Original Article

Baby-Risk of malocclusion assessment index: An assessment tool for preventive orthodontic treatment needs in a selected population of children in southeast of Iran

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ABSTRACT

Context: Preventive orthodontic treatments are performed in the primary or mixed dentition period and provide a proper development of occlusion to avoid dentofacial anomalies. **Aims:** This study aims to evaluate the Baby-Risk of Malocclusion Assessment Index (ROMA) index regarding ease of use, reproducibility, and the epidemiological assessment of major orthodontic problems in children aged 4–6-year-old in Kerman (Iran) kindergartens. **Setting and Design:** This cross-sectional study was conducted on 1000 children aged 4–6 in Kerman (Iran) kindergartens, selected by cluster sampling, and data were collected using the Baby-ROMA index. **Methods:** After recording a demographic data collection form, the clinical examination of the teeth was carried out by a dental student. The data were analyzed with SPSS 18 using *t*-test, analysis of variance, Chi-squared test, and Mann–Whitney test at a significance level of $P < 0.05$. **Results:** In this study, the most common cause of malocclusion was dental caries (7.5%), followed by crossbite (6.1%). Furthermore, 31.6% of the subjects had one type of malocclusion, and 20.5% needed monitoring the occlusion before the growth spurt, while 11.1% needed immediate orthodontic treatment (mostly 6-year-old children). Moreover, 15.3% of the subjects had systemic problems; 3.4% had craniofacial, 22% had dental, and 2% had functional problems. The prevalence of class I canine relationship in the right canines was 82.32%, with 82.5% on the left side. The prevalence of open bite was higher in females with thumb-sucking habit. **Conclusion:** The Baby-ROMA index presented good reliability and ease of use for evaluating early orthodontic treatment needs in primary and mixed dentition periods.

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Introduction

The purpose of preventive orthodontic treatments, in particular in the primary or early mixed dentition period, is to provide a proper development of the occlusion by avoiding the progression of malocclusion.[1,2]

Such treatments provide more stable clinical results, less need for the extraction of permanent teeth, a lower cost in comparison with the conventional ones, a decrease in the incidence of enamel hypoplasia and periodontal diseases and an increase in parents' satisfaction.[3-5]

Early orthodontic treatments have good clinical results in primary and mixed dentitions, including the treatment of class III malocclusion caused by maxillary hypoplasia,[6,7] correction of functional posterior crossbites, space management.[6,7] However, the debate still continues regarding the effectiveness of the dual-phase treatments in the case of class II malocclusions.[8-11]

Evaluating the severity of malocclusion is performed using various indices of occlusal parameters, mostly for permanent teeth.[12] Among several indices, the occlusal index (OI) is only based on primary dentition, and since it does not address the skeletal and functional problems, its data collection is complicated.[13] Furthermore, the Index for Preventive and Interceptive Orthodontic Need (IPION) is a valuable tool for preventing malocclusion in children 6–9 years of age, but it cannot measure the prevalence of malocclusion. Severe malocclusions are in the lowest category in this index due to the futility of preventive treatments.[14] On the other hand, the Index of Complexity Outcome and Need (ICON) is suitable for the late mixed and permanent period.[15] Since the above-mentioned indices do not evaluate the orthodontic treatment needs for primary dentition, this study assesses the use of the Baby-Risk of Malocclusion Assessment Index (ROMA) index.

The ROMA was developed to evaluate the prevalence of malocclusion in permanent and mixed dentition periods which was validated[16] by testing on a population of 9–13-year-old Italian children.[17,18] This index has been modified to the new Index of Baby-ROMA, primarily characterized for primary dentition, approved by[19] Grippaudo *et al*. (2007), thus is fast, sensitive, and reliable for diagnosing and prioritizing orthodontic treatment needs.[16] In addition, early diagnosis and correction of maxillofacial anomalies increase the oral health-related quality of life for the children who spent many years of their childhood having craniofacial anomalies with low self-esteem.[20,21]

Due to the inability of the traditional indices (OI,[13] IPION,[14] and ICON,[15]), in primary dentition and the lack of such studies, the present investigation aimed to assess the Baby-ROMA index in terms of ease of use and reliability, as well as the epidemiological assessment of major orthodontic problems in 4–6-year-old children requiring orthodontic treatment.

Methods

This cross-sectional/descriptive-analytical study was conducted on 1000 (50.2% males and 49.8% females) children aged 4–6 years in the south-east of Iran (Kerman) kindergartens in 2017. The sample size was calculated at 400 participants (based on the sample size formula $n = (Z_{1-\alpha/2})^2 p\,(1-p)/d^2$), which was finally multiplied by two according to the sampling method and the design effect (800 subjects); the sample size was increased by 20% to accommodate possible sample dropouts; finally, 1000 subjects were included in this study.

The children were selected using the random cluster sampling method. As such, Kerman city was divided into four urban areas, and five kindergartens from each region were considered, and finally, 50 children from each kindergarten were selected by simple random sampling method. The proposal of this study was approved by the Ethics Committee of the Research Council of Kerman University of Medical Sciences under the ethics code of 96000356.

The data were collected using the Baby-ROMA index [Table 1].

The index mentioned above was modified from the ROMA Index set up by Russo *et al*.[22] to evaluate skeletal and functional aspects of malocclusions in mixed and permanent dentitions. After validating the ROMA Index[16] and examining a large sample of Italian children aged 9–13,[17,18] it was targeted on the primary dentition and modified to the Baby-ROMA index. The Baby-ROMA index is divided into four main groups (systemic, craniofacial, dental, and functional), in which the index measures occlusal parameters and skeletal and functional factors. Each group has a number that indicates the intensity and a letter of the alphabet that represents different types of malocclusion and evaluates the need for interceptive orthodontic treatment in a score scale: scores of 4 and 5 require immediate orthodontic treatment, 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. Scores of 1 and 2 need only routine follow-ups to monitor the occlusion; score 2 is more exposed to the action of risk factors.

After submitting the informed consent form to the parents and recording a demographic data collection form, the clinical examination of the teeth was carried out using a disposable mirror and a dental probe under a 100-Watt lamp in the kindergarten class by a dental student. All the children exhibited a complete deciduous dentition or an early mixed dentition. Noncooperative children and children with ongoing orthodontic treatment were excluded from the study. The participants were free to leave the study at any stage of the study. The data collection form was anonymous, and all the demographic data remained confidential. The teeth examined were recorded in the relevant table for each person according to the index guidelines' coding and score of each code. Furthermore, in the end, the children participating in the study were awarded a toothbrush and given oral health behavior instructions.

Table 1: Baby-risk of malocclusion assessment index

Systemic problems	
Maxillofacial trauma	
With condylar fracture	5a
Without condylar fracture	2a
Congenital syndromes/malformations	5b
Postural/orthopedic problems	2c
Medical or auxological conditions	2d
Inheritance of malocclusion	2e
Craniofacial problems	
Facial or mandibular asymmetries	4f
TMJ dysfunctions	4g
Outcomes of trauma or surgery of the craniofacial region	5j
Maxillary hypoplasia/mandibular hyperplasia	
OVJ <0	4k
OVJ >0	2k
Maxillary hyperplasia/mandibular hypoplasia	
OVJ >6 mm	3h
3 mm < OVJ <6 mm	2h
Dental problems	
Caries and early loss of deciduous teeth	4l
Scissor bite	4m
Crossbite	
>2 mm or lateral shift	4n
<2 mm or no lateral shift	2n
Displacement	
>2 mm displacement	3o
>1 mm-absence of diastema	2o
Open bite	
>4 mm	3p
>2 mm	2p
Hypodontia	
Up to 2 teeth	3q
> 2 teeth	4q
Functional problems	
Supernumerary teeth	4q
OVB >5 mm	2r
Poor oral hygiene	2t
Parafunctions (bruxism, jaw clenching)	2v
Thumb/finger sucking habit	2w
Oral breathing/OSAS	2x

OVJ=Overjet; TMJ=Temporomandibular joint; OVB=Overbite; OSAS=Obstructive sleep apnea syndrome

The data were analyzed using SPSS Inc. Released 2009. PASW Statistics for windows, version 18.0. Chicago, USA:SPSS Inc. at a significance level of $P < 0.05$ using *t*-test, analysis of variance, Chi-squared test, and Mann–Whitney test.

Results

In this study, 50.2% of the participants were male, and 49.8% were female (34.5% were 4-year-old, 24% 5-year-old, and 41.5% 6-year-old). The most common cause of malocclusion was dental caries (7.5%), followed by crossbite (6.1%). In addition, 31.6% of the subjects had one type of malocclusion, 20.5% needed monitoring and check-up of the occlusion before the growth spurt, and 11.1% needed immediate orthodontic treatment. This study showed that 15.3% of the subjects had systemic problems, 3.4% had craniofacial problems, 22% had dental problems, and 2% had functional problems [Tables 2 and 3].

A significant difference was found in the mean score of the Baby-ROMA index in terms of the presence or absence of dentofacial problems ($P = 0.0001$) [Table 4].

The most prevalent facial form in the population was normal (68.8%), followed by mesial step molar relationship in the right (82.5%) and left (79.9%) molars. The prevalence of Class I canine relationship was 82.32% in right canines and 82.5% on the left side. There was no significant relationship between molar and canine relationships and gender [Table 5]. Nevertheless, there was a significant relationship between right molars' relationship and age ($P = 0.02$), but no significant correlation was detected between left molars and canine relationships and age [Table 5].

Table 2: Frequency distribution of measured parameters in children

	n (%)
Systemic problems	
Maxillofacial trauma	5a (0)
	2a (0.1)
Congenital syndromes, malformations	5b (0)
Postural/orthopedic problems	2c (7/3)
Medical or auxological conditions	2d (0.1)
Inheritance of malocclusion	2e (8)
Craniofacial problems	
Facial or mandibular asymmetries	4f (0)
TMJ dysfunctions	4g (0)
Outcomes of trauma or surgery of the craniofacial district	5j (0.2)
Maxillary hypoplasia/mandibular hyperplasia	
OVJ <0	4k (2.5)
OVJ >0	2k (0.7)
Maxillary hyperplasia/mandibular hypoplasia	
OVJ >6 mm	3h (1.3)
3 mm < OVJ <6 mm	2h (4.3)

TMJ=Temporomandibular joint; OVJ=Overjet

Table 3: Frequency distribution of measured parameters in children continued

	n (%)
Dental problems	
Caries and early loss of deciduous teeth	4l (7.5)
Scissor bite	4m (0.4)
Crossbite	
>2 mm or lateral shift	4n (1.8)
<2 mm or no lateral shift	2n (4.3)
Displacement	
>2 mm displacement	3o (0.7)
>1 mm-absence of diastema	2o (1)
Open bite	
>4 mm	3p (0.7)
>2 mm	2p (0.9)
Hypodontia	
Up to 2 teeth	3q (0.3)
>2 teeth	4q (0.1)
Supernumerary teeth	4q (0.2)
OVB >5 mm	2r (1.9)
Poor oral hygiene	2t (5.7)
Functional problems	
Parafunctions (bruxism, jaw clenching)	2v (0.3)
Thumb/finger-sucking habit	2w (1.2)
Oral breathing/OSAS	2x (0.7)

OVB=Overbite; OSAS=Obstructive sleep apnea syndrome

Table 4: Comparison of the baby-risk of malocclusion assessment index mean in terms of the presence or absence of the problem

Frequency	Presence of the problem	Mean±SD	*P*
Systemic problems	No	0.61±1.317	0.0001*
	Yes	2.37±0.733	
Craniofacial problems	No	0.78±1.311	0.0001*
	Yes	3.65±0.884	
Dental problems	No	0.29±0.812	0.0001*
	Yes	2.95±1.021	
Functional problems	No	0.831±0.372	0.0001*
	Yes	3.05±0.887	

*=0.05; SD=Standard deviation

Notably, there was a significant relationship between gender and anterior open bite parameter in children of Kerman kindergartens ($P = 0.04$), but the prevalence of severe open bite was higher in females.

Overall, the results showed a significant relationship between age and postural/orthopedic problems in children of Kerman kindergartens ($P = 0.0001$), which increased with aging. Age exhibited a significant relationship with the variables of caries and early loss of primary teeth in children of kindergartens in Kerman ($P = 0.0001$) and caries with a higher rate in the age group of 6 years [Table 6]. There was no significant relationship between caries and early loss of primary teeth and gender ($P = 0.69$), and the dental condition was similar in both sexes [Table 6]. Furthermore, there was a significant relationship between the open bite variable and thumb/finger-sucking habit ($P = 0.0001$).

Discussion

Ideally, interceptive orthodontic treatments are performed to decrease the risk of more complicated treatments in permanent dentition. In this study, the most common cause of malocclusion was caries and premature loss of deciduous teeth, confirmed by the significant correlation between age, dental caries, and premature loss of deciduous teeth.

The most likely occlusal abnormality was crossbite, which differs from the results of a study by Luzzi *et al*.[23] Grippaudo *et al*.[24] reported that increased overbite was the most common occlusal abnormality, consistent with the data reported by Petrén *et al*. in primary dentition[25] and Lin *et al*.[26] due to the age difference in the studies mentioned above. In a study by Asiry and AlShahrani, the most prevalent malocclusion trait was crowding (26.6%), followed by spacing (20.6%), increased overjet (19.5%), increased overbite (19.4%), posterior crossbite (8.5%), and anterior open bite (6.1%),[27] whereas Perrotta *et al*.[28] reported that posterior crossbite was observed in 12% of children. Since posterior crossbite leads to asymmetric mandibular development, parents should be informed about the importance of early intervention.

Among the 4–6-year-old children in Kerman kindergartens, 11.1% needed immediate orthodontic treatment, and 20.5% needed monitoring and routine occlusion check-ups before the pubertal growth spurt. Grippaudo *et al*. concluded that 31.5% of children required immediate orthodontic treatment, and 18.5% needed evaluation and routine occlusion follow ups before puberty.[24] Such difference is because in the study by Grippaudo *et al*., children who had problems were referred, and therefore, they had more dentofacial anomalies.

Farrokh Gisour *et al*.[29] used IOTN on 6–11-year-old children and found that 24.1% of children required immediate orthodontic treatment and 34.3% had an intermediate need for orthodontic treatment. This difference is possibly due to the sample age range (6–11) and the relevant index. Therefore, with increasing age and the end of the primary and mixed dentition periods, the need for orthodontic treatment increases. Considering the problems, 15.3% of the subjects had systemic problems, 3.4% had craniofacial problems, 22% had dental problems, and 2% had functional problems, while in the study of Grippaudo *et al*.,[24] 1% had systemic, 12.5% had craniofacial, 38.5% had dental, and 6% had functional problems. This indicates that dental problems were the most common in both studies. There was a significant correlation between age and postural orthopedic problems in children of Kerman city ($P = 0.0001$); however, with

Table 5: Frequency distribution of molar and canine relationships in terms of age and gender

Relationship type	Gender		P	Age (years old)			P
	Male	Female		4	5	6	
Right molar							
Distal step	2	3	0.88	0	0	5	0.02
Mesial step	415	410		298	198	335	
Flush terminal plane	6	4		53	40	67	
Left molar							
Distal step	5	5	0.80	0	3	7	0.12
Mesial step	400	391		281	190	320	
Flush terminal plane	87	95		61	44	77	
Right canine							
Class I	412	411	0.73	282	198	343	0.80
Class II	80	74		56	38	60	
Class III	10	13		7	4	12	
Left canine							
Class I	410	415	0.59	286	199	340	0.87
Class II	77	66		49	33	61	
Class III	15	16		9	8	14	

Table 6: Frequency distribution of measured parameters according to age and gender

Variable	Scoring	Age			P	Gender		P
		4, *n* (%)	5, *n* (%)	6, *n* (%)		Male, *n* (%)	Female, *n* (%)	
Postural/orthopedic problems	No	32.0	23.7	37.0	0.0001*	47.2	45.5	0.10
	Yes, score 2	2.5	0.3	4.5		3.0	4.3	
Inheritance of malocclusion	No	31.6	21.6	38.8	0.26	45.8	46.2	0.37
	Yes, score 2	2.9	2.4	2.7		4.4	3.6	
Maxillofacial trauma	No	34.4	24.0	41.5	0.38	50.2	49.7	0.31
	Yes, score 2	0.1	0.0	0.0		0.0	0.1	
Maxillary hypoplasia/mandibular hyperplasia	No	33.4	23.3	40.1	0.67	48.5	48.3	0.32
	Yes, score 2	0.2	0.3	0.2		0.2	0.5	
	Yes, score 4	0.9	0.4	1.2		1.5	1.0	
Caries and early loss of deciduous teeth	No	33.5	22.7	36.3	0.0001*	46.5	46.0	0.87
	Yes, score 4	1.0	1.3	5.2		3.7	3.8	
Crossbite	No	32.4	22.5	39.0	0.99	46.9	47.0	0.75
	Yes, score 2	1.5	1.1	1.7		2.4	1.9	
	Yes, score 4	0.6	0.4	0.8		0.9	0.9	
Displacement	No	34.3	23.7	40.3	0.10	49.3	49.0	0.76
	Yes, score 2	0.2	0.2	0.6		0.6	0.4	
	Yes, score 3	0.0	0.1	0.6		0.3	0.4	
Open bite	No	34.0	23.7	40.7	0.86	49.4	49.0	*0.04
	Yes, score 2	0.2	0.2	0.5		0.1	0.6	
	Yes, score 3	0.3	0.1	0.3		0.1	0.6	
Supernumerary teeth	No	34.5	23.9	41.4	0.52	50.1	49.7	0.99
	Yes, score 4	0.0	0.1	0.1		0.1	0.1	
Thumb/finger sucking habit	No	34.1	23.8	40.9	0.78	49.8	49.0	0.24
	Yes, score 2	0.4	0.2	0.6		0.4	0.8	

increasing age, the habits of undermining the hand and stress-induced tongue biting are increased. No significant correlation was observed between gender with molar and canine relationships, as found by Shen *et al*.[30] In addition, a large number of studies showed that no gender differences in malocclusion.[31-34] This investigation also showed that 31.6% of the subjects had one type of malocclusion, consistent with Sahafian's study in Mashhad,[35] where the prevalence of malocclusion was reported to be 95.3%, which could be due to differences in age group and different scales and regions. A significant relationship was evident between age and dental condition in kindergartens in Kerman city (P = 0.0001), and with increasing age, the need for orthodontic treatment increased. Also, the greatest need for orthodontic treatment was observed in the 6-year-old age group. It was noteworthy that most children had Mesial step with a prevalence of

82.5% on the right and 79.1% on the left sides. Bhayya *et al*.[36] suggested that 52.5% of children (4–6 years), and Shen *et al*.[30] reported that 10.52% had a flush terminal pattern, but the distal step pattern was the least frequent parameter in the above studies.

Our results are similar to a meta-analysis by Akbari *et al*. on 3–5-year-old children[37] and another study in Jordan, in which the mesial step was the most prevalent and the distal step was the least prevalent.

The prevalence of class I canine relationships was 82.2% and 82.5% on the right and left sides, consistent with studies by Bhayya *et al*., Hegde *et al*., and Yilmaz *et al*., in which the prevalence of class I canine relationships was the most prevalent.[36,38,39] Other studies agreed on the low prevalence of the Cl III pattern, like studies by Perrotta *et al*.[28] and Asiry and AlShahrani,[27] in which the most and the least prevalent occlusion patterns were class I and class III. As such, we found no association between age and an increased tendency toward class I canine relationship. However, Hegde *et al*. suggested that the forward movement of the mandible and eruption force of the first permanent molar could imply a Class I canine relationship in most previous studies.[38]

A significant correlation was observed between thumb-sucking and open bite (P = 0.0001); thus, some habits such as thumb and finger-sucking are known as the main causes of anterior open bite, leading to problems at anterior-posterior, vertical, and transverse plans. Therefore, this makes early intervention necessary, especially in girls in whom the prevalence of severe open bite was significantly higher (P = 0.04).

Since this study was only conducted on 1000 children aged 4–6 in Kerman city, it is evident that further investigations should concentrate on more participants to ensure that the Baby-ROMA index is efficient and has excellent reliability and sensitivity for the diagnosis of early orthodontic treatment needs in the primary dentition.

Conclusion

Most 4–6-year-old children in Kerman had one type of malocclusion, while one-third of them need immediate orthodontic treatment. Of these, 6-year-old children were most likely to need immediate orthodontic treatment, but there was no difference between genders in their need for orthodontic treatment. In our study, the Baby-ROMA index exhibited good reliability and ease of use for evaluating early orthodontic treatment needs in primary and mixed dentitions.

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Conflicts of interest

There are no conflicts of interest.

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