Preventive and interceptive orthodontic needs among Syrian children

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Background

Preventing or intercepting a developing malocclusion in a public health program requires identifying or measuring the degree of malocclusion. The present study aimed to quantify the proportion of Syrian children in Damascus who would benefit from preventive and interceptive orthodontic treatment.

Materials and methods

In total, 1096 children (431 boys and 665 girls) of grade 1 up to grade 3 from 16 government elementary schools in Damascus city were evaluated using the index for preventive and interceptive orthodontic need (IPION). On the basis of IPION, the overall scores of children were distributed into three groups – no treatment need, moderate treatment need, and definite treatment need. According to dental development, children were divided into two groups – IPION-6 and IPION-9.

Results

Of the enrolled children, 15.4% showed no treatment need, 26.7% showed moderate treatment need, and 57.9% showed definite treatment need. Comparison between male and female children indicated no significant effect on the overall treatment need distribution ($P=0.439$). The IPION groups had a significant effect on treatment distribution (6 vs. 9, $P=0.038$); the IPION-9 scores were significantly higher than the IPION-6 scores.

Conclusion and recommendations

The prevalence of preventive and interceptive orthodontic needs is unsatisfactorily high in Syrian children, which emphasizes the importance of including preventive and interceptive orthodontic treatment in the local dental healthcare program.

Keywords:

early orthodontic needs, index, interceptive, index for preventive and interceptive orthodontic need, prevalence, preventive, Syria

Introduction

Preventive orthodontics is defined as any action taken to preserve the integrity of a normal occlusion, and interceptive orthodontics is defined as procedures that eliminate or reduce the severity of a developing malocclusion. Preventive orthodontics would include space maintenance, oral habit checkups, and caries control, and interceptive orthodontics would include space regaining appliances and serial extractions [1].

Preventive and interceptive orthodontics have been referred to in the orthodontic literature, with emphasis on reducing later need for publicly funded complex orthodontic treatment [2–4], which could increase the comprehensiveness of healthcare and bolster primary care, thereby improving the health of the population [5]. Proper diagnosis and treatment planning can produce the most satisfying results during the mixed dentition stage [6], and may have long-term stability than late treatment [7]. It is accepted that these procedures will not produce perfect occlusions but can considerably reduce the need for orthodontic treatment in public healthcare systems with limited resources [8–10].

A great number of orthodontic indices have been developed. Some of these indices have attempted to determine orthodontic treatment needs [11], whereas others indices were developed to assess the quality of treatment [12] or both [13]. Only one of these indices was, however, specifically designed to determine the need for preventive and interceptive orthodontic treatment. The index for preventive and interceptive orthodontic need (IPION) developed by Coetzee [14], is the only such reported index. It allows early detection of developing malocclusion, so that simple interceptive treatment can be undertaken to minimize or eliminate the need for more extensive and costly orthodontic treatment later [14].

As the IPION is the only orthodontic index that measures preventive and interceptive orthodontic treatment needs, and as no published studies utilizing this index currently exist for the Syrian population, research having the precession of measuring early orthodontic treatment need in this population is highly needed. Generating such data would be critical in spotlighting this important health problem and could help in producing policy changes,

perhaps directing for the allotment of a certain amount of treatment or budget solely for early orthodontic treatment.

The present study aimed to utilize the IPION to quantify the proportion of Syrian schoolchildren who would benefit from preventive and interceptive orthodontic treatment.

Materials and methods

Study design and children
We carried out a cross-sectional study on a sample of children of Damascus city whose ages ranged from 6 to 9 years.

Sample size estimation
The confidence level was defined to be 95% with specified absolute precision required on either side of the proportion of 0.03. The prevalence of early orthodontic treatment need in the original population was assumed to be 50%, which is statistically the safest proportion. On the basis of the practical manual for sample size determination in health studies [15], the sample size was estimated to be 1067 children. This number was increased to 1150 patients to compensate for potential exclusion.

The index for preventive and interceptive orthodontic need
The IPION identifies children aged between 6 and 9 years, who would most likely benefit from early preventive and/or interceptive orthodontic treatment, allowing certain characteristics of the occlusion to be weighted more heavily than the others. The IPION leads to the calculation of an overall score, which is reflective of the child's amenability to being treated early. As different factors affect the development of malocclusion between 6 and 9 years of age, two indices were developed – the IPION-6 and IPION-9. Each index comprised five components: primary component, anterior component, posterior component, occlusion, and soft tissue. Although the two indices are based on the same principles, there are a few different factors that distinguish each of them (Tables 1 and 2) [14].

Children and data collection
The present cross-sectional study included clinical examination of school children in Damascus city after obtaining approval of the Ministry of Education. The data were collected from October 2014 to May 2015. Parents of the children were informed about the study, and their consents for participation were obtained. Of the 1150 children for whom consent was secured, only 1119 were present in school and were examined on the days of the examination. According to their parents, 23 of these children had previous or current orthodontic treatment, and thus the final sample consisted of 1096 children. Inclusion criteria included students of grade 1 up to grade 3 from 16 government elementary schools with no

previous or current orthodontic treatment. The sample was randomly constructed using multistage cluster sampling.

For observing universal precautions and infection-control procedures, all children were examined, and the data were recorded while they were sitting in a chair using head-borne light and light held by an assistant. Instruments included disposable rulers and disposable mouth mirrors and probes.

All the features of the IPION-6 and IPION-9 were recorded, and the variables were multiplied by weighting factors according to the instructions of the original study by Coetzee [14] (Tables 1 and 2). The IPION-9 was used for any child whose permanent maxillary central incisors were visible upon examination. As this scoring sheet has more categories than the IPION-6, it derives more information about a malocclusion [16].

On the basis of Coetzee's study, the overall scores were divided into three categories of treatment need. The scores of 0–5 were considered 'no treatment need', the scores of 6–14 were considered 'moderate treatment need', and the scores of 15 or higher were considered 'definite treatment need' [14].

Two trained and calibrated examiners (the researchers) evaluated all the cases together, and the disagreements were discussed until consensus was reached. The raw data were recorded manually using paper sheets specially designed for the present study.

Ethics considerations
Ethics approval for the present study was obtained from the Research Ethics Committee at the Faculty of Dentistry, Syrian Private University.

Statistical analysis
The final data were entered into and analyzed using statistical package for the social sciences software (version 20; IBM Corp., Armonk, New York, USA).

The χ^2-test was used to detect statistical differences between the indices and the sex groups. A P value of 0.05 or less was considered to be statistically significant.

Results
In the IPION-6 group, 529 children were examined (208 boys and 321 girls); their ages ranged from 6 years and 1 month to 7 years and 9 months. In the IPION-9 group, 567 children were examined (223 boys and 344 girls); their ages ranged from 6 years and 10 months to 9 years and 2 months.

The distribution of the three categories of treatment need based on the overall scores in the total sample was detected by calculating frequencies and percentages. To isolate the impact of caries, the weighted points accumulated for caries were subtracted from the overall scores for each student. Consequently, a modified

Table 1. The five components and the weighting factors of the index for preventive and interceptive orthodontic need 6

The five components of the IPION-6	Description of variable	Weighting factor
Primary component		
Interproximal caries	Caries of maxillary and mandibular primary canines	1
	Caries of maxillary and mandibular first primary molars	2
	Caries of maxillary and mandibular second primary molars	4
	Caries of maxillary and mandibular first permanent molars	4
Premature loss of primary teeth	Early loss of maxillary primary canines	1
	Unilateral early loss of mandibular primary canines	8
	Bilateral early loss of mandibular primary canines	2
	Early loss of maxillary and mandibular first primary molars	2
	Early loss of maxillary and mandibular second primary	4
Anterior component	Supernumerary teeth	4
Posterior component	Rotation of maxillary first permanent molars	4
	Tipping of mandibular first permanent molars	4
Occlusion	Overjet	2
	Anterior cross-bite	10
	Overbite	1
	Anterior open bite	4
	Posterior cross-bite without functional lateral shift of the mandible during closing	1
	Posterior cross-bite with functional lateral shift of the mandible during closing	10
Soft-tissue assessment	Lip competency	1

IPION, index for preventive and interceptive orthodontic need.

Table 2. The five components and the weighting factors of the index for preventive and interceptive orthodontic need 9

The five components of the IPION-9	Description of variables	Weighting factor
Primary component		
Interproximal caries	Caries of maxillary and mandibular canines	1
	Caries of maxillary and mandibular first primary molars	2
	Caries of maxillary and mandibular second primary molars	4
	Caries of maxillary and mandibular first permanent molars	4
Premature loss of primary teeth	Early loss of maxillary second primary molars	2
	Early loss of mandibular second primary molars	3
Submerged teeth	Submerged (ankylosed) first primary molars	1
	Submerged (ankylosed) second primary molars	2
Anterior component	Active frenum	1
	Supernumerary teeth	4
	Diastema	4
	Absent permanent incisors	3
Posterior component	Rotation of maxillary first permanent molars	4
	Tipping of mandibular first permanent molars	4
	Impeded (ectopic) eruption of first permanent molars	4
Occlusion	Overjet	2
	Anterior cross-bite	10
	Overbite	1
	Anterior open bite	4
	Molar relationship	1
	Posterior cross-bite without functional lateral shift of the mandible during closing	1
	Posterior cross-bite with functional lateral shift of the mandible during closing	10
Soft-tissue assessment	Lip competency	1

IPION, index for preventive and interceptive orthodontic need.

distribution of the three categories of treatment need was obtained (Fig. 1).

Figure 1 shows that the category of 'no treatment need' formed 15.4% of the total sample. However, this percentage increased to 29.5% when points of caries were neglected. On the other hand, the 'definite treatment need' category formed 57.9% of the total sample.

No differences between males and females in the distribution of the three categories of treatment need were found (Table 3).

Table 4 shows the treatment need distribution of the three categories according to the IPION groups. The moderate and definite percentages in the IPION-9 group were significantly larger than percentages in the IPION-6 group.

Figure 1.

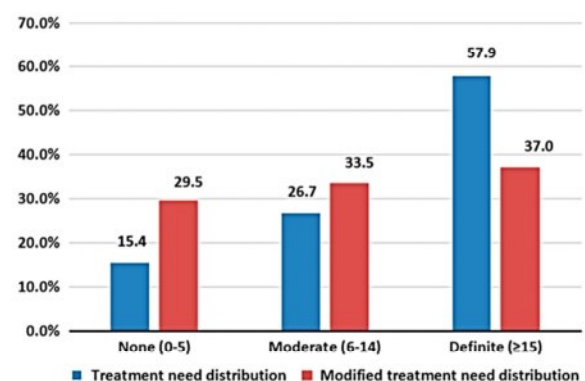The treatment need distribution in the total group.

Discussion

Only a few studies using the index of preventive and interceptive orthodontic treatment need are available [16,17], and no previous study has been conducted in Syria. Therefore, this study has precession in this field.

The present study showed that according to the IPION only 15.4% of the enrolled children scored 0–5. However, 26.7% scored 6–14 and 57.9% scored greater than and

Table 3. The treatment need distribution according to sex in Syrian school-aged children, Damascus city, 2014–2015

Treatment need	Total N	None (0–5) [n (%)]	Moderate (6–14) [n (%)]	Definite (≥15) [n (%)]	P value
Males	431	62 (14.4)	119 (27.6)	250 (58.0)	0.439
Females	665	112 (16.8)	174 (26.2)	379 (57.0)	
Total	1096	169 (15.4)	293 (26.7)	634 (57.9)	

Table 4. The treatment need distribution according to the index for preventive and interceptive orthodontic need groups in Syrian school-aged children, Damascus city, 2014–2015

Treatment need	Total N	None (0–5) [n (%)]	Moderate (6–14) [n (%)]	Definite (≥15) [n (%)]	P value
IPION-6	529	101 (19.1)	132 (24.9)	296 (56.0)	0.038*
IPION-9	567	68 (12.0)	161 (28,4)	338 (59.6)	
Total	1096	169 (15.4)	293 (26.7)	634 (57.9)	

IPION, index for preventive and interceptive orthodontic need.
*Significant at $P < 0.05$.

equal to 15, which implies high treatment need percentage in the present sample. As caries was the most common trait in the children, consistent with the literature [18–21], it was decided to exclude it to detect the impact of the other traits. Consequently, the percentages turned to be 29.5% showing no treatment need, 33.5% showing moderate treatment need, and 37% showing definite treatment need. Although the percentage of definite treatment need sharply decreased to be 37% when points of caries were omitted, it was still high.

Haider [16] tested a sample of American children. His findings indicated that the percentages of none, moderate, and definite treatment need were originally 17.2, 21.9, and 60.9%, respectively. When caries were excluded, these numbers turned out to be 36.8, 32.2, and 31%, respectively [16]. By comparing these changes in the percentages with those of the present study, it may be inferred that the impact of excluding caries was clearer in his study, which may be interpreted by higher prevalence of caries in his sample or higher prevalence of the other IPION components in the present sample.

Prabhakar et al. [22] found that 63.4% of the children of the tested Indian sample needed orthodontic treatment, which is slightly higher than that found in the present study. This difference could be attributed to the fact that older children were tested in their study. In addition, they did not use the same index for assessment [22].

Comparison between male and female children showed no significant effect on the overall treatment need distribution ($P = 0.439$), which means that the treatment need is not related to sex. This finding is consistent with that of Prabhakar et al. [22] on an Indian sample and Haidar [16] on an American sample who referred to no significant difference between the incidence of malocclusion in males and females. These consistent findings may encourage predicting that preventive and interceptive orthodontic treatment needs are independent of sex regardless of populations.

The IPION groups (aged 6 vs. 9) had a significant effect on treatment need distribution ($P = 0.038$); the IPION-9 scores were significantly higher than the IPION-6 scores. These differences may be attributed to the fact that the

IPION-9 was used for children with relatively more advanced developmental stage. In addition, the IPION-9 had more categories. Consequently, more scores are potential, which may lead to a higher percentage of children in the moderate and definite need categories.

Haider [16] in his study on American children found that the percentages of none and moderate treatment need were lower in the IPION-9 group than in the IPION-6. However, the definite need sharply rose in the IPION-9 group (25.0, 31.2, and 43.8% none, moderate, and definite treatment needs in the IPION-6 group respectively, compared with 12.7, 16.4, and 70.9% none, moderate, and definite treatment needs in the IPION-9 group, respectively) [16].

Although Karaiskos et al. [17] found different scores in a sample of Canadian children, their findings emphasized the impact of the IPION group on the treatment need distribution. They reported that a considerable proportion of children scored 5 or higher: 20.9% of children in the IPION-6 group and 37.1% in the IPION-9 group [17]. It is essential to notice that their tested distribution depended on the children who scored 0, the children who scored 1–4, and the children who scored greater than and equal to 5, which may reflect less preventive and interceptive orthodontic treatment need in their sample.

The IPION includes many important features such as interproximal caries, premature loss of primary teeth, anterior and posterior components, occlusion, and lip competency. These comprehensive features make this index an effective diagnostic tool. However, it lacks the component of oral habits, which have an important role in developing malocclusion [23]. The identification of abnormal habits and the assessment of their potential effects should be made at an early stage [24]. These arrangements are essential for preventing related occlusive problems [25]. Therefore, a proper modification to the IPION may be required to make it a perfect index of preventive and interceptive orthodontic treatment need.

Limitations and generalizability
In the present study, the two investigators examined the children simultaneously. Although this method might

benefit in correcting some misreading by discussion and consensus between the investigators, the individual readings would give an opportunity to make an inter-examiner comparison, which could be used to detect the accuracy of the study.

Owing to ethical considerations, radiographs cannot be taken during an epidemiological survey, and thus congenitally missing incisors, supernumerary teeth, and other dental anomalies could not be verified.

The used sampling process emphasizes the possibility of generalizability of the findings of the present study. This process included using a statistically sufficient sample size and a randomly constructed sample using the multistage cluster sampling. On the other hand, using a school population, rather than populations from dental clinics or healthcare centers, has yielded results that could be more appropriately representing the Syrian population.

Conclusion and recommendations

The high scores of the moderate and high levels of the IPION reveal unsatisfactorily high preventive and interceptive orthodontic needs among Syrian students aged 6 and 9 years regardless of sex. Moreover, when caries are completely disregarded, the proportion of children demonstrating definite early orthodontic treatment need is still unacceptably high. Definite early orthodontic treatment need is higher in the IPION-9 group than in the IPION-6 group, which means that the treatment needs increase with the development of occlusion and time.

The findings of the present study emphasize the importance of including preventive and interceptive orthodontic treatment in local dental healthcare programs. Meanwhile, more affordable dental care can be provided.

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