Characterization of Soft Tissue Cephalometric Norms of Kurdish Population of Iran

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ABSTRACT

Sufficient information is not available on face shape characteristics of Iranian populations. This study sought to assess soft tissue cephalometric norms of the Kurdish population. This descriptive, analytical study evaluated 100 Kurds (40 males, 60 females) who met our inclusion criteria. Hold away, and Legan and Burstone soft tissue analyses were performed on lateral cephalograms of participants and linear and angular measurements were made. According to Hold away analysis, soft tissue facial angle, nose prominence and upper lip thickness were significantly smaller in Kurds than Caucasians (P<0.05).The values of H-angle, skeletal profile convexity, basic upper lip thickness, upper lip strain, lower lip to H line, inferior sulcus to H line and soft tissue chin thickness were significantly greater in Kurds. In Legan and Burstone analysis, vertical lip-chin ratio and interlabial gap were smaller in Kurds while facial convexity angle, maxillary and mandibular prognathism, lower face-throat angle, nasolabial angle, lower lip protrusion, mentolabial sulcus depth and maxillary incisor exposure were greater in Kurds. Nose prominence, basic upper lip thickness, upper lip thickness and strain, inferior sulcus to H-line and soft tissue chin thickness in Hold away analysis and maxillary prognathism, lower vertical height-depth ratio, mentolabial sulcus depth and vertical lip-chin ratio in Legan and Burstone analysis were greater in males. In conclusion, Kurds have significantly different soft tissue cephalometric norms compared to Caucasian norms.

Key words: Cephalometry, European Continental Ancestry Group, Population Groups, Face

INTRODUCTION

The success of orthodontic treatment depends on both hard tissue and soft tissue parameters. Improving facial esthetics is a primary goal of orthodontic treatment. For many patients, an esthetic facial appearance is even more important that ideal occlusal function [1]. To achieve optimal facial esthetics in orthodontic treatment, clinicians perform soft tissue analyses on lateral cephalograms using Legan and Burstone [2], and Hold away [3, 4] soft tissue analyses. However, cephalometric norms used in these analyses have been derived from the data of Caucasians of European-American ancestry, which might not be well applicable to other ethnic groups [1, 5-7].

Sufficient knowledge about normal dentofacial patterns specific for each ethnic group would increase treatment success in achieving optimal facial harmony and result in higher patient satisfaction [8]. The available data about soft tissue parameters and norms in the Middle East region show some controversies. Some differences have been reported in soft tissue norms of Middle Eastern individuals and those of Caucasians while

some similarities have also been reported [9-12]. Studies on Saudi Arabians[9, 10] and Egyptians [11]found significant differences in soft tissue parameters between these ethnic populations and Caucasians while Basciftci *et al.,* [12]revealed that most soft tissue measurements in Turkish adults were similar to soft tissue norms in Caucasians. The studies on soft tissue norms in the Iranian population are limited and the few available ones show significant differences in some indices with Caucasians [1, 13]. Almost all the available cephalometric data of ethnic subgroups residing in Iran have been derived from skull measurements and have shown some differences in cephalometric indices between different ethnic groups; however, the effect of ethnicity on soft tissue parameters has not been well studied [14-16]. The Kurds are an ethnic group in the Middle East mainly inhabiting an area spanning adjacent parts of southeastern Turkey, western Iran, northern Iraq and northern Syria. They are estimated to number about 50 million [17]. To the best of authors' knowledge, there is a gap of information about soft tissue cephalometric norms of Kurds for orthodontic purposes. Thus, the present study sought to assess soft tissue cephalometric norms of a sample population of Kurds living in western Iran in comparison with widely accepted Caucasian norms.

MATERIALS AND METHODS

This descriptive analytical study was performed on patients presenting to the Department of Orthodontics, Faculty of Dentistry, Kermanshah University of Medical Sciences requiring orthodontic treatment. The study was approved by the Ethics Committee of Kermanshah University of Medical Sciences (Code:KUMS.REC.1395.393).

Patients and Cephalometry

After extra- and intraoral examinations of 300 individuals, 100 participants (40 males and 60 females) who met the following inclusion criteria were selected by convenience sampling. The sample size was calculated according to a previous study by Jain and Kalra[18].Inclusion criteria: Kurds residing in Iran with their two previous generations speaking Kurdish, having symmetric faces, no history of surgical procedure, class I molar and canine relationship with no or mild crowding, normal overjet (0-2mm), normal overbite (maximum of 40%), absence of crossbite, presence of all teeth in dental arch (no missing)

except for third molars and no history of orthodontic, orthognathic or prosthodontic treatment[19,20].Participants were briefed about the study and signed informed consent forms prior to participation in the study. Lateral cephalometry was requested for all participants. Lateral cephalograms were obtained in normal head position, maximum intercuspation of teeth and at rest position of the lips using a panoramic X-ray machine (PM 2002 cc Proline; Planmeca, Helsinki, Finland). Cephalograms had equal magnification and were traced on acetate tracing papers by an orthodontist. Soft tissue cephalometric norms were analyzed using Holdaway[3,4] (Figure 1), and Legan and Burstone[2] soft tissue analyses (Figure 2), which included 20 linear and five angular measurements (a total of 25 measurements).
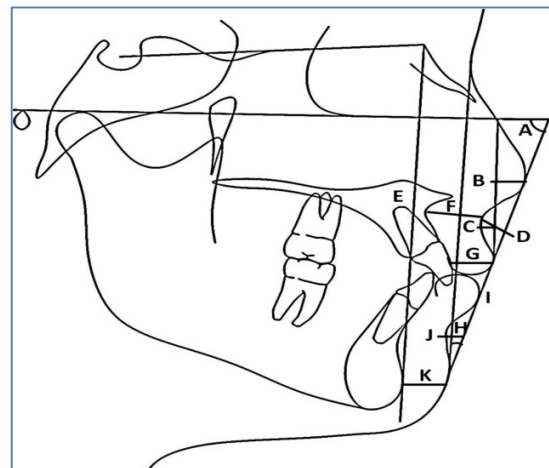
Figure 1: Holdaway soft tissue analysis measurements. (A) Soft tissue facial angle; (B) Nose prominence; (C) Superior sulcus depth; (D) Soft tissue subnasale to H line; (E) Skeletal profile convexity; (F) Upper lip thickness; (G) Upper lip strain; (H) H angle; (I) Lower lip to H line; (J) Inferior sulcus to H; (K) Soft tissue chin thickness

To prevent errors, only five cephalograms were traced each day. All measurements were made in triplicate by the same orthodontist. To ensure intra-examiner reliability, 35% of cephalograms were randomly chosen and traced again by the same orthodontist. The intra-class correlation coefficient was calculated to be 0.96, which is considered excellent.

Statistical analysis

Statistical differences between the Kurdish norms and the currently used Caucasian norms in the Holdaway, and Legan and Burstone analyses were

calculated using one-sample t-test. To compare measurements between men and women, independent samples t-test was used. The level of statistical significance was set at P<0.05 and the data were expressed as mean and standard deviation values.
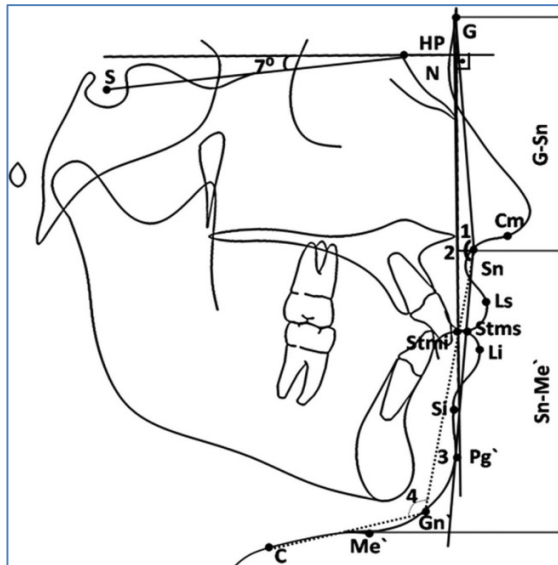

Figure 2: Legan–Burstone soft tissue analysis. Horizontal reference plane (HP), constructed by drawing a line through nasion (N) 7 degrees up from the sella–nasion line. (1) Facial convexity angle (G–Sn–Pg'); (2) Maxillary prognathism (G vertical–Sn); (3) Mandibular prognathism (G vertical–Pg'); (4) Lower face–throat angle (Sn–Gn'–C); vertical height ratio (G–Sn/Sn–Me'), lower vertical height–depth ratio (Sn–Gn'/C–Gn'), nasolabial angle (Cm–Sn–Ls), upper lip protrusion (Ls to Sn–Pg'), lower lip protrusion (Li to Sn–Pg'), mentolabial sulcus (Si to Li–Pg'), vertical lip–chin ratio (Sn–Stms/Stmi–Me'), maxillary incisor exposure (Stms–UI), interlabial gap (Stms–Stmi)

RESULTS

Comparison of soft tissue cephalometricnorms of Kurds with Caucasian norms

Table 1 shows soft tissue measurements according to the Holdaway analysis in Kurds compared to Caucasian norms. Statistical analyses revealed that soft tissue facial angle, nose prominence and upperlip thickness were smaller in Kurds while H-angle, skeletal profile convexity, basic upperlip thickness, upperlip strain, lower lip to H-line, Inferior sulcus to H-line and soft tissue chin thickness were greater in Kurds compared to Caucasian norms.

Table 2 compares Kurdish and Caucasian soft tissue norms according to the Legan and Burstone analysis. As seen, vertical lip-chin ratio, and interlabial gap were significantly smaller in Kurds compared to Caucasian norms while facial convexity angle, maxillary prognathism, mandibular prognathism, lower face-throat angle, nasolabial angle, lowerlip protrusion, mentolabialsulcus depth and maxillary incisor exposure were significantly greater in Kurds compared to Caucasian norms.

Comparison of soft tissue cephalometric norms between Kurdish males and females

Table 3 presents differences in soft tissue cephalometric norms between Kurdish males and females according to the Holdaway analysis. The values of nose prominence, basic upperlip thickness, upperlip thickness, upperlip strain, inferior sulcus to H-line andsoft-tissue chin thickness were significantly greater in males.

Table 1: Comparison of Kurdish and Caucasian soft tissue norms according to the Holdaway analysis

Variables	Kurdish (n=100)					Caucasian		P value
	Mean	SD	Min	Max	Percentage in range	Mean	Range	
Soft-tissue facial angle	89.33	5.09	80	119	89%	91	84-98	0.001*
H-angle	15.11	4.05	5.00	23	45%	10	7-14	< 0.001*
Nose prominence	15.42	3.34	8.00	24.5	70%	19‡	14-24	< 0.001*
Upper-lip sulcus depth	3.08	1.3	0	7	85%	3	1-4	0.513
Soft-tissue subnasale to H-line	5.10	2.58	0	13	65%	5	3-7	0.685
Skeletal profile convexity	3.02	1.88	0	9	-	0	§	< 0.001*
Basic upper lip thickness	16.11	3.5	10	25	-	15	§	0.002*
Upper lip thickness	12.32	2.61	7	19	21%	14	13-14	< 0.001*
Upper lip strain	4.00	2.4	0	9	-	1	§	< 0.001*
Lower lip to H-line	1.23	1.4	0	7	85%	0	-1-2	< 0.001*
Inferior sulcus to H-line	5.67	1.99	2	13	-	5	§	0.001*
Soft-tissue chin thickness	12.17	2.13	7	17	51%	11‡	10-12	< 0.001*

‡ Mean calculated as midpoint of the range when not provided by original author

§ Range not provided by original author

*P ≤ 0.01 was considered significant.

SD: Standard deviation; Min: Minimum; Max: Maximum

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Table 2: Comparison of Kurdish and Caucasian soft tissue norms according to the Legan and Burstone analysis

Variables	Kurdish (n=100)				Caucasian		P value
	Mean	SD	Min	Max	Mean	SD	
Facial form							
Facial convexity angle	16.98	4.94	7.00	28.00	12	4	< 0.001*
Maxillary prognathism	7.11	4.27	0.00	19.00	6	3	0.011*
Mandibular prognathism	6.42	4.72	0.00	19.00	0	4	< 0.001*
Vertical height ratio	0.99	0.11	0.75	1.29	1	0	0.662
Lower face-throat angle	109.13	11.29	70.00	140.00	100	7	< 0.001*
Lower vertical height-depth ratio	1.21	0.20	0.78	1.75	1.2	0	0.725
Lip position and form							
Nasolabial angle	121.65	12.58	82.00	150.00	102	8	< 0.001*
Upper lip protrusion	3.25	1.62	0.00	7.00	3	1	0.135
Lower lip protrusion	2.90	1.93	0.00	8.00	2	1	< 0.001*
Mentolabial sulcus depth	5.85	1.53	2.00	10.00	4	2	< 0.001*
Vertical lip-chin ratio	.45	0.06	0.13	0.56	0.5	0	< 0.001*
Maxillary incisor exposure	2.79	1.73	0.00	7.00	2	2	< 0.001*
Interlabial gap	1.42	1.40	0.00	6.00	2	2	< 0.001*

*P ≤ 0.01 was considered significant; SD: Standard deviation; Min: Minimum; Max: Maximum

Table 4 comparessoft tissue cephalometric norms between Kurdish males and females according to the Legan and Burstone analysis. As seen in Table 4, vertical height ratio and maxillary incisor exposure in males were significantly smaller than those in females, whilst maxillary prognathism, lower vertical height-depth ratio, mentolabialsulcus depth and vertical lip-chin ratio were significantly greater in males than in females.

Table 3: Statistical comparison of soft tissue cephalometric norms between Kurdish males and females according to the Holdaway analysis

Variables	Males (n=40)		Females (n=60)		P value
	Mean	SD	Mean	SD	
Soft-tissue facial angle	89.75	5.80	89.05	4.59	0.503
H-angle	16.05	4.05	14.48	3.96	0.058
Nose prominence	16.24	3.54	14.87	3.11	0.045*
Upper lip sulcus depth	3.15	1.37	3.04	1.25	0.684
Soft tissue subnasale to H-line	5.21	2.57	5.03	2.61	0.736
Skeletal profile convexity	3.08	1.69	2.99	2.00	0.829
Basic upper lip thickness	18.72	3.11	14.37	2.52	< 0.001**
Upper lip thickness	13.76	2.45	11.37	2.27	< 0.001**
Upper lip strain	5.01	2.31	3.33	2.24	< 0.001**
Lower lip to H-line	1.21	1.25	1.24	1.50	0.919
Inferior sulcus to H-line	6.31	2.40	5.24	1.54	0.015*
Soft tissue chin thickness	13.01	2.29	11.62	1.83	0.001**

* P ≤ 0.05 was considered significant.
**P ≤ 0.01 was considered significant.
SD: Standard deviation

Table 4: Statistical comparison of soft tissue cephalometric norms between Kurdish males and females according to the Legan and Burstone analysis

Variables	Males (n=40)		Females (n=60)		P value
	Mean	SD	Mean	SD	
Facial form					
Facial convexity angle	17.46	4.80	16.65	5.04	0.423
Maxillary prognathism	8.81	4.63	5.98	3.63	0.001**
Mandibular prognathism	7.25	5.46	5.88	4.11	0.179
Vertical height ratio	0.95	0.10	1.03	0.12	< 0.001**
Lower face-throat angle	111.46	13.71	107.58	9.13	0.092
Lower vertical height-depth ratio	1.27	0.22	1.17	0.17	0.017*
Lip position and form					
Nasolabial angle	119.80	14.67	122.88	10.92	0.232
Upper lip protrusion	3.40	1.58	3.14	1.66	0.439
Lower lip protrusion	3.01	1.95	2.82	1.92	0.621
Mentolabial sulcus depth	6.45	1.74	5.45	1.24	0.002**
Vertical lip-chin ratio	0.47	0.04	0.44	0.07	0.047*
Maxillary incisor exposure	1.90	1.38	3.38	1.70	< 0.001**
Interlabial gap	1.25	1.32	1.53	1.46	0.331

* P ≤ 0.05 was considered significant.
**P ≤ 0.01 was considered significant.
SD: Standard deviation

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DISCUSSION

Evidence shows a wide variability in hard tissue and soft tissue cephalometric norms of different populations and ethnic groups. Thus, norms of a specific population may not be applicable to other ethnic groups and studies are required on different racial and ethnic populations to find norms specific for each race/ethnicity [1, 21]. The present study was undertaken to obtain soft tissue cephalometric norms of Kurds residing in Iran and compare their data with widely accepted Caucasian norms. Conduction of this study on patients presenting to Kermanshah University of Medical Sciences was because of the fact that Kermanshah is the capital city of Kermanshah Province and Kermanshah School of Dentistry is considered a referral center in Kurdish provinces for orthodontic treatment. Thus, the population of patients presenting to the university clinic can be considered as a true representative of the population of Kurdish Provinces.

The Holdaway [3, 4]; and Legan and Burstone[2] soft tissue analyses were used for soft tissue measurements in our study since these analyses are among the most efficient and comprehensive soft tissue analyses widely used for this purpose [1, 9]. The available studies on cephalometric norms of Iranian populations have mainly focused on hard tissue cephalometric measurements and studies on soft tissue norms are scarce. Thus, the present study was unique in that it evaluated soft tissue characterization of Kurds and revealed that face shape in Kurds was more convex and they had more prominent lips and smaller nose compared to Caucasians. Thus, these facial features are considered acceptable in this ethnic population and must be considered in the orthodontic treatment of this group as a norm. Larger nasolabial angle in this population is also acceptable. Studies on soft tissue cephalometric norms of different populations and ethnic groups have yielded variable results indicating that each ethnic group has its own unique craniofacial characteristics. For instance, in East Asia, craniofacial norms are characterized by oblong eyes and small nose whilst these features may not be accepted as norms in other ethnic groups [1, 21]. Studies carried out on Egyptians [11], Yemenis [20] and Indians [18] showed greater facial convexity in these populations in comparison with Caucasians.

Bagwan *et al.,* [22] compared soft tissue norms of Egyptians with Caucasian standards and found significant differences. In general, Egyptians had a more convex face, more prominent lips and higher nasolabial angle compared to Caucasians. Their findings with regard to differences with Caucasian norms were in line with our results in Kurds. Al-Gunaid *et al.,* [20] compared soft tissue cephalometric norms of Yemeni males with North American males and found that Yemeni males had higher facial convexity, greater protrusion of the maxilla and mandible and thicker lips compared to North Americans. Their results were in agreement with ours. Anić-Milošević *et al.,* [5] compared 100 Croatians with Brazilian whites and revealed that Croatians had a more prominent nose and deeper labial sulcus. They used photographs of patients instead of cephalograms but their findings also point to differences in facial soft tissue norms between different racial groups. Jain and Karla [18] used Legan and Burstone analysis to compare North Indians and Caucasians in terms of soft tissue cephalometric norms and reported that Indians had more prominent lips and more convex faces. Abu-Tayyem *et al.,* [23] evaluated Emirati males and females and showed significant differences in soft tissue norms compared with Caucasians. Ahsan *et al.,* [24] compared Bangladeshi and Japanese adults and reported that Bangladeshi adults had a shorter inferior facial height and bimaxillary protrusion compared to Japanese and Caucasian norms. Alcalde et al. [25] evaluated soft tissue cephalometric norms in adults and discussed that their findings were mostly similar to Caucasian norms and only a few differences as in lip protrusion and nasolabial angle were detected. Gu *et al.,* [26] assessed craniofacial characteristics of Chinese and Caucasian young adults and showed that Chinese individuals had a shorter nose, more retruded lips, smaller nasolabial angle and thinner soft tissue of the chin compared to Caucasians. Azarbayejani *et al.,* [1] compared Iranians with Caucasians in terms of soft tissue norms and showed that Iranians had a more convex face, which was similar to our findings.

In the current study, we showed that the upper lip thickness, soft tissue chin thickness, protrusion of the maxilla, mandible and lower lip, nasolabial angle, H angle, lower face–throat angle and mento-labial sulcus depth were significantly greater in Kurds than in Caucasians. Also, the upper incisor exposure was greater in Kurds. On the other hand, the nasal prominence, vertical lip-chin ratio and interlabial gap were smaller in Kurds compared to Caucasian norms. These findings are in agreement

with those reported in Egyptians [11], Yemenis [20], Saudi Arabians [9, 10], and Indians [18]. Surprisingly, Chinese populations have shorter nose, smaller nasolabial angle and the thinner soft tissue of the chin in comparison with Caucasians [26].

We found significant differences between Kurdish males and females as well. Males had greater soft tissue thickness in the chin area and lip thickness while females had a smaller nose. Similar results were reported by Kalha *et al.,* [27] and Sachan *et al.,* [28] in south Indian and north Indian ethnic populations, respectively. Our study also showed that the inferior sulcus to the H-line was greater in males than females. This result was in line with that of Sachan et al.[28], and may be attributed to the greater chin and lower lip thickness in males. According to the Legan and Burrstone analysis, the vertical height ratio and maxillary incisor exposure in males were significantly smaller than those in females. This result was in agreement with that of Bagwan *et al.,* [22]. Abu-Tayyem *et al.,* [23] evaluated Emirati males and females and showed that Emirati males had longer faces and more protruded anterior teeth compared to females. In our study, maxillary prognathism was significantly greater in males. This result was in line with that of Jain and Kalra [18] and *et al.,* [22]. Also, in our study, the mean values of mentolabial sulcus depth and vertical lip-chin ratio in males were significantly greater than those in females. Similar results were reported by Bagwan *et al.,* [22]. Yadav and Gaharwar [29] evaluated soft tissue cephalometric norms in a central India population and reported significant differences with Caucasians. They emphasized on the need for developing separate standards for different populations.

Regarding the Iranian population in general, Aghili *et al.,* [30] assessed the soft tissue cephalometric norms in Iranian normal subjects. They reported that the norms of Iranian subjects were different from those of Bergman in upper and lower lip thickness, facial profile angle and aupper lip length in males. Sexual dimorphism was determined in lower facial height, upper lip length, upper lip thickness and lower lip thickness. They concluded that Iranian norms differ from those of other populations, which was in accord with our findings; although our study was conducted on an Iranian subpopulation. Amini *et al.,* [31] evaluated soft tissue cephalometric norms of Iranian class I adults. They assessed 25 anthropometric variables

and found significant differences between males and females regarding the mentocervical angle, the nasolabial angle, Merrifield's Z-angle, the angle of facial convexity, soft tissue chin thickness, and upper lip thickness. They concluded that the Holdaway norms are not efficient for the Iranian population for most measurements. Our results confirmed their findings.

Evaluation of cephalometric norms in Kurdish population of Iran was major strength of this study since no similar previous study has been conducted on this ethnic group. Selection of individuals with class I molar and canine relationship and exclusion of other classes of malocclusion was a limitation of this study. The above-mentioned differences between different racial and ethnic groups are attributed to genetics, epigenetics and residing in different geographical locations. The obtained data in this study highlight the need for defining specific norms for each population/ethnic group to increase the success of orthodontic treatment and achieve higher patient satisfaction. Similar studies on other populations and ethnic groups and also on a more diverse sample size in terms of class of occlusion are required to better elucidate this topic.

CONCLUSION

Within the limitations of this study, the results showed that Kurds had significantly different soft tissue cephalometric norms compared to Caucasians and had more convex faces.

Abbreviations
G–Sn–Pg': Facial convexity angle
G vertical–Sn: Maxillary prognathism
G vertical-Pg': Mandibular prognathism
Sn–Gn'–C: Lower face–throat angle
G–Sn/Sn–Me': Vertical height ratio
Sn–Gn'/C–Gn': Lower vertical height–depth ratio
Cm–Sn–Ls: Nasolabial angle
Ls to Sn–Pg': Upper lip protrusion
Li to Sn–Pg': Lower lip protrusion
Si to Li–Pg': Mentolabial sulcus
Sn–Stms/Stmi–Me': Vertical lip–chin ratio
Stms–UI: Maxillary incisor exposure
Stms–Stmi: Interlabial gap

Author Contributions
Mohammad Moslem Iman &Mohadeseh Delavarian designed the study and contributed to analysis, interpretation of data, and drafting of manuscript. Seyed Ali Hosseini reviewed and edited the manuscript for intellectual content. Sepideh Arab revised the manuscript of this

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review. All authors gave final approval of the version to be published.

Conflict of interest

The authors have declared that there was no conflict of interest.

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