Assessment of early orthodontic treatment need and its associated factors among Tanzanian children using ipion-index

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ASSESSMENT OF EARLY ORTHODONTIC TREATMENT NEED AND ITS ASSOCIATED FACTORS AMONG TANZANIAN CHILDREN USING IPION-INDEX

By

Joseph Paulinus Tungaraza,

A Dissertation Submitted in (partial) Fulfillment for Requirements for the Degree of Master of Dentistry (Paediatric Dentistry) of

Muhimbili University of Health and Allied Sciences
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CERTIFICATION

The undersigned certify that they have read and hereby recommend for acceptance by Muhimbili University of Health and Allied Sciences a dissertation entitled ***"Assessment of early orthodontic treatment need and its associated factors among Tanzanian children using IPION-index"*** in (Partial) fulfilment of the requirements for the degree of Master of Dentistry (Paediatric Dentistry) of Muhimbili University of Health and Allied Sciences.

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Dr. Matilda Mtaya-Mlangwa

(Supervisor)

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Date

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Dr. Emeria A. Mugonzibwa

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Date

DECLARATION AND COPYRIGHT

I, **Joseph Paulinus, Tungaraza**, declare that this **dissertation** is my own 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 dissertation is dedicated to:

My late Father	Paulinus Tungaraza Bunyara
My Mother	Zitta Gabaseki Gregory Luginga
My lovely wife	Adiltruda Demii Mroso
My lovely daughter	Brightness Joseph Tungaraza Bunyara
My lovely son	Brighton Joseph Tungaraza Bunyara

LIST OF ABBREVIATIONS

ABO	-	American Board of Orthodontics
DED	-	District Executive Director
DMO	-	District Medical Officer
DPGS	-	Director of Postgraduate Studies
EOT	-	Early Orthodontic Treatment
IOTN	-	Index of Orthodontic Treatment Need
IPION	-	Index for Preventive and Interceptive Orthodontic Need
OPCD	-	Orthodontics, Paedodontics and Community Dentistry
MDENT	-	Master of Dentistry
MoHCDGEC	-	Ministry of Health, Community Development, Gender, Elderly and Children
MUHAS	-	Muhimbili University of Health and Allied Sciences
NBS	-	National Bureau of Statistics
SOD	-	School of Dentistry
SPSS	-	Statistical Package for Social Sciences
TMJ	-	Temporomandibluar joint
WHO	-	World Health Organization

DEFINITION OF KEY TERMS

Anterior crossbite is defined as a malocclusion resulting from the lingual positioning of the maxillary anterior teeth in relationship to the mandibular anterior teeth (Tsai, 2001).

Anterior open bite is a space between the upper and lower incisor edges (Mitchell, D. and Mitchell, L., 2014).

Dental caries means a localized post eruptive, pathological process of external origin involving softening of the hard tooth tissue and proceeding to the formation of a cavity (WHO, 1962).

Early loss of primary teeth is defined as the loss of a deciduous teeth before the time of their natural exfoliation (Cavalcanti et al., 2008).

Early orthodontic treatment need is the treatment started in either the primary or mixed dentitions that is performed to enhance the dental and skeletal development before eruption of the permanent dentition (Bishara et al.,1997).

Frenum is a thin fold of mucous membrane with enclosed muscle fibers that attach the lips to the alveolar mucosa and underlying periosteum (Proffit WR, 2000).

IOTN denotes an Index for Orthodontic Treatment Need (Mitchell, 2005).

IPION is an index that records various occlusal traits in the mixed dentition (age 6 and 9), with scores depending on their severity (Coetzee and De Muelenaere, 1998).

Lips incompetency are the lips that remain parted during the relaxed position of muscle of facial expression and mandible is in rest position (Alam, 2011).

Malocclusion is a condition that reflects an expression of variability in the way the maxillary and the mandibular teeth occlude (Singh, 2007).

Occlusal traits are defined as abnormal features of the dental alveolar arch and the teeth, which make up the malocclusions (Coetzee and De Muelenaere, 1998)

Oral functional are oral facial soft tissues that include midline diastemas and incompetent lips (Edward,1977).

Overbite is defined as overlap of the incisors in the vertical plane (Mitchell, D. and Mitchell, L., 2014).

Overjet is defined as horizontal overlap of incisors (Mitchell, D. and Mitchell, L., 2014).

Posterior crossbite is when the buccal cusp of the maxillary tooth occluded lingual to the buccal cusp of the mandibular antagonists (at least one pair of teeth) (Sepp et al., 2017).

Submerged teeth are teeth that is below the plane of occlusion (Farlex, P., 2009).

ABSTRACT

Background

Early orthodontic treatment aims **to** identifying and intervening occlusal conditions occurring in the primary and early mixed dentition. This treatment is effective and desirable when the correction of malocclusions in young patient is requested, where a stable result may be achievable, less extraction of permanent teeth may be needed, the duration of orthodontic treatment in permanent dentition may be reduced and future costly treatment need may be eliminated. Thus, this study identified EOT need which is pivotal for organizing and planning preventive orthodontic services and care in Tanzanian children.

Aim

The aim of this study was to assess early orthodontic treatment need and its associated factors among children in Dar es salaam, Tanzania.

Methodology

This was an analytical cross sectional study, in which primary and nursery school children aged 6 and 9 years from Kinondoni Municipality, in Dar es Salaam were involved. About 720 school children were expected to participate in the study, after being selected by multistage cluster sampling technique. Data collection was done using a questionnaire for obtaining demographic characteristics. A clinical examination form was used for recording occlusal traits and other oral health problems in order to obtain the IPION-scores. Data was coded and analyzed using a computer software, SPSS version 20.0. Frequency distributions of demographic characteristics and various clinical variables were generated. Chi-square and logistic regression models were used to test for statistically significant differences between two variables in bivariate analysis of need for EOT (dependent variable) and factors associated with the need for EOT (independent variables e.g. socio-demographic factors) and in multivariate analysis for interactions between multiple variables, respectively. The *p-value* for statistical significance was set at $p<0.05$ and the confidence interval (CI) was at 95%.

Results

A total of 667 children (59.5% girls; 52.5% 9-year-olds) were able to participate in the study. Most children had carious teeth (age 6 years, 77.9% and age 9 years, 60%). The most common prematurely lost teeth were the lower second primary molars (these were affected in 6% of 6-year-olds and 4.9% of 9-year-olds). The most commonly recorded occlusal anomaly in both ages was an increased overjet (recorded in 18.9% of 6-year-olds and 34.9% of 9-year-olds). Active frenum was the commonest functional characteristic, found in 16.9% of the 9-year-olds. The overall early orthodontic treatment need per IPION index was 41.7%. Regarding the relationship between socio-demographic characteristics and orthodontic treatment need per IPION index, significantly many 9-year-old boys needed treatment than girls in both ages (in the 6-years, boys 78.3% vs girls 66.5%; *p-value 0.024* and in the 9-years, boys 70.5% vs girls 58.7%; *p-value 0.030*). Following logistic regression model; caries (OR 50.5, CI 13.3-192.4; $p<0.001$), premature loss of primary teeth (OR 4.5; CI 1.8-11.2; $p<0.001$), anterior crossbite (OR 5.3, CI 1.6-17.5; $p<0.05$) and anterior open bite (OR 27.2, CI 5.3-139.8; $p<0.001$), remained as significant determinants for having a definite treatment need in the 6-year-olds. As for the 9-year-olds; caries (OR 319.9, CI 58.1-1763.4; $p<0.001$), anterior crossbite (OR 67.6, CI 4.3-1053.1; $p<0.05$), deep bite (OR 10.3, CI 2.1-51.1; $p<0.05$), anterior open bite (OR 49.1, CI 8.3-289.9; $p<0.001$) and lips incompetency (OR 6.2, CI 1.5-25.5; $p<0.05$), remained as significant determinants for having a definite treatment need**.**

Conclusion

Early orthodontic treatment need for malocclusions was high in school children of Kinondoni municipality, Dar es Salaam, Tanzania. Whereby, about half of the participants had a definite EOT need according to the IPION-scores. The factors associated with the overall IPION-score were mainly clinical conditions such as having dental caries, premature loss of primary teeth, anterior crossbite, open bite, deep bite and lip incompetence. The children would thus benefit from preventive and interceptive orthodontic treatment programs.

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CHAPTER ONE

1.0 INTRODUCTION

Malocclusion is a condition that reflects an expression of variability in the way the maxillary and the mandibular teeth occlude (Singh, 2007). Untreated malocclusions usually have physical, psychological and social effects to individuals, where, Mtaya et al., (2008) found that in 23% of children from two Tanzanian Districts, were dissatisfied because of having malocclusions. Hence, treatment of malocclusions can result into improvement of oral functions and oro-facial aesthetics (Zhang et al., 2006; Mtaya et al., 2008**),** and ultimately an improved individuals' satisfaction.

Early orthodontic treatment thus aims at identifying and treating malocclusions and malocclusion related conditions occurring in children's primary and early mixed dentition (Ricketts, 1979). The College of Diplomates of the American Board of Orthodontics (ABO) defined early orthodontic treatment (EOT) as "treatment started in either the primary or mixed dentitions that is performed to enhance the dental and skeletal development before eruption of the permanent dentition"(Bishara et al.,1997). This treatment is also effective and desirable in the correction of skeletal malocclusions in young patients, where stable results may be achievable, less extractions of permanent teeth may be needed, the duration of orthodontic treatment in permanent dentition may be reduced and future costly of treatment need may be reduced (Grippaudo et al., 2014). The treatment therefore tends to eliminate the primary etiological factors for malocclusions and prevent the progression of inharmonious skeletal, dental and functional occlusal conditions (Siqueira et al., 2015). Moreover, the psychological influence that a malocclusion could have on the patient would also be addressed at an earlier stage (Kerosuo, 2002; King and Brudvik, 2010), through provision of an early intervention.

Strategies for EOT may include preventive or interceptive measures or programs. Principally, there is a slight difference between interceptive orthodontics and preventive orthodontic treatment. Interceptive orthodontics refers to the procedures that eliminate or reduce the severity of a developing malocclusion, while preventive orthodontics is any action taken to preserve the integrity of a normal occlusion (Popovich and Thompson, 1973). Additionally,

preventive treatment in orthodontics aim at promoting a physiological development of a good occlusion and avoiding further progression of a malocclusion (Grippaudo et al., 2014). Hence, early diagnosis of conditions affecting the normal development of dental occlusion can contribute to overall reduction in the incidence of malocclusions (Siqueira et al., 2015).

As far as the treatment cost is concerned, successful early orthodontic treatment with simple appliances provide a potential cost benefit compared to complex treatment with fixed appliance treatment (Borrie and Felicity, 2013). It is generally understood that complex treatment of malocclusions is very expensive, normally it is not affordable by less affluent people, who are abundant in Tanzania. Unfortunately, most insurance schemes are hesitant to cover orthodontic treatment for malocclusions, and worse enough the health system, which is already overburdened by many other conditions, cannot wholly cover the cost for complex orthodontic treatment. If fixed appliances can be avoided by judicious interceptive treatment a decrease in iatrogenic damages can be achieved (Thilander and Rönning, 1995; Borrie and Felicity, 2013). These facts support the importance of early orthodontic treatment, compared to the complex one.

Prior to initiation of early orthodontic treatment in children, it is important to consider different socio-demographic and behavioral factors influencing the development of malocclusions in children. Different indices thus exist for specific ages (Karaiskos et al., 2005). IPION index was chosen in the present study, because it exactly focuses on children aged 6 and 9 years. Whereby, in most six year-olds there is initiation of mixed dentition, and in nine-year-olds there is beginning of eruption of canine-premolar group of teeth (Rauten et al., 2016). Generally, these children have characteristic mixed dentition stages and are thus prone to various malocclusions/ occlusal deviations (Mitchel, 2005). Furthermore, (IPION) was developed to rank malocclusions in a population of 6 and 9 year-olds to be considered for impending preventive and /or interceptive treatment. Generally, IPION-index allows early detection of developing malocclusions, facilitates the provision of interceptive treatment, minimizes or even eliminates the need for complex treatment (Coetzee, 1999; Borrie and

Felicity, 2013) in future. In addition, the IPION-index measures various occlusal traits (Appendix VII) and assigns a value depending on the severity of those occlusal traits.

Regarding the factors related to the IPION-index, there are varieties of such factors, these include but are not limited to age and sex of children (Karaiskoset al., 2005; Burhan and Nawaya, 2016). Despite the importance of the IPION index, information on orthodontic treatment need as determined by the index, and factors associated with it, could not be retrieved in Tanzania. Thus, this study reports early orthodontic treatment need and its associated factors using an IPION-index among 6 and 9-year-olds Tanzanian children from Kinondoni District of Dar es Salaam region in Tanzania.

1.1 LITERATURE REVIEW

1.1.1 Prevalence of malocclusions

Dental malocclusion or occlusal trait is a common phenomenon, being present in all societies. Various authors have examined occlusal traits, either visually or metrically in the primary dentition (Rop, 2011) and in permanent dentition (Mtaya et al., 2009). But the reported prevalence of malocclusions contrasts in different parts of the world and among various populations. Differences in the age ranges of the population studied, ethnicity and the number of subjects examined could explain some of the variations (Alhaija et al., 2004).

The reported prevalence of malocclusions in primary dentition varies between 20% and over 70 % (Malandris and Mahoney, 2004; Carvalho et al., 2011; Dimberg et al., 2009; Krishna et al., 2013). In the permanent dentition, it ranges from 39% in Indian (Dhar et al., 2007) to 64% in Tanzanian children (Mtaya, 2009). Severity of occlusal traits was used to determine the early orthodontic treatment need (Mitchell, 2005) of a particular population. Thus, this study assessed the magnitude of malocclusions among children aged 6 and 9-years, information which is relevant for planning prevention and early orthodontic treatment.

1.1.2 Factors associated with need for early orthodontic treatment

1.1.2.1 Occlusal traits

Different factors have contributions to the IPION-scores and are associated with a high risk of developing malocclusions in the early mixed dentition. Grippaudo et al. (2014) reported more than 10% of cross-bites among Italian children that needed treatment. Previously in Tanzania (using the IOTN index), the main severe occlusal feature placing children into the category of need for orthodontic treatment was a cross-bite among 38-69% of the participants, and open bite was the next feature that was found in 14-16% of the participants (Mugonzibwa et al., 2004). Overbite, overjet and open bite have also been reported by various authors to contribute to the prevalence of malocclusions among children that needed orthodontic treatment (Coetzee, 1999; Karaiskos et al., 2005). Therefore, different occlusal traits were assessed in this study in order to identify EOT need by using the IPION-index among Tanzanian children residing in the Dar es Salaam region. This will provide guidelines on early detection, treatment and prevention of malocclusion.

1.1.2.2 Dental caries

Dental caries is the most common aetiological factor for early loss of teeth which is a risk for malocclusions. In Tanzania, dental caries prevalence among children aged between 12 and 14 years was found to be 22 % (Mbawalla et al., 2011). Whilst, among 6 – 36 months, the prevalence of dental caries was reported to be 3.6% (Masumo et al., 2012). Globally, dental caries was reported to affect 60-90% of school-aged children and most adults (Petersen et al., 2005; Mashoto, 2011). Over the years, evidence has suggested a decline in the prevalence of dental caries, particularly among children, adolescents and young adults in developed countries (Brukiene et al., 2005; Mashoto, 2011).

Dental caries tend to shorten the dental arches either through breakdown of interproximal surfaces or loss of teeth (Karaiskos et al., 2005; Rauten et al., 2016). Additionally, dental caries largely contributes to the IPION-scores and it is well related to early loss of deciduous teeth. This is hence an important environmental aetiological factor for malocclusions in children (Karaiskos et al., 2005; Rauten et al., 2016). So, the current study assessed caries status as one of the components of the IPION-index. Consequently, the results obtained in the current study, enabled the researcher to document on the contribution of dental caries in the IPION index. This is information is essential for planning malocclusion prevention programs in children aged 6 and 9 years**.**

1.1.2.3 Early loss of primary teeth

Early loss of deciduous teeth should be intervened earlier as it usually shortens the dental arches (Siqueira et al., 2015), particularly where the first permanent molars drift into the left out spaces (Karaiskos et al., 2005), reducing spaces for permanent teeth. A previous research reported that, early loss of second primary molar can result into migration in the sagittal plane of the first permanent molar ending up with a molar relationship change, of either Class II or III (Rauten et al., 2016). Loss of a deciduous molar usually produces a rapid and more or less extensive collapse of the buccal segment so that there is insufficient space for the succeeding teeth.

Another study documented further that, most important of all, is the loss of second deciduous molar as it may cause the first permanent molar to move forward very rapidly (Coetzee, 1999). In the present study, it was also acknowledged that, spaces in the upper jaw close more rapidly than in the lower one (Coetzee, 1999). Likewise, it has been suggested that in early loss of deciduous teeth space maintainers should be used to prevent the migration of adjacent teeth (Siqueira et al., 2015; Rauten et al., 2016)**.** Thus, this study assessed the extent of early loss of primary teeth, which was required to identify the need for EOT. The information is pertinent for planning prevention of malocclusions and EOT in children of both ages (6 and 9 years), through early detection and determining the extent of the problem.

1.1.3 Oral functional problems

Oral functional problems include but are not restricted to conditions like oral facial soft tissue problems i.e. maxillary midline diastemas and incompetent lips. Maxillary midline diastemas are easy to close quickly with modern orthodontic mechanics; however, they have high relapse rate (Edward, 1977). They are normally seen in the mixed and permanent dentition stages (Keen, 1963). Active frenum is occasionally associated with a large maxillary midline diastema but not continually. A central maxillary diastema of more than 2mm is considered as an abnormality (Haider et al.,2013). However, a diastema may or may not close by itself during eruption of permanent canines, so the frenal attachment may or may not lead to future esthetic issues (Haider et al.,2013). Rauten et al. (2016) reported an active fraenum prevalence of 2.6% among Romanian children.

Orofacial soft tissues and behaviors have an impact on positioning of the upper and lower lips. Dixit and Shetty, (2013) compared various soft tissue parameters; they observed larger numbers of children with tongue thrusting tendencies, also having lips incompetency. This was seen in 86% of their children with tongue thrusting compared to 14% without tongue thrusting. Besides, Lee and Kim (2018), regarded elimination of the lip incompetency as being important in improving one’s facial profile. These conditions have rarely been considered in many Tanzanian studies. Thus, lip incompetency, diastemas and active frenum were assessed in this study; because they are constituents of the IPION index, which determines the EOT need.

1.1.4 Early orthodontic treatment need

Several studies have been conducted worldwide to assess early orthodontic treatment need for malocclusions in different child-populations (Al-Nimri and Richardson, 2000; Keski-Nisula et al., 2003; Karaiskos et al., 2005; Kerosuo et al., 2008; King and Brudvik, 2010). The studies were performed using different indices and scoring methods (Al-Nimri and Richardson, 2000; Keski-Nisula et al., 2003; Karaiskos et al., 2005; Kerosuo et al., 2008; King and Brudvik, 2010). As a result the previous studies have yielded various findings. For example two Finnish studies found that the need for orthodontic treatment was present in 25.8% and 20.4% of the populations they assessed (Jarvinen, 1981; Heikinheimo and Salmi, 1987). In the United States of America, 15% of the population studied, were in need for early orthodontic treatment (Ackerman and Proffit, 1980).On the other hand, the study by Karaiskos et al. (2005) who used an IPION-index among Canadian children, over 28% of children they examined needed early orthodontic treatment. In Syria, 26.7% of children studied were found to have moderate orthodontic treatment need and 57.9% of children were found to have definite treatment need, using the IPION-index (Burhan and Nawaya 2016).

In a previous Tanzanian study that utilized the IOTN-index, among children aged between 3 to 16 years, orthodontic treatment need was recorded in 3-12% of the children (Mugonzibwa et al., 2004). However, in Tanzania, there was no study that had assessed early orthodontic treatment need using the IPOIN-index; henceforth the magnitude of the need for EOT in children aged 6 and 9 years were determined in the present study and will be used for planning prevention of malocclusion and EOT. This is because the obtained information will enable timely identification of the problems and will reveal the affected group of the children to be targeted by early orthodontic programs.

1.1.5 Social demographic characteristics

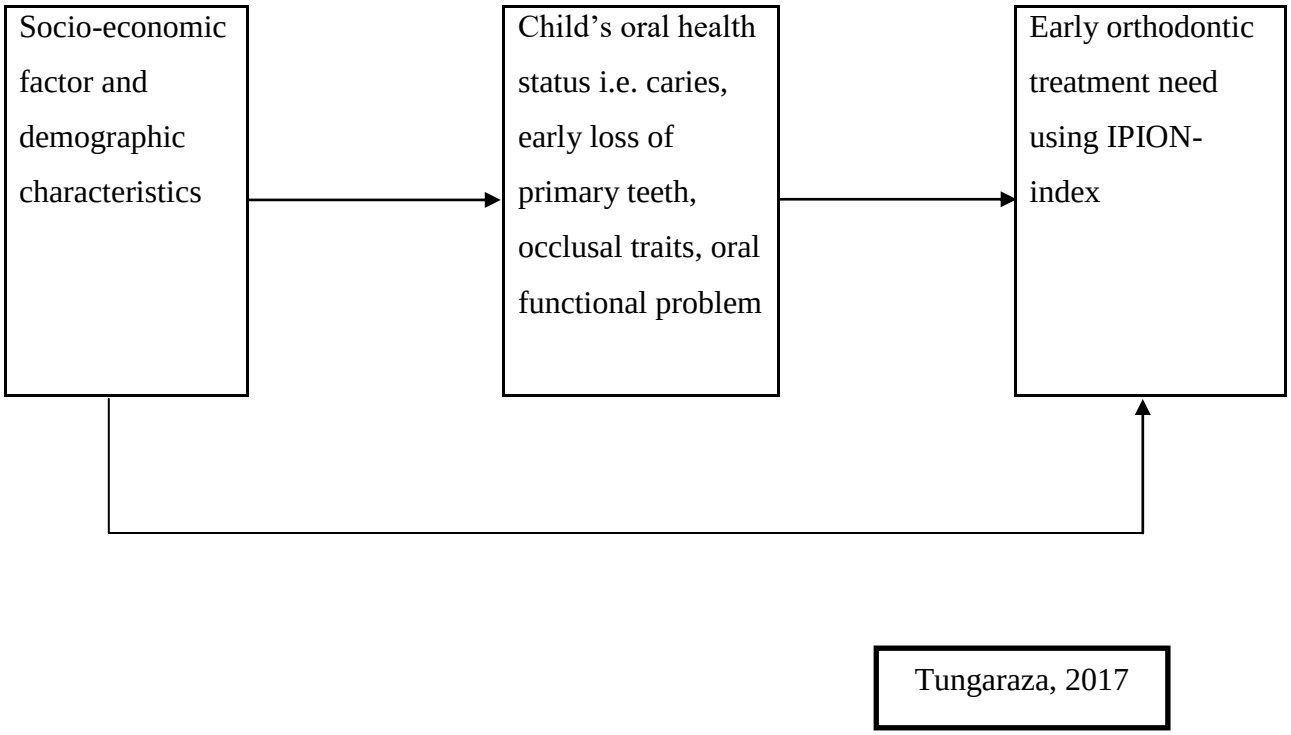
The social demographic characteristics have been found to have impact on dental care seeking behaviors (Mbawalla et al., 2010; Ismail, 1998; Tinanoff et al., 1998). Families with poor socio-economic status rarely seek orthodontic care even though their children may have the need. Moreover, their children may have deleterious oral habits, but the parents may not

bother since they lack knowledge (Hebling et al., 2008) of the consequences of habits. More researchers have emphasized that the presence of caries and early loss of deciduous teeth are conditions that are frequently occurring in poor populations, deprived of basic dental care services (Mtaya et al. 2009; Farias et al., 2013). Furthermore, in another Tanzanian study, it was documented that three quarters of the low-income countries have insufficient human and financial resources to provide essential health care package for their children (Mosha, 1990), impacting negatively on their oral health status. Thus, it was considered important to compare the IPION-scores among children with different socio-demographic characteristics in Dar es Salaam. The information attained was used to summarize the need for EOT, to be used to plan focused early orthodontic care for specific groups of children.

1.2 CONCEPTUAL FRAMEWORK

A conceptual framework (Fig 1) guided this study. The conceptual framework suggests that; demographics and socio-economic factors e.g. age of a child and level of parents' education affects or determines the oral health status of a child such as having caries, early loss of primary teeth and bad occlusal conditions. A child's oral health status such as bad occlusal condition is the component of the IPION-index. Moreover, the child's socioeconomic and socio-demographic characteristics can directly be associated with EOT need.

Figure 1: Conceptual framework.



1.3 PROBLEM STATEMENT

Malocclusion is a condition with the common occurrence in children. It has been found to affect almost three quarters of 12-14 year-olds Tanzanian children (Mtaya et al., 2009). Malocclusions may go unnoticed and unattended until later in life. This may predispose children to severe forms of the condition, which can be carried on to the permanent dentition and to adulthood. Although malocclusions are not life threatening, they can be associated with imperative public health issues. The public health issues of concern are the likelihood of developing serious oral health problems such as dental caries as well as periodontal diseases, at the same time dental caries can be an aetiological factor for malocclusions (a vicious cycle).

Malocclusions have further been associated with serious psychosocial implications such as lowered self-esteem in affected individuals. Most forms of malocclusions can be prevented or intercepted earlier; this is an inexpensive way of malocclusion management. Earlier Tanzanian study found that 3-12 percent of the children had EOT need (Mugonzibwa et al., 2004). However, most children attend for orthodontic treatment at later ages requiring them to undertake comprehensive orthodontic treatment; consequently they are subjected to lots of obstacles. Overall, the failure to get EOT may be due to inaccessibility and underutilization of oral health care services, inadequate qualified personnel and high cost of comprehensive treatment.

Malocclusions in children that are associated with early loss of primary teeth, dental caries and behavioral factors or those which arise due to poor socio-economic status are prevalent. Yet, they are preventable and treatable at early stages. Nevertheless, no study had utilized the IPION index to identify the need for EOT, before the current study.

1.4 RATIONALE

In Tanzania, information regarding early orthodontic treatment need and associated factors is relevant for organizing early orthodontic interventions for various occlusal conditions in children. If malocclusions are left untreated until later stages, they may need complicated treatment with fixed orthodontic appliances. Since, individuals with severe malocclusions may encounter social discrimination and problems with oral health status and oral function; this compels them to seek treatment for one or both reasons.

Tanzania is a developing country, for that reason the health system of Tanzania may not be able to meet the need of all those who have occlusal problems, as the treatment they may require could be costly and complicated. When patients demand orthodontic treatment, they are faced with obstacles such as unavailability of orthodontists, high costs and unavailability of equipment and materials. In such circumstances, prevention and interception of malocclusions remains as a feasible option. Although prevention and early orthodontic treatment does not always stop the future need for comprehensive orthodontic care, they tend to reduce the extent and duration of comprehensive orthodontic treatment and its adverse effects. So, screening, detection, prevention and prompt intervention of abnormal occlusal development are of immense help.

The other advantage of information obtained in this study is that it enabled the understanding of the extent of different occlusal conditions and their associated factors. This will eventually assist in planning and development of preventive and interceptive orthodontic strategies for Tanzanian children. Generally, this research enabled the researcher to generate data on early orthodontic treatment need of children in Tanzania**.** Moreover, the information from this study is instrumental for orthodontists, other dental clinicians, researchers and educators, as it will enable them to understand the extent of EOT need in children. For educators, the study findings will also be used as evidence based information, to be shared with their students. Thus, this study availed a baseline data on early orthodontic treatment need and its associated factors. It has henceforth laid a foundation for future comprehensive research on the matter. Lastly, the study was required for partial fulfilment of Master Degree in Paediatric Dentistry.

1.5 RESEARCH HYPOTHESIS

1.5.1 Null hypothesis

There is no early orthodontic treatment need and its associated factors among Tanzanian children using IPION-index.

1.5.2 Alternative hypothesis

There is early orthodontic treatment need and its associated factors among Tanzanian children using IPION-index.

1.5.3 Research questions

1. What proportion of primary school children in Kinondoni District of Dar es Salaam region have early orthodontic treatment need as assessed by the IPION index?
2. What factors are associated with the early orthodontic treatment need among children in Kinondoni District of Dar es Salaam region using the IPION-index?

1.6 Objectives

1.6.1 Broad objectives

To assess early orthodontic treatment need and its associated factors among Tanzanian children aged 6 and 9 years using IPION-index.

1.6.2 Specific objectives

1. To determine the prevalence of different types of occlusal traits among primary school children in Dar es Salaam using the IPION-index.
2. To determine the prevalence of caries among primary school children in Dar es Salaam using the IPION-index.
3. To determine proportion of primary school children in Dar es Salaam with early loss of primary teeth using the IPION-index.
4. To determine proportion of primary school children in Dar es Salaam with oral functional problems using the IPION-index.
5. To determine proportion of primary school children in Dar es Salaam with EOT need using IPION-index.
6. To determine the relationship between early orthodontic treatment need using the IPION index and factors associated with the index among primary school children in Dar es Salaam.

CHAPTER TWO

2.0 MATERIALS AND METHODS

2.1 Study Design

This was an analytical cross sectional study, in which primary school children from Kinondoni Municipality, in Dar es Salaam were involved.

2.2 Study area

This study was carried out in Kinondoni Municipality in Dar es Salaam. Dar es Salaam region is a region that was established in 1973 from the former Coast Region. It is the main commercial city of Tanzania and a major sea port on the shores of Indian Ocean. It comprises of five Districts; Temeke, Kigamboni, Kinondoni, Ubungo and Ilala. Dar es Salaam population is estimated to be 4,364,541 (female 51.3%, children 32%) (Dar Es Salaam region socio-economic, 2014). This region was chosen since it is the most densely populated as well as it is the most socially heterogenic region in Tanzania.

2.3 Study population

School children aged 6 and 9-year-olds from public primary schools were involved.

2.4 Inclusion criteria

- Age 6 and 9-year-olds with mixed dentition. Ages was determined by the child's age at the last birthday.
- The child has no history of orthodontic treatment.

2.5 Exclusion criteria

- Children who were too uncooperative to undertake the interview and clinical examination, in a classroom setting.

2.6 Sample size estimation

The sample size estimation was based on the formula below.

$$n = [z2p\ (1-p)/e2]*2$$

Where n= sample size

p = Proportions of early orthodontic treatment need- 28% (Karaiskos et al., 2005).

z = Normal standard deviation (1.96 for 95%) confidence level

e = maximum tolerable error 5%, CI=95%.

*2= design effect (used in multistage sampling)

Therefore n = 620 as minimum sample size required.

Ten percent from the minimum sample size was added to cater for drop outs, hence the sample size was supposed to be 682. But at least 40 pupils per school was involved, since there were 18 schools, 720 children comprised the sample size.

2.7 Sampling technique

A stratified multistage cluster sampling method was utilized. At the first stage districts were sampled randomly. Kinondoni district was selected randomly from the list of all Dar Es Salaam districts. In the second stage, systematic random sampling method was employed to sample primary schools (which have both primary and nursery schoolchildren). Eighteen (18) out of 77 primary schools from 20 wards were chosen randomly. Eligible children aged 6 and 9-year-olds from the schools was selected and participated in the study. The method utilized class attendance registers. Children's names were picked randomly by using ballot papers until the required number of children per school was reached.

2.8 Subject recruitment

All children selected to participate were given consent letters to be signed by their parents. Then parents were asked to fill in their details in the questionnaire designed to obtain socio-demographic characteristics. The clinical examination was involved amongst the participants. Only children who had signed informed consent forms, from their parents/guardians were recruited in the study.

2.9 Reliability of data

A test retest clinical examination was carried out in about a month after initial examination. The Cohen's Kappa values for the test retest examination were calculated accordingly. This was done based on double measurements of 80 cases. The Kappa values for the clinical variables assessed are presented in Table 1 below:

Table 1: Kappa values for clinical variables

Teeth type and occlusal traits	Kappa value age 6 years	Kappa value age 9 years
Upper primary canine	0.76	0.69
Upper primary first molar	1.00	0.85
Upper primary second molar	0.90	0.86
Upper permanent first molar	1.00	0.70
Lower primary canine	0.88	0.70
Lower primary first molar	0.86	0.95
Lower primary second molar	0.80	0.95
Lower permanent first molar	1.00	0.70
Molar relationship right side	1.00	0.94
Molar relationship left side	1.00	0.97
Overjet	0.87	0.85
Anterior crossbite	1.00	0.94
Overbite	0.46	0.74
Open bite	0.79	1.00

NB: 0.81-1.00= Perfect; 0.61-0.80= Substantial; 0.41-0.60=Moderate

2.10 Validity of data

The principal investigator was calibrated by an Orthodontist and a Pediatric dentist specialist, prior to the main study. The clinical examination was done as per IPION-index.

2.11 Data collection

Data collection was through a questionnaire for socio-demographic characteristics including children's age, sex, parents' level of education and parents' occupation. This was responded by the parents/guardians of the involved children. The clinical examination was performed after questionnaire administration. The clinical examination included caries status, functional characteristics and occlusal traits (Appendix VI), information obtained were filled in a special form designed for age 6-and 9-years as per IPION-index. The treatment need (Cut off points) were set as follows; 0-5 No treatment need, 6-14 Moderate treatment need and 15+ definite treatment need. Clinical examination was carried out under natural day light. For each individual, disposable examination gloves, disposable plastic rulers, sterile probes/CPI, mouth mirrors and gauzes were used during clinical examination. All the instruments were disinfected accordingly and sterilized daily at the MUHAS Dental School.

2.12 Variables

The dependent variable was IPION score, measured by the weighted scores of caries status, various occlusal traits and functional characteristics. Independent variables were socio-demographic factors, namely; sex, child's grade, father's education, mother's education, father's occupation and mother's occupation.

2.13 Data entry and analysis

Data was analyzed and then coded using a computer software SPSS version 20.0. Basic descriptive statistics to measure percentages and frequencies of different variables was applied. In bivariate analyses interaction between the need for EOT (dependent variable) and factors associated with the need for EOT (independent variables e.g. socio-demographic factors) were assessed. Chi-square statistics was used to assess statistical significance of the bivariate associations. Interactions between multiple variables were assessed by multivariate analyses; this was performed in a logistic regression model. The *p-value* was set at $p<0.05$, with 95% Confidence Interval.

2.14 Ethical clearance and ethical consideration

Ethical clearance was sought from MUHAS Institutional Review Board (IRB). Permission to conduct the study was obtained from Kinondoni Municipal Council administration. Parents/guardians signed informed consent forms. Parents/guardian and the children were verbally informed about the purpose of the study, and their willingness to participate in the study was requested. Confidentiality of the information provided was maintained and freedom to withdraw without penalty from the study was allowed. For children who were found with caries or occlusal problems they were advised to seek consultations at the nearest dental clinic and oral health information was given to all participants after the clinical examination.

2.15 Study limitation and mitigation

Some children were not able to tell the reason for their early loss of teeth/tooth, to rule out congenitally missing teeth. The mitigation was that, this information was based on the time for exfoliation and eruption of teeth both for primary and permanent dentition.

2.16 Dissemination plan

The dissertation report was submitted to the Director of Post graduate studies, the School of Dentistry and the Department of Orthodontics Paedodontics and Community Dentistry as a requirement for the fulfillment of the Master Degree offered at the Muhimbili University of Health and Allied Sciences (MUHAS) and the MUHAS library. The findings from this study will also be presented and published in scientific conferences and journals.

CHAPTER THREE

3.0 RESULTS

3.1 Socio-demographic characteristics

A total of 667 (59.5% girls) children participated in the study. Only 10 (1.5%) parents did not give consent for their children to participate. In the 6-year-olds, 317 children were examined (56.5% girls) and in the 9-year-olds, 350 children were examined (62.3% girls). Most of the primary school children (53.7%) were in Grade one and Nursery class, while 46.3% of the primary school children were in Grade two and three**.** Majority of parents/guardians of the children who participated in the study had primary education level and below (Fathers 59.8% and Mothers 75.1%). Only 27.6% of male parents had formal occupation and 41.4% of female parents were housewives (Table 2).

3.2 Dental Caries

In the 6-year-olds, 35.1% of children had caries affecting up to four teeth; in the 9-year-olds, 20.2% had caries affecting up to four teeth (Table 3). For the 6-year-olds, caries mostly affected primary lower first molars (47.3%), this was followed by the primary lower second molars (43.9%); in the 9-year-olds, primary lower first molars were mostly affected (33.5%), followed by the lower primary canines (32.3%) (Table 4).

3.3 Premature Loss of Teeth

The 6-year-olds who had at least one primary tooth prematurely lost comprised 10.7% and the 9-year-olds with at least one primary tooth prematurely lost comprised 4.9% of all the participants (Table 5). The most common prematurely lost teeth were the lower primary second molars (6%) followed by the lower primary canines for the 6-year-olds. Also, for the 9-year-olds, the lower primary second molars were the most prematurely lost teeth (they were missing in 4.9% of the children) (Table 6).

3.4 Occlusal characteristics

An Overjet of >3mm was recorded in 20.5% of children aged 6-years. The 9-year-olds with an Overjet of > 3mm comprised 36% of all children (Figure 2). A deep bite was recorded in 7.6% of the 6-year-olds and 12.3% of the 9-year-olds (Figure 3). For the 6-year-olds, an open bite

was found in 7.9% and for the 9-year-olds it was found in 9.7% of the children (Figure 4). Anterior crossbite was found in 3.4% of the 6-year-olds and 2.6% of the 9-year-olds (Figure 5). Among the 6-year-olds, 89% presented with Class I molar relationship, according to Angle's Classification. In the 9-year-olds, 64% presented with Class I molar relationship (Table 7 (a)). Posterior crossbite was among the least common malocclusions, it was present in 0.6% of the 6-year-olds and in 1.1% of the 9-year-olds (Table.7 (a)).

3.5 Functional characteristics, mesial rotation of the first permanent molar and absence of permanent incisors

Functional shift was found in 0.6% of the 6-year-olds and in 2.6% of the 9-year-olds. An active frenum was present 16.9% of the 9-year-olds but it was not recorded in the 6-year-olds (according to the index). Diastema was found in 6% of the 9-year-olds and it was not recorded in the 6-year-old as per index (Table.7 (b)). Lips were incompetent in 5.7% and 13.7% of the 6-year-olds and 9-year-olds, respectively, these had < or = 4mm space between their lips at rest. In 1.6% and 2% of the 6-year-olds and 9-year-olds, respectively,> 4mm space between their lips at rest was recorded (Figure 6). Mesial rotation of the first permanent molar was found to be 0.6% in the lower jaw of six-year-olds and none of them had mesial tipping of the first permanent molars (not presented in the table). In all ages, no child presented with supernumerary tooth. In nine-year-olds, none of them had neither submerged nor impeded eruption of the first permanent molars. Absence of permanent incisors was found in the lower jaw, with 0.3% of the 9-year-olds (Table 7 (b)).

3.6 Association between socio-demographic characteristics and occlusal and functional characteristics

Compared to girls, significantly more boys had caries (67.4% in boys vs 55.5%% in girls, *p-value 0.027*), increased overjet (47.0% in boys vs 29.4% in girls, *p-value 0.001*), Class II molar relationship (28.0% in boys vs 17.9% in girls, *p-value 0.026*) and incompetent lips (25.8% in boys vs 9.6% in girls, *p-value 0.000*). There were no significant differences in 6 year-olds as observed in the 9 year-olds.

3.7 IPION Scores

IPION scores for both groups are indicated in Figure. 7. The scores were grouped into no treatment need, moderate and definite treatment need. Moderate need for early orthodontic treatment was obtained in 25.2% and 25.7% of the 6-year-olds and 9-year-olds, respectively. Definite need for orthodontic treatment was obtained in 46.4% and 37.4% of the 6-year-olds and 9-year-olds, respectively. The overall early orthodontic treatment need revealed that, only 32.8% of the participants had no treatment need while, 25.5% and 41.7% of all the participants had moderate and definite treatment need, respectively (Figure 7).

3.8 Association between socio-demographic characteristics and moderate and definite treatment need

Apart from the child's sex, there was no statistically significant association between most of the socio-demographic characteristics and moderate and definite treatment need. Where, many boys had treatment need (moderate and definite) compared to girls in both 6-year-olds (78.3% boys vs 66.5% girls, *p=0.024*) and 9-year-olds (70.5 % boys vs 58.7% girls, *p=0.030)* (Table 8). In 9-year-olds, many boys (45.5%) had definite treatment need compared to girls (32.6%) (*p-value 0.017)* (Table 9).

In the logistic regression analysis, most of the socio-demographic factors did not remain statistically significant in the final model (Table 10 (a)). Compared to children in age 6 with no caries, those with caries were more likely to have a definite need for early orthodontic treatment (OR=50.5; CI 13.3 – 192.4: *p-value =0.000*). Regarding 9-year-olds with no caries, those with caries were more likely to have definite need for early orthodontic treatment for malocclusions (OR= 319.9; CI 58.1- 1763.4: *p-value= 0.000*). Also the six year-olds with anterior crossbite was more likely to have a definite need for early orthodontic treatment for malocclusions (OR=5.3; CI 1.7-17.5: *p-value=0.006*). Among nine year-olds, those with anterior crossbite had definite need for early orthodontic treatment (OR=67.6; CI 4.3-1053.1: *p-value =0.003)*. Compared to 6-year-olds with no anterior open bite, those with anterior open bite were more likely to have a definite need for early orthodontic treatment for malocclusions (OR=27.2; CI 5.3-139.8: *p-value =0.000*). For the 9-year-olds with no anterior open bite,

those with anterior open bite were more likely to have a definite need for early orthodontic treatment for malocclusions (OR=47.1; CI 8.3-298.9: *p-value= 0.000*) (Table 10 (b)).

Table 2: Distribution of participants by socio-demographic characteristics.

Variable	Category	Number	Percentage
Age	*6*	317	47.5
	9	350	52.5
Sex	*Male*	270	40.5
	Female	397	59.5
Grade of the child	*Grade II&III*	309	46.3
	Grade 1&Nursery	358	53.7
Father's education	*Primary education and below*	399	59.8
	Secondary education and above	268	40.2
Mother's education	*Primary education and below*	501	75.1
	Secondary education and above	166	24.9
Father's occupation	*Formal employment*	184	27.6
	Informal employment	483	72.4
Mather's occupation	*Housewife*	276	41.4
	Formal and informal employment	391	58.6

Table 3: Percentage distribution of participants by numbers of teeth affected with caries.

	6 years	9 years
Number of teeth	**n (%)**	**N (%)**
0	(61) 22.1	140 (40)
1	(36) 13	52 (14.9)
2	(52) 18.8	59 (16.9)
3	(30) 10.9	28 (8)
4	(97) 35.1	71 (20.2)

NB: In 0.1% (41 children) in 6-year-olds the first permanent molars were not yet erupted

Table 4: Percentages distribution of participants by type of teeth most commonly affected by caries.

	6 years	9 years
Tooth type	**n (%)**	**n (%)**
Upper primary canine	128 (40.4)	70 (20)
Lower primary canine	137 (43.2)	78 (32.3)
Upper 1st primary molar	97 (30.6)	80 (22.9)
Lower 1st primary molar	150 (47.3)	117 (33.5)
Upper 2nd primary molar	111 (35)	104 (29.7)
Lower 2nd primary molar	139 (43.9)	109 (31.1)
Upper 1st permanent molar	7 (2.2)	11 (3.1)
Lower 1st permanent molar	22 (6.9)	23 (6.6)

Table 5: Percentages of participants by the number of prematurely lost primary teeth.

	6 years	**9 years**
No. of teeth	**n (%)**	**n (%)**
0	270 (85.2)	332 (94.8)
1	34 (10.7)	17 (4.9)
2	7 (2.2)	1 (0.3)
3	6 (1.9)	0 (0)

Table 6: Percentage distribution of participants by numbers with a specific type of primary tooth lost prematurely.

Category	**6 years**	**9 years**
	n (%)	**n (%)**
Upper primary canine	7 (2.2)	*
Lower primary canine	14 (4.4)	*
Upper primary 1st molar	8 (2.5)	*
Lower primary 1st molar	9 (2.8)	*
Upper primary 2nd molar	9 (2.8)	2 (0.6)
Lower primary 2nd molar	19 (6.0)	17 (4.9)

**primary teeth which were exfoliated normally*

Table 7 (a): Percentage distribution of children with of different occlusal characteristics

	6 years	**9 years**
Occlusal characteristics	n (%)	n (%)
Angle's Class I	282 (89%)	224 (64%)
Angle's Class II	35 (11%)	126 (36%)
Overjet		
Normal overjet	252 (79.5%)	224 (64%)
Increased overjet	60 (18.9%)	122 (34.9%)
Not measurable	5 (1.6%)	4 (1.1%)
Anterior crossbite		
Not present	306 (96.5%)	341 (97.4%)
Present	11 (3.5%)	9 (2.6%)
Overbite		
Normal	293 (92.4%)	307 (87.8%)
Abnormal	24 (7.6%)	43 (12.2%)
Open bite		
Not present	292 (92.1%)	316 (90.3%)
Present	25 (7.9%)	34 (9.7%)
Posterior crossbite		
Not present	315 (99.4%)	98.9% (346)
Present	2 (0.6%)	4 (1.1%)

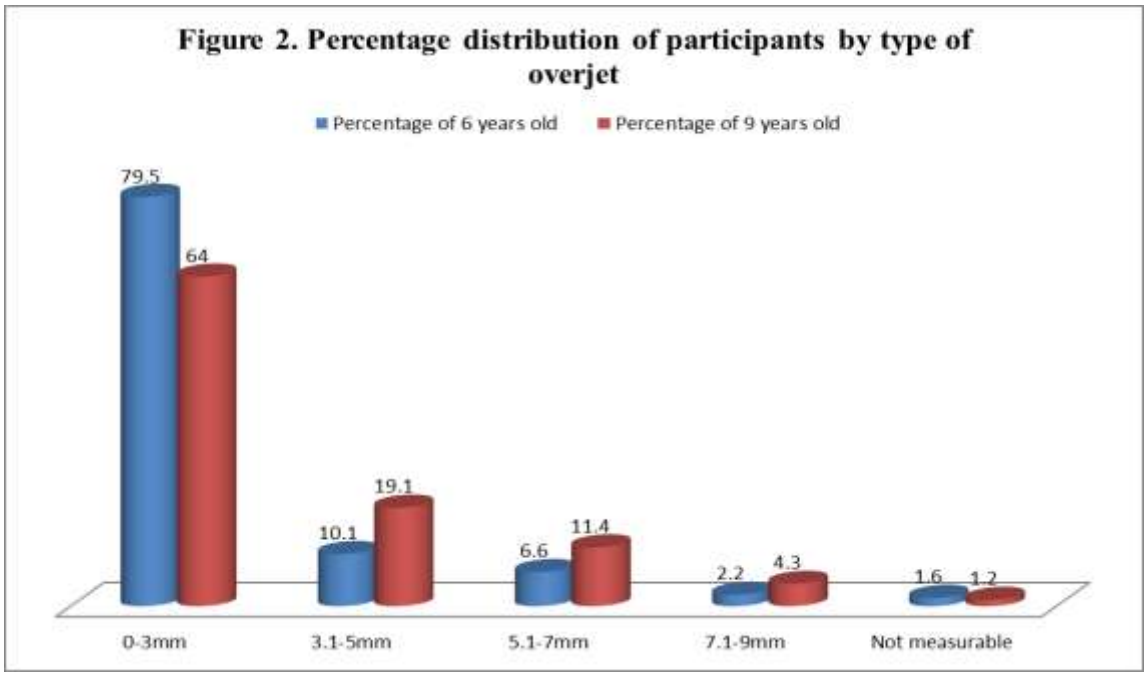


Figure 2. Percentage distribution of participants by type of overjet
Percentage of 6 years old
Percentage of 9 years old
79.5
64
10.1
19.1
6.6
11.4
2.2
4.3
1.6
1.2
0-3mm
3.1-5mm
5.1-7mm
7.1-9mm
Not measurable

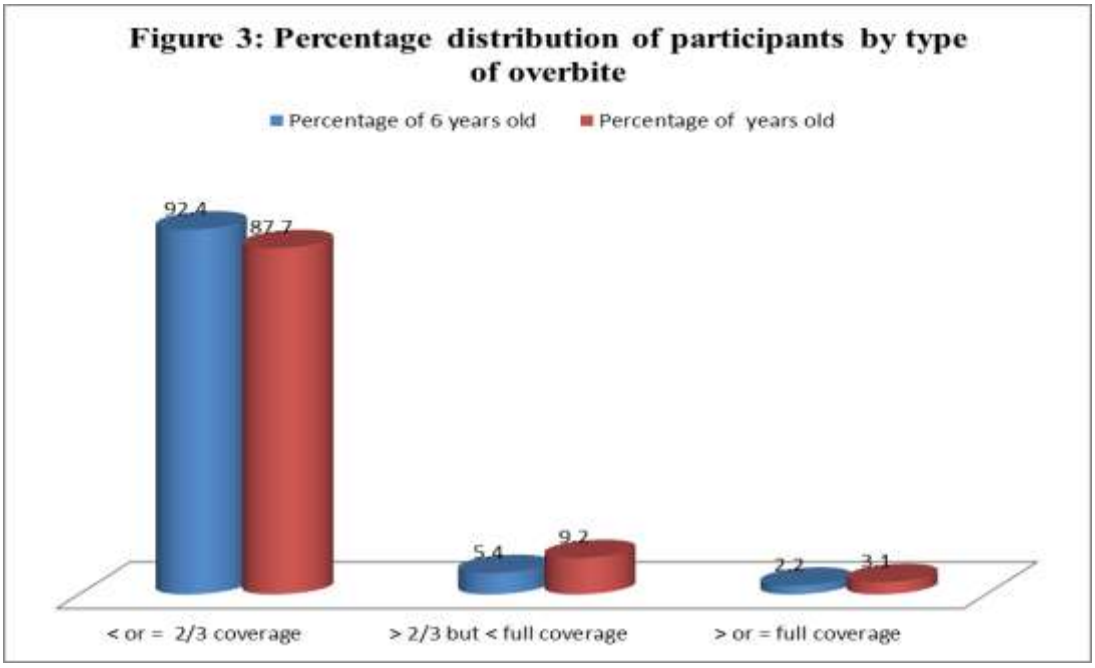


Figure 3: Percentage distribution of participants by type of overbite
Percentage of 6 years old
Percentage of years old
92.4
87.7
5.4
9.2
2.2
3.1
< or = 2/3 coverage
> 2/3 but < full coverage
> or = full coverage

Figure 4: Percentage distribution of participants by open bite categories

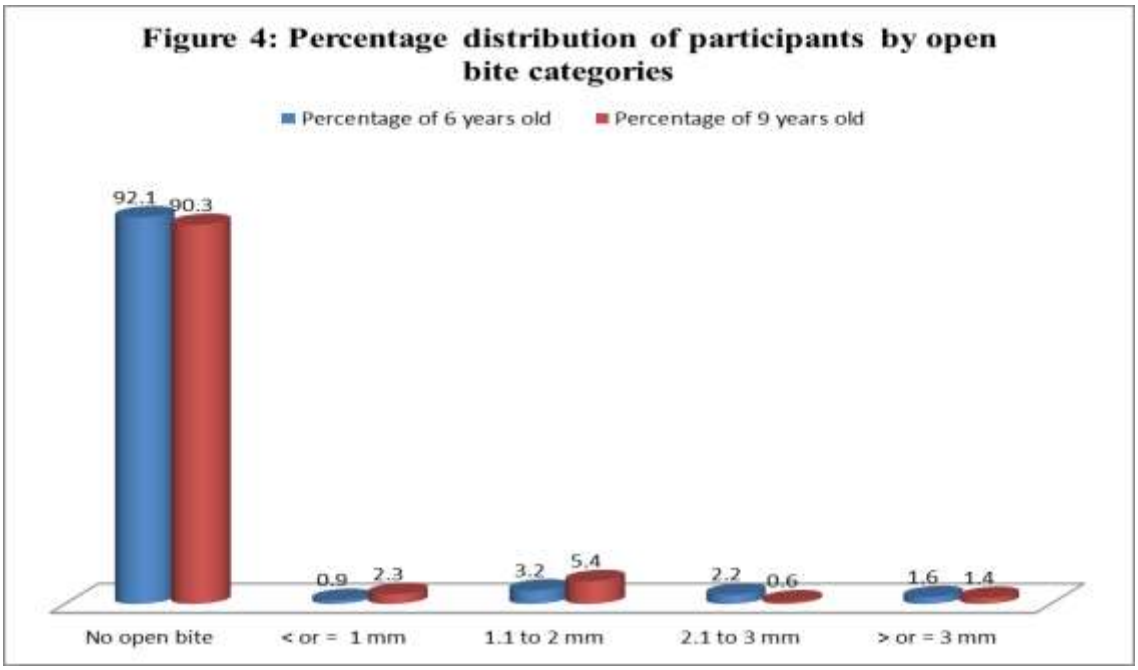


Figure 5: Percentage distribution of participants by anterior crossbite categories

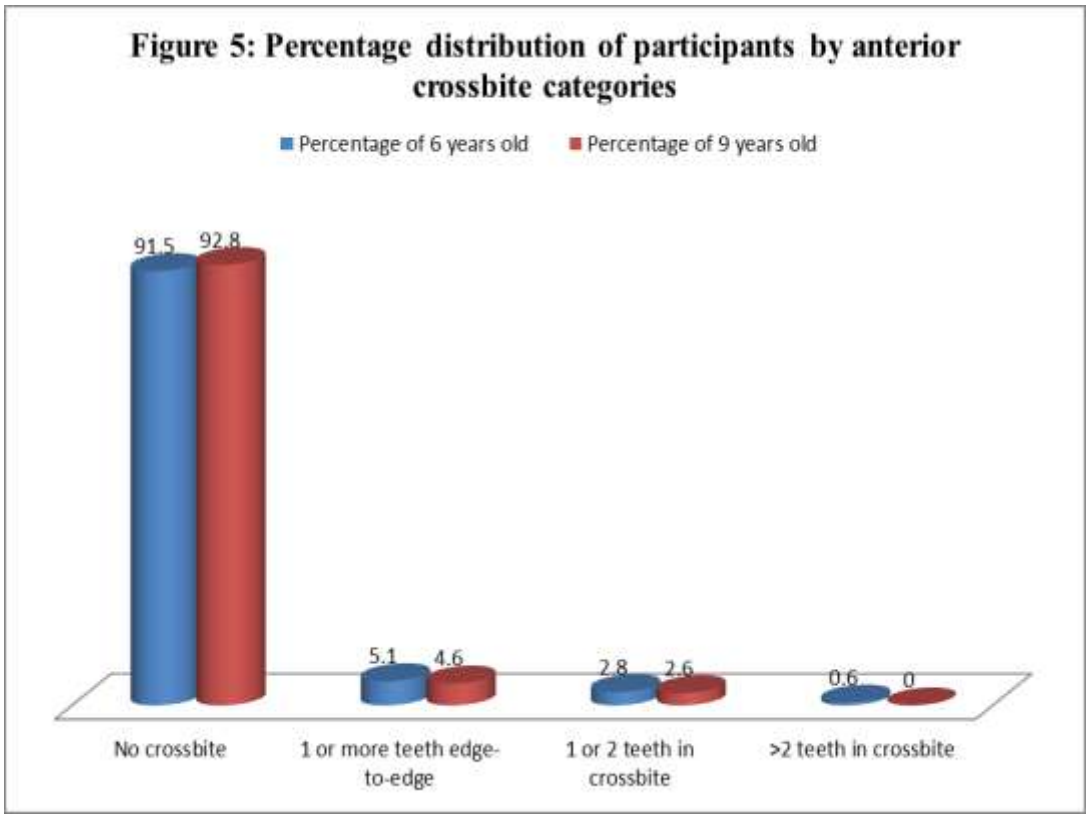


Table 7 (b) Prevalence (n & %) of functional shift status, active frenum status and diastemas in the participants.

	6 years	9 years
Variable	**n (%)**	**n (%)**
Functional shift		
Absent	315 (99.4%)	341 (97.4%)
Present	2 (0.6%)	9 (2.6)
Active frenum		
No active frenum	*	291 (83.1%)
Active frenum present	*	59 (16.9%)
Diastema		
Absent	*	329 (94%)
Present	*	21 (6%)
Absent of permanent incisors		
Present	*	349 (99.7%)
Absent (lower)	*	1 (0.3%)

**These were not recorded in age 6 years, as per index*

Figure 6: Percentage distribution of participants by lip competencies

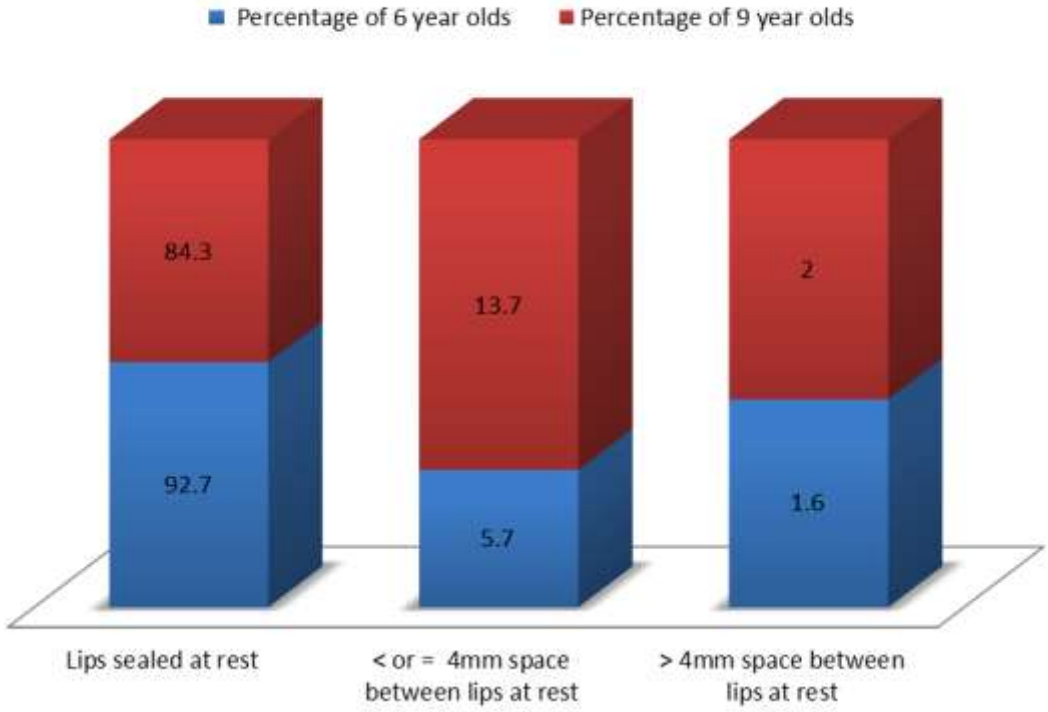


Table 8: Percentage distribution of participants by socio-demographic characteristics and their treatment need. (* *p< 0.05).*

Socio-demographic characteristics		Treatment need (moderate and definite)									
		6 years					9 years				
	Category	no		yes		*p-value*	no		yes		*p-value*
		n	%	n	%		n	%	n	%	
Class	*I & Nursery*	89	28.5	223	71.5	1.000	17	37	29	63	1.000
	II & III	1	20	4	80		112	36.8	192	63.2	
Sex	*Boys*	30	21.7	108	78.3	*0.024	39	29.5	93	70.5	*0.030
	Girls	60	33.5	119	66.5		90	41.3	129	58.7	
Education	*Father (sec & above)*	37	30.3	85	69.7	0.609	51	34.9	95	65.1	0.575
	Father (Prim & below)	53	27.2	142	72.8		78	38.2	126	61.8	
	Mother (Sec & above)	24	32	51	68	0.464	31	34.1	60	65.9	0.614
	Mother (Prim & below)	66	27.3	176	72.7		98	37.8	161	62.2	
Occupation	*Father (formal employment)*	24	27.9	62	72.1	1.000	35	35.7	63	64.3	0.806
	Father (Informal employment)	66	28.6	165	71.4		94	37.3	158	62.7	
	Mother (housewife)	38	26	97	74	0.450	53	36.6	92	63.4	1.000
	Mother (employed)	56	30.1	130	69.9		76	37.1	126	62.9	

Table 9: Percentage distribution of participants by socio-demographic characteristics and definite treatment need. (*$p< 0.05$).

Socio-demographic characteristics		Definite treatment need 6 years					Definite treatment need 9 years				
	Category	no		yes		*p-value*	no		yes		*p-value*
		n	%	n	%		n	%	n	%	
Class	*I & Nursery*	169	54.2	143	45.8	0.187	32	69.6	14	30.4	0.330
	II & III	1	20	4	80		187	61.5	117	38.5	
Sex	*Boys*	67	48.6	71	51.4	0.114	72	54.5	60	45.5	*0.017
	Girls	103	57.5	76	42.5		147	67.4	71	32.6	
Education	*Father (sec & above)*	62	50.8	60	49.2	0.448	87	59.6	59	40.4	0.370
	Father (Prim & below)	108	55.4	87	44.6		132	64.7	72	35.3	
	Mother (Sec & above)	38	50.7	37	49.3	0.597	51	56	40	44	0.166
	Mother (Prim & below)	132	54.5	110	45.5		168	64.9	91	35.1	
Occupation	*Father (formal employment)*	44	51.2	42	48.8	0.614	57	58.2	41	41.8	0.325
	Father (Informal employment)	126	54.5	105	45.5		162	64.3	90	35.7	
	Mother (housewife)	73	55.7	58	44.3	0.568	89	61.4	56	38.6	0.737
	Mother (employed)	97	52.2	89	47.8		130	63.4	75	36.6	

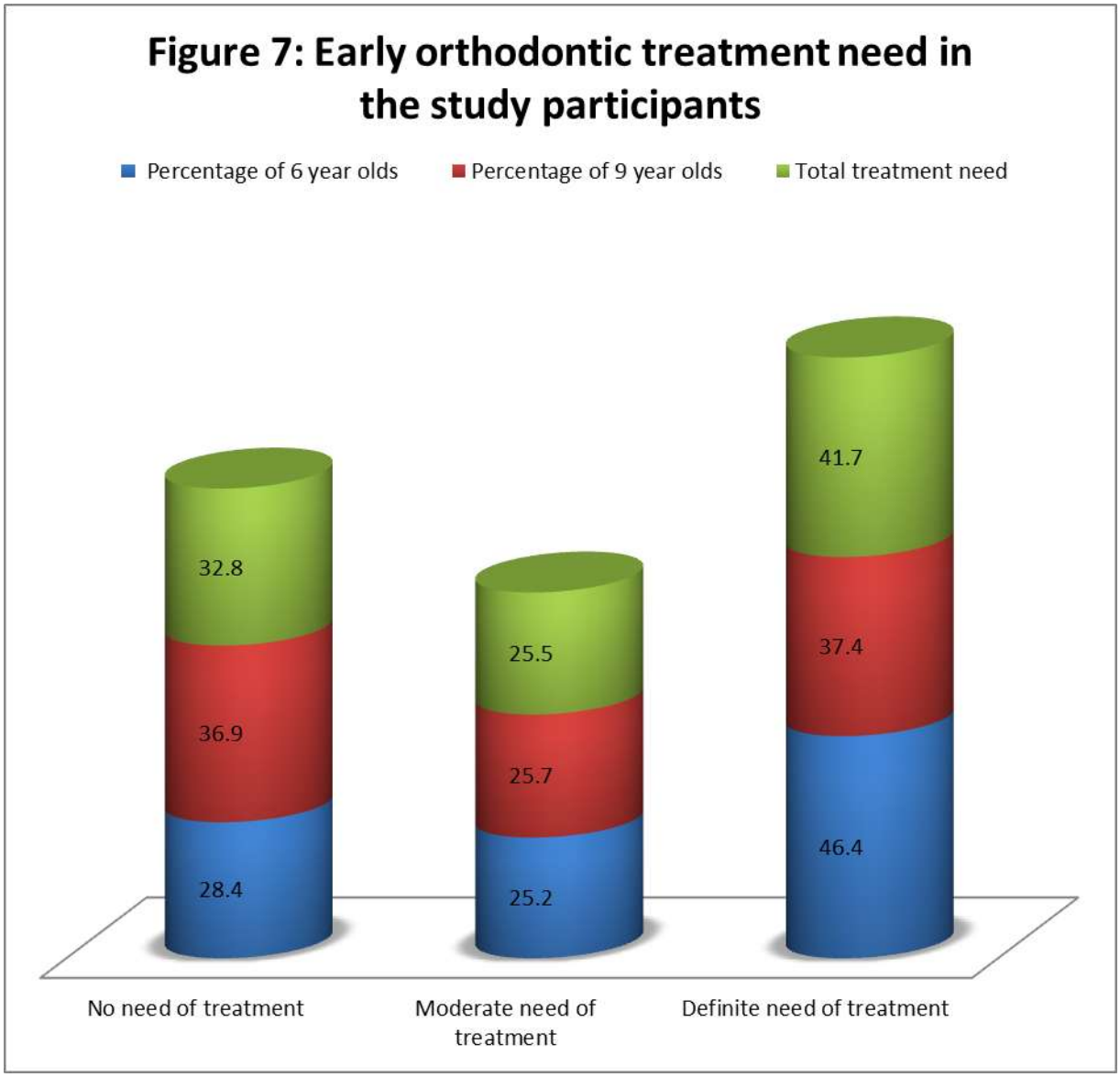


Figure 7: Early orthodontic treatment need in the study participants
Percentage of 6 year olds
Percentage of 9 year olds
Total treatment need
32.8
36.9
28.4
25.5
25.7
25.2
41.7
37.4
46.4
No need of treatment
Moderate need of treatment
Definite need of treatment

Table 10 (a): Unadjusted and logistic regression analysis by treatment need and socio-demographic characteristics.

** p<0.05*

Variables		6 years		9 years	
	Category	Unadjusted (no. and %)	Adjusted OR (95 % CI)	Unadjusted (no. and %)	Adjusted OR (95 % CI)
Sex	*Girls*	76 (42.5)	1	71 (32.6)	1
	Boys	71 (51.4)	1.5 (0.8-2.6)	60 (45.5) *	1.3 (0.6-2.6)
Child's grade	*Grade II&III*	4 (80.0)	1	117 (38.5)	1
	Nursery & Grade I	143 (45.8)	0.1 (0.0-1.4)	14 (30.4)	1.5 (0.6-3.9)
Father education	*Secondary & above*	60 (49.2)	1	59 (40.4)	1
	Primary & below	87 (44.6)	0.9 (0.4-2.4)	72 (35.3)	1.1 (0.4-2.8)
Mother education	*Secondary & above*	37 (49.3)	1	40 (44.0)	1
	Primary & below	110 (45.5)	0.6 (0.2-1.5)	91 (35.1)	0.8 (0.3-2.1)
Father occupation	*Formal*	42 (48.8)	1	41 (41.8)	1
	Informal	105 (45.5)	1.5 (0.6-3.8)	90 (35.7)	0.8 (0.3-2.2)
Mother occupation	*Housewife*	58 (44.3)	1	56 (38.6)	1
	Employed	89 (47.8)	1.8 (0.9-3.2)	75 (36.6)	0.9 (0.4-1.9)

Table 10 (b): Unadjusted and logistic regression analysis by treatment need, occlusal characteristics and soft tissues status.

Variables		6 years		9 years	
	Category	Unadjusted (% and no.)	Adjusted OR (95 % CI)	Unadjusted (% and no.)	Adjusted OR (95 % CI)
Caries	*No*	8 (10.3)	1	7 (5.0)	1
	Yes	139 (58.2) **	50.5 (13.3-192.4)**	124 (59.0) **	319.9 (58.1-1763.4)**
Premature loss	*No*	108 (40.0)	1	117 (35.2)	1
	Yes	39 (83.0) **	4.5 (1.8-11.2)**	14 (77.8) **	4.4 (0.9-20.1)
Active frenum	*No*	-	-	100 (34.4)	1
	Yes	-	-	31 (52.5) *	1.8 (0.6-5.5)
Diastema	*No*	-	-	117 (35.6)	1
	Yes	-	-	14 (66.7) *	3.1 (0.5-19.6)
Overjet	*No*	114 (44.4)	1	65 (29.0)	1
	Yes	33 (55.0)	0.8 (0.2-2.9)	66 (52.4) **	1.0 (0.3-3.1)
Anterior crossbite	*No*	128 (44.1)	1	111 (34.0)	1
	Yes	19 (70.4) *	5.3 (1.6-17.5)*	20 (83.3) **	67.6 (4.3-1053.1)*
Overbite	*No*	134 (45.7)	1	108 (35.2)	1
	Yes	13 (54.2)	2.0 (0.4-9.4)	23 (53.5) *	10.3 (2.1-51.1)*
Open bite	*No*	127 (43.5)	1	106 (33.5)	1
	Yes	20 (80.0) **	27.2 (5.3-139.8)**	25 (73.5) **	49.1 (8.3-289.9)**
Molar relationship	*Class I*	122 (43.5)	1	85 (31.0)	1
	Class II&III	25 (71.4) *	2.5 (0.5-13.7)	46 (60.5) *	3.1 (0.8-12.1)
Lips incompetency	*No*	128 (43.5)	1	92 (31.2)	1
	Yes	19 (82.6) **	6.5 (0.9-45.8)	39 (70.9) **	6.2 (1.5-25.5)*

** P<0.05 ** P<0.001*

CHAPTER FOUR

4.0 DISCUSSION

This study has considered early orthodontic treatment need for malocclusions and its associated factors in Tanzanian children using IPION-index. It is the first population-based study to describe the need for EOT utilizing the index. The participants were sampled to represent a population of children aged 6 and 9 years in Kinondoni District of the Dar es Salaam Region. Moreover, no one among the participants had received interceptive or corrective orthodontic treatment. In studies describing occurrence of malocclusions in a particular population, it is recommended that participants should be taken from a population of non-orthodontically treated individuals (Thilander et al., 2001). Therefore, the current study conforms to the standard methodology.

The socio-demographic profile of parents of the present participants showed that, most parents/guardians of the children who were involved, had primary education level and below. This profile conforms well to the profile of parents of most children attending public schools in Tanzania (NBS, 2014).

In this study various occlusal traits and other conditions related to malocclusions were investigated in children who participated (Appendix VII). Considering all the clinical parameters examined for the purpose of determining early orthodontic treatment need for malocclusions, caries was the most common condition associated with the IPION index. This may be due to schoolchildren's snacking behaviours, since they are able to access sugary snacks and drinks available around their schools' premises, coupled with the children's low fluoride exposures. This finding is in line with those obtained from other studies (Haider et al., 2013; Burhan and Nawaya, 2016; Rauten et al., 2016). Moreover, 77.9% of the 6-year-olds and 60% of the 9-year-olds had at least one tooth affected by caries, and many of their lower primary teeth were affected by caries. This result support what was documented in the World Health Organization report, which highlighted that 60-90% of the schoolchildren population, is affected by caries (Petersen et al., 2003). In addition, the high prevalence of caries in 6-year-

olds might be due to inadequate tooth brushing supervision by their parents, inadequate tooth brushing skills and poor manual dexterity during the tooth brushing process (Maya et al., 2017). Untreated dental caries in primary dentition is the most common etiological factor for early loss of teeth. This may create a potential risk for malocclusions by loss of space available for permanent dentition and subsequent drifting of the teeth (Thilander and Ronning,1995).

Premature loss of primary teeth is an environmental aetiological factor for malocclusions (Thilander and Ronning, 1995) and it is a component of the IPION index (Coetzee, 1999). In this study, early loss of primary teeth was seen in 14.8% of the 6-year-olds and in 5.1% of the 9-year-olds. Nonetheless, the children who were found to have premature primary teeth loss are fewer than those in studies of Cavalcanti et al. (2008), Ahamed et al. (2012) and Rauten et al. (2016). The main reason behind loosing teeth prematurely among the current participants could be due to extractions. Since it is a treatment modality offered to many of those who demand dental care to relieve their dental pain, due to caries (Nyamuryekung'e et al., 2015). Usually, when premature extractions are done, placement of space maintainers to preserve spaces for the coming permanent teeth is often recommended, to prevent migration of adjacent teeth (Liegeois et al., 1992; Mitchell, 2005). The other consequences of losing spaces for permanent teeth include; impaction of the permanent canines and inter incisive line diversion (Hudson et al., 2011).

As regards the commonly missing teeth currently, the second lower primary molars were mostly affected. This finding is in contrast to the findings obtained by other researchers elsewhere (Cavalcanti et al., 2008; Ahamed et al., 2012; Haider et al., 2013; Rauten et al., 2016). Where, the lower first primary molars were found to be the most frequently extracted teeth in those studies. Caufield et al., (1993) reported that the pattern of losing lower molars was explained as being the effect of chronological age, exposure of those teeth to oral environment, food becoming packed in them, accumulation of dental plaque and bacterial metabolism. It should be noted that, all these factors can be aggregated as someone ages.

The outcome of losing early a second primary molar can be an altered Molar relationship in the future (Thilander and Ronning,1995).

Regarding occlusal characteristics, majority of the current participants were found with a Class I Molar relationship according to a classification by Angle. This was found in 89% of children aged 6 years and 64% of 9-year-olds. The finding is in line with the prevalence obtained from previous Tanzanian studies (Mugonzibwa et al., 2004; Mtaya et al., 2009), which found Class I Molar relationship as a dominant Molar relationship in their participants.

The other occlusal characteristics investigated included the overjet, overbite, open bite and crossbites. The prevalence of an altered overjet in the six and nine year-olds was 18.9% and 34.9%, respectively. This result is comparable to those obtained in previous Tanzanian studies and in a study elsewhere (Mugonzibwa et al., 2004; Mtaya et al., 2009; Tausche et al., 2005). Currently, an overjet of more than 5mm was found in 8.8% of the 6-year-olds and 15.7% of the 9-year-olds. These findings support those obtained in studies done by Mtaya et al. (2009), Haider et al. (2013); Rauten et al. (2016).

In this study, the prevalence of deep bite among six and nine year-old children was found to be 7.6% and 12.2%, respectively. This finding is contrary to that reported by Karaiskos et al. (2005), but analogous to that obtained by Rauten et al. (2016). Presently, few 6- and 9-year-olds, had greater than or equal to full coverage of the lower incisors, when their teeth were assessed for overbite status. This finding do not conform well to that reported by Mtaya et al. (2009), regarding the presence of a deep bite in Tanzanian children. Deep bite is a condition with detrimental effects, such as; TMJ problems, attrition of the anterior teeth, direct trauma of the palatal gingiva, periodontal problems and restriction of the development of the mandibular anterior dento-alveolar process. Additionally, deep bite is a condition which is difficult to treat (Darendeliler et al., 2004, Patti et al., 2005; Singla et al., 2013).

In this study, anterior open bite prevalence was lower than those reported in earlier Tanzanian studies (Mugonzibwa et al., 2004; Mtaya et al., 2009). However, Karaiskos et al.(2005) and Rauten et al. (2016) reported a higher prevalence of anterior open bite among the children of Canada and Romania, respectively. Open bite is a malocclusion that can be associated with multiple functional disorders, namely; atypical swallowing of protrusion type, oral breathing problems and phonetic disorders (Urzal et al., 2012; Dixit et al., 2013).

Regarding presence of anterior crossbite in the current study, similar findings were reported by Karaiskos et al. (2005) among 6- and 9-year-old Canadian children. Presently, posterior crossbite prevalence among 9-year-olds was about twice the proportion of the 6-year-olds with the condition (1.1% vs. 0.6%, respectively). It is recommended that, all forms of crossbites should be treated as early as possible when detected, untreated crossbites may lead to unfavorable growth changes in the temporomandiblar joint and altered skeletal and dental patterns (Faber, 1981; Profit, 2000; Mc Namara, 2002). For instance presence of posterior crossbites can cause a functional shift (Profit, 2000). Moreover, anterior crossbite should be treated as early as possible to prevent the upper incisors to traumatically occlude with the lower incisors. If no treatment is initiated, potential adverse outcomes may occur, such as; periodontal problems, subsequent mobility of teeth and even fractures (Richardson, 1982; Karaiskos et al., 2005).

In this study, mesial rotation of the first permanent molar was only found in 0.6% of the children, in the lower jaws of the six year-olds. Mesial rotation could be related to an early loss of primary molars. Additionally, 0.3% of the present 9-year-olds had absence of permanent incisors, and in all ages, none of the children had mesial tipping of the first permanent molars. This finding is similar to the one obtained in a study by Mugonzibwa et al. (2004). In nine year-old children neither of the children had submerged nor impeded eruption of the first permanent molars, this is in contrast to what was reported by Mugonzibwa et al. (2004).

Currently, a functional shift was found in 0.6% of the 6-year-olds and in 2.6% of the 9-year-olds. These percentages are lower than those reported by Haider et al. (2013) among American children. A functional shift may be associated with TMJ problems (Mitchell, 2005) hence early correction is necessary. Concerning active frenum presence reported in this study, it was recorded in 16.9% of the 9-year-olds, this is a higher percentage compared to that found by Karaiskos et al. (2005) among Canadian children. Presence of active frenum is important to be assessed, as it is to be removed, particularly if a diastema closure is planned (Harikrishnan, 2005).

Measurements of caries, occlusal and functional characteristics were used to calculate the IPION index in this study. The IPION scores indicated that 32.8% of the participants had no treatment need. However, 25.5% and 41.7% of all the participants had moderate and definite treatment need. Thus, the need for EOT in these children were quite high, the finding is somewhat similar to that reported by Burhan and Nawaya. (2016). In the present study, the 6-year-olds and 9-year-olds that were categorized into moderate to definite treatment need group, comprised respectively, 71.6% and 63.1% of all children. It is imperative to say that these children would benefit from EOT, regardless their skeletal pattern. The current IPION scores are higher compared to those obtained by Rauten et al., 2016. The higher IPION scores obtained here are possibly due to; inadequate access to dental services, poor socio-economic status and lower educational level of the parents. All of these are the necessary attributes when it comes to accessing oral health care and maintaining good oral health status of children. Moreover, these results are in line with those reported by Haider et al. (2013), where their 6-year-olds and 9-year-olds had EOT need of 75% and 87%, respectively. Furthermore, comparing between boys and girls presently, it was revealed in bivariate analysis that many boys than girls needed EOT when a combined moderate and definite treatment need was considered. Likewise, many boys than girls had caries and other malocclusions that contributed to the total IPION scores. This could be because many boys than girls, are subjects of oral health detrimental behaviours (Sharma et al., 2015). Thus, there is a need to set specific preventive and interceptive orthodontics interventions for children.

In the logistic regression analysis performed in this study, caries remained as one of the significant determinant of having a definite need for EOT, as per the IPION index. Thus, a relatively high prevalence of dental caries is an important contributory factor associated with the IPION index in the present group of children. Whereby, the presence of caries largely increased the value of the IPION index in the population studied. In 1971, Proffit and Ackerman documented that adequate prevention and control of caries would result in a decreased number of children with early loss of primary teeth; which would contribute to reduction in malocclusions.

The other conditions, namely; premature loss of primary teeth and lips incompetence, also remained as significant predictors of EOT need. The effect of premature loss of primary teeth could be due to the presence of caries, and the effect of lips incompetence could be due to the presence of occlusal conditions such as open bite and increased overjet (Thilander et al., 2001; Mitchell, 2005). Therefore, there is a need to set intervention on caries prevention which will also prevent premature loss of primary teeth. Accordingly, occlusal anomalies like; open bite, deep bite and crossbites, as well contributed to the current high IPION scores. Various studies have revealed a reduction of malocclusions of more than 70% in children who received early orthodontic treatment (Kerosuo et al., 2008; Jolley et al., 2010; Kulbersh et al., 2018). Kallunki et al. (2018) reported high level of evidence that early treatment of Class II malocclusion reduces overjet and improves skeletal relationships. In a Finnish study by Vakipata et al. (2005), it was established that there was a clear reduction in treatment need of 8 to 12 year-old children, who were treated earlier for anterior or lateral crossbites, increased overjet and deep bite. Children from this study could also benefit from early interventions in most of their presented malocclusions. Interventions could be in form of space salvage and planned extractions, space maintainers and oral habit breakers. Overall, early orthodontic treatment (EOT) will have a public health importance of improving quality of life among children and in future adult life. Then preventive and interceptive orthodontic treatment can be planned and instituted in children when they are in either their primary or mixed dentition stage/s. Eventually, this will reduce the need for future complicated orthodontic treatment

which may require sophisticated and expensive materials as well as highly skilled dental professionals.

Noteworthy, the EOT procedures may not produce perfect occlusion but can considerably reduce the need for complex orthodontic treatment in children (Al- Nimri and Richardson, 2000; Kerosuo et al., 2008; King and Brudvik, 2010). In addition, due to the fact that most of the EOT modalities are relatively inexpensive; they are relevant for the Tanzanian health care system, which already has limited resources.

CHAPTER FIVE

5.0 CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions

The revealed need for early orthodontic treatment for malocclusions was high in schoolchildren of Kinondoni district, Dar es Salaam, Tanzania. Whereby, about half of the participants had definite EOT need according to the IPION-scores. The factors associated with the overall IPION-score were mainly clinical conditions such as having dental caries, premature loss of primary teeth, anterior crossbite, open bite, deep bite and lips incompetence.

5.2 Recommendations

For dental professionals:

1. Should initiate earlier the preventive and interceptive orthodontic treatment programs for children.
2. The programs such as provision of school health programs, oral health education sessions and appropriate school oral health interventions. These should target both nursery schoolchildren and primary schoolchildren.

For policy makers:

1. The Government and health insurance companies should effect policy changes to allow certain amount of treatment costs to be directed to EOT or budget solely for EOT in children.

For parents/guardians:

1. Should consider regular dental visits for their children in order to detect malocclusions or malocclusion related factors early, and enable interventions for developing malocclusions in children to be undertaken timely.

CHAPTER SIX

6.0 STUDY STRENGTHS AND WEAKNESS

The clinical registrations were based on the IPION scoring method utilized by (Coetzee, 1999). IPION scoring method has been used in many studies (Karaiskos et al., 2005; Haider et al., 2013; Rauten et al., 2016; Burhan and Nawaya, 2016) and allows objective comparisons of the need for EOT for malocclusions between different populations. For example, the children ages chosen in the present study are the same ages used in other studies that have utilized the IPION index. Therefore, comparisons of the present findings with those of other studies can be made.

However, no radiographs or study casts were used in the present investigation. The reason was that the researcher was trying to avoid imminent costs for x-rays to be incurred by the participants, and also it was beyond the scope of the budget of the present study. Thus, the probability of having under- or overestimated some prevalence estimates such as supernumerary teeth and some details on the deviations of teeth positions, cannot be overlooked.

Further, it has been shown that records made on the basis of casts seem to give a higher prevalence of deviations than direct recordings (Helm, 1970; Heikinheimo, 1978), but it was beyond the scope of the budget of the present study to employ dental cats. Nonetheless, given the researcher's adherence to the criteria described in IPION scoring method, the calibration exercise, the sample size and the selection criteria used in this study, the present findings provide a reasonably accurate indication of the need for EOT for malocclusions in 6- and 9-year-olds children in Kinondoni District of the Dar es Salaam region in Tanzania.

CHAPTER SEVEN

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8.0 APPENDICES

Appendix I: Consent form- English version

MUHIMBILI UNIVERSITY OF HEALTH AND ALLIED SCIENCES

DIRECTORATE OF RESEARCH AND PUBLICATIONS, MUHAS

INFORMED CONSENT FORM

ID-NO | | | |

Consent to Participate in a Study

Greetings! My name is Dr. Tungaraza Joseph; I am conducting this research with the objective of investigating on assessment of early orthodontic treatment need and its associated factors among Tanzanian children using IPION-index.

Purpose of the study

The study is conducted in partial fulfillment of the requirements for the degree of Master of Dentisty in Paediatric Dentistry of MUHAS. You are being asked to participate in this study because you have required criteria. Kindly, please be honest and true for betterment of the results that could lead to better intervention and recommendations for future.

What Participation Involves

If you agree to join the study, you will be interviewed in order to answer a series of questions in the questionnaire prepared for the study. You will also undergo clinical examination in order to know the clinical presentation of your problems.

Confidentiality

I assure you that all the information collected from you will be kept confidential. Your name will not be written on any questionnaire or in any report/documents that might let someone identify you. Your name will not be linked with the research information in any way. All information collected on forms will be entered into computers with only the study identification number. Confidentiality will be observed.

Risks

We do not expect that any harm will happen to you because of participating in this study. Some questions could potentially make you feel uncomfortable. You may refuse to answer any particular question and may stop the interview at any time.

Right to Withdraw and Alternatives

Taking part in this study is completely voluntary. You can stop participating in this study at any time, even if you have already given your consent. Refusal to participate or withdrawal from the study will not involve penalty.

Benefits

The information gathered from you will help to determine the magnitude of conditions and guide for early orthodontic need among children.

Who to Contact

If you ever have questions about this study, you can contact the Principal Investigator, Dr TUNGARAZA, Joseph of Muhimbili University of Health and Allied Sciences, P. O. Box 65001, Dar es Salaam. If you ever have questions about your rights as a participant, you may contact Dr Bruno Sunguya Chairperson of the Senate Research and Publications Committee, P. O. Box 65001, Telephone: +255 22 2152489 Dar es Salaam. You may also contact my supervisors Dr Matilda Mtaya Mlangwa (Phone: 0754212109) and Dr Emeria A. Mugonzibwa (Phone: 0713606581).

Do you agree?

Participant agrees ……. Participant does NOT agree ……...

I ……have read the contents in this form. My questions have been answered. I agree to participate in this study.

Signature of participant…….…….....Signature of Investigator ……

Date of signed consent …….

Kiambatanisho II: Fomu ya ridhaa- Kiswahili

CHUO KIKUU CHA AFYA NA SAYANSI SHIRIKISHI MUHIMBILI

KURUGENZI YA UTAFITI NA UCHAPISHAJI, MUHAS

Namba ya usajili | | | |

Ridhaa ya kushiriki kwenye utafiti

Ndugu mzazi/mlezi wa ……

Habari!

Mimi ni Dr Tungaraza Joseph, mwanafunzi wa shahada ya uzamili katika Chuo Kikuu cha Afya na Sayansi Shirikishi Muhimbili. Ninafanya utafiti huu wenye lengo la kutaka kujua uhitaji wa matibabu ya mapema ya mpangilio wa meno na sababu husishi katika watoto wenye umri wa miaka sita na tisa kwa wanafunzi wa shule za msingi za Wilaya ya kinondoni, Dar es Salam, Tanzania.

Dhumuni la utafiti

Utafiti huu unafanyika katika kutimiza sehemu ya matakwa ya shahada ya uzamili ya matibabu ya meno kwa watoto katika Chuo Kikuu cha Afya na Sayansi Shirikishi Muhimbili. Ninaandika kukuomba umruhusu mtoto wako kushiriki katika utafiti huu.

Ushiriki unahusisha nini?

Endapo utaridhia mwanao kushiriki katika utafiti huu, ataulizwa maswali yaliyopo katika fomu iliyoandaliwa mahususi kwa ajili ya utafiti huu wa kuchunguzwa hadhi ya kinywa na meno kama vile kutoboka kwa meno, kama ameng'oa meno mapema na mpangilio wa meno kinywani.

Usiri

Taarifa zote zitakazoainishwa kwenye fomu ya uchunguzi zitaingizwa kwenye kompyuta kwa kutumia namba za utambulisho. Kutakuwa na usiri na mtu yeyote asiyehusika hata pata taarifa zilizokusanywa. Taarifa hizo zitatumika kwa dhumuni la utafiti tu na si vinginevyo.

Athari : Haitegemewi madhara yoyote kutokea kwa mwanao kutokana na ushiriki wake katika utafiti huu.

Uhuru wa kushiriki na haki ya kujitoa

Ushiriki wa mwanao kwenye utafiti huu ni wa hiari. Anaweza kujitoa kwenye utafiti huu wakati wowote hata kama umeshajaza fomu ya ridhaa ya kushiriki kwenye utafiti. Kukataa kushiriki au kujitoa kwenye utafiti hakutaambatana na masharti yoyote, wala kukosa huduma iliyopangwa kufanyika.

Faida

Kama utakubali mwanao ashiriki kwenye utafiti huu taarifa tutakazopata zitatuwezesha kujua ukubwa wa tatizo ambao ni muhimu katika kupanga njia za kuzuia au kupunguza tatizo lenyewe. Mwanao akikutwa na tatizo la afya ya kinywa au meno utashauriwa kumpeleka hospitali kwa matibabu. Uangalifu mkubwa utafuatwa katika kuchunguza watoto hawa, kwa kuzingatia kila tahadhari ya usafi.

Nani wa kuwasiliana naye

Kama una maswali kuhusiana na utafiti huu, wasiliana na mkuu wa utafiti huu; Dr TUNGARAZA, Joseph wa Chuo Kikuu cha Afya na Sayansi Shirikishi Muhimbili, S. L. P. 65001, Dar es Salaam. Simu: 0714592294.

Kama una swali kuhusu uhalali wa utafiti huu wasiliana na Dr Bruno Sunguya Mwenyekiti wa kamati ya Utafiti na Uchapishaji, S.L.P 65001, Simu: 255 22 2152489 Dar es Salaam au wasimamizi wa utafiti huu Dr Matilda Mtaya Mlangwa ambaye ni msimamizi wa utafiti huu (Simu: 0754212109) na Dr Emeria A. Mugonzibwa ambaye ni msimamizi mwenza (Simu: 0713606581).

Je unakubali kushiriki?

Mshiriki amekubali ….....….....

Mimi ..... nimesoma maelezo ya fomu hii.

Maswali yangu yamejibiwa.Nakubali mtoto wangu ashiriki katika utafiti huu.

Sahihi ya mzazi/mlezi……..... Tarehe ya kutia sahihi ya idhini ya kushiriki……

Mshiriki hajakubali .....…….....

Appendix III: Questionnaire for parents/guardians/children- English version

Assessment of early orthodontic treatment need and its associated factors among Tanzanian children using IPION-index

ID No: ☐

Day Month Year

Date of birth ☐☐ ☐☐ ☐☐ Age of the child ☐

Sex.....1. M 2. F..... ☐

Choose the right option from the questions below

1. Which class is your child studying?
   a. Class I
   b. Class II
   c. Class III ☐
   d. Class IV
2. Have your child ever attended a dental clinic?
   a. Yes ☐
   b. No

   If the answer is YES proceed to question 3, if no go to question 4

3. Which treatment did he/she receive?.....

4. Father's level of education
   a. No formal education
   b. Primary education ☐
   c. Secondary education
   d. College/University

5. Mother's level of education
   a. No formal education ☐
   b. Primary education
   c. Secondary education
   d. College/University

6. Father's occupation
    a. Small scale business/ self employed
    b. Day worker
    c. Employed
    d. Business man

7. Mother's occupation
    a. House wife
    b. Small scale business/ self employed
    c. Day worker
    d. Employed
    e. Business woman

Thanking you in advance!

Kiambatanisho IV: Dodoso kwa mzazi/mlezi/mtoto - Kiswahili

UHITAJI WA MAPEMA WA MATIBABU YA MPANGILIO WA MENO NA SABABU HUSISHI KWA WATOTO WENYE UMRI WA MIAKA 6 NA 9 TOKA KATIKA WILAYA YA KINONDONI, DAR ES SALAAM

Namba ya utambulisho: | | | |

Ndugu mzazi naomba ujibu dodoso hili kuhusiana na mtoto aliyekuletea

Tarehe ya mtoto ya kuzaliwa | | | Siku | | | Mwezi | | | Mwaka | | | Umri wa mtoto | |

Jinsia ya mtoto: 1. Me 2. Ke. |

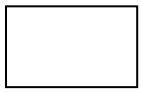
Weka herufi husika kisanduku pembeni ya swali

1. Mtoto wako anasoma darasa la ngapi?
    a. Darasa la kwanza
    b. Darasa la pili
    c. Darasa la tatu
    d. Darasa la nne |
2. Mtoto wako amewahi kutibiwa meno?
    a. Ndiyo
    b. Hapana |

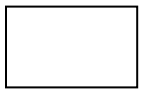
Kama jibu ni NDIYO endelea swali la 3, kama hapana nenda swali la 4

3. Alipewa tiba gani?.....
4. Elimu ya baba:
    a. Hajamaliza elimu ya msingi
    b. Elimu ya msingi
    c. Elimu ya sekondari
    d. Chuo |
5. Elimu ya mama:
    a. Hajamaliza elimu ya msingi
    b. Elimu ya msingi
    c. Elimu ya sekondari
    d. Chuo |

6. Kazi ya baba:
    a. Biashara ndogondogo
    b. Kibarua
    c. Mwajiriwa
    d. Mfanya biashara
    e. Amejiajiri (Taja .....)



7. Kazi ya mama:
    a. Mama wa nyumbani
    b. Biashara ndogondogo
    c. Kibarua
    d. Mwajiriwa
    e. Mfanya biashara
    f. Amejiajiri (Taja .....)



Nakushukuru sana kwa kujibu dodoso hili.

Appendix V: Clinical examination form

Assessment of early orthodontic treatment need and its associated factors among Tanzanian children using IPION-index.

Clinical examination form A: IPION 6			Code	Scores
1	Examiner number		V1	
2	Patient number		V2	
3	Primary components			
		Interproximal caries		
		Upper C	V3	
		D	V4	
		E	V5	
		6	V6	
		Lower C	V7	
		D	V8	
		E	V9	
		6	V10	
		Early loss		
		Upper C	V11	
		Lower C	V12	
		Upper D	V13	
		Upper D	V14	
		Upper E	V15	
		Lower E	V16	
4	Anterior components			
		Supernumerary teeth	V17	
		Upper	V18	
		Lower	V19	
5	Posterior component			
		Molar		
		Upper Rotation	V20	
		Upper Tipping	V21	
		Lower Rotation	V22	
		Lower Tipping	V23	
6	Occlusion			
		Overjet		
		Positive	V24	

		(increased)		
		Crossbite	V25	
		Overbite		
		Overbite	V26	
		Open bite	V27	
		Buccal		
		Crossbite Right	V28	
		Crossbite Left	V29	
		Functional crossbite	V30	
		Scissorsbite Right	V31	
		Scissorsbite Right	V32	
		Molar relationship		
		Right class (II) div. I	V33	
		Left class (II) div. I	V34	
		Right class(II) div. II	V331	
		Left class (II) div. II	V341	
		Right class III	V332	
		Left class III	V342	
7	Soft tissue			
		Lip competency	V35	

Clinical examination form B: IPION 9			Code	Scores
1	Examiner number		V1	
2	Patient number		V2	
3	Primary components			
		Interproximal caries- Upper C	V3	
		D	V4	
		E	V5	
		6	V6	
		Lower C	V8	
		D	V9	
		E	V10	
		6	V11	
		Early loss		
		Upper C	V12	
		Lower C	V13	
		Submerged upper D	V14	
		Upper E	V15	
		Lower D	V141	
		Lower E	V151	
4	Anterior components			
		Active frenum	V16	
		Supernumerary teeth-Upper	V17	
		Lower	V18	
		Diastema Upper	V19	
		Lower	V20	
		Absent incisors Upper	V21	
		Lower	V22	
5	Posterior component			
		Molar: Upper Rotation	V23	
		Tipping	V24	
		Impeded eruption	V25	
		Lower Rotation	V26	
		Tipping	V27	
		Impeded eruption	V28	
6	Occlusion			
		Overjet: Positive (increased)	V29	
		Crossbite	V30	

		Overbite: Deep bite	V31	
		Open bite	V32	
		Molar relationship		
		Right class II div1	V33	
		Left class II div 1	V34	
		Right class II div 2	V331	
		Left class II div 2	V341	
		Right- class III	V332	
		Left -class III	V342	
		Buccal: Crossbite Right	V35	
		Crossbite Left	V36	
		Scissorsbite Right	V351	
		Scissorsbite Left	V361	
		Functional crossbite	V37	
7	Soft tissue			
		Lip competency	V38	

Appendix VI: IPION-Index scoring

IPION for 6 years old

Primary Component

Interproximal caries C: Primary canines will be examined for caries or restorations. Each tooth will be scored.

0: No visible caries or restorations on a canine.

1: One interproximal surface with caries or restorations.

2: Two interproximal surfaces with caries or restorations.

-Scores will be added.

-WEIGHTING: Score will be multiplied by 1.

Interproximal caries D: Primary first molars will be examined for caries or restorations and each tooth will receive a score.

0: No visible caries or restorations on a primary first molar.

1: Occlusal restoration only.

2: Mesial restoration, distal restoration, or mesial and distal restoration.

-Scores will be added.

-WEIGHTING: Score will be multiplied by 2.

Interproximal caries E: Primary second molars will be examined for caries or restorations. Each tooth will receive a score.

0: No visible caries or restorations on a primary second molar.

1: Occlusal restoration only.

2: Mesial restoration, distal restoration, or mesial and distal restoration.

-Scores will be added.

-WEIGHTING: Score will be multiplied by 4.

Interproximal caries 6: Permanent first molars will be examined for caries or restorations. Each tooth will receive a score.

0: No visible caries or restorations on a permanent first molar.

1: Occlusal restoration only.

2: Mesial restorations, distal restoration, or mesial and distal restoration.

X: permanent molars were not visible intraorally.

-Scores will be added.

-WEIGHTING: Score was multiplied by 4.

Early loss upper C: The number of missing upper primary canines will be counted and recorded.

-WEIGHTING: Score will be multiplied by 1.

Early loss lower C: The number of missing lower primary canines will be counted and recorded.

-WEIGHTING: Score will be multiplied by 2 for bilateral loss of mandibular primary canines. Score will be multiplied by 8 for unilateral loss of mandibular primary canines.

Early loss D: The number of missing upper and lower primary first molars will be counted and recorded.

-WEIGHTING: Score will be multiplied by 2.

Early loss upper E: The number of missing upper primary second molars will be counted and recorded.

-WEIGHTING: Score will be multiplied by 4.

Early loss lower E: The number of missing lower primary second molars will be counted and recorded.

-Weighting: score will be multiplied by 4.

Anterior Component

Supernumerary teeth: The number of supernumerary teeth visible intraorally mesial to the canines will be recorded.

Due to time and cost implications, radiographs cannot be taken during the study.

-WEIGHTING: Score will be multiplied by 4.

Posterior Component

Mesial movement of first permanent molars: Mesial movement of first permanent molars will be recorded only when interproximal caries with loss of the marginal ridge, early loss and/or ankylosis of the primary molars in that quadrant are present. Mesial rotation of the upper molars will be confirmed when an extension of an imaginary line between the disto-buccal cusp and the mesio-lingual cusp of the upper molars crossed distal to the contact point of the contralateral first and second primary molar. The number of rotated upper molars will be recorded.

The number of mesially tipped first permanent lower molars will also be recorded. If rotation and or tipping couldn't be measured due to unerupted or partially erupted permanent molars, it will be recoded as not measurable (X).

-Weighting: score will be multiplied by 4.

Occlusion

Overjet: The most prominent incisor overjet will be identified and the overjet will be recorded by holding a plastic ruler parallel to the occlusal plane.

The overjet will be scored:

0: 0-3mm.

1: 3.1-5mm.

2: 5.1-7mm.

3: 7.1-9mm.

4: Greater than 9mm.

X: Not measurable.

-WEIGHTING: Score will be multiplied by 2.

Anterior Crossbite: The teeth in anterior crossbite will be scored as follows:

0: No crossbite or one or more teeth edge-to-edge (edge-to-edge incisor relationship is regarded normal at six years of age).

2: One or two teeth in crossbite.

3: More than two teeth in crossbite.

-Weighting: score will be multiplied by 10.

Overbite: The worst vertical overlap or open bite of any of the four incisors will be recorded.

0: Less than or equal to 2/3 coverage of lower incisors.

1: Greater than 2/3 coverage of the lower incisor, but less than full coverage.

2: Greater than or equal to full coverage of the lower incisor.

X: Not measurable.

-WEIGHTING: Score will be multiplied by 1.

Open bite: The worst vertical overlap or open bite of any of the four incisors will be recorded.

0: No open bite.

1: Less than or equal to 1mm open bite.

2: 1.1-2mm open bite.

3: 2.1-3mm open bite.

4: Greater than or equal to 3.1mm open bite.

-WEIGHTING: Score will be multiplied by 4.

Transverse buccal occlusion: Crossbite will be scored as follows:

0: No crossbite.

1: crossbite tendency (teething an edge to edge relationship).

2: Single tooth in crossbite.

3: More than one tooth in crossbite.

4: More than one tooth in scissorbite.

-Each of the right and the left sides will receive a score.

-WEIGHTING: Score will be multiplied by 1.

-Functional shift will also be scored as either 1 (detectable) or 0 (undetectable).

-WEIGHTING: Score will be multiplied by 10.

Soft Tissue Assessment

Lip competency: Lip position at rest will be noted and scored as follows, measuring with a plastic ruler.

0: Lips sealed at rest.

1: Less than or equal to 4mm space between lips at rest.

2: Greater than 4mm space between lips at rest.

-WEIGHTING: Score will be multiplied by 1.

IPION for 9 years old

Primary component

Interproximal caries C: Primary canines will be examined for caries or restorations. Each tooth will receive a score.

0: No visible caries or restorations on a canine.

1: One interproximal surface with caries or restorations.

2: Two interproximal surfaces with caries or restorations.

-The score will be added.

-WEIGHTING: Score will be multiplied by 1.

Interproximal caries D: Primary first molars will be examined for caries or restorations and each tooth will receive a score.

0: No visible caries or restorations on a primary first molar.

1: Occlusal restoration only.

2: Mesial restoration, distal restoration, or mesial and distal restoration.

-The scores will be added.

-WEIGHTING: Score will be multiplied by 2.

Interproximal caries E: Primary second molars will be examined for caries or restorations. Each tooth will receive a score.

0: No visible caries or restorations on a primary second molar.

1: Occlusal restoration only.

2: Mesial restoration, distal restoration, or mesial and distal restoration.

-The scores will be added.
-WEIGHTING: Score will be multiplied by 4.

Interproximal caries 6: Permanent first molars will be examined for caries or restorations. Each tooth will receive a score.
0: No visible caries or restorations on a permanent first molar.
1: Occlusal restoration only.
2: Mesial restoration, distal restoration, or mesial and distal restoration.
X: Permanent first molars not visible intraorally.
-Scores will be added.
-WEIGHTING: Score will be multiplied by 4.

Early loss upper E: The number of missing upper primary second molars will be counted and recorded.
-WEIGHTING: Score will be multiplied by 2.

Early loss lower E: The number of missing lower primary second molars will be counted and recorded.
-WEIGHTING: Score will be multiplied by 3.
Any primary molar in which occlusal surface will be situated gingival to occlusal plane will be considered as submerged. The number submerged teeth will be recorded.
-WEIGHTING: For first primary molars, score will be multiplied by 1. For second primary molars, score will be multiplied by 2.

Anterior Component
Active frenum: If the interdental papilla blanched when mild to moderate traction was placed on the labial frenum, the frenum will receive a score of 1.
-WEIGHTING: Score will be multiplied by 1.

Supernumerary teeth: The number of supernumerary teeth visible intraorally mesial to the canines will be recorded.

Due to time and cost implications, radiographs cannot be taken during the study.

-WEIGHTING: Score will be multiplied by 4.

Diastema: Diastema between the upper central incisors will be recorded with a plastic ruler:

0: Less than or equal to 2mm.

1: Greater than 2mm.

X: Not measurable.

-Weighting: score will be multiplied by 4.

Absent permanent incisors: All absent permanent incisors will be recorded when not visible or palpable in the patient's mouth. In cases where all eight permanent incisors are present, the score will be 0.

-WEIGHTING: Score will be multiplied by 3.

Posterior Component

Mesial movement of first permanent molars: Mesial movement of first permanent molars will be recorded only when interproximal caries with loss of the marginal ridge, early loss and/or ankylosis of the primary molars in that quadrant are present.

Mesial rotation of the upper molars will be confirmed with an extension of an imaginary line between the disto-buccal cusp and the mesio-lingual cusp of the upper molars crossed distal to the contact point of the contralateral first and second primary molar. The number of rotated upper molars will be recorded.

The number of mesially tipped first permanent lower molars will be recorded.

If rotation and /or tipping could not be measured due to unerupted or partially erupted first permanent molars, it will be recorded as "not measurable" (X).

-WEIGHTING: Score will be multiplied by 4.

Impeded eruption of first permanent molars: The number of first permanent molars not fully erupted into occlusion will be noted, whether caused by ankylosis, ectopic eruption or any other known or unknown reason.

-Weighting: score will be multiplied by 4.

Occlusion

Overjet: The most prominent incisor overjet will be identified and recorded by holding a plastic ruler parallel to the occlusal plane.

The overjet will be scored:

0: 0-3mm.

1: 3.1-5mm.

2: 5.1-7mm.

3: 7.1-9mm.

4: Greater than 9mm.

X: Not measurable.

-WEIGHTING: Score will be multiplied by 2.

Anterior Crossbite: The teeth in anterior crossbite will be scored as follows:

0: No crossbite.

1: One or more teeth edge-to-edge.

2: One or two teeth in crossbite.

3: More than two teeth in crossbite.

-WEIGHTING: Score will be multiplied by 10.

Overbite: The worst vertical overlap or open bite of any of the four incisors will be recorded

0: Less than or equal to 2/3 coverage of lower incisors.

1: Greater than 2/3 coverage of the lower incisor, but less than full coverage.

2: Greater than or equal to full coverage of the lower incisor.

X: Not measurable.

-WEIGHTING: Score will be multiplied by 1.

Open bite: The worst vertical overlap or open bite of any of the four incisors will be recorded.

0: No open bite.

1: Less than or equal to 1mm open bite.

2: 1.1-2mm open bite.

3: 2.1-3mm open bite.

4: Greater than or equal to 3.1mm open bite.

-WEIGHTING: Score will be multiplied by 4.

Antero-posterior molar relationship: Recordings will be made with the teeth in occlusion and when the first molars will be absent in the present occlusion, the primary second molars will be used. Record as follows:

0: class I normal or class III without anterior functional shift.

2: Class II.

5: Class III with anterior functional shift.

-WEIGHTING: Score will be multiplied by 1.

Transverse buccal occlusion: Crossbite will be scored as follows:

0: No crossbite.

1: Crossbite tendency (teeth in an edge-to-edge relationship noted).

2: Single tooth in crossbite.

3: More than one tooth in crossbite.

4: More than one tooth in scissorbite.

-Each of the right and the left sides will receive a score.

-WEIGHTING: Score will be multiplied by 1.

-Functional shift will score as either 1 (detectable) or 0 (undetectable).

-WEIGHTING: Score will be multiplied by 10.

Soft Tissue Assessment

Lip competency: Lip position at rest will be noted and scored as follows, measuring with a plastic ruler.

0: lips sealed at rest.

1: Less than or equal to 4mm space between lips at rest.

2: Greater than 4mm space between lips at rest.

-WEIGHTING: Score will be multiplied by 1.

Appendix VII: Occlusal traits and criteria measured by the IPION index.

6 years olds	9 years olds
Caries	Caries
Early loss	Early loss
Molar relationship	Molar relationship
Rotation / tipping of molars	Rotation / tipping of molars
Overjet	Overjet
Overbite	Overbite
Anterior crossbite	Anterior crossbite
Posterior crossbite	Posterior crossbite
Open bite	Open bite
Lip incompetency	Lip incompetency
	Submerged teeth
	Active frenum
	Absent teeth

Source: Karaiskos et al.(2005)