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Evaluation of Skeletal Variations and Establishment of Cephalometric Norms in a sample of Kurdish Population Using Bjork Jarabak's Analysis

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Abstract

Background and Objective: Cephalometric analysis is essential in orthodontics for diagnosing malocclusion and understanding craniofacial growth. The Bjork-Jarabak analysis is widely used to evaluate skeletal variations and establish normative data for different populations, Bjork-Jarabak analysis is essential for effective diagnosis and treatment planning. This study aimed to establish cephalometric norms for the Kurdish population in Erbil city/ Iraq, using the Bjork-Jarabak method, addressing the lack of localized data.

Methods: The study enrolled 222 Kurdish adults aged 18 - 47 years at Hawler Medical University's College of Dentistry. Participants with no orthodontic history, balanced facial profiles, and no craniofacial anomalies were included. Lateral cephalographs were taken using the Newtom Giano machine and analyzed with WEBCEPH Imaging Software "A.I. Web-based Orthodontic & Orthognathic Platform". Cephalometric measurements, including the Jarabak quotient, facial height ratio, and polygon "Jarabak sum", were compared to Bjork-Jarabak norms. Gender-specific analyses were also conducted.

Results: Most cephalometric measurements significantly differed from Jarabak norms, except SNB. Gonial angle, Bjork sum, and facial length on the Y-axis were lower, while ramus height, ANB, posterior and anterior facial heights, and facial concavity were higher. Males had greater posterior facial height, mandibular body length, and ramus height, whereas females had higher facial convexity. Normodivergence was observed in, 85.6 %, with males showing more hypo- and hyperdivergence. Significant cephalometric differences were found between male and female Kurdish participants.

Conclusion: The study reveals significant cephalometric differences in the Kurdish population compared to Bjork-Jarabak norms, showing a hypodivergent profile and gender-based variations. These findings emphasize the need for population-specific standards to improve orthodontic diagnosis and treatment outcomes.

Keywords: Cephalometric analysis, Bjork-Jarabak Norms, Hyperdivergent profile, Kurdish Population

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INTRODUCTION

Cephalometric analysis is an essential tool in clinical orthodontics for the study of malocclusion, skeletal structure, and craniofacial research. It provides valuable insights into the skeletal and dental relationships within the craniofacial complex. It has been shown to be consistent for the study of skeletal and soft tissue structures and is considered the standard in the literature.[1,2,3,4]

Jarabak's cephalometric analysis is a clinically valuable tool for assessing craniofacial development. It aids in identifying skeletal anomalies, predicting facial growth patterns, and evaluating potential responses to various orthodontic treatments. Key factors such as morphological characteristics, tendencies toward functional alterations, and the specific growth direction "whether vertical or horizontal" are essential considerations. Understanding these elements enables orthodontists to tailor treatment plans effectively. For practitioners working with growing patients, it's crucial to determine the individual's unique growth pattern and its potential trajectory. Only after this assessment can appropriate orthodontic mechanics be selected and applied to achieve optimal outcomes.[5,6,7]

The Bjork-Jarabak analysis, a well-recognized method in cephalometrics, offers a comprehensive approach to assessing skeletal variations and establishing normative data for different populations. This analysis is particularly useful in understanding skeletal patterns and growth trajectories, which are important for effective orthodontic diagnosis and treatment planning.[8]

The Bjork Jarabak analysis is a useful tool for examining the relationship between facial form, occlusion, and jaw growth variations.[9] It involves measuring cephalometric angles such as the saddle angle and facial height ratio, which are very critical in diagnosing malocclusion conditions such as open bite or deep bite before formulating treatment plans.

While cephalometric norms serve as valuable tools for orthodontic treatment, they are primarily measured from previous studies. Research has shown considerable variation in craniofacial anatomy, particularly the oral and maxillofacial regions, among different racial and ethnic groups.10 Applying generalized norms to different populations, may result in diagnostic inaccuracies and reduce effectiveness in therapeutic interventions.

This study aims to evaluate skeletal variations and establish cephalometric norms specific to the Kurdish population in Erbil city/ Iraq, using Bjork-Jarabak's analysis. By conducting a detailed cephalometric assessment of a representative sample, this study seeks to address the gap in localized data and provide a more precise basis for orthodontic diagnosis and treatment planning. While previous studies have examined the non-Kurdish Iraqi population in the central and southern regions, no research has yet determined normative cephalometric values for the Kurdish population. This study analyzes the craniofacial patterns of Kurdish adults to evaluate skeletal variations and compare measurements using standardized values of Bjork Jarabak's analysis.

MATERIALS AND METHODS

This study was conducted in consultation clinics of the college of Dentistry at Hawler Medical University, involving 222 adult Kurdish patients. The study extended over 6 months from August 2024 to April 2025, during which 222 healthy individuals aged 18 to 47 years were assessed during routine dental checkups and for orthodontic diagnosis, the study ethics were performed in regard to approval of Ethical Committee of Hawler Medical University and confidentiality of data (HMUD, 2425159). Participants had no prior orthodontic treatment, exhibited different facial profiles, with no history of craniofacial anomalies, extractions, or cleft lip and palate. Patients with the history of orthodontic intervention, extractions, and facial traumas were excluded from the study.

After obtaining the patient's history and performing clinical examinations, consent forms were signed by the patients. Lateral cephalographs were taken using the Newtom Giano machine in a standardized position. The cephalographs were then analyzed using WEBCEPH Imaging Software Fig. 1, with cephalometric landmarks and reference points identified according to the Bjork -Jarabak method.[10]

Cephalometric landmarks were recognized, and both linear and angular measurements were calculated following the Björk-Jarabak method. Facial morphology was then classified based on distinct growth patterns determined by the Jarabak quotient or facial height ratio, measuring the pol-

ygon “Jarabak sum”, and Jarabak ratio, which include: 1- Hyperdivergent growth pattern, 2- Normodivergent growth pattern, 3- Hypodivergent growth pattern.
Statistical analysis was performed using SPSS “Special package for the Social Sciences” version 25. Differences in skeletal patterns, including facial growth patterns and facial height, were analyzed. The cephalometric measurements of the sample population were compared with Jarabak norms using a sample student t-test, while male and female parameters were compared using two-sample student t-test.

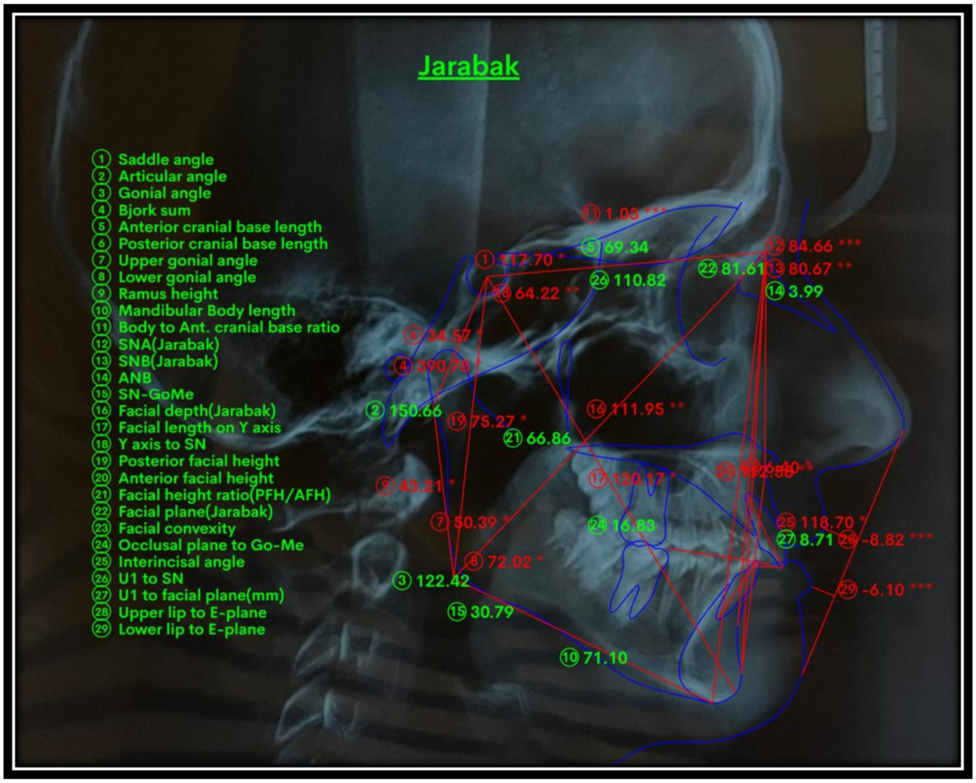

Figure 1. Cephalometric analysis “Jarabak” using WEBCEPH

RESULTS

This study included 222 participants with a mean age of 23.9 years, ranging from 18 to 47 years. More than half, 51.8 %, of the enrolled cases were between 20 and 29 years old. Females comprised, 60.8 % of the sample Table 1.

Table 1. Demographic characteristics of participants.

Variable	No. of participant	Percentage
Age mean ± SD (23.9 ± 5.3 years)		
< 20 years	76	34.2
20 - 29 years	115	51.8
30 - 39 years	29	13.1
40 - 47 years	2	0.9
Gender		
Male	87	39.2
Female	135	60.8
Total	**222**	**100.0**

SD=Standard Deviation.

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As shown in Table 2, all cephalometric measures of our participants were significantly different from Jarabak norms, $p \leq 0.05$, except for SNB, $p = 0.7$. The means of Gonial angle and Bjork Sum of our sample were significantly lower than the means of Jarabak Gonial angle and Bjork Sum norms, $p < 0.001$. In contrast, the mean of ramus height and ANB were significantly higher in the Kurdish population compared to Jarabak norms, $p < 0.001$. Additionally, the mean facial length on Y Axis of our population was significantly lower than the corresponding Jarabak mean, $p < 0.001$. Both posterior and anterior facial heights, as well as the facial concavity, were significantly higher than the mean Jarabak ratio, whereas the interincisal angle was lower. The mean Jarabak ratio of our sample was significantly higher than the standard Jarabak ratio, $p < 0.001$.

Table 2. Cephalometric measures of the Kurdish sample compared to Jarabak norms

Measures	Study groups		Change direction	P
	Jarabak norms	Kurd population		
	Mean±SD	Mean±SD		
Saddle Angle	123.0 ± 6	124.65 ± 5.6	High	**0.002** ***
Articular angle	143.0 ± 5	148.23 ± 9.26	High	**< 0.001** ***
Gonial Angle	130.0 ± 6	120.06 ± 6.45	Low	**< 0.001** ***
Bjork Sum	396.0 ± 5	392.86 ± 6.16	Low	**< 0.001** ***
Anterior Cranial Base	71 ± 3	70.3 ± 1.2	Low	**0.001** ***
Posterior Cranial Base	32 ± 3	35.06 ± 3.42	High	**< 0.001** ***
Upper Gonial Angle	45.73 ± 3.6	47.44 ± 3.61	High	**< 0.001** ***
Lower Gonial Angle	77.17 ± 4.1	72.59 ± 5.44	Low	**< 0.001** ***
Ramus height	44 ± 5	49.25 ± 5.44	High	**< 0.001** ***
Mandibular body length	71 ± 5	75.17 ± 4.85	High	**< 0.001** ***
SNA	80 ± 2	82.65 ± 3.52	High	**< 0.001** ***
SNB	78 ± 2	78.1 ± 3.64	High	0.7 NS
ANB	2 ± 1.8	4.74 ± 2.46	High	**< 0.001** ***
Facial length on Y axis	139.47 ± 6	125.39 ± 7.92	Low	**< 0.001** ***
Y Axis to SN	70.92 ± 3.4	68.18 ± 4	Low	**< 0.001** ***
Posterior facial height	77.5 ± 7.5	80.97 ± 6.58	High	**< 0.001** ***
Anterior facial height	112.5 ± 7.5	121.53 ± 8.71	High	**< 0.001** ***
Jarabak ratio	63.51 ± 1.5	66.73 ± 4.86	High	**< 0.001** ***
Facial Plane angle	81.75 ± 1.2	79.08 ± 3.74	Low	**< 0.001** ***
Facial Convexity	1.3 ± 2.4	8.49 ± 5.56	High	**< 0.001** ***
Interincisal Angle	130 ± 5.8	127.32 ± 10.29	Low	**< 0.001** ***
Upper lip to E line	-4.7 ± 2	-3.73 ± 3.11	High	**< 0.001** ***
Lower lip to E line	-2 ± 2	-0.71 ± 3.57	High	**< 0.001** ***

*= p < 0.05, **= P < 0.01, ***= P < 0.001, NS=Not significant, P=Probability, SD=Standard Deviation.

When analyzing males and females separately, all cephalometric measurements of male Kurdish participants showed significant differences from Jarabak norms, $p \leq 0.05$, except for saddle angle, $p = 0.9$ and interincisal angle, $p = 0.4$. The mean gonial angle and Bjork sum of our male participants were significantly lower than means of Jarabak norms, $p < 0.001$. The mean ramus height and ANB were significantly higher than Jarabak norms, $p < 0.001$. The mean facial length along Y Axis was significantly lower than the corresponding Jarabak value, $p < 0.001$. Posterior and Anterior facial height and facial concavity were significantly higher than mean Jarabak ratio, while interincisal angle was lower. The mean Jarabak ratio of our males was significantly higher than the mean Jarabak norm, $p < 0.001$ Table 3.

Table 3. Cephalometric measures of the male Kurdish sample compared to Jarabak norms

Measures	Study groups		Change direction	P
	Jarabak norms	Male Kurd		
	Mean±SD	Mean±SD		
Saddle Angle	123.0 ± 6	123.02 ± 5.99	High	0.9 NS
Articular angle	143.0 ± 5	148.13 ± 6.68	Low	**< 0.001** ***
Gonial Angle	130.0 ± 6	120.9 ± 6.79	Low	**< 0.001** ***
Bjork Sum	396.0 ± 5	392.07 ± 6.48	Low	**< 0.001** ***
Anterior Cranial Base	71 ± 3	71.74 ± 0.37	High	**< 0.001** ***
Posterior Cranial Base	32 ± 3	36.45 ± 3.52	High	**< 0.001** ***
Upper Gonial Angle	45.73 ± 3.6	47.36 ± 3.39	High	**< 0.001** ***
Lower Gonial Angle	77.17 ± 4.1	73.56 ± 5.86	Low	**< 0.001** ***
Ramus height	44 ± 5	51.61 ± 5.04	High	**< 0.001** ***
Mandibular body length	71 ± 5	76.58 ± 5.26	High	**< 0.001** ***
SNA	80 ± 2	82.84 ± 3.8	High	**< 0.001** ***
SNB	78 ± 2	78.86 ± 3.8	High	**0.003** **
ANB	2 ± 1.8	4.34 ± 2.63	High	**< 0.001** ***
Facial length on Y axsis	139.47 ± 6	130.16 ± 8.01	Low	**< 0.001** ***
Y Axis to SN	70.92 ± 3.4	67.79 ± 3.92	Low	**< 0.001** ***
Posterior facial height	77.5 ± 7.5	84.61 ± 6.4	High	**< 0.001** ***
Anterior facial height	112.5 ± 7.5	125.32 ± 8.85	High	**< 0.001** ***
Jarabak ratio	63.51 ±1.5	67.59 ± 5.02	High	**< 0.001** ***
Facial Plane angle	81.75 ± 1.2	79.88 ± 3.82	Low	**< 0.001** ***
Facial Convexity	1.3 ± 2.4	7.11 ± 5.63	High	**< 0.001** ***
Interincisal Angle	130 ± 5.8	129.39 ± 11.23	Low	0.4 NS
Upper lip to E line	-4.7 ± 2	-3.87 ± 3.41	High	**0.001** ***
Lower lip to E line	-2 ± 2	-0.51 ± 3.99	High	**< 0.001** ***

*= p < 0.05, **= P < 0.01, ***= P < 0.001, NS=Not significant, P=Probability, SD=Standard Deviation.

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Similarly, all cephalometric measurements of the females were significantly different from Jarabak norms, p ≤ 0.05, except for SNB, p = 0.14 and posterior facial height, p = 0.07. The mean gonial angle and Björk sum were significantly lower than the Jarabak norms, p < 0.001, p = 0.005, respectively). The mean ramus height and ANB of our females were significantly higher than the Jarabak norms, p < 0.001. The mean facial length along the Y-axis was also significantly lower than the Jarabak mean, p < 0.001. Anterior facial height and facial concavity were significantly higher than the Jarabak ratio, while the interincisal angle was lower. The mean Jarabak ratio for our female sample was significantly higher than the Jarabak norm, p < 0.001, Table 4.

Table 4. Cephalometric measures of the female Kurdish sample compared to Jarabak norms

Measures	**Study groups**		**Change direction**	**P**
	Jarabak norms	**Female Kurd**		
	Mean±SD	**Mean±SD**		
Saddle Angle	123.0 ± 6	125.69 ± 5.08	High	**< 0.001** ***
Articular angle	143.0 ± 5	148.29 ± 10.63	High	**< 0.001** ***
Gonial Angle	130.0 ± 6	119.52 ± 6.18	Low	**< 0.001** ***
Bjork Sum	396.0 ± 5	392.69 ± 5.96	Low	**0.005** **
Anterior Cranial Base	71 ± 3	69.37 ± 0.21	Low	**< 0.001** ***
Posterior Cranial Base	32 ± 3	34.17 ± 3.05	High	**< 0.001** ***
Upper Gonial Angle	45.73 ± 3.6	47.49 ± 3.76	High	**< 0.001** ***
Lower Gonial Angle	77.17 ± 4.1	71.96 ± 5.07	Low	**< 0.001** ***
Ramus height	44 ± 5	47.72 ± 4.26	High	**< 0.001** ***
Mandibular body length	71 ± 5	74.26 ± 4.35	High	**< 0.001** ***
SNA	80 ± 2	82.52 ± 3.33	High	**< 0.001** ***
SNB	78 ± 2	77.61 ± 3.41	Low	0.14 NS
ANB	2 ± 1.8	5 ± 2.32	High	**< 0.001** ***
Facial length on Y Axis	139.47 ± 6	122.31 ± 6.15	Low	**< 0.001** ***
Y Axis to SN	70.92 ± 3.4	68.43 ± 4.05	Low	**< 0.001** ***
Posterior facial height	77.5 ± 7.5	78.62 ± 5.56	High	0.07 NS
Anterior facial height	112.5 ± 7.5	119.09 ± 7.71	High	**< 0.001** ***
Jarabak ratio	63.51 ± 1.5	66.18 ± 4.68	High	**< 0.001** ***
Facial Plane angle	81.75 ± 1.2	78.57 ± 3.62	Low	**< 0.001** ***
Facial Convexity	1.3 ± 2.4	9.38 ± 5.34	High	**< 0.001** ***
Interincisal Angle	130 ± 5.8	125.99 ± 9.43	Low	**< 0.001** ***
Upper lip to Eline	-4.7 ± 2	-3.65 ± 2.91	High	**0.001** ***
Lower lip to Eline	-2 ± 2	-0.83 ± 3.28	High	**< 0.001** ***

*= p < 0.05, **= P < 0.01, ***= P < 0.001, NS=Not significant, P=Probability, SD=Standard Deviation.

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The facial height ratios FHR distribution of our sample showed that, 85.6 %, exhibited Normodivergence Fig. 2, 10.8 %, showed Hypodivergence Fig. 4, and, 3.6 % ,had Hyperdivergence Fig. 3. A statistically significant difference in FHR was observed between males and females, p < 0.001. Hypodivergence and Hyperdivergence were significantly more prevalent among males, while the majority of female participants, 92.6 %, fell within the Normodivergent category Table 5.

Table 5. Distribution of FHR of the participants

Variable	Gender				P
	Male		Female		
	No.	Percentage	No.	Percentage	
FHR					**< 0.001** ***
Normodivergent	65	74.7	125	92.6	
Hypodivergent	15	17.2	9	6.7	
Hyperdivergent	7	8.0	1	0.7	

*= p < 0.05, **= P < 0.01, ***= P < 0.001

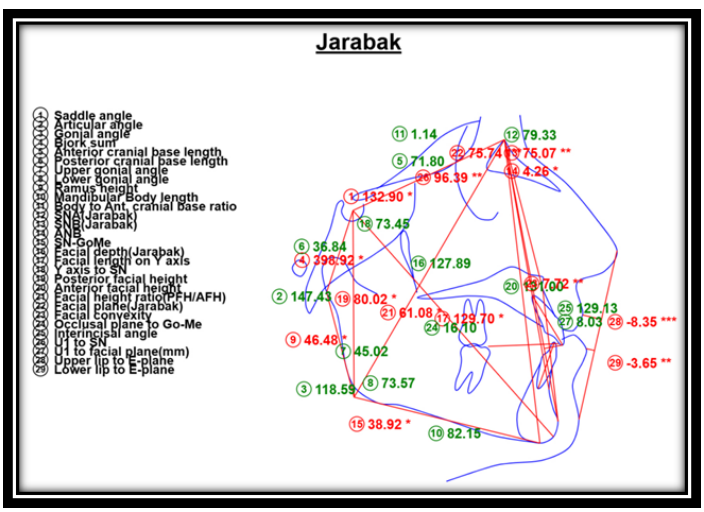

Figure 3. Hyperdivergent patient example

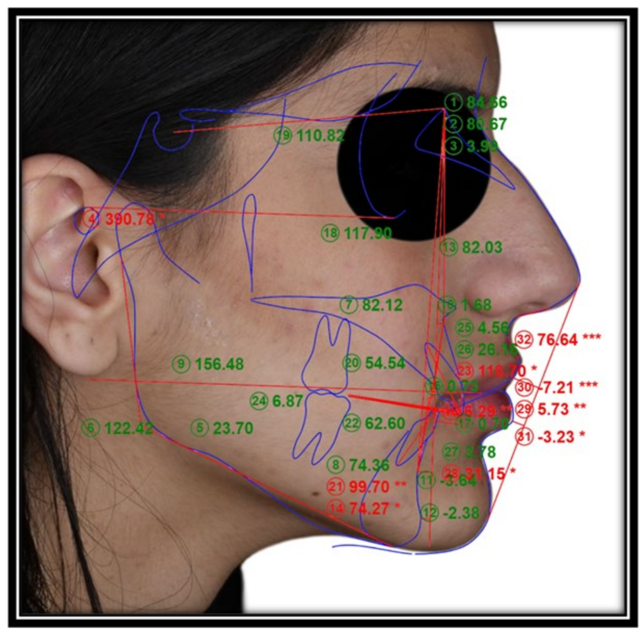

Figure 2. Normodivergent patient example

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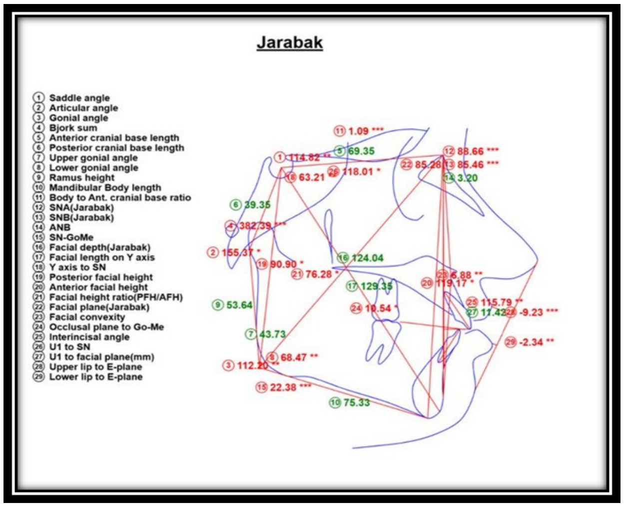

Figure 4. Hypodivergent patent example

When the cephalometric values are compared between males and females separately, this study found that the mean saddle angle and facial convexity were significantly higher in females compared to males, p ≤ 0.05. The mean values for anterior cranial base length, posterior cranial base length, mandibular body length, SNB, facial length along the Y-axis, posterior facial height, anterior facial height, Jarabak ratio, facial plane, lower gonial angle and interincisal angle were significantly higher in the males, p < 0.05. No significant differences were found between males and females in other cephalometric measurements Table 6.

Table 6. Differences in the cephalometric measures between male and female Kurdish participants

Measures	Study Groups Male Kurd Mean±SD		P
	Female Kurd Mean±SD	Male Kurd Mean±SD	
Saddle Angle	125.69 ± 5.08	123.02 ± 5.99	**< 0.001** ***
Articular angle	148.29 ± 10.63	148.13 ± 6.68	0.901 NS
Gonial Angle	119.52 ± 6.18	120.9 ± 6.79	0.119 NS
Bjork Sum	392.69 ± 5.96	392.07 ± 6.48	0.561 NS
Anterior Cranial Base	69.37 ± 0.21	71.74 ± 0.37	**< 0.001** ***
Posterior Cranial Base	34.17 ± 3.05	36.45 ± 3.52	**< 0.001** ***
Upper Gonial Angle	47.49 ± 3.76	47.36 ± 3.39	0.788 NS
Lower Gonial Angle	71.96 ± 5.07	73.56 ± 5.86	**0.031** *
Ramus height	47.72 ± 4.26	51.61 ± 5.04	0.474 NS
Mandibular body length	74.26 ± 4.35	76.58 ± 5.26	**< 0.001** ***
SNA	82.52 ± 3.33	82.84 ± 3.8	0.513 NS
SNB	77.61 ± 3.41	78.86 ± 3.8	**0.011** *
ANB	5 ± 2.32	4.34 ± 2.63	0.26 NS
Facial length on Y Axis axsis	122.31 ± 6.15	130.16 ± 8.01	**< 0.001** ***
Y Axis to SN	68.43 ± 4.05	67.79 ± 3.92	0.25 NS
Posterior facial height	78.62 ± 5.56	84.61 ± 6.4	**< 0.001** ***
Anterior facial height	119.09 ± 7.71	125.32 ± 8.85	**< 0.001** ***
Jarabak ratio	66.18 ± 4.68	67.59 ± 5.02	**0.03** *
Facial Plane angle	78.57 ± 3.62	79.88 ± 3.82	**0.01** *
Facial Convexity	9.38 ± 5.34	7.11 ± 5.63	**0.003** **
Interincisal Angle	125.99 ± 9.43	129.39 ± 11.23	**0.016** *
Upper lip to Eline	-3.65 ± 2.91	-3.87 ± 3.41	0.416 NS
Lower lip to Eline	-0.83 ± 3.28	-0.51 ± 3.99	0.725 NS

*= p < 0.05, **= P < 0.01, ***= P < 0.001, NS=Not significant, P=Probability, SD=Standard Deviation.

DISCUSSION

Effective orthodontic management is mainly dependent on a full understanding of the relationship between cranial and facial growth and development. To achieve optimal orthodontic results, orthodontists must be aware of various dental and skeletal parameters, particularly those related to craniofacial growth variations, which can differ across populations.[11,12] The Björk-Jarabak polygon is a frequently used method for the evaluation of the facial biotype by cephalometric analysis.[13,14]

The perception of facial attractiveness is inherently subjective, influenced by factors such as ethnicity, age, gender, culture, and personality, which shape average facial traits. Different racial and ethnic groups exhibit distinct dental and facial patterns, necessitating the use of cephalometric norms specific to each group.[15,16]

In this study, all cephalometric measurements of Kurdish participants significantly deviated from Bjork Jarabak's norms, except for SNB. This interesting finding aligns with a previous cross-sectional study in Saudi Arabia, which also reported significant differences in certain cephalometric measures compared to Bjork Jarabak's analysis.[17] However, it contrasts with a Brazilian study that found most cephalometric measures consistent with Bjork Jarabak's norms, except for SN measures.[18] Specifically, our sample exhibited higher values for the gonial angle, Bjork sum, interincisal angle, Jarabak ratio, saddle angle, SNA, and ANB compared to Bjork Jarabak's norms. The outcome of the present analysis revealed that the Kurdish population has greater anterior and posterior facial heights than Jarabak's values, leading to a slight increase in anterior facial height and an upward-forward growth rotation, resulting in a predominantly hypodivergent profile.[17] These findings are consistent with previous literature.[11,19]

In the Kurdistan region of Iraq, a recent cross-sectional study using Steiner's parameters found that the cephalometric measures of Kurds were statistically different from Steiner's norms, except for SNB and ANB,[20], suggesting a protrusive maxilla. This indicates that the upper jaw may be positioned more forward relative to the cranial base. In contrast, a study in Sudan found no significant differences in saddle angle, Bjork sum, and cranial lengths compared to Bjork Jarabak's norms.[9] These inconsistencies may stem from variations in skeletal growth and development across populations, differences in the standard norms used for comparison, and methodological or sample size variations between studies.

The current study also found that all cephalometric measures for male Kurdish participants were significantly different from Jarabak norms, except for saddle angle, and interincisal angle. These results are consistent with a previous Saudi Arabian study.[18] For female Kurdish participants, all cephalometric measures significantly differed from Jarabak norms, except for SNB, and posterior facial height, aligning with findings from a recent Pakistani study.[21] Our study further revealed that males exhibited significantly higher values for anterior cranial base length, posterior cranial base length, lower gonial angle, mandibular body length, SNB, facial length on the Y-axis, posterior facial height, anterior facial height, Jarabak ratio, facial plane, and interincisal angle compared to females. These differences may reflect the larger, more robust craniofacial structure typically seen in males, characterized by more pronounced and angular features, such as larger jawbones, longer cranial bases, and greater facial heights.[12] These trends are likely driven by genetic and hormonal influences. Conversely, females had significantly higher saddle angles and facial convexity, consistent with findings from a recent Yemeni study that reported significant gender-based differences in cephalometric measures.[22]

The study also highlighted that the facial profile of the Kurdish population is characterized by an increased Jarabak ratio, posterior facial height, and ramus height, along with a forward growth rotation of the face, as indicated by a significant decrease in the Bjork sum angle and gonial angle. Regarding facial height ratio FHR, the study found Normodivergence in, 85.6 %, of participants, Hypodivergence in, 10.8 %, and Hyperdivergnce in, 3.6 %. These results are similar to a recent Romanian retrospective cohort study, which reported Normodivergence in, 65.8 %, of participants.[23,24] Additionally, a statistically significant difference in FHR was observed between male and female Kurdish participants, with hypo- and Hyperdivergence being more prevalent among males. This may be attributed to variations in cephalometric measures across different populations.

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CONCLUSION

The study findings revealed that most cephalometric measures of Kurdish individuals significantly differ from Jarabak norms. The study concluded gonial angle, Bjork sum and facial length on Y axis values are reduced, while the ramus height, Jarabak ratio, anterior and posterior facial height values are increased. Regarding the sagittal dimension, the findings depicted that the ANB and facial convexity angles are increased. The overall findings indicating a tendency to hypodivergent profile and forward growth rotation. Gender-based differences were notable, with males exhibiting larger craniofacial dimensions as the posterior and anterior facial heights are higher, and the prevalence of hypodivergence and hyperdivergence are higher in males, while females revealed majority of normodivergence increased saddle angles and facial convexity. These results highlight the need for population-specific cephalometric norms and underscore the influence of ethnicity and gender on craniofacial growth patterns.

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