

Original article

Index of Orthodontic Treatment Need (IOTN) for Libyan Children in Benghazi: An epidemiological survey on school children in Benghazi city

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ABSTRACT

Background: malocclusion is a common oral health problem that can affect the psychosocial well-being in the long term. Many indices were developed to prioritize patients so that those who have the greatest need receive treatment. **Objectives:** this study was aimed to assess the orthodontic treatment need of Libyan children using index of orthodontic treatment need (IOTN). **Methods:** Total of 511 students (260 females, 251 males) constituted the sample, which was randomly selected from age group of 12-14 years in Benghazi public schools. The dental health component (DHC) of IOTN was applied to assess orthodontic need, whereas the aesthetic components (AC) of IOTN along with a questionnaire were used to evaluate participants' perception towards their own orthodontic status. **Results:** the majority of participants (79.5%) displayed smile satisfaction, with gender difference ($p < 0.05$). Satisfaction with teeth appearance was showed by 39.7% of the respondents while 60.3% of the participants were dissatisfied, owing dissatisfaction to various reasons such as color of their teeth (9%) and teeth arrangement (34.8%). More than half of respondents (55%) considered well arrangement of teeth is crucial for overall facial appearance. According to ac there was a strong agreement between researcher and respondents in treatment need. The researcher found 10% were definitely needed treatment against 6.2% found by self-perceived need; the researcher categorized 71.4% of the respondents as no treatment need against 71.4% found by self-perceived need.

Conclusions: most of the children in Benghazi's public schools are satisfied with teeth appearance. Most of the public schools children in Benghazi need no/slight orthodontic treatment need. Age, gender and socioeconomic were not influencing factors affecting orthodontic treatment need among Libyan children in Benghazi.

Keywords: IOTN, Orthodontic Index, Malocclusion, School Children

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INTRODUCTION

One of the most common dental disorders is malocclusion the severity of which varies, and accordingly the treatment need.¹ The severity of the disorder governs the need for orthodontic treatment and arrays it from the least needy to the most mandating orthodontic disorder.² For this diversity of malocclusion-severity, different indices were developed. These indices have been developed in order to make a clearer picture of priorities of orthodontic treatment need; in other words, indices provide the authorities with data

base according to which orthodontic treatment services can be delivered to the neediest orthodontic patients.^{2,3} However, ironically it has been reported that the orthodontic treatment demand surpassed the real need.⁴⁻⁷

In addition to their usefulness as epidemiological tools, orthodontic treatment indices have been created and applied in countries that include dental health services with the governmental health insurance such as Denmark, Sweden, UK and Norway.³ Massler and Frankel in 1951 are

considered as the pioneers in this context, who had pointed to the importance of quantitative malocclusion assessment and treatment need as well as monitoring orthodontic treatment results.^{3, 8} Subsequently, in 1959 Van Kirk and Pennell invented the malalignment index that made up of quantitative grading of dental irregularities.⁹ During the era of 1960s there were several and more popular indices that assess and grade orthodontic anomalies quantitatively based on which kind of orthodontic treatment needed. Those indices included: The Occlusal Index of Summers CJ in 1966, the Treatment Priority Index by Grainer RM in 1967 and the Handicapping Malocclusion Assessment by Salzmann in 1968.¹⁰⁻¹² In 1974 the Swedish National Board Index was designed by Linder Aronson. It was aimed to figure out orthodontic cases that are in need and worth free health services which is provided by the government.¹³

A popular and widely accepted index in UK and other European countries, the Index of Orthodontic Treatment Need (IOTN) was created by Brook and Shaw in 1989.¹⁴ The index which is considered as a reliable and fast index evaluates malocclusions and assesses their orthodontic treatment need.¹⁵ IOTN comprises of two independent components: firstly, the Dental Health Component (DHC) which assesses orthodontic treatment need from dental health perspective and it is considered as subjective part of the index since it assesses the orthodontic treatment need according to the investigator's perception toward the patients' teeth and smile.^{3,14,16} DHC is of five grades with definite demarcation points; in the first grade the occlusion is highly acceptable and almost no treatment is indicated. The malalignment in grade 2 is a minimum and it also does not mandate treatment, whereas grade 3 represents more occlusal deformities but still borderline indication for treatment. Frank need for treatment is expressed in grade 4 where the malocclusion is interfering with dental health status, and in grade 5 there is even more severe dental health disorder.^{3,14,16} Secondly, the Aesthetic Component (AC) which assesses the need for orthodontic treatment from aesthetic perspective and it is considered the objective part of the index since it records the aesthetic orthodontic treatment need according to the patients' perception toward their teeth and smile.^{3,14,16}

In AC ten standardized colored photographs which are graded on ranking scale according to malocclusion severity levels. Photos of the 1st, 2nd, 3rd and 4th grades represent no or slight need for

orthodontic treatment and photos of the 5th, 6th and 7th grades are of moderate or borderline case, while photos of the 8th, 9th and 10th grades indicate strict need for orthodontic treatment.¹⁷

In the Libyan society there is scarcity, or almost no information, regarding the demands of orthodontic treatment, since no concrete investigation has yet been performed on the Libyans. This study is a part of a bigger project of investigating orthodontic treatment need using IOTN in most of the main cities in Libya. Such a project would provide the academic institutes, the public dental health service provider and the authorities in the country with very useful data base regarding the demands of orthodontic problems in the population, helping them to put plans and consider the required budget to meet treatment demands. This study was performed to investigate the needs of orthodontic treatment among Libyan children in Benghazi using index of orthodontic treatment need (IOTN).

MATERIAL AND METHODS

The sample: The suggested sample size was computed using Steven Thompson equation.¹⁸ According to Steven Thompson equation the recommended sample size should not be less than 380, however the sample size in this study was 511 children.

Sample selection: The sample members (12-14-year-old pupils) were haphazardly chosen by simple random procedure from each allocated school. A list of the public primary schools was collected from the Ministry of Education authorities in Benghazi. Twelve schools were randomly selected by stratified procedure from five directions of the city: three from east of the city, two schools from west, two schools from south, two from north and another three schools from center of the city. After application of the inclusion and exclusion criteria the study conducted on 511 of the respondents from a total of 561 children examined.

Equipment

Camera, disposable latex gloves, disposable tongue depressor, graduated periodontal probes, ruler, and colored album of IOTN aesthetic component photographs.

The Questionnaire

A simple questionnaire to record demand for orthodontic treatment. Each child answers the questionnaire by interview with the investiga-

tors. The survey made of three sections: the primary area was asking for demographic characteristics, especially age, gender and parents' work status, the second segment dealt with awareness

of the children's own occlusion, and the third segment evaluate the respondent's perception towards the malocclusion. The questions were scaled as the following:

Table 1: Questions asked to the patient

1- Do you have a nice smile?				
1-yes	2- no	3-do not know		
2- Are you happy with your teeth?				
1-yes	2- no	3-do not know		
3- If your answer to 2 is no, what would you change about your teeth?				
1-color	2- size	3-arrangement		
Do you consider well- orchestrated teeth imperative for in general facial appearance?				
i)very important	ii) Important	iii) Does not matter	iv) Not important	v) Not important at all

Aesthetic Component (AC)

This component assesses the respondent's perception of malocclusion. Frontal intra-oral photo was taken for each participate while teeth in centric occlusion, then the respondent was asked to compare her/his teeth photo with the 10 front intra oral photos that illustrate varying grade of dental occlusion, and attractiveness. These views are presented in horizontal arrangement from 1 (attractive dental appearance) on the left to 10 (unattractive dental appearance) on the right. The AC grading was obtained by children. A choice made between 1 and 4 will signify that the child does not or slight need treatment. A choice between 5 to 7 means the child may or may not need treatment thus is a borderline case. A choice of 8 to 10, implies that the child will definitely need treatment on aesthetic grounds.^{2, 4, 19}

Dental Health Component (DHC)

The normative or objective assessment portion was conducted to measure occlusal characteristics according to the grades of dental health component DHC of IOTN by the investigator. The examination was conduct at school under daylight with the help of latex gloves, tongue blade, mirror, probe, and ruler. A grade of the DHC is dependent on the scores with the grade (i. e. if child had two or more scores for the occlusal anomalies in the same grade, the worst would be considered). The hierarchical scale of occlusal anomalies was used to help identify the worst occlusal feature, which follow MOCDO rule²⁰:

- 1) Missing teeth (including congenital absence ectopic and impacted teeth).
- 2) Overjets (including reverse overjets).
- 3) Cross bites.
- 4) Displacement of contact points.
- 5) Overbites (including open bites)

The final grade of IOTN can determined by comparing both components of IOTN (DHC and AC), these components were combined to give a single score and the component that had the higher grade represent the final score for the index of orthodontic treatment need (IOTN).

Reproducibility: The investigator was trained and calibrated to use IOTN before data collection began to ensure attainment of valid data. The intra-examiner reliability was calculated according to the Kappa statistic and was found to be 0.848 for the AC (almost perfect Kappa agreement) and 1.000 for the DHC (perfect Kappa agreement). Every tenth participant was re-examined to determine the reliability of the examiner and the two measurements were compared. A total of 39 children were re-examined, approximately 7% of the total sample of 511 that were screened.²¹

Statistical Analysis

Data was analyzed using IBM Statistical Package for Social Sciences version 20.0 (SPSS Inc, Chicago, Illinois, USA). Two-way frequency tables for IOTN groups by age, gender and occupation of the parents were compiled. Cross tabulation and chi-square statistics were used to assess bivariate relationships. The p esteem for statistical significance was set at 0.05.

RESULTS

Results were displayed respecting: the frequency distribution and comparisons of responses to the questionnaire, grades of DHC, Treatment Need as determined by AC, correlation between DHC and AC and influence of gender and age on the respondent perception towards their smile.

The frequency distribution and comparisons of responses to the questionnaire:

Most of the respondent (79.5%) was satisfied with their smile, while 20.5% were unhappy with their smile (Figure 1). In respect with teeth, 203 children (39.7%) responded positively about their teeth and 308 children (60.3%) were despondent with the appearance of their teeth (Figure 2). In the last group, who are un-happy with their teeth appearance, (34.8%) would like to change arrangement of their teeth, (16.4%) wanted their teeth size to be changed and 9% specified color of their teeth as the one that must be changed (Figure 3). While the least percentage for grade 4 at 8.4% and grade 5 at 1.6% (Figure 4).

The grades of DHC

Grades 1 and 2 showed the heights percentages that they were 32.3% and 39.1% respectively, followed by grade 3:18.

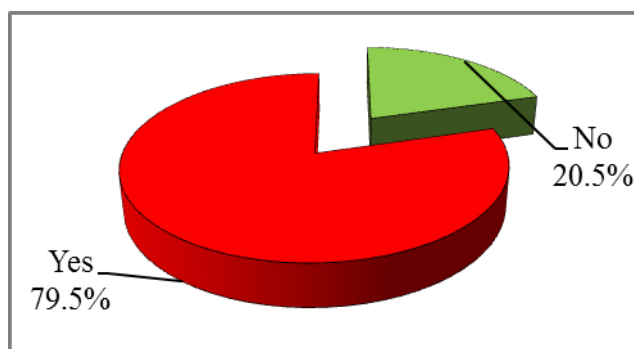


Figure 1: The satisfaction of the responders with smile.

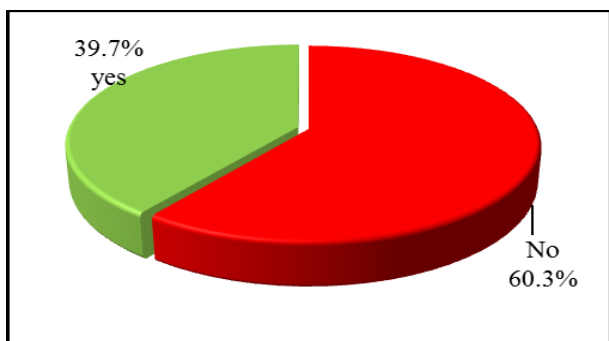


Figure 2: The satisfaction of the responders with their teeth appearance

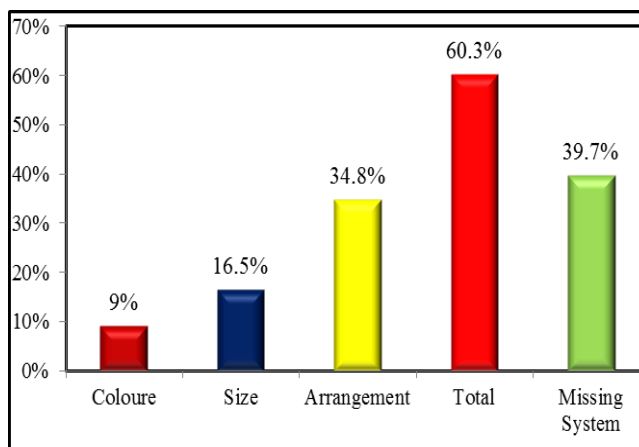


Figure 3: Dissatisfaction with the teeth

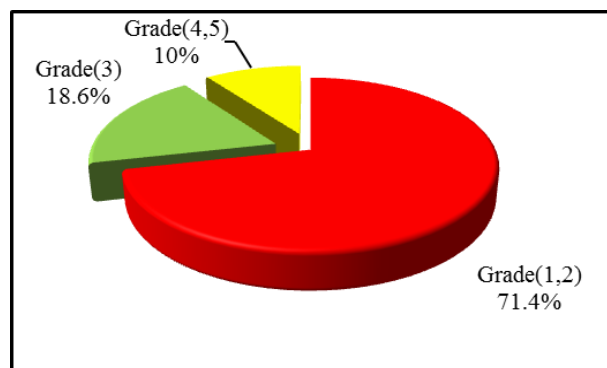


Figure 4: Orthodontic treatments need as determined by the investigators using DHC grades

Treatment Need as determined by AC

Photograph 3 was the most popular at 22.1% with the greatest percentage, Photograph 1 came second with 19.2% of the total respondents, followed by photographs 2 and 4 at percentage 17.8% and 15.1%. While photographs 9 and 10 were the least selected at percentage 0.6% for both (Figure 5).

Influence of age, gender and socioeconomic status on self-perceived IOTN

Age, gender and socioeconomic were not influence self-perceived orthodontic treatment need.

Correlation between DHC and AC

The relationship between the two factors AC and DHC of IOTN could be important strong correlation as represented by Spearman's correlation coefficient (0.923) at $P < 0.05$ (Figure 6).

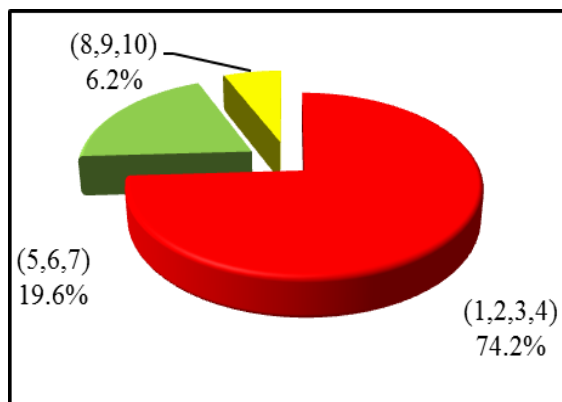


Figure 5: Orthodontic treatment need as determined by the children using (AC) photographs

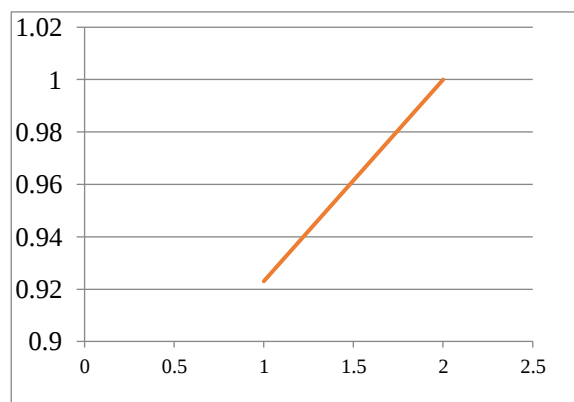


Figure 6: Correlation between DHC and AC

DISCUSSION

Need for orthodontic treatment is expanding as awareness has increased in the growing population.²² By age of 12-14 year-old, children possess intellectual maturity making them capable to understand and comprehend the procedures and detect problems with their teeth; and as a matter of fact, the rating scale of IOTN has been developed on intraoral dental photographs of children at age of 12-years-old children.^{17, 23} According to psychological researches,²⁴ the human face, specifically oral area plays a central role in evaluation of beauty especially among teenagers.^{25, 26}

The IOTN is a popular index that is epidemiologically used to plot priorities for orthodontic treatment needs aiming to preserve the resources.²⁷ The IOTN meets the requirements of ideal index by WHO¹⁹ and it has several characteristics that make it superior including: fast and easiness, it needs 2-3 minutes for malocclusal traits assessment;^{28, 29} it is applicable directly, on oral cavity, as well as indirectly on, dental model,⁴ since it assess the malocclusion basing on the level of need for treatment, it is applicable in screening of populations;^{3, 29} because IONT allows the respondents to evaluate their AC, there is feasibility to assess the perceived orthodontic treatment need, hence including socio-psychological factors in the assessment. When allowing the patient to assess their own AC it was the first.^{22,25, 26}

The sample was selected from the public schools since the vast majority of the Libyan children go to public schools. The participants are from

middle and in some instances from lower socioeconomic group (this is made out of the occupations of the participants' parents that were mainly officers, professionals, trader or merchant). Orthodontic treatment need was mainly associated with family social status that is clearly linked to income and maternal educational level.³⁰⁻³² There was a difficulty to obtain clear information about income and education level from the participants and in Libya there was no clear determinant parameter to classify the participants according to socioeconomic class, therefore, in this study the employment status of the parents used as an indicator for the socioeconomic status. The result suggested that the employment status were unlikely to be comparable or significant statistically across the low to middle socioeconomic groups. With regard to the employment status of the children's parents it was found that: 61.4% of the parents had an officer worker, 28.6% of the participants parents had a business worker, 5.3% of the children with laborer parents and 4.7% had no form of employment.

In respect to Aesthetic Component of the index (AC), this study revealed that the highest percent of the participants (74.2%) ranked their teeth with grades 1 to 4 which indicates slight or no treatment needed. Around $\frac{1}{5}$ of the children (19.6%) ranked their teeth-looks in grade 5 and grade 7, on the other hand 6.3% of the "borderline need for treatment category", and 6.3% of the respondents considered their dentition in 8 to 10 categories which means great treatment need levels. The distribution of outcomes is uneven which can be justified by: since children dislike dental treatments, they response subconsciously ranking their dental

appearance as acceptable or attractive escaping treatment. Nevertheless, AC demonstrates only the frontal view of the teeth, subsequently the child cannot recognize well and rank precisely occlusal anomalies such as deep over bite and exaggerated over jet.^{22, 27, 33}

The outcomes of this study resemble outcomes of other studies, Ucuncu and Ertugay in 2001 found that the vast majority (90.4%) of the children in Turkish schools required no treatment, whereas borderline grades were represented by only 4.8%, and another 4.8% of the respondents showed definite need for treatment.³⁴ In the western region of Saudi Arabia 60. 6% of children do not need or need minor treatment, 23.3% were in borderline area and only 16. 1 % believed that they need orthodontic intervention to correct malocclusion.

These find has be postulated by Hassan.³⁵ According to Abu Alhaija, Al Nimri and Al-Khatee, 75% of Jordanian children considered their dental esthetic appearance is acceptable and do not need orthodontic treatment, 23% were in borderline need, the portion who perceived themselves as in definite orthodontic treatment need were 2%.⁴ In investigation performed by Hedayati et al,³⁶ 91.31 % of the sample from Iranian children put themselves under category of no treatment need, 2. 44% considered themselves as borderline cases, and only 6. 21% believed that they need definite orthodontic treatment. Mugonzibwa et al,³⁷ were exception in this context. Since they worked on older age groups, they come across a little bit different result. They found that 38% of the Tanzanian subjects were not in orthodontic treatment need category, 30% borderline need; and 11% were definitely in need for treatment.

Evaluation of the dental health component (DHC) of IOTN in this study illustrated that 71.4% of the participants was set in grades 1 and 2 showing no or slight need for treatment, 18.6% in grade 3 demonstrating border line/moderate need for treatment and 10% of the children evaluated in grades 4 and 5 indicating definite/extreme need for orthodontic treatment. Variable percentages have been detailed by other studies performed in Arab countries. For instance, Omer et al, found that 31% of children were in definite orthodontic treatment need in Lebanon ³⁸. While Al-Zubair ³⁹ showed that 19% of participants had severe/extreme malocclusion among 12 years old Yamani school students. Applying DHC (IOTN) Al-Hummayani et al⁴⁰ conducted that the almost half (51.3%) of the Saudi children belong to no/slight need of treatment, and 24. 3% of the sample were severely in need for orthodontic treatment. In southern Asia, Cai et al ⁴¹

found that 24. 1% of young adult (17-24 years) had definite needs for orthodontic treatment. In Malaysia, Zamzuri et al.⁴² showed that 27% of participants were in severe/extreme need among 700 Malaysian schoolchildren aged 13-14 years.

A strong correlation was found, in this study, between the researcher evaluation for normative orthodontic treatment need (DHC) and subjective orthodontic treatment need as evaluated by the children (AC). This finding indicates Spearman's correlation coefficient was 0.923 ($P < 0. 01$) indicating that the IOTN components are accurate, reproducible, and valid for use in epidemiological studies in Libya. And it appears that the children are able of assessing their teeth with a high degree of accuracy. Zreaqat et al.⁴³ in Malaysia uncovered a similar connection between subjective assessment AC and the objective assessment DHC of the index. Ying et al.⁴¹ they concluded that there is an obvious correlation between the subjective treatment need (AC) and the normative treatment need (DHC). Contrarily, in 2006 Ali H Hassan³⁵ in western Saudi-Arabia, and Ghijselings et al. ⁴⁴ in Belgium claimed that a significant difference, in addition to negative correlation between the perceptive AC and objective DHC. This variability can be attributed to several factors including the fact that AC effectively reflect the child's motivation and concern for orthodontic treatment that being totally different from practitioner's judgment, in addition to lack of awareness among the children towards presence of occlusal anomalies, poor dental health education and parents' carelessness.^{35, 44}

The present work revealed that age of participants has no influence on smile perception, while it showed that the gender does. These outcomes go well with findings of Albarakati who.³³ On the other hand, Aikins et al.⁴⁵ concluded that no effect of gender on perception of malocclusion among Nigerian adolescents from 16 to 18 years old. This variation can be explained by the fact that there is an increase in the level of perception of need by age, so males become the as females in their awareness towards their teeth aesthetics. Athira et al.²⁷ and Abu Alhaija et al.⁴⁶ claimed that age as well as gender effect the smile perception. The variability between this study and the others could be justified by: there was no even distribution of participants on various age groups; inclusion of older children of 18 years whose perception of beauty is mature. Gender and age differences in the self-perception of malocclusion may be explained by the desire to looking more attractive by females and the older age group who stated that awareness of dental attractiveness increases with age.^{27, 46}

Conclusion

There is a strong correlation between self-perceived orthodontic treatment need and satisfaction with dental appearance. Basing on IOTN (AC & DHC) the majority of the Libyan students in Benghazi suffer from slight or no orthodontic anomalies. Age, gender and socioeconomic were not influence self-perceived orthodontic treatment need.

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