Comparison of Wits appraisal among different ethnic groups

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ABSTRACT

Objectives: The Wits values for various ethnic groups are different and the applicability of the norms described in these analyses to different populations is difficult. The objectives of this study were to establish the normal values of Wits appraisal in a sample from the western region of Saudi Arabia and to evaluate the existence of gender dimorphism. Also, to compare the results with previously published Wits values.

Materials and Methods: A total of 66 lateral cephalometric digital radiographs of Saudi patients from the western region (25 males and 41 females, mean age 19.32±8.16 years and 20.88±8.77 years, respectively). All subjects had angle class-I occlusion, well-balanced faces, all premolars had erupted and in occlusion, and no history of orthodontic treatment. Tracing was performed using the VistadentOC® software.

Results: Wits mean values were greater in males (−0.73±2.48) than females (1.79±2.06), with significant gender difference ($P<0.001$). Comparisons with previously published showed that there is a significant differences between ethnic groups, especially in females' data.

Conclusion: Wits appraisal appears to be gender-specific and ethnicity-specific for female values.

Key words: Cephalometric, Saudi norms, Wits appraisal

INTRODUCTION

A new innovation began in orthodontics with the introduction of cephalometrics in the diagnosis and treatment planning with the help of anthropometric techniques.[1] Since then, different analyses were developed, including Bjork,[2] Downs,[3] Riedel,[4,5] Steiner,[6] Ricketts,[7] and Tweed,[8] among others. All these analyses were introduced to measure skeletal, dental, and soft tissue patterns. A special emphasis was aimed to evaluate the relationship of the mandible to maxilla. Different methods were developed to determine the skeletal anteroposterior jaw relationship, such as Sella-Nasion-A point (SNA), Sella-Nasion-B point (SNB), and A point-Nasion-B point (ANB) angles;[4,5] point A and pogonion distances to Nasion perpendicular (to Frankfort Horizontal plane (FH)),[9] distance between points A and B projected onto FH,[10] and the FH to AB plane angle.[11] One of the commonly used and the simplest measurement is the ANB angle.[4-6,12] However, studies have shown that the ANB angle can be altered even though the inter-maxillary relationships were unchanged. Different factors

have been suggested, including age, spatial position of N point, the upward or downward rotation of the jaw or the SN line, the SN plane change in relation to the occlusal plane, and the degree of facial prognathism.[10,13-18] To eliminate the influence of these factors, another diagnostic aid was introduced, which was originally described by Jenkins[19] in 1955 and later adapted and modified by Jacobson in 1975, and was referred to as "Wits" appraisal (named after the University of the Witwatersrand, South Africa).[14]

Jacobson drew a perpendicular line on the lateral cephalometric head film tracing from points A and B on the maxilla and the mandible, respectively, to the occlusal plane. The occlusal plane was defined as the line drawn through the overlap of the mesiobuccal cusps of the first molars and the buccal cusps of the first premolars. This measurement was less affected by variation in craniofacial physiognomy. The distance between the points of contact of the perpendicular lines on the occlusal plane (AO=A point to occlusal plane and BO=B point to occlusal

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plane) served as an indicator of skeletal anteroposterior relationship. He found that for adult males, point BO was approximately 1 mm ahead of point AO, mean was −1.2 mm, with standard deviation (SD) of ±1.9 (range, −2 to 4 mm). In adult females, points AO and BO generally coincided, with a mean of −0.1 mm and SD of ±1.8 (range, −4.5 to 1.5 mm). Therefore, in skeletal class-II jaw relationship, point BO would be located behind point AO (a positive reading), whereas in skeletal class-III jaw relationship, the Wits reading would be negative, that is, point BO being forward of point AO.

Several studies have been conducted to establish the Wits values for different races. Robertson and Pearson[20] in a cephalometric study of 50 children (25 males, 25 females) for the South Wales population found Wits value of −0.1 mm (±1.9) and −0.3 mm (±1.7) for males and females, respectively, which were similar to those values reported by Jacobson.[14] Connor and Moshiri[21] established the norms in Black North American adults (25 males, 25 females) aged 18-50 years. They found a Wits mean value of 0.59 mm (±3.8) for males and −0.3 mm (±3.1) for females. So *et al.*,[22] performed a cephalometric study on a sample of the southern Chinese population (55 males and 46 females). They found Wits a value of −4.9 mm (±3.6) in males and −4.5 mm (±4.2) in females. From these previous reports, the applicability of the norms described in these analyses to different populations could be difficult. Therefore, the aims of this study were to establish the normal values of Wits appraisal in a sample from the western region of Saudi Arabia and to evaluate the existence of gender dimorphism. Also, to compare the results with previously published Wits values.

MATERIALS AND METHODS

The sample consisted of 66 lateral cephalometric radiographic digital images of Saudi patients (25 males and 41 females; aged 13-43). The data were obtained from the orthodontic records at Faculty of Dentistry, King Abdulaziz University, Jeddah, Saudi Arabia.

The following criteria were used for sample selection: (1) Angle class-I molar relationship with pleasant profile from clinical examination; (2) normal growth and development; (3) no obvious craniofacial deformities; (4) all premolars are present and erupted into occlusion; (5) no history of previous orthodontic treatment; and (6) the patient is Saudi from the western region of Saudi Arabia. The study was reviewed and approved by the Research Ethics Committee, Faculty of Dentistry, King Abdulaziz University.

The lateral cephalometric images for each subject were taken using a Kodak 8000C digital panoramic and cephalometric system (Kodak-Trophy, Croissy-Beaubourg, France). All subjects were positioned in the cephalostat with ear rods placed in the external auditory meatus to stabilize the head with the sagittal plane at right angle to the path of the X-ray and the Frankfort plane parallel to the horizon, the nose rest piece positioned on the soft tissue Nasion, and the teeth in centric occlusion, with the lips in a relaxed and closed position. Cephalogram images were then imported into the VistadentOC® software (VistadentOC; Dentsply, Bohemia, NY, USA), which was shown to be reliable for cephalometric tracing.[23,24] Wits analysis was measured according to the methods used by Jacobson.[14] Briefly, the following landmarks: Subspinale (A), supramentale (B), and occlusal plane (O) were identified. AO and BO lines, which were defined as perpendicular lines from points A and B to occlusal plane, were drawn automatically with the software. The linear distance reading between AO and BO was measured in millimeters and corrected for magnification using the ruler on the nose rest, and the software calculated and calibrated the measurements. Wits values reported by Jacobson and from 11 other studies, including one conducted here in the central region of Saudi Arabia,[14,20-22,25-31] were compared with the Wits values from this study.

Descriptive statistics, mean, ±SD, and range values were calculated for each measurement. The Wits mean values for both genders were compared to each other and also compared with previously reported values. To evaluate the Wits values between genders and compare the results with previously published values, an independent-sample *t*-test was conducted. Paired-sample *t*-test was used to evaluate intra-examiner error when evaluating Wits values recorder at two time points. A 5% level of significance was used for all analyses. To correct for type-I error, the Bonferroni method was used. Statistical analyses were performed using the software Statistical Package for Social Science (SPSS version 11; Chicago, IL, USA) and MS Excel (Microsoft® Excel 2011; USA)

RESULTS

The mean age for males and females was 20.29 years (±8.47). No difference was found between the mean age of male and female subjects: Mean=19.32±8.16 years and 20.88±8.77 years, respectively, $P>0.05$. Twenty randomly selected images from the studied 66 images were retraced 2 weeks later to evaluate intra-examiner error. Paired-sample *t*-test showed that there were no significant differences between both readings at the significance level of 5% ($P>0.05$). The Wits appraisal for the male and female subjects was significantly different: Mean=−0.73 (±2.48) and 1.79 (±2.06), respectively, $P<0.001$ [Table 1].

The mean Wits values for males from this study were compared with previously published data. Student's *t*-test showed that it was significantly less than the reported values for Saudis from

Table 1: Comparison of Wits mean values between males and females

Gender	Mean in mm (±SD)	Range	*t* test	Significance
Males (25)	−0.73 (±2.48)	−4.9-3.2	−4.26	<0.001
Females (41)	1.79 (±2.06)	−4.1-5.8		
Total	0.84 (±2.53)	−4.9-5.8		

the central region[25] and the data from Brazil,[28] whereas it was significantly greater than the reported values for the southern Chinese population[22] [Table 2]. The female Wits values on the other hand were significantly greater than all reported values [Table 3].

DISCUSSION

Orthodontic diagnosis and treatment planning are largely driven by cephalometric information. Incorrect diagnosis will lead to an inappropriate treatment plan and hence, untoward results that will cause dissatisfaction for the patients or their parents. There are several cephalometric analyses and the most commonly used measurement for the anteroposterior jaw relationship is the ANB angle. This angle is based on a cranial reference plane in relation to points A and B (maxilla and mandible, respectively). However, a number of reports showed that the ANB angle is not consistent even when the inter-maxillary relationships are unchanged. Several factors were suggested to affect this angle, such as age, spatial position of N point, the upward or downward rotation of the jaw or the SN line, SN plane change in relation to the occlusal plane, and the degree of facial prognathism.[10,13-18] The Wits appraisal was introduced to prevent such errors. It provided adequate anteroposterior measurement for skeletal disharmony of the jaw because the

reference plane used is neither a cranial nor an extra-cranial plane, but it is a common plane to both dentures, the occlusal plane.[14] However, this plane was observed to be concave in many subjects. Therefore, Jacobson recommended that the most suitable and convenient method of standardizing the plane of occlusion was to join the midpoint of overlap of the mesiobuccal cusps of the first molars and the buccal cusps of the first premolars (functional occlusal lane).[15] Since Wits values were shown not to be affected by age,[32] it was critical to evaluate other variables such as race and gender, which may affect the normal skeletal, dental, and soft tissues characteristics of an individual. Therefore, identifying the normal features of a specific race or ethnic group, as well as gender, is considered important for proper diagnosis and treatment planning, and hence, the need for ethnicity- and gender-specific norms. In a previous study conducted in the central region of Saudi Arabia, involving dental students, the Wits mean values were 0.82 and 0.41 for males and females, respectively. However, it does not represent the multi-racial background of the Saudi population.[25] This is supported by the present study were the values from the central region were found to be significantly different for both genders. This difference could be attributed to the diversity of the ethnic background of the people in the western region compared with the central region. Further more, Al-Barakati[25] found no gender differences,

Table 2: Comparison of Wits mean values between Saudi males from the western region and previous reports

Group	Sample size	Age (years)	Wits (±SD)	t test	Significance
Saudi males from western region	25	13-42	−0.73 (±2.48)	_	_
Jacobson (South Africa)[14]	21	Adult	−1.17 (±1.90)	0.68	NS
Robertson and Pearson (South Wales, UK)[20]	25	19	−0.1 (±1.90)	−0.98	NS
Connor and Moshiri (Blacks, USA)[21]	25	18-50	0.59 (±3.84)	−1.44	NS
Galvao and Madeire (Brazil)[28]	51	11-18	2.61 (±4.34)	−3.68	<0.001
So et al. (Southern China)[22]	55	10-15	−4.88 (±3.61)	5.97	<0.001
Kim et al. (South Korea)[29]	102	11.6	−0.33 (±2.73)	0.71	NS
Miyajima et al. (Japan)[30]	26	20-25	−0.50 (±2.50)	−0.38	NS
Oktay (Turkey)[31]	63	9-14	−0.3 (±4.03)	0.61	NS
Bishara et al. (Egypt)[27]	39	12.5	−0.10 (±2.8)	−0.94	NS
Al-Jame et al. (Kuwait)[26]	82	13-14	−0.48 (±2.36)	−0.45	NS
Al-Barakati (Saudi central region)[25]	30	22-23	0.82 (±2.20)	−2.43	0.019

NS = Non-significant

Table 3: Comparison of Wits values between Saudi females from the western region and previous reports

Group	Sample size	Age (years)	Wits (±SD)	t test	Significance
Saudi females from western region	41	13-42	1.79 (±2.06)	_	_
Jacobson (South Africa)[14]	25	Adults	−0.10 (±1.77)	3.95	<0.001
Robertson and Pearson (South Wales, UK)[20]	25	15	−0.3 (±1.7)	4.47	<0.001
Connor and Moshiri (Blacks, USA)[21]	25	18-50	−0.3 (±3.05)	3.03	0.004
Galvao and Madeire (Brazil)[28]	52	11-18	−0.18 (±5.21)	2.49	0.015
So et al. (Southern China)[22]	46	10-15	−4.47 (±4.19)	8.99	<0.001
Kim et al. (South Korea)[29]	102	11.6	−0.33 (±2.73)	5.05	<0.001
Miyajima et al. (Japan)[30]	28	20-25	−1.70 (±2.30)	6.45	<0.001
Oktay (Turkey)[31]	82	9-14	−0.59 (±4.41)	4.08	<0.001
Bishara et al. (Egypt)[27]	51	12.5	0.7 (±2.0)	2.56	0.012
Al-Jame et al. (Kuwait)[26]	80	13-14	−0.48 (±2.36)	5.46	<0.001
Al-Barakati (Saudi central region)[25]	30	22-23	0.41 (±2.30)	2.61	0.011

whereas in the current study females exhibited a significantly greater value than males. It is interesting to note that this finding is in agreement with Jacobson[14] with regard to the existence of gender dimorphism. The mean value of Wits appraisal in males was similar to a number of previously reported data, but not all [Table 2]. For females' values, the case was different. Their Wits values were significantly different from all previously published reports. One limitation of the current comparisons with the previously published works is that there could be a serious problem with the interference of great systematic errors between the different studies, and specifically when defining the occlusal plane. The distance between the points used, that is, the line through the overlap of the mesiobuccal cusps of the first molars and the buccal cusps of the first premolars, is too short and variation in the definition between the observers could lead to errors. It is agreeable that such comparisons can be important; however, risk of errors due to systematic differences in the definition of the points should be recognized. One method to overcome this obstacle is to perform comparisons between different ethnic groups by a group of researches who will perform the measurements themselves after careful calibration to reduce inter- and intra-examiner errors.

The Wits appraisal is a simple linear measurement, which can be used as an adjunctive diagnostic aid and overcome the limitation of other analyses when calculating the anteroposterior skeletal relationship. It is also important to remember that cephalometric interpretation depends on a number of different values and not one single absolute value.

CONCLUSIONS

- The Wits appraisal for the Saudi sample from the western region was −0.73 (±2.48) and 1.79 (±2.06) for males and females, respectively.
- There was a significant gender difference.
- Wits appraisal appears to be more gender-specific and less ethnicity-specific.

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