Orthodontic Treatment Need in Dubai School Adolescents: A Study of 20,000 School-age Adolescents in 66 Public and Private Schools Comparing Orthodontic Treatment Need by Gender and Ethnicity

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Abstract

Aim: The purpose of the study was to compare and contrast the orthodontic treatment needs of Dubai school-age school age children as a function of gender and ethnicity.

Methods: A total of 20,880 subjects were screened in 66 public and private school located in Dubai, United Arab Emirates. The study sample was grouped according to seven geographic regions. The total sample included 9,765 females and 11,115 males. Ages ranged from 9.08 years to 24.4 years with an overall mean age of 14.5 years. Calibrated dentists examined school age children using Peer Assessment Rating Index (PAR). PAR scores were translated to Index for Orthodontic Treatment Need (IOTN) scores based upon the description of each of the 31 IOTN line item descriptions that constitute IOTN grades from 1 to 5. Upon completion, statistical comparison of the study variables by gender and ethnicity was applied.

Results: Evaluation of IOTN grade by gender demonstrated significantly higher male (2.52) than female (2.47, p=0.002) grade; comparison of IOTN grade by region showed South Asia (2.58) significantly higher than Middle East (2.43). IOTN grade was highest for South Asia males (2.62) which was significantly higher than South Asia females (2.55, p=0.023) and higher than both Middle East males and females (2.45 and 2.41, p=.000). Moreover, average South Asia female IOTN grade was significantly higher (p=0.000) than for both Middle East males and females.

Conclusions

1. In Dubai school-aged adolescents, 53.2% of the study sample would benefit from orthodontic treatment and 14.4% were profiled as “treatment require”.
2. Within the Middle East region, UAE subjects had higher mean IOTN grade than subjects from Iran, Syria and Yemen.
3. India males had significantly higher mean IOTN grades than Middle East male and female subjects from UAE, Iran, Syria, and Yemen.
4. India females had significantly higher mean IOTN grades than Middle East female subjects from UAE, Iran, Syria, and Yemen.

It may be concluded that males and females from India have the greatest orthodontic treatment need in Dubai public and private schools.

Introduction

Malocclusion is a common oral disorder which manifests itself during childhood, and the correction of malocclusion vis-à-vis orthodontic treatment is frequently carried out during childhood. With the growing demand for orthodontic treatment, a variety of clinician based indices have been developed to classify various types of malocclusion and determine orthodontic treatment need. These indices can be used in estimating the demand for orthodontic c are, prioritizing treatment need particularly where there are limited resources for orthodontics among pubic health care services, and safeguarding the patient’s welfare.

Health care policy and changes in health care policy are affected by the population of patients such policy serves. The oral health condition and needs of the school-age school age children in Dubai is virtually unknown, and the lack of epidemiological data has made it difficult to assess the extent of public dental health problems. It is in the dentist’s best interest to understand the needs of the population they will serve. The incidence of malocclusion provides the basis for an understanding of how the population can best be served by the dental and orthodontic profession.

Oral health conditions such as malocclusion vary in degree of severity and treatment need. Malocclusion indices such as Peer Assessment Review Index (PAR) and Index for Orthodontic Treatment Need are designed for related but different purposes. According to Shaw, the IOTN assesses both dental aesthetics and dental health need [1,2]. The PAR index provides a single summary score for the overall alignment and occlusion. The difference between the pre- and post-treatment scores reflects the degree of improve ested the PAR Index that is typically used to judge the degree to which malocclusion has been resolved [3]. PAR Index i s used to assess the degree to which malocclusion deviates from normal alignment and occlusion. PAR scoring can be done using study casts or intra-orally, and pre-treatment malocclusion are usually compared to orthodontic treatment outcomes. The PAR Index has five components:

1) Upper and lower anterior segment alignment,
2) Right and left buccal occlusal assessments,
3) Over jet measurements,
4) Open bite/overbite measurements, and
5) Center line measurements.

Brook and Shaw (1989) developed and tested the validity and reliability of the Index for Orthodontic Treatment Need (IOTN) as an index of treatment needs [4]. The IOTN Index

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attempts to rank malocclusion in terms of the significance of various occlusal traits for an individual's dental health and perceived esthetic impairment [5]; the intension of the IOTN Index is to identify those individuals who would most likely benefit from orthodontic treatment.

The PAR and IOTN Indices have become widely used in the UK as orthodontic audit tools. Turbill (1996) indicated that the indices provided valuable data to inform public, political and clinical debate on the quality of General Dental Service's orthodontics [6]. According to Fox (2004) and others, two different measurement protocols must be learned in order to assess treatment inputs and outcomes using IOTN and PAR [7,8].

Fox (2002) evaluated and compared 55 consecutively treated cases using the PAR, IOTN and ICON [9]. The study showed significant correlations between IOTN and ICON with respect to need and PAR and ICON with respect to outcome. The authors concluded that ICON may effectively replace PAR and IOTN as a means of determining need and outcome.

Järvinen (2001) described treatment need indexes and their uses in everyday practice, and pointed out that there are differences in the validity of the indexes, even though it is not possible to evaluate the degree of validity with the knowledge we have today [10]. Turbill (1996) observed only limited agreement between PAR and IOTN and indicted the Indices are essentially an epidemiologic tool that have shortcomings in assessing individual cases [6].

In this investigation, PAR Index scores were gathered during a 10 month period in a large-scale dental epidemiological investigation. In order to ascertain the orthodontic treatment need of Dubai school-age children. PAR scores were converted into IOTN Index data, this modification cannot directly be compared with original IOTN score. The purpose of the study was to compare and contrast the orthodontic treatment needs of Dubai school-age children as a function of gender and ethnicity. The null hypothesis tested was no difference in orthodontic treatment need as a function of gender or ethnicity in Dubai school-age children.

Materials and Methods

Sample

School school-age children were screened in 66 public and private schools in Dubai. Selection criteria for subject inclusion for this study included the following:

1) Enrolled in a public or private primary or secondary school in Dubai.

2) Permanent dentition generally.

Specific criteria for subject Exclusion for this study included the following:

1) Not enrolled in a public or private primary or secondary school in Dubai,

2) Greater than 3 primary teeth present in the mouth, and

3) Presence of fixed orthodontic appliances or history of orthodontic treatment.

A total of 20,880 subjects were screened in 66 public and private school located in Dubai, United Arab Emirates. The study sample was grouped according to seven geographic regions as follows: Middle East (11,542 or 55.3%), South Asia (7,781 or 37.3%), Africa (1077 or 5.2%), Americas (170 or 0.8%), Greater Asia (149 or 0.7%), Europe (115 or 0.6%), and Australia/New Zealand (46 or 0.2%). Overall, 19,323 (92.5%) of the sample subjects were from the geographic regions of Middle East and South Asia.

The total sample of 20,880 subjects included 9,765 females and 11,115 males. Ages ranged from 9.08 years to 24.42 years with an overall mean age of 14.55 ± 2.02 years; average age of females (14.55 years) was nearly identical to males (14.54 years).

The sample was then redistributed according to cultural region or identity wherein northern Africa countries (Egypt, Algeria, Libya, and Morocco) were moved from Africa to the Middle East to create a "Cultural-Region" Middle East sample. Finally, the "Cultural-Region" category was further restricted by including only countries represented by 100 study subjects; this resulted in only Egypt being added to the Middle East category. Final sample size for Middle East was 12,022 or 57.6% of initial sample and for South Asia was 7,610 or 36.5% of initial sample; combined Middle East and South Asia sample comprised 19,632 or 94.1% of total initial sample screen. This "right-sizing" method was performed to make statistical testing more reasonable and remainder of testing was based upon a 19,632 sample size (*Table 1*).

Middle East and South Asia countries with greater than 100 subjects were represented in the study. The final study sample included 17,614 subjects from 13 countries with greater than 100 subjects: 4 South Asia countries including India, Pakistan, Philippines, and Bangladesh, and 9 Middle East countries including Egypt moved from Africa to the Middle East as well as UAE, Yemen, Syria, Iran, Jordan, Iraq, Palestine, and Lebanon.

Procedures

Ethical clearance for this study was obtained from the Research Committee of the European University College. 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 the local language of Arabic and English was distributed to the school age children, and a questionnaire regarding social data on the child and family was sent to parents for completion.

Following multiple calibration sessions, five school screeners licensed to practice dentistry in Dubai examined school age children using the PAR Index in 66 public and private schools. The screeners examined school age children for PAR Index parameters using a screening form outlining all PAR Index scoring categories. (*Figure 1*)

Five school study screeners licensed to practice dentistry in Dubai were required to read a PAR scoring publication [3] followed by initial instruction on how to score patient cases using the PAR Index. A patient case was presented by PowerPoint showing appropriate intra-oral malocclusion views and screeners were asked to score using the PAR Index form. At the end of each case scoring session, score sheets were gathered and reviewed; results were discussed with the 5 screeners by identifying which scores were different from the others. Consensus scoring agreement was reached by the

Table 1. *Descriptive statistics of the study sample by age including sample number (N), percentage of sample (Percent), mean, and standard deviation (SD); breakdown is by gender, by Geographic-Region, and by Cultural-Region which comprised 94.1 percent of the total sample.*

Subgroups	N	Percent	Mean	SD
Gender				
Female	9765	46.8	14.55	2.02
Male	11115	53.2	14.54	2.10
Total	20880	100.0	14.55	2.02
Geographic-Region				
Africa	1077	5.2	14.74	1.90
South Asia	7781	37.3	14.06	1.84
Greater Asia	149	0.7	14.67	1.59
Middle East	11542	55.3	14.86	2.08
Europe	115	0.6	14.33	1.83
Americas	170	0.8	14.36	1.76
Australia & NZ	46	0.2	13.92	1.78
Total	20880	100.0	14.55	2.02
Cultural-Region				
Middle East	12022	58.6	14.84	2.07
South Asia	7610	37.3	14.06	1.84
Total	19632	94.1		

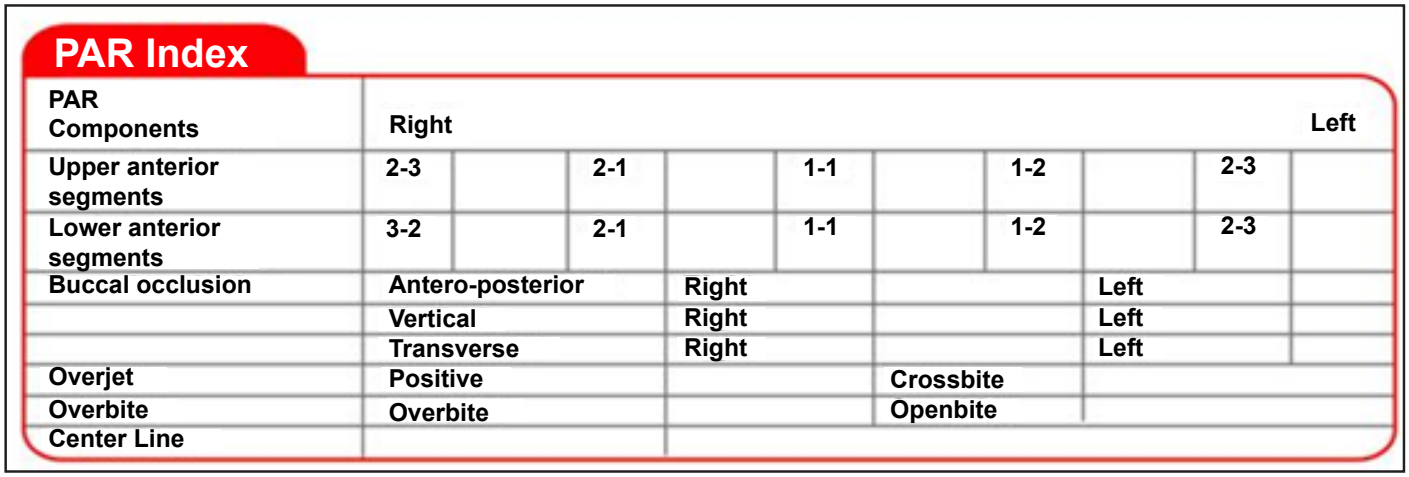

Figure 1. *Screening form used to collect PAR Index data by calibrated school screeners.*

group for each case before scoring the next 4 cases. A week later, all screeners together scored sequentially 5 different patient cases presented by PowerPoint followed by discussion of deviating scores on each case and consensus agreement. On the third session a week later, all screeners were tested by scoring 5 different cases without any discussion; score sheets were statistically compared using the Dahlberg reliability formula with results demonstrating less than 5% deviation for each of the scoring parameters and a 96.4% compliance with PAR Total Score. After two months of screening school age children in schools, the calibration exercise was repeated using 2 different patient cases presented by PowerPoint with same scoring parameters outcome (<5%) and PAR Total Score of 95.2%.

Examinations were carried out in the schools under typical room lighting conditions using gloves and sterile protocols. 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.

The examiners used wooden tongue depressors for retracting of lips and were aided with pen-light illumination. Data was collected on the screening form and later transferred to Excel for storage while maintaining strict subject confidentiality.

Peer Assessment Rating Index (PAR): The PAR Index is a widely accepted, objective index which assigns points to the various occlusal traits that may make up a malocclusion. Five components are scored to make up the PAR Index:

1. Upper and lower anterior segments. Scores are recorded for both upper and lower anterior segment alignment. The features recorded are crowding, spacing and impacted teeth. Scoring is 0 to 4 for inter-proximal contact displacements from 0 to >8 mm; a score of 5 means impacted tooth.

2. Buccal occlusion. The buccal occlusion is recorded for both left and right sides. The recording zone is from the canine to the last molar. All discrepancies are recorded when teeth are in occlusion. Scoring is for antero-posterior ranges from 0 to 2 with 2 representing half cusp discrepancy or greater. Vertical scoring ranges from 0 to 1 with 1 representing lateral open bite on at least two teeth greater than 2.0 m. Transverse scoring ranges from 0 to 4 with 4 representing more than one tooth in scissor bite.

3. Overjet. Positive overjet as well as teeth in crossbite is recorded. The most prominent aspect of any one incisor is recorded. If the two lateral incisors are in crossbite while the

central incisors are with increased overjet of 4mm, the score will be 3 for crossbite and 1 for the positive overjet, 4 in total. Overjet scoring ranges from 0 to 4 with 4 representing greater than 9mm. Anterior Crossbite scoring ranges from 0 to 4 with 4 representing more than two teeth in crossbite.

4. Overbite. The vertical overlap or open bite of the anterior teeth is recorded.

5. Centerline assessment. The centerline discrepancy between the upper and lower dental midline is recorded in relation to lower central incisors. Centerline scoring ranges from 0 to 2 with 2 representing greater than ½ lower incisor width discrepancy.

Index for Orthodontic Treatment Need (IOTN) has two parts, the dental health component (DHC) and the Aesthetic Component (AC). The DHC is based on the Swedish index [11] and evaluates occlusal traits thought to be related to the morbidity of the dentition and the surrounding structures. Sixteen traits are graded from 1 (no need for treatment) to 5 (great need for treatment). DHC is considered reliable and was used in the present study. In the aesthetic component, the patient's situation is rated with a series of 10 intraoral photographs that represent no need for treatment on aesthetic grounds (photos 1-4) to borderline need (5-7) to treatment need (8-10). After treatment the patients should fall into the first category. The aesthetic component has low reliability and was not used in the present study.

PAR scores were translated to IOTN scores based upon the description of each of the 31 IOTN line item descriptions that constitute IOTN grades from 1 to 5. PAR translations were under estimated when IOTN criteria did not exactly match (*Table 2*).

Statistical Analysis

The data initially collected on screening forms was de-personalized and transferred to Excel spreadsheet format prior to converting to SPSS format for data processing. Using SPSS software, inter-group comparisons for PAR scores were made on the basis of ethnicity using non-parametric Mann-Whitney U and Kruskal Wallis H-testing. All tests of significance were completed at the 95% confidence level ($p<0.05$).

Table 2. *PAR scores were translated to IOTN scores based upon the description of each of the 31 IOTN line item descriptions that constitute IOTN grades from 1 to 5. See text for definition of PAR Index variables.*

IOTN Grade	IOTN Index	PAR Index
1	1. Extremely minor malocclusions, including displacements less than 1 mm	All PAR scores = 0
2	2.a Increased Overjet > 3.5 mm but ≤ 6 mm	Overjet = 1
	2.b Reverse overjet greater than 0 mm but ≤ 1m	Anterior crossbite = 1
	2.c Anterior or posterior crossbite with ≤ 1mm discrepancy between retruded contact position and intercuspal position	Anterior crossbite = 1
	2.d Displacement of teeth > 1mm but ≤ 2 mm	Any displacement score = 1
	2.e Anterior or posterior open bite > 1mm but ≤ 2 mm	Open Bite = 2
	2.f Increased overbite ≥ 3.5mm (without gingival contact)	Over Bite = 1
	2.g Pre normal or post normal occlusions with no other anomalies includes up to half a unit discrepancy	Buccal AP right = 1 Buccal AP left = 1
3	3.a Increased overjet > 3.5 mm but ≤ 6 mm	Overjet = 2
	3.b Reverse overjet greater than 1 mm but ≤ 3.5mm	Anterior crossbite = 2
	3.c Anterior or posterior crossbites with >1 mm but ≤ 2 mm discrepancy between the retruded contact position and intercuspal position	Anterior crossbite = 2
	3.d Displacement of teeth >2 mm but ≤4 mm	Any displacement score = 2
	3.e Lateral or anterior open bite > 2 mm but ≤ 4 mm	Buccal vertical right or left = 1 Open Bite = 3
	3.f Increased and incomplete overbite without gingival or palatal trauma	Over Bite = 2
4	4.a Increased overjet > 6 mm but ≤ 9 mm	Overjet = 3
	4.b Reverse overjet > 3.5 mm with no masticatory or speech difficulties	Anterior crossbite = 3
	4.c Anterior or posterior crossbites with > 2 mm discrepancy between the retruded contact position and intercuspal position	Anterior crossbite = 3
	4.d Severe displacements of teeth > 4	Any displacement score = 3
	4.e Extreme lateral or anterior open bites > 4 mm	Open Bite = 4
	4.f Increased and complete overbite with gingival or palatal trauma	Over Bite = 3
	4.g Less extensive hypodontia requiring pre-restorative orthodontics or orthodontic space closure to obviate the need for a prosthesis	(No PAR score equivalent)
	4.h Posterior lingual crossbite with no functional occlusal contact in one or more buccal segments	Buccal transverse right = 4 Buccal transverse left = 4
	4.i Reverse overjet > 1 mm but < 3.5 mm with recorded masticatory and speech difficulties	(No PAR score equivalent)
	4.j Partially erupted teeth, tipped and impacted against adjacent teeth	(No PAR score equivalent)
	4.k Existing supernumerary teeth	(No PAR score equivalent)
	5.i Impeded eruption of teeth (apart from 3rd molars) due to crowding, displacement, the presence of supernumerary teeth, retained deciduous teeth, and any pathological cause	Any displacement score = 5
	5.m Reverse overjet > 3.5 mm with reported masticatory and speech difficulties	Anterior crossbite = 4
	5.p Defects of cleft lip and palate	(No PAR score equivalent)
	5.s Submerged deciduous teeth	(No PAR score equivalent)

Results

PAR scores for a sample of 17,840 school-aged school age children representing Middle East and South Asia countries with 100 or greater subjects were translated into IOTN grades based upon the IOTN description for each of the 5 grades levels (*Table 2*). Grade 1 defined as "no treatment needed" comprised 14.5% of the study population or 2,593 subjects; Grade 2 defined as "little need" was represented by 40.3% or 7,197 subjects; Grade 3 defined as "borderline treatment" comprised 38.8% or 5,489 subjects; Grade 4 defined as "treatment required" was represented by 9.9% or 1,763 subjects; and Grade 5 also defined as "treatment required" was comprised of 4.5% of the study population or 798 study subjects (*Figure 2*).

Mean IOTN grade for the study sample was 2.49 ± 1.00; IOTN male (2.52) score was significantly higher than female (2.47, p=0.002). IOTN average for South Asia (2.58 ± 1.01) was significantly higher than mean Middle East (2.43 ± 1.00, p=0.000) grade (*Table 3*). The frequency distribution of IOTN grades 4 and 5 combined for "treatment required" was greater in the South Asia (17.9%) compared to Middle East (9.1%) demonstrating more severe malocclusion in the South Asia sample (*Figure 3*).

Evaluation of IOTN grade by gender in the two regions demonstrated that IOTN grade was significantly higher for South Asia males (2.62) and for South Asia females (2.55, p=0.023) and for both Middle East males and females (2.45 and 2.41, p=0.000). Moreover, average South Asia female IOTN grade was significantly higher (p=0.000) than for both Middle East males and females (*Table 3 and Figure 4*).

When IOTN grades were compared by countries within regions, no differences were found in South Asia countries represented by more than 100 subjects; India (2.60) had the highest average IOTN grade and Bangladesh had the lowest grade (2.47). However, in the Middle East, UAE (2.47) IOTN grade was significantly higher than Syria (2.28, p=0.036) as well as Yemen and Iran (2.29 and 2.23, p=.000) (*Table 4 and Figure 5*).

IOTN grades were compared by gender-country within regions and no differences (p>0.05) were found within South Asia countries represented by more than 100 subjects. However, in the Middle East, IOTN grade for UAE males (2.48 ± 1.02) was significantly higher than Syria female (2.13 ± 0.86, p=0.036) as well as Iran female (2.12 ± 0.99, p=0.02) subjects.

IOTN grades were compared by gender-country after combining the Middle East and the South Asia countries. The largest average IOTN grades were found in India males (2.64) followed by Pakistan males (2.58) then India females (2.56). India males were significantly higher in mean IOTN grade than females from Iran, Syria, Yemen, Iraq, and UAE as well as males from Iran, Yemen, Syria and UAE. India females were significantly higher in mean IOTN grade than females from Iran, Syria, Yemen, and UAE as well as males from Yemen. Pakistan males were significantly higher in mean IOTN grade than females from Iran, Syria, and Yemen as well as males from Yemen (*Table 5*).

Discussion

Data for this research was collected between May 2008 and February 2009 but the five year old data would not appear to

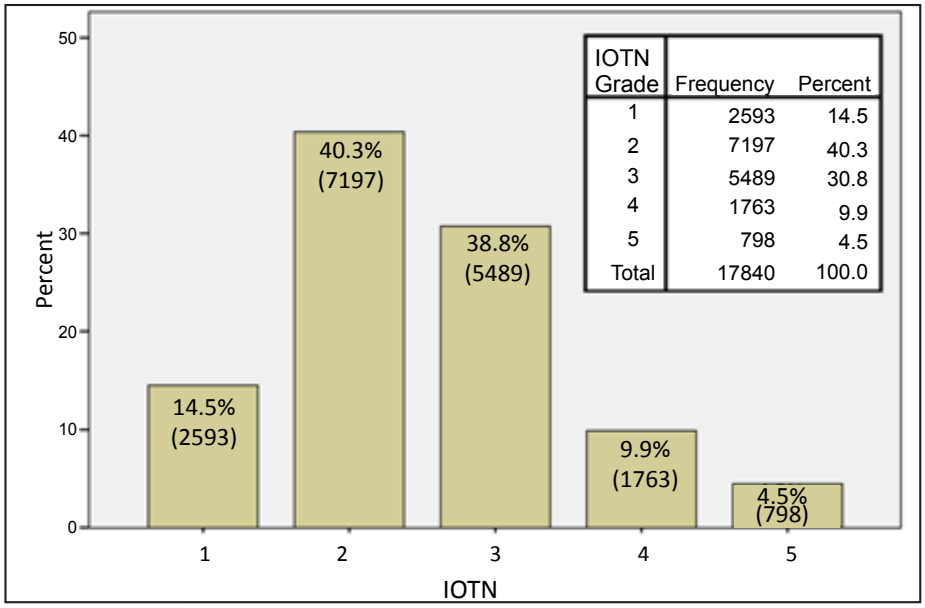

Figure 2. *Frequency distribution of the study sample of 17,840 Dubai school-aged school age children by IOTN Grade level 1 through 5 demonstrating percent of study sample and number of subjects per IOTN grade.*

Table 3. *A comparison of IOTN mean grade by region and by gender-region demonstrating significantly higher mean IOTN grades for South Asia subjects.*

Region	N	IOTN Mean	SD	Probability (p)
Middle East	10056	2.43	1.00	
South Asia	6721	2.58	1.01	p=.000
Female - ME	4347	2.41	.99	
Male - ME	5709	2.45	1.00	
Female - SA	3176	2.55	.99	p=.000 vs M-ME & F-ME
Male - SA	3545	2.62	1.02	p<.023 vs F-SA, M-ME & F-ME

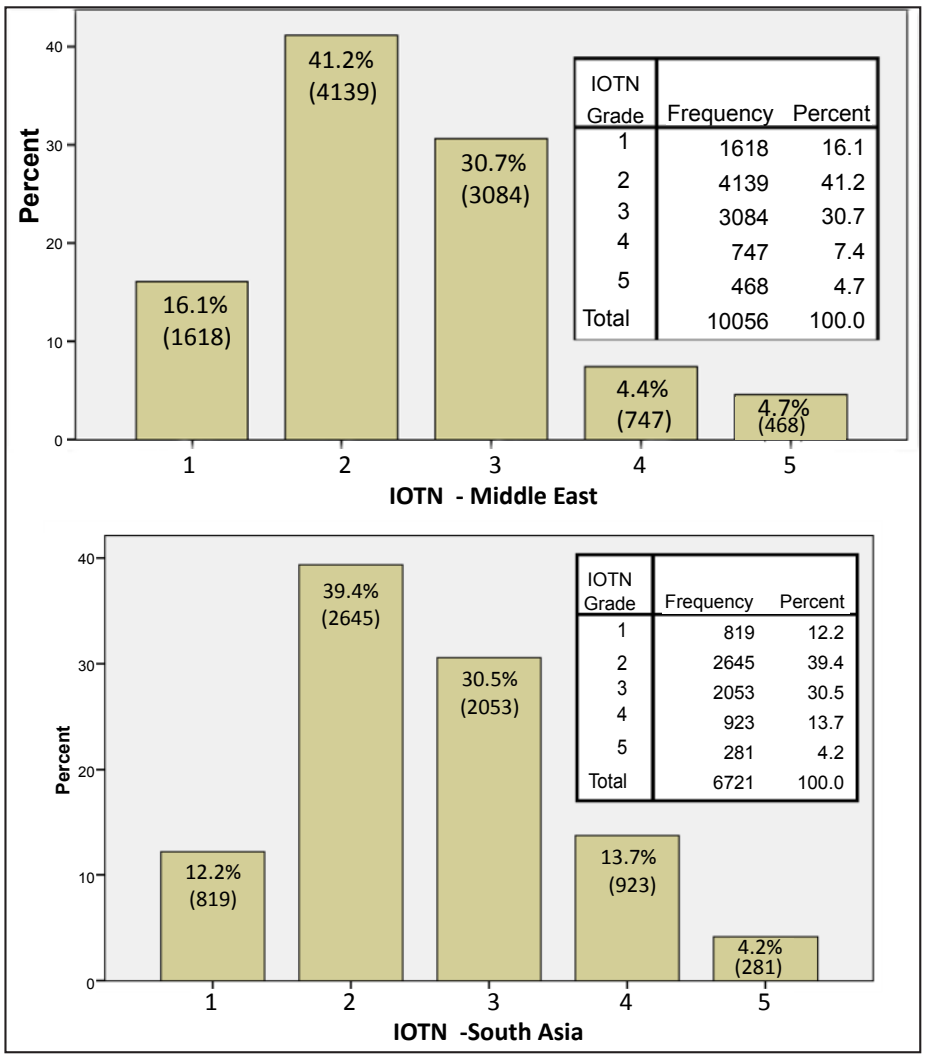

Figure 3. *Frequency distribution of the IOTN Grade level 1 through 5 for South Asia and Middle East samples demonstrating a higher percent of "treatment required" type malocclusion in the South Asia subjects.*

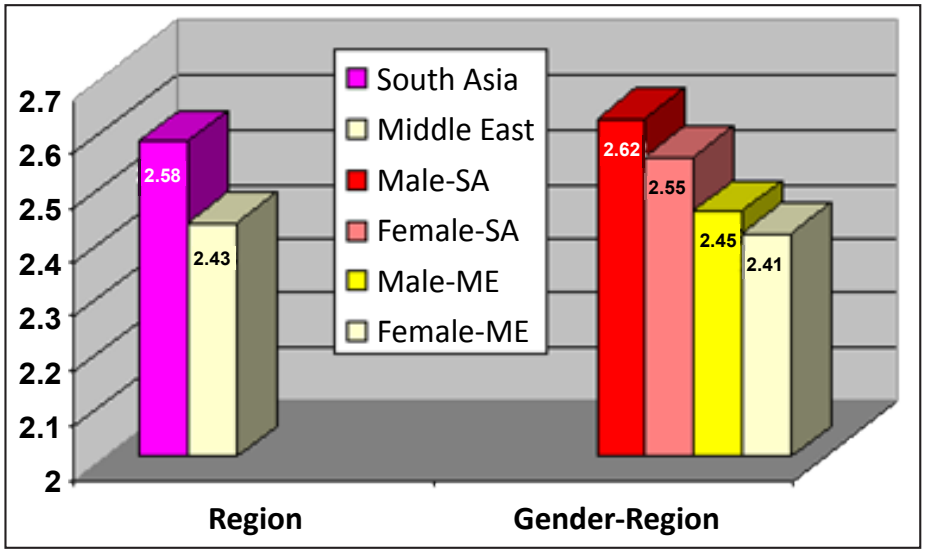

Figure 4*. A comparison of IOTN mean grade by region and by gender-region demonstrating significantly higher mean IOTN grades for South Asia subjects.*

be a confounding factor. Dubai has increased in population at a steady rate of approximately 5% per annum for the past five years, and there have been no major changes in the demographics of expatriate ethnicity since 2009.

IOTN Grade 1 defined as "no treatment needed" comprised 14.5% of the study population or 2,593 subjects; Grade 2 defined as "little treatment need" was represented by 40.3% or 7,197 subjects; Grade 3 defined as "borderline treatment need" comprised 38.8% or 5,489 subjects; Grade 4 defined as "treatment required" was represented by 9.9% or 1,763 subjects; and Grade 5 also defined as "treatment required" was comprised of 4.5% of the study population or 798 study subjects.

Mean IOTN grade for the study sample of was 2.49. Average IOTN grade for South Asia (2.58) was significantly higher than mean Middle East grade (2.43). Combining IOTN grades 4 and 5 demonstrated a higher percentage of subjects in the "treatment required" category from South

Table 4. *A comparison of IOTN mean grade by region and by gender-region demonstrating no differences among the South Asia countries but significantly higher mean IOTN grades for UAE compared Iran, Syria and Yemen subjects.*

Middle East	N	IOTN Mean	SD	Probability (p)
Iran	302	2.23	0.91	p=.002 vs UAE
Syria	305	2.28	0.01	p=.036 vs UAE
Yemen	572	2.29	0.94	p=.001 vs UAE
Palestine	243	2.37	0.96	
Iraq	284	2.39	0.94	
Lebanon	118	2.39	0.96	
Jordan	297	2.40	0.93	
Egypt	553	2.44	0.96	
UAE	7382	2.47	1.02	p<.036 vs Yemen, Iran & Syria
South Asia	**N**	**IOTN Mean**	**SD**	**Probability (p)**
Bangladesh	131	2.47	1.03	
Philippine	404	2.50	.96	
Pakistan	979	2.54	.97	
India	5207	2.60	1.01	

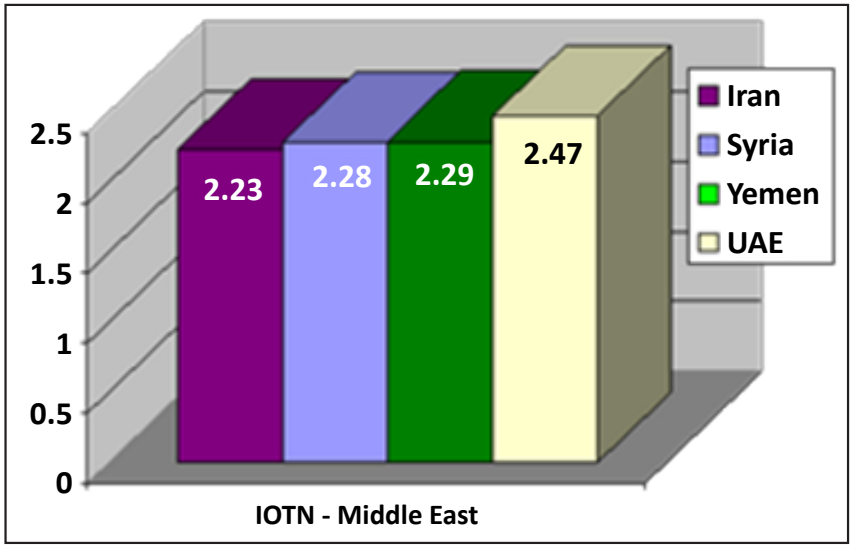

Figure 5*. A comparison of IOTN mean grade by region and by gender-region demonstrating no differences among the South Asia countries but significantly higher mean IOTN grades for UAE compared Iran, Syria and Yemen subjects.*

Table 5*. IOTN grade compared by gender-country after combining Middle East and South Asia subjects. Average IOTN grade for India males was highest and significantly higher than either male or female (or both) subjects from 9 subgroups representing 5 Middle East countries. Mean India female IOTN grade was higher than 5 other subgroups, and mean Pakistan male IOTN grade was higher than 4 other subgroups.*

Gender-Country	N	IOTN Mean	SD	Gender-Country	N	IOTN Mean	SD	Probability (p)
Male - India	2732	2.64	1.02	Female - Iran	109	2.12	0.99	p=0.000
				Female - Syria	103	2.13	0.86	p=0.000
				Female - Yemen	194	2.26	0.88	p=0.000
				Female - Iraq	109	2.27	0.86	p=0.036
				Male - Iran	193	2.30	0.86	p=0.000
				Male - Yemen	378	2.30	0.88	p=0.000
				Male - Syria	202	2.36	0.93	p=0.028
				Female - UAE	3303	2.44	1.02	p=0.000
				Male - UAE	4079	2.48	1.02	p=0.000
Female - India	2475	2.56	1.00	Female - Iran	109	2.12	0.99	p=0.002
				Female - Syria	103	2.13	0.86	p=0.004
				Female - Yemen	194	2.26	0.88	p=0.014
				Male - Yemen	378	2.30	0.88	p=0.001
				Female - UAE	3303	2.44	1.02	p=0.002
Male - Pakistan	505	2.58	1.00	Female - Iran	109	2.12	0.99	p=0.003
				Female - Syria	103	2.13	0.86	p=0.006
				Female - Yemen	194	2.26	0.88	p=0.032
				Male - Yemen	378	2.30	0.88	p=0.007

Asia (17.9%) compared to Middle East (9.1%). Overall, a more severe malocclusion was represented in the South Asia sample, and this theme was found repeating in many of the other comparisons. Mean IOTN grades for India males (2.62) and females (2.55) as well as Pakistan males (2.58) were significantly higher than many gender-Middle East comparisons.

Results of the present study demonstrated that 17.9% of the South Asian subjects were rated "treatment required" with India male subjects representing the highest IOTN scores. Sharma (2009) reported on a sample of 700 Nepalese aged 7 to 49 years; the IOTN grade "treatment required" was 62.0% and very inconsistent with the results of the present study [12]. Soh (2004) compared orthodontic treatment need in 339 Asian male army recruits aged 17–22 years, (Chinese 258, Malay 60, Indian 21) with no history of orthodontic treatment [13]. About fifty percentage of each sample ethnic subgroup was rated "treatment required" a percentage considerably higher than in the present study.

Iranian orthodontic treatment need in urban schoolchildren was investigated by Borzabadi-Farahani (2009); included were 502 school age young adolescents attending 6 different schools in the city of Isfahan [14]. The sample was comprised of 253 females and 249 males, aged 11-14 years and subjects were randomly selected and examined. IOTN scoring demonstrated 36.1% graded "treatment required" (grade 4 and 5), 20.2% were "borderline need" (grade 3), and 43.8% were graded "little or no treatment need" (grade 1 and 2). Hedayati (2007) examined 2000 school children, aged 11 to14 years and consisting of 1200 boys and 800 girls from various parts of the city of Shiraz, Iran and found the following: 18.39% graded "treatment required", 25.8% were "border line need", 55.7% had a "little or no treatment need" [15]. The percentages in each grade of the Hedayati study were similar to the overall results of the present study with the majority showing "little to no treatment need". In the present study, only 8.3% of Iran subjects were graded "treatment required", 24.8% were graded "borderline need", and 66.9% were "little or no treatment need". Hence, considerably less treatment need was demonstrated in the present study for Iranian school aged children.

The orthodontic treatment need in 2,788 London school children was studied by Alkhatib [16]. An IOTN comparison was made between minority ethnic groups (black, Indian, Chinese, mixed) and a Caucasian sample. No significant variation was found in the need for orthodontic treatment between different ethnic backgrounds, and approximately 15% were graded "treatment required". The authors concluded that orthodontic treatment need in children of ethnic minorities does not differ significantly from the vast majority of white children. The differences demonstrated in the present study could be due to small sample sizes in the Alkhatib study.

North Jordanian school children aged 12-14 years were studied by Abu Alhaija (2004) for orthodontic treatment need [17]. Thirty-four percent of the 1002 Jordanian children examined were graded "treatment required" which were higher than results of the present study showing only 14.4% graded in the "treatment required" category. Uçüncü (2001) investigated the need for orthodontic treatment in a Turkish school population and a group of population referred for orthodontic treatment [18]. The study groups were 250 school children, 11-14 years of age, and 250 patients, 11-14 years of age, referred to the department of orthodontics. IOTN scoring resulted in 38.8% graded "treatment required", 24.0% graded "borderline", and 37.2% "little or no treatment need". The Turkish study demonstrated much higher "treatment required" which is not surprising because the sample had been referred for orthodontic treatment. Likewise, the orthodontic treatment need of 703 school children from the southern part of Italy aged 12 years was studied by Perillo [19]. The sample was comprised of 331 males and 372 females and all orthodontically untreated. IOTN grade "treatment required" was 27.3% and higher than the Dubai school-aged children study of 14.4%.

The Spanish orthodontic treatment need study by Manzanera (2009) reported similar findings to most other recent studies in Europe [20]. IOTN "treatment required" results were found in a sample of 655 Spanish school children aged 12 to 16 years. After analysis between gender (306 males and 349 females) and age (363 aged 12-year and 292 aged 15 to 16-years) the authors reported IOTN "treatment required" was 23.5% in the 12-year old group and 18.5% in the 15 to 16 years group; no gender differences were found. Approximately 1 in 5 to 6 adolescents were identified with an orthodontic treatment requirement compared to 1 in 7 in the present study.

Kolawole (2008) determined the orthodontic treatment need of a group of 250 Nigerian school children and 150 children referred for orthodontic treatment [21]. The IOTN grade "little or no need" was 66%, "borderline need was "20%, and "treatment required" was 14% in the school children subgroup; "treatment required" percentage was of course much higher (63%) in the Kolawole referred subgroup. Results of the present study were similar in category percentages to the Kolawole school children subgroup. There were no significant gender differences found in the Kolawole study but gender differences were demonstrated in the present study.

Conclusions

IOTN grade 2 "little need" represented the largest category (40.3%) in the sample followed by grade 3 "borderline need" (38.8%), then grade 1 "no treatment "(14.5%), and lastly grades 4 and 5 "treatment required" (14.4%).

Evaluation of IOTN grade by gender demonstrated significantly higher male (2.52) than female (2.47, p=.002) grade; comparison of IOTN grade by region showed South Asia (2.58) significantly higher than Middle East (2.43). IOTN grade was highest for South Asia males (2.62) which was significantly higher than South Asia females (2.55, p=0.023) and higher than both Middle East males and females (2.45 and 2.41, p=0.000). Moreover, average South Asia female IOTN grade was significantly higher (p=0.000) than for both Middle East males and females.

The study revealed the following results:

1. In Dubai school-aged adolescents, 53.2% of the study sample would benefit from orthodontic treatment and

14.4% were profiled as “treatment require”.

2. Within the Middle East region, UAE subjects had higher mean IOTN grade than subjects from Iran, Syria and Yemen.
3. India males had significantly higher mean IOTN grades than Middle East male and female subjects from UAE, Iran, Syria, and Yemen.
4. India females had significantly higher mean IOTN grades than Middle East female subjects from UAE, Iran, Syria, and Yemen.

It may be concluded that males and females from India have the greatest orthodontic treatment need in Dubai public and private schools.

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