTN – AC by sociodemographic characteristics.

Sociodemographic characteristics		Perceived Malocclusion (n=483)			Statistics (*p-value*)
		Normal occlusion *n* (%)	Malocclusion present *n* (%)	Total	
Sex	Boys	175 (84.1)	33 (15.9)	208	0.859^{ns}
	Girls	233 (84.7)	42 (15.3)	275	
Class	Six (6)	196 (83.1)	40 (16.9)	236	0.399^{ns}
	Seven (7)	212 (85.8)	35 (14.2)	247	
Age (years)	12 years	178 (85.2)	31 (14.8)	209	0.712^{ns}
	Above 12 years	230 (83.9)	44 (16.1)	274	
Place of residence	Southern Kinondoni Wards	179 (81.7)	40 (18.3)	219	0.130^{ns}
	Northern Kinondoni Wards	229 (86.7)	35 (13.3)	264	

Key: Chi-Square test, $*p<0.05$ significant, $**p<0.001$ highly significant, and ns not statistically significant

Objective 3: Magnitude of perceived orthodontic treatment need

The proportion of children's perception on the need for orthodontic treatment is presented in Figure 5. Total of 483 were asked if they thought that they needed their teeth to be realigned. Their responses showed that, about half of them (52%) expressed the need for realignment of their teeth. Only 4%, didn't know whether or not they needed the treatment.

Table 7 shows the perception of orthodontic treatment need by socio-demographic characteristics. The results showed a higher proportion of class six children (61.4%) with perceived orthodontic treatment need, than those in class seven *(p<0.001)*. Also, on residence, a higher proportion of those residing in Southern Kinondoni wards (61.2%) perceived the need for orthodontic treatment than those from Northern Kinondoni wards *(p<0.001)*.

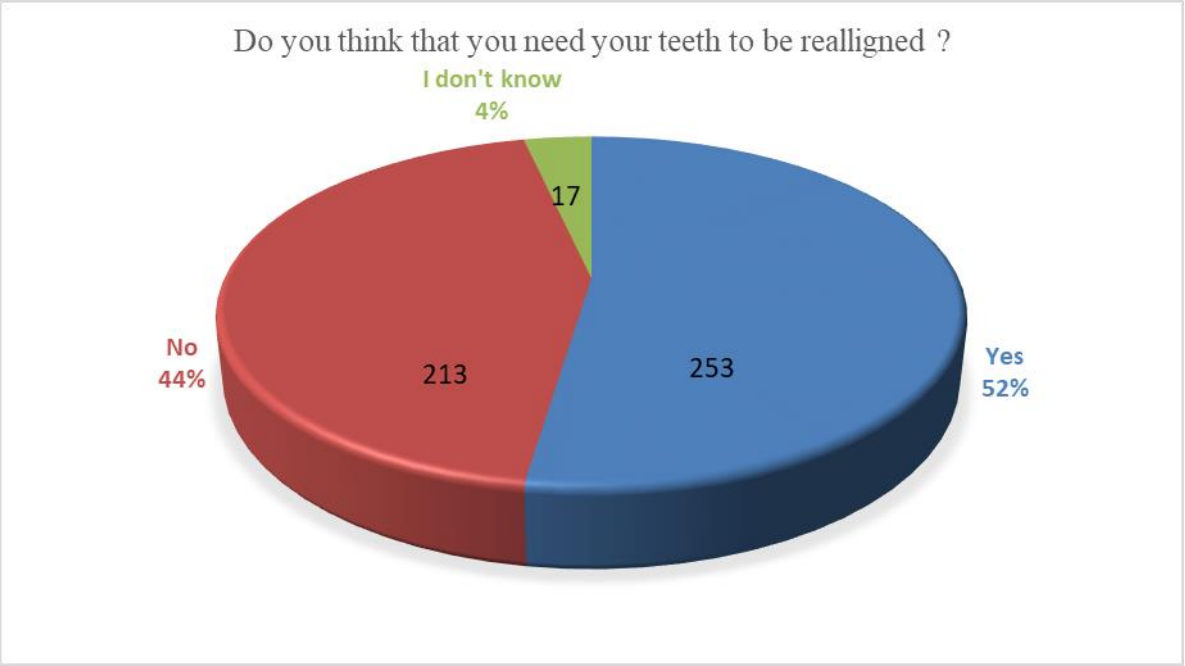


Figure 4: Perceived orthodontic treatment need.

Table 7: Participants perceived orthodontic treatment need by socio-demographic characteristics.

Sociodemographic characteristics		**Do you think you need Orthodontic treatments? (n=483)**			**Statistics (*p-value*)**
		Yes *n* (%)	**No *n* (%)**	**Total**	
Sex	Boys	111 (53.4)	97 (46.6)	208	*0.706*^{ns}
	Girls	142 (51.6)	133 (48.4)	275	
Class	Six (6)	145 (61.4)	91 (38.6)	236	*0.000* **
	Seven (7)	108 (43.7)	139 (56.3)	247	
Age (years)	12 years	120 (57.4)	89 (42.6)	209	*0.053* ^{ns}
	Above 12 years	133 (83.9)	141 (16.1)	274	
Place of residence	Southern Kinondoni Wards	134 (61.2)	85 (38.8)	219	*0.000* **
	Northern Kinondoni Wards	119 (45.1)	145 (54.9)	264	

Key: Chi-Square test, *$p<0.05$ significant, **$p<0.001$ highly significant, and ns not statistically significant

Objective 4: Relationship between perceived treatment needs and associated factors

Factors such as age, sex, class of a pupil, residence, and severity of normative malocclusion/treatment need, perceived malocclusion, and possession of health insurance were assessed in relation to the perception of orthodontic treatment need (Table 8). Perception of orthodontic treatment need was shown in a greater proportion of class six schoolchildren (61.4%) *($p<0.001$),* compared to class seven. Many children with definite to handicapping malocclusion found with perceived orthodontic treatment need, compared with their counterparts (58.9%) *($p=0.001$).* A number of children who perceived themselves to have malocclusion, also perceived the need for orthodontic treatment (86.7%) *($p<0.001$).* Furthermore, many children who reside in Southern Kinondoni wards expressed orthodontic treatment need, as compared to those in Northern part of the Kinondoni district (61.2%) *($p<0.001$).*

Table 8: Cross-tabulation of the perceived (subjective) orthodontic treatment need and their associated factors.

Variables		**Perceived treatment need (n=483)**			**Statistics (*p-value*)**
		Need treatment n (%)	**Do not need treatment n (%)**	**Total**	
Sex	Boys	111 (53.4)	97 (46.6)	208	*0.706*^{ns}
	Girls	142 (51.6)	133 (48.4)	275	
Class	Six (6)	145 (61.4)	91 (38.6)	236	*0.000***
	Seven (7)	108 (43.7)	139 (56.3)	247	
Age (years)	12 years	120 (57.4)	89 (42.6)	209	*0.053* ^{ns}
	Above 12 years	133 (48.5)	141 (51.5)	274	
Do you have health insurance?	Yes	68 (58.6)	48 (41.4)	116	*0.123*^{ns}
	No	185 (50.4)	182 (49.6)	367	
Severity of malocclusion (DAI)	Normal occlusion	94 (44.1)	119 (55.9)	213	*0.001**
	Malocclusion present	159 (58.9)	111 (41.1)	270	
Perceived malocclusion (IOTN)	Grade 1,	188 (46.1)	220 (53.9)	408	*0.000***
	Grade 2 and 3	65 (86.7)	10 (13.3)	75	
Place of residency	Southern Kinondoni Wards	134 (61.2)	85 (38.8)	219	*0.000***
	Northern Kinondoni Wards	119 (45.1)	145 (54.9)	264	

Key: Chi-Square test, **p<0.05* significant, ***p<0.001* highly significant, and ns not statistically significant

Multivariate analysis

Multivariate analysis of the factors associated with perception of orthodontic treatment need are shown in Table 9. The bivariate analyses of these factors showed that, perception of orthodontic treatment need was influenced by age (12 years), class (class 6), normative malocclusion (according to DAI), perceived malocclusion (as assessed by the IOTN-AC), possession of health insurance, and residing in Southern wards of the Kinondoni district, as was shown in Table 8. All these factors had *p-values* of less than *0.2*. The influence of these contributing factors was confirmed by multivariate analysis, taking care of the possible confounding effects. The results showed that schoolchildren who perceived themselves as having moderate to severe malocclusion as per IOTN-AC, and those who had definite to handicapping malocclusion as per DAI scores, were more likely to perceive the need for orthodontic treatment, than their counterparts ((OR 1.736, CI 1.509-1.998; *p<0.001*) and (OR 1.252, CI 1.051-1.492; *p=0.012*), respectively)**.** Furthermore, schoolchildren in class seven were found to be less likely to express perceived orthodontic treatment need, compared to those in class six (OR 0.712, CI 0.567-0.892; *p =0.003*).

Table 9: Adjusted Odds ratio (aOR) and 95% Confidence interval (CI) for overall perceived of orthodontic treatment need and contributing factors.

VARIABLES		PERCEIV-ED OTN *n* (%)	cOR (95%CI)	*p-value*	aOR (95%CI)	*p-value*
Age groups	12 years	120 (57.4)	Ref	*0.053* ^{ns}	Ref	*0.224* ^{ns}
	>12years	133 (48.5)	1.429 (0.995-2.054)		1.128 (0.928-1.369)	
Class of schoolchildren	Standard 6	145 (61.4)	Ref	*<0.001***	Ref	*0.003**
	Standard 7	108 (43.7)	2.051 (1.429-2.949)		0.712 (0.567-0.892)	
Perceived malocclusion	Normal	188 (46.1)	Ref	*<0.001***	Ref	*<0.001***
	Malocclusion	65 (86.7)	7.606 (3.801-15.22)		1.736 (1.509-1.998)	
Place of residence	Southern wards	134 (61.2)	Ref	*<0.001***	Ref	*0.150* ^{ns}
	Northern wards	119 (45.1)	1.921 (1.335-2.765)		0.865 (0.712-1.053)	
Health insurance	Yes	68 (58.6)	Ref	*0.123* ^{ns}	Ref	*0.124* ^{ns}
	No	185 (50.4)	1.394 (0.914-2.126)		0.874 (0.737-1.037)	
Normative malocclusion	Normal	94 (44.1)	Ref	*0.001**	Ref	*0.012**
	Malocclusion	159 (58.9)	1.813 (1.261-2.608)		1.252 (1.051-1.492)	

Key: Multiple logistic regression **p<0.05, **p<0.001* and ns not statistically significant, cOR= crude OR, aOR= adjusted OR, OTN=Orthodontic treatment need

CHAPTER FIVE

5 DISCUSSION

The study involved schoolchildren aged 12-15 years, attending the selected public primary schools in Kinondoni District of the Dar es Salaam region, in Tanzania. This study investigated malocclusion, severity and orthodontic treatment need by studying prevalence of normative malocclusion, perceived malocclusion, perceived treatment needs and factors influencing perception of the treatment need. It is the first study in Tanzania to examine all the variables at the same time.

Prevalence of Malocclusion

In this study, a higher proportion of the participants had malocclusion (55.9%), this finding is contrary to that of Muasya *et al.* who reported a prevalence of 47% (25), and Rwakatema *et al.* who reported a prevalence of 33.3% (30). However, the current findings are in line with the obtained Worldwide prevalence of malocclusion in children and adolescents, which is estimated to be above 50% (22). Notably, Mtaya *et al*. and Rwekaza *et al.* conducted their studies at a geographical location like the one in the present study. Both studies reported a relatively higher proportions of children to have malocclusion, compared to the findings in the present study (3,61). The observed differences could be attributed to the methodological tools used to assess malocclusion. As opposed to the current study, the earlier two Tanzanian studies used a Bjork criteria to assess malocclusion (62).

By considering the distribution of individual malocclusion traits, crowding was found to be the most common recorded malocclusion in this study, followed by spacing and increased overjet. This finding is in line with those reported by earlier studies, which reported the dominance of crowding compared to other traits of malocclusion (6,25,63). Spacing was recorded as the second most common malocclusion trait presently, the more or less similar results have been found in studies which were formerly conducted in Dar es Salaam (3). More than 85% of the subjects in this study showed normal molar relationship (Angle's Class I), similar findings were found by other Tanzanian studies (3,61,64), and another study in Nairobi (25). In the current study, noteworthy percentage (6.8%) of schoolchildren had at least one permanent tooth missing. This could be attributed to the fact that, age 12-

15 is the transitional age group, from mixed to permanent dentition. Since there were no radiological investigation to confirm the absence of these teeth, and the researchers could only rely on the clinical judgement, and the children's explanations which are not always reliable.

Regarding the prevalence of maxillary overjet, the results of the current study indicated that 61.7% of the participants presented with a normal maxillary overjet. This result corroborate well with that of Muasya *et al.,* (25) in Kenya. Taking into account the presence of anterior cross-bite in the present study, this trait was found in 2.9% of the schoolchildren. This finding is similar to that obtained by Mtaya *et al.,* in Dar es Salaam schoolchildren (65). However, the observed prevalence of anterior cross-bite in this study is relatively higher than those reported by Ng'ang'a *et al.* and Rwakatema *et al.* (30); and relatively less than that reported by Mtaya *et al.* (3). Prior to the present study, there were no retrievable comparable studies which have reported about the occurrence of malocclusion, utilizing the DAI scores. Therefore, comparisons of the current results by those from earlier studies, should be done with caution.

Presently, on studying the relationship between the general prevalence of malocclusion and sociodemographic characteristics, there was no statistically significant difference that was found. This observation conforms well with the results obtained in a study which was formerly done in Tanzania (26), and to the studies which were done in other places (12,66). In Tanzania, Gustav *et al.* (61) reported a statistically significant difference in the relationship between malocclusion and education level of the children's parents. This variable was not assessed in this study. Future broader studies will be planned, where as many variables as possible will be included, to gain a deeper insight on this subject.

Subjective malocclusion

Majority of the schoolchildren (84.5%) in this study perceived themselves to have normal occlusion. This falls into the Grade 1 of IOTN-AC (Score 1-4), implying "Normal occlusion". This finding is similar to those from other studies, whereby, majority of the participants of past studies also rated themselves as having normal occlusion (35,36). Furthermore, the current findings showed a predominance of females, class 7 schoolchildren and the 12-year-olds, who perceived themselves to have normal occlusion,

compared with their counterparts. However, there were no statistically significant differences that were found with respect to other sociodemographic characteristics. This result is similar to those obtained from former studies elsewhere (35,36). Meanwhile, there are some prior studies which were done, which reported a statistically significant difference between the perceived malocclusion as they relate to the age and sex of an individual (33). Regarding the teeth arrangements, there were divergent results compared to the present ones, Mugonzibwa *et al.* reported that half of their participants were happy with the arrangement of their teeth (41), and Rwakatema *et al.* reported that majority of their participants agreed that their teeth are not properly aligned in their mouths (30). The noted differences might have been caused by the variation in the methodologies used to obtain the data, and/or geographical location of the studied population. Whereby, Rwakatema *et al.* conducted their study in an area with a higher prevalence of fluoride in drinking water, it is very likely that their study included children with dental fluorosis, so the dislike of their dental appearances might have been exaggerated by the presence of the teeth with fluorosis. The results further showed that majority of the children perceived themselves to have normal occlusion, even though they had some degree of malocclusion. Hence, more education is needed to raise awareness on malocclusion and oral health in general.

Subjective orthodontic treatment need

The current study showed that, half of the children would have liked their teeth to be rearranged to improve their alignment. Only few (4%) of the present schoolchildren didn't know whether or not they needed orthodontic treatment to realign their teeth. These findings are supported by other studies which were done in other places (44,46), and the one which was done in Tanzania (30). Some other studies have reported a relatively lower proportions of the perceived orthodontic treatment needs (35,47,48). The differences obtained, might have been attributed to the differences in the methods employed to determine the subjective orthodontic treatment need and the participants' ages. Even though majority of the children rated themselves as having normal occlusion, still majority of them perceived that they needed orthodontic treatment. Therefore, further education is needed to raise awareness on malocclusion, orthodontic treatment and oral health in general.

Relationship between perceived (subjective) orthodontic treatment needs and associated factors

In the analysis performed in this study, the need for treatment was almost similar among boys and girls. Comparable to the present results, Rwakatema *et al.* reported that there was no statistically significant association between the need for orthodontic treatment and gender (30). Conversely, Simon *et al.* showed that being a female was the strongest predictor of orthodontic treatment need for both, adults and children (49).

The current findings suggested that, being in class 6 as compared to class 7, influenced the perception of the treatment need. This finding is in line with the fact that, children aged 12 years were more in class 6 than in class seven. The age 12 is a transition age from the mixed dentition stage, to the permanent dentition stage. Henceforth, spaces and partially erupted permanent teeth are more likely to be present in this group of children, compared with those above 12 years. This finding is supported by the results of Yilmaz *et al.*, who reported that many younger children tend to have subjective need for orthodontic treatment compared to older ones (50). On the other hand, Shaw *et al.* reported conflicting findings (51). Despite the predominance of the 12-year-olds in this study, and considering the subjective orthodontic treatment needs, this study could not establish statistically significant differences related to age groups. While some studies have reported statistically significant differences regarding the perception of orthodontic treatment need, favouring children belonging to either younger age groups or older age groups (50,51), respectively.

In this study, it was shown that, having malocclusion was significantly associated with perceiving the need for orthodontic treatment. This result is similar to that obtained in a past study (52). Other researchers have reported that the perceived orthodontic treatment need is statistically significantly influenced by the DAI scores (severity of malocclusion) (53). In a Tanzanian study, Mugonzibwa *et al.* concluded that the Tanzanian children with higher objective need of treatment, also had higher subjective need of treatment (41). The explanation could be, “the more severe malocclusion is, the more negative aesthetic perception, the psychosocial and functional impact it causes, and therefore the greater the orthodontic treatment need” (67).

Regarding the perception of malocclusion, the current study demonstrated a very strong association ($p<0.001$) between perception and the subjective orthodontic treatment need, in the bivariate analysis. In the majority of schoolchildren who scored themselves as having moderate to severe malocclusion, most of them reported to have subjective orthodontic treatment needs. These findings are in line with those reported by Feldens *et al.* (52). Naturally, people who perceive themselves as having malocclusion, are more likely to have the desire to undertake orthodontic treatment. Surprisingly, in the study of Schroeder *et al.* it was concluded that, motivation to seek orthodontic treatment was not related to perception of the severity of malocclusion (53).

The current study showed a very strong association between the place of residence and perception of orthodontic treatment need, in bivariate analysis. Whereby, a greater proportion of children from the Southern wards of Kinondoni, claimed to have subjective orthodontic treatment need, compared with their counterparts. Since both areas are in urban settings, the possible explanation for the observed differences could be related to the children's SES. Most of the Southern wards' residents (Tandale, Hananasif and Kigogo) are of a relatively lower SES, and most of those from the Northern wards (Kunduchi and Kawe) are from relatively higher SES areas. This observation is supported by the studies that reported that, majority of subjects with a higher socioeconomic status perceived no need for orthodontic treatment, compared with their counterparts from the lower SES (54).

The results from bivariate analysis showed that, being in class six, children with definite to handicapping malocclusion, children who perceived themselves as having moderate to severe malocclusion, and children residing in the Southern wards of Kinondoni district, many of them reported to have a need for orthodontic treatment, compared with their counterparts. Using a Modified Poisson Regression for assessing interaction between many variables, the results obtained showed that schoolchildren who perceived themselves as having ill arranged teeth and those with normative malocclusion were more likely to report the need for orthodontic treatment. Moreover, the schoolchildren belonging to class seven, were less likely to report orthodontic treatment need compared with those in class six. This finding could be attributed to the fact that majority of class six children are of age 12 years which is a transitional stage from mixed to permanent dentition and hence perceiving very negatively, having malocclusion.

5.1 Study Limitations and Mitigation

No radiological investigation was used to confirm the absence of teeth in the "missing teeth" category, given the settings of the study. Therefore, assessment for missing teeth was solely performed based on clinical judgement, and the child's dictated history. This might have contributed to relatively higher proportion (6.8%) of schoolchildren with at least one permanent tooth missing, and hence the overall DAI score of the participant. However, the standard tools were used for the study, the questionnaires were not too long, and were pilot tested to sort all ambiguous questions for easy understanding by the schoolchildren and the researcher was well calibrated to obtain appropriate data.

5.2 Conclusion

Majority of the schoolchildren (55.9%) had malocclusion with the severity ranging from definite to handicapping malocclusion, as per the DAI scores with their orthodontic treatment needs ranged from elective to mandatory. The subjective orthodontic treatment needs were more likely to be influenced by the perceived malocclusion and presence of normative malocclusion. Also, most children belonging to a younger age group were found with subjective orthodontic treatment need, with majority of them belonging to class six.

5.3 Recommendations

- The current study obtained a high prevalence of malocclusion in schoolchildren from Kinondoni district, this finding should be used to assist in planning orthodontic care in the district, in order to avoid a substantial burden of the condition in future, as well as to meet the reported unmet subjective and the objective orthodontic treatment needs.
- It is recommended to train and recruit orthodontists who can work with the Municipality to address the orthodontic treatment needs of the schoolchildren.
- Although the proportion of the subjective and normative orthodontic treatment needs are more or less the same, yet the district should adopt an orthodontic treatment need index (for example DAI) in its clinical assessment of the treatment needs.
- Further research should be planned, to address all the factors that influence the need for orthodontic treatment, like SES, cost of treatment and availability of treatment.

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APPENDICES

Appendix 1(a): Informed Consent Form (English version)

ASSESSMENT OF MALOCCLUSION, SEVERITY, AND ORTHODONTIC TREATMENT NEED AMONG SCHOOLCHILDREN IN KINONDONI DISTRICT, IN DAR-ES-SALAAM, TANZANIA.

ID No _____ Tel. _____

Consent to Participate in this Study.

Hello! My name is Dr. Makala Yesaya, a postgraduate student at Muhimbili University of Health and Allied Sciences. I am doing my research on the Assessment of Malocclusion, Severity, and Orthodontic Treatment needs among primary schoolchildren in Kindondoni District in Dar-Es-Salaam, Tanzania.

Purpose of the study

To assess malocclusion, severity, and the need for orthodontic treatment among children attending public primary schools in Kinondoni district, Dar-Es-Salaam, Tanzania

Participant involvement

If you agree to be a participant in this study, your child will be needed to answer the questions on the questionnaire and let the investigator examine their teeth.

Confidentiality

All data collected on questionnaires will be entered into the computer with an identification number. The questionnaires will be handled with great discretion to maintain confidentiality throughout the study.

Risks

There are no direct risks related to this study.

Right to withdraw

Participation in this study is voluntary. If you decide not to participate in this study, there will be no effect on your rights to services that you normally acquire from the school.

Benefits

If you decide to participate in this study, your child will benefit as an individual but also as the country in general. The child will benefit by knowing the level of severity of malocclusion they have and if they require treatment.

Who to contact

In case of any inquiries about this study, you can contact Dr. Makala Yesaya at +255653776208. For any questions about your rights as a participant, you can contact the chairperson of the MUHAS ethical Committee, P. O. Box 65001, and Telephone: 255 22 2152489 Dar-es-Salaam or Supervisors of this study Dr. Mtaya Matilda Mlangwa (Cell: 0754212109) or Dr. Machibya Ferdnand (Cell; 0764982522).

Signatures;

I have read the content of this form. My questions have been answered.

□ Participant agrees; Signature……..

□ Participant does NOT agree; Signature……..

Date; …/…/ 2024

Appendix 1(b): Informed Consent Form (Swahili version)

No ya Utambulisho: _____ Simu: _____

FOMU YA RIDHAA.

Habari! Naitwa Dk Makala Yesaya, ni mwanafunzi wa shahada ya pili ya udaktari katika Chuo Kikuu cha Afya na Sayansi Shirikishi Muhimbili. Ninafanya utafiti kuhusiana nauwepo na ukubwa wa tatizo la mpangilio mbaya wa meno na mahitaji ya matibabu kwa wanafunzi wa shule za msingi za umma wilaya ya Kinondoni, Dar Es Salaam- Tanzania.

Dhumuni la utafiti

Kutathmini uwepo na ukubwa wa hali ya mpangilio mbaya wa meno na mahitaji ya matibabu kwa wanafunzi wa shule za msingi za umma wilaya ya Kinondoni, Dar Es Salaam- Tanzania.

Ushiriki

Kama ukikubali kushiriki katika zoezi hili mwanao atahitajika kujibu maswali yaliyopo kwenye dodoso na pili, daktari wa meno atafanya uchunguzi mfupi wa meno yake.

Usiri

Taarifa zote zitakazokusanywa kupitia dodoso zitaingizwa kwenye ngamizi kwa kutumia namba za utambulisho. Kutakuwa na usiri na hakuna mtu yeyote asiyehusika atakayepata taarifa zako zilizokusanywa.

Hatari

Hakuna madhara yoyote yanayotegemewa kutokea kwa kushiriki kwako kwenye utafiti huu.

Faida

Ukishiriki kwenye utafiti huu mwanao atapata faida binafsi na kwa taifa kwa ujumla. Faida atakayoipata ni pamoja na kujua hali yake ya afya ya kinywa na meno na kama kuna tatizo utapatiwa ushauri wa kitaalam bure.

Uhuru wa kushiriki na haki ya kujitoa

Kushiriki kwako kwenye utafiti huu ni hiari. Ukiamua kukataa kushiriki au kujitoa kwenye utafiti huu hakutaathiri haki zako zingine za kila siku.

Mawasiliano

Kama una maswali kuhusiana na utafiti huu, wasiliana na Mtafiti: Dr. Makala Yesaya (0653776208) wa Chuo Kikuu cha Afya na Sayansi Shirikishi Muhimbili (MUHAS), S. L. P. 65001, Dar-es-Salaam.

Kama una swali kuhusu stahili zako kama mshiriki unaweza kuwasiliana na Mwenyekiti wa kamati ya Utafiti na Uchapishaji, P. O. Box 65001, Simu: 255 22 2152489 Dar-es-Salaam au wasimamizi wa utafiti huu Dr. Mtaya Matilda Mlangwa (Simu: 0754212109) au Dr. Ferdinand Machibya (Simu; 0764982522).

Nimesoma maelezo ya fomu hii. Maswali yangu yamejibiwa.

□ Mshiriki amekubali; Sahihi……..

□ Mshiriki hajakubali; Sahihi……..

Tarehe …/…/ 2024

Appendix 1(c): Assent Form (English version)

PARTICIPANT ASSENT

Pupil's Name: _____ **Age:** _____

Class _____

1. I, Dr. Makala Yesaya, am doing a study about the assessment of malocclusion, severity and orthodontic treatment needs.

2. We are requesting you to take part in this study because we want to learn more about **dental malocclusion and treatment needs among public primary schoolchildren in Kinondoni District - Dar es Salaam.**

3. If you approve to be in this study, you are going to be asked to: **respond to the questions on the questionnaire and the investigator will examine your teeth** to identify the presence and severity of malocclusion (if any).

4. Things that occur to individuals in research studies that make them feel uncomfortable are called "risks." There are **no risks associated with this study.**

5. Things that occur to individuals in research studies that are good are called "benefits". The benefit of this research study is that if you are found with significant malocclusion you will be informed so that you can be brought to the hospital for further assistance.

6. We will do everything possible to keep your information private.

7. Participation in this study is voluntary. You are not forced to be in this study if you don't feel like doing it. You may as well stop being in this study at any point.

8. Your parent(s) or caregiver will be asked for their permission for you to participate in this study. But even if they "agree," you can still choose not to.

9. You have the right to ask any questions about the study.

☐ I don't want to participate in this study.

☐ I do want to participate in this study.

_____ _____

Signature of Pupil Date

Appendix 1(d): Assent Form (Swahili version)

IDHINI YA KUSHIRIKI KATIKA UTAFITI

Jina la Mwanafunzi: _____ **Umri:** _____

Darasa _____

1. Mimi, Dk. Makala Yesaya, nafanya utafiti kuhusu uwepo na kiwango cha mpangilio mbaya wa meno na uhitaji wa matibabu.
2. Tunakuomba ushiriki katika utafiti huu kwa sababu tunataka kujifunza zaidi kuhusu hali ya mpangilio mbaya wa meno na uhitaji wa matibabu kwa watoto wa shule za msingi za umma wilaya ya Kinondoni - Dar es Salaam.
3. Ikiwa utakubali kushiriki katika utafiti huu, utaulizwa maswali ya utafiti kupitia dodoso na mchunguzi atakuchunguza meno yako ili kutambua uwepo na kiwango cha mpangilio mbaya wa meno.
4. Mambo yanayowakumba watu katika utafiti ambayo huwafanya wahisi vibaya huitwa "hatari". Hakuna hatari yoyote ya moja kwa moja inayohusiana na utafiti huu.
5. Mambo yanayowakumba watu katika utafiti ambayo ni mazuri huitwa "faida". Faida za utafiti huu ni: kama utagundulika kuwa na tatizo la mpangilio mbaya wa meno, wazazi wako watataarifiwa kuhusiana na tatizo hilo ili uweze kupelekwa hospitalini kwa msaada zaidi.
6. Tutafanya kila tuwezalo kuhifadhi taarifa yako kwa siri.
7. Ushiriki wako kwenye utafiti huu ni hiari. Unaweza kuacha kushiriki katika utafiti huu wakati wowote
8. Mzazi/mlezi wako ataombwa idhini ya ushiriki wako katika utafiti huu. Lakini hata kama watasema "ndiyo," bado unaweza kuamua kutoshiriki.
9. Unaweza kuuliza maswali yoyote unayoyahitaji kuhusu utafiti huu. Ikiwa utakuwa na maswali mengine baadaye, unaweza kuniuliza pia.

☐ Sitaki kushiriki katika utafiti huu.

☐ Nataka kushiriki katika utafiti huu.

…….. ……

Sahihi ya Mwanafunzi Tarehe

Appendix **2: Investigation tools**

Appendix 2 (a): Questionnaire (English version)

1. ID No:
2. Date:
3. Sex: 1=Male 2=Female
4. Age(years):
5. Education level (Standard): _____
6. Address: _____
7. Occupation of your parent/guardian 1= Business man/woman, 2= Employed, 3= Self-employed, 4= No formal work
8. Do you have health insurance? 1= Yes, 2= No
9. If you were to rate yourself, which picture do you think correlates with your dental appearance (select one among the given ten pictures of different occlusions on the attachment provided) (Attachment 1)
10. "Do you think that you need orthodontic treatment?" 1 = yes; 2 = no; 3 = I don't know.
11. DAI assessment (Attachment 2)

Attachment 1: IOTN-AC



Attachment 2: DAI

DAI	VARIABLE	SCORE	WEIGHT	TOTAL SCORE
1	Number of visibly missing teeth		6	
2	Crowding		1	
	0= No segment			
	1= 1 Segment			
	2= 2 Segments			
3	Spacing in the anterior segment		1	
	0= No segment			
	1= 1 Segment			
	2= 2 Segments			
4	Diastema in anterior segment(mm)		3	
5	Largest irregularity in the maxilla(mm)		1	
6	Largest irregularity in the mandible(mm)		1	
7	Maxillary overjet(mm)		2	
8	Mandibular overjet(mm)		4	
9	Anterior open bite(mm)		4	
10	Molar relationship		3	
	0 = Normal			
	1 = Difference of ½ a cusp			
	2 = Difference of ≥ 1 cusp			
11	Constant		13	
	TOTAL SCORE			

Appendix 2 (b): Questionnaire (Swahili version)

1. Namba ya utambulisho:
2. Tarehe:
3. Jinsia**:** 1= mme, 2= mke
4. Umri (miaka):
5. Kiwango cha elimu (Darasa): _____
6. Mahali unapoishi: _____
7. Kazi ya Mzazi/Mlezi: 1= Mfanya biashara, 2= Ameajiriwa, 3= Kajiajiri, 4= Hana kazi maalum
8. Je, una bima ya afya? 1= Ndio, 2= Hapana
9. Kama ukijitathmini mwenyewe, unafikiri ni picha gani inaendana na muonekano wa meno yako kati ya hizi?(Changua moja kati ya picha kumi za meno ulizopewa) (Kiambatisho 1)
10. “Unafikiri unahitaji matibabu ya kupanga meno?” 1 = Ndio, 2 = Hapana, 3 = Sijui
11. Tathmini ya DAI (Kiambatisho 2)

Kiambatisho 1: IOTN-AC



Kiambatisho 2: DAI

DAI	VARIABLE	SCORE	WEIGHT	TOTAL SCORE
1	Number of visibly missing teeth		6	
2	Crowding		1	
	0= No segment			
	1= 1 Segment			
	2= 2 Segments			
3	Spacing in the anterior segment		1	
	0= No segment			
	1= 1 Segment			
	2= 2 Segments			
4	Diastema in anterior segment(mm)		3	
5	Largest irregularity in the maxilla(mm)		1	
6	Largest irregularity in the mandible(mm)		1	
7	Maxillary overjet(mm)		2	
8	Mandibular overjet(mm)		4	
9	Anterior open bite(mm)		4	
10	Molar relationship		3	
	0 = Normal			
	1 = Difference of ½ a cusp			
	2 = Difference of ≥ 1 cusp			
11	Constant		13	
	TOTAL SCORE			

Appendix 3: Ethical Clearance

UNITED REPUBLIC OF TANZANIA

MINISTRY OF EDUCATION, SCIENCE AND TECHNOLOGY

MUHIMBILI UNIVERSITY OF HEALTH AND ALLIED SCIENCES

OFFICE OF THE DIRECTOR – RESEARCH, PUBLICATIONS AND INNOVATIONS

Ref. No.DA.282/298/01.C/2196 Date: 29/04/2024

MUHAS-REC-04-2024-2196
DR MAKALA YESAYA
SCHOOL OF DENTISTRY
MUHAS

RE: APPROVAL FOR ETHICAL CLEARANCE FOR A STUDY TITLED: SEVERITY OF MALOCCLUSION AND ORTHODONTIC TREATMENT NEED AMONG SCHOOL CHILDREN IN KINONDONI DISTRICT, DAR ES SALAAM TANZANIA

Reference is made to the above heading,

I am pleased to inform you that the Chairperson has on behalf of the University Senate, approved ethical clearance of the above-mentioned study, on recommendations of the Senate Research and Publications Committee meeting accordance with MUHAS research policy and Tanzania regulations governing human and animal subjects research.

APPROVAL DATE: 29/04/2024
EXPIRATION DATE OF APPROVAL: 29/04/2025

STUDY DESCRIPTION:

Purpose:

The purpose of this community based descriptive cross sectional study is to determine severity of malocclusion and orthodontic treatment need among public primary school children of Kinondoni District, Tanzania, by using the Dental Aesthetic Index (DAI)

The approved protocol and procedures for this study is attached and stamped with this letter, and can be found in the link provided: https://irb.muhas.ac.tz/storage/Certificates/Certificate%20-%2015273.pdf and in the MUHAS archives.

The PI is required to:

1. Submit bi-annual progress reports and final report upon completion of the study.
2. Report to the IRB any unanticipated problem involving risks to subjects or others including adverse events where applicable.
3. Apply for renewal of approval of ethical clearance one (1) month prior its expiration if the study is not completed at the end of this ethical approval. You may not continue with any research activity beyond the expiration date without the approval of the IRB. Failure to receive approval for continuation before the expiration date will result in automatic termination of the approval for this study on the expiration date.
4. Obtain IRB amendment (s) approval for any changes to any aspect of this study before they can be implemented.
5. Data security is ultimately the responsibility of the investigator.
6. Apply for and obtain Data Transfer Agreement (DTA) from NIMR if data will be transferred to a foreign country.
7. Apply for and obtain Material Transfer Agreement (MTA) from NIMR, if research materials (samples) will be shipped to a foreign country.
8. Apply for and obtain permission to publish the results from National Institute for Medical Research. The application should be before submitting to a publisher and not concurrently through the email publications@nimr.or.tz.
9. Any researcher, who contravenes or fail to comply with these conditions, shall be guilty of an offence and shall be liable on conviction to a fine as per NIMR Act No. 23 of 1979, PART III section 10 (2)
10. The PI is required to ensure that the findings of the study are disseminated to relevant stake holders.
11. PI is required to be versed with necessary laws and regulatory policies that govern research in Tanzania. Some guidance is available on our website https://drp.muhas.ac.tz/.

Dr. Nahya Salim Masoud,
Chairperson, MUHAS Research and Ethics Committee

Muhimbili University of Health and Allied Sciences
DIRECTOR
Research, Publications & Innovations
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