Malocclusion and quality of life in Tanzanian schoolchildren

Matilda Mtaya

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Dedicated to my Husband David, sons Rodgers and Ronald and my beloved daughter Hellen

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ACRONYMS

SMO	Sum score of Malocclusion
GDP	Gross Domestic Product
MUHAS	Muhimbili University of Health and Allied Sciences
OIDP	Oral Impacts on Daily Performance
OR	Odds ratio
WHO	World Health Organization
MOH	Ministry Of Health
OHI-S	Oral Hygiene Index-Simplified
OHRQoL	Oral Health Related Quality of Life
DHE	Dental Health Education
OHP	Oral Hygiene Practice
MM	Matilda Mtaya
DMFT	Decayed Missing and Filled Teeth
CI	Confidence Interval
OIDPSC	Oral Impacts on Daily Performance Sum Score
OIDPADD	Oral Impacts on Daily Performance Additive score

LIST OF PAPERS

The thesis is based on the following papers.

Paper I

Mtaya M, Brudvik P, Åstrøm AN. Prevalence of malocclusion and its relationship with socio-demographic factors, dental caries and oral hygiene in 12-14 year-old Tanzanian schoolchildren. *European Journal of Orthodontics*; 2008 (in press)

Paper II

Mtaya M, Åstrøm AN, Tsakos G. Applicability of an abbreviated version of the Child-OIDP inventory among primary schoolchildren in Tanzania. *Health and Quality of Life Outcomes 2007, 5:40*

Paper III

Mtaya M, Åstrøm AN, Brudvik P. Malocclusion, psycho-social impacts and treatment need: a cross-sectional study of Tanzanian primary school-children. *BMC Oral Health 2008, 8:14*

ABSTRACT

Objective: The main objective of this study was to assess the prevalence of malocclusion, its associated factors, its impact on quality of life and estimate its socio-dental treatment need in children living in Kinondoni and Temeke Districts of Dar es Salaam, Tanzania.

Methods: Cross sectional surveys of children aged 3-5 and 12-14 years, residing in two districts of Dar es Salaam region, was conducted from November 2005 to June 2006. A stratified proportionate two stage cluster sample design with primary schools as the primary sampling unit (N = 1601 Survey I) and a census (N = 253 Survey II) was utilized. In survey I, participants from the selected primary schools (12-14 year-olds) were clinically examined for decayed, missing and filled teeth due to caries, according to the criteria described by the World Health Organization (1997). Oral hygiene was assessed using simplified Oral Hygiene Index by Greene and Vermillion (1964). Interview schedules for 12-14 year-olds were conducted using structured questionnaires, which included socio-demographic details, perceived oral problems, satisfaction / dissatisfaction with mouth and teeth and Kiswahili version of the Child Oral Impacts on Daily Performances (Child-OIDP) and also questions regarding their perceived general and oral health conditions and oral health related behaviors. In Survey II (3-5-year-olds) parents were interviewed regarding their socio-demographic details and their children's sucking habits and feeding methods. In both surveys (I and II) malocclusion was assessed according to the criteria by Björk et al. (1964) with some modifications by al-Emran et al. (1990).

Data were analyzed using Statistical Package for Social Scientists, SPSS version 14.0. Cross tabulation and Chi-square statistics were used to assess bivariate relationships. Multivariate analyses were performed by multiple logistic regression, with 95% confidence interval (CI) given for the odds ratios indicating statistically significant relationship if both values were above or below 1.

Results: The overall prevalence of malocclusion was 63.8% in 12-14 year-olds and 32.5% in 3-5 year-olds. For the 12-14-year-old children, residing in Temeke (a less socio-economically privileged district) was associated with higher odds (OR 1.8) of being diagnosed with an open bite, after controlling for socio-demographic factors. When subjects with and without caries experience (DMFT) were compared, those with DMFT > 0 were more likely to have any type of malocclusion (SMO>0), a midline shift, Angle Class II/III and an open bite. Oral hygiene varied in unexpected direction with malocclusion (a midline shift) in this study. For the 3-5-year-old children, malocclusion (an open bite) was associated with sucking habits. After controlling for socio-demographic variables, only current sucking habits and gender remained significant determinants for an open bite with the odds ratios of 13.5 and 2.2, respectively. The Kiswahili version of the Child-OIDP inventory preserved the overall concept of the original English version and was applicable to use among primary schoolchildren. A total of 28.6% of the participants had at least one oral impact. Problem with eating was the performance reported most frequently followed by cleaning teeth in both districts. The most frequently reported causes of impacts were toothache, ulcer in mouth and position of teeth. Furthermore, moderate proportions of primary schoolchildren reported problems related to teeth and mouth; ranging from 7.7% (space position) to 20.7% (pain). The odds ratios of having problems with teeth position, spaces, pain and swallowing if having any malocclusion were respectively, 6.7, 3.9, 1.4 and 6.8. A total of 23.3% primary schoolchildren were dissatisfied with dental appearance and function. Primary schoolchildren dissatisfied with their dental appearance were less likely to be Temeke residents and having parents of higher education. They were more likely to report problems with teeth position (OR= 4.3) and have oral impacts (OIDP>0) (OR=2.2). The socio-dental treatment need of 12% was five times lower than a normative estimate of 63.8% based on the overall prevalence of malocclusion (SMO>0).

Conclusion: The study showed that, caries and social demographic status (in terms of district of residence) were associated with malocclusion in primary schoolchildren. Sucking habits and gender were associated with malocclusion in pre-school children. Kiswahili version of the Child-OIDP inventory was applicable for use among Tanzanian primary schoolchildren. Oral impacts and dissatisfaction with teeth appearance and function were not common among 12-14-year-olds. The socio-dental treatment need of 12% was five times lower than a normative estimate of 63.8% based on the overall prevalence of malocclusion (SMO>0). Thus, prophylactic measures which may either totally prevent or at least lessen the development of many forms of malocclusion are recommended, with a particular emphasis to less affluent societies. Moreover, clinical measures of malocclusion together with reported functional- and psychosocial impact scores determined subjects' evaluation of their teeth appearance and function and hence demand for orthodontic care, therefore these should be taken into account when estimating treatment needs.

1. INTRODUCTION

1.1. Outline of the thesis

This thesis concerns the prevalence, associated factors and socio-demographic distribution of malocclusion in Tanzanian children aged 3-5- and 12-14 years emanating from socio-economically different districts of Tanzania. Secondly, this thesis assesses the applicability of a Kiswahili version of the Child Oral Impact on Daily Performance (Child-OIDP) questionnaire to 12-14-year-old primary school children. Thirdly, as part of the validation of the Child-OIDP inventory, this thesis assesses the predictive potential of the Child-OIDP with respect to schoolchildren's perceived appearance and function of their teeth within the theoretical framework of Gilbert et al. (1998) thus accommodating a range of social-, clinical and non-clinical oral health related factors. Fourthly, this thesis assesses the socio-psychological impact of malocclusion and estimate a need for orthodontic treatment in 12-14 year old schoolchildren using a modified socio-dental approach proposed by Gherunpong (2006a). Specifically this thesis considers the following:

1) Prevalence and socio-demographic correlates of malocclusion in 3-5-year-old preschool children (unpublished results presented in the summary).

2) Prevalence of malocclusion and its associated factors in 12-14-year-old primary school children (paper I).

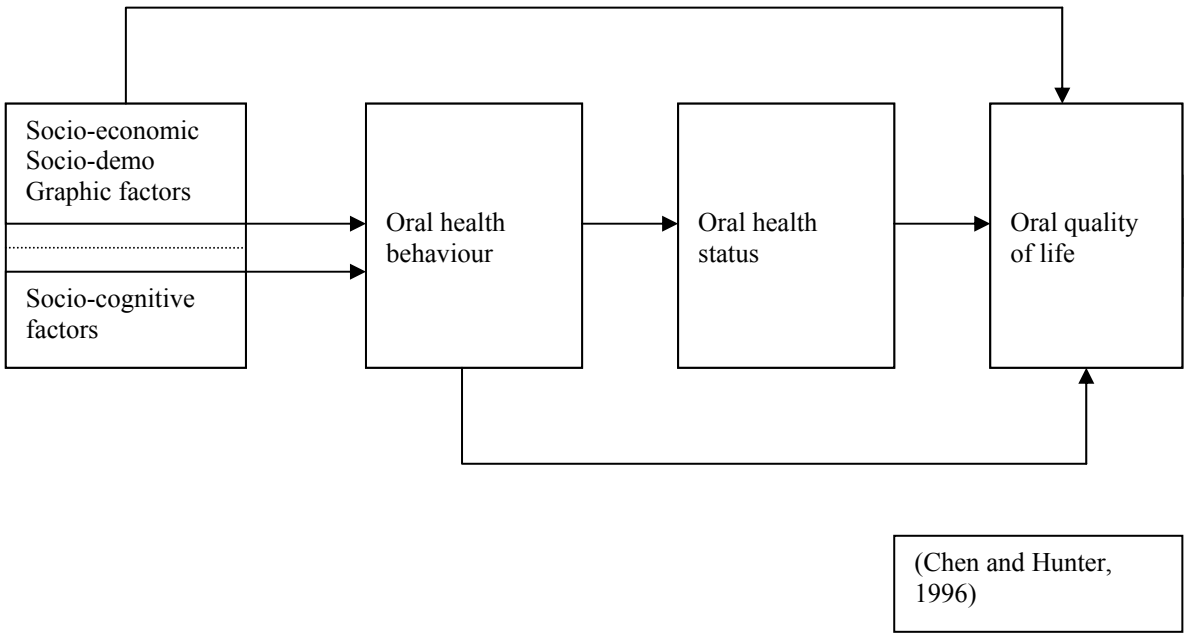
3) Psychometric properties in terms of reliability and validity of a Kiswahili version of the Child-OIDP questionnaire in 12-14-year-olds (paper II).

4) Prevalence and correlates of perceived orthodontic conditions and dissatisfaction with teeth appearance and function and estimate orthodontic treatment need using a socio-dental approach in 12-14-year-olds (paper III).

A conceptual model (Fig 1), developed by Chen and Hunter (1996), guides the three papers and the thesis. According to this conceptual model, demographic- and socio-economic factors

at the environmental level and socio-psychological factors at the individual level affect oral health-related behavior, which in turn affects oral health status. A child's oral health status is the primary determinant of his or her well-being and various dimensions of oral quality of life. According to this conceptual model, distal factors in terms of socio-economic conditions and oral health behaviors might influence oral quality of life directly or indirectly through proximal factors in terms of clinical measures of oral health status (paper I, II and III).

Fig 1. A conceptual model guiding Papers I-III and the Thesis



The thesis outlined here is justified by the fact that with few exceptions mostly emanating from West Africa (Otuyemi et al., 1998, Onyeaso and Aderinokun, 2003, Onyeaso and Arowojolu, 2003, Onyeaso and Sanu, 2005a, Onyeaso and Sanu, 2005b), there is a lack of studies of sub Saharan African origin that consider the prevalence of malocclusion in non-orthodontically treated schoolchildren and that encompass a wide range of socio-demographic correlates and socio-psychological implications of this oral health problem. Knowledge on the

distribution of malocclusion and causes/risk indicators of malocclusion in early childhood can facilitate efforts to prevent such a disorder (especially that caused by environmental factors) and its consequences and make it possible to reduce the complexity of costly orthodontic treatment. Furthermore, this knowledge might help to minimize future treatment need, considering that Tanzania is lacking human resources, materials and equipment for orthodontic services. So far, little is known (Kerosuo, 1990) regarding risk indicators or associated factors related to malocclusion in Tanzanian children. Oral health promotion programs have been included in the School Health Program and in the Mother and Child Health (MCH) clinics, aiming at fostering proper oral health behavior among school age children and mothers of 0-5-year-olds, respectively (MOH, 1988). Therefore, information regarding the magnitude of occlusal anomalies, their associated factors as well as their impact on quality of life and well being would first assist in identifying what kind of information public health workers should provide to school children, in MCH clinics and community at large. Secondly, such information is important for the purpose of planning an organized orthodontic service, which at the moment is virtually non-existent in Tanzania.

1.2. Malocclusion in the permanent and primary dentition of children in developed and developing countries

Maloccclusion is any deviation in the arrangement of the teeth exceeding the standards of normal occlusion (Rønning and Thilander, 1995). It may be associated with anomalies within the dental arches (i.e. crowding and spacing), malrelation of dental arches (i.e. antero-posterior, vertical and transverse anomalies) and skeletal discrepancies (Rønning and Thilander, 1995, Proffit and Fields, 2000). Many studies have reported on the prevalence of malocclusion in different populations (al-Emran et al., 1990, Ng'ang'a et al., 1996, Thilander et al., 2001, Onyeaso, 2004, Ciuffolo et al., 2005, Josefsson et al., 2007). The reported

prevalence of malocclusions in deciduous dentition ranges from 13% among American children to 76% in Brazilian children (Table 1). Malocclusions in the permanent dentition have been reported to range from 39% in Indian (Dhar et al., 2007) to 98% in Tanzanian (Rwakatema et al., 2006) children. Divergence in the prevalence figures may depend on ethnic differences, wide ranges in number, as well as in the age range of subjects examined (Abu Alhaija et al., 2005a). Moreover, the criteria for the recorded items (registration methods) seem to play an important role for the variation in the prevalence figures (Thilander et al., 2001).

Table 1. Prevalence (per cent) of malocclusion in the deciduous dentition in different ethnic groups worldwide, published between 1988-2008

		Subjects		Registration	
Authors	Population	n	Age	Method	%
Visković et al. (1990)	Croatian	301	3-6	WHO indices	47.5
Kerosuo (1990)	Tanzanian	580	3-4	Occlusal classification	18
Jones et al. (1993)	USA	493	3-4	-	13
Kabue et al. (1995)	Kenyan	221	3-6	Björk et al.	51
Trottman and Elsbach (1996)	USA	238	2-5	Angle Classification	49.8
Chevitarese et al. (2002)	Brazilian	112	4-6	-	75.8
Stahl and Grabowski (2003)	Germany	1225	mean 4½	Klink-Heckmann & Bredy	42
Mugonzibwa et al. (2004a)	Tanzanian	197	3½-5	Björk et al.	19.8
Katz et al. (2004)	Brazilian	330	4	Occlusal classification	49.7
Grabowski et al. (2007)	Germany	766	mean 4½	-	74.7
Robke (2008)	Germany	434	2-6	Modified WHO indices	75.1

1.3. Risk indicators for malocclusion

Risk is the term used in epidemiology to express the probability that a particular outcome (bad one) will occur within a given period of time, following a particular exposure (Burt, 2005). In order to establish risk factors for malocclusion in primary and permanent dentition, longitudinal studies are required. On the other hand, cross-sectional data provide evidence of risk indicators of malocclusion, since exposure and outcome data are collected at the same time (Burt, 2005). Thus, a risk indicator may be a probable risk factor, although causality cannot be inferred from cross-sectional data alone. In this thesis, the concept of risk indicators is used since risk is imputed from cross-sectional data. It is generally acknowledged that two major groups of aetiological factors for the development of malocclusion may be distinguished, namely, genetic factors (inherited abnormalities) and non-genetic (environmental) factors (Rønning and Thilander, 1995). A combination of both factors has often been found in the same individual. Schopf (1981) highlighted the importance of environmental (non-genetic) factors for the development of malocclusion. The author (Schopf, 1981) found that in 75% of the subjects, the occurrence of anomalies had been encouraged by environmental factors such as caries in deciduous teeth, early loss of teeth, and biting habits. Genetic or developmental forms of malocclusion were found less often in that study. Hence, this thesis intended to focus only on the environmental factors associated with the occurrence of malocclusion in Tanzanian pre- and primary schoolchildren. Yet, the role of genetic factors may not be ruled out in a cross-sectional study. Dental caries, early extraction of deciduous teeth, abnormal pressure and sucking habits, abnormal swallowing and mouth breathing are among important environmental factors associated with malocclusion (Rønning and Thilander, 1995, Proffit and Fields, 2000).

1.3.1. Dental caries

Numerous epidemiological studies on the relationship between dental caries and malocclusion in children have been presented in the literature (Helm and Petersen, 1989, Stahl and Grabowski, 2004, Ciuffolo et al., 2005, Frazão and Narvai, 2006, Gábris et al., 2006, Nobile et al., 2007). Some authors have suggested that dental caries and premature loss of primary teeth are predisposing factors for occlusal and space anomalies in the mixed and permanent dentitions (Pedersen et al., 1978, Ravn, 1980). Laine (1984) further stated that, the high incidence of caries and the great number of extractions of severely decayed teeth have given rise to several analyses of the effects of extraction such as occlusal disturbances and interference with speech. Nevertheless, some previous attempts to investigate a possible association of malocclusion and dental caries have shown conflicting results (Helm and Petersen, 1989, Ben-Bassat et al., 1997).

1.3.2. Sucking habits

Sucking habit is a common behavior among young children in various populations (Fukuta et al., 1996, Farsi and Salama, 1997). Sucking habits may initiate thrusting of the tongue and abnormal swallowing pattern (Rønning and Thilander, 1995). The relationship between prolonged sucking and occlusal abnormalities has been studied extensively (Øgaard et al., 1994, Karjalainen et al., 1999, Larsson, 2001, Warren and Bishara, 2002). Decreased maxillary arch width and increased mandibular arch width, with a correspondingly higher prevalence of posterior crossbite have been reported to be some of the effects of prolonged sucking (Øgaard et al., 1994). Fukuta et al. (1996) also mentioned anterior open bite as the most frequently occurring malocclusion with digit sucking. However, other studies have shown inconclusive results regarding the effect of these habits on occlusion (Farsi and Salama, 1997, Warren and Bishara, 2002).

1.3.3. Socio-demographic factors

Dental caries, one of the most important environmental factor for malocclusion, has been considered a social class disease (Gratrix and Holloway, 1994). In the developed and increasingly also in developing countries studies have shown that the burden of dental caries and the need for dental care is highest among the poor and disadvantaged populations (for review see Petersen (2005)). Frazão and Narvai (2006) reported that greater caries incidence combined with more untreated dental caries increased the risk of malocclusions in less affluent Brazilian public-school students. Furthermore, Tickle et al. (1999) found normative need for orthodontic treatment to be more common amongst deprived UK children than among their affluent counterparts. In this regard therefore, socio-economic class (a socio-demographic factor) is considered as a risk indicator for malocclusion in this thesis.

1.4. Oral health related quality of life indicators for children

In this thesis, the *World health Organization quality of life* groups definition of quality of life is embraced in terms of "an individual's perception of his/her position in life in the context of culture and value systems in which they live and in relation to their goals, expectations, standards and concerns" (WHOQOL, 1995). Although assessments of adults' oral health related quality of life (OHRQoL) have existed for decades (Slade and Assessing oral health outcomes, 1997), there is a lack of measures developed and designed for children (for a review see Kida et al. (2006)). This is peculiar since pediatric oral disorders such as dental caries and malocclusion are common and likely to affect children's quality of life negatively. In an overview of studies from developed and developing countries, Kiwanuka (2006) found the prevalence rates of reported pain and other oral impacts in children to vary from 21.6% in 0-18-year-old Kenyan to 68% in 12-year-old Indian children.

A few instruments (i.e. socio-dental indicators) are now available for measuring OHRQoL in school-aged children; the Child Oral Quality of Life questionnaire including the Parental Caregiver Perception Questionnaire, the Family Impact Scale, three Child Perception Questionnaires for children aged 6-7-, 8-10- and 11- to 14 years, the Child Oral Impacts on Daily Performance (Child-OIDP) inventory, that has been applied in the present thesis and Child Oral Health Impact Profile for school aged children 8-15 years (see paper II for review). Recently, the Early Childhood Oral Health Impact Scale (ECOHIS) was developed to assess oral health impacts among preschool children aged 0-5 years and the impact of child's oral condition on the family (Pahel et al., 2007).

The dominance of short term memory, strong influence of recent incidents, absence of a fully developed long term perspective, language problems and reading ability may impact the reliability and validity of child's responses regarding their own OHRQoL (Eiser and Morse, 2001). Using parents and caregivers as proxy informants, suggests that they have in general low to modest agreement with the children's own rating, emphasizing the usefulness of obtaining both child and caregivers report of the child OHRQoL (Wilson-Genderson et al., 2007, Weyant et al., 2007). However, according to child developmental specialists, early school aged children are capable of expressing a range of emotions (such as anxiety and happiness) as well as cultural values such as beauty (Hetherington et al., 1999). Recently developed generic and disease specific OHRQoL questionnaires have demonstrated that with appropriate technique, it is possible to obtain valid and reliable reports from children (Jokovic et al., 2002). Table 2 shows an overview of recently developed generic and disease specific OHRQoL instruments for children in various age groups, their number of items and the wording of items in terms of positively and negatively worded items.

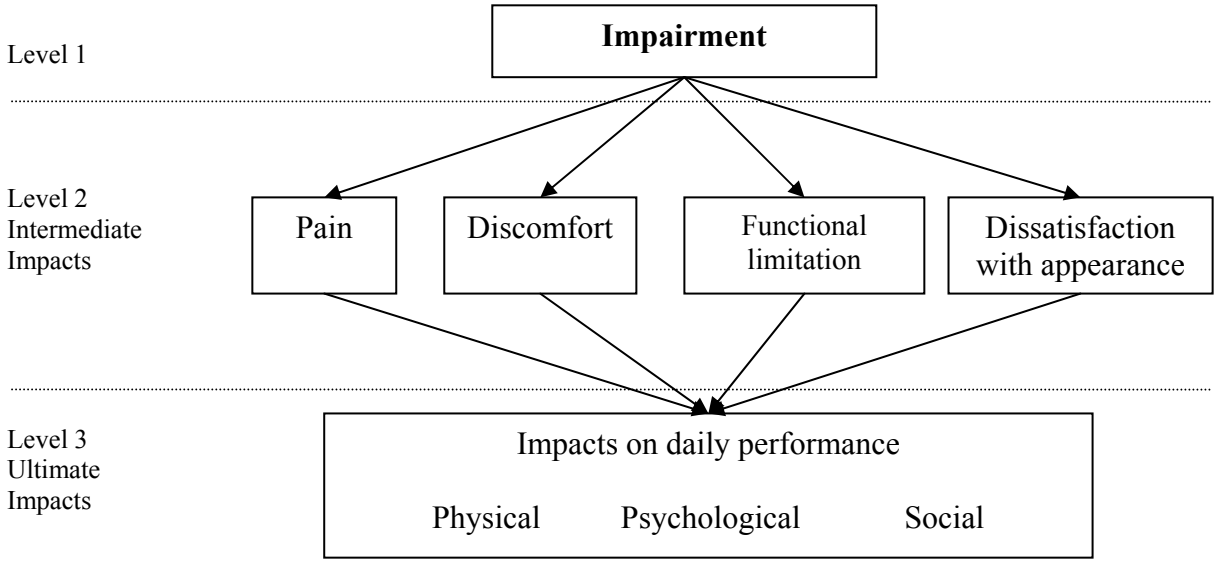
Table 2. Oral Health Related Quality of Life instruments used in children, their abbreviations, number of items contained and original reference

Instrument	**Abbreviation**	**Number of items**	**Wording of items**	**Original Reference**
Early Childhood Oral Health Impact Scale	ECOHIS	13	Negatively worded	Pahel et al. (2007)
Child Oral Health Impact Profile	COHIP for children 8-15 yrs	34	Positively and negatively	Broder and Wilson-Genderson (2007)
Surgical Orthodontic Outcome Questionnaire	SOOQ	33	Negatively worded	Locker et al. (2007a)
Child Oral Health related Quality of Life	COHRQoL for 8-10 yr olds	25	Negatively worded	Humphris et al. (2005)
Child-Oral Impact on Daily Performance	Child-OIDP	8	Negatively worded	Gherunpong et al. (2004b)
Parental Perception Questionnaire	P-CPQ	31	Negatively worded	Jokovic et al. (2003)
Family Impact Scale	-	14	Negatively worded	Locker et al. (2002)
Child Perceptions Questionnaire	CPQ $_{11-14}$	37	Negatively worded	Jokovic et al. (2002)

Most measures developed to assess the OHRQoL in children, commonly referred to as socio-dental indicators or subjective oral health indicators, appear to be theory based and well tested for psychometric properties in terms of reliability and specific attributes of validity (i.e. content, construct and criterion validity) (Brondani and MacEntee, 2007). Most OHRQoL instruments, are based on Parson's sick role theory (Streiner and Norman, 1995) and an explicit conceptual framework of the World Health Organization's International Classification of Impairments, Disabilities and Handicaps (ICIDH, Badley (1987)) (Fig 2). Impairments (level 1) refer to the immediate biophysical outcomes of disease, commonly assessed by clinical indicators. The concepts of functional limitations, pain and discomfort (level 2) refer

to functioning, behavior experience and psychological and social well-being assessed through self report procedures. Disability and handicap on the other hand, refer to any difficulty in performing activities of daily living and to the broader social disadvantages and deprivation-named “ultimate impacts” (level 3), respectively. The ICIDH provides a theoretical basis for the empirical exploration of the links between various dimensions of oral health and has been amended for dentistry by Locker (1988). In accordance with emerging consensus in the literature that OHRQoL is multidimensional consisting of social-, functional and psychological dimensions, researchers have started to examine the factorial validity of instruments in addition to the more traditional attributes of validity using exploratory and confirmative factor analyses (Brondani and MacEntee, 2007, Humphris et al., 2005).

Fig 2. Theoretical Framework of consequences of oral impacts



One of the most promising inventories that have been applied in the present thesis is the Child Oral Impacts on Daily Performances (Child-OIDP) scale. The original OIDP version for use among adults has been translated into different languages (for review see Åstrøm and Okullo

(2003) , Masalu and Åstrøm (2003) and Kida et al. (2006)). The child version of the OIDP was developed and tested in Thailand (Gherunpong et al., 2004a, Gherunpong et al., 2004b) and has been found to be valid when applied to children in Tanzania (paper II), France and UK (Tubert-Jeannin et al., 2005, Yusuf et al., 2006). Whereas psychometric properties of the OIDP have been found to be satisfactory in various cultural contexts, there is less evidence as to whether this inventory should be interpreted as a uni-dimensional or multidimensional construct. Moreover, the issue of comparing scores between groups within and across cultures remains problematic due to lack of evidence of its factorial validity for use in comparative research (Åstrøm and Mtaya (2008), *submitted*).

1.5. Psycho social impacts of malocclusion in children

In addition to several multi-item scales for the assessment of children's quality of life and well being, single-item global indicators, such as self-rated dental appearance and function are also widely used in oral health research (Locker and Gibson, 2005). As summary indicators, intergrating several oral health concepts such as biological states, symptoms and physical-, psychological- and social functioning, single item global indicators can substitute more complex multi-item scales. However, single item global indicators of oral health have seldom been used as the primary outcome in dental studies focusing children from developing countries. Tables 3 and 4 respectively, show an overview of studies focusing the impact of malocclusion on quality of life and well being in children and those that have assessed perception of malocclusion from developed and developing countries.

Table 3. An overview of studies published globally between 1998 and 2008 focusing on the impact of malocclusion on Oral Health Related Quality of Life (OHRQoL) among children and adolescents

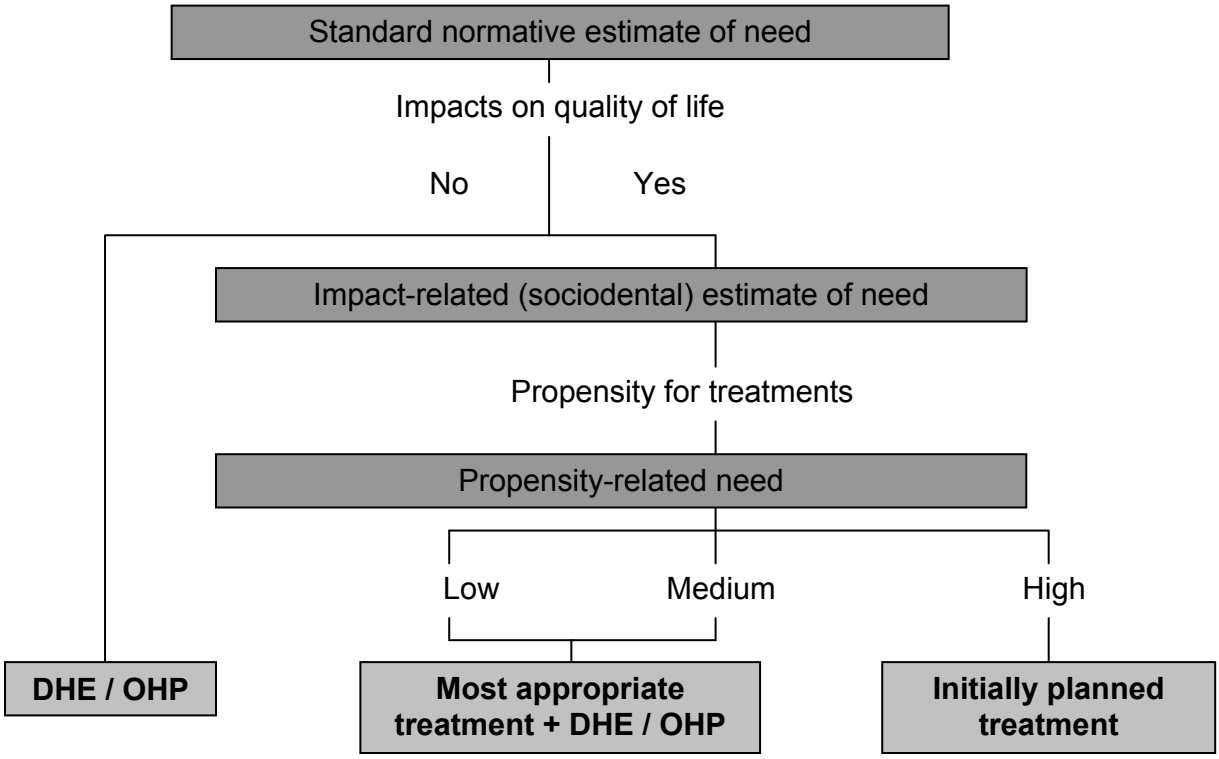
Author(s)	Country	Subjects		OHRQoL Index
		n	Age	
Bernabé et al. (2008)	Brazil	1060	15-16	Oral Impacts on Daily Performances (OIDP)
De Oliveira et al. (2008)	UK	187	11-16	Child Perceptions Questionnaire (CPQ $_{11-14}$)
Bernabé et al. (2007a)	Brazil	1318	15-16	Oral Impacts on Daily Performances (OIDP)
Bernabé et al. (2007b)	Peru	805	11-12	Child Oral Impacts on Daily Performances (Child-OIDP)
Locker (2007)	Canada	370		Child Perceptions Questionnaire (CPQ $_{11-14}$)
O'Brien et al. (2007)	UK	147	11-14	Child Perceptions Questionnaire (CPQ)
Locker et al. (2007b)	Canada	141		Child Perceptions Questionnaire (CPQ $_{11-14}$)
Traebert and Peres (2007)	Brazil	414	18	Oral Impacts on Daily Performances (OIDP)
Johal et al. (2007)	UK	180	13-15	Child and Parental Perceptions Questionnaire (CPQ and P-CPQ)
Tsakos et al. (2006)	Thailand	1034	11-12	Child Oral Impacts on Daily Performances (Child-OIDP)
Brown and Al-Khayal (2006)	Saudi Arabia	174	11-14	Child Perceptions Questionnaire (CPQ $_{11-14}$)
Gherunpong et al. (2006b)	Thailand	1126	11-12	Child Oral Impacts on Daily Performances (Child-OIDP)
O'Brien et al. (2006)	UK	325	11-12	Child Perceptions Questionnaire (CPQ $_{11-14}$)
Marques et al. (2006)	Brazil	333	10-14	Oral Impacts on Daily Performances (OIDP)
Traebert and Peres (2005)	Brazil	414	18	Oral Impacts on Daily Performances (OIDP)
Foster Page et al. (2005)	New Zealand	430	12-13	Child Perceptions Questionnaire (CPQ $_{11-14}$)
Kok et al. (2004)	UK	204	10-12	Child Perceptions Questionnaire (CPQ)
de Oliveira and Sheiham (2004)	Brazil	1675	15-16	Oral Impacts on Daily Performances and Oral Health Impacts Profile (OIDP and OHIP-14)
Jokovic et al. (2002)	Canada	123	11-14	Child Perceptions Questionnaire (CPQ $_{11-14}$)

Table 4. An overview of studies published globally between 1998 and 2008 focusing on perception of malocclusion among children and adolescents

Author(s)	Country	Subjects		Conclusions
		n	Age	
Nobile et al. (2007)	Italy	1000	11-15	Children's perceptions of orthodontic treatment do not overlap with high normative orthodontic treatment need
Hassan (2006)	Saudi Arabia	743	17-24	Patient's perception to orthodontic treatment does always correlate with professional assessment
Onyeaso and Sanu (2005a)	Nigeria	577	12-17	Significant, negative, weak correlations were found between adolescents awareness of malocclusion and satisfaction with personal dental appearance at various severity levels of malocclusion
Onyeaso and Sanu (2005b)	Nigeria	614	12-18	Subjects with certain malocclusion traits expressed unfavourable perceptions of teeth significantly more than others
Abu Alhaija et al (2005b)	Jordan	1404	13 and 17	Students who reported a definite need for treatment perceived their teeth to be worse than others
Mugonzibwa et al. (2004b)	Tanzania	386	9-18	Most children recognized well-aligned teeth as important for overall facial appearance, objective and subjective treatment need did not coincide
Onyeaso and Arowojolu (2003)	Nigeria	567	12-18	Considerable proportions of adolescents perceived, desired and objectively needed orthodontic care, but discrepancy was observed between subjective felt need and objectively determined need
Onyeaso and Aderinokun (2003)	Nigeria	614	12-18	There was a weak but significant correlation between objectively determined need and children's perceptions of the appearance of their teeth
Abdullah and Rock (2002)	Malaysia	5112	12-year-olds	'Definite need for orthodontic treatment' perceived by children and parents were much lower than those of a trained orthodontist
Esa et al. (2001)	Malaysia	1519	12-13	Significant associations were found between objectively determined need and children's perception of need for orthodontic treatment, satisfaction with dental appearance and social functioning
Sheats et al. (1998)	USA	1155	12-16	Clinical judgment of orthodontic need differed significantly among levels of satisfaction with teeth
Otuyemi et al. (1998)	USA and Nigeria	1337 US & 200 Nigerian	15-18 US & 12-18 Nigerians	Perceptions of dental aesthetics of Nigerian subjects were very similar to those of the US subjects, but showed the least correlation with US orthodontists

Malocclusion or the variation of normal growth and development affecting muscles and facial bones during childhood and adolescence, can cause psychological and social problems related mainly to impaired dental and facial aesthetics (Kenealy et al., 1989). Thus, an important aspect of orthodontic treatment is to improve dental aesthetics and enhance well being (Shaw et al., 1991). It has been shown that a pleasing dental appearance is an important factor for adolescents psychosocial well being (Peres et al., 2008). However, considerable discrepancies are commonly found between measures of normative need for orthodontic treatment (such as a measure of the prevalence of moderate to severe malocclusion) and oral impacts in terms of psychosocial implications (i.e. dissatisfaction with teeth appearance and function) (Peres et al., 2008). High proportions of children have been found to have normative need without psychosocial impacts and vice versa. Gherunpong et al (2006a) developed a socio-dental approach to assess dental treatment needs in children as a response to the suggestion that both measures of normative need for treatment and measures of psycho-social implications should be considered in combination to cover various dimensions of oral health. The conceptual model for a socio-dental approach to need assessment is described in Paper III of this thesis. Fig 3 provides a schematic representation of a socio-dental approach to need assessment for non progressive oral conditions.

Fig 3. Basic model of dental needs – *Gherunpong et al. (2006b)*



1.6. Aim of the study

This study examined the prevalence, socio-demographic distribution, associated factors of malocclusion and its impact on perceived dental appearance and function in Tanzanian children with no history of orthodontic treatment. Considering the importance of perceived teeth appearance for orthodontic treatment need and thus for the planning of oral health care services, this study estimated a need for orthodontic treatment using a modified integrated socio-dental approach. Moreover, this study examined the psychometric properties of a quality of life assessment scale developed for children, the Child Oral Impact of Daily Performance (Child-OIDP) and evaluated its applicability in Tanzanian primary school children. Such information is pivotal for the planning and implementation of orthodontic programs aimed at promoting oral health among children in Tanzania.

1.6.1. Research questions

Paper I. Prevalence of malocclusion and its relationship with socio-demographic factors, dental caries and oral hygiene in 12-14-year-old Tanzanian schoolchildren

Focusing 12-14-year-old primary schoolchildren, this study assessed:

1. Prevalence of malocclusion.
2. Its distribution according to socio-demographic factors, caries experience and oral hygiene status.

Paper II. Applicability of an abbreviated version of the Child-OIDP inventory among primary schoolchildren in Tanzania

Focusing 12-14-year-old primary schoolchildren, this study aimed to assess:

1. Psychometric properties of the Kiswahili version of the Child-OIDP.
2. Prevalence and perceived causes of the Child-OIDP and its socio-behavioral correlates.

Paper III. Malocclusion, psycho-social impacts and treatment need: a cross-sectional study of Tanzanian primary school-children

Focusing 12-14-year-old primary schoolchildren, this study aimed to assess:

1. The prevalence of self reported dissatisfaction with teeth appearance and function and its relationship with socio-demographics, malocclusion and self reported oral health problems.

   Following the theoretical model of Gilbert et al (1998), it was hypothesized that:

   a. Reported oral problems (pain, space, swallowing) would increase with increased prevalence of malocclusion.

b. Dissatisfaction with teeth appearance/function would increase with increased prevalence of malocclusion, reported oral problems and increased Child-OIDP.

2. This study estimated orthodontic treatment need- using an integrated socio-dental approach.

Unpublished manuscript. Prevalence of malocclusion and its relationship with socio-demographic factors in 3-5-year-old preschool children

Focusing 3-5-year-old pre-school children, this study assessed:

1. Prevalence of malocclusion.
2. Its distribution according to socio-demographic factors.

2. MATERIALS AND METHODS

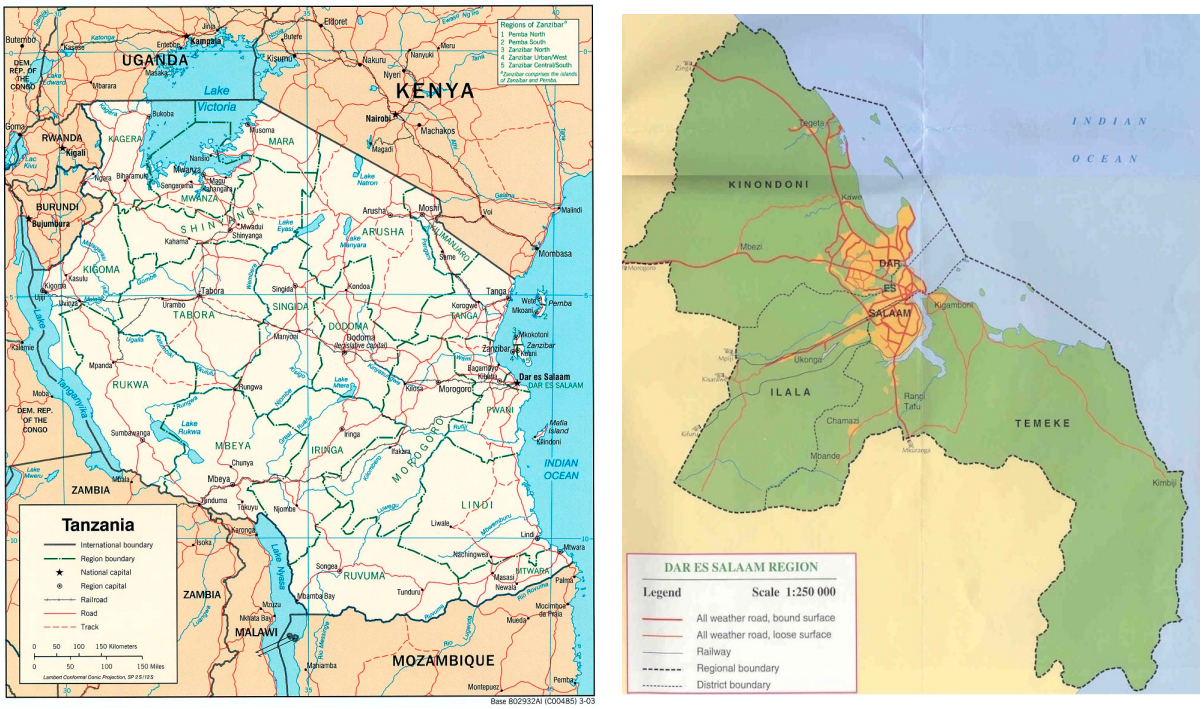
2.1. Study area

Tanzania is a country located along the shores of the Indian Ocean and it is the biggest of the East African countries. The country has about 50% of the population living below the poverty line (http://www.tanzania.go.tz/profile.html). The gross domestic product (GDP) per capita of Tanzania was estimated to US Dollars 251 in 2001 (http://www.tanzania.go.tz/profile.html) and total health expenditure as percent of GDP in 2003 (http://www.who.int/countries/tza/en/) was 4.3%. Tanzania has a total population of about 34 million with a growth rate of 2.8% annually, according to the 2002 (http://www.tanzania.go.tz/census/) population and housing census. About 46% of the population is under the age of 15 (WHO, 2000), with basic or first level of education (which include pre- and primary schools) available for all of them (http://www.tanzania.go.tz/profile.html). The basic education facilities exist both in urban and rural areas. Medium of instruction in public primary schools is Kiswahili language. The learning of Kiswahili enables pupils to keep in touch with their cultural values and heritage

(http://www.tanzania.go.tz/profile.html). Kiswahili is also a national and an official language and almost all (more than 95%) of the Tanzanians speak the language proficiently. Administratively, Tanzania is divided in 26 regions (21 mainland and 5 Zanzibar) and 130 administrative districts (120 mainland and 10 districts in Zanzibar).

The present thesis is based on two surveys conducted among children attending pre- and primary schools in Dar es Salaam region with about 1mg fluoride/L (1 ppm) in drinking water (Fig 4). Dar es Salaam is the commercial capital and major sea port of Tanzania, located in the eastern part, on the shores of Indian Ocean. Dar es Salaam is the most densely populated and socially and culturally heterogenic region in Tanzania. According to the 2002 population and housing survey in Tanzania (NBS, 2004), Dar es Salaam has a total population of 2.5 million and population density of 1,793 per square km. Dar es Salaam is divided into three districts; Kinondoni, Ilala and Temeke with total population sizes of 1.083,913, 634,924 and 768,451 people, respectively. Kinondoni and Temeke are quite diverse districts in terms of their socio-demographic profile, with the former having higher employment rates, literacy rates and proportions of the population using the most expensive form, electricity, as their main source of energy for cooking (NBS, 2004).

Fig 4. A map of Tanzania and Dar es Salaam



2.2. Selection procedure and study profiles

The present thesis is based on two surveys; Survey I-II outlined in Table 5.

Table 5. Survey I and survey II constituting the basis of the 3 papers and unpublished results of this thesis

Paper	Focus	Sample description
I	SURVEY I Malocclusion prevalence and socio-demographic factors	Stratified proportionate two-stage cluster sampling, n=1601of 12-14 year olds in Kinondoni and Temeke, Year 2005-2006
II	Applicability of an abbreviated version of the Child-OIDP inventory	
III	Malocclusion, psycho-social impacts and treatment need	
Summary of thesis (Unpublished manuscript)	SURVEY II Malocclusion in the primary dentition and socio-behavioural factors	Census of pre-school children taken from the selected primary schools, n=253, 3-5 years old children and caregivers in Kinondoni and Temeke, Year 2006

2.2.1. Survey I

The material for survey I, which applies for paper I, II and III, was collected between November 2005 and June 2006. The study population comprised of children attending standard 7 in public primary schools in Kinondoni and Temeke districts. A stratified proportionate two-stage cluster sampling design with public primary schools as the primary sampling unit was utilized. To obtain a sample of schoolchildren of mixed socio-economic background, schools were selected at random from urban and rural areas in the Kinondoni and Temeke districts in Dar es Salaam. Overall, 43 rural- (N=4,809 standard 7 pupils) and 78 urban primary schools (N=14725 standard 7 pupils) were listed in Kinondoni. The corresponding number of schools in Temeke were 22 rural (N=1707 standard 7 pupils) and 77 urban (N= 14103 standard 7 pupils) schools. A sample size of 1200 schoolchildren aged 12-14 years was calculated to be satisfactory for two sided tests, assuming the prevalence of malocclusion and oral impacts to be 0.40 and 0.50 in children with and without caries experience, a significance level of 5% , power of 90% and a design factor of 2 (Lwanga and Lemeshow, 1991). At the first stage, 4 rural (4/43 n= 755 standard 7 pupils) and 6 urban (6/77, n=1157 standard 7 pupils) schools in Kinondoni and 1 rural (1/22 n=184 standard 7 pupils) and 5 urban (5/78, n=949 standard 7 pupils) schools in Temeke were selected by systematic random sampling using a unified sampling fraction within each area. From a total of 3045 standard 7 pupils available in the selected schools, about 100 students in each selected school (i.e. 1601 students constituting 52.6% of standard 7 students in the selected schools) who fulfilled the inclusion criteria (being between 12-14 years, with permanent dentition and without being orthodontically treated) were randomly selected from the accessible classes (an overview of the selection process is shown in fig 5). The response rate was about 100% from each school. Table 6 depicts the number of participating schools in urban and rural areas of Kinondoni and Temeke, number of eligible standard 7 pupils in each

school and number of participants. The sample was self weighted, (with respect to urban/rural schools in each district) i.e. equal probability samples were achieved in Kinondoni (sample probability/sampling fraction of urban and rural schools, 0.09) and Temeke (sample probability/sampling fraction of urban and rural schools, 0.05). However, since variable sampling fraction was used in Kinondoni and Temeke, sample weights were used to achieve unbiased population estimates for the two districts combined. Primary schoolchildren participated in the interview followed by a clinical examination. A test-retest was carried out on a randomly selected sub-sample of 71 primary schoolchildren considered to be a representative of the study subjects, at a time interval of 3 weeks after the main survey. Test-retest reliability of the 8 categorical Child-OIDP items was also assessed.

Fig 5. Selection procedure (Survey I)

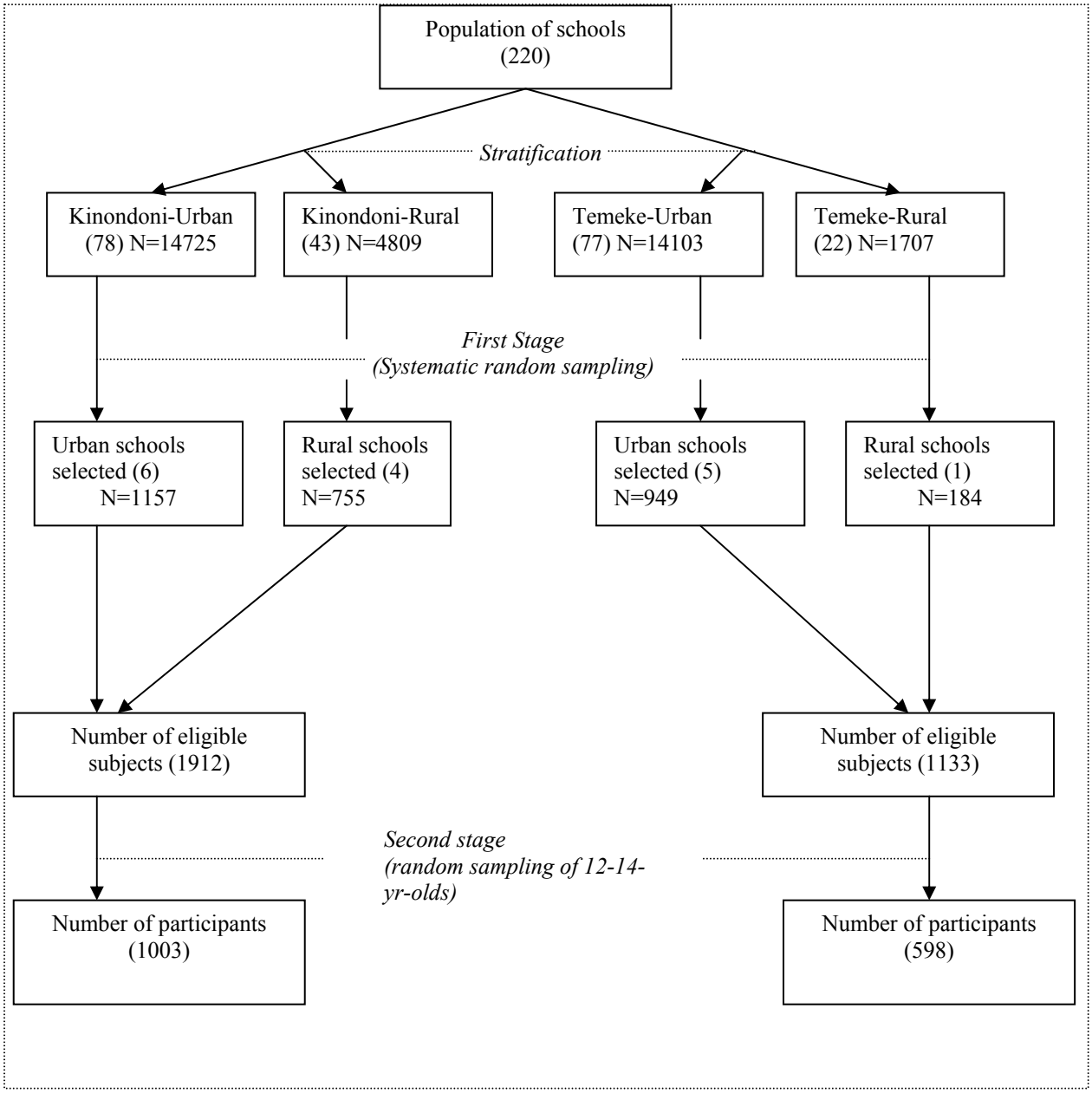


Table 6. Distribution of primary school children according to number (n) of eligible subjects in each school and percentage of participation

District	Primary school	Number of eligible standard seven pupils per school n	Participants n	Percentage of pupils participated %
Temeke	Wailes (u)	215	97	45.1
	Miburani (u)	198	92	46.5
	Mbagala A (u)	216	103	47.7
	Mbagala Rangi 3 (u)	200	92	46
	Azimio (u)	120	108	90
	Kongowe (r)	184	106	57.6
Kinondoni	Dr Omary (u)	175	103	58.9
	Mabibo (u)	199	102	51.2
	Hekima (u)	153	95	62.1
	Msasani (u)	221	104	47
	Tumaini (u)	218	116	53.2
	Mbuyuni (u)	191	117	61.2
	Jitihada (r)	92	89	96.7
	Mbezi (r)	282	110	39
	Bunju A (r)	145	89	61.4
	Pwani (r)	236	78	33
	Total	3045	1601	52.6

(u) Urban, (r) Rural

2.2.2. Survey II

Children 3-5 years of age attending the pre-school part of the selected primary schools in Kinondoni and Temeke districts were invited to participate in Survey II. Most of the public (government) primary schools in Tanzania are equipped with pre-school facilities. The study was conducted during April-May 2006. Letters for permission to work with pre-school children and their parents/caregivers were given to all targeted pre-school administrations, at the same time when Survey I was taking place. School administration obtained consent from parents before giving permission to conduct the study. A total of 8 of the 16 available pre-schools gave permission to work with their children and were included in the study (Table 7). All consenting parents (and their children) were given specific dates to be present for the study. In order to obtain a sample of children with complete primary dentition, pre-school children who were below 3- and above 5-years of age were excluded from the study. A total of 253 of 305 (83% response rate) eligible pre-school children and their parents participated in Survey II.

Table 7. Distribution of pre-school children according to number (n) of eligible subjects in each school and response rate

District	Pre-school	Total number of eligible pre-school children per school n	Participants n	Response rate %
Temeke	Miburani (u)	31	24	77.4
	Mbagala A (u)	31	25	80.6
	Azimio (u)	32	27	84.4
Kinondoni	Mabibo (u)	30	12	40
	Msasani (u)	51	43	84.3
	Tumaini (u)	30	25	83.3
	Mbezi (r)	65	65	100
	Pwani (r)	35	32	91.4
	Total	305	253	83

(u) Urban, (r) Rural

2.3. Survey instrument

2.3.1. Survey I

A structured questionnaire including the Child-OIDP inventory, questions on socio-demographic characteristics, general health- and oral health status/perceived treatment needs and oral health related behaviors was administered by 2 trained research assistants and completed by primary school pupils in face to face interviews at the schools. The interviews were of approximately 5-7 minutes duration and privacy was ensured in the interaction between researcher and interviewee. The questionnaire had to be translated from English (Appendix III) to Kiswahili (Appendix IV), the national and official language in Tanzania.

Description of the translation process has been provided in paper II. The questionnaire was pilot tested and adjusted accordingly before being used in the field. For further information about the variables included see Appendix III.

2.3.2. Survey II

A structured interview schedule was administered by 2 trained research assistants and completed by parents/caregivers of the 3-5-year-old pre-school children in face to face interviews in a classroom setting. The interviews were of approximately 5 minutes duration and privacy was ensured in the interaction between researcher and interviewee. The questionnaire was translated from English to Kiswahili and included questions on socio-demographic characteristics, sucking habits, attitudes of parents towards sucking habits and their children's feeding methods. The questionnaire was pilot tested and adjusted accordingly before being used in the field. For further information about the variables included see Appendix VI.

Socio-demographics were assessed in terms of district (Kinondoni/Temeke), gender, age, parental education and number of rooms in their houses. History of sucking was assessed by asking the parents whether their children had ever sucked finger/lip or dummy. Response categories were given as (1) yes and (2) no. These were then recoded into (1) no (2) yes for use in cross tabulation and logistic regression analysis. Current sucking habit was assessed by asking the parents if their children had any sucking habits currently. Response categories were given as (1) no and (2) yes. Parental education was constructed into (0) 'high' (from original categories 4, 5 and 6) and (1) 'low' (from original categories 1, 2, 3 and 7) variables (Appendix VI). Number of rooms was constructed into (0) 'more than 1 room' (original

categories 2 and 3) and (1) ‘1 room’ (original categories 1 and 4) variables, for use in cross tabulation and logistic regression analysis.

2.4. Clinical examination

2.4.1. Survey I

One trained and calibrated dentist (MM) conducted all clinical examinations in a classroom setting with natural daylight as the source of illumination and with a trained assistant recording the observations. First a dentist practiced on orthodontic casts, and then was compared to an experienced orthodontist whose malocclusion diagnosis served as the standard (gold standard) for comparison. In addition, the examiner (MM) was also trained on a routine clinical orthodontic examination (orthodontic diagnosis) on schoolchildren in the Orthodontic Clinic at the Department of Clinical Dentistry, University of Bergen, supervised by an orthodontist for one week. For the diagnosis of caries and oral hygiene, a dentist was compared to an experienced clinician. For a detailed description of the clinical examination in Survey I, see papers I, II and III. Caries experience was assessed in accordance with the WHO criteria (WHO, 1997). Oral hygiene was assessed using the simplified Oral Hygiene Index (OHI-S) (Greene and Vermillion, 1964). Malocclusion was assessed in accordance with the criteria evolved by Bjørk et al. (1964) with modifications by al-Emran et al. (1990) (Appendix V).

2.4.2. Survey II

One trained and calibrated dentist (MM) conducted all clinical examinations in a classroom setting with natural daylight as the source of illumination and with a trained assistant recording the observations. The clinical examination took place in a private space set aside for

this purpose in a classroom setting. Pre-school children were clinically examined in the presence of their parents/caregivers (after their parents had completed the interview). Pre-school children were clinically examined for malocclusion only. The registration criterion was according to Björk et al. (1964) with some modifications by al-Emran et al. (1990) (as described in paper I, Appendix VIII). For the deciduous dentition, the molar relationship was classified as Angle Class I, II or III when distal plane of the second deciduous molars in centric occlusion was straight, distal (distal step) or had a mesial (mesial step) discrepancy, respectively. Similarly, the deciduous canine was in a Class I relationship when the tip of the maxillary deciduous canine occluded in the embrasure of the mandibular deciduous canine and the first deciduous molar, Class II when the tip of the maxillary deciduous canine was anterior to Class I relationship and Class III when it was posterior to Class I relationship. Furthermore, occlusion in the anterior segment could not always be determined in pre-school children due to shedding of the deciduous incisors. Such cases were excluded for the overjet and overbite analyses, but were included in the analyses for other malocclusions. A sum score of malocclusions (SMO) was constructed to provide the overall prevalence of malocclusion, based on the diagnosis of the absence (0)/ presence (1) of the following recordings; a maxillary overjet, a mandibular overjet, Class II/Class III molar occlusion, an open bite, a deep bite, a lateral crossbite, a midline shift, crowding and spacing.

2.5. Characteristics of data and statistical analyses

Data were analyzed using the Statistical Package for Social Sciences (SPSS) version 14.0 (papers I, II, III and unpublished manuscript in the thesis); AMOS 6.0 (paper II) and STATA version 9.0 with survey command (papers II and III). Table 8 summarizes the statistical methods used for different papers. P-value for statistical significance was set at 0.05.

Table 8. Statistical tests and methods that were used in papers I, II and III

Statistics and methods used	Paper I	Paper II	Paper III	Thesis (Unpublished manuscript)
Chi-Square test	+	+	+	+
Mc Nemar's statistics	-	-	+	-
Cohen's Kappa	+	+	+	-
Principal Component Analysis	-	+	-	-
Confirmatory factor analysis (CFA)	-	+	-	-
Logistic Regression	+	+	+	+
Cronbach's alpha	-	+	+	-
Mann-Whitney U test	-	+	-	-

2.6. Ethical considerations

Ethical clearance was obtained from all relevant persons, authorities and committees in Tanzania, including written permission and clearance from the Research and Publication Committee of the Muhimbili University of Health and Allied Sciences, MUHAS (Appendix I). Permission to work with school children was obtained from Kinondoni and Temeke municipalities, their respective educational authorities, schools administrations and parents. Only consenting subjects were included in the studies, informed verbal consent was obtained from all participating primary school children and from the parents.

3. RESULTS

3.1. Survey I

3.1.1. Paper I: Prevalence of malocclusion and its relationship with socio-demographic factors, dental caries and oral hygiene in 12-14-year-old Tanzanian schoolchildren.

A total of 1601 children (mean age 13 years, 60.5% girls) attending 16 primary schools in Kinondoni and Temeke districts participated in the study. The overall crude prevalence rate of malocclusion (i.e. sum score of malocclusion, SMO>0 – any type of malocclusion) in the total population, in Kinondoni and in Temeke was respectively, 63.8%, 62.6% and 66.0%. The weighted (using sampling weights) unbiased prevalence estimate of malocclusion in the total population (i.e. Kinondoni and Temeke) was 64.0%. The most frequently recorded anomalies in the total population were midline shift (22.5%), spacing of at least 2 mm (21.9%) and open bite (16.1%). A majority (93.6%) of the children showed a Class I molar relationship. Class II and Class III were registered in 4.4% and 2.0%, respectively. Residing in Temeke (a less socio-economically privileged district) was associated with higher odds (OR 1.8) of being diagnosed with an open bite, after controlling for socio-demographic factors. When subjects with and without caries experience were compared, those with caries experience (DMFT > 0) were more likely to have any type of malocclusion (SMO>0), midline shift, Angle Class II/III and open bite than those without caries experience.

3.1.2. Paper II: Applicability of an abbreviated version of the Child-OIDP inventory among primary schoolchildren in Tanzania.

The Kiswahili version of the Child-OIDP inventory preserved the overall concept of the original English version and revealed good reliability in terms of Cronbach's alpha coefficient of 0.77 (Kinondoni: 0.62, Temeke: 0.76). Weighted Kappa scores from a test-retest were 1.0 and 0.8 in Kinondoni and Temeke, respectively. Validity was supported in that the Child-

OIDP scores varied systematically and in the expected direction with self-reported oral health measures and socio-behavioral indicators. Confirmatory factor analyses, CFA, confirmed three dimensions underlying the eight item Child-OIDP questionnaire initially identified by Principle Component Analysis. A total of 28.6% (crude prevalence rate) of the participants had at least one oral impact. The weighted unbiased Child-OIDP prevalence estimate for the total population (Kinondoni and Temeke) was 30.0%. The prevalence of oral impacts was 18.5% and 45.5% in Kinondoni and Temeke districts, respectively. Problems with eating was the performance reported most frequently (13.3% in Kinondoni, 35.3% in Temeke) followed by cleaning teeth (8.6% in Kinondoni, 26.9% in Temeke). The most frequently reported causes of impacts were toothache, ulcer in mouth and position of teeth.

3.1.3. Paper III: Malocclusion, psycho-social impacts and treatment need: a cross-sectional study of Tanzanian primary school-children.

Moderate proportions of children reported problems related to teeth and mouth; ranging from 7.7% (space position) to 20.7% (pain). The odds ratio of having problems with teeth position, spaces, pain and swallowing if having any malocclusion were respectively, 6.7, 3.9, 1.4 and 6.8. In the total population (Temeke and Kinondoni), 23.3% children (the weighted estimate was 22.3%) were dissatisfied with dental appearance/function. The corresponding crude prevalence estimates of dissatisfaction in Kinondoni and Temeke was 25.6% and 19.4%, respectively. Children dissatisfied with their dental appearance were less likely to be Temeke residents and having parents of higher education and more likely to reporting problem with teeth position (OR= 4.3) and having oral impacts (OIDP>0) (OR=2.2). The socio-dental treatment need of 12% was five times lower than a normative estimate of 63.8% based on the overall prevalence of malocclusion (SMO>0).

3.1.4. Direct age standardization of the crude prevalence estimates for children in Kinondoni and Temeke districts

To adjust for a possible biasing effect of age in the two populations of 12-14-year-old schoolchildren in Konondoni and Temeke, direct standardization of the crude prevalence estimates of malocclusion, Child-OIDP and dissatisfaction with dental appearance/function was applied. The crude prevalence rates in Kinondoni and Temeke were adjusted using the Tanzanian 2002 housing and population census for the two districts as reference population (Central Census Office, 2003). Tables 9-11 shows the crude and age adjusted prevalence rates of malocclusion, Child-OIDP and dissatisfaction with appearance/function among 12-14-year-olds in Kinondoni and Temeke. As shown in the tables, the standardization did not accentuate the district differences with respect to any of the main variables examined in this thesis.

Table 9. Crude and direct age standardized prevalence rates of malocclusion (SMO>0) in Kinondoni and Temeke using Tanzanian 2002 housing and population census as reference population (Central Census Office, 2003)

	Konondoni		Temeke		
	Size (n)	ASE (%)	Size (n)	ASE (%)	Stand population
12 yr	263	61.3	143	61.4	25220
13 yr	420	60.3	290	68.2	20901
14 yr	321	66.9	165	65.4	21224
Total	1003		598		67345
Crude rates (%)		62.7		66.0	
Standardized (%)		62.7		64.6	

ASE- age specific estimates

Table 10. Crude and direct age standardized prevalence rates of Child-OIDP (OIDP>0) in Kinondoni and Temeke using Tanzanian 2002 housing and population census as reference population (Central Census Office, 2003)

	Kinondoni		Temeke		
	Size (n)	ASE (%)	Size (n)	ASE (%)	Stand pop
12 yr	263	17.2	143	36.4	25220
13 yr	420	19.5	290	47.2	20901
14 yr	321	18.4	165	50.3	21224
Total	1003		598		67345
Crude rates (%)		18.5		45.5	
Standardized (%)		18.2		44.1	

ASE- age specific estimates

Table 11. Crude and direct age standardized prevalence rate of dissatisfaction with teeth appearance /function using Tanzanian 2002 housing and population census as reference population (Central Census Office, 2003)

	Kinondoni		Temeke		
	Size (n)	ASE (%)	Size (n)	ASE (%)	Stand pop
12 yr	263	22.1	143	21.0	25220
13 yr	420	25.2	290	19.7	20901
14 yr	321	29.0	165	17.6	21224
Total	1003		598		67345
Crude rates (%)		25.6		19.4	
Standardized (%)		25.2		19.5	

ASE- age specific estimates

3.2. Survey II

3.2.1 Unpublished manuscript: Prevalence of malocclusion and its relationship with socio-demographic factors in 3-5-yr-old preschool children

A total of 253 pre-school children (mean age 5 years, 53% boys) attending 8 pre-schools in Kinondoni and Temeke districts participated in the study. The overall prevalence of malocclusion (i.e. SMO>0 – any type of malocclusion) in the total population was 32.5%. A majority (90.9%) of the children showed a Class I molar relationship. Class II and Class III were registered in 0.8% and 8.3%, respectively. The most frequently recorded anomalies in the total population were spacing of at least 2 mm (19.8%), open bite (18.6%) and Class III molar relationship (8.3%). A majority of the children (65.6%) in the total population had maxillary overjet < 5 mm, and the proportion was significantly greater in children from Kinondoni than Temeke (68.4% versus 59.2%, $p<0.05$) (Table 12). There were no significant district and gender differences in the diagnoses of other malocclusion. Twenty eight percent of the pre-school children had a history of sucking either their thumb/finger (20.9%), tongue (5.1%) or (lip 2%). Current sucking habits were reported in 19% of the children (not presented in the tables). Open bite was the single malocclusion trait associated with sucking habits. Pre-school children with the history of sucking habit had significantly more open bite registered than children without such a history ($p<0.001$). Similarly, pre-school children with current sucking habits were diagnosed with open bite more often than pre-school children with absence of such habits ($p<0.001$). After controlling for socio-demographic variables, only current sucking habits and gender remained significant determinants for open bite with the odds ratios of 13.5 and 2.2, respectively (Table 13).

Table 12. Percentages (%) and number (n) of occlusal and space characteristics in Tanzanian pre-school children according to district and gender

	District		Gender		Total
	Kinondoni	Temeke	Boys	Girls	
	% (n)	% (n)	% (n)	% (n)	% (n)
Occlusal					
Sagittal					
Molar relationship					
Class I	92.1 (163)	88.2 (67)	91.8 (123)	89.9 (107)	90.9 (230)
Class II	1.1 (2)	0 (0)	0 (0)	1.7 (2)	0.8 (2)
Class III	6.8 (12)	11.8 (9)	8.2 (11)	8.4 (10)	8.3 (21)
Maxillary overjet					
1-4.9 mm	68.4 (121)*	59.2 (45)	67.9 (91)	63 (75)	65.6 (166)
5-8.9 mm	0 (0)	3.9 (3)	1.5 (2)	0.8 (1)	1.2 (3)
n/a	31.6 (56)	36.8 (28)	30.6 (41)	36.1 (43)	33.2 (84)
Mandibular overjet					
<0--1.9 mm	6.8 (12)	2.6 (2)	6 (8)	5 (6)	5.5 (14)
Vertical					
Overbite					
0.1-2.9 mm	63.3 (111)	55.3 (42)	63.4 (85)	58 (68)	60.9 (153)
3-4.9 mm	5.6 (10)	7.9 (6)	6 (8)	6.7 (8)	6.3 (16)
n/a	31.6 (56)	36.8 (28)	30.6 (41)	36.1 (43)	33.2 (84)
Open bite					
0-1.9 mm	18.1 (32)	10.5 (8)	13.4 (18)	18.5 (22)	15.8 (40)
≥ 2 mm	3.4 (6)	1.3 (1)	1.5 (2)	4.2 (5)	2.8 (7)
Transversal					
Absent	98.9 (175)	98.7 (75)	100 (134)	97.5 (116)	98.8 (250)
Cross bite: Present	1.1 (2)	1.3 (1)	0 (0)	2.5 (3)	1.2 (3)
Midline shift					
Absent (< 2 mm)	92.7 (164)	90.8 (69)	92.5 (124)	91.6 (109)	92.1 (233)
≥ 2 mm	7.3 (13)	9.2 (7)	7.5 (10)	8.4 (10)	7.9 (20)
Space					
Absent (or < 2 mm)	81.4 (144)	75 (57)	80.6 (108)	78.2 (93)	79.4 (201)
Crowding (≥2 mm)	1.1 (2)	0 (0)	0.7 (1)	0.8 (1)	0.8 (2)
Spacing (≥ 2 mm)	17.5 (31)	25 (19)	18.7 (25)	21 (25)	19.8 (50)

*$p<0.05$

Table 13. Percentages (%) and number (n) of schoolchildren with open bite according to district, gender, sucking habits (past and present). Logistic regression, odds ratios (OR) and 95% confidence intervals (CI) (adjusted for age, gender, parental educational status and number of rooms in their houses)

	Open bite present	
	% (n)	Adjusted OR (95% CI)
District: Kinondoni	21.5 (38)	1
Temeke	11.8 (9)	0.5 (0.2-1.3)
Gender: Male	14.9 (20)	1
Female	22.7 (27)	2.2 (1.1-4.7) *
Ever sucking: Yes	38 (27) **	1
No	11 (20)	0.9 (0.2-3.7)
Current sucking: Yes	55.3 (26) **	1
No	10.2 (21)	13.5 (3.3-55.4) **

*p<0.05, **p<0.001

4. DISCUSSION

This section considers methodological issues of importance for the present thesis and the main findings of the constituting papers. A more detailed discussion of the results is found in the individual papers included in this thesis.

4.1. Methodological issues

The data utilized in this thesis was collected in two cross-sectional sample surveys using interview schedules and clinical examinations. Sample surveys are designed by definition to provide estimates of the characteristics of a defined population (Moser and Kalton, 1971). One study population consisted of 3-5-year-old pre-school children in Kinondoni and Temeke districts. The second study population consisted of 12-14-year-old primary school children in the same area. The main strength of the present study, as one of the advantages of a sample

survey approach, is that it yields information on many variables of a large number of people at a relatively low cost (Moser and Kalton, 1971). However, it might be subject to various sources of error, which might bias the results and the conclusions provided (Locker, 2000). Bias is any systematic error in the data and occurs as two major categories. Selection bias stem from study participants (e.g. non response) and information bias or misclassification stem from errors in the information collected from participants (e.g. recall bias). The methodological problems associated with the present approach are discussed in detail in the separate papers. Some of the most important limitations are discussed below.

4.1.1. Reliability

Reliability is concerned with the degree of consistency or accuracy with which an instrument measures an attribute (Moser and Kalton, 1971, Polit and Hungler, 1991). An instrument is recognized to be reliable when it maximizes the true component and minimizes the error component of the score. The stability aspect of reliability (precision) can be assessed by comparing the same measure for the same sample at two or several points in time and then translating it into convenient statistics (McDowell and Newell, 1996). A test-retest approach was applied in Survey I. Other measures taken in this study to ensure data quality included training of research assistants, use of pilot studies and repeated checks during the data entry process (Survey I and Survey II). Due to logistical reasons, re-interviews and test retest clinical examination could not be carried out in Survey II.

For measurement of consistency, a sub-sample of primary school children were re-examined clinically after a period of three weeks. Cohens' kappa statistics were 0.74, 0.78, 0.79, 0.82, 0.93, 0.93 and 0.97 for the OHI-S-, midline shift-, deep bite-, mandibular overjet-, maxillary overjet-, DMFT- and spacing scores, respectively. Regarding the scores for an open bite,

Angle classification, a crossbite, a scissor bite and crowding, the Kappa statistics were 1.00. Test retest reliability for the 8 Child-OIDP items were 0.7 (emotional state), 0.8 (carrying out major schoolwork) and 1.00 (eating, speaking, cleaning teeth, sleeping, smiling and socio contact). These figures indicate respectively, substantial, perfect and very good agreement according to Landis and Koch (1977). Weighted Cohen's kappa for the categorical Child-OIDPSC scores were 0.91 (1.0 in Kindondoni and 0.83 in Temeke) and Intra-Class Correlation coefficient for Child-OIDPADD scores were 0.98.

Cronbach's alpha was used to assess internal consistency reliability (Streiner and Norman, 2003). The more homogenous the items, the higher the correlation (Cronbach's alpha) and therefore the more reliable the measure, indicating that, they measure the same underlying concept. Internal consistency reliability (standardized item alpha) was 0.77 (0.62 in Kinondoni and 0.76 in Temeke, indicating moderate and extensive internal consistency (paper II) according to McDowell and Newell (1996). Item total correlation coefficient is the correlation of the individual item with the scale total omitting that item (Streiner and Norman, 2003). It is recommended that, the items should correlate with the total score above 0.20 for the instrument (test) to be reliable. Paper II shows that all the item total correlation coefficients for the Child-OIDP inventory ($r \geq 0.21$), were above the recommended total score (Streiner and Norman, 2003).

4.1.2. Validity

A measure, test or scale is said to be valid if it measures what it claims to measure (McDowell and Newell, 1996). Internal validity deals with the question of whether a true measure is obtained for the subjects under study. External validity relates to whether it is permissible to generalize findings from the sample to a wider population (Moser and Kalton, 1971).

Internal validity

An optimal method for obtaining correct diagnoses of malocclusion would have been to include model (orthodontic casts) and radiographic (orthopantomogram, periapical status, cephalometric analysis) analysis (Rønning and Thilander, 1995). For optimal diagnosis of dental caries, x-ray units, adequate lighting and patient's dental records to obtain reasons for missing teeth would be required. Using a field method for data collection, the possibility of misclassification by underreporting the prevalence of malocclusion and dental caries cannot be ruled out. To limit biases in clinical registrations, the dentist (MM), was calibrated before the main survey. Using dental casts, the dentist was compared with an experienced orthodontist whose diagnosis served as the standard (gold standard) for comparison. Furthermore, the dentist practiced on clinical examination (in schoolchildren) for one week in the orthodontic clinic at the University of Bergen under supervision of an orthodontist. It was also ensured that the clinical examinations adhered to the criteria set for field surveys by the World Health Organization (WHO, 1997), Greene and Vermillion (1964) and Bjørk et al. (1964).

The present study relies on self reported data in the assessment of risk indicators and subjective oral health status. Studies have shown that self reports have proven to be valid in assessing number of teeth although the validity varied with the degree of specificity required (Gilbert et al., 1997, Gilbert et al., 2002). Common threats to the validity of self-reports that can lead to information bias is social desirability and recall bias. Retrospective studies are always prone to recall bias and children's ability to recall past events and interpret the questions might have influenced the validity of their answers, which indicates the respondents' tendency to represent a favorable image of one-self. In addition, there is a possibility that socially desired and undesired behaviors have been over-and underestimated

in both Survey I and II. To overcome the problems with social desirable answers, interviews were carried out before the clinical examination. It has been recognised that with the appropriate questionnaire techniques, valid and reliable information can be obtained from children (Jokovic et al., 2003, Jokovic et al., 2004, Tubert-Jeannin et al., 2005). As far as parents' questionnaire is concerned, the questionnaire was administered as an interview to clarify any queries. Generally, the questionnaires used among 3-5-year-old pre-school children's parents and 12-14-year-old primary schoolchildren were pre-tested and adjusted accordingly in order to make them socially acceptable.

As validity (i.e. construct validity) is dependant on theory, the observed associations harmonizing the propositions of the Gilbert et al (1998) model (paper III) is as much a test of theory as of the validity of the measurements. Similarly, a recall of three months utilized in the Child-OIDP inventory has proved successful in a number of studies of child populations (Gherunpong et al., 2004a, Gherunpong et al., 2004b, Tubert-Jeannin et al., 2005, Yusuf et al., 2006).

External validity

The 12-14-year-old children investigated reflect the variety of characteristics of Tanzanian children of that age attending primary schools in Kinondoni and Temeke districts. A comparison of the sample characteristics with the Kinondoni and Temeke 12-14-year-old child populations on markers of sex and parental education suggests that the sample was fairly representative of the population of children of that age group in those districts. Direct age standardization did not accentuate the district differences with respect to any of the main outcomes investigated among 12-14-year-olds. It is questionable however, whether the schoolchildren investigated are representative of urban and rural primary schoolchildren in

Tanzania generally. The proportionate stratified two-stage cluster sample employed for primary school children within each district provided a self weighted sample with respect to urban and rural residents, making weighting of the within district results to adjust for different probability selection unnecessary. However, with respect to the combined population of Kinondoni and Temeke, the sample was not self weighting due to unequal sampling fraction applied in the two districts. Thus, sample weights were applied to obtain unbiased estimates of the prevalence of malocclusion, oral impacts and dissatisfaction with teeth appearance and teeth function in the total population covering both districts (Moser and Kalton, 1971).

The use of cluster sampling design with schools as the primary sampling unit materially simplified and cheapened the field work. Random sampling of school pupils within each selected school (i.e. primary sampling unit) was utilized in a second stage to make the clusters equal in size, to reduce the size of the clusters and thus the design effect and to keep the standard errors within a certain limit. To adjust for the cluster effect and avoid overestimating the precision (i.e. underestimating the standard errors) data were transferred to STATA version 9.0 to adjust for the cluster effect. The 95% confidence intervals of the estimates were adjusted accordingly although the initial results provided without taking the survey design into consideration were left essentially unchanged.

Although a census of pre-school children (and their parents) in the eligible pre-schools were invited to participate in Survey II, taking this opportunity relied on each single parent/caregiver. Initial differences due to self-selection attrition should make one attentive to the potential presence of a divergence between the targeted parental population and the studied one. A bias towards health conscious participants is a well-known problem in studies where participation is voluntary (Locker, 2000). There was a good response rate (over 80%)

obtained in both surveys, being on average 100% in Survey I and 83% in Survey II. These high response rates were probably due to the clear and appropriate information given to the respondents and to the pre-testing exercises.

Nonetheless, lack of information about non-respondents precludes any firm conclusion about selection bias and implies that the results of the present surveys, particularly Survey II, should be drawn with caution. The results of the present thesis might be representative for primary school children in Kinondoni and Temeke districts, given the sampling method, the good response rate and the fact that almost all children of school going age are now enrolled in pre- and primary schools. However, they might not be generalized to primary schoolchildren in the whole country.

Cross cultural adaptation

Oral health related quality of life instruments are commonly developed in English and are intended for use in English speaking countries (Guillemin et al., 1993). It would be costly both in terms of time and money to develop measures specifically designed for use in other non-English speaking populations, such as Tanzanian children. This is so although cultural groups differ in disease expression and in use of various health care systems (Guillemin et al., 1993). Translation and adaptation of oral health related quality of life instrument is recommended and has become a common practice. Thus, translation and adaptation of the Child-OIDP inventory into Kiswahili, was for this reason mandatory (paper II). In this study guidelines for cross cultural adaptation (paper II) were adhered to in order to preserve sensibility of the Child-OIDP inventory among Tanzanian schoolchildren (Guillemin et al., 1993). The interpretation of Child-OIDP concepts was further confirmed by the focus group discussions held among 10 schoolchildren, before the main survey.

4.2. Comments on the main findings

4.2.1. Prevalence of malocclusion, reported dental problems, Child-OIDP and dissatisfaction with dental appearance among primary school children

This study has demonstrated that although malocclusions were prevalent in primary schoolchildren (crude prevalence rate 63.8%) and with the most frequently recorded anomalies being a midline shift (22.5%), spacing of 2 millimeters or more (21.9%) and an open bite (16.1%), only moderate proportions of children reported dental problems (e.g. 23.3% dissatisfaction with appearance and function). Numerous studies have identified a gap between professionally- and self reported oral health, suggesting that they document different dimensions of human experience, which are conceptually and often empirically distinct and which have different implications for treatment need (Locker and Miller, 1994). In accordance with findings obtained previously, this gap was reflected in the relatively modest associations obtained between malocclusion and dissatisfaction with teeth appearance and function and between DMFT status and OIDP scores (paper II and paper III). A possible explanation of the weak associations observed, is limitation on the part of the Child-OIDP scale itself describing daily problems that are relatively complex and serious. In spite of showing satisfactory psychometric properties in the study group investigated (paper II), the floor effect was large and the mean OIDP score of 1.2 for the total sample of Tanzanian primary schoolchildren showed only limited variability (paper II).

The overall prevalence of malocclusion (63.8%) among primary schoolchildren presented in paper I, was found to be in agreement with that reported for Saudi Arabian children of similar age (62.4%) (al-Emran et al., 1990), much lower than that reported earlier in Tanzania (97.6%) by Rwakatema et al. (2006), but higher than those obtained by previous studies

among Tanzanian children (45%, 51%) (Kerosuo et al., 1991, Mugonzibwa et al., 2004a). Differences in the methods of registration may explain the variability of the findings.

In Tanzania, as in other non-industrialized countries little is known about children's self reported oral health status or their psycho-social responses to oral problems (see Kiwanuka (2006)). With few exceptions, the prevalence of self reported oral health observed in Tanzanian primary schoolchildren corroborates what has been reported in similar age groups in other developing countries. In a previous study of 13-19-year-old Ugandan secondary school pupils, 28% and 62% were respectively dissatisfied with teeth and had experienced at least one oral impact during the 6 months preceding the survey (Åstrøm and Okullo, 2003). Another study focusing on Ugandan primary schoolchildren of 10-14 years found that despite the low mean DMFT observed, the prevalence of dental pain reported was considerable (47.6%) (Kiwanuka and Åstrøm, 2005). David and Åstrøm (2006) concluded in a study of 12-year-old pupils from India that, in spite of their low average DMFT status, nearly one fourth (23%) were dissatisfied with their teeth.

4.2.2. Prevalence of malocclusion in pre-school children

The total prevalence of malocclusion (32.5%) among pre-school children presented in this thesis, was found to be lower than that reported among USA (Trottman and Elsbach, 1996) and Germany (Robke, 2008) children. On the other hand, it was much higher than those obtained by previous studies among Tanzanian children (Kerosuo et al., 1991, Mugonzibwa et al., 2004a). Method of malocclusion registration could be the most important factor explaining these differences.

4.2.3. Socio-demographic differentials

Kinondoni and Temeke are quite diverse districts in terms of their socio-demographic profile, with the former having higher employment rates, literacy rates and proportions of the population using the most expensive form, electricity, as their main source of energy for cooking (NBS, 2004). Thus, Kinondoni dwellers are recognized to be more affluent and highly educated than Temeke dwellers.

District (Temeke/Kinondoni), place of residence (urban/rural) and level of parents' education emerged as important risk indicators with respect to an open bite, reported dental problems, OIDP and dissatisfaction with teeth appearance /function (paper I-III). The findings reported in paper I, II and III indicated that the prevalence of any malocclusion (66.0% versus 62.6%) and the prevalence of OIDP (45.5% versus 18.5%) were higher in the socioeconomically less affluent Temeke district than in socioeconomically affluent Kinondoni. Conversely, Temeke children were less likely to confirm dissatisfaction with teeth appearance and function than their Kinondoni counterparts. A social gradient with respect to malocclusion in children and adolescents has been reported elsewhere (Tickle et al., 1999, Frazão and Narvai, 2006). Socio-demographic related inequalities in children's oral health have been reported widely in the literature, although less frequently from developing countries (Åstrøm and Okullo, 2003). Contemporary evidence suggest that the lower the material standard of living, the worse the oral health status irrespective of the measure (clinical or self reported) used to assess it (Locker, 2007). Social and behavioral inequality in clinically recorded oral health status has been identified in comparative studies of children from some sub Saharan African and South East Asian countries where oral health services are not commonly available at the local community level (for review see Petersen (2005)). In a recent publication concerning Canadian children 5-14 years of age, Locker (2007) identified socio-economic disparities in

their oral health related quality of life, with low income children reporting the poorest oral impact scores. A social gradient in children's response to dental pain was not identified, however, among 10-14-year-old Ugandan children (Kiwanuka and Åstrøm, 2005).

The district gradient in malocclusion among Tanzanian primary school children reported in paper I might be attributed to the fact that Temeke schoolchildren had on average more caries, more sucking habits and showed significantly higher OHI-S score than their counterparts in Kinondoni (paper I and II). Thus, it has been assumed that inequality in oral health has multiple causes and that the effect on oral health of socio-economic and demographic factors is mediated through environmental exposure, psychosocial factors, lifestyle and availability of health care services (Watt, 2007). Evaluating the mediating role of dental behavior in oral health inequality, (Sanders et al., 2006) found that the slope of the social economic status gradient in oral health impact profile (OHIP-14) scores was significantly attenuated by dental visiting but not by dental self care practices.

As reported in paper III, the prevalence of children confirming dissatisfaction with teeth appearance/function was larger in Kinondoni than in Temeke (25.6% vs. 19.4%). Social and cultural context in which these children live might have influenced their concern with dental appearance. It is evident for instance that spacing (especially median diastema) is significantly disliked in white cultures (Helm et al., 1986, Kerosuo et al., 1995), but it is considered desirable and a sign of beauty in many African cultures (Mugonzibwa et al., 2004b). Notably, Temeke children were less dissatisfied with teeth appearance and function and at the same time they showed a higher prevalence of any malocclusion (SMO> 0) and open bite than their Kinondoni counterparts (paper I and III). This is noteworthy since children's feelings concerning their dental appearance and function tend to predict their demand for orthodontic

treatment (Bowling, 1997, Zhang et al., 2006). Many studies on subjects' perceived malocclusion have reported on a mismatch between subjectively and objectively determined orthodontic treatment need (Birkeland et al., 1996, Onyeaso and Arowojolu, 2003, Mugonzibwa et al., 2004b, Onyeaso and Sanu, 2005a, Hassan, 2006).

4.2.4. Clinical differentials

Dental caries emerged as important risk indicator of malocclusions among 12-14-year-old primary schoolchildren (paper I). Children with caries experience were more likely to have any malocclusion (SMO<0), midline shift, Angle Class II/III and open bite. Although, the mean DMFT was low (0.38, sd=0.85) among the schoolchildren examined, untreated caries (D component) constituted the greater percentage of the total score, followed by the missing component of the DMFT. This result reflects a low priority given to the preservation of teeth and a lack of dental treatment in general in Tanzanian children. Numerous studies have indicated that decayed and premature loss of primary teeth and first permanent molars, can bring about various malocclusion traits due to drifting of the neighbouring teeth (Graber, 1972, Koch and Poulsen, 2001, Stahl and Grabowski, 2004, Mitchell, 2005, Alkilzy et al., 2007). Many other studies have further reported on a positive association between dental caries and malocclusion (Stahl and Grabowski, 2004, Gábris et al., 2006, Alkilzy et al., 2007, Peres et al., 2008).

4.2.5. Behavioral differentials

In paper I, girls confirmed more sucking habits than boys. As a result, the prevalence of an open bite was higher in girls than in boys. Moreover, Temeke primary schoolchildren confirmed more sucking habits than their counterparts in Kinondoni. Consequently, the prevalence of an open bite was higher in Temeke children compared with Kinondoni children.

Likewise, pre-school children who had a history of sucking habits and who had current sucking habits were diagnosed with an open bite more often than their counterparts without such habits (Survey II). It should be noted however, that the prevalence of open bite in pre-school children might have been under estimated due to elimination in the analysis of the 3-5-year-olds who had their deciduous incisors shedded.

In addition, an open bite was a single malocclusion trait associated with sucking habits in both surveys (paper I and Survey II). Previous studies of various designs, have provided evidence of a positive relationship between sucking habits and various malocclusion traits (Øgaard et al., 1994, Fukuta et al., 1996, Farsi and Salama, 1997, Karjalainen et al., 1999, Larsson, 2001, Katz et al., 2004).

It has been indicated in the literature that sucking habits tend to decrease with age (Rønning and Thilander, 1995). Similarly, in this study the prevalence of current sucking was higher among 3-5-year-olds (19%) than in 12-14-year-olds (12.1%). It is important to note however, that some Tanzanian children continue with the sucking habits until their permanent dentition stage (12-14 years).

4.2.6. Socio-dental orthodontic treatment need

As a prelude to the planning of orthodontic care to combat psychosocial implications of malocclusions in Tanzania, a socio-dental approach to the estimation orthodontic treatment need was utilized (paper III). This is the first large population based African study to employ a modified socio-dental approach to estimate orthodontic treatment need in children. Using the theoretical framework by Gherunpong et al. (2006b), a socio-dental orthodontic treatment need of 12% was obtained for Tanzanian primary schoolchildren (paper III). Compared with the overall prevalence of any malocclusion (63.8%) observed in survey I, the treatment need based on the socio-dental approach dropped by five times. This drop in the prevalence of

children with treatment need might have been overestimated since the total prevalence of malocclusion was utilized as a measure of normative need. However, irrespective of the measure of normative need utilized, a socio-dental approach for need assessment might be a more realistic approach in Tanzania than a normative need assessment based on professional judgment of clinical conditions. Previous studies have reported a 70% reduction in volume of estimated treatment need, using a more restrictive measure of normative need assessment (Gherunpong et al., 2006a, Gherunpong et al., 2006b). As discussed in paper III, caution should be made when comparing the socio-dental orthodontic treatment need obtained in this study with estimates reported elsewhere. This is because an Index of Orthodontic Treatment Need (IOTN index) for normative need assessment, a malocclusion specific OIDP score and dental attendance patterns were not applied in the present analyses.

4.2.7. Implication for preventive and therapeutic orthodontic services

Knowledge about the extent, associated factors, distribution and psychosocial impacts of malocclusion as provided by Survey I and Survey II, clearly suggests a need for developing preventive orthodontic services and strengthening therapeutic oral health services among schoolchildren aged 3-5- and 12-14-years in Dar es Salaaam, Tanzania. In view of the relatively scarce resources that are available for dental health care services in Tanzania, emphasis should be put on oral health education to both dental health personnel (in terms of continuing education) and community at large, oral health promotion activities and simple treatment procedures (such as preventive and interceptive orthodontics). In doing so, malocclusions related to environmental factors and their impacts may be minimized and oral health improved in general.

The various risk indicators with respect to children's malocclusion as identified in Survey I and Survey II, in terms of low socio-economic status, dental caries and sucking habits suggest the need to review the existing health policy and methods for oral health promotion in Tanzania (Watt, 2003). Children are at risk of other non-communicable diseases than malocclusions and other oral health problems, which are related to lifestyle. Adoption of the common risk factor approach should be employed, utilizing a holistic approach rather than a narrow disease focus in prevention of oral diseases (Sheiham and Watt, 2000, Watt, 2003).
In general, the findings of the present study point to the importance of early caries prevention, restoration of decayed teeth and elimination of sucking habits as an early phase of orthodontic interventions. Children from less social economically advantaged areas should be the primary targets of preventive and interceptive orthodontic programs.

Data generated by Survey I and Survey II strongly indicates that proven preventive measures such as oral health education (e.g. information on oral hygiene, diet, the effects of sucking habits), preventive orthodontics such as atraumatic restorative treatment (ART) and topical fluoride application (for dental caries), should be utilized. Given the cost for orthodontic treatment, restoration of carious teeth such as deciduous molars to keep them as natural space maintainers should be encouraged along with other preventive measures. Thus, malocclusions that may be brought about or exacerbated by environmental factors and their subsequent psychosocial impacts may be avoided. Parents and children should also be encouraged to adopt preventive checkups and monitoring of oral health instead of the existing pattern of symptomatic dental visits reported in this study (paper II). School based oral health programs which have proved successful should be adopted in all parts of Tanzania.
Children represent a major focus of dental health research and practice and the key to successful oral care is rooted in childhood; it is therefore the dental health personnel,

pediatricians and parents' job to guide and control the acquisition of acceptable occlusion and healthy oral status.

Further studies on indication for preventive and interceptive orthodontics and oral health related quality of life in children should be considered.

4.2.8. Conclusions

- The prevalence of any malocclusion (SMO>0) in 12-14-year-olds was 62.6% and 66.0% in Kinondoni and Temeke districts, respectively. The figure for the 3-5-year-olds was 32.5%. Dental caries, and socio-economic status, in terms of district of residence were important risk indicators of malocclusion in 12-14-year-olds, whereas sucking habits were important risk indicators of open bite among 3-5- year olds.

- The Kiswahili Child-OIDP inventory was applicable for use, in terms of acceptable psychometric properties among Tanzanian primary schoolchildren. The district specific prevalence of oral impacts (OIDP>0) was low to moderate, amounting to 18.5% in Kinondoni and 45.5% in Temeke. In both districts impacts on eating was the most frequently reported impact.

- Dissatisfaction with dental appearance and function was not common, amounting to only 23.3% among primary schoolchildren aged 12-14 years in the present study. Children who were dissatisfied with their dental appearance were less likely to be Temeke residents and having parents of higher education and more likely to report problem with teeth position and having oral impacts (OIDP>0). Subjects with malocclusion reported problems most frequently and malocclusion together with other psycho-social impact scores determined children's dissatisfaction with teeth

appearance /function. The socio-dental treatment need of 12% was five times lower than a normative estimate of 63.8% based on the overall prevalence of any malocclusion (SMO>0).

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6. ORIGINAL PAPERS I – III

Paper I

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Prevalence of malocclusion and its relationship with socio-demographic factors, dental caries and oral hygiene in 12-14 year-old Tanzanian schoolchildren

SUMMARY The aim of this study was to assess the prevalence of malocclusion and its association with socio-demographic characteristics, caries experience and level of oral hygiene in schoolchildren aged 12-14 years residing in two socio-economically different districts of Tanzania. A total of 1601 children (mean age 13 years, 60.5% girls) attending 16 primary schools in Kinondoni and Temeke districts participated in clinical examination and were interviewed in school settings. Chi-square and multiple logistic regression models were used to test for various statistically significant differences between different groups. The results showed that 63.8 percent (62.6% in Kinondoni and 66.0% in Temeke) of the subjects had at least one type of anomaly, with a midline shift (22.5%), spacing of at least 2 mm (21.9%) and an open bite (16.1%) being most frequently recorded. A majority (93.6%) of the children showed a Class I molar relationship. Class II and Class III malocclusions were registered in 4.4 and 2.0 percent, respectively. Multiple logistic regression analyses controlling for socio-demographic factors showed that the odds ratio (OR) for having an open bite was 1.8 if residing in a less socio-economically privileged district. Subjects with caries experience (DMFT > 0) were respectively 1.7, 2.1, 2.4 and 1.7 more likely to be diagnosed with any type of malocclusion, a midline shift, Angle Class II/III and an open bite. Schoolchildren with fair/poor oral hygiene were less likely than their counterparts with good oral hygiene to be diagnosed with a midline shift in this study. It was concluded that malocclusions were prevalent in Tanzanian children investigated and were associated with environmental factors in terms of caries experience and residing in a less affluent Temeke district. Preventive programmes to combat the prevalence are recommended.

Introduction

Planning orthodontic treatment within a public health system requires information on the prevalence and distribution of malocclusion (Foster and Menezes, 1976). A malocclusion is defined as an irregularity of the teeth or a malrelationship of the dental arches beyond the range of what is accepted as normal (Walther et al., 1994). Malocclusion is one of the most common dental problems annoying mankind, together with dental caries, gingival diseases and dental fluorosis (Dhar et al., 2007). Maloccluded teeth can cause psychosocial problems related to impaired dento-facial aesthetics (Kenealy et al., 1989); disturbances of oral function, such as mastication, swallowing, and speech (Proffit and Fields, 2000); and greater susceptibility to trauma (Grimm et al., 2004) and periodontal disease (Greiger, 2001).

Numerous studies have been published regarding the prevalence of malocclusion in various populations. The results have shown wide variations, with the reported prevalence ranging from 39-98 percent (Table 1). Differences in the age ranges of the populations studied, ethnicity and the number of subjects examined could explain some of the variations (Abu Alhaija et al., 2005). Moreover, differences in the methods of registration are probably the most important factors explaining these variations.

In Tanzania, a number of epidemiological studies have provided evidence of the prevalence of malocclusion in the child population. Kerosuo et al. (1988) examined schoolchildren aged 11-18 years in the city of Dar es Salaam and found that 96 percent of the 642 children had Class I molar occlusion, whereas 3, 1 and 16 percent had respectively distal occlusion, mesial occlusion and crowding. The overall prevalence of malocclusion was reported to be 45 percent (Kerosuo et al., 1991). In a sample of 353 12-year-olds from Bukoba and Moshi (townships in the Northern parts of Tanzania), a Class I occlusion was observed in 90 percent

while a large overjet (>3.5 mm), deep bite (≥3.5mm) and spacing were found in 35, 35 and 50 percent, respectively (Mugonzibwa et al., 1990). Another study in Dar es Salaam examined 698 schoolchildren aged 6-18 years. Ninety-three to ninety-six percent of the children showed a Class I molar occlusion, 9-13 percent anterior open bite, and more than 33 percent spacing (Mugonzibwa, 1992). In a further study by Mugonzibwa et al. (2004) considering 869 schoolchildren (3–16 years) in Dar es Salaam, an overall prevalence of malocclusion of up to 51 percent was found. Recently, the overall prevalence of malocclusion among 289 schoolchildren (12-15 years) in Moshi was reported to be 97.6 percent (Rwakatema et al., 2006). Thus, earlier reports indicated a wide variation in the prevalence of malocclusion among Tanzanian children.

Previous attempts to investigate a possible association of malocclusion and dental caries have shown conflicting or inconclusive results (Helm and Petersen, 1989a, Stahl and Grabowski, 2004). While some authors reported upon a positive association between malocclusion and dental caries (Gábris et al., 2006, Nobile et al., 2007), others could not establish any significant relationship (Helm and Petersen, 1989a, Stahl and Grabowski, 2004). Moreover, conflicting results have been obtained in studies considering a possible relationship between malocclusion and various oral hygiene measures (Ramfjord, 1987). The presence of a positive association between malocclusion and periodontal health have been described by Helm and Petersen (1989b) and Gábris et al. (2006). Yet, other studies found no association when the amount of plaque, calculus, gingivitis or pocketing was related to various indices of malocclusion (Katz, 1978, Buckley, 1980).

The relationship between dental caries, oral hygiene and malocclusion has not yet been investigated in Tanzania. Since the Tanzanian oral health policy gives priority to children as a

target group for oral health care services (Ministry of Health, 2002), such information is worthy of consideration. Knowledge concerning the distribution of malocclusion in the child population and the identification of predisposing factors and associated conditions might help in understanding its occurrence and assist public-health policy makers improve interventions (Frazão and Narvai, 2006). Considering the varying prevalence of malocclusion that has been reported among Tanzanian children, the wide age ranges and mixed ethnicity of the study groups, the relatively small samples sizes employed and the fact that many studies have been confined to only one district, large scale epidemiological study was, therefore, conducted focusing on schoolchildren aged 12-14 years residing in two socio-economically different districts of Tanzania. This study aim to assess the prevalence of malocclusion and its distribution by socio-demographic characteristics, dental caries experience and oral hygiene status.

Subjects and methods

Subjects

The study was carried out in Kinondoni and Temeke districts of the Dar es Salaam region in Tanzania. These two districts differ in that Kinondoni (with higher employment rate, literacy rate and proportions of the population using electricity) is more affluent than Temeke (National Bureau of Statistics, 2004). A stratified proportionate two-stage cluster sampling design with public primary schools as the primary sampling unit was utilized. One thousand six hundred and one (632 boys, 969 girls) primary schoolchildren aged 12-14 years were randomly selected from 16 schools from a total of 220 public schools. The schools were selected from urban and rural areas of the two districts covering different socio-economic background. Lists of all schoolchildren in the 16 selected schools with information on age and gender were collected from the schools. Selected children fulfilled the inclusion criteria of

being in the defined age range of 12-14 years and of having only permanent dentition. Only consenting subjects were included in the study and none of the pupils invited for participation had a history of orthodontic treatment (either interceptive or elective). A more detailed description of the sampling procedure can be found elsewhere (Mtaya et al., 2008). Ethical clearance was obtained from all relevant persons, authorities and committees in Tanzania. These included written permission and clearance for the study from the Research and Publication Committee of the Muhimbili University of Health and Allied Sciences (MUHAS). Permission to work with school children was obtained from Kinondoni and Temeke municipalities, their respective educational authorities, schools administrations, parents and children.

Interview

Before being examined clinically, the participants completed a questionnaire in a face to face interview undertaken by two trained research assistants. The content and performance of the interview has been described in detail elsewhere (Mtaya et al., 2007).

Clinical Examination

One trained and calibrated dentist (MM) conducted all clinical examinations in a classroom setting with natural daylight as the source of illumination and with an assistant recording the observations. Participants identified with problems that needed treatment were referred or advised to seek treatment at the two municipal hospitals of Kinondoni and Temeke districts. Oral health education sessions were provided for all participants. Before commencing the present investigation, a pilot study on 63 children was performed. Caries experience was assessed in accordance with the criteria by the World Health Organization (WHO, 1997). Oral hygiene was assessed using the simplified-Oral Hygiene Index (OHI-S) (Greene and

Vermillion, 1964). The simplified oral hygiene index is an index developed to assess oral hygiene status, obtained by combining the average individual or group debris and calculus scores (Greene and Vermillion, 1964). Occlusion was registered according to Björk et al. (1964), with some modifications by al-Emran et al. (1990).

Sagittal molar occlusion: the basic Angle classification was used. The intermaxillary relationship of first permanent molars was registered as Class I (normal/neutral) when the mesiobuccal cusp of the maxillary first permanent molar occluded in line with mesiobuccal groove of the mandibular first permanent molar. A Class II (distal) or Class III (mesial) molar occlusion was recorded when there was deviation of at least one half cusp width distally or mesially to Class I, respectively. It was recorded as Class I (CL I=1), II (CL II=2) and III (CL III=3), and dichotomized into 0 (CL I) and 1(CL II and III) for use in cross tabulation and logistic regression analysis. When the first permanent molars were missing, the registration was considered not applicable.

Overjet: the distance from the most labial point of the incisal edge of maxillary right central incisor to the most labial surface of the corresponding mandibular incisor. Measured to the nearest half millimetre, using a metal ruler parallel to the occlusal plane. A positive value (maxillary overjet) was recorded if the upper incisor was ahead of the lower incisor, and a negative value (mandibular overjet), when the upper incisor was behind the lower incisor.

Maxillary overjet was categorized as 1; 1-4.9 mm (grade 1), 2; 5-8.9 mm (grade 2) and 3; ≥ 9 mm (grade 3). It was considered increased when the value exceeded 5 mm, and dichotomized into 0 < 5 mm and 1 ≥ 5 mm for use in cross tabulation and logistic regression analyses. Mandibular overjet was coded as 0; absent, 1; < 0 to -1.9 mm (grade 1) and 2; ≤ - 2 mm (grade 2) and recoded into 0 = absent and 1 = present (1 and 2).

Overbite: the vertical overlap of incisors, measured to the nearest half millimetre vertically from the incisal edge of the maxillary right central incisor to the incisal edge of the

corresponding mandibular right incisor. If the right central incisor was missing or fractured, it was substituted by the left central incisor. It was coded as 1; 0.1-2.9 mm (grade 1), 2; 3-4.9 mm (grade 2) and 3; ≥ 5 mm (grade 3), then recoded into 0 = absent (< 5 mm) and 1 = present (≥ 5 mm). It was considered as a deep bite when the value exceeded 5 mm.

Open bite: an anterior open bite (AOB) was recorded when there was no vertical overlap of the incisors, measured to nearest half millimetre. A visible space between antagonistic fully erupted canines, premolars or molars was registered as a lateral open bite. An open bite was coded as 0; absent, 1; 0-1.9 mm (AOB grade 1), 2; ≥ 2 mm (AOB grade 2) and 3; lateral open bite, and recoded into 0 = absent and 1 = present (1, 2 and 3).

Lateral crossbite: registered when one or more buccal cusps of the mandibular canines, premolars and/or molars occluded bucally to the buccal cusps of the maxillary antagonists, recorded either as 1; absent, 2; present unilaterally or 3; present bilaterally. It was then dichotomized into 0 = absent (1) and 1 = present (2 and 3).

Scissor bite: registered when any of the maxillary premolars and/or molars totally occluded to the buccal surface of the opposing mandibular teeth, recorded either as 1; absent, 2; present unilaterally or 3; present bilaterally. It was then dichotomized into 0 = absent (1) and 1 = present (2 and 3).

Midline shift: defined as non-coincident upper and lower midlines when the posterior teeth were in maximum intercuspation. It was coded as 1; absent and 2; present when the displacement was at least 2 mm or more. It was then recoded into 0 = absent (1) and 1 = present (2).

Crowding: was recorded when the total sum of slipped contacts measured in the segment was at least 2 mm. It was coded as 1; absent, 2; present upper jaw, 3; present lower jaw and 4; present both jaws. Then it was recoded into 0 = absent (1) and 1 = present (2, 3 and 4).

Spacing: was recorded when the total spacing was at least 2 mm in a segment. It was coded as 1; absent, 2; present upper jaw, 3; present lower jaw and 4; present both jaws. Then it was recoded into 0 = absent (1) and 1 = present (2, 3 and 4).

A sum score of malocclusions was constructed for use in cross tabulation and logistic regression, based on the diagnosis of the absence (0)/ presence (1) of the following recordings; maxillary overjet, mandibular overjet, Class II and Class III molar occlusion, open bite, deep bite, lateral crossbite, scissor bite, midline shift, crowding and spacing.

Statistical analyses

Data were analyzed using the Statistical Package for Social Sciences version 14.0 (SPSS Inc., Chicago, Illinois, USA). Test-retest reliability for the clinical parameters was assessed using Cohen's weighted kappa statistics. Cross-tabulation and chi-square statistics were used to assess bivariate relationships. Multivariate analysis was conducted using multiple logistic regression analysis. The P-value for statistical significance was set at 0.05.

Test retest reliability

Duplicate clinical examinations were carried out by the dentist (MM) on a randomly selected sub-sample of 71 participants considered to be representative of the study subjects, at a time interval of 3 weeks. Analyses performed on the duplicate examination recordings gave Kappa values of 0.78, 0.79, 0.82, 0.93 and 0.97 for midline shift, deep bite, mandibular overjet, maxillary overjet and spacing, respectively. The Kappa values for open bite, sagittal molar relationship, crossbite, scissor bite and crowding were one. Intra-examiner consistencies for Decayed, Missing and Filled Teeth (DMFT) and Oral Hygiene Index-Simplified scores gave the Kappa values of 0.93 and 0.74, respectively. These figures indicate very good intra-examiner reliability (World Health Oraganization, 1997).

Results

Sample profile

A total of 1003 children from Kinondoni (63.5% urban, 58.9% girls, mean age 13.1 years) and 598 children from Temeke (82.3% urban, 63.2% girls, mean age 13.0 years) completed an extensive personal interview and underwent a full mouth clinical examination. The mean Decayed, Missing and Filled Teeth scores were 0.37 (sd=0.86) and 0.39 (sd=0.84) in Kinondoni and Temeke, respectively. Corresponding scores concerning Oral Hygiene Index-Simplified scores were 1.0 (sd=0.53, range 0.0-3.3) and 1.2 (sd= 0.54, range 0.0-4.2). Finger sucking was reported in 12.1 percent of the total sample. Table 2 provides the percentage distribution of participants' socio-demographic characteristics, Decayed, Missing and Filled Teeth scores, Oral Hygiene Index-Simplified score and sucking habits according to district of residence.

Prevalence of malocclusion

Overall findings

As shown in Figure 2, dentitions without any irregularity were found in 36.2 percent of the children. Thus, 63.8 percent (62.6% in Kinondoni and 66% in Temeke) of the children had one or several types of the anomalies recorded. The majority of children had one (33%) and two anomalies (21.5%), whereas more than five anomalies were registered in 0.2 percent of the sample.

Sagittal molar occlusion

A Class I (normal/neutral) occlusion was observed in 93.6 percent of the total sample, while Class II (distocclusion) and Class III (mesiocclusion) were recorded in 4.4 and 2.0 percent, respectively (Table 3). There were no significant differences in diagnoses between districts

and gender. In 141 schoolchildren the molar relationship could not be registered due to missing first molars and those children were excluded from sagittal molar occlusion analysis.

Maxillary overjet

A majority of the children (73.3%) in the total population had a maxillary overjet < 5 mm, and the proportion was significantly greater in children from Kinondoni than in children from Temeke (76.4% versus 68.2%, p<0.001). Overall, an overjet ≥ 5 mm occurred in 11.1 percent and severe increased overjet (≥ 9 mm) was registered in 0.4 percent. A mandibular overjet was found in 8.4 percent of the schoolchildren and 6.8 percent of the schoolchildren had an edge to edge bite (Table 3).

Overbite

A normal overbite (grade 1; 0.1-2.9 mm) was recorded in 65.9 percent of the total sample, while grade 2 (3-4.9 mm) and deep bite (grade 3; ≥ 5 mm) were registered in 17.9 and 0.9 percent, respectively. Furthermore, children in Kinondoni had significantly more overbite grade 2 (3-4.9 mm) than in Temeke (P<0.001, Table 3).

Open bite

An AOB was recorded in 15 percent of the entire sample (Table 3). An AOB < 2 mm was found less often in Kinondoni (7.4%) than in Temeke (11.5%) (P<0.001). Moreover, the occurrence of an AOB of < 2 mm was significantly higher in girls (10.6%) than in boys (6.3%) (P< 0.05). A lateral open bite was registered in 1.1 percent of all children (Table 3).

Transverse anomalies

Of the transverse anomalies, a midline shift (≥ 2 mm) was recorded in 22.5 percent of the whole sample (Table 3). In addition, Temeke schoolchildren experienced more midline shift (27.4%) than Kinondoni children (19.6%) ($P<0.001$). A posterior crossbite was found in 5.1 percent while a scissor bite was registered in 14.3 percent of all children.

Space discrepancies

Overall crowding (≥ 2 mm) was found in 14.1 percent of the sample. No gender or district differences were recorded (Table 3). Spacing was noted in 21.9 percent of the subjects. This anomaly was more frequent among children in Kinondoni than in Temeke (24.1% versus 18.2%, $p<0.001$).

Dental caries, oral hygiene, socio-demographic variables and malocclusions

The association between malocclusions, Decayed, Missing and Filled Teeth, Oral Hygiene Index-Simplified score and socio-demographic variables was analyzed by cross tabulation and Chi-square test (Table 4). Possible confounding factors due to strong associations between the explanatory variables were taken into consideration in a multivariate logistic regression analysis (Table 4). In the final models the district of residence and the Decayed, Missing and Filled Teeth status varied systematically with malocclusion. After controlling for all other variables in the analysis, district varied systematically with an open bite. Compared with Kinondoni children those from Temeke were 1.8 times more likely to have an open bite. District did not vary systematically with a midline shift in the multivariate logistic regression analysis, although it was significant in the bivariate analysis. Caries experience varied systematically with a midline shift and an open bite. Compared with children without caries experience those with DMFT > 0 were 2.1 times more likely to have a midline shift and 1.7

times more likely to have an open bite. Children with caries experience were also 2.4 and 1.7 times more likely than caries free children to have an Angle Class II and III molar relationship and to score above zero on the sum score of malocclusion. Oral Hygiene Index-Simplified score was not statistically significant in the bivariate analysis but varied systematically with a midline shift in the multiple logistic regression analysis. Thus, compared with children with OHI-S score of zero, those with OHI-S score above zero were less likely to have a midline shift (Table 4).

Discussion

Methodological issues

The present research is the first large population based study considering the prevalence of malocclusion and its relationship with socio-demographic factors, dental caries and oral hygiene among schoolchildren in Tanzania. Comparison of the sample characteristics with the Kinondoni and Temeke child population statistics on the markers of gender and parental education, suggest that the sample was representative of the population of children aged 12-14 years in those districts. None of the children had received orthodontic treatment, either by interceptive or corrective measures. It has been noted that in studies concerning the prevalence of malocclusion, the material should be obtained from a well-defined population and be large enough and cover non-orthodontically treated children (Thilander et al., 2001). The present sample seems to satisfy those requirements.

The clinical registrations were based on the method evolved by Björk et al. (1964) with some modifications by al-Emran et al. (1990). Björk's method has been used in many studies and allows objective comparisons of the presence of malocclusion between different populations. However, comparisons of the present findings with those of other studies must be done cautiously because different methods and indices have been applied in varying age ranges of

the populations. Moreover, no radiographs or study casts were used in the present study. The probability of having under- or overestimated some prevalence estimates such as agenesis, supernumerary teeth, the accuracy of space analysis as well as some details on the deviations of tooth positions cannot be overlooked. It has been shown that records made on the basis of casts seem to give a higher prevalence of deviations than direct recording (Helm, 1970, Heikinheimo, 1978). Nevertheless, given the sample size and the selection criteria used in this study, the findings give a reasonably accurate indication of the occurrence of malocclusion in 12- to 14-year-old children in Dar es Salaam.

Prevalence of malocclusion

Overall findings

The overall prevalence of malocclusion (63.8%) registered among schoolchildren in Dar es Salaam was found to be in agreement with that reported for Saudi Arabian children of a similar age (al-Emran et al., 1990), lower than that reported by Rwakatema et al. (2006), but much higher than those obtained in previous studies among Tanzanian children (Kerosuo et al., 1991, Mugonzibwa et al., 2004). Differences in the registration methods may explain the variability of the findings.

Sagittal molar occlusion

In accordance with the findings of previous studies (Lew et al., 1993, Ng'ang'a et al., 1996, Silva and Kang, 2001, Thilander et al., 2001, Abu Alhaija et al., 2005), the predominant sagittal molar relationship among Tanzanian schoolchildren was Angle Class I (93.6%). The prevalence of a Class II molar relationship (4.4%) was in line with the previous investigations from Tanzania (Kerosuo et al., 1988, Mugonzibwa et al., 1990), but was lower than that reported among Swedish adolescents and Swedish Eastern European and Asian immigrants (Josefsson et al., 2007). Moreover, the prevalence of a Class III molar relationship (2%)

compares with that reported by Mugonzibwa (1992) but lower than that reported by Josefsson et al. (2007).

Mandibular overjet

The occurrence of a mandibular overjet was in agreement with that found in Colombian children by Thilander et al (2001). The differences in the prevalence between Class III (2%) and mandibular overjet (8.4%) observed in the present study may indicate a functional anterior crossbite (Thilander et al., 2001). However, the possibility of early loss of upper primary canines, leading to palatal tipping and/or distal migration of the upper permanent anterior teeth, can not be excluded.

Maxillary overjet

The prevalence of an increased overjet (≥ 5 mm, 11.5%) found in the present study, was in concordance with previous studies among Tanzanian and Kenyan children (Kerosuo et al., 1988, Ng'ang'a et al., 1996), lower than that reported among Saudi children (al-Emran et al., 1990) but higher than that observed by Mugonzibwa (1992). Differences in the definition of an increased overjet between the aforementioned studies might have contributed to the variations in the reported results.

Overbite

The majority of children in the present sample had a normal overbite. A severe deep bite that exceeded 5 mm was rare (0.9%). This finding accords with a previous finding among Tanzanian children with complete permanent dentition (ES4) (Mugonzibwa et al., 2004). Most of the children in this study had full eruption of the premolars and second molars, which might have stabilized their occlusion resulting in a decreased prevalence of a deep bite (Thilander et al., 2001).

Open bite

An AOB (15%) was a more common vertical occlusal anomaly. Its prevalence in the present study was close to that reported by Mugonzibwa et al. (2004) in children in the emergence stage 4 (ES4). Thilander et al. (2001) pointed out that an AOB is more frequently observed in Black than in White American adolescents, indicating that its occurrence might be genetically determined, demonstrating a long lower-face and high mandibular plane angle on the part of Black adolescents. However, environmental factors such as mouth breathing associated with the warm climate (Lamberton et al., 1980) as well as prolonged sucking habits after eruption of the permanent incisors (Larsson and Bishara, 2003) might have played a role. In this study, the prevalence of an open bite was higher in girls who performed sucking habits more than boys. The prevalence of prolonged sucking habits was 15.2 and 7.4 percent in girls and boys, respectively (not presented in the tables). Nevertheless, a lateral open bite was rare and its occurrence compares with that reported by Laine and Hausen (1983) and al-Emran et al. (1990).

Transverse anomalies

The prevalence of a crossbite (5.1%) was in concordance with that reported in the literature by Kerosuo et al. (1988), but lower and higher than those reported respectively by Mugonzibwa (1992) and Abu Alhaija et al. (2005). A posterior crossbite has been considered as a consequence of sucking habits which differ between different populations (Abu Alhaija et al., 2005). On the other hand, the present prevalence of a scissor bite (14.3%) was much higher than reported in earlier studies (Mugonzibwa et al., 1990, Kerosuo et al., 1991, Ng'ang'a et al., 1996, Mugonzibwa et al., 2004, Abu Alhaija et al., 2005). A midline shift (22.5%) was the most common anomaly in this study, its frequency was much higher than that found among Kenyan and Saudi children (al-Emran et al., 1990, Ng'ang'a et al., 1996). The high prevalence of midline shift found in the present study, might have been caused by a

unilateral premature loss of primary teeth particularly primary canines (Hollander and Full, 1992).

Space discrepancies

Spacing of 2 mm or more (21.9%) was the second most common anomaly present. Its prevalence was in agreement with that reported among rural Nigerian children (Otuyemi and Abidoye, 1993) but lower than that among Tanzanian children (Mugonzibwa et al., 1990). Large arches in black people might explain the occurrence of more spacing than crowding (Abu Alhaija et al., 2005). The prevalence of crowding (14.1%) was similar to that observed by Gábris et al. (2006) and Kerosuo et al. (1988). Furthermore, both crowding and spacing were found more often in the upper than lower jaws (data not presented). This finding was in agreement with that observed among Kenyan children (Ng'ang'a et al., 1996).

Dental caries, oral hygiene, socio-demographic variables and malocclusions

By examining the relationship between malocclusions, dental caries, oral hygiene and socio-demographic characteristics using multiple logistic regression analysis, it was possible to compare the strength of the influence from each. Children with caries experience (DMFT > 0) were almost two times more likely to have any type of malocclusion (sum score of malocclusion > 0) as compared with their counterparts without caries experience (DMFT = 0). Similar results were obtained by Gábris et al. (2006) among Hungarian adolescents. Moreover, Stahl and Grabowski (2004) reported that dental caries and premature loss of primary teeth are predisposing factors for occlusal and space anomalies in the mixed and permanent dentition. In addition, schoolchildren with DMFT > 0 were two times more likely than their counterparts without caries experience to be diagnosed with a midline shift. This finding is consistent with that found in Israeli children (Ben-Bassat et al., 1997). A midline shift may be a result of a unilateral loss of the primary canine or first molar due to caries (Mitchell, 2005). Dental caries was further associated with an Angle Class II/III molar

relationship, where children with DMFT > 0 were two times more likely to be diagnosed with an Angle Class II/III than children with no caries. A similar finding was reported by Ben-Bassat et al. (1997). Untreated proximal caries in pimary molars or early loss of a second primary molar may lead to forwards drift of the first permanent molar, promoting the change in molar relationship (Graber, 1972, Koch and Poulsen, 2001, Mitchell, 2005). Thus, some of the children with an Angle Class II or Class III recorded in the present investigation might, indeed, have a neutral skeletal relationship. Lastly, the likelihood of being diagnosed with an open bite was almost two times more in children with dental caries than in children without caries. Corresponding results were reported by Peres et al. (2007) among Brazilian children. Reduced salivary flow in children with an AOB and with a mouth breathing habit, may have enhanced susceptibility to dental caries (Thylstrup and Fejerskov, 1994).

A considerable difference in the occurrence of an open bite was observed in the two districts, children from Temeke were almost two times more likely than their Kinondoni counterparts to be diagnosed with that anomaly. This result might reflect the role of environmental factors in the occurrence of an open bite, with children from Temeke being not only less socio-economically privileged but were also prolonged finger suckers to a larger extent than their counterparts from Kinondoni.

Regarding oral hygiene in this study, children with fair/poor oral hygiene were less likely than their counterparts with good oral hygiene to be diagnosed with a midline shift. In contrast, Helm and Petersen (1989b) found higher scores of gingivitis and periodontal pocketing in subjects with various malocclusion.

Conclusion

Malocclusions are still prevalent in Tanzanian primary schoolchildren with a prevalence that is comparable with that observed in similar aged children from non-industrialized

communities. The most prevalent malocclusion traits were a midline shift, spacing (≥ 2 mm) and an open bite. Furthermore, the most important finding in this study was the identification of environmental factors (caries experience and residing in a less affluent district) associated with malocclusion. This information is relevant for oral health policy making i.e. planning preventive measures.

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Table 1 Percentage (%) distribution of malocclusion in children and adolescents in different ethnic groups.

Authors	Population	Subjects		Registration	%
		n	Age		
Thilander and Myrberg (1973)	Swedish	5459	13	Björk et al. (1964)	73.8
al-Emran et al. (1990)	Saudi Arabian	500	14	Björk et al. (1964)	62.4
Kerosuo et al. (1991)	Finnish	458	12-18	Angle classification	88
Kerosuo et al. (1991)	Tanzanian	642	11-18	Angle classification	45
Lew et al. (1993)	Chinese	1050	12-14	Foster and Day (1974)	92.9
Ng'ang'a et al. (1996)	Kenyan	919	13-15	Björk et al. (1964)	72
Silva and Kang (2001)	American-Latino	507	12-18	Angle classification	93
Thilander et al. (2001)	Colombian	1441	13-17	Björk et al. (1964)	88
Mugonzibwa et al. (2004)	Tanzanian	869	3½-16	Björk et al. (1964)	Up to 51
Onyeaso (2004)	Nigerian	636	12-17	Angle Classification	76
Abu Alhaija et al. (2005)	Jordanian	1003	13-15	Björk et al. (1964)	92
Behbehani et al. (2005)	Kuwaiti	1299	13-14	Angle classification	86
Ciuffolo et al. (2005)	Italian	810	11-14	Criteria by US National Health and Nutrition Examination Survey	93
Gábris et al. (2006)	Hungarian	483	16-18	Dental Aesthetic Index	70.4
Rwakatema et al. (2006)	Tanzanian	289	12-15	Björk et al. (1964)	97.6
Dhar et al. (2007)	Indian	812	11-14	WHO oral health assessment (1999)	38.9

Table 2 Distribution of socio-demographic characteristics, Decayed Missing and Filled Teeth-, Oral Hygiene Index Simplified- status and sucking habits in Kinondoni and Temeke districts.

Variables	Categories	Kinondoni % (n)	Temeke % (n)	p-value
Gender	Male	41.1 (412)	36.8 (220)	0.050
	Female	58.9 (591)	63.2 (378)	
Age	12 yrs	26.1 (262)	23.9 (143)	0.033
	13 yrs	41.9 (420)	48.5 (290)	
	14 yrs	32.0 (321)	27.6 (165)	
Parental education	Both low	38.5 (210)	53.8 (149)	< 0.001
	One low/one high	24.2 (132)	20.9 (58)	
	Both high	37.2 (203)	25.3 (70)	
Place of residence	Urban	63.5 (637)	82.3 (492)	< 0.001
	Rural	36.5 (366)	17.7 (106)	
DMFT	0	78.3 (785)	77.6 (464)	0.399
	≥ 1	21.7 (218)	22.4 (134)	
OHI-S score	Good	68.0 (682)	61.9 (370)	0.007
	Fair/poor	32.0 (321)	38.1 (228)	
Sucking habit	no	88.5 (888)	86.8 (519)	0.301
	yes	11.5 (115)	13.2 (79)	

Table 3 Percentages (%) and number (n) of occlusal and space characteristics in Tanzanian schoolchildren according to district and gender.

	District		Gender		Total
	Kinondoni	Temeke	Boys	Girls	
	% (n)	% (n)	% (n)	% (n)	% (n)
Occlusal					
Sagittal					
Molar relationship					
Class I	93.8 (855)	93.2 (511)	93.4 (539)	93.7 (827)	93.6 (1366)
Class II	3.8 (35)	5.5 (30)	4.3 (25)	4.5 (40)	4.4 (65)
Class III	2.4 (22)	1.3 (7)	2.3 (13)	1.8 (16)	2.0 (29)
Maxillary overjet					
1-4.9 mm	76.4 (766) **	68.2 (408)	75 (474)	72.2 (700)	73.3 (1174)
5-8.9 mm	11.1 (111)	11.2 (67)	11.2 (71)	11.0 (107)	11.1 (178)
≥9 mm	0.2 (2)	0.8 (5)	0.6 (4)	0.3 (3)	0.4 (7)
Mandibular overjet					
0-1.9 mm	8.8 (88)	7.2 (43)	9.5 (60)	7.3 (71)	8.2 (131)
≥2 mm	0.1 (1)	0.5 (3)	0.3 (2)	0.2 (2)	0.2 (4)
Vertical					
Overbite					
0.1-2.9 mm	65.4 (656)	66.7 (399)	66.9 (423)	65.2 (632)	65.9 (1055)
3-4.9 mm	21.1 (212) **	12.5 (75)	19.0 (120)	17.2 (167)	17.9 (287)
≥ 5mm	0.9 (9)	1.0 (6)	0.9 (6)	0.9 (9)	0.9 (15)
Open bite					
0-1.9 mm	7.4 (74) **	11.5 (69)	6.3 (40) *	10.6 (103)	8.9 (143)
≥ 2 mm	4.8 (48)	8.2 (49)	6.0 (38)	6.1 (59)	6.1 (97)
Lateral open bite	1.0 (10)	1.2 (7)	1.3 (8)	0.9 (9)	1.1 (17)
Transversal					
Absent	82.0 (823)	78.0 (467)	79.3 (501)	81.4 (789)	80.6 (1290)
Crossbite	4.4 (44)	6.4 (38)	4.7 (30)	5.4 (52)	5.1 (82)
Scissor bite	13.6 (136)	15.6 (93)	16.0 (101)	13.2 (128)	14.3 (229)
Midline shift					
Absent (< 2 mm)	80.4 (806)	72.6 (434)	75.9 (480)	78.4 (760)	77.5 (1240)
≥ 2 mm	19.6 (197) **	27.4 (164)	24.1 (152)	21.6 (209)	22.5 (361)
Space					
Absent (± 2 mm)	60.8 (610)	69.4 (415)	60.9 (385)	66.1 (640)	64.0 (1025)
Crowding (≥2 mm)	15.1 (151)	12.4 (74)	15.7 (99)	13.0 (126)	14.1 (225)
Spacing (≥ 2 mm)	24.1(242) **	18.2 (109)	23.4 (148)	20.9 (203)	21.9 (351)

*p<0.05, **p<0.001

Table 4 Percentages (%) and number (n) of schoolchildren with malocclusion according to district, dental caries and oral hygiene status. Logistic regression, odds ratios (OR) and 95 pecent confidence intervals (CI). Adjusted for age, gender, parental educational status and urban /rural residency.

	Sum score of malocclusion > 0		Midline shift present		Angle Class II and III		Open bite present	
	% (n)	Adjusted OR (95% CI)	% (n)	Adjusted OR (95% CI)	% (n)	Adjusted OR (95% CI)	% (n)	Adjusted OR (95% CI)
District: Kinondoni	62.6 (549)	1	19.6 (197)	1	6.3 (57)	1	13.2 (132)	1
Temeke	66.0 (316)	1.3 (0.9-1.8)	27.4 (164)**	1.3 (0.9-1.9)	6.8 (37)	0.9 (0.5-1.7)	20.9 (125)**	1.8 (1.2-2.7)
Decayed Missing and Filled Teeth = 0	62.1 (667)	1	20.2 (252)	1	5.6 (70)	1	14.4 (180)	1
Decayed Missing and Filled Teeth > 0	70.2 (198)*	1.7 (1.1-2.6)	31.0 (109)**	2.1 (1.5-3.2)	11.4 (24)**	2.4 (1.3-4.6)	21.9 (77)**	1.7 (1.1-2.6)
Simplified Oral Hygiene Index score = 0	62.9 (562)	1	22.6 (238)	1	6.1 (58)	1	15.6 (164)	1
Simplified Oral Hygiene Index score > 0	65.4 (303)	0.8 (0.6-1.2)	22.4 (123)	0.6 (0.4-0.9)	7.2 (36)	1.3 (0.7-2.3)	16.9 (93)	1.1 (0.8-1.7)

*p<0.05, **p<0.001

Figure 1 Map of Tanzania showing Kinondoni and Temeke districts of the Dar es Salaam region.

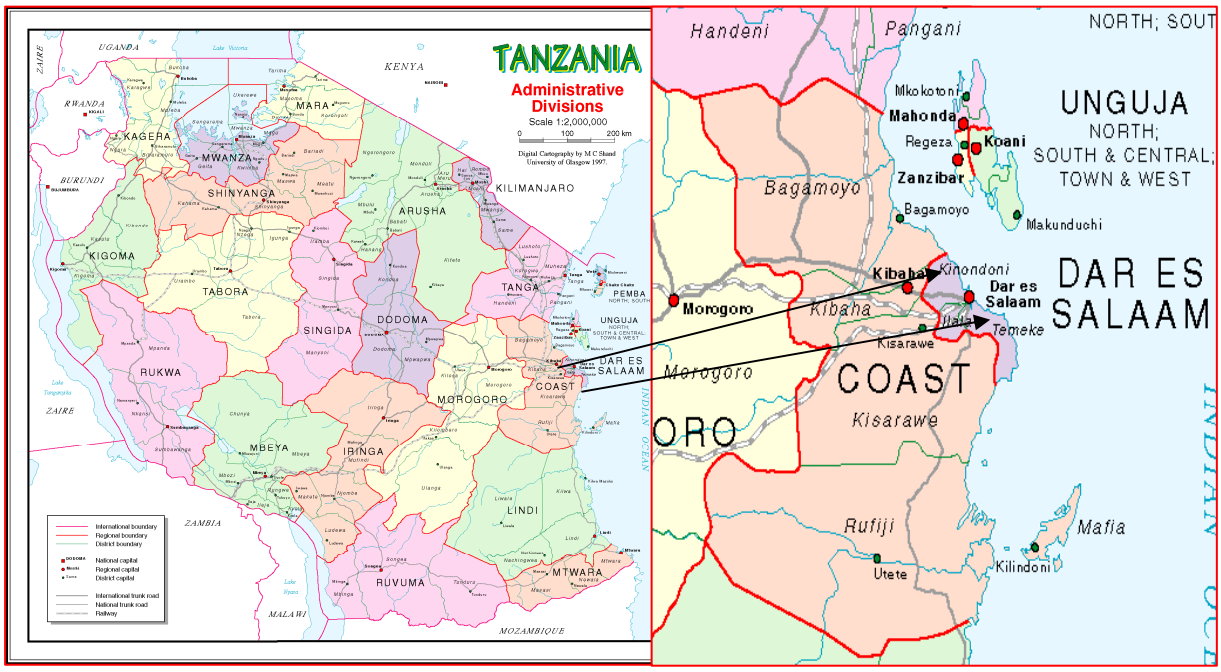
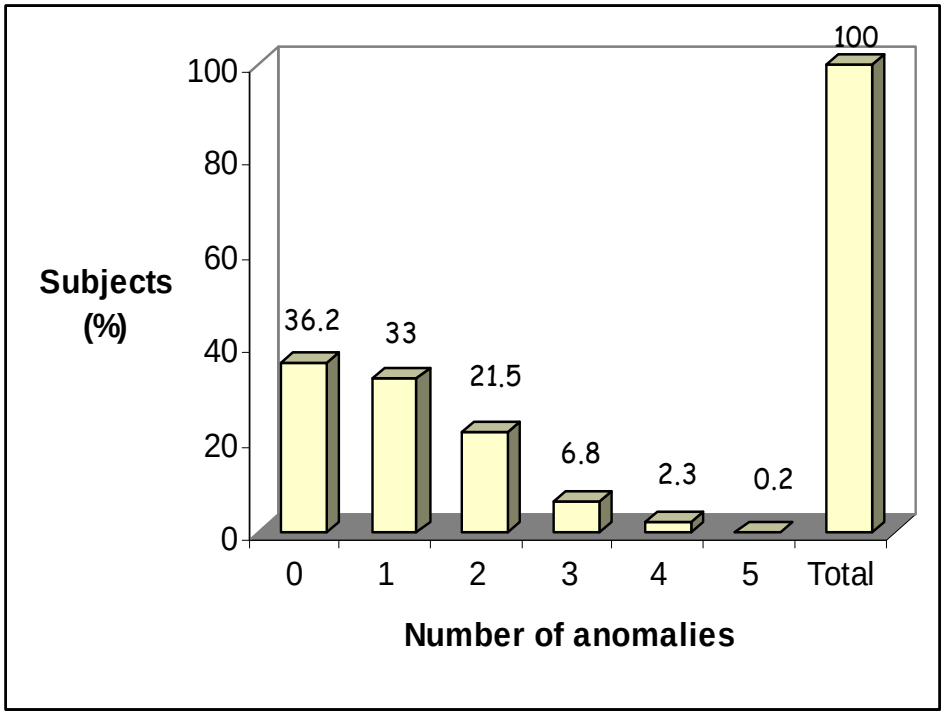


Figure 2 Percentage of schoolchildren according to number of anomalies.



Paper II

Health and Quality of Life Outcomes

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Research

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Applicability of an abbreviated version of the Child-OIDP inventory among primary schoolchildren in Tanzania

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Abstract

Background: There is a need for studies evaluating oral health related quality of life (OHRQoL) of children in developing countries.

Aim: to assess the psychometric properties, prevalence and perceived causes of the child version of oral impact on daily performance inventory (Child-OIDP) among school children in two socio-demographically different districts of Tanzania. Socio-behavioral and clinical correlates of children's OHRQoL were also investigated.

Method: One thousand six hundred and one children (mean age 13 yr, 60.5% girls) attending 16 (urban and rural) primary schools in Kinondoni and Temeke districts completed a survey instrument in face to face interviews and participated in a full mouth clinical examination. The survey instrument was designed to measure a Kiswahili translated and culturally adapted Child-OIDP frequency score, global oral health indicators and socio-demographic factors.

Results: The Kiswahili version of the Child-OIDP inventory preserved the overall concept of the original English version and revealed good reliability in terms of Cronbach's alpha coefficient of 0.77 (Kinondoni: 0.62, Temeke: 0.76). Weighted Kappa scores from a test-retest were 1.0 and 0.8 in Kinondoni and Temeke, respectively. Validity was supported in that the OIDP scores varied systematically and in the expected direction with self-reported oral health measures and socio-behavioral indicators. Confirmatory factor analyses, CFA, confirmed three dimensions identified initially by Principle Component Analysis within the OIDP item pool. A total of 28.6% of the participants had at least one oral impact. The area specific rates for Kinondoni and Temeke were 18.5% and 45.5%. The most frequently reported impacts were problems eating and cleaning teeth, and the most frequently reported cause of impacts were toothache, ulcer in mouth and position of teeth.

Conclusion: This study showed that the Kiswahili version of the Child-OIDP was applicable for use among schoolchildren in Tanzania.

Background

Emerging consensus in the literature has identified oral health related quality of life (OHRQoL) as a multidimensional construct containing physical, social and psychological domains [1]. Over the years several socio-dental indicators have been developed, ranging from single item indicators to composite inventories or scoring systems, covering the aforementioned OHRQoL domains [2]. The indices are requested to be simple to use, reliable, valid, precise, acceptable, amenable to statistical analysis, correspond to decision making criteria and to be supported by a relevant theoretical model [3].

Although a number of indices have been developed and tested in population-based studies and studies of patients with specific disorders, most research has been carried out on adults in industrialized countries [4-6]. Yet, there is a lack of OHRQoL measures designed for children and few attempts have been made to evaluate OHRQoL and its determinants in the child populations of non-industrialized countries [7-11]. This is notable, considering that oral disorders are numerous in children globally and likely to affect their quality of life negatively [7]. Untreated dental caries might lead to dental pain which in turn results in impacts of affected play and sleep, avoidance of certain types of food and decreased school performance [12]. Children who have poor oral health have been reported to be 12 times more likely to have restricted activity days than those who do not [12]. A review of studies considering children's self-reported dental pain revealed prevalence rates of 68% in 12-year-old Indians, 42% in 10–14 year-old Ugandans and 21% among 0–18-year-olds in Kenya [13].

Numerous methodological and conceptual problems are involved when developing health related quality of life measures for children; as such measures have to take into consideration distinct changes in the growing child [14]. Most of the changes related to growth may affect the child and therefore the oral health related quality of life measures may have to be age specific. Recently, it has been recognized that using appropriate questionnaire techniques, children can give valid and reliable information and thus should be the primary source of information regarding their OHRQoL [7,15,16]. Two instruments have been developed to measure OHRQoL in younger age groups, namely the Child Perception Questionnaire assessing symptoms, functional limitations and well being in 6–10-year- and 11–14-year-olds and the Child version of the Oral Impacts on Daily Performance (OIDP) inventory [7,8,15,17]. The Child-OIDP, which has been derived from the OIDP [5,18], was developed and tested among Thai school children aged 11–12 yr [7,8]. It has been found to be a reliable and valid instrument when applied to children in Thailand, France and UK [7,8,19,20]. However, further evaluation of its performance across countries and age groups has been requested. As with the adult OIDP, the Child-OIDP measures oral impacts that seriously affect the person's daily life. It is based on the conceptual framework of the World Health Organisation's International Classification of Impairments, Disabilities and Handicaps, ICIDH [21], which has been amended for dentistry by Locker [22]. The OIDP concentrates only on disability and handicap, thus demonstrating strong theoretical coherence and reduced possibility of double scoring of the same oral impacts at different levels [5,18]. Considering respondent burden, the OIDP (and the Child-OIDP) is suitable for use in population surveys, not only in terms of being easier when measuring behaviours rather than feeling states, but also in being short. In order to suit children's cognitive development, the Child-OIDP deviates from the OIDP with respect to the sequence of questions, having a shorter recall period in terms of 3 months instead of 6 months and with pictures used as interviews guide [7]. Since the Tanzanian oral health policy gives priority to children as a target group for oral health care services [23], the Child-OIDP questionnaire is worthy consideration because of its adaptation for use in oral health care needs assessment making it useful for planning services. The original OIDP inventory has previously been translated into Kiswahili and found to be applicable to young adults and older people in Tanzania whilst administered as self-performed questionnaires and in face to face interviews [24,25].

The aim of this study was to assess validity, reliability and prevalence estimates of a Kiswahili translated version of the Child-OIDP frequency inventory for use in primary schoolchildren emanating from two socio-economically different districts in Tanzania.

Methods

Study area

A cross sectional survey was conducted in Dar es Salaam, the commercial capital and major sea port of Tanzania, from November 2005 to June 2006. Dar es Salaam is the most densely populated and socially and culturally heterogenic city in Tanzania. According to the 2002 population and house survey in Tanzania, Dar es Salaam has a total population of 2.5 million and population density of 1,793 per square km. Dar es Salaam is divided into three districts; Kinondoni, Ilala and Temeke with total population sizes of 1.083,913, 634,924 and 768,451 people respectively. All districts have drinking water with fluoride content of about 1 mg fluoride/L (1 ppm). Kinondoni and Temeke are quite diverse districts in terms of their socio-demographic profile, with the former having higher employment rates, literacy rates and proportions of the population using the most expensive form, electricity, as their main source of energy for cooking [26].

Sampling

The study population comprised of children attending standard 7 in public primary schools. A stratified proportionate two-stage cluster sampling design with public primary schools as the primary sampling unit was utilized. To obtain a sample of schoolchildren of mixed socio-economic background, schools were selected at random from urban and rural areas in the Kinondoni and Temeke districts in Dar es Salaam. Overall, 43 rural- (N = 4,809 standard 7 pupils) and 78 urban primary schools (N = 14.725 standard 7 pupils) were listed in Kinondoni. The corresponding number of schools in Temeke were 22 rural (N = 1707 standard 7 pupils) and 77 urban (N = 14103 standard 7 pupils) schools. A sample size of 1200 school children aged 12–14 yr was calculated to be satisfactory for two sided tests, assuming the prevalence of oral impacts to be 0.40 and 0.50 in children with and without caries experience, a significance level of 5%, power of 90% and a design factor of 2 [27]. At the first stage, 4 rural (4/43 n = 755 standard 7 pupils) and 6 urban (6/77, n = 1157 standard 7 pupils) schools in Kinondoni and 1 rural (1/22 n = 184 standard 7 pupils) and 5 urban (5/78, n = 949 standard 7 pupils) schools in Temeke were selected by systematic random sampling using a unified sampling fraction. From a total of 3045 standard 7 pupils available in the selected schools, about 100 students in each selected school (i.e. 1601 students constituting 52.6% of all standard 7 students in the selected schools) and fulfilling the inclusion criteria of being in the defined age range of 12–14 yr were randomly selected from the accessible classes. Only consenting subjects were included in the study and none of the students invited for participation were ill, had a history of psychiatric problems or were disabled. Ethical clearance was obtained from all relevant persons, authorities and committees in Tanzania. These included written permission and clearance for the study from the Research and Publication Committee of the Muhimbili University College of Health Sciences (MUCHS). Permission to work with school children was obtained from Kinondoni and Temeke municipalities, their respective educational authorities, schools administrations, parents and children.

Translation and adaptation of the Child-OIDP inventory

A structured interview schedule, including the 8 item Child-OIDP inventory was translated from English into Kiswahili, the language of instruction in all Tanzanian public primary schools, by three professionals fluent in Kiswahili and English and back-translated into English by two independent translators. A group of dental professionals reviewed the Kiswahili version of the questionnaire for semantic, experiential and conceptual equivalence with the source version. Sensitivity to culture and selection of appropriate words were considered. The inventory was subsequently discussed and compared with *de novo* oral impacts on daily performances identified in a focused group interview with 10 primary school children. No modifications to scale content and wording were made and the questionnaire was finally pilot tested in a new convenience sample of 63 primary schoolchildren. This confirmed the feasibility of the methodology and helped to determine the time necessary for completion of the interview (about 5–7 minutes). It also led to the decision to avoid pictures as interview guides as well as the severity scales for logistic-, time sparing- and simplicity reasons. In accordance with previous studies that have applied the Child-OIDP inventory [7,8,19], the participants of this study were able to respond to the questions without the aid of pictures and had no difficulty understanding both the content of the questionnaire and any specific words in particular.

Interview variables

The children completed the Kiswahili version of the Child-OIDP frequency questionnaire at school in face to face interviews administered by two trained research assistants before the clinical examination. The interview started with the children reviewing common oral problems and tick off whether they had experienced them during the previous 3 months [7,8]. The Child-OIDP frequency index referred to difficulty carrying out eight daily life activities namely eating, speaking, cleaning mouth, sleeping, smiling, school work, emotion and social contact each scored 0–3 where (0) never, (1) once or twice a month, (2) once or twice a week, (3) very day/nearly every day [7,8]. Participants were also asked to identify the oral condition that caused the specific impacts by answering for each reported item (1) yes or (0) no to the following alternatives: "toothache, sensitive teeth, tooth exfoliation, problems with position of teeth, ulcer in mouth, bleeding in mouth, swollen gums, bad breath, problems with colour of teeth, problems with spaces of teeth, other problems". The total Child-OIDP score was constructed in two ways. First, by adding the 8 performance scores as originally scored (0–3) into a Child-OIDP additive score (ADD) (range 0–24). Second, the Child-OIDP simple count (SC) score (range 0–8) was constructed by summing the dichotomized frequency items of (1) affected and (0) not affected.

The predictor variables and the number of subjects according to categories are summarized in Table 1. Sociodemographics were assessed in terms of place of residence (urban/rural), district (Kinondoni/Temeke), gender, age and parental education. A group variable on parental education was constructed from two dummy variables (0/1) on father's and mother's highest level of education. Self reported oral health status, satisfaction with teeth/mouth and self rated health status were coded on 4-point Likert scales and recoded further into dummy variables in terms

of (0) good/satisfied and (1) bad/dissatisfied. Overall satisfaction with teeth was constructed as a sum variable from 4 variables (satisfaction with mouth/teeth, position of teeth, appearance and colour of teeth) and dichotomized for use in cross tabulation and logistic regression analysis. Frequency sugar intake was made up by a sum score of items assessing the frequency intake of biscuits, chocolate/toffee/sweets, ice cream, soda, and sugared fruit juice. Each item originally assessed on a scale ranging from (1) more than once a day to (4) seldom or never was dichotomized into (1) (categories 1,2) and (0) (categories 3,4); then, the scores of those derived variables were again summed and dichotomized. Dental attendance was constructed into two Yes (1) and No (0) variables originally scored from (1) attended more than 3 times to (5) never attended. Sucking behaviour, including finger, lip tongue sucking was scored as Yes (1) and No (2) variables.

Clinical Examination

One trained and calibrated dentist (MM) conducted all clinical examinations in the classroom setting with natural daylight as the source of illumination and with an assistant recording the observations. Participants identified with problems that needed treatment were referred or advised to seek treatment at the two municipal hospital of Kinondoni and Temeke districts and oral health education sessions were provided. Caries experience was assessed in accordance with the WHO criteria [28]. Oral hygiene was assessed using the simplified-Oral Hygiene Index (OHI-S) [29]. Duplicate clinical examinations were carried out on a randomly selected sub-sample of 71 participants considered to be representative of the study subjects. Analyses performed on the duplicate examination recordings gave kappa statistics of 0.93 and 0.74 for the DMFT- and OHI-S scores, respectively. These figures indicate very good intra-examiner reliability [28].

Statistical analyses

Test-retest reliability for the clinical parameters and the questionnaire variables was assessed using Cohen's weighted kappa statistics with an independent convenience sample of 60 12–14-year-olds and a time interval of 1.5 weeks. Internal consistency reliability was assessed in the main sample using Cronbach's alpha [30]. Construct validity was determined by comparing OIDP scores of groups that differ regarding subjective measures of health status. Furthermore, differences in Child-OIDP were also assessed between groups according to socio-economic-, clinical and behavioral characteristics. Construct validity was also evaluated using exploratory factor analysis, EFA (i.e. Principle Component Analysis with Varimax rotation) with the independent sample constituting the test-retest group- and confirmative factor analysis, CFA with the main sample. The parameters of CFA were estimated with maximum likelihood estimation (ML) and bootstrapping advocated for non-normally distributed variables [31]. Bias corrected 90% CI (SE/BC 90% CI) was reported for the estimates. Adequacy of the model fit was assessed using chi-square statistics, the Goodness of Fit index (GFI), the Incremental Fit Index (IFI), the Normed Fit Index (NFI) and the Comparative Fit Index [31]. Cross-tabulation and chi-square statistics were used to assess bivariate relationships. Multivariate analysis was done by Logistic regression. For the purpose of cross tabulation and logistic regression analysis the OIDPSC score (0–8) was dichotomized as 0/1+, producing the categories (0) "no daily performance affected" and (1) "at least one daily performance affected". The distribution of the OIDPSC scores supported this cut-off point. Data were analyzed using SPSS version 14.0 and AMOS 6.0. To adjust for the effect of the cluster design, data were reanalysed using STATA 9.0 with survey command. P-value for statistical significance was set at 0.05.

Results

Sample profile

A total of 1003 children from Kinondoni (63.5% urban, 58.9% girls, mean age 13.1 yr) and 598 children from Temeke (82.3% urban, 63.2% girls, mean age 13.0 yr) completed an extensive personal interview and underwent a full mouth clinical examination. The mean DMFT scores were 0.37 (sd = 0.86) and 0.39 (sd = 0.84) in Kinondoni and Temeke, respectively. Corresponding scores concerning OHI-S were 1.0 (sd = 0.53, range 0.0–3.3) and 1.2 (sd = 0.54, range 0.0–4.2). Table 1 provides the percentage distribution of participants' socio-demographic-, clinical-, perceived oral health- and behavioral characteristics in the total sample and according to district of residence.

Reliability and validity of the Child-OIDP

All the participating subjects completed the Child-OIDP frequency inventory providing support to its face validity. Internal consistency reliability (standardized item alpha) was .77 (.62 in Kinondoni, .76 in Temeke). The inter item correlations ranged from 0.05 (speaking/carrying out major work) to 0.79 (speaking/contact with people). The corrected item total correlation (i.e. the correlation between each item and the total score omitted for that item) ranged from .21 (carrying out major work) to .69 (contact with people) being above the minimum level of 0.20 for including an item into a scale [30]. The Cronbach's alpha decreased when any one item was deleted from the scale except for the items of emotion and schoolwork. Test-retest reliability of the 8 categorical Child-OIDP items in terms of weighted Cohen's kappa were 0.7 (emotional state), 0.8 (carrying out major schoolwork) whereas eating, speaking, cleaning teeth, sleeping, smiling and social contact showed a kappa value of 1.00. Weighted Cohen's kappa for the categorical Child-

Table 1: Frequency distribution of independent variables and their categories according to district

Variables	Categories	Kinondoni % (n)	Temeke %(n)	p-value
Sex	Male	41.1 (412)	36.8 (220)	P = 0.050
	Female	58.9 (591)	63.2 (378)	
Age	12 Yrs	26.1 (262)	23.9 (143)	P = 0.033
	13 yrs	41.9 (420)	48.5 (290)	
	14 yrs	32.0 (321)	27.6 (165)	
Parental education	Both low	38.5 (210)	53.8 (149)	P = 0.000
	One low/one high	24.2 (132)	20.9 (58)	
	Both high	37.2 (203)	25.3 (70)	
Place of residence:	Urban	63.5 (637)	82.3 (492)	P = 0.000
	Rural	36.5 (366)	17.7 (106)	
DMFT	0	78.3 (785)	77.6 (464)	P = 0.399
	> 1	21.7 (218)	22.4 (134)	
OHIS Debris score	Good	68.0 (682)	61.9 (370)	P = 0.007
	Fair/poor	32.0 (321)	38.1 (228)	
Overall satisfaction	Satisfied	87.8 (881)	90.1 (539)	P = 0.092
with oral health	Dissatisfied	12.2 (122)	9.9 (59)	
State of teeth	Good	84.8 (851)	91.6 (548)	P = 0.000
	Bad	15.2 (152)	8.4 (50)	
State of health	Good	93.2 (935)	96.5 (577)	P = 0.003
	Bad	6.8 (68)	3.5 (21)	
Oral problems	None	43.3 (434)	30.1 (180)	P = 0.000
	≥1	56.7 (569)	69.9 (418)	
Finger sucking	No	70.6 (708)	66.1 (395)	P = 0.033
	Yes	29.4 (295)	33.9 (203)	
Dental attendance	No	86.8 (871)	80.9 (484)	P = 0.001
	Yes	13.2 (132)	19.1 (114)	
Sugar intake	0–1 item	35.3 (354)	36.5 (218)	P = 0.339
	> 1 items	64.7 (649)	63.5 (380)	

OIDPSC scores were 0.91 (1.0 in Kinondoni and 0.83 in Temeke) and intraclass correlation coefficient for Child-OIDPADD scores were 0.98.

Construct validity was demonstrated in that the Child-OIDP scores increased as the children's self-reported oral health-, general health-, dental appearance- and oral problems status changed from healthy to unhealthy. This was evident with Chi-square test in cross-tabulation analyses and with Mann Whitney U test using the Child-OIDP SC and the Child-OIDP ADD scores, respectively (Table 2). Children that were not satisfied with their oral health and rated their teeth status as bad had mean Child-OIDP ADD score at least twice as high as that of children who felt satisfied and rated their teeth status to be good (Table 2). The Child-OIDP SC and the Child-OIDP ADD scores also varied with socio-demographic variables (Table 3).

By examining the relationship between Child-OIDP SC and clinical and non-clinical variables in a single regression model, possible confounding due to strong associations between the explanatory variables was taken into consideration (Table 4). Socio-demographic and behavioral variables were entered in the first step with model summary in terms of Nagelkerkes R^2 = .147 and with all variables being statistically significantly associated with Child-OIDP. By entering the DMFT and OHI-S status in step 2, the model summary increased to Nagelkerkes R^2 = .152. Variables on self-reported oral health entered in step 3 raised the model summary to Nagelkerkes R^2 = .301. In the final model (Model Chi Square = 377.006, df = 14, p = 0.001), district of residence (Kinondoni/Temeke), area of residence (urban/rural) and reported satisfaction with oral health, status of teeth, status of health and reported number of oral problems remained highly statistically significant predictors with odds ratios of 4.8, 1.6, 1.9, 3.1, 1.8 and 3.9, respectively. Interactions between district and DMFT status (B = -0.704, p = 0.016) and between districts and sugar frequency intake (B = -0.780, p = 0.005) upon Child-OIDP scores were revealed indicating that the tendency of children with caries experience and frequent sugar intake to be more likely than their counterparts without those characteristics to report any oral impact (Child-OIDP > 0) was evident in Kinondoni but not in Temeke district.

EFA gave 3 factors with eigenvalue greater than 1. The factors accounted for 71.7% of the Child-OIDP variables. Factor 1 consisted of "speaking" "smiling" and "social contact" (loading higher than 0.4), Factor 2 consisted of

Table 2: The Child-OIDP scores and self-reported and clinically assessed variables. Percent of children with Child-OIDP > 0 and mean Child-OIDP scores with differences in mean rank, DMR, (Mann Whitney U test).

Self rated oral health	% Child OIDPSC > 0	Mean (SD) Child OIDP ADD scores	DMR
Overall satisfaction with teeth			
Satisfied	26.0 (369)	1.0 (2.5)	
Dissatisfied	49.2 (89)**	2.4 (3.8)**	91.1
State of teeth			
Good	25.1 (351)	1.0 (2.6)	
Bad	53 (107)**	2.3 (3.4)**	120.5
State of general health			
Good	27.6 (417)	1.1 (2.7)	
Bad	46.1 (41)**	1.9 (3.3)**	38.0
Reported oral problems			
No problem	11.6 (71)	0.4 (1.7)	
≥1 problems	39.2 (387)**	1.6 (3.1)**	256.2
DMFT			
DMFT = 0	26.7 (333)	1.1 (2.6)	
DMFT > 0	35.5 (125)*	1.5 (3.1)**	59.5
Oral Hygiene score			
Good	27.3 (287)	1.1 (2.7)	
Fair/poor	31.1 (171)ns	1.2 (2.8) ns	34.1

**p < 0.001, *p < 0.05

"eating" and "cleaning" (loading above 0.4) and Factor 3 consisted of "emotion" and "schoolwork", all with factor loadings above 0.4. "Sleeping" loaded highly (loading 0.5) on both Factor 2 and 3. CFA was then used to test the hypothesized 3-factor (social function, physical function, psychological function) model identified from the EFA which is consistent with previous experience [32]. The four indices from CFA indicated acceptable fit of the model with the data in terms of GFI (0.96), AGFI (0.93). NFI (0.95) and CFI (0.96). However, the Chi -square was statistically significant (Chi-square = 221.137 (17), p < 0.001) and the RMSEA (0.08) a bit below the optimal level of 0.05 indicating a mediocre fit. The amount of variance (R^2) accounted for was 26% (.012/0.24–0.28), 32% (.03/0.28–0.37) and 4% (0.04/0.03–0.05) by the social (speaking, smiling, contact with people), functional/physical (eating, cleaning) and psychological (emotion, schoolwork, sleeping) dimensions, respectively. The

Table 3: The Child OIDP and socio-demographic and behavioral variables. Percent of children with OIDP > 0 and mean OIDP scores with differences in mean rank (Mann Whitney U test).

Socio-behavioral variables	% OIDP > 0	Mean (SD) OIDP ADD scores	DMR
Place of residence			
Urban	28.3 (319)	1.1 (2.7)	
Rural	29.4 (139)ns	1.2 (2.7) ns	9.7
Age			
12 yrs	24.0 (97)	1.1 (2.8)	
13 yrs	30.8 (219)	1.2 (2.5)	
14 yrs	29.2 (142)*	1.3 (2.9) ns	37.6
District			
Kinondoni	18.5 (186)	0.4 (1.2)	
Temeke	45.5 (272)**	2.3 (3.9)**	247.1
Finger sucking			
No	25.8 (285)	1.0 (2.7)	
Yes	34.7 (173)**	1.4 (2.9)**	74.8
Dental attendance			
No	26.5 (359)	1.1 (2.6)	70.1
Yes	40.2 (99)**	1.8 (3.4)**	
Sugar intake			
0–1 item	25.2 (144)	1.1 (2.9)	
> 1 items	30.5 (314)*	1.2 (2.6)*	48.1

** p < 0.001. *p < 0.05

Table 4: Unadjusted and adjusted odds ratios and 95% confidence interval (CI) of having at least one oral impact on daily performances (OIDP = 1) according to non-clinical and clinical variables.

	Unadjusted OR (95% CI)	Adjusted OR (95% CI)	p-value
Step 1			
District: Kinondoni	1	1	P = 0.001
Temeke	3.6 (2.9–4.5)	4.8 (3.6–6.2)	
Area: Urban	1	1	P = 0.001
Rural	1.0 (0.8–1.3)	1.6 (1.2–2.2)	
Sex: Male	1	1	P = 0.736
Female	0.9 (0.7–1.1)	0.9 (0.7–1.2)	
Age: 12 yrs	1	1	P = 0.052
13 yrs	1.4 (1.1–1.8)	1.3 (1.0–1.7)	
14 yrs	1.3 (0.9–1.7)	1.2 (0.9–1.7)	
Finger/lip sucking: no	1	1	P = 0.093
yes	1.5 (1.2–1.9)	1.2 (0.9–1.6)	
Sugar items: 0–1	1	1	P = 0.207
> 1	1.3 (1.0–1.6)	1.2 (0.9–1.5)	
Dental attendance: no	1	1	P = 0.062
yes	1.8 (1.4–2.7)	1.3 (0.9–1.9)	
Step 2			
DMFT = 0	1	1	P = 0.238
DMFT > 0	1.5 (1.2–1.9)	1.2 (0.8–1.6)	
Step 3			
OHIS: good	1	1	P = 0.916
fair/poor	1.2 (1.0–1.5)	1.0 (0.7–1.3)	
Satisfied with oral health	1	1	P = 0.001
Dissatisfied with oral health	2.8 (2.0–3.7)	1.9 (1.3–2.8)	
No oral problem	1	1	P = 0.001
≥1 oral problems	4.9 (3.7–6.5)	3.9 (2.9–5.2)	
State of teeth: good	1	1	P = 0.001
bad	3.3 (2.4–4.5)	3.1 (2.1–4.5)	
State of health: good	1	1	P = 0.023
bad	2.2 (1.4–3.4)	1.8 (1.1–3.0)	

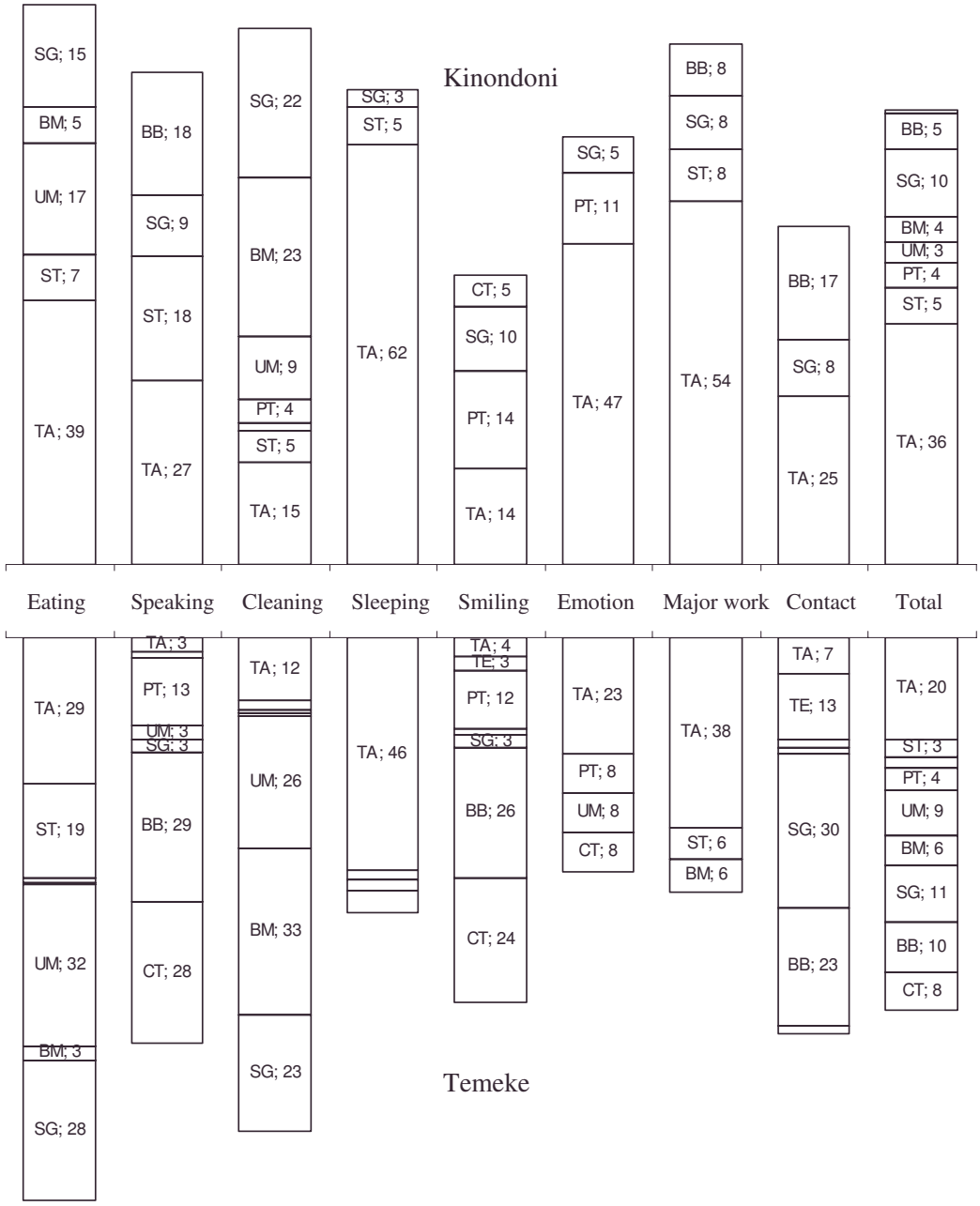
present model appeared to provide the "best" description of the Child-OIDP data in this study when compared with a 2-factor and a 1-factor model.

Child-OIDP prevalence and the perceived causes of oral impacts

The most common oral problems in both districts initially listed by the schoolchildren were toothache (Kinondoni: 18.7%, Temeke: 24.1%), having ulcer in the mouth (Kinondoni: 15.7%, Temeke: 26.6%), bleeding (Kinondoni: 15.4%, Temeke: 17.4%) and swollen gums (Kinondoni: 18.1%, Temeke 21.4%). The mean Child-OIDP ADD scores for the total sample showed limited variability with a mean of 1.2 (sd= 2.8). Overall, a total of 28.6% (95% CI: 26.6, 30.6) had at least one oral impact. As can be seen from Table 5, the prevalence of oral impacts was moderate in Kinondoni (18.5%; 95% CI: 16.5, 20.5) but relatively high in Temeke (45.5%; 95% CI: 42.5, 48.5). Impacts on eating were the most prevalent reported impairment in Temeke (35.3%), followed by cleaning teeth (26.9%) and smiling without embarrassment (13.0%). The corresponding figures in Kinondoni were eating (13.3%) and cleaning teeth (8.6%), with all other activities showing very low levels of oral impacts. Impacts on emotion and school work were the least frequently reported impacts in both districts. As shown in Figure 1, toothache was the most frequently perceived cause of impairments for almost all performances particularly in Kinondoni. In Temeke, the majority of impacts on speaking and smiling were attributed to bad breath, colour of teeth and position of teeth. Swollen gums, bad breath and bleeding in mouth were frequently perceived causes of impairments in both districts.

Discussion

The present study is the first large population based survey about OHRQoL covering schoolchildren in Tanzania. Comparison of the sample characteristics with the Kinondoni and Temeke child populations on the markers of sex and parental education suggest that the sample was representative of the population of children aged 12–14 yr in those districts. When administered in face to face interviews, the Kiswahili version of the inventory showed good reliability and validity in 12–14-year-old schoolchildren,



Abbreviations:
TA-Toothache; ST-Sensitive teeth; BM-Bleeding in the mouth; SG-Swollen gums: BB-Bad breath; PT-Position of teeth; CT-Colour of teeth; TE-Tooth exfoliation; UM-Ulcer in the mouth
Note: Unmarked spaces and causes of impacts not presented in the figure had value <3%

Figure 1
Perceived oral problems associated with oral impacts in schoolchildren from Kinondoni and Temeke districts.

Table 5: Percentage distribution of the eight Oral Impacts on Daily Performance (OIDP) frequency items in the whole sample (n = 1601) and by district of Kinondoni and Temeke.

Child – OIDP performance items	All % (n)	Kinondoni % (n)	Temeke % (n)
Eating	21.5 (344)	13.3 (133)	35.3 (211)
Speaking	5.4 (86)	1.1 (11)	12.5 (75)
Cleaning teeth	15.4 (247)	8.6 (86)	26.9 (161)
Sleeping/relaxing	5.3 (85)	3.7 (37)	8.0 (48)
Smiling	6.2 (99)	2.1 (21)	13.0 (78)
Emotional	2.0 (32)	1.9 (19)	2.2 (13)
School work	1.8 (29)	1.3 (13)	2.7 (16)
Enjoying contact with people	5.1 (81)	1.2 (12)	11.5 (69)
% with at least one OIDP	28.6 (458)	18.5 (186)	45.5 (272)

thus indicating its applicability. The internal consistency reliability was successfully tested in several ways. All inter-item correlations were positive and all corrected item total correlations were above the minimum level of 0.20 for an item to be included into a scale [30,33]. Cronbach'a alpha was 0.77 which is satisfactory according to the standards of 0.50 and 0.70 thresholds set by most authors for group comparisons [33]. These figures compare in magnitude with those reported for the Thai-, UK- and French version of the Child-OIDP inventory [7,8,19,20]. Previous applications of OIDP among adolescents and young adults in various populations in Africa have yielded higher internal consistency values ranging from 0.70 to 0.91 [34,35].

All participating children completed the 8 item Child-OIDP inventory adding support to the face validity of its Kiswahili version. There was no indication from the reference groups of academics or from the focus group discussions and pilot surveys that the relevance of any of the items was low in the Tanzanian context. This suggests that Tanzanian schoolchildren were capable of fully understanding the Kiswahili translated version without altering the meaning of the questions and that the Kiswahili and English frequency inventories are comparable. Whereas face and content validity was assessed by a ground up or *de novo* approach based on qualitative focus group interviews with the targeted children, hypotheses regarding the construct validity were confirmed in that the inventory varied systematically and in the expected direction with self-reported oral health indicators. Thus, the Child-OIDP scores indicated lower levels of oral impacts when the self-perceived oral health was better and when no oral problems were recorded.

By examining the relationships between the Child-OIDP scores and clinical-, non clinical and socio-behavioral variables in a single regression model, it was possible to obtain a better understanding of their combined effects and to compare the strength of the influence from each. Consistent with previous findings and with the propositions derived from the ICIDH conceptual framework [21], the present results suggest that adjacent concepts such as oral health perceptions and reported oral problems were the strongest predictors of oral impacts. In contrast, the effects of the more remote concepts of clinical scores of DMFT- and OHI-S did not remain statistically significant in the multivariate analyses, suggesting that their effects were mediated through other variables. Previous studies conducted in Tanzania have shown that the OIDP frequency scale is able to discriminate between subjects with and without at least one clinically defined problem, and between older adults with complete and reduced number of posterior occluding support [24,25]. Bivariate associations between the Child-OIDP scores and number of decayed primary and permanent teeth were recently reported among French children [19].

The more frequent oral impairments reported by children already disadvantaged in terms of being Temeke residents and from a rural area must have been due to factors associated with material and social deprivation and could not entirely be attributed to various levels of oral diseases. Although not statistically significant in the multiple logistic regression analysis, the present results indicate a clear negative gradient with respect to dental visiting; the more frequent this habit, the less favorable the children's oral quality of life. This is consistent with results reported previously [34,35] and suggest that dental attendance may be recognized as a proxy for oral problems among Tanzanian school children. The results of the CFA confirm the three dimensions structure that the EFA identified namely the social-, physical-, and psychological-functional dimensions in the Kiswahili version of the Child-OIDP inventory. Those dimensions explain, respectively, 26%, 32% and 4% of the variance supporting the relative importance of the three domains of OHRQoL in this particular context. Factor analyses have been used previously with many other OHRQoL indicators to group their items into domains of various numbers, whereas some instruments consider OHRQoL as a single construct [32,36,37].

The Tanzanian Child-OIDP index exhibited marked floor effects in Kinondoni (81.5%) and Temeke (54.5%) but sufficient discriminative properties suggest that it is suitable for detecting group differences in cross-sectional studies. However, a substantial difference between the two districts occurred across the 8 aspects of daily living with 18.5% and 45.5% of children in Kinondoni and Temeke having experienced any oral impact during the 3 months preceding the survey. The observed prevalence is lower than those observed among similar age groups in other cultures [7,8,19], and also lower than those observed between older adolescents in Uganda as well as among Tanzanian adults of various ages [24,25,34]. Nevertheless, the prevalence rate of the Child-OIDP in Temeke compares with that obtained among UK children using the same instrument [20]. The higher prevalence of OIDP seen in Temeke as compared to Kinondoni is in line with Kinondoni children having a healthier profile generally both in terms of better clinical- and subjective oral health measures as well as socio-demographic characteristics such as parental education (Table 1). Eating was the most frequently reported impairment in both districts, a finding that is consistent with those of other populations using the adults and child versions of the OIDP instrument [6-8,19,20]. Although the prevalence of dental caries was low, toothache was recognized as the main cause of 6 out of 8 performances in Kinondoni and the main cause of 4 out of 8 performances evaluated in the Child-OIDP in Temeke where children reported a large range of oral problems as causes of oral impacts.

Further evaluation of the performance of children's OHR-QoL instruments across countries and age groups has been requested. Validation of such instruments at the population level is important since clinical samples due to their biased nature may give a misleading picture. Further studies should assess its evaluative properties to determine its applicability to support clinical measures in oral health care intervention research.

Competing interests

The author(s) declare that they have no competing interests.

Authors' contributions

MM: Principle investigator, conceived of the study, designed the study, collected data, performed statistical analyses and manuscript writing.

ANÅ: Main supervisor, designed study, guided the statistical analyses. She has been actively involved in manuscript writing.

GT: He has provided valuable comments on the paper in general and on the OIDP scoring in particular. He has been actively involved in manuscript writing.

All authors read and approved the final manuscript.

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Malocclusion, psycho-social impacts and treatment need: A cross-sectional study of Tanzanian primary school-children

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Abstract

Background: studies on the relationship between children's malocclusion and its psycho-social impacts are so far largely unexplored in low-income countries. This study aimed to assess the prevalence of malocclusion, reported dental problems and dissatisfaction with dental appearance among primary school children in Tanzania. The relationship of dissatisfaction with socio-demographic characteristics, clinically defined malocclusion and psychosocial impacts of dental anomalies was investigated. Orthodontic treatment need was estimated using an integrated socio-dental approach.

Method: One thousand six hundred and one children (mean age 13 yr) attending primary schools in the districts of Kinondoni and Temeke completed face to face interviews and a full mouth clinical examination. The survey instrument was designed to measure a Kiswahili translated and culturally adapted Child Oral Impact on Daily Performance (Child-OIDP) frequency score, reported dental problems, dissatisfaction with dental appearance/function and socio-demographic characteristics.

Results: The prevalence of malocclusion varied from 0.9% (deep bite) to 22.5% (midline shift) with a total of 63.8% having at least one type of anomaly. Moderate proportions of children admitted dental problems; ranging from 7% (space position) to 20% (pain). The odds ratio of having problems with teeth position, spaces, pain and swallowing if having any malocclusion were, respectively 6.7, 3.9, 1.4 and 6.8. A total of 23.3% children were dissatisfied with dental appearance/function. Children dissatisfied with their dental appearance were less likely to be Temeke residents (OR = 0.5) and having parents of higher education (OR = 0.6) and more likely to reporting problem with teeth position (OR = 4.3) and having oral impacts (OR = 2.7). The socio-dental treatment need of 12% was five times lower than the normative need assessment of 63.8%.

Conclusion: Compared to the high prevalence of malocclusion, psycho social impacts and dissatisfaction with appearance/function was not frequent among Tanzanian schoolchildren. Subjects with malocclusion reported problems most frequently and malocclusion together with other psycho-social impact scores determined children's satisfaction with teeth appearance- and function.

Background

It is generally accepted that the main benefit of orthodontic treatment relates to improvements in oral function and oro-facial aesthetics and thus to improved oral health related quality of life [1-3]. A recent review on the impact of malocclusion on quality of life based on studies from industrialized countries concluded that patients are motivated to seek orthodontic care due to the physical, psychological and social effects of malocclusion [3,4]. Thus, information regarding the psycho social impacts of malocclusion is important in providing understanding of the demand for orthodontic treatment beyond clinical indicators [3,4]. Valid and reliable oral health related quality of life instruments for use among children are emerging and have the potential to provide information about the subjectively experienced consequences of oral diseases including malocclusion, the effect of malocclusion if left untreated and to facilitate appropriate treatment need assessment for dental service planning [3,5-8]. However, values attributed to dental esthetics and functioning vary according to social and cultural contexts and studies regarding the relationship between malocclusion and its psycho social impacts is so far largely unexplored in low income countries [9-14]. Recent studies of Nigerian adolescents suggest that consciousness of malocclusion does not agree with the objectively determined orthodontic treatment need [15-17]. In Tanzania, studies investigating the functional and behavioral consequences of malocclusion in children are either non-existent or very few [9,18]. This is noteworthy as normatively assessed orthodontic treatment needs based on clinical indicators alone are commonly found to vary according to age, to be high (60–90%) and thus are unlikely to be met due to the high costs of treatment that goes beyond the financial capabilities of this country [19,20]. Three quarters of the low-income countries lack sufficient human and financial resources to provide an essential health care package for their children [21].

Considering the impracticality and inappropriateness of a normative approach to the assessment of children's need for orthodontic treatment, Gherunpong et al [11] developed a new theoretical framework and model for estimating orthodontic treatment need in children. In their model they integrated clinical measures of orthodontic anomalies with children's feeling of impacts related to appearance and function as well as with measures of their oral health related behaviors. This socio-dental system for need assessment includes three levels. The first level refers to standard normative need assessment and is based solely on professionally judged malocclusions that normally require orthodontic treatments. The second level refers to impact related need assessment and relies on the integration of normative need with OHRQoL. Children who have both normative needs and their oral quality of life impaired by malocclusion are considered to have impact related need for orthodontic treatment. Propensity related need assessment (level three) is calculated by integrating normative need assessment with impacts on OHRQoL and children's behavioral propensity in terms of appropriate oral hygiene and dental attendance patterns, thus taking into account the effectiveness and appropriateness of suggested treatments in the decision making process. Following this socio-dental approach, Gherunpong et al [10-12] reported that relying on normative methods (i.e. clinical diagnosis) alone without integrating the psychosocial dimensions of oral health, seriously overestimated need for orthodontic treatment in 11–12 year old Thais. Compared to a normative approach to need assessment, the socio-dental approach provided a reduction of 70% in the volume of estimated treatment need [10-12]. Accordingly, a normative measure of orthodontic treatment need estimated by converting clinical measures alone is expected to be too high to be met in a Tanzanian context where the government's oral health care budget is inadequate to meet the increasing oral health needs of the population [21].

The present study aims to assess the prevalence and correlates of perceived orthodontic conditions and dissatisfaction with dental appearance/dental function in Tanzanian schoolchildren that are without any history of orthodontic treatment. The conceptual model of Gilbert et al [22] (Fig 1) classifying oral health outcomes into four main levels was applied to organize the independent variables and to guide the analyses. These four levels were as follows; 1) oral disease and tissue damage referring to disorder at the organic level such as active disease or tissue loss, 2) oral pain/discomfort denoting the immediate consequences of disease in terms of physical dysfunction such as the inability to speak, swallow and chew food adequately, 3) oral disadvantage referring to the psychosocial and behavioral consequences of oral diseases, such as difficulties performing daily activities and 4) overall satisfaction with dental health. The final concept of *satisfaction with dental health* is subjects' expressed overall evaluation, incorporating expectations, values and social and cultural background. Following this model, it was hypothesized that reported problems in terms of pain, swallowing, teeth position and spaces of teeth and reported oral impacts on daily performances would increase with increased prevalence of malocclusion. Secondly, it was hypothesized that dissatisfaction with dental appearance/function would increase with increased prevalence of malocclusion, increased frequency of reported problems related to teeth and increased oral impacts on daily performances. Considering that feelings regarding teeth appearance and function are central for need assessment and thus for the planning and implementation of oral health care services

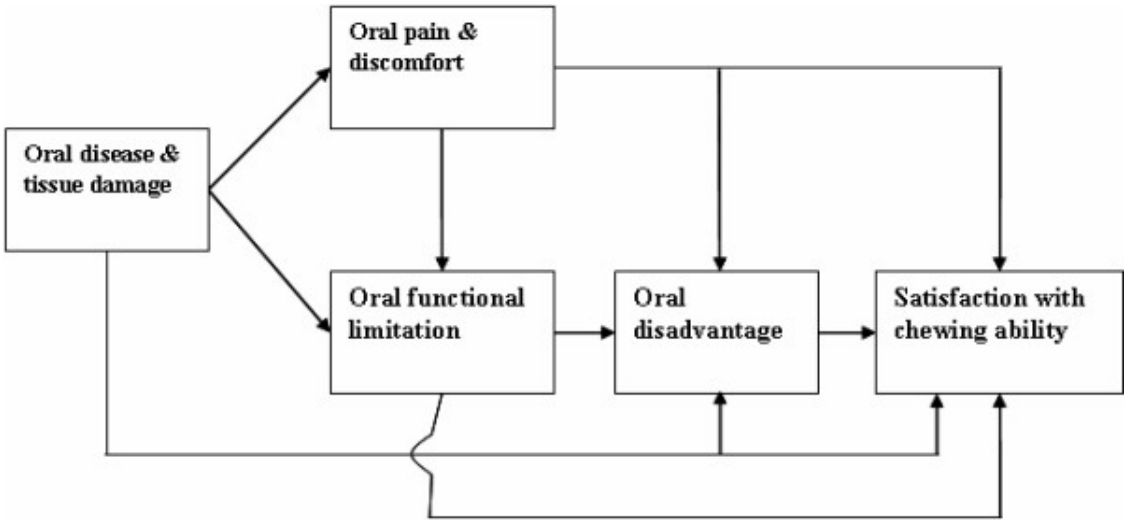

Figure 1
Conceptual model of chewing satisfaction showing associations between oral health constructs (Gilbert et al. 1998).

in Tanzania, orthodontic treatment need was estimated using a modified integrated socio-dental approach [11].

Methods

A cross-sectional survey was conducted in Dar Es Salaam, the commercial capital and major sea port of Tanzania, from November 2005 to June 2006. Dar Es Salaam is the most densely populated and socially and culturally heterogenic city in Tanzania. According to the 2002 population and house survey in Tanzania, Dar Es Salaam has a total population of 2.5 million and population density of 1,793 per square km. Dar es Salaam is divided into three districts; Kinondoni, Ilala and Temeke with total population sizes of 1.083,913, 634,924 and 768,451 people respectively. All districts have drinking water with fluoride content of about 1 mg fluoride/L (1 ppm). Kinondoni and Temeke are quite diverse districts in terms of their socio-demographic profile, with the former having higher employment rates, literacy rates and proportions of the population using the most expensive form, electricity, as their main source of energy for cooking [23].

The study population comprised of children attending standard 7 in public primary schools. A stratified proportionate two-stage cluster sampling design with public primary schools as the primary sampling unit was utilized. To obtain a sample of schoolchildren of mixed socio-economic background, schools were selected at random from urban and rural areas in Kinondoni and Temeke districts. Overall, 43 rural- (N = 4,809 standard 7 pupils) and 78 urban primary schools (N = 14.725 standard 7 pupils) were listed in Kinondoni. The corresponding number of schools in Temeke were 22 rural (N = 1707 standard 7 pupils) and 77 urban (N = 14103 standard 7 pupils) schools. A sample size of 1200 school children aged 12–14 yr was calculated to be satisfactory for two sided tests, assuming the prevalence of oral impacts to be 0.40 and 0.50 in children with and without orthodontic anomaly, a significance level of 5%, power of 90% and a design factor of 2 [24]. At the first stage, 4 rural (4/43 n = 755 standard 7 pupils) and 6 urban (6/78, n = 1157 standard 7 pupils) schools in Kinondoni and 1 rural (1/22 n = 184 standard 7 pupils) and 5 urban (5/77, n = 949 standard 7 pupils) schools in Temeke were selected by systematic random sampling using a unified sampling fraction. From a total of 3045 standard 7 pupils available in the selected schools, about 100 students in each selected school (i.e. 1601 students constituting 52.6% of all standard 7 students in the selected schools) and fulfilling the inclusion criteria of being in the defined age range of 12–14 yrs were randomly selected from the accessible classes. Only consenting subjects were included in the study and none of the students invited for participation were ill, had a history of psychiatric problems or were disabled. Ethical clearance was obtained from all relevant persons, authorities and committees in Tanzania. These included written permission and clearance for the study from the Research and Publication Committee of the Muhimbili University College of Health Sciences (MUCHS). Permission to work with school children was obtained from Kinondoni and Temeke municipalities, their respective educational authorities, schools administrations, parents and children.

A structured interview schedule was constructed in English and translated into Swahili by two trained research assistants. Oral health professionals reviewed the interview schedule for semantic, experiential and conceptual equivalence. Sensitivity to culture and selection of appropriate words were considered. The interview schedule was piloted before administration [9]. The model of Gilbert and coworkers [22] linking oral diseases with their functional and behavioral outcomes was applied to identify which factors to consider as determinants of dissatisfaction with dental appearance/function, and to help structure the multivariate regression analysis. The interview schedule in Swahili contained three of the four key concepts derived from this model. Oral pain and discomfort, the second level in Gilbert's model [22], was assessed by asking subjects, whether or not they had experienced problems with pain, tooth position and tooth spaces during the previous 3 months. Response categories were given as (0) no and (1) yes. Problems with swallowing was registered in clinical examination as present = 1 and absent = 0. Oral disadvantage, referring to the third level of Gilbert's model [22], was measured broadly using the eight item Child-OIDP, inventory (e.g. During the previous 3 months – how often have problems with your teeth and mouth caused you any difficulty with; eating, speaking, cleaning teeth, smiling, sleeping, emotional balance, study and social contact). For purpose of cross tabulation and logistic regression analysis the OIDPscore (0–8) was dichotomized as 0/1+, producing the categories (0) "no daily performance affected" and (1) "at least one daily performance affected". The scoring method, reliability and validity of the Kiswahili version of the Child-OIDP inventory have been described in detail in a previous paper [9]. Reported state of teeth was assessed using the categories (1) very good (2) good (3) bad (4) very bad and dichotomized into (0) good (original categories 1,2) and (1) bad (original categories 3,4). Satisfaction with teeth appearance/function was coded on 4-point Likert-scales and recoded further into dummy variables in terms of (0) satisfied and (1) dissatisfied. Overall satisfaction with teeth appearance/functioning was constructed as a sum variable from the 2 variables and dichotomized for use in cross tabulation and logistic regression analysis. Sociodemographics were assessed in terms of place of residence (urban/rural), district (Kinondoni/Temeke), gender, age and parental education. A group variable on parental education was constructed from two dummy variables (0/1) on father's and mother's highest level of education. The independent and dependent variables and the number of subjects according to categories are summarized in Table 1.

One trained and calibrated dentist (MM) conducted all clinical examinations in classroom setting with natural

Table 1: Frequency distribution of independent and dependent variables and their categories in Kinondoni and Temeke districts

Variables	Categories (code)	Kinondoni % (n)	Temeke %(n)	p-value
Sex e	Male (1)	41.1 (412)	36.8 (220)	P = 0.050
	Female (2)	58.9 (591)	63.2 (378)	
Age	12 Yr (1)	26.1 (262)	23.9 (143)	P = 0.033
	13 yr (2)	41.0 (420)	48.5 (290)	
	14 yr (3)	32.0 (321)	27.6 (165)	
Parental education	Both low (1)	38.5 (210)	53.8 (149)	P = 0.000
	One low/one high (2)	24.2 (132)	20.9 (58)	
	Both high (3)	37.2 (203)	25.3 (70)	
Place of residence:	Urban (1)	63.5 (637)	82.3 (492)	P = 0.000
	Rural (2)	36.5 (366)	17.7 (106)	
State of health	Good (0)	93.2 (935)	96.5 (577)	P = 0.003
	Bad (1)	6.8 (68)	3.5 (21)	
Reported problems tooth position	Yes (1)	10.5 (105)	13.9 (83)	P = 0.025
	No (2)	89.5 (898)	86.1 (515)	
Reported problems tooth spaces	Yes (1)	7.8 (78)	7.5 (45)	P = 0.465
	No (2)	92.2 (925)	92.5 (553)	
Problem swallowing	No (0)	93.5 (938)	90.8 (543)	P = 0.030
	Yes (1)	6.5 (65)	9.2 (55)	
Problem pain	No (0)	81.3 (815)	75.9 (454)	P = 0.066
	Yes (1)	18.7 (188)	24.1 (144)	
OHIS debris score	Good = 0	68.0 (682)	61.9 (370)	P = 0.007
	Fair/poor = 1	32.0 (321)	38.1 (228)	
OIDP extent	None = 0	81.5 (817)	54.5 (326)	P = 0.001
	> 1 = 1	18.5 (186)	45.5 (272)	
Malocclusion index (SMO)	No (0)	37.4 (328)	34.0 (163)	P = 0.237
	Yes (1)	62.6 (549)	66.0 (316)	
Dissatisfied appearance/function	Yes (0)	25.6 (257)	19.4 (116)	P = 0.002
	No (1)	74.4 (746)	80.6 (482)	
Reported state of teeth	Good (1)	84.8 (851)	91.6 (548)	P = 0.001
	Bad (2)	15.2 (152)	8.4 (50)	

daylight as the source of illumination and with an assistant recording the observations. Participants identified with problems that needed treatment were referred or advised to seek treatment at the two municipal hospitals of Kinondoni and Temeke districts and oral health education sessions were provided. Occlusion was registered according to Björk et al., [25], with some modifications by Al-Emran et al., [26]. Caries experience was assessed in accordance with the criteria by the World health Organization [27]. Oral hygiene was assessed using the simplified-Oral Hygiene Index (OHI-S) [28].

Sagittal molar occlusion: the basic Angle classification was used. The intermaxillary relationship of first permanent molars was registered as CL I (normal/neutral) when the mesiobuccal cusp of the maxillary first permanent molar occluded in line with mesiobuccal groove of the mandibular first permanent molar. CL II (distal) or CL III (mesial) molar occlusion was recorded when there was deviation of at least one half cusp width distally or mesially to CL I, respectively. It was recorded as Class I (CL I = 1), II (CL II = 2) and III (CL III = 3), and dichotomized into 0 (CL I) and 1(CL II and III) for use in cross tabulation and logistic regression analysis. When first permanent molars were missing, the registration was considered not applicable. Overjet: the distance from the most labial point of the incisal edge of maxillary right central incisor to the most labial surface of the corresponding mandibular incisor. Positive value (maxillary overjet) was recorded if the upper incisor was ahead of the lower incisor, and negative value (mandibular overjet), was registered if the upper incisor was behind the lower incisor. Maxillary overjet was categorized as 1; 1–4.9 mm (grade 1), 2; 5–8.9 mm (grade 2) and 3: ≥ 9 mm (grade 3). It was considered increased when the value exceeded 5 mm, and dichotomized into 0 < 5 mm and 1 ≥ 5 mm for use in cross tabulation and logistic regression analyses. Mandibular overjet was coded as 0; absent, 1: < 0 to -1.9 mm (grade 1) and 2; ≤ – 2 mm (grade 2) and recoded into 0 = absent and 1 = present (1 and 2). Overbite: the vertical overlap of incisors, measured to the nearest half millimetre vertically from the incisal edge of the maxillary right central incisor to the incisal edge of the corresponding mandibular right incisor. If the right central incisor was missing or fractured, it was substituted by left central incisor. It was coded as 1; 0.1–2.9 mm (grade 1), 2; 3–4.9 mm (grade 2) and 3; > 5 mm (grade 3), then recoded into 0 = absent (< 5 mm) and 1 = present (> 5 mm). It was considered deep bite when the value exceeded 5 mm. Open bite: frontal open bite was recorded when there was no vertical overlap of the incisors, measures to nearest half millimetre. A visible space between antagonistic fully erupted canines, premolars or molars was registered as a lateral open bite. Open bite was coded as 0; absent, 1; 0–1.9 mm (frontal open bite grade 1), 2; ≥ 2 mm (frontal open bite grade 2) and 3; lateral open bite, and recoded into 0 = absent and 1 = present (1, 2 and 3). Lateral crossbite: was registered when one or more buccal cusps of the mandibular canines, premolars and/or molars occluded bucally to the buccal cusps of the maxillary antagonists, recorded either as 1; absent, 2; present unilaterally or 3; present bilaterally. It was then dichotomized into 0 = absent (1) and 1 = present (2 and 3). Scissors bite: registered when any of the maxillary premolars and/or molars totally occluded to the buccal surface of the opposing mandibular teeth. It was recorded as 1 = absent, 2 = present unilaterally or 3 = present bilaterally. It was then dichotomized into 0 = absent (1) and 1 = present (2 and 3). Midline shift: was defined as non-coincident upper and lower midlines when the posterior teeth were in maximum intercuspal relationship. It was coded as (1) absent (2) present when the displacement was at least 2 mm or more and recoded into 0 = absent (1) and 1 = present (2). Crowding: was recorded when the total sum of crowding in the segment was at least 2 mm. It was coded as 1 = absent, 2 = present upper jaw, 3 = present lower jaw and 4 = present both jaws. It was recoded into 0 = absent (1) and 1 = present (2, 3 and 4). Spacing: was recorded when the total spacing was least 2 mm in a segment. It was coded as 1; absent, 2; present upper jaw, 3; present lower jaw and 4; present both jaws. Then it was recoded into 0 = absent (1) and 1 = present (2, 3 and 4).

A sum score of malocclusions (SMO) was constructed for use in logistic regression, based on the diagnosis of the absence (0)/presence (1) of the following recordings; maxillary overjet, mandibular overjet, Class II and Class III molar occlusion, open bite, deep bite, lateral cross bite, midline shift, scissors bite, crowding and spacing.

Statistical analyses

Data were analyzed using SPSS version 14.0. Test-retest reliability for the clinical parameters and the questionnaire variables was assessed using Cohen's weighted kappa statistics with an independent sample of 71 12–14-year-olds and a time interval of 3 weeks. Internal consistency reliability was assessed in the main sample using Cronbach's alpha. Cross-tabulation, Chi-square statistics, Mc Nemar's statistics and multiple logistic regression analyses were used for bivariate- and multivariate analyses, respectively. To adjust for the effect of the cluster design, data were reanalysed using STATA 9.0 with survey command. P-value for statistical significance was set at 0.05.

Results

Sample profile

A total of 1003 children from Kinondoni (63.5% urban, 58.9% girls, mean age 13.1 yr) and 598 children from Temeke (82.3% urban, 63.2% girls, mean age 13.0 yr)

completed an extensive personal interview and underwent a full mouth clinical examination. The mean OHI-S scores were 1.0 (sd = 0.53, range 0.0–3.3) in Kinondoni and 1.2 (sd = 0.54, range 0.0–4.2) in Temeke. Table 1 provides the percentage distribution of participants' independent and dependent variables in the districts of Kinondoni and Temeke.

Reproducibility

Duplicate clinical examinations gave Kappa statistics of 0.74, 0.78, 0.79, 0.82, 0.93 and 0.97 for the OHI-S-, midline shift-, deep bite-, mandibular overjet-, maxillary overjet and spacing scores, respectively. Regarding the scores for open bite, Angle classification, cross bite, scissor bite and crowding, the kappa statistics were 1. Test retest reliability for the 8 Child- OIDP items were in the range 0.7 (emotional state) to 1.00 (eating, speaking, cleaning teeth, sleeping, smiling and social contact). Kappa values for the items assessing satisfaction with teeth appearance and teeth function and self-reported problems with teeth were all 1.00. These figures indicate very good intra-examiner reliability according to Landis & Koch [29].

Prevalence and correlates of self- reported problems with teeth

The prevalence of malocclusions varied from 22.5% (midline shift) to 0.9% (deep bite). Prevalence of mandibular overjet and crowding were statistically significantly higher in children who were dissatisfied with dental appearance and function than in their counterparts who were satisfied. A total of 63.8% had at least one type of anomaly (i.e. scored above zero on the SMO score) and the prevalence was higher in dissatisfied- than in satisfied children (71.6% versus 62.5%, $p < 0.001$). Moderate proportions of the children investigated confirmed problems with pain (20.7%), teeth position (11.7%) and problems with spaces (7.7%). Moreover, a total of 7.5% of the children were observed with swallowing problems, whereas 28.6% had at least one oral impact (OIDP > 0) (not in table). After controlling for possible confounding effects of socio-demographic factors, the odds ratios for confirming problems with teeth position, spaces, pain and swallowing were respectively 6.7, 3.9 and 1.4, and 6.8 if having any occlusion anomaly (SMO > 0) compared to being without such anomaly (Table 2, 3). Problems related to teeth position were consistently more frequently reported among children in Temeke than among their counterparts in Kinondoni (Table 2, 3).

Prevalence and correlates of dissatisfaction with dental appearance/functioning

In total, 23.3% (373/1601) children were dissatisfied with their dental appearance/function. The corresponding figures in Kinondoni and Temeke were 25.6 (257/1003) and 19.4 (116/598), respectively. Table 4 depicts unadjusted and adjusted OR from binary and multiple logistic regression analysis of children being dissatisfied with their dental appearance/function according to socio-demographic-, clinically assessed malocclusion, reported dental problems and oral disadvantage variables. Age, gender, district, place of residence and parental education were entered into step one providing a Nagelkerke's R^2 of 0.016 (Model Chi square: 9.133, df = 7, p = 0.243). Entering the SMO index in step two raised the Nagelkerke's R^2 to 0.026 (Model Chi square: 14,546, df = 8, p = 0.069). Entering four variables of reported dental problems in step three and the OIDP score and self rated health in step four raised the Nagelkerke's R^2 to 0.095 (Model Chi square

Table 2: Percentage and OR (95% CI) of participants who reported problem with position- and spaces of teeth by socio demographic variables and malocclusion index, SMO.

	Tooth position % (n)	Adjusted step OR (95% CI	Space % (n)	Adjusted step OR (95% CI)
Socio demographics				
Kinondoni	10.5 (105)	1	7.8 (78)	1
Temeke	13.9 (83)*	1.6 (1.0–2.5)	7.5 (45)	0.9 (0.5–1.6)
Boy	13.1 (83)	1	8.4 (53)	1
Girl	10.8 (105)	0.7 (0.4–1.0)	7.2 (70)	1.1 (0.6–1.7)
Urban	11.3 (128)	1	8.4 (95)	1
Rural	12.7 (60)	1.1 (0.7–1.8)	5.9 (28)	0.7 (0.4–1.3)
12 yr	11.9 (48)	1	7.7 (31)	1
13 yr	12.5 (89)	0.8 (0.4–1.4)	6.8 (48)	0.7 (0.3–1.3)
14	10.5 (51)	0.7 (0.3–1.3)	9.1 (44)	1.1 (0.5–1.9)
Both parents low education	14.2 (51)	1	8.9 (32)	1
One low/one high	8.9 (17)	0.5 (0.2–0.9)	11.6 (22)	1.3 (0.7–2.3)
Both parents high education	13.2 (369	0.8 (0.5–1.3)	8.8 (24)	0.9 (0.5–1.7)
Clinical status				
SMO = 0 (no malocclusion diagnosed)	1.6 (8)	1	2.9 (14)	1
SMO > 0	16.4 (142)**	6.7 (3.3–13.3)	8.8 (76)**	3.9 (2.0–7.8)

**p < 0.001, *p < 0.05

Table 3: Percentage and OR (95% CI) of participants who reported problem with swallowing and pain by socio demographic variables and malocclusion index, SMO.

Variables	Problem with swallowing % (n)	Adjusted step OR (95% CI	Problem with pain % (n)	Adjusted step OR (95% CI)
Socio demographics				
Kinondoni	6.5 (65)	1	18.7 (188)	1
Temeke	9.2 (55)*	1.3 (0.7–2.3)	24.1 (144)**	1.5 (1.1–2.1)
Boy	6.6 (42)	1	19.3 (12)	1
Girl	8.0 (78)	1.5 (0.8–2.7)	21.7 (210)	1.3 (0.9–1.8)
Urban	8.4 (95)	1	20.9 (236)	|
Rural	5.3 (25)*	0.4 (0.2–0.8)	20.3 (96)	1.2 (0.8–1.8)
12 yr	7.2 (29)	1	18.0 (73)	1
13 yr	6.1 (43)	0.8 (0.4–1.7)	20.1 (143)	1.2 (0.7–1.8)
14	9.9 (48)	1.1 (0.5–2.3)	23.9 (116)	1.3 (0.8–2.1)
Both parents low education	8.4 (30)	1	20.3 (73)	1
One low/one high	7.4 (14)	0.9 (0.4–1.8)	21.6 (41)	1.1 (0.7–1.7)
Both parents high education	7.0 (19)	0.8 (0.4–1.6)	20.5 (56)	1.1 (0.7–1.7)
Clinical status				
SMO = 0 (at least one malocclusion diagnosed)	1.0 (5)	1	17.1 (87)	1
SMO > 0	5.3 (46)**	6.8 (2.7–17.4)	21.0 (182)**	1.4 (1.0–2.0)

**p < 0.001, *p < 0.05

Table 4: Unadjusted and adjusted odds ratio (OR) and 95% confidence interval (CI) of being dissatisfied with dental appearance and function according to socio-demographics (step I), clinically assessed criteria of malocclusion, SMO (step II) and subject-rated oral health (step III)

Variables	Unadjusted OR (95% CI)	Adjusted step I OR (95% CI
Step I (socio demographics R^2=		
Kinondoni	1	1
Temeke	0.7 (0.5–0.8)	0.5 (0.3–0.8)
Boy	1	1
Girl	0.9 (0.7–1.1)	1.0 (0.7–1.4)
Urban	1	1
Rural	0.9 (0.7–1.2)	0.7 (0.4–1.0)
12 yr	1	1
13 yr	1.0 (0.8–1.4)	0.8 (0.5–1.3)
14	1.2 (0.8–1.6)	0.9 (0.7–1.4)
Both parents low education	1	1
One low/one high	0.7 (0.4–1.1)	0.7 (0.4–1.1)
Both parents high education	0.6 (0.4–0.9)	0.6 (0.4–0.9)
Step II (clinical status)		
SMO = 0	1	1
SMO > 0	1.6 (1.2–1.9)	1.2 (0.6–1.6)
Step III (reported problems)		
Pain : no	1	1
Pain: yes	1.4 (1.1–1.8)	0.8 (0.5–1.3)
Problem swallowing: no	1	1
Problem swallowing: yes	1.5 (1.0–2.1)	1.1 (0.5–1.9)
Problem position: no	1	1
Problem position: yes	3.4 (2.5–4.7)	4.3 (2.7–6.9)
Problem spaces: no	1	1
Problem spaces: yes	1.7 (1.1–2.4)	1.4 (0.8–2.3)
Step IV (oral disadvantage)		
OIDP = 0	1	1
OIDO > 0	1.8 (1.4–2.3)	2.2 (1.4–3.1)
Self rated health: good	1	1
Self rated health: bad	3.3 (2.1–5.1)	2.7 (1.5–5.1)

54.926, df = 12, p < 0.001) and to 0.139 (Model Chi square = 81.379, df = 14, p < 0.001), respectively. In the final model, dissatisfied children were less likely to be from Temeke (OR = 0.5), having both parents with high education (OR = 0.6), reporting problems with teeth positioning (OR = 4.3), having at least one oral impact (OR = 2.2) and confirming bad health status (OR = 2.7). Although the SMO index discriminated statistically significantly between satisfied and dissatisfied children at the bivariate level, the clinical variable did not maintain its statistically significant effect in the final regression model.

Normative-, impact-, and propensity related need for orthodontic treatment

A total of 63.8 % (865/1601) children fulfilled the criteria for professionally judged normative treatment need in terms of having at least one diagnosed malocclusion (i.e. SMO > 0). In turn, a total of 18.9% (303/1601) children fulfilled the criteria of impact related treatment need, i.e. having normative treatment need and also reporting impacts on daily performances related to malocclusion. Finally, a total of 12% (8.4% in Kinondon and 18.1% in Temeke) (192/1601) had propensity related need, i.e. having impact related need and good behavioral propensity in terms of satisfactory oral hygiene scores. Thus, they should be treated as initially planned. For those children who fulfilled the criteria for impact related need but did not have high propensity (6.9% or 111/1601), oral health promotion should be offered and orthodontic treatment delayed until their oral hygiene improves in terms of maintenance of adequate oral hygiene scores. Mc Nemar test revealed statistically significant differences between the normative need estimate on the one hand side and the impact- and propensity related need estimates on the other (p < 0.001).

Discussion

This is one of the first studies to systematically investigate the psycho-social impacts of malocclusion and orthodontic socio-dental needs among children in a sub-Saharan African country. A comparison of the sex-and parental education characteristics of the Kinondoni and Temeke study participants with the corresponding data for the target populations indicated that the study sample was broadly representative of the populations of school going children 12–14 yr in those districts. In spite that the prevalence of overall malocclusion was relatively high (63.8%), only a minority reported dissatisfaction with dental appearance/function (23.3%), confirmed dental problems- (7.5%–21%) and had oral impacts on daily performances (overall prevalence 29%) (not in table). As shown in Table 2 and 3, all self-reported dental problems were positively and statistically significantly associated with the measure of normative orthodontic treatment need after controlling for socio-demographic factors (p < 0.001). Thus, the risk of reporting problems if having any malocclusion (SMO > 0) varied from OR 1.4 with respect to dental pain to OR = 6.8 regarding problems with swallowing (Table 3). In accordance with previous studies considering the psycho-social impacts of children's orthodontic status, the present results suggest that malocclusion associates with perceived orthodontic status, dental symptoms and the oral health domain of appearance/functional limitations in Tanzanian children [29-31]. Whereas malocclusion does not cause dental pain directly, it has been suggested that it gives rise to pain indirectly by causing temporo-mandibular disorder (TMD) and dental-, gingival- and mucosal trauma [4]. In the present study, malocclusion was related to swallowing problems. Such problems might affect food choices and finally deteriorate children's nutritional status. A review of eight studies revealed that, malocclusion was positively associated with diet and malnutrition [32].

Notably, large proportions of children with a normative treatment need did not confirm any psycho-social impact. For example 83% and 94% of children with SMO > 0 did not report problems with teeth positions and swallowing, respectively. This supports previous studies showing that children and adolescents are less concerned with their malocclusion than professionals and have lower threshold to detect malocclusion traits [33]. In evaluating a questionnaire to measure oral quality of life in 11–14 year old children, Jokovic et al [5] found the mean child perception questionnaire score (CPQ) to be comparably low in children with malocclusion. Most studies have shown that using clinical criteria for the estimation of diagnosis of malocclusion overestimates the problem when compared with individuals' perception [10-12]. However, the results of a Brazilian study focusing 10 to 14-year-olds came to a different conclusion, in that 87% of the children perceived a need for orthodontic treatment, whereas the normative treatment need was only 52% [13]. Whilst there may be less direct impact on quality of life indicators from malocclusion among children, by early adulthood young people will probably think differently about the impact on their dental appearance and function.

Malocclusion when used in combination with perceived dental problems and other psycho-social impact scores explained significantly more of children's concern about their dental appearance/function than did the clinical measure of occlusal status alone. The results from multivariate logistic regression analysis support Gilbert's [22] model in that dissatisfaction scores were influenced, statistically significantly but differently by at least one variable from each oral health outcome domain. Reported problem with teeth position was the strongest predictor (OR = 4.3), followed in descending order by self-rated health status (OR = 2.7) and OIDP scores (OR = 2.2)

(Table 4). In the bivariate model, but not in the final multiple regression analysis, children with SMO > 0 had a higher probability than their counterparts without to be dissatisfied with dental appearance/function. Consistent with previous studies, the present one indicated that crowding and mandibular overjet were the conditions of most concern to Tanzanian children [15,18,29-34]. As shown in Table 2 and 3, the overall malocclusion scores showed positive associations with perceived orthodontic status and symptoms after controlling for socio-demographic factors, indicating that in the final analysis (Table 4) these variables have mediated the effect of malocclusion upon dissatisfaction scores. Temeke children were more likely than their Kinondoni counterparts to confirm problems with teeth position, with pain and swallowing and to report oral impacts. Nevertheless, less affluent children from Temeke and children having parents with higher education were, irrespective of diagnosed malocclusion and its psycho-social impacts, less likely than their counterparts in the opposite groups to confirm dissatisfaction. This suggests that children's concern about their dental appearance is influenced by the social and cultural context in which they live. It is evident for instance that spacing is disliked in white cultures but considered a sign of beauty in many African cultures [15,18]. Locker reported on socio-economic disparities in children's oral quality of life, with children from low income households having the poorest oral health related quality of life [35].

Children's feelings concerning their dental appearance and function corresponds to broader concepts of oral health and are thus central to the assessment of orthodontic treatment need [3]. Consistent with what has been reported among Tanzanian adults with respect to needs for prosthodontic treatment, children's estimated normative orthodontic treatment need decreased markedly when a socio-dental approach was used [36]. Among the children with a normative need defined as any type of dental irregularity, SMO > 0, (63.8%), only 18.9% had an impact related need and 12% had high propensity related need, indicating that about one fifth of those with any malocclusion would actually demand some kind of orthodontic care. A minority of the children had low propensity (6.9%) and should initially be offered an alternative intervention with oral health education. The estimated normative need by far exceeded a more realistic estimate based on a modified version of an integrative socio-dental approach. This result corroborates those of a previous study using the same socio-dental approach to estimate orthodontic treatment need among Thai children in that normative need for orthodontic care was found to be much higher (35%) than the medium to high propensity related need (18.9%) [10-12]. High amounts of children's normative treatment need have also been reported from other countries, ranging from 38% among primary school children in Turkey to 57% and 30% in respectively 9 year old- and 12 year old children from UK, for review see [37,38]. Caution should be made when comparing the estimates of normative need made in this study with those in other studies using the IOTN index for need assessment. Some caution should also be taken when evaluating the results from the present study since the overall- and not a malocclusion specific OIDP score attributing oral impacts to malocclusion, was used in the analyses. However, the overall oral disease burden among the Tanzanian children investigated was not high [9]. Thus, it is less likely that other oral conditions commonly found in children have contributed much into the overall OIDP scores. Finally only one of two behaviors (i.e. oral hygiene but not dental attendance) was utilized to assess propensity related need. As there is no dental health care service offered on a regular basis to children in Tanzania, behaviors related to compliance with dental appointments were not considered appropriate for use in the present study.

Conclusion

In conclusion, contrary to the prevalence of malocclusion, reported psycho social impacts and dissatisfaction with appearance/function was not very frequent among Tanzanian primary schoolchildren. Subjects with malocclusion reported problems most frequently and malocclusion together with other psycho-social impact scores determined children's overall evaluation of their dental appearance and function. Finally, a marked difference was found between the standard normative- and socio-dental need assessment approaches with socio-dental needs being five times lower than the standard normative need assessment.

Competing interests

The authors declare that they have no competing interests.

Authors' contributions

ANÅ conceived of the study and drafted the manuscript. MM carried out the data collection, made the data amenable for statistical analyses, analyzed the data and have contributed to the development of the paper. She has critically revised the intellectual content of the manuscript. PB has been involved in drafting the manuscript and has critically revised its intellectual content.

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7. APPENDICES I – IX

Appendix I

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Ref.No.MU/RP/AEC/Vol.IV/83

21st February, 2006

Dr. Matilda Mtaya,
School of Dentistry,
MUCHS.

RE: APPROVAL OF ETHICAL CLEARANCE FOR A STUDY TITLED, "NON-NUTRITIVE SUCKING HABITS IN TANZANIAN CHILDREN: EFFECT ON THE DECIDUOUS AND PERMANENT DENTITION AND ORAL HEALTH RELATED QUALITY OF LIFE"

Above heading refers.

I am pleased to inform you that the College Research and Publications Committee (CRPC) and the Chairman of the Academic Board have approved the ethical clearance of the above mentioned study.

This approval is w.e.f. 22nd February, 2006 to 21st February, 2007. To continue with your study beyond the granted period; you will need to apply for a renewal of ethical clearance.

Prof. M. M. Aboud
Ag.CHAIRMAN, COLLEGE RESEARCH & PUBLICATIONS COMMITTEE

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DAR ES SALAAM

c.c. Principal,
MUCHS.
c.c. Registrar,
MUCHS.
c.c. Dean,
School of Dentistry,
MUCHS.

Appendix II

APPENDIX II

Request to participate in the Non-nutritive sucking habits and Oral Quality of Life survey for children in Tanzania

Dear participant,

We hereby would like to ask you to participate in a study, entitled ***'Non-nutritive sucking habits in Tanzanian children: Effects on the deciduous and permanent dentition and oral health related quality of life'*** considering your/your child's occlusion status, dental health and quality of life. Participation involves completion of a clinical dental examination and /a personal interview. Participation in the study is voluntary. Through this study we want to gain information on non-nutritive sucking habits, occlusion status, oral health status oral health related quality of life in Tanzanian children aged 3-5 and 12-14 years. Similar studies have been carried out in many countries worldwide but are scarce in Tanzania and other sub-Saharan African countries. The clinical examination and the interview will be carried out at the school premises. All information gained through examination and interview will be treated confidentially. The present study is carried out by the University of Bergen and Muhimbili University College for health Sciences in Tanzania.

Serial number ☐

Date ☐

CONSENT FORM

(Participating subject/parent)

Title of the project: **Non-nutritive sucking habits in Tanzanian children: Effects on the deciduous and permanent dentition and oral health related quality of life**

Name of researcher:

Matilda Mtaya

1. I confirm that I have been informed about the present study. I also confirm that I had the opportunity to ask questions and that I fully understand the information provided ☐
2. I understand that my participation is voluntary and that I am free to withdraw at any time with out giving any reason. ☐
3. I accept the invitation to participate in the above study. ☐

Name of participant/parent Date Signature (of parent)

_____ ____/____/____ _____

Name of interviewer Date Signature

_____ ____/____/____ _____

Appendix III

Appendix III
STRUCTURED PERSONAL INTERVIEW FOR CHILDREN 12-14 YEARS
(Quality of life, oral health behaviours assessment)

A: Identification details.

ID No. .....

Name of district .....

Urban/rural .....

Name of school .....

Class ..... **Stream** .....

Name of the respondent .....

Date of interview .....

B: The first questions are about you and your family.

Please choose the answer that fits you the best. Tick only one answer for each question

B1 Age (give your age at last birthday) .....

B2 Gender of informant 1. ☐ Boy 2. ☐ Girl

B3 Where and with whom do you live now?

1. ☐ Home with parents
2. ☐ Home with guardians
2. ☐ Hostel
3. ☐ Other (specify).....

B4 What is your religion?

1. ☐ Muslim
2. ☐ Christian
3. ☐ Hindu
4. ☐ No religion

B5 Up to what level did your mother go to school?

1. ☐ No formal education
2. ☐ Not completed primary school
3. ☐ Completed primary school
4. ☐ Secondary school
5. ☐ Completed secondary education
6. ☐ College / university
7. ☐ Don't know

B6 Up to what level did your father go to school?

1. ☐ No formal education
2. ☐ Not completed primary school
3. ☐ Completed primary school
4. ☐ Secondary school
5. ☐ Completed secondary education
6. ☐ College / university
7. ☐ Don't know

B7 Does any member of your family (with whom you live) own a bicycle?

1. ☐ Yes 2. ☐ No

B8 Does any member of your family (with whom you live) own a motorcycle?

1. ☐ Yes 2. ☐ No

B9 Does any member of your family (with whom you live) own a car?

1. ☐ Yes 2. ☐ No

B10 Does any member of your family (with whom you live) own a television?

1. ☐ Yes 2. ☐ No

B11 Does any member your family (with whom you live) own a refrigerator?

1. ☐ Yes 2. ☐ No

B12 How many rooms are there in your home?

1. ☐ One
2. ☐ Two to five
3. ☐ Six or more
4. ☐ I don't have a house

B13 What is the main source of cooking fuel at home?

1. ☐ Gas cooker
2. ☐ Kerosene stove
3. ☐ Wood
4. ☐ Cow dung
5. ☐ Charcoal
6. ☐ Electricity
7. ☐ Other (specify).....

C: The following are questions about your mouth and teeth

(Oral quality of life- using the OIDP frequency scale)

Please tick only one answer for each statement.

C1) Think back on the previous 3 months, have you experienced the following?

	Yes	**No**
A Toothache?	1 ☐	2 ☐
B Sensitive teeth?	1 ☐	2 ☐
C Tooth exfoliation?	1 ☐	2 ☐
D Problems with the positioning of your teeth?	1 ☐	2 ☐
E Ulcer in the mouth?	1 ☐	2 ☐
F Bleeding in the mouth?	1 ☐	2 ☐
G Swollen gums?	1 ☐	2 ☐
H Bad breath?	1 ☐	2 ☐
I Problems with the colour of your teeth?	1 ☐	2 ☐
J Problems with spaces for your teeth?	1 ☐	2 ☐

Please answer the next questions irrespective of the answers to the above problems (tick only one category)

C2) During the past 3 months- how often have problems with your mouth or teeth (for example such as mentioned above or other) caused you any difficulty with **eating and enjoying food?**

0 ☐ Never

1 ☐ Once or twice a month

2 ☐ Once or twice a week

3 ☐ Everyday/ nearly everyday

C3) What was the actual oral problem(s) that caused your difficulty with **eating and enjoying food?**

Condition	**Yes**	**No**
Toothache		
Sensitive teeth		
Tooth exfoliation		
Problems with the position of your teeth		
Ulcer in the mouth		
Bleeding in the mouth		
Swollen gums		
Bad breath		
Problems with the colour of your teeth		
Problems with spaces between your teeth		
Other problems		

C4) During the past 3 months- how often have problems with your mouth or teeth caused you any difficulty with **speaking and pronouncing clearly?**

0 ☐ Never

1 ☐ Once or twice a month

2 ☐ Once or twice a week

3 ☐ Everyday/ nearly everyday

C5) What was the actual oral problem(s) that caused your difficulty with **speaking and pronouncing clearly?**

Condition	Yes	No
Toothache		
Sensitive teeth		
Tooth exfoliation		
Problems with the position of your teeth		
Ulcer in the mouth		
Bleeding in the mouth		
Swollen gums		
Bad breath		
Problems with the colour of your teeth		
Problems with spaces between your teeth		
Other problems		

C6) During the past 3 months- how often have problems with your mouth or teeth caused you any difficulty with **cleaning teeth?**

0 ☐ Never

1 ☐ Once or twice a month

2 ☐ Once or twice a week

3 ☐ Everyday/ nearly everyday

C7) What was the actual oral problem(s) that caused your difficulty with **cleaning teeth?**

Condition	Yes	No
Toothache		
Sensitive teeth		
Tooth exfoliation		
Problems with the position of your teeth		
Ulcer in the mouth		
Bleeding in the mouth		
Swollen gums		
Bad breath		
Problems with the colour of your teeth		
Problems with spaces between your teeth		
Other problems		

C8) During the past 3 months- how often have problems with your mouth or teeth caused you any difficulty with **sleeping and relaxing?**

0 ☐ Never

1 ☐ Once or twice a month

2 ☐ Once or twice a week

3 ☐ Everyday/ nearly everyday

C9) What was the actual oral problem(s) that caused your difficulty with **sleeping and relaxing?**

Condition	**Yes**	**No**
Toothache		
Sensitive teeth		
Tooth exfoliation		
Problems with the position of your teeth		
Ulcer in the mouth		
Bleeding in the mouth		
Swollen gums		
Bad breath		
Problems with the colour of your teeth		
Problems with spaces between your teeth		

C10) During the past 3 months- how often have problems with your mouth or teeth caused you any difficulty with **smiling, laughing and showing teeth without embarrassment?**

0 ☐ Never

1 ☐ Once or twice a month

2 ☐ Once or twice a week

3 ☐ Everyday/ nearly everyday

C11) What was the actual oral problem(s) that caused your difficulty with **smiling, laughing and showing teeth without embarrassment?**

Condition	**Yes**	**No**
Toothache		
Sensitive teeth		
Tooth exfoliation		
Problems with the position of your teeth		
Ulcer in the mouth		
Bleeding in the mouth		
Swollen gums		
Bad breath		
Problems with the colour of your teeth		
Problems with spaces between your teeth		

C12) During the past 3 months- how often have problems with your mouth or teeth caused you any difficulty with **maintaining usual emotional state without being irritable?**

0 ☐ Never

1 ☐ Once or twice a month

2 ☐ Once or twice a week

3 ☐ Everyday/ nearly everyday

C13) What was the actual oral problem(s) that caused your difficulty with **maintaining usual emotional state without being irritable?**

Condition	**Yes**	**No**
Toothache		
Sensitive teeth		
Tooth exfoliation		
Problems with the position of your teeth		
Ulcer in the mouth		
Bleeding in the mouth		
Swollen gums		
Bad breath		
Problems with the colour of your teeth		
Problems with spaces between your teeth		

C14) During the past 3 months- how often have problems with your mouth or teeth caused you any difficulty with **carrying out major school work or social role?**

0 ☐ Never

1 ☐ Once or twice a month

2 ☐ Once or twice a week

3 ☐ Everyday/ nearly everyday

C15) What was the actual oral problem(s) that caused your difficulty with **carrying out major school work or social role?**

Condition	**Yes**	**No**
Toothache		
Sensitive teeth		
Tooth exfoliation		
Problems with the position of your teeth		
Ulcer in the mouth		
Bleeding in the mouth		
Swollen gums		
Bad breath		
Problems with the colour of your teeth		
Problems with spaces between your teeth		

C16) During the past 3 months- how often have problems with your mouth or teeth caused you any difficulty with **enjoying contact with people?**

0 ☐ Never

1 ☐ Once or twice a month

2 ☐ Once or twice a week

3 ☐ Everyday/ nearly everyday

C17) What was the actual oral problem(s) that caused your difficulty with **enjoying contact with people?**

Condition	**Yes**	**No**
Toothache		
Sensitive teeth		
Tooth exfoliation		
Problems with the position of your teeth		
Ulcer in the mouth		
Bleeding in the mouth		
Swollen gums		
Bad breath		
Problems with the colour of your teeth		
Problems with spaces between your teeth		

Reported general & oral health status/perceived treatment needs. *Please tick only one answer*

C 18 What do you think about the state of your teeth?

1. ☐ Very good
2. ☐ Good
3. ☐ Bad
4. ☐ Very bad

C19 Are you satisfied or dissatisfied with your mouth/teeth?

1. ☐ Very satisfied
2. ☐ Satisfied
3. ☐ Dissatisfied
4. ☐ Very dissatisfied

C20 How satisfied or dissatisfied are you with the position of your teeth?

1. ☐ Very satisfied
2. ☐ Satisfied
3. ☐ Dissatisfied
4. ☐ Very dissatisfied

C21 How satisfied or dissatisfied are you with the appearance of your teeth?

1. ☐ Very satisfied
2. ☐ Satisfied
3. ☐ Dissatisfied
4. ☐ Very dissatisfied

C22 How satisfied or dissatisfied are you with the colour of your teeth?

1. ☐ Very satisfied
2. ☐ Satisfied
3. ☐ Dissatisfied
4. ☐ Very dissatisfied

C23 What do you think about the state of your general health?

1. ☐ Very good
2. ☐ Good
3. ☐ Bad
4. ☐ Very bad

D: The following are questions about your oral health related behaviors?

Please tick only one answer for each question.

D1 How often do you usually brush your teeth?

1. ☐ More than once a day
2. ☐ Once a day
3. ☐ Several times a week
4. ☐ Seldom/Never

D2 For cleaning your teeth what do you use?

	Yes	No
A Finger	1 ☐	2 ☐
B Tooth brush	1 ☐	2 ☐
C Chewing stick	1 ☐	2 ☐
D I don't clean	1 ☐	2 ☐

E Other (specify) .....

D3 With what substance do you clean your teeth?

	Yes	No
A Toothpaste	1 ☐	2 ☐
B I don't use anything	1 ☐	2 ☐

C Other (specify) .....

D4 Have you ever attended dentist? 1. ☐ Yes 2. ☐ No

D5 Think back on the previous 2 years- how often did you attend?

1. ☐ Attended more than three times
2. ☐ Attended three times
3. ☐ Attended twice
4. ☐ Attended once
5. ☐ Never attended

Think back on the previous 2 years- how often have you taken the following?

D6 Biscuits

1. ☐ More than once a day
2. ☐ Once a day
3. ☐ Several times a week
4. ☐ Seldom/Never

D7 Chocolates or toffees/sweets

1. ☐ More than once a day
2. ☐ Once a day
3. ☐ Several times a week
4. ☐ Seldom/Never

D8 Sugared Ice sticks

1. ☐ More than once a day
2. ☐ Once a day
3. ☐ Several times a week
4. ☐ Seldom/Never

D9 Soda (pepsi, coca cola etc)

1. ☐ More than once a day
2. ☐ Once a day
3. ☐ Several times a week
4. ☐ Seldom/Never

D10 Sugared fruit juice

1. ☐ More than once a day
2. ☐ Once a day
3. ☐ Several times a week
4. ☐ Seldom/Never

D11 Sugared tea/coffee

1. ☐ More than once a day
2. ☐ Once a day
3. ☐ Several times a week
4. ☐ Seldom/Never

Sucking habits *Please tick only one answer*

D12 Have you ever sucked your finger/s (or lip, tongue etc)? 1. ☐ Yes 2. ☐ No

D13 If yes, when did you start? _____

D14 When did you stop? _____

D15 How often were you sucking?

1. ☐ 1 hr/day
2. ☐ 2-5 hr/day
3. ☐ ≥ 6 hr/day
9. ☐ Not applicable

D16 Do you suck your finger/s (or lip, tongue etc) currently? 1. ☐ Yes 2. ☐ No

D17 If yes, how often do you suck?

1. ☐ 1 hr/day
2. ☐ 2-5 hr/day
3. ☐ ≥ 6 hr/day
9. ☐ Not applicable

D18 Does your sucking activity affect your school performance or socialization with others?

1. ☐ Yes 2. ☐ No 9. ☐ Not applicable

D19 Do you have conjoined behaviours with sucking, as listed below?

1. ☐ Hair pulling (causing hair loss)
2. ☐ Nose picking
3. ☐ Genital fondling
4. ☐ Other (specify).....
9. ☐ Not applicable

D20 Do you frequently perform sucking activity to avoid confrontation?

1. ☐ Yes 2. ☐ No 9. ☐ Not applicable

Appendix IV

Kiambatanisho IV

Usaili binafsi kwa watoto wa miaka 12-14 (Ubora wa Maisha, kupima tabia za afya ya Kinywa)

A: Maelezo ya Utambulisho

Namba ya Utambulisho.....

Jina la Wilaya .....

Mjini/Vijijini .....

Jina la Shule .....

Darasa .... Mkondo.....

Jina la Mtafitiwa .....

Tarehe ya usaili .....

B: Maswali ya kwanza ni kukuhusu wewe na familia yako.

Tafadhali chagua jibu linalokufaa zaidi. Tia tiki jibu moja tu kwa kila swali

B1 Umri (toa umri wako hadi siku ya kuzaliwa iliyopita)

B2 Jinsia 1. ☐ Mvulana 2. ☐ Msichana

B3 Sasa unaishi wapi na unaishi na nani?

1 ☐ Nyumbani na wazazi
2 ☐ Nyumbani na walezi
3 ☐ Hosteli
4 ☐ Kwingineko (taja).....

B4 Wewe ni dini gani?

1 ☐ Muislamu
2 ☐ Mkristo
3 ☐ Hindu
4 ☐ Sina dini

B5 Mama yako alikwenda shule hadi kufikia kiwango gani?

1 ☐ Hana elimu rasmi

2 ☐ Hakumaliza elimu ya msingi

3 ☐ Alimaliza elimu ya msingi

4 ☐ Elimu ya sekondari

5 ☐ Alimaliza elimu ya sekondari

6 ☐ Elimu ya chuo/Chuo Kikuu

7 ☐ Sifahamu

B6 Baba yako alikwenda shule hadi kufikia kiwango gani?

1 ☐ Hana elimu rasmi

2 ☐ Hakumaliza elimu ya msingi

3 ☐ Alimaliza elimu ya msingi

4 ☐ Elimu ya sekondari

5 ☐ Alimaliza elimu ya sekondari

6 ☐ Elimu ya chuo/Chuo Kikuu

7 ☐ Sifahamu

B7 Je kuna mwana familia (katika familia unayoishi) anamiliki Baiskeli?

1. ☐ Ndiyo 2. ☐ Hapana

B8 Je kuna mwana familia (katika familia unayoishi) anamiliki pikipiki?

1. ☐ Ndiyo 2. ☐ Hapana

B9 Je kuna mwana familia (katika familia unayoishi) anamiliki gari?

1. ☐ Ndiyo 2. ☐ Hapana

B10 Je kuna mwana familia (katika familia unayoishi) anamiliki televisheni?

1. ☐ Ndiyo 2. ☐ Hapana

B11 Je kuna mwana familia (katika familia unayoishi) anamiliki jokofu?

1. ☐ Ndiyo 2. ☐ Hapana

B12 Nyumba yenu ina vyumba vingapi?

1 ☐ Kimoja

2 ☐ Viwili hadi vitano

3 ☐ Sita au zaidi

4 ☐ Sina nyumba

B13 Mnapika kwa kutumia nishati gani hasa hapo nyumbani?

1 ☐ Jiko la gesi

2 ☐ Jiko la mafuta ya taa

3 ☐ Kuni

4 ☐ Kinyesi cha ng'ombe

5 ☐ Mkaa

6 ☐ Umeme

7 ☐ Nyingine .....

C: Yafuatayo ni maswali kuhusu kinywa chako na meno yako

(Ubora wa maisha ya kinywa – kwa kutumia skeli ya mrudio wa OIDP)

Tafadhali tia tiki kwenye jibu moja tu kwa kila kauli

C1 Fikiria nyuma katika miezi mitatu iliyopita, umeshapata lolote kati ya haya yafuatayo?

	Ndiyo	Hapana
A Maumivu ya jino?	1. ☐	2. ☐
B Meno hisishi/meno kufa ganzi?	1. ☐	2. ☐
C Kung'ooka kwa meno ya utoto?	1. ☐	2. ☐
D Matatizo ya namna meno yalivyokaa ?	1. ☐	2. ☐
E Kidonda kwenye mdomo?	1. ☐	2. ☐
F Kutoka damu kwenye mdomo?	1. ☐	2. ☐
G Fizi kuvimba?	1. ☐	2. ☐
H Harufu mbaya mdomoni?	1. ☐	2. ☐

I Matatizo ya rangi ya meno yako? 1. ☐ 2. ☐

J Matatizo ya nafasi katika meno yako 1. ☐ 2 ☐

Tafadhali jibu maswali yanayofuata bila kujali majibu uliyotoa kwa maswali ya hapo juu (tiki jibu moja tu)

C2 Katika miezi mitatu iliyopita ni mara ngapi umekuwa na matatizo katika kinywa chako au meno (kwa mfano kama yale yaliyotajwa hapo juu au mengine) yaliyokusababishia taabu wakati wa **kula na kufaidi chakula?**

0 ☐ Hata mara moja haijatokea

1 ☐ Mara moja au mbili kwa mwezi

2 ☐ Mara moja au mbili kwa wiki

3 ☐ Kila siku/ karibu kila siku

C3 Ni matatizo gani hasa ya kinywa yaliyokusababishia taabu wakati wa **kula na kufaidi chakula?**

Hali	Ndiyo	Hapana
Maumivu ya jino		
Meno hisishi (meno kufa ganzi)		
Kung'ooka kwa meno ya utoto		
Matatizo ya namna meno yalivyokaa		
Kidonda kwenye mdomo		
Kutoka damu kwenye mdomo		
Fizi kuvimba		
Harufu mbaya mdomoni		
Matatizo ya rangi ya meno yako		
Matatizo ya nafasi katika meno yako		

C4 Katika miezi mitatu iliyopita ni mara ngapi umekuwa na matatizo katika kinywa chako au meno yaliyokusababishia taabu wakati wa **kuzungumza na kutamka kwa uwazi?**

0 ☐ Hata mara moja haijatokea

1 ☐ Mara moja au mbili kwa mwezi

2 ☐ Mara moja au mbili kwa wiki

3 ☐ Kila siku/ karibu kila siku

C5 Ni matatizo gani hasa ya kinywa yaliyokusababishia taabu wakati wa **kuzungumza na kusema kwa uwazi?**

Hali	Ndiyo	Hapana
Maumivu ya jino		
Meno hisishi (meno kufa ganzi)		
Kung'ooka kwa meno ya utoto		
Matatizo ya namna meno yalivyokaa		
Kidonda kwenye mdomo		
Kutoka damu kwenye mdomo		
Fizi kuvimba		
Harufu mbaya mdomoni		
Matatizo ya rangi ya meno yako		
Matatizo ya nafasi katika meno yako		

C6 Katika miezi mitatu iliyopita ni mara ngapi umekuwa na matatizo katika kinywa chako au meno yaliyokusababishia taabu wakati wa **kuyasafisha meno yako?**

0 ☐ Hata mara moja haijatokea

1 ☐ Mara moja au mbili kwa mwezi

2 ☐ Mara moja au mbili kwa wiki

3 ☐ Kila siku/ karibu kila siku

C7 Ni matatizo gani hasa ya kinywa yaliyokusababishia taabu wakati wa **kuyasafisha meno yako?**

Hali	Ndiyo	Hapana
Maumivu ya jino		
Meno hisishi (meno kufa ganzi)		
Kung'ooka kwa meno ya utoto		
Matatizo ya namna meno yalivyokaa		
Kidonda kwenye mdomo		
Kutoka damu kwenye mdomo		
Fizi kuvimba		
Harufu mbaya mdomoni		
Matatizo ya rangi ya meno yako		
Matatizo ya nafasi katika meno yako		

C8 Katika miezi mitatu iliyopita ni mara ngapi umekuwa na matatizo katika kinywa chako au meno yaliyokusababishia taabu wakati wa **kulala na kupumzika?**

0 ☐ Hata mara moja haijatokea

1 ☐ Mara moja au mbili kwa mwezi

2 ☐ Mara moja au mbili kwa wiki

3 ☐ Kila siku/ karibu kila siku

C9 Ni matatizo gani hasa ya kinywa yaliyokusababishia taabu wakati wa **kulala na kupumzika?**

Hali	Ndiyo	Hapana
Maumivu ya jino		
Meno hisishi (meno kufa ganzi)		
Kung'ooka kwa meno ya utoto		
Matatizo ya namna meno yalivyokaa		
Kidonda kwenye mdomo		
Kutoka damu kwenye mdomo		
Fizi kuvimba		
Harufu mbaya mdomoni		
Matatizo ya rangi ya meno yako		
Matatizo ya nafasi katika meno yako		

C 10 Katika miezi mitatu iliyopita ni mara ngapi umekuwa na matatizo katika kinywa chako au meno yaliyokusababishia taabu katika **kutabasamu, kucheka, na kuonyesha meno bila kuona aibu?**

0 ☐ Hata mara moja haijatokea

1 ☐ Mara moja au mbili kwa mwezi

2 ☐ Mara moja au mbili kwa wiki

3 ☐ Kila siku/ karibu kila siku

C11 Ni matatizo gani hasa ya kinywa yaliyokusababishia taabu Katika **kutabasamu, kucheka, na kuonyesha meno bila kuona aibu?**

Hali	Ndiyo	Hapana
Maumivu ya jino		
Meno hisishi (meno kufa ganzi)		
Kung'ooka kwa meno ya utoto		
Matatizo ya namna meno yalivyokaa		
Kidonda kwenye mdomo		
Kutoka damu kwenye mdomo		
Fizi kuvimba		
Harufu mbaya mdomoni		
Matatizo ya rangi ya meno yako		
Matatizo ya nafasi katika meno yako		

C12 Katika miezi mitatu iliyopita ni mara ngapi umekuwa na matatizo katika kinywa chako au meno yaliyokusababishia taabu katika **kuendelea kuwa na hali ya kawaida ya mhemko bila ya kukereka?**

0 ☐ Hata mara moja haijatokea

1 ☐ Mara moja au mbili kwa mwezi

2 ☐ Mara moja au mbili kwa wiki

3 ☐ Kila siku/ karibu kila siku

C13 Ni matatizo gani hasa ya kinywa yaliyokusababishia taabu Katika **kuendelea kuwa na hali ya kawaida ya mhemko bila ya kukereka?**

Hali	Ndiyo	Hapana
Maumivu ya jino		
Meno hisishi (meno kufa ganzi)		
Kung'ooka kwa meno ya utoto		
Matatizo ya namna meno yalivyokaa		
Kidonda kwenye mdomo		
Kutoka damu kwenye mdomo		
Fizi kuvimba		
Harufu mbaya mdomoni		
Matatizo ya rangi ya meno yako		
Matatizo ya nafasi katika meno yako		

C14 Katika miezi mitatu iliyopita ni mara ngapi umekuwa na matatizo katika kinywa chako au meno yaliyokusababishia taabu katika **kufanya kazi kubwa za shule au kutekeleza majukumu ya kijamii?**

0 ☐ Hata mara moja haijatokea

1 ☐ Mara moja au mbili kwa mwezi

2 ☐ Mara moja au mbili kwa wiki

3 ☐ Kila siku/ karibu kila siku

C15 Ni matatizo gani hasa ya kinywa yaliyokusababishia taabu katika **kufanya kazi kubwa za shule au kutekeleza majukumu ya kijamii?**

Hali	Ndiyo	Hapana
Maumivu ya jino		
Meno hisishi (meno kufa ganzi)		
Kung'ooka kwa meno ya utoto		
Matatizo ya namna meno yalivyokaa		
Kidonda kwenye mdomo		
Kutoka damu kwenye mdomo		
Fizi kuvimba		
Harufu mbaya mdomoni		
Matatizo ya rangi ya meno yako		
Matatizo ya nafasi katika meno yako		

C16 Katika miezi mitatu iliyopita ni mara ngapi umekuwa na matatizo katika kinywa chako au meno yaliyokusababishia taabu **kufurahia kukutana na watu?**

0 ☐ Hata mara moja haijatokea

1 ☐ Mara moja au mbili kwa mwezi

2 ☐ Mara moja au mbili kwa wiki

3 ☐ Kila siku/ karibu kila siku

C17 Ni matatizo gani hasa ya kinywa yaliyokusababishia taabu **kufurahia kukutana na watu?**

Hali	Ndiyo	Hapana
Maumivu ya jino		
Meno hisishi (meno kufa ganzi)		
Kung'ooka kwa meno ya utoto		
Matatizo ya namna meno yalivyokaa		
Kidonda kwenye mdomo		
Kutoka damu kwenye mdomo		
Fizi kuvimba		
Harufu mbaya mdomoni		
Matatizo ya rangi ya meno yako		
Matatizo ya nafasi katika meno yako		

Taarifa ya afya kwa ujumla & Hali ya afya ya kinywa/ mahitaji ya matibabu. Tafadhali tiki jibu moja tu.

C18 Unaifikiria vipi hali ya meno yako?

1 ☐ Nzuri sana

2 ☐ Nzuri

3 ☐ Mbaya

4 ☐ Mbaya sana

C19 Unaridhika au huridhiki na hali ya kinywa chako/meno yako?

1 ☐ Ninaridhika sana

2 ☐ Ninaridhika

3 ☐ Siridhiki

4 ☐ Siridhiki kabisa

C20 Unaridhika au huridhiki kwa kiasi gani na jinsi meno yako yalivyokaa?

1 ☐ Ninaridhika sana

2 ☐ Ninaridhika

3 ☐ Siridhiki

4 ☐ Siridhiki kabisa

C21 Unaridhika au huridhiki kwa kiasi gani na jinsi meno yako yanavyoonekana?

1 ☐ Ninaridhika sana

2 ☐ Ninaridhika

3 ☐ Siridhiki

4 ☐ Siridhiki kabisa

C22 Unaridhika au huridhiki kwa kiasi gani na rangi ya meno yako?

1 ☐ Ninaridhika sana

2 ☐ Ninaridhika

3 ☐ Siridhiki

4 ☐ Siridhiki kabisa

C23 Unaifikiriaje hali yako ya afya kwa ujumla?

1 ☐ Nzuri sana

2 ☐ Nzuri

3 ☐ Mbaya

4 ☐ Mbaya sana

D: Yafuatayo ni maswali kuhusu tabia zinazohusiana na afya ya kinywa chako.

(*Tafadhali tiki jibu moja tu kwa kila swali)*

D1 Kwa kawaida ni mara ngapi unapiga mswaki?

1 ☐ Zaidi ya mara moja kwa siku

2 ☐ Mara moja kwa siku

3 ☐ Mara kadhaa kwa wiki

4 ☐ Mara chache/sisafishi

D2 Unatumia nini kwa kusafisha meno yako?

	Ndiyo	**Hapana**
A Kidole	1. ☐	2. ☐
B Mswaki	1. ☐	2. ☐
C Mswaki wa kijiti/mti	1. ☐	2. ☐
D Sisafishi	1. ☐	2. ☐

E Kingine (Taja) ----------

D3 Unasafisha meno yako kwa kitu gani?

		Ndiyo	**Hapana**
A	Dawa ya mswaki	1. ☐	2. ☐
B	Situmii kitu cho chote	1. ☐	2. ☐

C Kingine (taja) ----------

D4 Umeshawahi kwenda kwa daktari wa meno?

1. ☐ Ndiyo 2. ☐ Hapana

D5 Fikiria nyuma katika miaka miwili iliyopita, ni mara ngapi umehudhuria kwa daktari wa meno?

1 ☐ Nimehudhuria zaidi ya mara tatu
2 ☐ Nimehudhuria mara tatu
3 ☐ Nimehudhuria mara mbili
4 ☐ Nimehudhuria mara moja
5 ☐ Sijahudhuria hata mara moja

Fikiria nyuma katika miaka miwili iliyopita, ni mara ngapi umekula vitu vifuatavyo?

D6 Biskuti

1. ☐ Zaidi ya mara moja kwa siku
2. ☐ Mara moja kwa siku
3. ☐ Mara kadhaa kwa wiki
4. ☐ Sijawahi kula biskuti

D7 Chokoleti/tofi/peremende

1. ☐ Zaidi ya mara moja kwa siku
2. ☐ Mara moja kwa siku
3. ☐ Mara kadhaa kwa wiki
4. ☐ Sijawahi kula chokoleti/tofi wala peremende

D8 Barafu (zenye sukari/iskrimu)

1 ☐ Zaidi ya mara moja kwa siku
2 ☐ Mara moja kwa siku
3 ☐ Mara kadhaa kwa wiki
4 ☐ Sijawahi kutumia

D9 Soda (pepsi, coca cola n.k)

1 ☐ Zaidi ya mara moja kwa siku
2 ☐ Mara moja kwa siku
3 ☐ Mara kadhaa kwa wiki
4 ☐ Sijawahi kutumia

D10 Maji ya matunda yenye sukari

1 ☐ Zaidi ya mara moja kwa siku
2 ☐ Mara moja kwa siku
3 ☐ Mara kadhaa kwa wiki
4 ☐ Sijawahi kula

D11 Chai/ kahawa yenye sukari

1 ☐ Zaidi ya mara moja kwa siku
2 ☐ Mara moja kwa siku
3 ☐ Mara kadhaa kwa wiki
4 ☐ Sijawahi kutumia

Tabia ya kunyonya vidole/mdomo/ulimi n.k*. Tafadhali tiki jibu moja tu.*

D12 Je umewahi kunyonya kidole(au mdomo,ulimi n.k.)?

1. ☐ Ndiyo 2. ☐ Hapana

D13 Kama ndiyo ulianza lini? ----------

D14 Uliacha lini? ----------

D15 Ulikuwa unanyonya kwa muda gani?

1. ☐ saa moja kwa siku
2. ☐ masaa 2-5 kwa siku
3. ☐ zaidi ya masaa 6 kwa siku
9. ☐ Haihusiki

D16 Unanyonya kidole (au mdomo, ulimi n.k) hivi sasa ?

1. ☐ Ndiyo 2. ☐ Hapana

D17 Kama ndiyo, unanyonya kwa muda gani?

1 ☐ saa moja kwa siku
2 ☐ masaa 2-5 kwa siku
3 ☐ zaidi ya masaa 6 kwa siku
9 ☐ Haihusiki

D18 Je kitendo chako cha kunyonya kinaathiri maendeleo yako shuleni au kujihusisha na watoto wengine?

1 ☐ Ndiyo 2. ☐ Hapana 9 ☐ Haihusiki

D19 Je una tabia zinazoambatana na kunyonya kidole/mdomo n.k. kama zilivyoorodheshwa hapo chini?

1 ☐ Kuvuta nywele (kunakosababisha kupoteza nywele)

2 ☐ Kuchokonoa puani

3 ☐ Kuchezea sehemu za siri
4 ☐ Nyingine (taja).....

9 ☐ Haihusiki

D20 Je mara kwa mara huwa unanyonya kidole/mdomo n.k. ili kuepuka ugomvi?

1. ☐ Ndiyo 2. ☐ Hapana 3. ☐ Haihusiki

Appendix V

Appendix V
CLINICAL EXAMINATION FORM FOR PRIMARY SCHOOL CHILDREN (12-14 yrs)

Date of interview ----------

ID NO ---------- Gender ☐ (M= 1, F= 2)

Name ---------- DATE OF BIRTH:____ /____/ _____

School ---------- Class ---------- Stream ----------

District ☐ (Kinondoni=1, Temeke=2) Place of residence ☐ (1= Urban, 2= rural)

I) FUNCTIONAL CHARACTERISTICS

1) Swallowing ☐ (1= normal, 2= tonguethrusting, 3= contraction of mentalis)

2) Habit ☐ (1=No, 2= Yes)

3) What do you actually suck? ☐ (1=Finger, 2=lip, 3=tongue, 9= not applicable)

4) Duration ----------

5) Speech problems ☐ (1=No, 2= Yes)

II) DENTITION STATUS (DMFT)

Upper right — Upper left

18	17	16	15	14	13	12	11	21	22	23	24	25	26	27	28

Lower right — Lower left

48	47	46	45	44	43	42	41	31	32	33	34	35	36	37	38

Tooth codes (WHO, 1997):
0=Sound tooth
1=Decayed
2=Filled with decay
3=Filled no decay
4=Missing due to caries
5=Missing any other reason
6=Fissure sealant
7=Bridge abutment, special crown veneer
8=Un-erupted crown
9=Not recorded
T=Trauma/fracture

III) Simplified Oral Hygiene Index (Greene and Vermillion, 1964):

Oral Debris:

Upper right upper left

16(B)	11(L)	26(B)

Lower right Lower left

46(L)	31(L)	36(L)

Oral Debris:

0= No debris or stain present
1= Soft debris covering not more than one 3rd of the tooth surface being examined/the presence of extrinsic stains without debris regardless of surface area covered
2= Soft debris covering more than one 3rd but not more than two 3rds of the exposed tooth surface.
3= Soft debris covering more than two 3rd of the exposed tooth surface.

Oral Calculus:

Upper right Upper left

16(B)	11(L)	26(B)

Lower right Lower left

46(L)	31(L)	36(L)

Oral Calculus:

0= No calculus present
1= Supragingival calculus covering not more than one 3rd of the exposed tooth surface being examined.
2= Supragingival calculus covering more than one 3rd but not more than two 3rds of the exposed tooth surface or the presence of individual flecks of subgingival calculus around the cervical portion of the tooth.
3= Supragingival calculus covering more than one 3rd of the exposed tooth surface or a continuous heavy band of subgingival calculus around the cervical portion of the tooth.

IV) OCCLUSION (Björk et al., 1964, with slight modification):
Sagittal

1. Maxillary overjet

1 = grade 1 (1-4.9 mm)
2 = grade 2 (5-8.9 mm)
3 = grade 3 (9 mm or more)

9= not registered ☐

2. Mandibular overjet

0 = absent
1 = grade 1 (<0 to-1.9 mm)
2 = grade 2 (≤-2 mm) ☐

3. Angle Classification

1 = class I
2 = class II (occlusion distal to Cl. I relation)
3 = class III (occlusion mesial to Cl. I relation)

9= not registered ☐

Vertical

4. Deep bite

1 = grade 1 (0.1-2.9 mm, overlapping of the upper & lower right incisors)
2 = grade 2 (3-4.9 mm)
3 = grade 3 (5 mm or more)

9= not registered ☐

5. Open bite

0 = absent
1 = frontal open bite grade 1 (0-1.9 mm)
2 = frontal open bite grade 2 (2 mm or more) ☐
3= lateral open bite

Transversal

6. Crossbite *(crossbite of one or more teeth in the side segments)*

1 = absent
2 = present unilateral ☐
3= present bilateral

7. Midline shift *(if the displacement in relation to the midline of the face was ≥2 mm)*

1 = absent
2 = present ☐

8. Scissor bite *(Scissor bite of one or more teeth in the side segments)*

1 = absent
2 = present unilateral ☐
3= present bilateral

9. Crowding (of ≥2mm in a segment)

1 = absent
2 = present upper jaw ☐
3= present lower jaw
4= present both jaws

10. Spacing (≥ 2mm in a segment)

1 = absent
2 = present upper jaw ☐
3= present lower jaw
4= present both jaws

Appendix VI

Appendix VI

STRUCTURED PERSONAL INTERVIEW FOR PARENTS

A: Identification details.

ID No. .....

Name of district .....

Urban/rural .....

Name of child's school .....

Child's class .....

Name of the respondent .....

Date of interview .....

B: Social demographic details

B1 Age (give your age at last birthday) .....

B2 Gender 1. ☐ Male 2. ☐ Female

B3 Relationship with the child 1. ☐ Parent 2. ☐ Guardian

B4 Religion

1. ☐ Muslim
2. ☐ Christian
3. ☐ Hindu
4. ☐ No religion

B5 Education

1. ☐ No formal education
2. ☐ Not completed primary school
3. ☐ Completed primary school
4. ☐ Secondary school
5. ☐ Completed secondary education
6. ☐ College / university
7. ☐ Don't know

B6 Does any member of your family (with whom you live) own a bicycle?

1. ☐ Yes 2. ☐ No

B7 Does any member of your family (with whom you live) own a motorcycle?

1. ☐ Yes 2. ☐ No

B8 Does any member of your family (with whom you live) own a car?

1. ☐ Yes 2. ☐ No

B9 Does any member of your family (with whom you live) own a television?

1. ☐ Yes 2. ☐ No

B10 Does any member of your family (with whom you live) own a refrigerator?

1. ☐ Yes 2. ☐ No

B11 How many rooms are there in your home?

1. ☐ One
2. ☐ Two to five
3. ☐ Six or more
4. ☐ I don't have a house

B12 What is the main source of cooking fuel at home?

1. ☐ Gas cooker
2. ☐ Kerosene stove
3. ☐ Wood
4. ☐ Cow dung
5. ☐ Charcoal
6. ☐ Electricity
7. ☐ Other (specify).....

B13 What is your child's birth rank?

1. ☐ First born
2. ☐ Last born
3. ☐ Other (specify).....

C. Sucking habits

C1 Have your child ever sucked finger/lip or dummy? 1. ☐ Yes 2. ☐ No

C2 If yes, what was your child actually sucking?

1. ☐ Thumb/finger
2. ☐ Dummy
3. ☐ Combined finger and dummy
4. ☐ Lip
5. ☐ Other (specify)_____
9. ☐ Not applicable

C3 At what age did he/she started the habit? _____

C4 At what age did he/she stopped? _____

C5 How often were he/she sucking?

1. ☐ 1 hour a day
2. ☐ 2-5 hours a day
3. ☐ ≥ 6 hours a day
9. ☐ Not applicable

C6 Does your child suck finger/lip or dummy currently? 1. ☐ Yes 2. ☐ No

C7 If yes, what is your child actually sucking?

1. ☐ Thumb/finger
2. ☐ Dummy
3. ☐ Combined finger and dummy
4. ☐ Lip
5. ☐ Other (specify)_____
9. ☐ Not applicable

C8 How often does he/she suck?

1. ☐ 1 hour a day
2. ☐ 2-5 hours a day
3. ☐ ≥ 6 hours a day

9. ☐ Not applicable

C9 Does the sucking activity of your child affect his/her school performance or socialization with others?

1. ☐ Yes 2. ☐ No 9. ☐ Not applicable

C10 Does your child have a conjoined behaviour with sucking, as listed below?

1. ☐ Hair pulling (causing hair loss)
2. ☐ Genital fondling
3. ☐ Other (specify)_____
9. ☐ Not applicable

C11 Does your child frequently retreat to the sucking behaviour to avoid confrontation?

1. ☐ Yes 2. ☐ No 9. ☐ Not applicable

D. Attitudes of parents towards sucking habits

D1 Do you accept sucking habit (finger/dummy/lip sucking etc) of your child?

1. ☐ No, I don't accept at all
2. ☐ Yes, up to 3-4 years of age
4. ☐ Other (specify)_____
9. ☐ Not applicable

D2 Will you attempt to intervene the habit?

1. ☐ Yes 2. ☐ No 9. ☐ Not applicable

D3 Why will you intervene?

1. ☐ Because of its effect on dental occlusion
2. ☐ Because of its effect on the finger/s
3. ☐ Because of its psychosocial effect on the child
4. ☐ Because of its effect on the child's speech
5. ☐ Because it causes loss of appetite on the child
6. ☐ Because it causes microbial transmission
7. ☐ Other (specify)_____
9. ☐ Not applicable

D4 Will you seek dental advice concerning the habit?

1. ☐ Yes 2. ☐ No 9. ☐ Not applicable

D5 Will you seek paediatrician advice concerning the habit?

1. ☐ Yes 2. ☐ No 9. ☐ Not applicable

D6 If your child had the habit in the past, did you accept it?

1. ☐ No, I did not accepted it at all
2. ☐ Yes, up to 3-4 years of age
4. ☐ Other (specify)_____
9. ☐ Not applicable

D7 Did you try to intervene?

1. ☐ Yes 2. ☐ No 9. ☐ Not applicable

D8 Why did you intervene?

1. ☐ Because of its effect on dental occlusion
2. ☐ Because of its effect on the finger/s
3. ☐ Because of its psychosocial effect on the child
4. ☐ Because of its effect on the child's speech
5. ☐ Because it causes loss of appetite on the child
6. ☐ Because it causes microbial transmission
7. ☐ Other (specify)_____
9. ☐ Not applicable

D9 Did you seek dental advice concerning the habit?

1. ☐ Yes 2. ☐ No 9. ☐ Not applicable

D10 Did you seek paediatrician advice concerning the habit?

1. ☐ Yes 2. ☐ No 9. ☐ Not applicable

D11 What technique/s did you use to stop the habit in your child?

1. ☐ Bitter taste (substances on the digit/dummy)
2. ☐ Reinforcement (reward)
3. ☐ Tape
4. ☐ Socks or gloves
5. ☐ Hot sauce
6. ☐ wrapping the hand
7. ☐ Physical punishment
8. ☐ Other (specify)_____

9. ☐ Not applicable

E. Feeding methods

E1 How was your child fed during the first 6 months of infancy?

1. ☐ was breastfed
2. ☐ was bottle fed
3. ☐ was fed with a cup
4. ☐ was breastfed and fed with a cup
5. ☐ was bottle fed and fed with a cup

E2 How long was your child breastfed?

1. ☐ ≥ 2 years
2. ☐ ≥ 6 months, but < 2 years
3. ☐ 1-5 months
4. ☐ was not breastfed at all
9. ☐ Not applicable

E3. How often was your child breastfed?

1. ☐ At will 2. ☐ Hourly 3. ☐ few times a day 9. ☐ Not applicable

E4. How long was your child bottle fed?

1. ☐ ≥ 2 years
2. ☐ ≥ 6 months, but < 2 years
3. ☐ 1-5 months
9. ☐ Not applicable

E5. At what age was your child weaned?

1. ☐ at 4 months
2. ☐ at ≥ 6 months
3. ☐ weaned and breastfed at the same time

Appendix VII

Kiambatanisho VII

USAILI BINAFSI KWA WAZAZI

A: Maelezo ya Utambulisho

Namba ya Utambulisho.....

Jina la Wilaya .....

Mjini/Vijijini .....

Jina la Shule ya mtoto .....

Darasa analosoma mtoto .....

Jina la Mtafitiwa .....

Tarehe ya usaili .....

B: Maelezo ya Kijamii na Kidemografia

B1 Umri (toa umri wako hadi tarehe ya kuzaliwa iliyopita)

B2 Jinsia 1. ☐ Mme 2. ☐ Mke

B3 Uhusiano na mtoto 1. ☐ Mzazi 2. ☐ Mlezi

B4 Dini

1 ☐ Muislamu

2 ☐ Mkristo

3 ☐ Hindu

4 ☐ Sina Dini

B5 Elimu

1 ☐ Sina elimu rasmi

2 ☐ Sijamaliza elimu ya msingi

3 ☐ Nimemaliza elimu ya msingi

4 ☐ Elimu ya sekondari

5 ☐ Nimemaliza elimu ya sekondari

6 ☐ Elimu ya Chuo/Chuo Kikuu

7 ☐ Sifahamu

B6 Je kuna mwana familia (katika familia unayoishi) anamiliki Baiskeli?

1. ☐ Ndiyo 2. ☐ Hapana

B7 Je kuna mwana familia (katika familia unayoishi) anamiliki pikipiki?

1. ☐ Ndiyo 2. ☐ Hapana

B8 Je kuna mwana familia (katika familia unayoishi) anamiliki gari?

1. ☐ Ndiyo 2. ☐ Hapana

B9 Je kuna mwana familia (katika familia unayoishi) anamiliki televisheni?

1. ☐ Ndiyo 2. ☐ Hapana

B10 Je kuna mwana familia (katika familia unayoishi) anamiliki jokofu?

1. ☐ Ndiyo 2. ☐ Hapana

B11 Nyumba yenu ina vyumba vingapi?

1 ☐ Kimoja

2 ☐ Viwili hadi vitano

3 ☐ Sita au zaidi

4 ☐ Sina nyumba

B12 Mnapika kwa kutumia nishati gani hasa hapo nyumbani?

1 ☐ Jiko la gesi

2 ☐ Jiko la mafuta ya taa

3 ☐ Kuni

4 ☐ Kinyesi cha ng'ombe

5 ☐ Mkaa

6 ☐ Umeme

7 ☐ Nyingine

B13 Huyu mtoto wako ni wangapi katika kuzaliwa?

1 ☐ Wa Kwanza kuzaliwa
2 ☐ Wa mwisho kuzaliwa
3 ☐ Nyingine (taja) .....

C Tabia ya Kunyonya Vidole/mdomo au kidanganyio

C1 Mtoto wako amewahi kunyonya kidole/mdomo au kidanganyio?

1. ☐ Ndiyo 2. ☐ Hapana

C2 Kama ndiyo, Mtoto wako alikuwa ananyonya kitu gain hasa?

1 ☐ Kidole
2 ☐ Kidanganyio/nyonyo bandia
3 ☐ Vyote, kidole na kidanganyio
4 ☐ Mdomo
5 ☐ Kingine (taja)----------
9 ☐ Haihusiki

C3 Alianza tabia hii akiwa na umri gani? ----------

C4 Aliacha tabia hii akiwa na umri gani? ----------

C5 Alikuwa ananyonya kwa muda gani katika siku moja?

1 ☐ Saa moja kwa siku

2 ☐ Masaa 2-5 kwa siku

3 ☐ Zaidi ya masaa sita kwa siku

9 ☐ Haihusiki

C6 Mtoto wako sasa ananyonya kidole/mdomo au kidanganyio?

1. ☐ Ndiyo 2. ☐ Hapana

C7 Kama jibu ni ndiyo mtoto wako ananyonya nini hasa?

1 ☐ Kidole
2 ☐ Kidanganyio/nyonyo bandia
3 ☐ Vyote, kidole na kidanganyio
4 ☐ Mdomo
5 ☐ Kingine (taja)----------
9 ☐ Haihusiki

C8 Ananyonya kwa muda gani kwa siku?

1 ☐ Saa moja kwa siku

2 ☐ Masaa 2-5 kwa siku

3 ☐ Zaidi ya masaa sita kwa siku

9 ☐ Haihusiki

C9 Je kitendo cha kunyonya anachofanya mtoto wako kinaathiri maendeleo yake shuleni au kujihusisha na watoto wengine?

1. ☐ Ndiyo 2. ☐ Hapana 9 ☐ haihusiki

C10 Je mtoto wako ana tabia zinazoambatana na kunyonya kidole/mdomo n.k. kama zilivyoorodheshwa hapa chini?

1. ☐ Kuvuta nywele (kunakosababisha kupoteza nywele)
2. ☐ Kuchezea sehemu za siri
3. ☐ Nyingine (taja).....
9. ☐ Haihusiki

C11 Je mtoto wako mara kwa mara huwa ananyonya kidole/mdomo n.k. ili kuepuka ugomvi?

1. ☐ Ndiyo 2. ☐ Hapana 9. ☐ Haihusiki

D Mwelekeo wa wazazi kuhusu tabia ya kunyonya

D1 Je unaikubali tabia ya kunyonya(kidole/kidanganyio/mdomo) ya mtoto wako?

1 ☐ Hapana, siikubali kabisa
2 ☐ Ndiyo, hadi umri wa miaka 3-4
3 ☐ Mengineyo (taja) .....
9 ☐ Haihusiki

D2 Je utajaribu kuingilia kati tabia hii (ili aache)?

1. ☐ Ndiyo 2. ☐ Hapana 9. ☐ Haihusiki

D3 Kwa nini utaingilia kati tabia hii?

1 ☐ Kwa sababu ya athari zake kwa mpangilio wa meno
2 ☐ Kwa sababu ya athari zake kwa kidole/vidole
3 ☐ Kwa sababu ya athari za kisaikolojia na kijamii kwa mtoto
4 ☐ Kwa sababu ya athari zake kwa kuongea kwa mtoto
5 ☐ Kwa sababu inasababisha mtoto kukosa hamu ya kula
6 ☐ Kwa sababu inasababisha maambukizi ya vijidudu vya maradhi
7 ☐ Nyingine (taja)----------
9 ☐ Haihusiki

D4 Je utaomba ushauri kutoka kwa daktari wa meno kuhusiana na tabia hii?

1. ☐ Ndiyo 2. ☐ Hapana 9. ☐ Haihusiki

D5 Je utaomba ushauri kutoka kwa daktari wa watoto kuhusiana na tabia hii?

1. ☐ Ndiyo 2. ☐ Hapana 9. ☐ Haihusiki

D6 Kama mtoto wako alikuwa na tabia hii hapo nyuma, je uliikubali?

1 ☐ Hapana, siikubali kabisa
2 ☐ Ndiyo, hadi umri wa miaka 3-4
3 ☐ Mengineyo (taja) ----------
9 ☐ Haihusiki

D7 Ulijaribu kuingilia kati tabia hiyo (ili aache)?

1. ☐ Ndiyo 2. ☐ Hapana 9. ☐ Haihusiki

D8 Kwa nini uliingilia kati?

1 ☐ Kwa sababu ya athari zake kwa mpangilio wa meno
2 ☐ Kwa sababu ya athari zake kwa kidole/vidole
3 ☐ Kwa sababu ya athari za kisaikolojia na kijamii kwa mtoto
4 ☐ Kwa sababu ya athari zake kwa kuongea kwa mtoto
5 ☐ Kwa sababu inasababisha mtoto kukosa hamu ya kula
6 ☐ Kwa sababu inasababisha maambukizi ya vijidudu vya maradhi
7 ☐ Nyingine (taja)----------
9 ☐ Haihusiki

D9 Je uliwahi kuomba ushauri kutoka kwa daktari wa meno kuhusiana na tabia hii?

1. ☐ Ndiyo 2. ☐ Hapana 9. ☐ Haihusiki

D10 Je Uliwahi kuomba ushauri kutoka kwa daktari wa watoto kuhusiana na tabia hii?

1. ☐ Ndiyo 2. ☐ Hapana 9. ☐ Haihusiki

D11 Ni mbinu gani uliitumia/ ulizitumia kufanya motto wako aache tabia hiyo?

1 ☐ Kuweka mwonjo wenye uchungu (kwenye kidole au kidanganyio)

2 ☐ Kumhimiza (kwa kutoa zawadi)

3 ☐ Kumweka gundi ya karatasi (tape)

4 ☐ Kumvisha soksi au glovu

5 ☐ Kumwekea pilipili

6 ☐ Kuviringisha kitu kwenye mkono

7 ☐ Adhabu ya kumpiga

8 ☐ Nyingine (taja) ----------

9 ☐ Haihusiki.

E. Mbinu za Kumlisha Mtoto

E1 Mtoto wako alikuwa analishwa namna gani katika kipindi cha miezi sita ya kwanza ya utoto?

1 ☐ Alinyonyeshwa maziwa ya mama
2 ☐ Alinyonyeshwa kwa chupa
3 ☐ Alilishwa kwa kikombe
4 ☐ Alinyonyeshwa maziwa ya mama na kulishwa kwa kikombe
5 ☐ Alinyonyeshwa kwa chupa na kulishwa kwa kikombe

E2 Mtoto wako alinyonyeshwa maziwa ya mama kwa muda gani?

1 ☐ Zaidi ya miaka miwili
2 ☐ Zaidi ya miezi 6 lakini chini ya miaka miwili
3 ☐ Mwezi 1-5
4 ☐ Hakunyonyeshwa maziwa ya mama kabisa
9 ☐ Haihusiki

E3 Mtoto wako alinyonyeshwa maziwa ya mama mara ngapi?

1. ☐ Kila anapotaka 2. ☐ kila saa 3. ☐ mara chache kwa siku
9. ☐ Haihusiki

E4 Mtoto wako alinyonyeshwa kwa chupa kwa muda gani?

1 ☐ Zaidi ya miaka miwili
2 ☐ Zaidi ya miezi 6 lakini chini ya miaka miwili
3 ☐ Mwezi 1-5
9 ☐ Haihusiki

E5 Mtoto wako alianzishiwa chakula cha kawaida akiwa na umri gani?

1. ☐ Alipokuwa na miezi minne
2. ☐ Alipokuwa na zaidi ya miezi 6
3. ☐ Alianzishiwa chakula cha kawaida na kunyonyeshwa maziwa ya mama wakati huo huo.

Appendix VIII

Appendix VIII
CLINICAL EXAMINATION FORM FOR PRESCHOOL CHILDREN
(3-5 yrs)

Date of interview ----------

ID NO ---------- Gender ☐ (M= 1, F= 2)

Name ---------- DATE OF BIRTH:____ /____/ _____

School ---------- Class ---------- Age ----------

District ☐ (Kinondoni=1, Temeke=2) Place of residence ☐ (1= Urban, 2= rural)

I) FUNCTIONAL CHARACTERISTICS

1) Swallowing ☐ (1= normal, 2= tonguethrusting, 3= contraction of mentalis)

2) Habit ☐ (1=No, 2= Yes)

3) What type? ☐ (1= finger, 2= lip, 3= tongue, 4= not applicable) 4) Duration -----

5) Speech problems ☐ (1=No, 2= Yes)

IV) OCCLUSION (Björk et al., 1964, with slight modification):
Sagittal
1. Maxillary overjet
1 = grade 1 (1-4.9 mm)
2 = grade 2 (5-8.9 mm)
3 = grade 3 (9 mm or more)
9= not registered ☐

2. Mandibular overjet
0 = absent
1 = grade 1 (<0 to-1.9 mm)
2 = grade 2 (≤-2 mm) ☐

3. Angle Classification
1 = class I
2 = class II (occlusion distal to Cl. I relation)
3 = class III (occlusion mesial to Cl. I relation) 9= not registered ☐

Vertical

4. Deep bite

1 = grade 1 (0.1-2.9 mm, overlapping of the upper & lower right incisors)
2 = grade 2 (3-4.9 mm)
3 = grade 3 (5 mm or more)
9= not registered ☐

5. Open bite

0 = absent
1 = frontal open bite grade 1 (0-1.9 mm)
2 = frontal open bite grade 2 (2 mm or more) ☐
3= lateral open bite

Transversal

6. Crossbite *(crossbite of one or more teeth in the side segments)*

1 = absent
2 = present unilateral ☐
3= present bilateral

7. Midline shift *(if the displacement in relation to the midline of the face was ≥ 2 mm)*

1 = absent
2 = present ☐

8. Scissor bite *(Scissor bite of one or more teeth in the side segments)*

1 = absent
2 = present unilateral ☐
3= present bilateral

9. Crowding (of ≥2mm in a segment)

1 = absent
2 = present upper jaw ☐
3= present lower jaw
4= present both jaws

10. Spacing (≥ 2mm in a segment)

1 = absent
2 = present upper jaw ☐
3= present lower jaw
4= present both jaws

Appendix IX

APPENDIX IX

ERRATA

We regret that some errors occurred in the following papers.

Paper II

Abstract: results section, last line; “problems eating” corrected to “problems with eating” and “cause of impacts” corrected to “causes of impacts”.

Methods (Interview variables): paragraph 1, 3rd line; “cleaning mouth” corrected to “cleaning teeth” and frequency option (3) “very day” corrected to “every day”. Paragraph 2, last line; a comma should be placed between lip and tongue.

Discussion: paragraph 1, 6th line “Cronbach’a alpha” corrected to “Cronbach’s alpha”.

Paper III

Table 1: variables column, 1st row; “sex e” corrected to “sex”.

Tables 2, 3 and 4: socio demographics column, 10th row; “14” corrected to “14 yr”.