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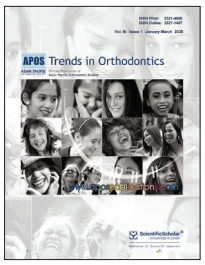

Original Article

Index of Complexity, Outcome, and Need (ICON) in Dubai school-aged adolescents

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ABSTRACT

Objectives: The purpose of the study was to epidemiologically assess the prevalence of malocclusion and orthodontic treatment need in school-aged adolescents in Dubai using the Index of Complexity, Outcome, and Need (ICON). Null hypothesis tested was no significant differences in ICON scores among Dubai students as a function of gender or geographic/ethnic background.

Materials and Methods: The sample was 17,763 adolescents with nearly equal by gender; India and the United Arab Emirates were represented about the same. Scores for malocclusion from Peer Assessment Rating (PAR) index evaluations combined with the esthetic component of the Index of Orthodontic Treatment Need (IOTN) comprised the ICON score.

Results: Male ICON scores were significantly greater than female scores. Three scores contributing to ICON were significantly higher in males, i.e., buccal anterior-posterior occlusion, incisor overbite, and esthetic component. ICON scores for South Asia were significantly higher than the Middle East, i.e., 59.9 versus 52.4, $P = 0.000$. ICON scores were no different for the UAE males and females but otherwise significantly different (>) as follows: Indian males > Indian females > UAE males = UAE females.

Conclusions: Dubai school-aged adolescents treatment need is the same for the UAE males and females, but there is a significantly greater orthodontic treatment need for males and females from India.

Keywords: Index of Complexity, Outcome, and Need, Treatment complexity, Malocclusion

INTRODUCTION

It is important to assess malocclusion while documenting the prevalence of dental health in population groups. Malocclusion data are important for epidemiologists and health-care administrators planning for the provision of orthodontic treatment and training programs for specialists. These data are not readily available in Dubai, the UAE. Only one study has evaluated orthodontic treatment need in Dubai school-age adolescents.[1] Such information is urgent because orthodontic treatment need in for school-aged adolescents in schools is ill-defined.

Socialized medicine and dentistry in Great Britain prompted the development of indices to assess malocclusion and determine the need for orthodontic treatment in the UK National Healthcare System. To quantify malocclusion, the Index of Orthodontic Treatment Need (IOTN)[2] was published in 1991 followed by the Peer Assessment Rating (PAR)[3] in 1992. The IOTN assessed both dental esthetics and dental health need, and the PAR index provided a single summary score

for the overall alignment and occlusion. It was suggested that the use of the occlusal indices would offer several advantages: (1) Uniformity in prescribing patterns, (2) safeguards for the patient, (3) patient counseling, and (4) monitoring and promoting standards.[4]

The Index of Complexity, Outcome, and Need (ICON) was developed in 2000 to enable assessments of treatment need and outcome using one set of occlusal traits. Components of the ICON index (with weighting factor) were assessments of the following: Dental esthetics (7), maxillary crowding (5), crossbite (5), incisor open bite, incisor overbite (4), and buccal segment anteroposterior (3).[5]

PAR scoring is performed using study cast or intraoral examination and pre-treatment malocclusion as well as post-orthodontic treatment outcomes are typically the focus. The PAR index uses five components for scoring: (1) Upper and lower anterior segment, (2) right and left buccal occlusal segments, (3) overjet, (4) overbite/open bite, and (5) dental centerline deviation.[3,4] IOTN scoring is based on a dental health component comprised maxillary incisor prominence, open bite, dental arch crowding and missing teeth, and an esthetic component, wherein the patient compares appearance of teeth with 10 malocclusion photographs which vary in severity.[2]

Comparing scores among indices IOTN, PAR, and ICON have received considerable attention in the scholarly literature.[6-13] The previous research suggested that the ICON could replace the PAR and IOTN (15) since the ICON was developed from the PAR and IOTN and correlated highly with both of these indices.[14] Khandakji *et al*.[15] recently concluded that the dental health component (DHC) and esthetic component (AC) of IOTN, ICON, and PAR reliably captured treatment need. The index ICON comprises five weighted measurements and owes some of its structure to IOTN and PAR. The measured traits include (1) dental esthetics as measured by the esthetic component of IOTN, (2) the presence of a crossbite, (3) anterior vertical relationship, i.e., deep bites and open bites as measured by PAR, (4) upper arch crowding/spacing on a 5-point scale, and (5) buccal segment anteroposterior relationship as measured by PAR.[10]

The IOTN index was used to evaluate orthodontic treatment need in Dubai school-age adolescents. In a sample of 17,840 Dubai school-aged students with a mean age of 14.5 years, Al Jeshi converted PAR index scores to IOTN scores and tested the null hypothesis of no difference in orthodontic treatment need as a function of gender or ethnicity in Dubai school-age students. Results of the study were as follows: (1) About 53.2% of the study sample would benefit from orthodontic treatment and 14.4% were profiled as "treatment require." (2) Indian males had significantly higher mean IOTN grades than the Middle East male and female subjects from the UAE. (3) Indian females had significantly higher mean IOTN grades than the Middle East female subjects from the UAE. The author concluded that males and females from India have the greatest orthodontic treatment need in Dubai public and private schools.[1]

The aim of the study was to epidemiologically assess the prevalence of malocclusion and orthodontic treatment need among a large group of schoolchildren aged 10–18 years in Dubai using the ICON index. The null hypothesis tested was no significant differences in ICON scores among Dubai students as a function of gender or geographic/ethnic background.

MATERIALS AND METHODS

Sample

The sample was retrospectively selected from 20,000+ school-aged adolescent subjects from 104 public and private schools located in Dubai, the United Arab Emirates, between May 1, 2008, and February 2, 2013. The students had been evaluated using the PAR index.

Inclusion criteria included 10–18 years old school-aged adolescents enrolled in a public or private primary or secondary school in Dubai. The students were selected on the presence of permanent dentition generally and no greater than three primary teeth present in the mouth. Exclusion criteria included the presence of fixed orthodontic appliances or a history of orthodontic treatment.

Procedures

1. Ethical clearance for the study was obtained from the IRB Committee Research of European University College.
2. Permission to participate in the study was first granted from the public and private schools. At the schools where permission was granted, a participant information statement explaining the study written in English and in the local Arabic language was distributed to the students, and a questionnaire regarding social data on the child and family was sent to parents for completion.
3. Following multiple calibration sessions, five screeners licensed to practice dentistry in Dubai examined students for PAR index parameters using a screening form outlining all PAR index scoring categories [Figure 1].
4. Examinations were carried out in the schools under typical room lighting conditions using gloves and sterile protocols. The examiners used wooden tongue depressors for retracting of lips and were aided with penlight illumination. Data were collected on the screening form and later transferred to Excel for storage while maintaining strict subject confidentiality. PAR

index scores for the entire index were gathered by examining the upper and lower anterior dentitions by visual inspection only and without the aid of dental probes.

5. ICON scores were created based on the appropriate information provided in the PAR score data as prescribed in the scholarly literature.[10] Data extracted from the PAR database scores were maxillary crowding, crossbite, anterior vertical relationships, i.e., incisor overbite open bite, and buccal segment anteroposterior relationship on both the right and left sides.
6. Converted scores were multiplied by weighting factors as prescribed in the literature, i.e., crowding weight 5, crossbite weight 5, incisor overbite weight 4, incisor open bite weight 4, and each right and left sides buccal anteroposterior relationship weight 3.[16]
7. The esthetic component of the IOTN was estimated for each subject based on the following criteria of priority: Incisor relationship (deep bite or open bite) > crowding > crossbite.
8. The weighted scores were tallied to provide the ICON score as follows: Esthetic component + maxillary crowding + crossbite + incisor open bite or overbite + right and left sides buccal occlusion relationship.

Statistical analysis

Descriptive statistics were computed for each of the five contributing variables as well as the ICON score using the SPSS software (v.15.0.1, IBM, Armonk, NY). Normality testing of data distribution demonstrated skewed right distributions. Even though very large sample sizes were represented in the study, lack of normal destruction violated the normal distribution assumption for parametric testing. Therefore, all summary scores were transformed using SPSS Log10 function to produce acceptable data distributions. For example, ICON score data were skewed right (1.06, standard error 0.018; Log10 data transformation reduced ICON score skewness to –0.25. Parametric testing was used to determine differences by gender and regional/ethnic background. $P < 0.05$ was used to determine statistical significance.

RESULTS

The sample was comprised 17,763 Dubai students with 9623 males and 8440 females. Samples from seven global regions were represented as follows from most to least: The Middle East > South Asia > Africa > Americas > North and East Asia > Europe > Australia [Table 1].

Highest to lowest ICON scores by region were as follows: South Asia > Africa > Americas > > Australia > Middle East > Europe > North and East Asia [Figure 2]. Discrepancies in the sample sizes precluded a statistical comparison.

The mean ICON score overall was 55.1 ± 33.6. Independent *t*-tests comparing ICON scores as a function of gender demonstrated significantly greater for 8140 males (55.7 ± 34.0) than 9623 females (53.3 ± 33.1, $P = 0.007$). To investigate further why male ICON scores were significantly higher than females, study variables that contributed to ICON score were analyzed separately, i.e., crowding, buccal occlusion, crossbite, overbite and open bite. Only esthetics, buccal occlusion, and overbite differed significantly ($P < 0.05$) by gender with all four male buccal variables mean greater than females [Table 2].

Table 1: Descriptive statistics included number of female and male subjects by age mean and standard deviation in years (A) and number of subjects per seven global regions (B).

	Age (years) (mean±SD)
A	
Gender (*n*)	
Female (8140)	14.48±2.03
Male (9623)	14.56±2.02
Total (17,763)	14.52±2.02
B	Sample size
Region	
Middle East	9,924
South Asia	7,068
Africa	370
Americans	144
North and East Asia	134
Europe	92
Australia	34
Total	17,763

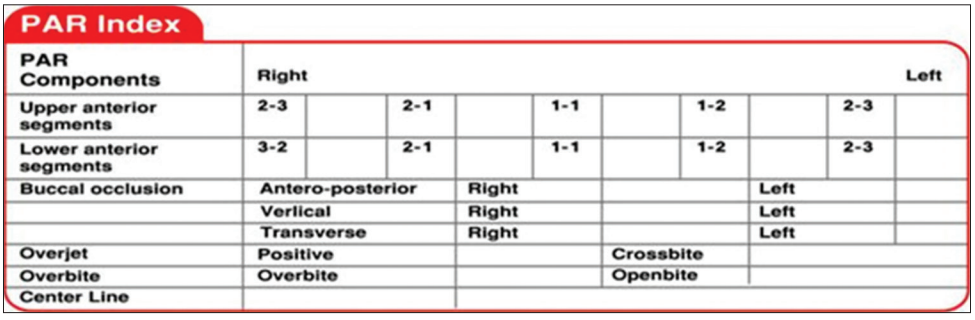

Figure 1: Screening form used to collect PAR index data by calibrated school screener – dentists.

ICON score as a function of region showed South Asia significantly higher than the Middle East, i.e., 59.9 versus 52.4, $P = 0.000$ (not shown). A comparison of ICON score by gender as a function of region demonstrated significant differences as follows: South Asia female > South Asia female > Middle East male = Middle East female [Figure 3].

Subsamples that were comparable by sample size were analyzed by gender and country. The two regions with greatest representation in the study were South Asia and the Middle East, i.e., Indian male = 2802, UAE male = 3851, Indian female = 2551, and UAE female = 3316. ICON scores and variables contributing to ICON score analyzed with one-way ANOVA testing demonstrated higher scores generally for India than the UAE with significantly ($P < 0.05$) higher means for Indian males except for open bite. Crowding and crossbite did not differ statistically ($P > 0.05$) [Figure 4].

International cutoff for orthodontic treatment need using the ICON index was 43, whereas others[16] recommended that an ICON cutoff of 52 was more valid. Both cutoff values were used to describe the entire sample of 17,763 students; for ICON ≥43, treatment need was represented by 64.6% of students; for ICON ≥53, treatment need was represented by 49.4% of total sample (not shown). When the ICON ≥53 cutoff values were applied by region, treatment need from highest to lowest was as follows: Australia > South Asia > Americas > Africa > Europe > Middle East > North and East Asia [Figure 5].

For subsamples that were comparable by sample size, the ≥53 cutoff ICON value was used to determine percentage by country – gender with the following order from greatest to least: Indian male (59.9%) > Indian female (55.1%) > UAE male (46.2%) > UAE female (44.0%) [Figure 6].

Table 2: ICON score compared by gender using the independent *t*-test demonstrated significantly ($P < 0.05$) higher male means for ICON score, esthetics, buccal occlusion (BOi), and overbite (OverBi) variables compared to females.

	Gender	Mean±SD	Mean dif.	*P* sig.
Esthetics	Female	26.6±16.5	−0.8	0.001
	Male	27.4±16.8		
BOi	Female	2.1±3.3	−0.1	0.014
	Male	2.2±3.5		
OverBi	Female	2.0±3.3	−0.3	0.000
	Male	2.3±3.6		
ICON	Female	54.3±33.1	−1.4	0.007
	Male	55.7±34.0		

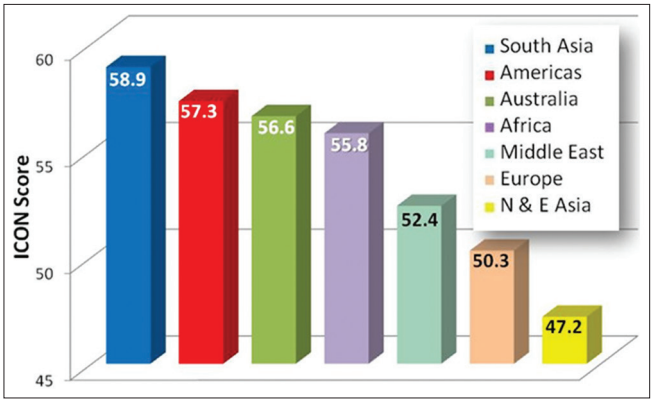

Figure 2: Highest to lowest ICON scores for total sample were as follows: South Asia > Americas > Australia > Africa > Middle East > Europe > North and East Asia.

DISCUSSION

The Dubai community is comprised slightly <90% expatriates, and its public and private schools are a reflection of the population diversity. The Dubai student adolescents

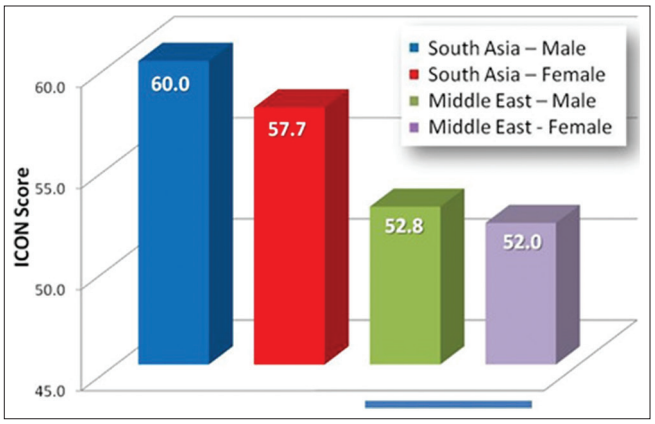

Figure 3: ICON score by gender as a function of South Asia and the Middle East regions demonstrated significant differences; ICON score was highest for South Asia males and lowest for the Middle East females. Blue horizontal lines overlapping bars represent statistical sameness ($P > 0.05$) and non-overlapping horizontal lines signify statistically significant differences ($P < 0.05$).

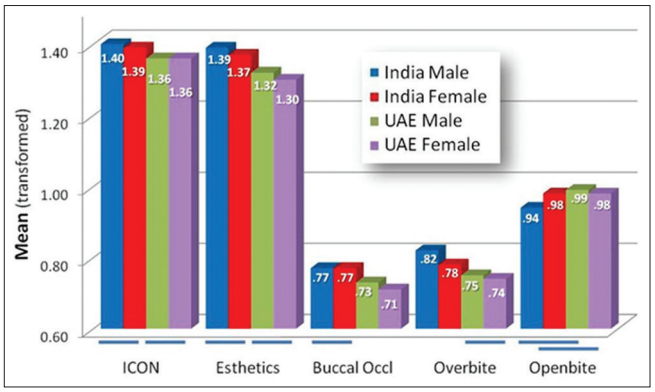

Figure 4: One-way ANOVA testing of transformed means demonstrated means generally higher for India than the UAE with Indian male means generally highest except for open bite.

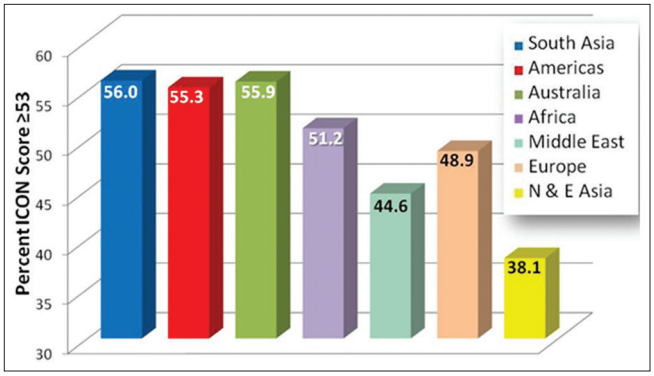

Figure 5: Percentage of student subjects with ≥53 cutoff ICON value. Greatest percentage was for Australia and the least was North and East Asia.

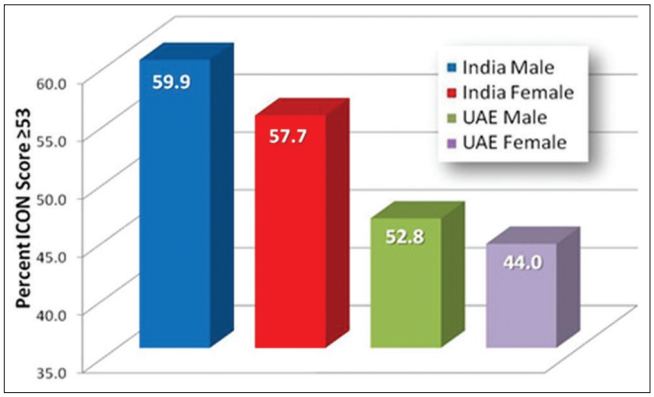

Figure 6: A comparison of the percentage of student subjects ≥53 cutoff ICON value by country – gender demonstrated higher treatment need for Indian males > Indian females > UAE males > UAE females.

comprising the sample of the present study were 17,763 strong with 9623 males and 8440 females averaging 14.52 years in age at time of examination and all presented with sufficient data to determine orthodontic treatment need based on ICON scoring. Both PAR scores and the esthetic component of the IOTN were used to compute ICON scores.

Orthodontic treatment need differs from one population to another depending on various factors which could influence the demand for orthodontic care such as social and cultural conditions, awareness and attitudes to orthodontic care, referral factors, and dentists awareness.[17] The mean ICON score obtained in this study was 55.1 which was higher than a study in Iran[18] with a mean score of 44.3, similar studies in Nigeria[19] and Senegal[20] with a mean score of 43 and in Estonia[21] with a median score of 31. Although the physical attributes of the ICON score are common, differences in the perception of the esthetic component could account for the variation.

In the present study, mean ICON scores differed by gender with males presenting the higher score, i.e., 55.7 versus 54.3, $P = 0.000$. This is consistent with a previous study that assessed orthodontic treatment need using IOTN scoring in Dubai by Al Jeshi *et al.*[1] These findings are also consistent with the reports of Burden[22] and Aikins *et al.*[23] also demonstrated in the present study that the scores contributing to ICON score also significantly ($P < 0.05$) different by gender were buccal anterior-posterior occlusion, incisor overbite, and the esthetic component while crowding, crossbite, and incisor open bite were not significantly ($P > 0.05$) different.

Results of the present study indicate that the highest to lowest ICON scores by region were as follows: South Asia > Africa > Americas > Australia > Middle East > Europe > North and East Asia; moreover, mean ICON score for South Asia was significantly higher than the Middle East. These findings were the same as Al Jeshi *et al.*[1] who used IOTN scoring.

The present study demonstrates that malocclusions for males were more severe than female, and in regions with comparable numbers of the study subject, the mean India ICON score was significantly higher than the mean UAE ICON score. Treatment need as determined by ICON scoring demonstrated the following hierarchy of treatment need: Indian males > Indian females > UAE males = UAE females.

CONCLUSIONS

The null hypothesis of no significant differences in ICON scores among Dubai students as a function of gender was rejected.

- Male ICON scores were significantly greater than female scores.
- Three scores contributing to ICON were significantly higher in males, i.e., buccal anterior-posterior occlusion, incisor overbite, and esthetic component.

The null hypothesis of no significant differences in ICON scores among Dubai students as a function of geographic/ethnic background was rejected.

- ICON scores for South Asia were significantly higher than the Middle East, i.e., 59.9 versus 52.4, $P = 0.000$.
- ICON scores were no different for the UAE males and females but otherwise significantly different (>) as follows: Indian males > Indian females > UAE males = UAE females.

Based on the conditions of the present study, Dubai school-aged adolescents treatment need is the same for the UAE males and females. In greater orthodontic treatment need than Emirates are Dubai school aged adolescent males and females from India.

Declaration of patient consent

Patient's consent not required as patient's identity is not disclosed or compromised.

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Nil.

Conflicts of interest

There are no conflicts of interest.

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