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The Analysis of Anterior Facial Dimensions Among the Sample of Kurdish Population

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ABSTRACT

Introduction: Cephalometric analysis is essential for assessing facial proportions and planning treatments in orthodontics. Different populations, like the Kurdish group, have unique facial features, requiring specific norms for accurate clinical practice. This study establishes these norms for the Kurdish population.

Materials and Methods: A cross-sectional study was conducted on 111 lateral cephalometric radiographs of Kurdish individuals aged 20-45 with balanced facial characteristics and class I occlusion. Radiographs were traced using digital tracing methods to measure total anterior facial height (TAFH), upper anterior facial height (UAFH), and lower anterior facial height (LAFH). The UAFH/TAFH and LAFH/TAFH ratios were also calculated. Statistical analysis was performed using SPSS version 29.

Results: The study establishes cephalometric norms for the Kurdish population, highlighting significant sex differences in facial height measurements. These findings contribute to a more nuanced understanding of facial morphology in the Kurdish population, with implications for improving orthodontic and orthognathic treatment outcomes.

Conclusion: The study provides cephalometric norms for the Kurdish population, aiding in personalized orthodontic and orthognathic treatment planning. It also highlights significant sex differences, essential for achieving culturally appropriate aesthetic outcomes.

Keywords: Anterior facial height; Cephalometric analysis; Facial morphology; Orthodontics; Orthognathic surgery.

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Introduction

The balance and aesthetic unity of the face is determined by the interplay between the facial skeleton and its overlaying soft tissues. Visual impact hinges on the structure of these soft tissues and their proportions. In orthodontics, the importance of soft tissue changes, especially in correcting dentofacial deformities through orthognathic surgery, highlights its significance [1,2]. Facial aesthetics at their best are strongly linked to the vertical dimension of the face. In orthodontics, a key objective is to attain the optimal vertical facial profile, typically achieved through growth modification tools for children and corrective jaw surgeries for adults. Numerous researchers underscore the role of soft tissue in shaping facial aesthetics, emphasizing its independent behavior from the underlying skeleton [1,2,3]. The findings of these early studies attracted considerable attention in orthodontics and orthognathic surgery, proving particularly beneficial for diagnosing and planning orthognathic procedures based on rectilinear measurements. It's crucial to note that these investigations predominantly involved Caucasians, and their reference values may not universally apply to individuals of other racial backgrounds [4,5].

It is advisable to evaluate cephalometric standards independently for diverse ethnic and racial populations. Consequently, clinicians need precise information in this domain to implement beneficial adjustments and minimize unintended adverse effects in orthodontic treatments Altemus (1960) noted that variations in skeletal, soft-tissue, and dental features exist among individuals of diverse races and ethnicities [6,7]. Anteroposterior or lateral cephalometric radiographs, three-dimensional facial scans, and photographs are utilized in research on the complex and evolving phenomenon of facial soft tissue growth and development. Cephalometric refers to the scientific measurement of the dimensions of the craniofacial complex, providing information on standard facial traits and the patient's soft tissue features. To maximize facial attractiveness, customized norms can be established based on these measurements [8,9]. Both hard and soft tissue cephalometric examination should be a part of the treatment plan for individuals who need orthognathic surgery [10]. Conversely, the growth and development of facial tissues are predominantly influenced by hereditary and environmental factors during the later stages of childhood and pubertal growth. Hormonal and biomechanical environmental factors play significant roles in shaping these processes. Predicting the shape of soft tissues from skeletal remains is useful in forensic and archaeological contexts, whereas, in orthodontics, it is essential to comprehend skeletal relationships from outward appearance. To determine whether it is possible to forecast the soft-tissue profile's outline shape based on the former, this study will look into the relationship between the two [8,11]. The evaluation of orthodontic patients benefits from cephalometric analysis, which examines the relationships among bone structures, dental tissue, and soft tissue. This comprehensive assessment aids in understanding malocclusion across different spatial dimensions. Facial height is a key factor in facial balance, and alterations in it can influence the position and rotation of the mandible, contributing to the development of deep bite or open Bite [12,13].

Examining the face's contours is essential to determining facial harmony and balance. It is crucial to take into account how the lips, chin, and nose relate to one another. The built facial contour's cephalometric parameters fell comfortably within normal bounds. Growth and orthodontic procedures can both change how the mouth, nose, and chin relate to one another. The soft tissue profile has grown as a result of a complex alteration in the face's hard and soft tissues [14]. One examines shapes or structures about size and shape. Regarding size or dimension, reference planes, and orientation, the shape describes the structure without regard to it. Significant size discrepancies may distort the estimation of structure because they may mask more subtle form differences, particularly in assessments of younger patients whose face growth and development is still in their infancy. By superimposing facial profiles independently of size, orthodontists and surgeons would need a simple method to quantify the reciprocal placements of face features [15]. This study aims to conduct a detailed analysis of the Anterior facial height within the Kurdish population. By thoroughly examining variations in facial features, proportions, and profiles, the research seeks to provide comprehensive insights. The findings are anticipated to contribute to the academic understanding of facial morphology specific to the Kurdish ethnicity, with potential implications for diverse fields including anthropology, dentistry, and plastic surgery.

Materials and Methods

This cross-sectional study, conducted from November 2023 to May 2024 at the College of Dentistry, University of Sulaimani-Iraq, utilized G-power 3.1 software to determine the sample size. The sample size calculation for correlation tests, with an effect size of 0.3 and

an alpha level of 0.05, resulted in 111 cases. The study received approval from the study was approved by the ethical committee of college of dentistry, university of Sulaimani (reference number 207/23, dated November 5, 2023). One hundred and eleven lateral cephalometric radiographs were obtained for therapeutic purposes from patients who were receiving different therapies. A checklist that is included after this article was used to collect data. Two experienced observers carried out the independent landmark identification and cephalometric analysis for each specimen. Participants in the study ranged in age from 20 to 45 and had class I occlusion, we only included patients with full dentition, balanced and proportionate facial characteristics, normal overjet, and overbite. A history of prior orthodontic treatment, surgical procedures, edentulous patients, against natural teeth, the presence of dental prosthesis, and having a syndrome causing facial deformity were among the exclusion criteria.

The parameters used to create the lateral cephalometric radiographs were 68 kVp, 10 mA, and 15.3 s of exposure utilizing Planmeca equipment (Panmeca Pro-Sensor®, Finland). All radiographs in this investigation were traced using orthodontic digital tracing (Dentaurum, Germany). The typical cephalometric measurements for the vertical dimensions of the face were undertaken according to the analyses by Wylie-Johnson, SiriwatJarabak, Gebeck, Merrifield, and Horn, and the vertical distances between the specified points were measured. Measurements were recorded in millimeters (mm) [16-18].

All radiographs were analyzed using digital tracing. The following measurements, in millimeters (mm), are shown in Figure 1:

1. Total anterior facial height (TAFH): The linear distance from Nasion (N) to Menton (Me).

2. Upper anterior facial height (UAFH): The linear distance from Nasion (N) to the anterior nasal spine (ANS).

3. Lower anterior facial height (LAFH): The linear distance from the anterior nasal spine (ANS) to Menton (Me).

4. Upper anterior facial height to total anterior facial height ratio (UAFH/TAFH).

5. Lower anterior facial height to total anterior facial height ratio (LAFH/TAFH).

All measurements collected were recorded in a checklist format. Data from this study underwent analysis using descriptive statistics. The data were analyzed using SPSS version 29 (Inc., Chicago, IL, USA).

Results

The sample consisted of 111 lateral cephalometric radiographs, the data of which were tabulated in Microsoft Excel© and analyzed by IBM SPSS statistical package version 29 and DATA tab Team (2024). DATA tab: Online Statistics Calculator. DATA tab E.U. Graz, Austria. The Shapiro–Wilk W-test was utilized to examine the normal distribution of the variables; the findings revealed that all the data did not deviate significantly from the normal distribution. Then, parametric tests were applied to analyze the data. The distribution of the subjects according to their ages and sexes is shown in Figure 2. Table 1 includes two rows: one assuming equal variance and the other assuming unequal variance. The Levene test produced a p-value of .263, which is above the standard significance level of 0.05. This indicates that there is sufficient evidence to reject the null hypothesis of unequal variance, suggesting that the variances of the two groups (male and female) are approximately equal. Therefore, the row assuming equal variances should be used. A two-tailed t-test for independent samples (assuming equal variances) revealed that the difference in UAFH/TAFH between females and males was not statistically significant, t (109)=1.44, p=.153, with a 95% confidence interval of [-0.01, 0.04]. Consequently, the null hypothesis, which posited no difference in the mean values between the two groups, was not rejected.

Table 2 also includes two rows: one assuming equal variance and the other assuming unequal variance. The Levene test produced a p-value of .519, which is above the standard significance level of 0.05. This indicates that there is sufficient evidence to reject the null hypothesis of unequal variance, suggesting that the variances of the two groups (male and female) are approximately equal. Therefore, the row assuming equal variances should be used. A two-tailed t-test for independent samples (assuming equal variances) revealed that the difference in LAFH/TAFH between females and males was not statistically significant, t (109)=-0.74, p=.459, with a 95% confidence interval of [-0.02,0.01]. Consequently, the null hypothesis, which posited no difference in the mean values between the two groups, was not rejected. A Pearson correlation analysis examined the association between individuals' ages and the upper- and lower anterior facial height ratio with the total anterior facial height. With p-values of 0.803 and

0.829, respectively, the findings suggested no significant link between age and the two variables as shown in Table 3. An additional discovery of this research is that the mean total anterior facial height of the individuals falls within the range of a minimum value: of 91.09, and a maximum value: of 137.3mm (mean value: 112.18,). This height classification designates the faces as short to moderate in length (Figure 3).

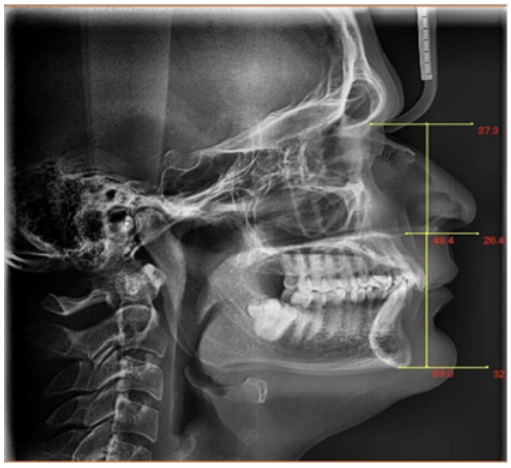

Figure 1. Measurements of various analyses on radiographs.

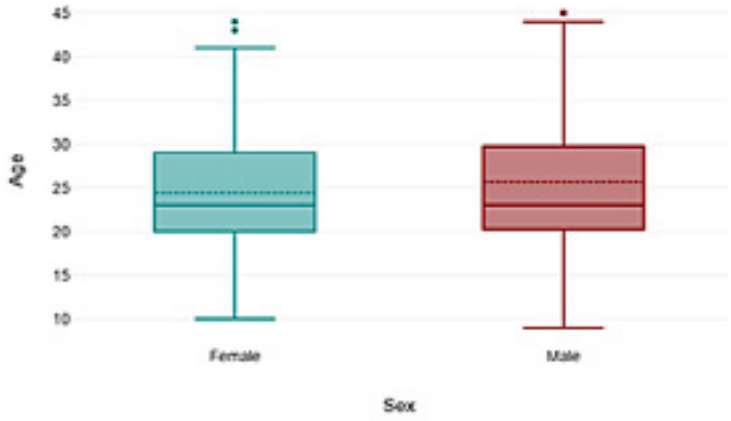

Figure 2. A box plot showing the age distribution according to the sexes.

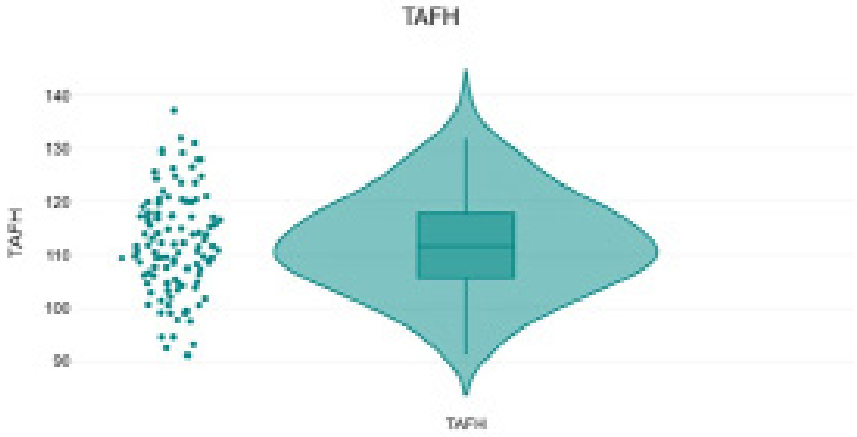

Figure 3. A violin plot with a box plot showing the distribution of total anterior facial height.

Table 1. The t-test results comparing the ratio of upper anterior facial height to total anterior facial height (UAFH/TAFH) between males and females:

		t	df	p-value	Cohen›s d
UAFH/TAFH	Equal variances	1.44	109	.153	0.29
	Unequal vari-ances	1.19	47.58	.238	0.24

Table 2. The t-test results comparing the ratio of lower anterior facial height to total anterior facial height (LAFH/TAFH) between males and females:

		t	df	p-value	Cohen›s d
UAFH/TAFH	Equal variances	-0.74	109	0.459	0.15
	Unequal variances	-0.75	76.7	.456	0.15

Table 3. The Pearson correlation between the age of individuals and the ratios of upper anterior facial height to total anterior facial height (UAFH/TAFH) and lower anterior facial height to total anterior facial height (LAFH/TAFH).

		UAFH/TAFH	LAFH/TAFH
Age	Correlation	0.02	-0.02
	p-value	.803	.829

Discussion

The lateral cephalometric radiograph is an essential tool for diagnosing anteroposterior and vertical discrepancies and for evaluating the relationship between soft tissue and dental structures. Consequently, the cephalometric analysis method employed must be accurate, safe, and highly reproducible. Therefore, the goal of this study was to determine the effectiveness and consistency of soft tissue analysis as a foundation for comparison. The features of the methodology and the sample should be taken into consideration when comparing the findings of this study with those of other investigations. Therefore, any discrepancy with other research could have to do with the impact of age groups, ethnic variance, sample size, and the kinds of techniques employed for measurement [19,20,21]. The significant sex differences and specific cephalometric characteristics observed in the Kurdish population have direct implications for clinical practice. Orthodontists and maxillofacial surgeons should consider these variations when planning treatments such as growth modification in children and corrective jaw surgeries in adults. Utilizing population-specific norms can enhance the accuracy of treatment plans, improve aesthetic outcomes, and minimize the risk of adverse effects [22,23]. Research shows significant variability in cephalometric norms across different ethnic groups. Therefore, norms established for one population might not be suitable for another. To address this, studies must be conducted to identify specific cephalometric standards for each ethnic group. This study aims to establish soft tissue cephalometric norms for Kurds living in Kurdistan-Iraq and compare these findings with the widely accepted norms for Caucasians [24]. This study uniquely examined the soft tissue characteristics of Kurds, finding their facial features to be more convex with more prominent lips and smaller noses compared to Caucasians. These traits are considered normal within the Kurdish population and should be factored into their orthodontic treatment plans. The larger nasolabial angle in Kurds is also typical. Such variability in cephalometric norms across different ethnic groups highlights the importance of establishing specific craniofacial standards for each ethnicity, as norms differ widely among populations [25].

Studies on Egyptians, Yemenis, and Indians have shown that these populations have greater facial convexity compared to Caucasians. Specifically, Egyptians were found to have more convex faces, more prominent lips, and higher nasolabial angles, similar to the Kurdish population. In this study, Kurds were shown to have significantly greater upper lip thickness, soft tissue chin thickness, maxillary and mandibular protrusion, lower lip protrusion, nasolabial angle, H angle, lower face-throat angle, and mento-labial sulcus depth compared to Caucasians. However, Kurds had smaller nasal prominence, vertical lip-chin ratio, and inter-labial gap than Caucasian norms [26,27,28]. Orthodontists may be able to develop more accurate and customized treatment plans by understanding the normative values of anterior facial height in the Kurdish population. This ensures that the specific anatomical characteristics of

Kurdish patients are taken into account in the design of interventions such as brackets or other orthodontic devices, resulting in more effective and aesthetic results [29]. For maxillofacial and craniofacial surgeons, having specific data on the anterior facial height of the Kurdish population can aid in pre-surgical planning and postoperative assessment. For procedures such as orthognathic surgery, where accurate anatomical knowledge can lead to improved outcomes and patient satisfaction, this is of particular importance [29,30]. For the identification and diagnosis of skeletal dysplasia and other developmental anomalies in the Kurdish population, the cephalometric standard may serve as a reference. To improve long-term health outcomes, early and accurate diagnosis can lead to timely and appropriate treatment [30,31].

Pediatricians and orthodontists can use these norms to assess growth and development in children and adolescents. Potential growth disorders or developmental issues may be identified if deviations from these standards are observed, leading to additional investigations or early intervention. To better understand craniofacial diversity, these data can be used as a means of comparison with other ethnic groups. This may improve the accuracy of epidemiological research on craniofacial morphology and its variations in different populations [31,32]. To make dental implants fit well with the patient's facial structure, it may be helpful for prosthodontists to understand their typical face height to design them to improve both function and aesthetics. Detailed cephalometric data may assist in identifying individuals based on skeletal remains, particularly where forensic anthropology and bioarchaeology are concerned [32,33]. The findings may be relevant to health policy decisions and the allocation of funding for services in dentistry and orthodontics which are tailored to the needs of the Kurdish population, to improve all aspects of community health. Health professionals can provide more efficient, personalized, and culturally sensitive care for patients from the Kurdistan community through the integration of these health issues in practice, which will ultimately improve healthcare quality. Despite its contributions, this study has several limitations. The sample size, while calculated to be statistically adequate, may not capture the full variability within the Kurdish population. Future studies with larger sample sizes and diverse age groups, including children and adolescents, are needed to validate and expand upon our findings. Additionally, incorporating three-dimensional imaging techniques could provide more detailed insights into craniofacial structures and their spatial relationships [34].

Conclusion

The research establishes standard measurements for the anterior facial height among the Kurdish population, emphasizing significant differences between genders and the importance of population-specific standards in orthodontic and orthognathic practices. These findings contribute to a better understanding of Kurdish facial morphology and have the potential to enhance clinical outcomes in dentistry and related fields. Further research is necessary to explore the wider implications of these findings and to refine cephalometric analysis techniques for diverse populations.

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Conflict of Interest

There is no conflict of interest to declare.

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