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Prevalence of malocclusion and its associated factors among pre-schoolchildren in Kinondoni and Temeke Districts, Tanzania

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Abstract
Background: Malocclusion is any deviation in the arrangement of teeth exceeding the standards of normal occlusion characterized by anomalies within the dental arches. The objective of this study was to assess the prevalence of malocclusion and its associated factors among pre-school children in Kinondoni and Temeke Districts in Tanzania.
Methods: This cross sectional survey of children aged 3-5 years was conducted in Kinondoni and Temeke Districts in Tanzania. Parents of pre-schoolchildren were interviewed regarding their socio-demographic details and their child's sucking habits. Clinical examination was performed to each child to assess malocclusions.
Results: The overall prevalence of malocclusion was 32.5%. In bivariate analysis, sucking habit was the significant factor associated with malocclusions. After controlling for socio-demographic variables, current sucking habits and sex remained significant determinants for having an open bite with odds ratios of 13.5 and 2.2, respectively.
Conclusion: The study showed that more than one third of pre-schoolchildren in the two districts had one or more forms of malocclusions. Open bite was the most common vertical malocclusion trait which was significantly related to sucking habits and child's sex. Thus, 3-5 year-olds can benefit from preventive and interceptive oral health measures which may either totally prevent or lessen the development of severe forms of malocclusions later in their lives.

Keywords: malocclusion, associated factors, oral habits, pre-schoolchildren, Tanzania

Introduction

Malocclusion is any deviation in the arrangement of teeth exceeding the standards of normal occlusion (Thilander & Rønning, 1995). It may be characterized by anomalies within the dental arches, malrelation of dental arches and skeletal facial discrepancies (Proffit *et al.,* 2012). The prevalence of malocclusions in different populations have been reported by many studies (al-Emran *et al*., 1990; Ng'ang'a *et al*., 1996; Thilander *et al*., 2001; Onyeaso, 2004; Malandris & Mahoney, 2004; Ciuffolo *et al.*, 2005; Josefsson *et al*., 2007; Carvalho *et al*., 2011; Dimberg *et al*., 2010; Krishna *et al*., 2013). The reported prevalence of malocclusions in pre-schoolchildren with mainly primary teeth varies between 20 and over 70 % (Malandris & Mahoney, 2004; Carvalho *et al*., 2011; Dimberg *et al.*, 2011; Krishna *et al*., 2013). The prevalence variance depends on the population studied, ethnic differences, criteria used for scoring malocclusions, wide ranges in number of participants and age range of participants examined (Thilander *et al*., 2001; Malandris & Mahoney, 2004; Abu Alhaija *et al*., 2005; Dimberg *et al.,* 2010; Carvalho *et al.,* 2011; Krishna *et al*., 2013).

The impact of a malocclusion is that it can cause psychological and social problems mainly related to impaired dental and facial aesthetics (Kenealy *et al.*, 1989). But also, a malocclusion can cause alterations in oro-facial structures (Larsson, 1994; Øgaard *et al.*, 1994; Fukuta *et al.*, 1996;

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Viggiano *et al.*, 2004; Poyak, 2006; Proffit *et al.,* 2012) with adverse oro-facial health effects such as increase in susceptibility to dental caries (Stahl & Grabowski, 2004).

It is generally acknowledged that malocclusions are developmental conditions that result from an interplay of genetic and environmental aetiological factors (Thilander & Rønning, 1995). A combination of both factors has often been found in the same individual (Mitchell, 2007). The environmental factors that have been implicated with the development of malocclusions include but not limited to early removal of primary teeth, dental caries experience and trauma to primary teeth (Thilander & Rönning, 1995). Some studies have also identified oral health related behaviours such as oral habits as substantial malocclusion influencing factors. They include thumb sucking habits, finger sucking habits and pacifier or dummy sucking (Katri *et al.*, 2003; Proffit *et al.,* 2012). Other unfavourable habits are lips sucking or tongue thrusting (Larsson, 1994; Poyak, 2006). Earlier studies have further indicated that these habits can be influenced by sex of the child, birth rank/order of birth of a child, socio-economic status and level of parents' education (Larsson *et al*., 1992; Farsi & Salama, 1997; Warren *et al*., 2000). The effects of unfavourable oral habits on oro-facial structures including untoward dental occlusion change have also been documented (Larsson, 1994; Thilander *et al*., 1995; Adair *et al.*, 1995; Farsi & Salama, 1997; Kerosuo, 2002; Proffit *et al.*, 2012; Varas *et al.*, 2012). Specifically, finger sucking habits have significantly been associated with development of an anterior open bite, increased overjet, Class II canine relationship and posterior cross-bite (Larsson, 1994; Ogaard *et al*., 1994; Fukuta *et al.,* 1996; Viggiano *et al.*, 2004; Poyak, 2006; Proffit *et al.*, 2012). Nonetheless, some studies have shown inconclusive results regarding the effects of oral habits on one's occlusion (Farsi & Salama, 1997; Warren & Bishara, 2002). Despite the magnitude and public importance of this condition, there is dearth of information on malocclusions and associated factors among children in Tanzania. Therefore, this study was conducted to assess the prevalence of malocclusion and its associated factors in Kinondoni and Temeke Districts of eastern Tanzania.

Materials and Methods

Study area and design

This cross sectional study was conducted among pre-schools of Kinondoni and Temeke districts in Dar es Salaam City in Tanzania. Dar es Salaam is the largest and most socially and culturally heterogenic City in Tanzania. Kinondoni and Temeke districts were selected for the study. The districts are diverse in terms of their socio-demographic profile, with Kinondoni 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. Study participants were obtained from a census of 3-5-year-olds attending 8 selected pre-schools in Kinondoni district (5 pre-schools) and Temeke district (3 pre-schools). A total of 253 of 305 eligible pre-school children and their parents participated in the survey, making the response rate of 83%.

Data collection

A face-to-face structured interview involved parents/caregivers of the 3-5-year-old pre-school children in a classroom setting. A pre-tested questionnaire in Kiswahili language was used. It included questions on socio-demographic characteristics and children's sucking habits. Socio-demographics were assessed in terms of district (Kinondoni/Temeke), sex, 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 thumb/finger, tongue or lip. Current sucking habit was assessed by asking the parents if their children had any sucking habits currently.

Clinical examinations were done in a classroom setting with natural daylight as the source of illumination. The children were clinically examined for malocclusions in the presence of their

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parents/caregivers (after their parents had completed the interview). The registration criterion was according to Björk *et* al. (1964) with some modifications by al-Emran *et al*. (1990). Absence/ presence of the following recordings was also examined: a maxillary overjet, a mandibular overjet, a Class II/Class III molar occlusion, an open bite, a deep bite, a lateral cross-bite, a midline shift, crowding and spacing. Occlusion in the anterior segment could not always be determined in pre-school children due to shedding of their primary incisors. Such cases were then excluded for overjet and overbite analyses, but were included in the analyses of other malocclusions. A sum score of malocclusions (SMO) was constructed to provide the overall prevalence of malocclusion, based on the diagnosis of absence/ presence a maxillary overjet, a mandibular overjet, a Class II/Class III molar occlusion, an open bite, a deep bite, a lateral cross bite, a midline shift, crowding and spacing.

Data analysis

Data was analysed using the Statistical Package for Social Sciences version 16.0 (SPSS Inc., Chicago, Illinois, USA). Frequencies were generated to assess percentage distribution/prevalence of different variables. Cross tabulations 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 $p<0.05$.

Ethical considerations

Ethical clearance was obtained from the Research and Publication Committee of the Muhimbili University of Health and Allied Sciences. Permission to work with pre-school children was obtained from Kinondoni and Temeke municipalities, their respective educational authorities, schools administrations and parents. Only those pre-school children whose parents provided either verbal and written consents participated in the study.

Results

A total of 253 pre-school children mean age= 5 years in eight pre-schools participated in the study. The overall prevalence of malocclusion (i.e. SMO>0 – having any type of a malocclusion) was 32.5%. The majority (90.9%) of the children showed Class I molar relationship. Class II and Class III were registered among 0.8% and 8.3% of the children, respectively. The most frequently recorded anomalies were spacing of at least 2 mm (19.8%) and open bite (18.6%). Overall, various malocclusion traits, including open bite, were identified slightly more in girls than in boys ($p>0.05$). There was no significant difference with respect to malocclusion traits between the district of residence of the pre-school children (Table 1).

As regards to sucking habits (Table 2), 28% of the pre-school children had a history of sucking habits. Thumb/finger sucking habits were the most common form of habits, reported among 20.9% of the pre-schoolchildren. Current sucking habits were reported among 19% of the children. Regarding association between malocclusions and related environmental factors, open bite was a single malocclusion trait that was statistically significantly associated with sucking habits (Table 3).

Pre-school children with a history of sucking habits had statistically 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 sex remained as strong determinants for an open bite with the odds ratios of 13.5 and 2.2, respectively (Table 3).

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Table 1. Percentages (%) and number (n) of occlusal and space characteristics among pre-school children by district and sex

		District		Sex		Total
		Kinondoni % (n)	Temeke % (n)	Boys % (n)	Girls % (n)	% (n)
Occlusion						
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	Cross bite					
	Absent	98.9 (175)	98.7 (75)	100 (134)	97.5 (116)	98.8 (250)
	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 anomalies	*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)

Table 2. Prevalence of different types of sucking habits among pre-school children

Sucking habits	Number (n)	Percentage (%)
History of sucking habits	71	28
Thumb/finger	53	20.9
Tongue	13	5.1
Lip/s	5	2
Current sucking habits	48	19

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Table 3. Factors associated with presence of open bite among pre-schoolchildren

Variable	Response	Number (Percentage)	Adjusted OR (95%CI)
District	Kinondoni	38 (21.5)	1
	Temeke	9 (11.8)	0.5 (0.2-1.3)
Sex	Male	20 (14.9)	1
	Female	27 (22.7)	2.2 (1.1-4.7)*
Ever sucking	Yes	27 (38.0)**	1
	No	20(11.0)	0.9 (0.2-3.7)
Current sucking	Yes	26 (55.3)**	1
	No	21 (10.2)	13.5 (3.3-55.4)**

Multivariate logistic regression: Chi-square, adjusted odds ratios (OR) and 95% confidence intervals (CI); %=percentages, n=number of pre-schoolchildren); *p<0.05, **p<0.001

Discussion

The total prevalence of malocclusion (SMO>0) among pre-school children presented in this study was lower than that reported among children in the United States (Trottman & Elsbach, 1996), Germany (Robke, 2008), Sweden (Dimberg *et al*., 2010) and Lithuania (Kasparaviciene *et al*., 2014). However, it was much higher than that reported by previous studies in Tanzania (Kerosuo *et al*., 1991; Mugonzibwa *et al*., 2004). Methods of malocclusion registration and age ranges of children involved in the studies could be important factors explaining these differences (Kasparaviciene *et al*., 2014; Wagner & Heinrich-Weltzien, 2015). In our study, spacing of at least 2 mm and open bite were the most common traits. This finding was similar to what was reported by Dimberg *et al*. (2010) and Kasparaviciene *et al*. (2014) in their studies among Swedish and Lithuanian children, respectively. Conversely, the results did not conform to the findings by Zhou *et al*. (2016) in a study among Chinese children.

Similar to the findings by Kasparaviciene *et al.* (2014) and Zhou et al. (2016) there was no significant difference in the occurrence of most occlusal traits between boys and girls among our study participants. However, girls had slightly more of different malocclusion traits than boys. The reason for this could be due to the role of sucking habits; these were reported to be performed more by girls than by boys. Sucking habits have been found to be associated with numerous occlusal problems in children (Farsi & Salama, 1997; Onyeaso & Sote, 2001; Dimberg *et al*., 2010; Warren *et al*., 2005; Quashie-Williams *et al.*, 2010; Zhou *et al.*, 2016). In this study therefore, the sucking habits were behaviours of interest that were significantly associated with one of the commonest malocclusion trait (open bite). Pre-school children, whoever performed these kinds of behaviours, comprised over a quarter of all the children. This proportion was lower than that reported by Dimberg *et al*. (2010) and higher than that reported among Nigerian children of similar age group (Onyeaso & Sote 2001; Onyeaso *et al*., 2002). Specifically, this study found that finger sucking habit was the commonest type of unfavourable sucking behaviour. In contrast, finger sucking was reported as the least common type of oral habits in a study in Lithuania (Kasparaviciene *et al*. (2014) while Dimberg *et al.* (2010) found dummy sucking to be a dominant non-nutritive sucking habit among Swedish children. Dummy sucking is usually not a common practice among Tanzanian children.

Noteworthy, open bite was a single malocclusion trait that was associated with sucking habits in this study. This finding is supported by earlier studies which provided evidence of a positive relationship between sucking habits and being detected with an open bite (Farsi & Salama, 1997; Warren *et al*., 2005; Dimberg *et al*., 2010; Wagner & Heinrich-Weltzien, 2015). It is also important to take into account that the prevalence of open bite in pre-school children in the current study might have been underestimated due to elimination in the analysis of 3-5-year-olds who had their primary incisors shed. Results on the extent, associated factors and distribution of malocclusions clearly suggests a

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need for developing preventive and interceptive orthodontic programs among pre-school children. In view of the relatively scarce resources that are available for oral health care services in Tanzania, emphasis should be put on oral health education to oral health professionals (in terms of continuing education) and parents/caregivers. Moreover, intervention programmes to pre-school children (such as interceptive orthodontics) should also be considered. In doing so, malocclusions related to environmental factors (such as sucking habits) can be timely altered and children's occlusal, psychosocial as well as overall oral health status can be considerably improved.

The findings of this study are likely to have some limitations. The study might have been subjected to sources of error, biasing the results and a conclusion drawn. The bias could be in terms of a systematic error which might have occurred as a results of selection bias from the participants' end (e.g. non response) and as information bias or misclassification related to the information collected from the participants. To minimize such kind of biases, interviews with parents in this study were done before examining their children clinically.

In conclusion, the prevalence of having any malocclusion (SMO>0) in 3-5-year-olds in Kinondoni and Temeke District in Tanzania was 32.5%. Sucking habits and sex are important risk indicators of malocclusion. Thus, preventive and interceptive orthodontic programmes are highly recommended in pre-school children.

Competing interests

The authors declare that they have no competing interests.

Authors' contributions

MM conceived the idea, designed the study, collected data, carried out statistical analysis and wrote the first draft of the manuscript. PB participated in the study design, methodology and manuscript writing. AA designed the study, carried out statistical analysis. All read and approved the final version of the manuscript.

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