RESEARCH ARTICLE

Prevalence of Malocclusion and Orthodontic Treatment Needs in Primary and Mixed Dentition Using Baby Roma Index and Index of Orthodontic Treatment Needs

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Abstract

Aim and objective: To find the prevalence of malocclusion and orthodontic treatment need in children of East Lucknow city.

Materials and methods: The present study was conducted in the Department of Pedodontic and Preventive Dentistry, Babu Banarasi Das College of Dental Sciences, Lucknow. The nursery and primary schools of East Lucknow were included in the study. Baby-ROMA Index and Index of Orthodontic Treatment Needs (IOTN) were tested on 400 children, which were divided into two groups of 200 in each group, referred from the Out Patient Department and school camps. A single operator who was trained and calibrated for the use of indices evaluated children.

Results: Intra-reliability test showed higher reproducibility of the index. It is shown that around 70% of the patient presented malocclusion from both indices.

Conclusion: Baby-ROMA Index and IOTN were helpful to assess the severity of malocclusion and the timing for orthodontic malocclusion in young patients (primary and mixed dentition).

Keywords: Baby-ROMA Index, IOTN, Treatment need.

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Introduction

Malocclusion is associated with a large degree of subjectivity and distortion regarding how treatment need is perceived. Many studies show that there is an association between malocclusion or orthodontic treatment needs and poor health-related quality of life.[1] Many developing countries including India are struggling to eradicate medical and dental diseases. The main reason behind this is an inadequate implementation of preventive oral healthcare programs, which need a sound base of epidemiological data. Epidemiological studies on occlusion and malocclusion not only help in orthodontic treatment planning and evaluation of dental services but also offer a valid research tool for ascertaining the role of distinct environmental and genetic factors in the etiology of malocclusion. Indices of orthodontic treatment are used in screenings and epidemiological studies to identify the priority of treatment.[2]

According to the studies conducted by Proffit et al.,[3] Kelly and Harvey,[4] Mills,[5] it is found out that prevalence of malocclusion varies from country to country and among different ages and sex groups. Several studies illustrating that there are state-wise variations on the prevalence, Dhar et al. in 2007 in Rajasthan found out the prevalence of malocclusion 66.7%. Pruthi et al. observed a 53% prevalence of malocclusion in the state of Himachal Pradesh. In Uttar Pradesh state, Agarwal et al. in 2015 found 34.09% had malocclusion in his prevalence study.[6] Indices are being used globally in the field of medicine and dentistry to classify the disease conditions, to understand the etiology, risk, prognosis, and treatment outcome, to determine prevalence and incidence of disease/conditions. Early orthodontic treatments are particularly effective and desirable when the correction of skeletal malocclusions in young children is required since more stable results are achievable with subsequent increased parental satisfaction (King;[7] Kluemper;[8] Musich[9]).

Orthodontic therapies in primary dentition contribute to oral health and avoid patients with more complicated treatments in permanent dentition (SIOI).[9] Thus, the present study was done to determine the prevalence of malocclusion and orthodontic treatment needs in children of East Lucknow city.

The objectives of this study are:

- To determine the prevalence of malocclusion in 3–12 years old children of east Lucknow city.
- To evaluate the orthodontic risk and treatment needs in 3–6 years old children by Baby ROMA index and in 7–12 years old children by the Index of Orthodontic Treatment Needs (IOTN).

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- To evaluate intra-examiner reproducibility of Baby-ROMA Index and IOTN for assessment of the risk of malocclusion in 3–12 years old children

Materials and Methods

The present study was conducted in the Department of Pedodontics and Preventive Dentistry, Babu Banarasi Das College of Dental Sciences; Lucknow after it was thoroughly reviewed and approved by the Institutional Ethical Committee. The nursery and primary schools of East Lucknow were included in the study to investigate the prevalence of malocclusion and their orthodontic treatment needs.

Study Area

The present study was conducted on a sample of 400 children with primary or mixed dentition, including both males and females. The subjects were randomly selected from the OPD of the Department of Pedodontics and Preventive Dentistry and the 6 schools of the East Lucknow region comprising of varying socioeconomic groups. The schools surveyed were as follows–King George School, Gharunda Camp, Gyan Convent Public School, Kids Kingdom School, Euro Kids School, Shaheed Chandra Shekhar Azad School.

This prevalence study is based on the hypothesis of clinical diagnosis using the malocclusion index that revealed the actual picture of malocclusion and their treatment needs.

The sample size was selected based on the formula for unknown population of a particular area:

$$n = \frac{Z^2 P \times (1-P)}{e^2}$$

Where, n = sample size, Z^2 = 3.84 (constant), P = proposed prevalence, E = 0.05 (permissible error 5%).

This gave a sample size of 400.

Children with primary and mixed dentition; Children who had not undergone any past orthodontic treatment; Children whose parents gave consent to participate in the study were included in the study. And those children with permanent dentition were excluded. The armamentarium used for the study was a Mouth mirror (Microlux Lighted mirror), Probe, Tweezers, examination Gloves, Cotton, Kidney tray, Digital caliper.

Prior consent was obtained from the parents of all the participants and the respective school authorities.

Study Design

The sample size of 400 subjects was divided into two groups; based on age groups and dentition.

Group (I): Aged between 3 years and 6 years with primary dentition.

Group (II): Aged between 7 years and 12 years with mixed dentition.

Clinical analysis of occlusal deformities in the group (I) was evaluated by Baby Roma Index and group (II) by IOTN-DHC Index.

Methods

Along with a thorough general examination of the child, detailed medical and dental history was obtained. The extraoral and intraoral examination was done to check the malocclusion of all the subjects which was performed by a single examiner using mouth mirrors, probe, and natural light as the source of illumination. The subjects were explained in detail the purpose and method of examination. A proforma was prepared which contains personal details such as name, gender, and age, and grading of the indices and later it was copied to an excel sheet. The average number of 10–15 children was examined per day to avoid the effects of tiredness.

IOTN Criteria

The index was classified on index IOTN-DHC.

The DHC of IOTN has five grades:

Grades I and II represent no/little need for treatment.

Grade III represents a borderline need for treatment.

Grades IV and V represent a high priority for treatment.

In use, 10 features or traits of malocclusion are considered: Overjet, anterior crossbite, overbite, open bite, lateral crossbite, displacement of teeth, impeded eruption of teeth, clefts of the lip and/or palate, Class II and Class III buccal occlusion, and hypodontia. The acronym "MOCDO" (missing, overjet, crossbite, displacement, and overbite) means that missing teeth and overjet, including reverse overjet, have the highest priority in the assessment of treatment needs. The hierarchical scale was designed to provide a guide for systematic examination, with the examiner recording and focusing the treatment activity to the higher evaluated anomaly in the case of two or more occlusal anomalies.

After screening and validation of the intra-examiner reliability, 40 subjects were recalled after 1 month.

The data were then subjected to statistical analysis for the prevalence of malocclusion.

Statistical Analysis

The results are presented in frequencies and percentages. A Chi-square test was used for comparisons. The reliability analysis was performed. Cronbach's Alpha and intra-class correlation coefficients were calculated. The p value < 0.05 was considered significant. All the analyses were carried out on the SPSS 16.0 version (Chicago, Inc., USA). Intra-class correlation coefficients (ICC): Scrutinize the output from the ANOVA and find the F value for the subject term. The retest correlation, calculated as an intra-class correlation coefficient (ICC), is derived from this F value: ICC = $(F - 1)/(F + k - 1)$,
where k = (number of observations – number of tests) (number of subjects – 1).

Results

Baby Roma Index

Table 1 depicts a sample size of 200 subjects, out of which 138 subjects had malocclusion and 62 subjects were free from malocclusion. Thus, the prevalence of malocclusion in 3–6-year-old children using the Baby ROMA index was 69% (95% CI = 62.0–75.0%). The male subjects had 60.6% malocclusion and female subjects had 78.1% malocclusion. The values were highly significant in females (0.007; $p < 0.05$) (Table 2).

The allocation of subjects according to age and malocclusion showed that there was a high prevalence of malocclusion in 3 years age group (80%) with significant values (0.03; $p < 0.05$) (Table 3).

Table 1: Prevalence of malocclusion in 3–6 years old children

Index: Baby Roma Index	*Subjects (n = 200)*	*Percentage*
Malocclusion	138	69.0
Normal	62	31.0

Table 2: Gender-wise prevalence of malocclusion in 3–6 years old children

		Malocclusion		*Normal*		
Gender	*No. of patients*	*No.*	*(%)*	*No.*	*(%)*	*p value*[1]
Male	104	63	60.6	41	39.4	0.007*
Female	96	75	78.1	21	21.9	

[1]Chi-square test, *Significant

Table 3: Age-wise prevalence of malocclusion in 3–6 years old children

		Malocclusion		*Normal*		
Age in years	*No. of patients*	*No.*	*%*	*No.*	*%*	*p value*[1]
3	90	72	80	22	24.4	0.03*
4	42	26	61.9	16	38.1	
5	40	20	50.0	20	50.0	
6	28	20	71.4	8	28.6	

[1]Chi-square test, *Significant

Table 4: Distribution of dental and skeletal features according to Baby ROMA Index in 3–6 years old children

Index values	*No. (n = 138)*	*%*	*Dental and skeletal features of baby ROMA index*
4l	52	37.7	Caries and early loss of deciduous teeth
2t	33	23.9	Hypodontia >2 teeth
4g	5	4	TMJ dysfunction
2a	6	4.3	Maxillofacial trauma without condylar fracture
3h	3	2.2	Maxillary hyperplasia OVJ >6 mm
3p	3	2.2	Open bite >4 mm
2w	6	4.3	Thumb sucking habit
2c	2	1.4	Postural/orthopedic problems
4f	8	5.8	Mandibular asymmetries
3q	8	5.8	Hypodontia <2 teeth
3o	2	1.4	Displacement > 2 mm
2x	2	1.4	Oral breathing
5b	1	0.7	Congenital syndromes/ malformations
2d	2	1.4	Medical and auxiological problems
5a	1	1.7	Maxillofacial trauma with condylar fracture
4k	1	1.7	Maxillary hypoplasia OVJ <6 mm
2n	1	1.7	Crossbite <2 mm or no lateral shift
3n	1	1.7	>2 mm crossbite or lateral shift
2v	1	1.7	Bruxism

Table 4 illustrates the prevalence of dental and skeletal features according to the Baby ROMA index in 3–6 years old children. The most common finding of the Baby ROMA index is Caries and early loss of deciduous teeth (37.7%), followed by hypodontia with >2 teeth (23.9%) and the mandibular asymmetries and hypodontia <2 teeth (5.8%).

Table 5: Orthodontic treatment needs in 3–6 years old children

Severity grades	*Percentage*
• Grade V = urgent treatment need	1.4
• Grade IV = treatment need	47.8
• Grade III = borderline treatment need	12.3
• Grade II = minor anomaly, no treatment need	38.5

Table 6: Prevalence of malocclusion in 7–12 years old children

Index: IOTN Index	*Subjects (n = 200)*	*Percentage*
Malocclusion	142	71.0
Normal	58	29.0

IOTN

Table 5 depicts the prevalence of orthodontic treatment needs in 3–6 years old children. It showed that 49.2% malocclusion was present in children who required orthodontic therapy (scores 4 and 5) It also revealed that 50.8% malocclusion was present in children that might persist or worsen with growth. Table 6 depicts the prevalence of malocclusion in 7–12 years old children. The prevalence of malocclusion in 7–12-year-old children using the IOTN index was 71% (95% CI = 64.3–76.8%). Table 7 illustrates the prevalence of dental and skeletal features according to the IOTN index in 7–12 years old children. The sequentially most common finding seen were as follows: impeded eruption of teeth –26.8%. Extensive hypodontia with restorative implications (>one tooth missing in any quadrant requiring pre-restorative orthodontics-19%, and posterior lingual cross-bite with no functional occlusal contact in one or more buccal segments-12%). The score of other findings was <10%. From Table 8, it is concluded that 75.4% malocclusion is present in children who required orthodontic therapy (scores 4 and 5). Malocclusion present in children that might persist or worsen with growth was 24.6% (grades II and III).

Comparison of the Two Indices

Table 9 illustrates the intraobserver reliability of the Baby ROMA index. A total number of 20 subjects were randomly selected and

Table 7: Distribution of dental and skeletal features according to IOTN in 7–12 years old children

Index values	*No. (n = 142)*	*(%)*	*Dental and skeletal features of IOTN index*
3f	5	3.5	Increased and incomplete overbite without gingival or palatal trauma
4j	3	2.1	Partially erupted teeth, tipped and impacted against adjacent teeth
4e	3	2.1	Extreme lateral or anterior open bites >4 mm
4h	17	12.0	Posterior lingual cross-bite with no functional occlusal contact in one or more buccal segments
4a	4	2.8	Increased overjet >6 mm but ≤9 mm
5i	38	26.8	Impeded eruption of teeth (apart from 3rd molars) due to crowding, displacement, the presence of supernumerary teeth, retained deciduous teeth, and any pathological cause
2a	4	2.8	Increased overjet >3.5 mm but ≤6 mm (with competent lips)
3d	3	2.1	Displacement of teeth >2 mm but ≤4 mm
2f	1	0.7	Increased overbite ≥3.5 mm (without gingival contact)
4c	3	2.1	Anterior or posterior cross-bites with >2 mm discrepancy between the retruded contact position and intercuspal position
3a	1	0.7	Increased overjet >3.5 mm but ≤6 mm (incompetent lips)
5m	3	2.1	Reverse overjet >3.5 mm with reported masticatory and speech difficulties
3e	12	8.5	Lateral or anterior open bite >2 mm but <= 4 mm
5h	27	19.0	Extensive hypodontia with restorative implications (more than one tooth missing in any quadrant requiring pre-restorative orthodontics)
4g	1	0.7	Less extensive hypodontia requiring pre-restorative orthodontics or orthodontic space closure to obviate the need for a prosthesis
2d	3	2.1	Displacement of teeth >1 mm but ≤2 mm
2e	3	2.1	Anterior or posterior open bite >1 mm but ≤2 mm
4f	3	2.1	Increased and complete overbite with gingival or palatal trauma
4i	1	0.7	Reverse overjet >1 mm but <3.5 mm with recorded masticatory and speech difficulties
4d	2	1.4	Severe displacements of teeth >4
2b	1	0.7	Reverse overjet >0 mm but ≤1 mm
4b	1	0.7	Reverse overjet >3.5 mm with no masticatory or speech difficulties
4k	1	0.7	Existing supernumerary teeth
2c	2	1.4	Anterior or posterior cross-bite with ≤1 mm discrepancy between retruded contact position and intercuspal position

Table 8: Orthodontic treatment needs in 7–12 years old children

Severity grades	*Percentage*
• Grade V = urgent treatment need	4 7.9
• Grade IV = treatment need	2 7.5
• Grade III = borderline treatment need	1 4.8
• Grade II = minor anomaly, no treatment need	9.8

Table 9: Intra-examiner reliability of Baby ROMA index

Reliability statistics	*Value*	*95% CI*	*p value*
Cronbach's Alpha	0.92	0.89–0.97	0.0001*
Intra-class correlation coefficients	0.96	0.92–0.98	0.0001*

*Significant

recalled after 1 month. There was a high intraobserver agreement of Baby ROMA index, high Cronbach's Alpha (0.92), and intra-class correlation coefficients were found to be 0.96 with a highly significant *p* value (0.0001). Thus, the Baby ROMA index is highly reproducible. Table 10 illustrates the intra-reliability of the IOTN index. A total number of 20 subjects were randomly selected and recalled after 1 month. There was a high intraobserver agreement of IOTN, high Cronbach's Alpha (0.91), and intra-class correlation coefficients were found to be 0.95 with a highly significant *p* value (0.0001). Thus, the IOTN index is highly reproducible.

Table 10: Intra-examiner reliability of IOTN index

Reliability statistics	*Value*	*95% CI*	*p value*
Cronbach's Alpha	0.91	0.87–0.96	0.0001*
Intra-class correlation coefficients	0.95	0.90–0.99	0.0001*

*Significant

Discussion

The epidemiological studies on occlusion and malocclusion not only help in orthodontic treatment planning but also offer a valid research tool for ascertaining the operation and depth of distinct environmental and genetic factors in the etiology of malocclusion. Extensive multicentric studies are required to obtain countrywide

representative data. A more practical and feasible alternative is to develop a regional database and compilation of such databases may provide an understanding of the national scenario.[10] This study was conducted as a part of a dental health program in schools of East Lucknow city.

After statistical analysis, 69% of children aged between 3 and 6 years and 71% of children aged between 7 and 12 years were found with malocclusion. Our results were similar to the study done by Arnrup and Bondemark[11] in which they obtained a 71.4% prevalence of malocclusion in 7–15 years old children.

A higher prevalence of malocclusion was reported by Boeck et al.[12] where they found an 80.29% prevalence of malocclusion in Araraquara children aged between 5 and 12 years old. However, Holmes[13] reported a lower prevalence of 32% of malocclusion in a survey done on 12-year-old Sheffield school children and Crowther et al.[14] obtained 31.3% malocclusion in 10-year-old New Zealand school children which were comparatively lower than our study results. In the age group of 3- to 6-year-old, females had more prevalence of malocclusion (78.1%) than males (60.6%) which was statistically significant (0.007; $p < 0.05$) and as per the findings of Hamdan,[15] Birkeland et al.,[16] and Baeshen.[17]

Ideally, the process of identifying and assessing the severity of malocclusion within national healthcare services should require a simple and reliable method. Several indices on occlusal parameters are used to assess the priority of orthodontic care. After a thorough examination and review of indices IOTN index for mixed dentition and the Baby ROMA index for primary dentition were selected for assessment of the prevalence of malocclusion and their orthodontic treatment needs in children of East Lucknow city.

IOTN is considered as a gold standard and a reliable index for assessment of malocclusion Ovsenik et al.[18] but it has a limitation of its applicability to the primary dentition. The ROMA index (Risk of Malocclusion Assessment Index) was developed by Russo et al.,[19] which was set up for mixed and permanent dentitions in growing patients and evaluates skeletal and functional aspects of malocclusion. The ROMA index was validated by Grippaudo et al.[20] and tested on a large sample of Italian children aged 9–13 years. Therefore, an index that assesses the need for orthodontic treatment in the primary dentition. When a wide variety of skeletal, dental, and functional factors, if unobserved could adversely influence occlusion and craniofacial growth, it is needed. Grippaudo et al.[21] authors have modified the ROMA Index and targeted the age of primary dentition (Baby-ROMA Index). The passage from primary to early mixed dentition is susceptible to changes that can often be caused by a variety of factors and may interfere with normal occlusion.

Keski-Nisula et al.[22] conducted a longitudinal study that indicates that malocclusion observed in primary dentition can fairly predict the malocclusion developing in mixed and/or permanent dentition. Franchi et al.[23] and Masucci et al.[24] have stated that earlier the treatment is carried out have greater chances of success, which are the results of skeletal changes rather than dental compensations with increased long-term stability.

Tschill et al.,[25] Kurol (2000),[26] Viazis,[27] Kurol (2006), Ngan (2006), and Proffit (2006)[28] considered that the ideal time for a treatment is in the late-mixed dentition stage because the dentoalveolar and skeletal maturity starts in this phase, while other authors Thilander et al., Farnik et al.,[29] Trottman and Elsbach,[30] Tschill et al., and Thilander et al.[31] concluded that early orthodontic treatments would be beneficial and desirable, especially to reduce skeletal and dental discrepancies and correct habits, dysfunction and malocclusion in their early stages.

In the present study, the most frequent malocclusions detected in the children aged 3–6 years were with caries and early loss of deciduous teeth (37.7%), hypodontia of more than 2 teeth (23.9%), and hypodontia of fewer than 2 teeth (5.8%). In the present study, the most common finding detected in the age group between 7 and 12 years old were crowding, displacement, presence of supernumerary teeth, retained deciduous teeth, and any pathological lesions 26.8%, 19% of children with extensive hypodontia with restorative implications, and 12% of children with posterior lingual crossbite with no functional occlusal contact.

Helm[32] reported that there was a high prevalence of crowding, rotation, tipping, and malformation (32%) which was a common finding in the age group of 6–7 years old children. The prevalence of posterior lingual crossbite was the third most common finding around 12% in the present study. In the present study, around 1.4% of the participants showed mouth breathing, and the 4.3% reported other deleterious oral habits. Brin et al.[33] and Vázquez-Nava et al.[34] stated that bad habits, such as persistent dummy or fingers sucking, can cause alterations of the occlusion and oral breathing associated with respiratory obstructions may cause alterations to the physiological patterns of the craniofacial growth. Kharbanda et al.[35] concluded from their study that 4.3% had a habit of mouth breathing, tongue thrusting 4.9%, and thumb sucking 8.7%. Sahin et al. (2016)[36] stated that 60% of malocclusions came under the category of treatment need.

In the present study, for the intra-examiner reliability of the Baby Roma Index, there was a high intraobserver agreement and the *p* value was found to be significant (0.0001). The intra-examiner observer agreement of the IOTN Index was also high and had a significant *p* value (0.0001). Ovsenik, Borzabadi,[1] and Bhagyalaskshmi et al.[37] have validated the IOTN index. Thus, the IOTN index is highly reproducible. Results obtained from statistical analysis suggested that the present study is by the formalized hypothesis. This hypothesis states that the prevalence of malocclusion in 3–6 years was 69% and in 7–12 years was 71% in the children of East Lucknow city. The present study also provided an insight into the patterns of complete skeletal, dental, craniofacial, and systemic problems in primary and mixed dentition in the East Lucknow region. Furthermore, we need more studies on the prevalence of malocclusion to diagnose malocclusion at the earliest level.

Conclusion

Based on observations made during the course of the study and their analysis the following conclusions have been drawn:

- The prevalence of malocclusion in 3–6 years was 69% and in 7–12 years it was 71% in children.
- The prevalence of malocclusion was more in females in the 3–6 years old age group 78.1% and the value was statistically significant (0.007; $p < 0.05$).
- The most common finding in primary dentition by using Baby ROMA index is Caries and early loss of deciduous teeth (37.7%), followed by hypodontia with >2 teeth (23.9%). The sequentially most common finding in mixed dentition by using the IOTN index were impeded eruption of teeth (apart from 3rd molars) (26.8%) and hypodontia (19%).

- In the age group of 3 to 6 years; 49.2% of children were in the category of immediate treatment need and treatment need (grades IV and V) and 50.8% of children were in the category of little or no treatment need (grades II and III).
- In the age group of 7–12 years old; 75.4% of children were in the category of immediate treatment need and treatment need (grades IV and V) and 24.6% of children were in the category of little or no treatment need (grades II and III).

Ethical approval for the study was taken from the Institutes Ethical Committee. Patient consent was taken before the study.

Consent for Publication

All authors give consent for the publication of the article.

Authors' Contributions

Alok Singh and Monika Rathore carried out the research work in gathering the articles for the study, thought of the concept, and drafted the manuscript. Somya Govil, Vinay Umale, and Rohit Kulshrestha participated in structuring the research, defined the intellectual content, and performed the quality check. Tushar Kolhe, Alok Singh, and Monika Rathore conceived of the study and participated in its design, coordination and helped to draft the final manuscript. Somya Govil, Vinay Umale, Rohit Kulshrestha, and Tushar Kolhe were part of the manuscript preparation, editing, and reviewing. All the authors read and approved the final manuscript.

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