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Determination of skeletal class using the Wits appraisal: Is it correct to differentiate the norm between sexes?

INVESTIGATION

Determinación de la clase esqueletal mediante el indicador de Wits: ¿es correcto diferenciar la norma entre sexos?

Determinação da classe esquelética pelo indicador de Wits: ¿é correto diferenciar a norma entre sexos?

Abstract

Objectives: to test the hypothesis of sex-dependent differences among individuals using the Wits appraisal.
Methods: a descriptive cross-sectional study was conducted with 135 lateral cephalometric radiographs of patients over 18 years old (78 women and 57 men), classified as skeletal class I according to the ANB angle. The Wits appraisal values were measured and compared between sexes using the Mann-Whitney test to evaluate the hypothesis guiding this work.
Results: the median value of the Wits appraisal was -1.77 mm. in women and -1.16 mm. in men. No statistically significant differences were found between sexes (p = 0.5597).
Conclusions: it is suggested that in orthodontic practice, no adjustment of the norm between sexes be made when establishing the skeletal class diagnosis.

Valentina Zaffiri [1]
Juan Diego Idrovo [1]
Germán Manríquez [2]
Alejandro Díaz [3]

CORRESPONDENCE
Alejandro Díaz:
adiaz@odontologia.uchile.cl

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1 Cirujano Dentista, Práctica Privada, Santiago, Chile.
2 Biólogo, Mg.Sc., Ph.D., Instituto de Investigación en Ciencias Odontológicas, Centro de Análisis Cuantitativo en Antropología Dental, Facultad de Odontología, y Departamento de Antropología, Grupo de Antropología Física, Facultad de Ciencias Sociales, Universidad de Chile.
3 DDS, Mg.Sc., Departamento del Niño y Ortopedia Dentomaxilar, Centro de Análisis Cuantitativo en Antropología Dental, Facultad de Odontología, Universidad de Chile. Servicio de Cirugía Maxilofacial, Hospital San Borja Arriarán, Santiago, Chile.

Resumen

Objetivos: contrastar la hipótesis nula que afirma la ausencia de diferencias estadísticamente significativas en el valor del indicador de Wits respecto del sexo de los individuos.
Métodos: se realizó un estudio descriptivo transversal con 135 telerradiografías de pacientes mayores de 18 años (78 mujeres y 57 hombres), clasificados como clase I esqueletal según el ángulo ANB. Se midieron los valores del indicador de Wits y se compararon entre sexos utilizando la prueba de Mann-Whitney para contrastar la hipótesis que guía este trabajo.
Resultados: la mediana del indicador de Wits fue de -1.77 mm. en mujeres y -1.16 mm. en hombres. No se encontraron diferencias estadísticamente significativas entre los sexos (p = 0.5597).
Conclusiones: se sugiere que en la práctica ortodóncica no se realice el ajuste de la norma entre sexos al momento de establecer el diagnóstico de clase esqueletal.

Palabras clave: Clase esqueletal, Indicador de Wits, Ortodoncia.

Resumo

Objetivos: testar a hipótese de diferenças dependentes do sexo entre os indivíduos usando o indicador de Wits.
Métodos: foi realizado um estudo descritivo transversal com 135 telerradiografias laterais de pacientes com mais de 18 anos (78 mulheres e 57 homens), todos classificados como classe esquelética I de acordo com o ângulo ANB. Os valores do índice de Wits foram medidos e comparados entre os sexos utilizando o teste de Mann-Whitney para avaliar a hipótese que orienta este trabalho.
Resultados: a mediana do indicador de Wits foi de -1,77 mm. em mulheres e -1,16 mm. em homens. Não foram encontradas diferenças estatisticamente significativas entre os sexos (p = 0.5597).
Conclusões: sugere-se que, na prática ortodôntica, não se faça o ajuste da norma entre os sexos ao estabelecer o diagnóstico da classe esquelética.

Palavras Chave: Classe esquelética, Indicador de Wits, Ortodontia

Introduction and Background

Skeletal class is defined as the sagittal relationship between the maxillary and mandibular bones [1]. In orthodontics, this skeletal relationship has been studied due to advancements in lateral skull cephalometric radiography and cephalometry [2]. Many cephalometric analyses have been used to determine skeletal class [3-7], with the ANB angle and Wits analysis being particularly popular. The Wits analysis, introduced by Jacobson in 1975, is based on determining the Wits appraisal, equivalent to the distance between perpendicular lines drawn from points A and B to the occlusal plane (**Figure 1**). This technique enables the assessment of sagittal maxilla-mandibular discrepancies by eliminating the influence of skull base inclination and length. Jacobson argues that this additional consideration enhances the overall accuracy of cephalometric analysis, thereby contributing to a more thorough and precise skeletal class diagnosis [4, 8]. According to this author, determining skeletal class considers the sex of the individuals. Thus, a normal anteroposterior relationship between the maxilla and mandible would measure 0 mm in women and -1 mm in men. This dimorphism is associated with the physical differences that men and women develop after puberty, resulting in variations in the size of the structures involved [9,10]. Although Jacobson proposed that different norms exist between women and men, he did not clarify in his paper the statistical analysis used to reach this conclusion. In this regard, several authors have conducted studies like Jacobson's. However, there is no full consensus on the results reported by the author [11-19]. Based on this background, this work aims to test the null hypothesis of no statistically significant sex-based differences in the Wits appraisal (H0: u1 = u2) against the alternative hypothesis suggesting that such differences do exist (HA: u1 ≠ u2, where u is the average parametric value of the appraisal).

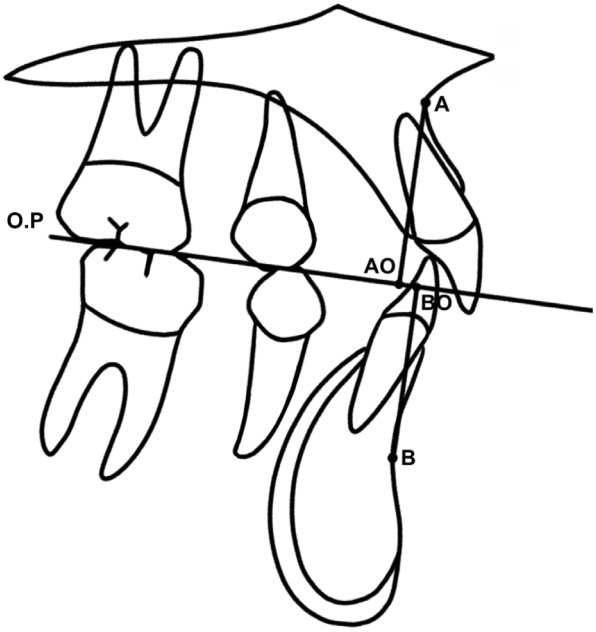

Figure 1. Wits appraisal drawing
O.P: Occlusal plane
A: Point A
AO: Perpendicular projection of A on O.P
B: Point B
BO: Perpendicular projection of B on O.P

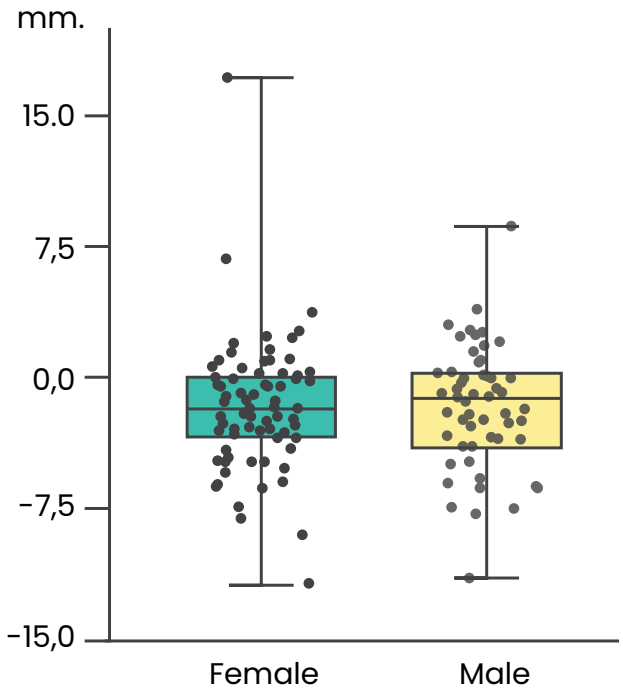

Figure 2.
Medians (center line in box), quartiles (1Q = lower; 3Q = upper), and maximum and minimum values (upper and lower whiskers, respectively) for the Wits appraisal by sex (y-axis = mm). The dots represent the individual records for each group.

Materials and Methods

This is a quantitative, descriptive cross-sectional study. The sample was taken from an anonymized database stored at the Faculty`s Center for Quantitative Analysis in Dental Anthropology containing 439 lateral cephalometric radiographs of patients who received orthodontic treatment at the Dental Clinic of the Faculty of Dentistry, University of Chile. A subsample of 135 lateral cephalometric radiographs was selected (78 women and 57 men), classified as skeletal class I according to the ANB angle [6], a widely used indicator in orthodontic literature [20]. The following inclusion criteria were applied: i) lateral skull cephalometric radiographs from patients over 18 years old, with no history of orthodontic, orthopedic, nor surgical treatments; ii) ANB angle between 0º and 4º; and iii) radiograph image quality adequate for accurately identifying the cephalometric points necessary for the Wits analysis. The lateral cephalometric images were entered and scaled on the WebCeph platform to perform linear measurements. The Wits appraisal value was determined for each lateral cephalometric radiograph, with all measurements conducted by the main author of this study. The data were then entered into a Microsoft Excel spreadsheet (version 2403).

To test the guiding hypothesis of this work, the Wits appraisal values for women and men were compared using Past software, v.4.03 [21]. The normality of data distribution was assessed using the Shapiro-Wilk test. To evaluate the statistical significance of the data of interest, the Mann-Whitney test was performed. A p-value of < 0.01 was considered statistically significant.

Results

The Shapiro-Wilk test indicated that the data for women did not follow the expected normal distribution (Shapiro-Wilk W = 0.8843, p = 3.599E-06), whereas the data

for men met this distribution criterion (Shapiro-Wilk W= 0.9821, p= 0.5571). According to the conservative statistical rule, if at least one group of data is not normally distributed, a non-parametric test should be applied. Thus, the Mann-Whitney test was used to test the null hypothesis of equality in medians. The median was -1.77 mm in women and -1.16 mm in men, with no statistically significant differences between the two sexes (p = 0.5597, Monte Carlo with 9999 permutations) (**Figure 2**). The parametric test for these same data also revealed no significant sex-dependent differences (t-test: t = 0.2003, p= 0.8484, Monte Carlo with 9999 permutations). Similar results were obtained using Bayesian statistics (Bayes factor = 0.1898), leading to the conclusion that there is substantial evidence to accept the null hypothesis of this work

Discussion

With the aim of testing the hypothesis of sex-dependent differences when using the Wits appraisal, this work analyzed whether there were differences for this appraisal in a male and female sample from the Chilean population. No statistically significant differences were found. Therefore, using the Wits appraisal as a diagnostic method, separating the norms for women and men in the Chilean population, does not seem justified.

Although there is considerable work reporting the absence of sex-dependent differences in various human populations [11-19], the Wits appraisal continues to be regarded as valid in educational texts used during the training of future dentists [22-25]. Additionally, when such differences are reported, as in Zawawi's study in the Saudi population [26], other authors using samples from the same population do not find them [19].

While sex-dependent morphological differences in the craniofacial region are mainly expressed in linear size differences relative to angular measurements, such differences have not been consistently demonstrated [9,10]. Most men and women share the same cephalometric norms. In this regard, some exceptions have been noted. For example, Delaire, in his Architectural Analysis, describes a difference in the angle of the anterior pillar of the face, formed by the skull base and the anterior pillar or canine, measuring 90° for males and 85° for females [27]. Other authors have found differences attributed to sex concerning the goniac angle [28-31]; however, this has not been confirmed by other studies [32]. The results of this work have implications for orthodontic clinical practice, especially regarding diagnosis. In this regard, we suggest that sex adjustment when determining skeletal class by Wits appraisal is not advisable. This suggestion would help establish a clinical practice that is effectively evidence-based.

Finally, regarding Jacobson's work, his sample selection was based on a relatively ambiguous concept, as the inclusion criteria included individuals he classified as having "excellent" occlusions [4]. Although he does not clarify this, it is assumed he is referring to class I dental occlusions or neutroclusions. It is empirically known among orthodontists that dental class does not always correspond directly to skeletal class. While some orthodontists use Wits analysis as an alternative to determine skeletal class, Jacobson does not recommend it for this purpose; instead, he suggests using it only as a tool for establishing the sagittal maxillomandibular relationship [4]. Methodologically, we believe that Jacobson introduces a confusing factor into his study, as his sample may have included individuals with excellent occlusion (neutroclusion) but with different maxillomandibular sagittal relationships. In summary, this work challenges the diagnostic use of the differential Wits appraisal for women and men, and it is suggested that in orthodontic practice, no adjustment of the norm between sexes should be made when establishing the skeletal class diagnosis.

Conclusions

This work challenges the diagnostic use of the differential Wits appraisal for women and men, and it suggests that in orthodontic practice, no adjustment of the norm between sexes should be made when establishing the skeletal class diagnosis.

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Data availability

The dataset supporting the results of this study is available at the Center for Quantitative Analysis in Dental Anthropology, Faculty of Dentistry, University of Chile.

Conflict of Interest Statement

The authors declare no conflicts of interest.

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Authorship Contribution and Collaboration Statement

FIRST AND LAST NAME	ACADEMIC COLLABORATION													
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Valentina Zaffiri			x	x	x	x	x	x		x			x	x
Juan Diego Idrovo				x		x	x		x	x			x	x
Germán Manríquez			x	x	x	x	x	x		x		x	x	x
Alejandro Díaz	x		x	x		x	x	x	x	x		x	x	x

1. Project Administration
2. Funding Acquisition
3. Formal Analysis
4. Conceptualization
5. Data Curation
6. Writing - Review & Editing
7. Research
8. Methodology
9. Resources
10. Writing-Original Draft Preparation
11. Software
12. Supervision
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