Comparative Study

A GENDER-BASED COMPARATIVE STUDY OF THE RISK OF MALOCCLUSION AND OCCLUSAL TRAITS AMONG PRESCHOOL-AGE CHILDREN

E. Kongo[1*], E. Gaçe[1], B.M. Gravina[2], I. Gribizi[1] and G.M. Gravina[1]

[1]Dentistry Department, Faculty of Medical Science, Albanian University, Tirana, Albania;
[2]University Vita-Salute San Raffaele, Milan, Italy

[*]*Correspondence to*:
Elona Kongo, DDS
Dentistry Department,
Faculty of Medical Science,
Albanian University,
Tirana, Albania
e-mail: elona.kongo@albanianuniversity.edu.al

ABSTRACT

The aim of the present study was to evaluate and compare the risk of malocclusion according to gender using the Baby-Roma Index and occlusal traits in a sample of Albanian preschool-age children. Three hundred thirty children 3-6 years old were screened, and data were collected using the Baby Roma Index. The overall prevalence of malocclusion was 68.8%. None of the examined children was assigned to grade 5 (systemic problems). 46.2% of children (56 males and 49 females) had a score of 4. Similarly, among the children in grade 3, there were more males than females. 31% of participants were assigned minor/no treatment needs. There was no significant relationship between genders and index grades. The most observed frequency of molar relationship right (52.4%) and left (54.1%) sides was flush terminal plane. Distal step was less frequent (17.6% right side and 18.9% left side). There was no significant change in right and left molar relationships between genders. Class I canine relationships (62% right side) and 64% (left side) were the most frequent. There was no significant relationship between canine relationships and gender. Malocclusion was widespread among children included in the study. Almost half of them need orthodontic treatment. There were no gender-based changes in the risk of malocclusion and occlusal traits.

KEYWORDS: *Baby Roma Index, Albanian preschool children, occlusal traits*

INTRODUCTION

The first stage of occlusal development is the primary dentition stage, which begins with the eruption of the first tooth (1). The development of malocclusion begins during the primary dentition stage (2, 3) and can be accordingly detected (4).

Previous studies have confirmed that malocclusion observed in primary dentition represents a risk factor for the necessary orthodontic treatment of permanent dentition (5) and an increase in the frequency in the mixed dentition phase (6). Moreover, children with previous anterior open bite (AOB), increased overjet (OVJ), and posterior crossbite (CB) have a greater risk of having the same characteristics in the mixed dentition (7). The multi-factorial etiology of malocclusion includes mouth breathing and non-nutritive sucking habits.

Received: 28 November 2024
Accepted: 2 January 2025

There are several consequences related to mouth breathing, including malocclusion, the deterioration of oral hygiene, increased prevalence of caries, periodontal diseases, and abnormal maxillofacial growth (8). Persistence of non-nutritive sucking beyond 3 years is implicated in malocclusions, such as AOB, PCB, and Class II molar relationship (9). Hence, it is important to intervene before the malocclusion stabilizes and escalates (3, 10). Interceptive treatments are known to be less invasive, less expensive, faster, and often reduce the need for other treatments (11).

There is concern about the necessity of assessing the need for orthodontic treatment in primary dentition when a wide variety of skeletal, dental, and functional factors, if unobserved, could adversely influence occlusion and craniofacial growth. Grippaudo et al. modified the ROMA (Risk of Malocclusion Assessment Index) index and targeted the age of primary dentition (Baby -ROMA Index). The index is divided into four main categories of problems: systemic, craniofacial, dental, and functional. Each category has a score (from 1 to 5) corresponding to the risk severity and an alphabet letter for each different type of malocclusion (12).

Epidemiological studies can assess the prevalence and establish the risk of malocclusions observed in preschool-age children, which in turn contributes to establishing the need for interceptive orthodontic treatment (13). Hence, considering the limited data regarding the prevalence and complete absence of previous data regarding the risk of malocclusion among Albanian preschool-age children, the aim of the present study was to evaluate and compare according to gender the risk of malocclusion using the Baby-Roma Index and occlusal traits in a sample of preschool age children visiting the University Dental Clinic.

MATERIAL AND METHODS

This descriptive cross-sectional study was conducted at the Dental Clinic of Albanian University, Tirana, Albania, from January 2022 to 2024. Only children with complete primary dentition with no history of previous orthodontic treatment were included in the study. The sample size (330) was calculated by applying the formula:

$$n= z^2 p (1 - p)/e^2$$

Involved children were examined by the authors of the study (E.K and E.G) at the Clinic. The presence of parents during the examination allowed us to collect all the necessary anamnestic data for the Baby Roma Index (12).

Thirty randomly selected children were double-examined for the intra-examiner and inter-examiner reliability tests through Cohen's Kappa coefficient. Both intra-examiner 0.82 and interexaminer 0.77 were considered optimal. Occlusal traits were assessed while each child was biting on his or her posterior teeth with the jaws in centric relation (maximal intercuspation).

The primary molar relationship of the maxillary and mandibular second primary molars for both sides in the vertical plane was classified according to Baume (14).

- flush terminal plane: the distal surfaces of upper and lower primary second molars are in one line with each other when the primary teeth are in occlusion;
- distal step: the distal surface of the lower primary second molar is distal to the distal surface of the primary upper second molar in occlusion;
- mesial step: The distal surface of the mandibular primary second molar was mesial to that of the maxillary primary second molar.

The primary canine relationship was also assessed on both sides (15) and classified as:

Class I: the cusp tip of the maxillary primary canine tooth was in the same vertical plane as the distal surface of the mandibular primary canine.

Class II: the cusp tip of the maxillary primary canine tooth was mesial to the distal surface of the mandibular primary canine.

Class III: the cusp tip of the maxillary primary canine tooth was distal to the distal surface of the mandibular primary canine.

Overjet (OVJ) expressed in (mm) was measured with a graduated periodontal probe from the mid-point of the labial surface of the most anterior lower central incisor to the mid-point of the labial surface of the most anterior upper central incisor.

Overbite (OVB) expressed in mm was measured with a graduated periodontal probe, which is the vertical distance between the incisal edges of the upper and lower central incisors. Spacing was recorded as present when the child had spacing between all teeth in the anterior segments of the maxilla and mandible and absent when there were no visible spaces or tooth rotation was present.

Anterior crossbite (CB) was recorded as present when one or more of the maxillary incisors/canine occluded lingually to the mandibular incisors/canine.

Posterior crossbite was recorded as present when one or more of the maxillary molars occluded lingually to the mandibular molars. Scissors bite was recorded as present when maxillary molars occluded to the buccal surfaces of the corresponding mandibular molars and/or mandibular molars occluded to the lingual surfaces of the corresponding maxillary molars.

Data were statistically assessed by descriptive analysis using the IBM SPSS Statistics 26.0 package program (IBM Corp., Armonk, New York, USA). The associations established between gender and risk of malocclusion Baby Roma Index and occlusal traits were performed using a chi-square test with a significance level set at 5%.

RESULTS

Table I depicts the observed frequency according to index grades. The overall prevalence of malocclusion is 68.8%. None of the examined children was assigned to grade 5 (systemic problems). According to index grades, the most prevalent is from grade 4 caries and early loss of deciduous teeth (35.6%). With reference to grade 4, our result indicates that the prevalence of CB >2mm or lateral shift (4n) is 8.8%, and the prevalence of negative OVJ is 4.8%. Regarding grade 3, the most prevalent is displacement >2mm (3o) 7.8%, and open bite > 4mm (3p) 3.6%.

In grade 2, the most prevalent malocclusion is OVJ 3-6mm (2h) 17.8% and CB<2mm or no lateral shift (2n) 9.3%. The functional problem also belongs to grade 2, and according to Table I, the most prevalent is thumb/finger sucking habit (2w) 24.9% and oral breathing/OSAS (2x) 19.6%.

Table I. *Frequency of Index grades.*

Systemic problems	**Index grade**	**Present**
Maxillo-facial Trauma		
with condylar fracture	5a	0%
without condylar fracture	2a	0%
Congenital Syndromes/Malformations	5b	0%
Postural/ Orthopaedic Problems	2c	0.9%
Medical or Auxological Conditions	2d	0%
Inheritance of malocclusion	2e	2.4%
Craniofacial Problems		
Facial or Mandibular Asymmetries	4f	0.6%
TMJ dysfunctions	4g	1.2%
Outcomes of trauma or Surgery		
of the craniofacial district	5j	0%
Maxillary Hypoplasia /		
Mandibular Hyperplasia		
OVJ<0	4k	4.8%
Dental Problems		
Maxillary Hyperplasia		
/ Mandibular Hypoplasia		
OVJ>6mm	3h	6.2%
3mm<OVJ<6mm	2h	17.8%
Caries and Early Loss		
of DeciduousTeeth	4l	35.6%
Scissor bite	4m	0%
Crossbite		
>2mm or lateral shift	4n	8.8%
<2mm or no lateral shift	2n	9.3%
Displacement		
>2mm displacement	3o	10.1%
>1mm – absence of diastema	2o	9.6%
Open bite		
>4mm	3p	8.4%
>2mm	2p	6.6%
Hypodontia up to 2 teeth	3q	0.6%
more than 2 teeth	4q	0%
Supernumerary teeth	4q	1.2%
OVB>5mm	2r	2.1%
Poor oral hygiene	2t	24.8%
Functional Problems		
Parafunctions (bruxism, jaw		
clenching)	2v	4.8%
Thumb/finger Sucking Habit	2w	24.9%
Oral breathing /OSAS	2x	19.6%
None of the problems		31.2%

Table II shows the frequency and comparison of the risk of malocclusion related to gender; 46.2% of children (56 males and 49 females) scored 4. Similarly, among the children in grade 3, there were more males than females. 31% of participants were assigned minor/no treatment needs. There was no significant relationship between genders and index grades (Table II).

Table II. *Comparison of index grades according to gender.*

Index grades	Female	Male	*p-value*
Minor/ no treatment need	37	33	
Borderline	21	31	0.229
Treatment need 4	49	56	

Results of occlusal traits observed and comparison according to gender are shown in Table III. The most observed frequency of molar relationship on the right (52.4%) and left (54.1%) side was a flush terminal plane. Distal step was less frequent (17.6% right side and 18.9%). There was no significant change in right and left molar relationships between genders.

Class I canine (62% right side) and 64% (left side) were the most frequent. There was no significant relationship between canine relationships and gender (Table III).

Table III. *Comparison of occlusal traits according to gender.*

	Female	Male	*p-value*
Right molar			
Flush terminal plane	54	65	0.707
Mesial step	37	31	
Distal step	19	21	
Left molar			
Flush terminal plane	63	60	0.628
Mesial step	36	44	
Distal step	24	19	
Right canine			
Class I	77	64	0.955
Class II	33	28	
Class III	12	13	
Left canine			
Class I	82	65	0.628
Class II	25	26	
Class III	14	15	

DISCUSSION

The aim of the present study was to evaluate and compare, according to gender, the risk of malocclusion using the Baby-Roma Index and occlusal traits in a sample of Albanian preschool-age children. Previous studies have consistently shown that malocclusion is widespread among preschool-age children, with prevalence rates of 42%, 81.44%, and 89% (6, 16, 17). Indeed, the results yielded from the present study revealed a predominance of children with malocclusion (68.8%) compared to children without malocclusion. Other authors using the same index have also pointed out almost similar frequency of malocclusion, 69%-71% (18, 19).

Apart from prevalence, the Baby Roma Index enables the categorization of the malocclusion with reference to the risk severity. Scores 4 and 5 require an immediate orthodontic treatment (12). 46.2% of our sample had a score of 4. Like Govil (18), who also found that most of the sample had a score of 4 that required an immediate treatment need, and the most frequent malocclusions from this category were caries and early loss of deciduous teeth 35.6%. Dental caries is the main reason for the early loss of deciduous teeth, affects the development of normal occlusion, and increases the need for orthodontic treatment at later stages (20, 21).

Results from various studies show that apart from being closely associated with oral habits (10, 22), the prevalence of posterior CB increases during the transition from primary to permanent dentition (23). The prevalence of posterior CB >2mm in our study was 8.8%, the second most prevalent malocclusion from scale 4. The overall prevalence of CB in our study (18.1%) agrees with the reported prevalence among Slovenian (15.2%) and Spanish children (19.7%) (10, 24).

A score of 3 indicates the presence of a malocclusion, which can persist or worsen; therefore, patients will be assessed again before the growth spurt. OVJ >6mm, open bite >4mm, and displacement >2mm are included in the score of 3. The available literature suggests that these malocclusions are highly prevalent among preschool-age children (6, 25, 26).

The frequency of score 3 in our result (22.8%) is higher than the frequency observed by Grippaudo (9%) and Singh (12.3%) (18,19). A possible explanation for this change is that displacement >2mm was more frequent among children included in this study (10.1% vs 5.1% and 1.4%). The presence of spacing has a strong impact on the eruption of permanent teeth and the establishment of occlusion. Consequently, the absence of spacing increases the occurrence of malocclusion and the necessity of orthodontic treatment (27). In addition to a significant relationship between caries and crowding, a previous study among Albanian preschool children also found that children without maxillary spacing were more susceptible to caries (17).

While a score of 1 is only a routine check-up to monitor the occlusion, a score of 2 is more exposed to the action of risk factors. Mouth breathing and bad oral habits were confirmed as risk factors from a study among Italian preschool children using the same index as in the present study that found a significant association between malocclusion traits such as AOB, increased OVJ, and CB (28). Results yielded from this study [thumb/finger sucking habit (2w) 24.9% and oral breathing/OSAS (2x) 19.6%] are in line with previous reports that similarly found that oral habits and mouth breathing are widespread among children of preschool age (26, 28).

Comparisons according to gender were among the aims of the study. Neither the risk scores nor occlusal traits showed statistically significant differences between females and males. There are various conclusions from other studies using other classification methods regarding gender differences in any malocclusion trait. The study involving Libyan children, except for OVB, did not find significant differences for OVJ, crowding, and CB (4).

Among German children, cross-bite and open-bite were recorded significantly more often in girls (29). Similarly, a study to evaluate the prevalence of subjects needing an interceptive orthodontic treatment (IOTN) found that CB and oral habits were more prevalent among females (11). Ovsenik, in her study, found that posterior CB was more frequent in females, but the difference was not significant (24). Additionally, a study involving Greek children found no significant gender differences in the sagittal relationships of second primary molars and primary canines (30).

CONCLUSIONS

By recognizing the risk of malocclusion during the primary dentition stage, which is already established and directly related to risk factors confirmed in this study, early detection is paramount in preventing the severity and subsequent orthodontic treatment needed in permanent dentition.

Increased awareness from pediatricians, considering that they perhaps examine preschool children more frequently than orthodontists, will benefit both children and parents.

ACKNOWLEDGMENTS

The authors would like to thank all parents who agreed to participate in the study.

Funding

The present study was funded by the Albanian University.

REFERENCES

1. American Academy of Pediatric Dentistry (AAPD). Guideline on Management of the Developing Dentition and Occlusion in Pediatric Dentistry. Published 2009. https://www.aapd.org/research/evidence-based-dentistry/AAPD-Clinical-Guidelines
2. Shavi GR, Hiremath NV, Shukla R, Bali PK, Jain SK, Sunil Lingaraj Ajagannanavar. Prevalence of Spaced and Non-Spaced Dentition and Occlusal Relationship of Primary Dentition and its Relation to Malocclusion in School Children of Davangere. *Journal of international oral health*. 2015;7(9):75-78.
3. Luzzi V, Ierardo G, Corridore D, et al. Evaluation of the orthodontic treatment need in a paediatric sample from Southern Italy and its importance among paediatricians for improving oral health in pediatric dentistry. *Journal of Clinical and Experimental Dentistry*. 2017;9(8). doi:https://doi.org/10.4317/jced.54005
4. Bugaighis. Prevalence of malocclusion in urban libyan preschool children. *Journal of orthodontic science* . 2013;2(2).
5. Caruso S, Nota A, Darvizeh A, Severino M, Gatto R, Tecco S. Poor oral habits and malocclusions after usage of orthodontic pacifiers: an observational study on 3–5 years old children. *BMC Pediatrics*. 2019;19(1).

doi:https://doi.org/10.1186/s12887-019-1668-3
6. Stahl F, Grabowski R. Orthodontic Findings in the Deciduous and Early Mixed Dentition?Inferences for a Preventive Strategy. *Journal of Orofacial Orthopedics/Fortschritte der Kieferorthopdie*. 2003;64(6):401-416. doi:https://doi.org/10.1007/s00056-003-0313-8
7. Góis EG, Vale MP, Paiva SM, Abreu MH, Serra-Negra JM, Pordeus IA. Incidence of malocclusion between primary and mixed dentitions among Brazilian children. *The Angle Orthodontist*. 2012;82(3):495-500. doi:https://doi.org/10.2319/033011-230.1
8. Lin L, Zhao T, Qin D, Hua F, He H. The impact of mouth breathing on dentofacial development: A concise review. *Frontiers in Public Health*. 2022;10. doi:https://doi.org/10.3389/fpubh.2022.929165
9. Majorana A, Bardellini E, Amadori F, Conti G, Polimeni A. Timetable for oral prevention in childhood—developing dentition and oral habits: a current opinion. *Progress in Orthodontics*. 2015;16(1). doi:https://doi.org/10.1186/s40510-015-0107-8
10. Galán-González AF, Domínguez-Reyes A, M. Eugenia Cabrera-Domínguez. Influence of bad oral habits upon the development of posterior crossbite in a preschool population. *BMC Oral Health*. 2023;23(1). doi:https://doi.org/10.1186/s12903-023-03572-0
11. Carli E, Fambrini E, L Lardani, G Derchi, P Defabianis. Early orthodontic treatment need in paediatric age: a prospective observational study in Italian school-children. *European journal of paediatric dentistry*. 2023;24(2):94-98. doi:https://doi.org/10.23804/ejpd.2023.1835
12. Grippaudo C, Paolantonio EG, Pantanali F, Antonini G, Deli R. Early orthodontic treatment: a new index to assess the risk of malocclusion in primary dentition. *Eur J Paediatr Dent* . 2014;15(4):401-406.
13. Polimeni A, Giordano A, Guarnieri R, et al. Epidemiology of Malocclusion in 3,491 Subjects Attending Public Dental Service in Rome (Italy): Evaluation of the Orthodontic Treatment Need Index. *The Journal of Contemporary Dental Practice*. 2019;20(5):631-638. doi:https://doi.org/10.5005/jp-journals-10024-2570
14. Baume L. Physiological tooth migration and its significance for the development of occlusion. I. The biogenetic course of the deciduous dentition. *American Journal of Orthodontics*. 1951;37(11):883-886. doi:https://doi.org/10.1016/0002-9416(51)90160-1
15. 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*. 2014;15(5):293-299. doi:https://doi.org/10.1007/s40368-014-0113-4
16. Normando TS, Barroso RFF, Normando D. Influence of the socioeconomic status on the prevalence of malocclusion in the primary dentition. *Dental Press Journal of Orthodontics*. 2015;20(1):74-78. doi:https://doi.org/10.1590/2176-9451.20.1.074-078.oar
17. Kongo E, Gribizi I, Spahiu E, Gravina GM. Prevalence of malocclusion and oral health-related factors among pre-school children in Northern Albania. *Journal of Clinical Pediatric Dentistry*. 2024;48(2). doi:https://doi.org/10.22514/jocpd.2024.025
18. Govil S, Rathore M, Singh A, Umale V, Kulshrestha R, Kolhe T. Prevalence of Malocclusion and Orthodontic Treatment Needs in Primary and Mixed Dentition Using Baby Roma Index and Index of Orthodontic Treatment Needs. *International Journal of Clinical Pediatric Dentistry*. 2021;14(S1):S22-S28. doi:https://doi.org/10.5005/jp-journals-10005-2014
19. Grippaudo C, Quinzi V, Manai A, et al. Orthodontic treatment need and timing: Assessment of evolutive malocclusion conditions and associated risk factors. *European Journal of paediatric dentistry*. 2020;21(3):3-2020. doi:https://doi.org/10.23804/ejpd.2020.21.03.09
20. Selvabalaji A, Vasanthakumari A, Ishwarya M, Preethi Archana S, Ekambareswaran K, Swetha RK. Prevalence of Early Primary Teeth Loss in 5-9-year-old Schoolchildren in and around Melmaruvathur: A Cross-sectional Study. *The Journal of Contemporary Dental Practice*. 2022;23(10):1004-1007. doi:https://doi.org/10.5005/jp-journals-10024-3403
21. Shakti P, Singh A, Purohit BM, Purohit A, Taneja S. Effect of premature loss of primary teeth on prevalence of malocclusion in permanent dentition: A systematic review and meta-analysis. *International Orthodontics*. 2023;21(4):100816. doi:https://doi.org/10.1016/j.ortho.2023.100816
22. Hegde KS, Bhat SS, Rao HA. Characteristics of Primary Dentition Occlusion in Preschool Children: An Epidemiological Study. *International Journal of Clinical Pediatric Dentistry*. 2012;5(2):93-97. doi:https://doi.org/10.5005/jp-journals-10005-1143
23. Gungor K, Taner L, Kaygisiz E. Prevalence of Posterior Crossbite for Orthodontic Treatment Timing. *Journal of Clinical Pediatric Dentistry*. 2016;40(5):422-424. doi:https://doi.org/10.17796/1053-4628-40.5.422
24. Maja Ovsenik. Incorrect orofacial functions until 5 years of age and their association with posterior crossbite. *American Journal of Orthodontics and Dentofacial Orthopedics*. 2009;136(3):375-381. doi:https://doi.org/10.1016/j.ajodo.2008.03.018
25. de Deus VF, Gomes E, da Silva FC, Giugliani ERJ. Influence of pacifier use on the association between duration of breastfeeding and anterior open bite in primary dentition. *BMC Pregnancy and Childbirth*. 2020;20(1). doi:https://doi.org/10.1186/s12884-020-03054-z
26. Seemann J, Kundt G, Stahl de Castrillon F. Relationship between occlusal findings and orofacial myofunctional status

in primary and mixed dentition. *Journal of Orofacial Orthopedics / Fortschritte der Kieferorthopädie*. 2011;72(1):21-32. doi:https://doi.org/10.1007/s00056-010-0004-1

27. Sun KT, Li YF, Hsu JT, et al. Prevalence of primate and interdental spaces for primary dentition in 3- to 6-year-old children in Taiwan. *Journal of the Formosan Medical Association*. 2018;117(7):598-604. doi:https://doi.org/10.1016/j.jfma.2017.07.010
28. Paolantonio EG, Ludovici N, Saccomanno S, La Torre G, Grippaudo C. Association between oral habits, mouth breathing and malocclusion in Italian preschoolers. *European journal of paediatric dentistry*. 2019;20(3). doi:https://doi.org/10.23804/ejpd.2019.20.03.07
29. Mirjam Berneburg, Zeyher C, Merkle T, Matthias Möller, Schaupp E, Gernot Göz. Orthodontic Findings in 4- to 6-year-old Kindergarten Children from Southwest Germany. *Journal Of Orofacial Orthopedics / Fortschritte Der Kieferorthopädie*. 2010;71(3):174-186. doi:https://doi.org/10.1007/s00056-010-9941-y
30. Davidopoulou S, Arapostathis K, Berdouses ED, Kavvadia K, Oulis C. Occlusal features of 5-year-old Greek children: a cross-sectional national study. *BMC Oral Health*. 2022;22(1). doi:https://doi.org/10.1186/s12903-022-02303-1