

Introduction

Malocclusion is regarded as an irregularity of the teeth or a mal-relationship between the dental arches beyond the normal range. Proper alignment of teeth in children has a strong positive impact on their quality of life as well as their social interaction skills (1,2). There is an increased awareness of the close association and role of the primary occlusal relationship to the permanent tooth alignment and occlusal features (3). Previous studies have proven that the presence of malocclusion in primary dentition will lead eventually to malocclusion in its successor (4,5). Moreover, malocclusion in deciduous dentition is considered a risk factor indicating the necessity of orthodontic treatment in the future. Therefore, it is important to closely monitor occlusion in children and initiate immediate intervention at an appropriate time, when required (5,6). Although characteristics of primary occlusion have been well addressed in the literature by different authors, it is known that different population groups and ethnic backgrounds can influence the development of the occlusion (7). Genetic and environmental factors have also been shown to strongly influence the development of either normal or abnormal occlusion (6).

Objective

No agreement on case definition of malocclusion was found in the literature, subsequently, no index is available to measure the prevalence of malocclusion in primary dentition. So, this study aimed to determine the prevalence of malocclusion in primary dentition and its associated risk indicators among a group of Saudi preschool children using a proposed definition that addresses the abnormal and not the norms of occlusion.

Materials and methods

A **cross-sectional** study was conducted on 3 to 5-year-old preschool children living in the capital of Saudi Arabia, Riyadh City. Ethical clearance was obtained from the Institutional Review Board of Princess Nourah bint Abdulrahman University (Reference number:180240).

A minimum required sample of 683 participants was calculated with an estimated 8.1% prevalence of malocclusion based on a previously published paper in Riyadh by Najat et al. in 1996 (8) with a 95% confidence interval and a 3% margin of error.

A convenient sample of kindergarten children from selected schools was used. Private and public schools from the five regions of Riyadh city; were covered with a total number of 9 schools to ensure sample representation. A written permission from school authorities was obtained before school visits. The study sample included 709 Saudi children of both genders with complete primary dentition, whose parents agreed to participate in the study. Children with any systemic diseases/syndromes, developmental tooth anomalies, extensive proximal and/or occlusal caries, premature loss, or erupted permanent teeth were excluded from the study.

Data collection: The research consisted of a self-administered questionnaire to the child's mother/caregiver, and a clinical examination to assess the occlusion of the child. A written informed consent along with the questionnaire was sent to the child's mother/caregiver, a couple of days before the examination visit. The child with signed informed consent, answered the questionnaire, and who met the inclusion criteria was examined.

The questionnaire was structured based on the one designed by Zhou et al. (9) and modified to meet the objectives of the study. It was divided into three main parts:

- Demographic data of the mother/caregiver: age, education level, and family income.
- Characteristics of the child: age, sex, natal and family history, as well as feeding methods.
- History of previous or persisting deleterious oral habits such as digit/pacifier sucking, lip habit, tongue thrusting, mouth breathing and or bruxism (10).

Training, and calibration of three examiners (AA, GA, and HA) were done under the guidance of an expert examiner to insure consistency and agreement on the diagnostic criteria. Inter- and intra-examiner reliability was conducted to assess the consistency of applying the diagnostic criteria among examiners using the Kappa Statistics with a result of kappa statistics inter-rater =.80 ; kappa statistics intra-rater =.89).

A pilot study was conducted to ensure the smooth running of the study on ten children aged 3- to 5-year-old in the PNU dental clinics. Data from this pilot study were used to modify the questionnaire and examination form.

Oral examination forms were made to record the following parameters in three spatial planes.

Anteroposterior dimension:

- Terminal plane relationships of the second primary molars were recorded as a flush terminal plane, mesial or distal steps (8,12).
- Primary canine relationships were rated as class I, II, or III (8).
- Primary molar and canine relationships were classified based on the bilateral symmetry of occlusion.
- The overjet was measured in millimeters and was considered either normal (0-3mm), increased (≥4mm), or anterior crossbite (1,13).

Transverse relationship:

- The midline of each arch was compared with the other, and the maxillary arch was checked against the midsagittal plane (12).

Vertical dimension:

- The overbite was graded according to the percentage of overlap of the total height of the mandibular incisor into normal (0% to 50%), deep overbite (>50%), or anterior open bite (1,13).

Alignment:

- Primate and developmental spaces were recorded as present or absent (10)
- Crowding was registered when there was an overlap between the proximal surfaces of teeth.

The presence of deleterious oral habits was also recorded based on the history from the child's parent/caregiver and clinical examination following documented indicators (12).

Assessment of malocclusion: Since there is a lack of a standardized index to assess malocclusion in the primary dentition, children displaying any deviation from normal occlusion defined by Bishara et al. (1) (flush terminal plane or a mesial step, 0 to 3 mm overjet, and 0% to 50% overbite) were considered as having malocclusion. Thus, malocclusion was recorded when one or more of the following traits were observed; distal step, increased overjet ≥4mm, anterior crossbite, deep overbite >50%, anterior open bite, posterior crossbite or crowding, in addition to class II and III canine relationships based on the findings of Peres et al. (5).

Statistical Analysis: Frequencies and percentages were calculated for all variables. Comparisons by gender, type of school, and malocclusion status were conducted using Chi-square or Fisher exact tests. Binary logistic regression was used to assess the effect of different factors on the malocclusion. The model was adjusted for potential confounders (child age, socioeconomic status, and school type). Odds ratios and 95% confidence intervals were calculated. Significance was set at P value < 0.05. Data were analyzed using SPSS statistical software version 23.

Results

Most children were > 4 years old (88.72%), females (50.63%), from private schools (62.06%), and born full-term (95.06%).

Most mothers were aged 20-35 years old (53.17%), were 26-34 years of age at childbirth (54.73%), with Bachelor's or higher degree (84.06%).

Table 1: Characteristics of the study participants (n. of children =709)

Variables		N (%)
Parent Information	Relation	Mother 537 (75.74%)
		Father 172 (24.26%)
		20-35 377 (53.17%)
	Age	36-45 285 (40.20%)
		≥45 47 (6.63%)
		≤25 208 (29.34%)
	Mother's age at childbirth	26-34 388 (54.73%)
		≥35 113 (15.93%)
		≤5000 SR 61 (8.6%)
	Family income	>5000-10000 SR 160 (22.57%)
>10000-15000 SR 189 (26.66%)		
>15000 SR 299 (42.17%)		
Illiterate /Primary and middle school 27 (3.81%)		
Level of education	High school 86 (12.13%)	
	Bachelor 448 (63.19%)	
	Postgraduate studies 148 (20.87%)	
	3-4 80 (11.28%)	
Child Information	Age/years	> 4-5 629 (88.72%)
	Sex	Male 350 (49.37%)
	Female 359 (50.63%)	
Type of schools	Public 269 (37.94%)	
	Private 440 (62.06%)	
	Prenatal/natal history	Full-term 674 (95.06%)
Premature birth 35 (4.94%)		

* SR Saudi Riyal

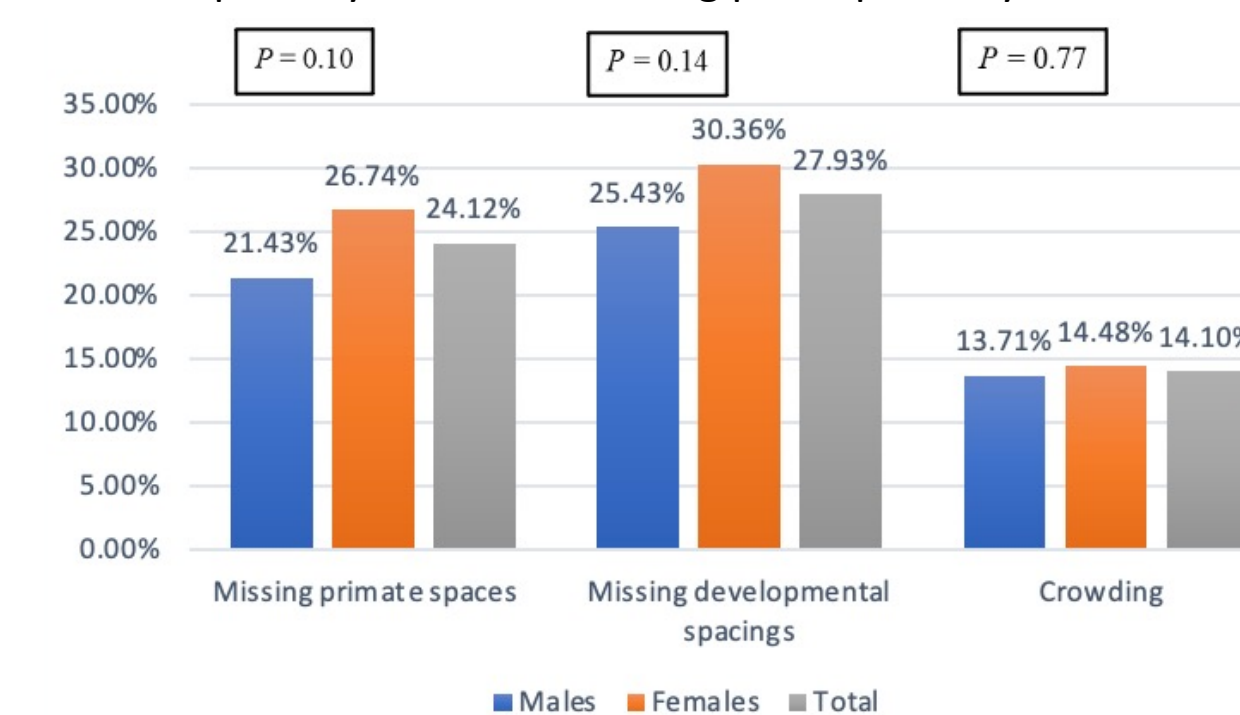
Mesial step was the most common terminal plane (55.01%), followed by the flush plane (42.03%). The most frequent canine relationship was class I (83.22%), followed by class II (9.59%), and class III (7.19%). Normal overjet and overbite represented more than 68% of the sample compared to 25.11% participants with increased overjet, and 26.23% with a deep overbite. Midline deviation was mostly observed in the mandible (15.23%). Unilateral lingual crossbite was more frequent than other types of crossbite. Overall, there were no significant differences between males and females across all occlusal characteristics.

Table 2 Frequency distribution of occlusal characteristics in the three spatial planes among children according to their sex

Spatial planes	Variables	Characteristics	Male N (%)	Female N (%)	Total N (%)	P-value
Molar relationship		Flush (40.86%)	143	155	298	0.80
		Mesial step (56.29%)	197	193	390	
		Distal step (2.85%)	10	11	21	
Sagittal dimension	Canine relationship	Class I (83.43%)	292	298	590	0.99
		Class II (9.43%)	33	35	68	
		Class III (7.14%)	25	26	51	
Overjet		Normal (0-3mm) (67.71%)	237	253	490	0.70
		Increased (≥4mm) (26.00%)	91	87	178	
		Anterior crossbite (>50%) (24.29%)	22	19	41	
Vertical dimension	Overbite	Normal (0% to 50%) (68.57%)	240	244	484	0.11
		Deep overbite (>50%) (24.29%)	85	101	186	
		Anterior open bite (7.14%)	25	14	39	
Transverse dimension	Crossbite	Maxilla (1.43%)	5	8	13	0.43
		Mandible (14.57%)	51	57	108	
		Unilateral lingual (5.14%)	18	12	30	
Crossbite		Unilateral lingual (5.14%)	18	12	30	0.59
		Unilateral buccal/ scissors (2.57%)	9	8	17	
		Bilateral lingual (0.57%)	2	1	3	
Crossbite		Bilateral buccal/ scissors (0.57%)	2	1	3	0.59
		Bilateral lingual (0.57%)	2	1	3	
		Bilateral buccal/ scissors (0.57%)	2	1	3	

Chi square test was used. MCP= Monte Carlo corrected P value.

Figure 1 Frequency distribution of spacing problems in primary dentitions among participants by sex.



Variables	Malocclusion		No malocclusion	P value
	Males	Females	N (%)	
Child sex	Males	208 (49.64%)	142 (48.97%)	0.86
	Females	211 (50.36%)	148 (51.03%)	
School type	Private school	252 (60.14%)	188 (64.83%)	0.21
	Public school	167 (39.86%)	102 (35.17%)	
Family income	≤5000 SR	37 (8.83%)	24 (8.27%)	0.62
	>5000-10000 SR	88 (21.00%)	72 (24.83%)	
	>10000-15000 SR	117 (27.92%)	72 (24.83%)	
	>15000 SR	177 (42.25%)	122 (42.07%)	
Parental educational level	Illiterate	2 (0.48%)	3 (1.04%)	MCP= 0.90
	Primary and middle school	13 (3.10%)	9 (3.10%)	
	High school	49 (11.69%)	37 (12.76%)	
	Bachelor	269 (64.20%)	179 (61.72%)	
Total		419 (59.10%)	290 (40.90%)	-

Chi square test was used. **P= Fisher exact test was used.

Table 3 Prevalence of malocclusion among participants by sex, school type, and socioeconomic status

Variables	Unadjusted model OR (95% CI)	P-value	Adjusted model OR (95% CI)	P-value	
Mother age at childbirth	≤25	1.56 (0.98, 2.48)	0.06	1.70 (1.04, 2.78)	0.03*
	26-34	1.32 (0.87, 2.01)	0.20	1.38 (0.89, 2.14)	0.15
	≥35	Reference	Reference	Reference	Reference
Prenatal history	Full-term	1.23 (0.62, 2.43)	0.55	1.24 (0.61, 2.50)	0.56
	Premature birth	Reference	Reference	Reference	Reference
Feeding method	Breastfeeding	0.85 (0.55, 1.32)	0.47	0.84 (0.53, 1.32)	0.44
	Bottle feeding	1.27 (0.90, 1.81)	0.18	1.26 (0.88, 1.80)	0.21
Family history of malocclusion	Yes	1.39 (0.84, 1.2.30)	0.21	1.34 (0.79, 2.25)	0.28
	No	1.18 (0.70, 1.99)	0.53	1.14 (0.67, 1.93)	0.64
Persistence of oral habits	Yes	1.38 (0.85, 2.26)	0.20	0.74 (0.44, 1.22)	0.23
	No	Reference	Reference	Reference	Reference

Model was adjusted for child age, socioeconomic status (family income and parental education) and school type. Model Chi square = 17.56, p value = 0.35, OR= Odds ratio, CI= Confidence interval

Table 4 Binary logistic regression for the association of different factors with malocclusion. An association only between mother aged 25 years and younger at childbirth with their child malocclusion in primary dentition [OR (95% CI):1.70 (1.04, 2.78)].

Conclusion

Based on the proposed case, the prevalence of malocclusion in primary dentition was considerably high in this study population. Increased overbite and overjet were the most prevalent occlusal discrepancies followed by arch spacing problems. The younger mother's age at childbirth is significantly associated with her child's malocclusion. The study results can serve as a baseline for future investigations in Saudi Arabia.

Acknowledgment

The authors acknowledge children and their parents who participated in this research.

References

- 1-Bishara SE, Khadiwi P, Jakobsen JR. Changes in tooth size-arch length relationships from the deciduous to the permanent dentition: a longitudinal study. American journal of orthodontics and dental orthopedics : official publication of the American Association of Orthodontists, its constituent societies, and the American Board of Orthodontics. 1995;108(6):607-13.
- 2- de Oliveira CM, Sheiham A. Orthodontic treatment and its impact on oral health-related quality of life in Brazilian adolescents. Journal of orthodontics. 2004;31(1):20-7; discussion 15.
- 3- Khan R, Singh N, Govil S, Tandon S. Occlusion and occlusal characteristics of primary dentition in North Indian children of East Lucknow region. European archives of paediatric dentistry : official journal of the European Academy of Paediatric Dentistry. 2014;15(5):293-8.
- 4-Onyiah CO, Nkwere MC. Occlusal changes from primary to mixed dentitions in Nigerian children. The Angle orthodontist. 2008;78(1):64-9.
- 5-Peres KG, Peres MA, Thomson WM, Broadbent J, Hallal PC, Menezes AB. Deciduous-dentition malocclusion predicts orthodontic treatment needs later: findings from a population-based birth cohort study. American journal of orthodontics and dental orthopedics : official publication of the American Association of Orthodontists, its constituent societies, and the American Board of Orthodontics. 2015;147(4):492-8.
- 6- Bishara SE, Hoppens BJ, Jakobsen JR, Kohout FJ. Changes in the molar relationship between the deciduous and permanent dentitions: a longitudinal study. American journal of orthodontics and dental orthopedics : official publication of the American Association of Orthodontists, its constituent societies, and the American Board of Orthodontics. 1995;108(6):607-13.
- 7- Lunc T. Orofacial analysis on the Adriatic islands: an epidemiological study of malocclusions on Hvar Island. Eur J Orthod. 2003;25(3):273-8.
- 8- Farsi NM, Salama FS. Characteristics of primary dentition occlusion in a group of Saudi children. International journal of paediatric dentistry. 1996;6(4):253-9.
- 9- Zhou Z, Liu F, Shen S, Shang L, Shang L, Wang X. Prevalence of and factors affecting malocclusion in primary dentition among children in Xi'an, China. BMC oral health. 2016;16(1):91.
- 10-Nowak AJ, Warren JJ. Infant oral health and oral habits. Pediatric clinics of North America. 2000;47(5):1043-66. vi.
- 11-Petersen PE, Baer RJ. World Health O. Oral health surveys: basic methods. 5th ed ed. Geneva: World Health Organization; 2013. 203.
- 12- Nowak AJ, Christensen JR, Matry TR, Townsend A, Welty M. Pediatric dentistry : infancy through adolescence.2019.
- 13-Farsi NM, Salama FS. Sucking habits in Saudi children: prevalence, contributing factors and effects on the primary dentition. Pediatric dentistry. 1997;19(1):28-33.
- 14- Abanto J, Carvalho TS, Mendes FM, Wanderley MT, Böncker M, Raggio DP. Impact of oral diseases and disorders on oral health-related quality of life of preschool children. Community dentistry and oral epidemiology. 2011;39(2):105-14.