



Orthodontic Treatment Need Assessed Using the Index of Orthodontic Treatment Need (IOTN) in 1,155 Children Aged 3–7 Years

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ABSTRACT

Background: Early identification of malocclusion can help prioritize orthodontic assessment and care. However, population-based evidence on orthodontic treatment need in young children remains limited.

Objective: To describe orthodontic treatment need, assessed using the dental health component (DHC) of the Index of Orthodontic Treatment Need (IOTN), in children aged 3–7 years and examine its distribution by age, sex, and dentition stage.

Methods: In this cross-sectional survey, 1,155 children aged 3–7 years were selected through two-stage random sampling and examined by an orthodontist. Treatment need was classified using the IOTN-DHC. Grade 1 was categorized as no treatment need, and grades 2–5 as increasing levels of need. Analyses included descriptive statistics, 95% confidence intervals (CIs), odds ratios (ORs), and chi-square tests.

Results: Overall, 837 children (72.5%) were classified as grade 1, while 318 (27.5%; 95% CI 25.0–30.2) were classified in grades 2–5. Grade 2 was the most frequent category (220; 19.0%), followed by grade 3 (55; 4.8%), grade 5 (28; 2.4%), and grade 4 (15; 1.3%). Treatment need was observed in 30.1% of children aged 3–5 years and 26.2% of those aged 6–7 years (OR 1.21; 95% CI 0.92–1.58; $p = 0.17$), and in 26.6% of girls and 28.4% of boys (OR 1.10; 95% CI 0.85–1.42; $p = 0.48$). Grades 3–5 were more frequent in children aged 3–5 years than in those aged 6–7 years (12.9% vs 6.3%; $p < 0.001$).

Conclusion: Approximately one in four children met the study definition of orthodontic treatment need, although grades 3–5 accounted for 8.5% of the sample. These findings support early assessment and appropriate referral, with treatment decisions individualized according to occlusal severity, function, and dental development.

Keywords: Index of Orthodontic Treatment Need; IOTN-DHC; malocclusion; children; early orthodontic assessment

1. INTRODUCTION

Malocclusion is a common oral condition that may affect dental function, occlusal development, facial aesthetics and, in selected cases, oral health. Epidemiological assessment of orthodontic treatment need is therefore relevant to both clinical planning and the allocation of public health resources.

The Index of Orthodontic Treatment Need (IOTN), developed by Brook and Shaw, was designed to provide a reproducible approach to prioritizing orthodontic treatment. Its dental health component comprises five grades

of increasing treatment priority [1]. The index has since been used in epidemiological studies to estimate the distribution of treatment need in different populations.

The age range of 3–7 years is particularly relevant to interceptive orthodontics because occlusal relationships change substantially during the transition from the primary to the early mixed dentition. Nevertheless, treatment need in very young children must be interpreted with caution, because some occlusal features may improve or evolve with growth and tooth eruption.

The present survey examined 1,155 children attending preschool and school settings. This manuscript focuses on the IOTN component of the dataset; dental caries indices and restorative status are not analyzed. The aim was to describe orthodontic treatment need among children aged 3–7 years and examine its distribution by age, sex, and dentition stage.

2. MATERIALS AND METHODS

2.1 Study design and population

A cross-sectional epidemiological survey was conducted among children aged 3–7 years attending preschool and school settings in the Oran region of Algeria. The sample was selected using a two-stage random sampling procedure that aimed to ensure representation of the administrative areas of the region. The minimum sample size was calculated as $n = Z^2PQ/C^2$, where $Z = 1.96$ (95% confidence level), $P = 60\%$ is the expected prevalence, $Q = 1 - P = 40\%$ and $C = 3\%$ is the margin of error, giving a minimum of 1024 children. Thirty percent of the sample was allocated to children attending preschool institutions (nurseries) and 70% to schoolchildren, assuming an average of 25 children per school class and 15 children per nursery. The final sample comprised 1,155 children.

2.2 Orthodontic assessment

Orthodontic treatment need was classified using the dental health component of the IOTN. The five grades were defined as follows: grade 1, no need for orthodontic treatment; grade 2, little need; grade 3, moderate need; grade 4, great need; and grade 5, very great need. Children in grades 2–5 were considered to have an orthodontic treatment need, and grades ≥ 3 were regarded as sufficiently important to warrant referral for specialist consultation. All examinations were performed by a qualified orthodontist.

The IOTN was originally developed as a valid and reproducible index of orthodontic treatment priority, combining dental health (functional) and aesthetic components [1].

2.3 Referral and follow-up procedure

Children with a low treatment need (grade 2) were advised to undergo long-term monitoring, with a six-monthly visit to an orthodontist to reassess their treatment need as the permanent dentition developed. Children in grades ≥ 3 were referred to the Department of Dentofacial Orthopedics of the University Hospital Centre of Oran for management. After screening, each child received an explanatory leaflet briefly describing the anomaly identified, together with an appointment notice. Referred children underwent a comprehensive examination, recorded on a second survey form. At the end of this examination, impressions were taken and, where indicated, a panoramic radiograph and a lateral cephalometric radiograph were obtained.

2.4 Variables and statistical analysis

The primary outcome was the IOTN grade. Secondary descriptive variables were age group, sex and dentition stage. Prevalence estimates are presented with 95% CIs (Wilson score method). Treatment need (grades 2–5 versus grade 1) was compared by age group and sex using the chi-square test, and effect sizes are expressed as ORs with 95% CIs. The association between treatment need and dentition stage was assessed using the chi-square test with a Monte Carlo p-value, because of small expected counts. In an exploratory analysis, the proportion of children in grades ≥ 3 was compared in the same way. Statistical significance was set at $p < 0.05$.

3. RESULTS

3.1 Overall distribution of IOTN grades

A total of 837 children (72.5%) were classified as grade 1, indicating no treatment need according to the study criteria. The remaining 318 children (27.5%; 95% CI 25.0–30.2%) were classified in grades 2–5 (Table 1).

The most frequent treatment-need category was grade 2, representing 220 children (19.0% of the total sample). Grades indicating moderate to very great need were less frequent: 55 children (4.8%) were grade 3, 15 (1.3%) were grade 4 and 28 (2.4%) were grade 5. Overall, 98 children (8.5%) were classified in grades 3–5.

Table 1. Distribution of IOTN grades

IOTN grade	Interpretation	n	%
Grade 1	No orthodontic treatment need	837	72.50%
Grade 2	Little need	220	19.00%
Grade 3	Moderate need	55	4.80%
Grade 4	Great need	15	1.30%
Grade 5	Very great need	28	2.40%
Total		1155	100.00%

3.2 IOTN treatment need by age group

Treatment need was observed in 117 of 389 children aged 3–5 years (30.1%; 95% CI 25.7–34.8) and in 201 of 766 children aged 6–7 years (26.2%; 95% CI 23.2–29.5). This difference was not statistically significant (chi-square test, $\chi^2 = 1.90$, $p = 0.17$; OR for ages 3–5 versus 6–7 years, 1.21; 95% CI 0.92–1.58). Thus, within this sample, age group was not significantly associated with the presence of orthodontic treatment need (Table 2). In the exploratory analysis, however, grades ≥ 3 were more frequent among children aged 3–5 years (50/389; 12.9%; 95% CI 9.9–16.5) than among those aged 6–7 years (48/766; 6.3%; 95% CI 4.8–8.2) ($\chi^2 = 14.42$, $p < 0.001$; OR 2.21; 95% CI 1.45–3.35).

Table 2. Distribution of IOTN treatment need by age group

Age group	n	Treatment need, n	% (95% CI)
3–5 years	389	117	30.1% (25.7–34.8)
6–7 years	766	201	26.2% (23.2–29.5)
Total	1155	318	27.5% (25.0–30.2)

3.3 Distribution of grades by age

Among children with an orthodontic treatment need, the distribution of severity varied by age (Table 3). A grade ≥ 3 was recorded in 87.5% of affected 3-year-olds (21/24), compared with 37.5% at age 4 (15/40), 26.4% at age 5 (14/53), 16.7% at age 6 (15/90) and 29.7% at age 7 (33/111).

Table 3. Distribution of IOTN grades by age

IOTN grade	3 y	4 y	5 y	6 y	7 y	Total
Grade 2	3	25	39	75	78	220
Grade 3	16	11	7	6	15	55
Grade 4	4	3	2	2	4	15



Grade 5	1	1	5	7	14	28
Total	24	40	53	90	111	318

3.4 IOTN treatment need by sex

Treatment need was observed in 151 of 568 girls (26.6%; 95% CI 23.1–30.4) and in 167 of 587 boys (28.4%; 95% CI 24.9–32.2) (Table 4). This difference was not statistically significant (chi-square test, $\chi^2 = 0.50$, $p = 0.48$; OR for boys versus girls, 1.10; 95% CI 0.85–1.42).

Table 4. Distribution of IOTN treatment need by sex

Sex	Total n	Treatment need n	Treatment need, % (95% CI)
Female	568	151	26.6% (23.1–30.4)
Male	587	167	28.4% (24.9–32.2)
Total	1155	318	27.5% (25.0–30.2)

3.5 IOTN grades and treatment need by dentition stage

The sample comprised 399 children (34.5%) in the primary dentition, 720 (62.3%) in the constitutional mixed dentition, 10 (0.9%) in the stable mixed dentition and 26 (2.3%) in the adolescent dentition (Table 5). The prevalence of treatment need was 28.3% (95% CI 24.1–32.9), 27.2% (95% CI 24.1–30.6), 30.0% (95% CI 10.8–60.3) and 26.9% (95% CI 13.7–46.1), respectively, and was not significantly associated with dentition stage ($p = 0.98$); the estimates for the stable mixed and adolescent dentitions are imprecise because of the small numbers. In the exploratory analysis, grades ≥ 3 were observed in 44 of 399 children (11.0%; 95% CI 8.3–14.5) in the primary dentition and in 52 of 720 (7.2%; 95% CI 5.5–9.3) in the constitutional mixed dentition (OR 1.59; 95% CI 1.04–2.43), although the overall association across the four stages was not significant ($p = 0.13$).

Table 5. Distribution of IOTN grades by dentition stage

IOTN grade	Primary dentition	Constitutional mixed dentition	Stable mixed dentition	Adolescent dentition	Total
Grade 1	286	525	7	19	837
Grade 2	68	144	2	6	220
Grade 3	32	23	0	0	55
Grade 4	9	5	1	0	15
Grade 5	3	24	0	1	28
Total	398	721	10	26	1155

4. DISCUSSION

This study provides data on orthodontic treatment need among 1,155 children aged 3–7 years, a sample larger than the calculated minimum of 1024, selected by two-stage random sampling and examined by a qualified orthodontist. The main finding was that 27.5% of the children were classified as having an orthodontic treatment need, whereas 72.5% were grade 1. Most affected children were in grade 2, and grades 4 and 5 together accounted for only 3.7% of the entire sample.

The concentration of the sample in the lower IOTN grades is clinically relevant. In a young population, a distinction should be maintained between the presence of an occlusal deviation and an immediate indication for comprehensive orthodontic treatment [1–3]. The IOTN provides a structured way of prioritizing cases, but



clinical decisions must still take into account dental development, growth, functional factors and the natural evolution of the occlusion.

The absence of a statistically significant difference between the 3–5-year and 6–7-year groups is noteworthy. Treatment need was numerically higher in the younger group (30.1% versus 26.2%; OR 1.21; 95% CI 0.92–1.58), but the difference did not reach statistical significance ($p = 0.17$). By contrast, grades ≥ 3 were significantly more frequent in the younger group (12.9% versus 6.3%), suggesting that the more severe occlusal deviations are already present in the youngest children, although this exploratory finding requires confirmation. The overall result differs from some preschool studies in which malocclusion prevalence was associated with age. For example, Sousa et al. reported a malocclusion prevalence of 62.4% among 732 Brazilian preschool children aged 3–5 years, with a significantly higher prevalence in younger children [4]. Such comparisons should be interpreted cautiously because the diagnostic criteria and indices differed.

In contrast, the prevalence observed in the present study was higher than that reported in a Southern Italian paediatric sample of 579 children aged 2–9 years evaluated with the IOTN-DHC, in which 19.3% of the children needed orthodontic treatment [5]. Differences in age distribution, sampling, diagnostic thresholds and the operational definition of treatment need may account for part of this variation.

A larger Italian preschool study of 1616 children aged 3–6 years used the Baby ROMA index rather than the IOTN and reported that 38% required orthodontic treatment, with a further 46% showing less severe malocclusion requiring monitoring and risk-factor control [6]. This substantially different estimate illustrates why prevalence figures obtained with different orthodontic indices should not be regarded as directly interchangeable.

In the Algerian context, a study from Blida involving 1260 children aged 9–11 years and using the IOTN reported that 42.5% had minimal need, 20% had moderate need and 37.5% had definite or imperative need [7]. The lower treatment-need burden observed in the present sample of 3–7-year-olds may partly reflect the younger age and developmental stage of the children.

The sex analysis showed no statistically significant association between sex and treatment need (26.6% in girls versus 28.4% in boys; OR 1.10; 95% CI 0.85–1.42; $p = 0.48$). This is consistent with the view that population-level malocclusion risk should not be inferred from referral or treatment-seeking patterns [8–10], which can be influenced by parental perceptions and aesthetic concerns [11–13].

The relatively stable prevalence across dentition stages suggests that treatment need is already detectable in the primary dentition, which supports the value of early screening. However, the purpose of screening should be prioritization and timely referral rather than the automatic initiation of treatment. In young children, interceptive management is most appropriate when a developing anomaly has a clear functional, dental health or growth-related indication.

Children with a low treatment need require long-term monitoring rather than immediate treatment; in the present survey, they were advised to attend six-monthly reassessments as the permanent dentition developed, whereas children in grades ≥ 3 were referred for specialist management. Radiographic records (panoramic and intraoral radiographs, lateral cephalograms and, in selected indications, cone-beam computed tomography) may be needed to clarify anomalies and plan treatment. Nevertheless, Ritschel et al. reported that cephalograms did not influence treatment decisions in early orthodontic treatment and should not be used routinely in very young patients [14].

5. CONCLUSION

Among the 1,155 children aged 3–7 years, 27.5% were classified as having orthodontic treatment need according to the IOTN-DHC. Grade 2 was the most frequent category, while grades 3–5 accounted for 8.5% of the sample. These findings support early orthodontic assessment, systematic screening, and referral based on clinical priority. Screening should guide assessment rather than automatically trigger treatment; decisions should reflect the severity and functional implications of the malocclusion, the stage of dental development,

and the likely benefits and timing of intervention. Integrating appropriate orthodontic assessment into child oral-health services may help identify children who could benefit from specialist care while supporting equitable use of resources.

These findings highlight the importance of early orthodontic assessment as part of comprehensive child oral health programmes. Systematic screening, combined with risk-based referral and appropriate follow-up, may facilitate the timely identification of children who could benefit from orthodontic intervention. From a public health perspective, integrating orthodontic screening into routine dental examinations and school-based oral health initiatives could improve access to care and support a more efficient allocation of available resources. Nevertheless, the identification of an orthodontic treatment need should not automatically imply immediate treatment, particularly in young children.

Clinical decisions should be individualized, taking into account the severity of the malocclusion, the stage of dental development, functional implications, and the potential benefits and timing of intervention. A balanced approach combining early detection, appropriate referral, and developmentally tailored management is essential to promote equitable access to orthodontic care while avoiding unnecessary or prematurely initiated treatment.

DECLARATIONS

Conflict of interest

The authors declare that they have no conflicts of interest.

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