

Iraqi Adult Cephalometric Standards: An Analytical Approach

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Objective: To establish a more accurate reliable standard value of the widely used cephalometric parameters for the Iraqi Arab adults and comparing them to the norms of Caucasians counterparts.

Materials and Methods: A meta-analysis of the pertinent cephalometric studies of Iraqi adults for period confined between 1988 to 2017 was conducted. 27 of the total of 92 collected studies were met the inclusion criteria. The selected studies have involved the published articles and unpublished master theses, all of them exhibit numerical data for both genders of Iraqi Arab individuals who have class I skeletal pattern with normal occlusion. Selection of 35 parameters took place, included mostly used skeletodental cephalometric measurements to be evaluated and compared. Statistical tests were applied to describe the means and SD, also to find out the statistical ethnic difference between the Iraqis and Caucasians.

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Results: The standard norms of many cephalometric parameters exhibited a significant gender difference in Iraqi adults' individuals, with greater linear hard tissues measurements in males, while non-significant gender differences appeared in facial soft tissue profile. On the other hands, most of the elected cephalometric parameters showed statistically significant differences between the Iraqi Arab and Caucasians compares. Generally, the Iraqis had smaller craniofacial dimensions, maxillary and mandibular skeletal retrusion and more convex profile.

Conclusions: Apparent sexual dimorphism in addition to significant ethnic difference requires the adoption of gender as well as ethnic specified standard norms during the cephalometric analysis of Iraqi Arab adult patients seeking orthodontic treatment, to reach an accurate diagnosis and treatment objectives.

Keywords: Cephalometric standard norms; Iraqi Arab adults; meta-analysis.

1. INTRODUCTION

A new era in orthodontics had begun with the discovery of cephalometric. It had become possible to identify and analyze each vertical and anteroposterior relationship between the different parts of the craniofacial region. With cephalometric, a perception for underlying skeletal and dental configuration for an individual which contribute to the existing malocclusion could be sought. Treatment planning and outcomes assessment in addition to the continual changes in an individual's growth could be detected and evaluated in the cephalograms [1,2,3].

At first, Numerous studies had been conducted by many researchers to find out cephalometric analyses which mainly considered hard tissues relationship [3,4,5]. These studies and analyses had created a set of linear and angular measurements that were later used in the analysis and exploration of the configuration of dentofacial components. Later on, other cephalometric usage was invented, which was measuring the facial soft tissues, and analyzing the inter-relationship between the various soft tissues parts [6,7]. Eventually, comprehensive cephalometric analysis became evaluate the relationships of the skeletal, dental and soft tissues [8].

The difference between men and women standards values of numerous dentofacial cephalometric parameters had explained in several studies [9,10]. So, gender specified standards values for many parameters had been provided.

Considerable morphological disparities in the craniofacial characteristics among the different races were explored by many investigators. Such studies clarified the ethnic variances in dimensions and angular measures within the

craniofacial region [11,12,13]. Therefore, normative values of various cephalometric analyses have been modified to result in several lists of standard norms, each one of them belonged to a different ethnic group, with frequent recommendations to adopt race specified cephalometric analysis [14].

The Arab as a specific ethnic group, also have distinct skeletal, dental and soft tissues features when compared to other races, particularly the Caucasians [15]. However, not all Arab populations represent a homogenous ethnic entity [16]. Many studies had researched the craniofacial dimensions and morphology of Iraqi population, but only a few ones, including a certain cephalometric analysis, had compared the Iraqi population with the other of European and American ancestry [17,18].

Most of the analyses of cephalograms of an orthodontic patient are generally done depending on widely available Caucasian standards, which may lead to unsatisfactory diagnosis and inadequate treatment planning if they use in population belonged to a different ethnic group, like the Iraqis. So, there is a demand to establish standard values more specific to adult Iraqi patients. Basing on this, the current meta-analysis study was designed to gather the largest sample of Iraqi adults, including both genders, to obtain stronger statistical means values can be representative to standard norms of commonly used cephalometric parameters in Iraqi population. Also, to investigate the racial variance between the Iraqi cephalometric normative values with their counterparts of Caucasians.

2. MATERIALS AND METHODS

Almost all studies which were conducted in the period confined between 1988 to 2017 to

investigate skeletal, dental and soft tissues cephalometric norms in Iraqi Arab population were collected to compose the database of this meta-analysis. Some of those studies were unpublished which involved the master theses submitted to the orthodontic department in the college of dentistry of Baghdad University, while most of them were the published articles in different Iraqi journals. Of collected 92 theses and articles, 27 studies were chosen in the meta-analysis, are summarized in Table 1. The chosen studies in the meta-analysis were met certain following criteria:

1. Lateral cephalometric study.
2. The study sample includes Iraqi adults, Arabic in origin, aged between 18 and 33 years old.
3. The study involves individuals exhibit Skeletal Class I jaws relationship with natural normal occlusion.
4. All individuals have clinically symmetrical faces with no history of orthodontic, orthopedic treatment and maxillofacial surgery.
5. The study describes cephalometric norms of hard and/or soft tissues, and for both males and females.

Both the hard and soft tissues cephalometric parameters that are helpful in diagnosis and treatment planning in orthodontics were chosen. The chosen cephalometric hard tissues measurements explained the dimensions of cranial base, maxilla, and mandible; in addition to anteroposterior jaw's relationships facial heights; dental relationship; and Growth axis. On the other hands, the soft tissues cephalometric variables revealed several commonly used angular and dimensions of facial soft tissue envelop. Twenty-seven hard tissue measurements with eight soft tissues measurements were elected so that they would offer a comprehensive cephalograms interpretation. The selected angular and linear Skeletodental measurements are shown in Figs. 1 and 2 and soft tissues measurements are shown in Fig. 3.

2.1 Statistical Analysis

The data was analyzed using SPSS program version 21.0. Firstly Shapiro-Wilk test is used to detect the normal distribution of data. All the measurements showed the normality; therefore, parametric statistical tests were used.

Table 1. Studies chosen for inclusion in meta-analysis

No.	Author	Year of study	Sample description
1	Al-Ta'ani MMA. [19]	1996	61 Subjects (27 Males, 34 Females)
2	Yousef MAS. [20]	2001	50 Subjects (25 Males, 25 Females)
3	Al-Joubori SK. [21]	2002	100 Subjects (50 Males, 50 Females)
4	Al-Aanbaky EF. [22]	2004	100 subjects (50 Males, 50 females)
5	Najimaldean JM. [23]	2005	Arab Class I Group 47 (22 males, 25 females)
6	Al-Labban YR. [24]	2006	Class I Group 46 (23 Males, 23 Females)
7	Al-Attar AM. [25]	2006	100 Subjects (50 Males, 50 Females)
8	Tarik HK. [26]	2007	Class I Group 36 (13 Males, 23 Females)
9	Mossa AA. [27]	2007	Class I Group 47 (24 Males, 23 Females)
10	Yassir AY, Al-Mulla AA. [28]	2009	Class I Group 75 (35 Males, 40 Females)
11	Al-Zubaidi SH. [29]	2009	30 Subjects (15 Males, 15 Females)
12	Mohammed SA. [30]	2009	30 Subjects (15 Males, 15 Females)
13	Al-Joubori SK, et al. [31]	2009	Class I Group 69 (34 Males, 35 Females)
14	Nahidh M [17]	2010	75 Subjects (33 Males, 42 Females)
15	Kadhom ZM, Al-Janabi MF. [32]	2011	60 Subjects (30 Males, 30 Females)
16	Yassir AY, et al. [33]	2011	Class I Group 38 (17 Males, 21 Females)
17	Agha NF, et al. [34]	2011	48 Subjects (22 Males, 26 Females)
18	Al-Mashhadany SM, Al-Mothaffar NMJ. [35]	2012	Class I Mesoprosopic Group 72 (30 Males, 42 Females)
19	Yassir AY, et al. [36]	2012	62 Subjects (25 Males, 37 Females)
20	Abd BI, Ali FA. [37]	2013	25 Subjects (12 Males, 13 Females)
21	Mohammed SA, et al. [38]	2013	Class I Group 30 (15 Males, 15 Females)
22	Nahidh M, Al-Mashhadany SMJ. [39]	2013	60 Subjects (23 Males, 37 Females)
23	Yassir YA. [40]	2013	95 Subjects (41 Males, 54 Females)
24	Ali Al. [41]	2014	Class I Group 55 (29 Males, 26 Females)
25	Al-Khawaja NFK, et al. [18]	2015	60 Subjects (30 Males, 30 Females)
26	Fadel AA, Ali FA. [42]	2015	Class I Group 30 (15 Males, 15 Females)
27	Berum HER, Fatah AA. [43]	2016	Class I Group 35 (20 Males, 15 Females)
Total sample number			1536 Subjects (725 Males, 811 Females)

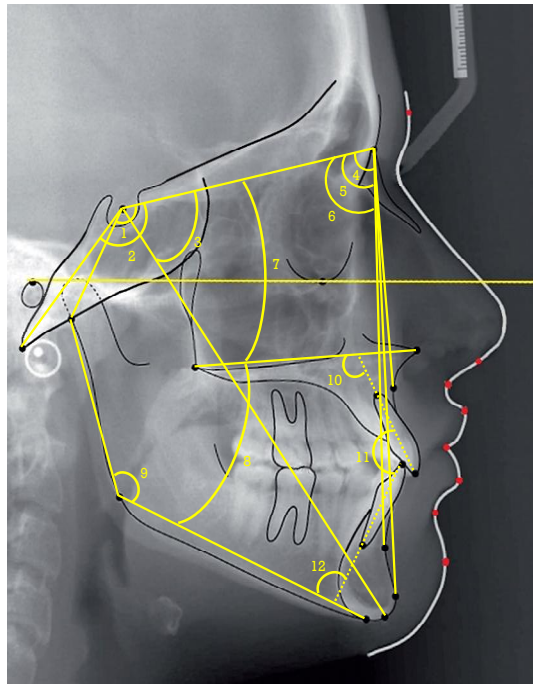


Fig. 1. Angular skeletodental measurements: (1) N.S.Ar; (2) N.S.Ba; (3) N.S.Gn; (4) SNA; (5) SNB; (6) S.N.Pog; (7) PP/SN; (8) MP/PP; (9) Ar.Go.Me; (10) UI/PP; (11) UI/LI; (12) LI/MP

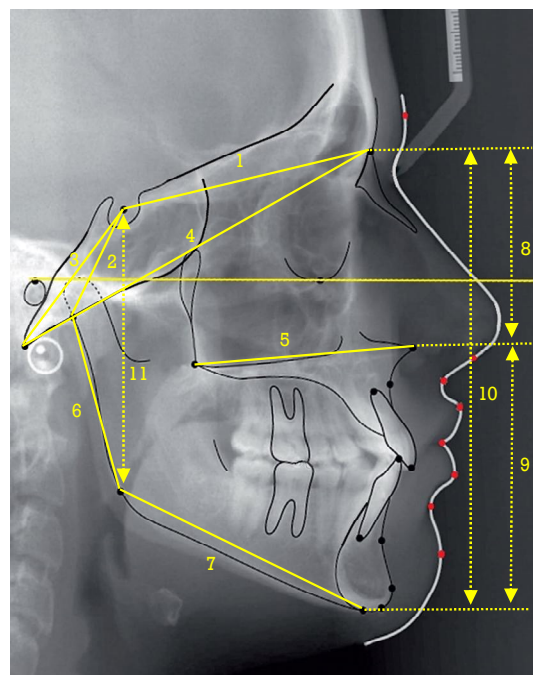


Fig. 2. Linear skeletodental measurements: (1) distance form N to S; (2) distance from S to Ar; (3) distance from S to Ba; (4) distance from N to B; (5) maxillary length distance from ANS to PNS; (6) ramus height, distance from Ar to Go; (7) mandibular body length, distance from Go to Me; (8) upper anterior facial height, distance from N to ANS; (9) lower anterior facial height, distance from ANS to Me; (10) total anterior facial height, distance from N to Me; (11) posterior facial height, distance from S to Go

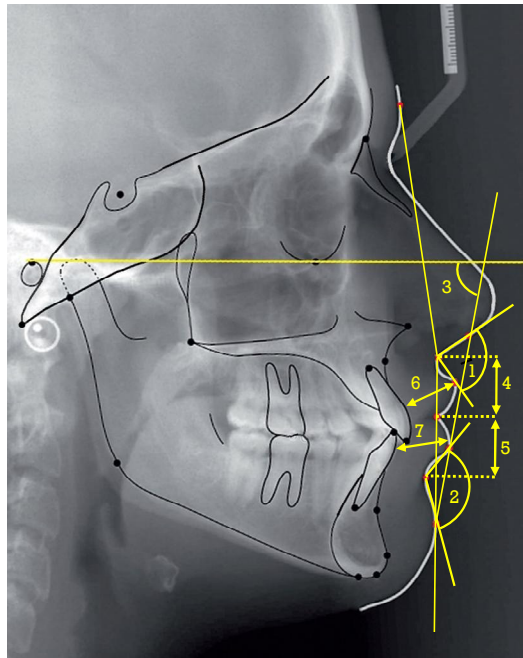


Fig. 3. Soft tissue measurements: (1) nasolabial angle; (2) Mentolabial angle; (3) Z-angle; (4) upper lip length; (5) lower lip length; (6) upper lip thickness; (7) lower lip thickness

After the descriptive statistic was applied, the means and standard deviation of all the measurements were extracted. Inferential statistic (independent t-test) was applied to find out any significant difference between Iraqi males and females. On the other hands, a one-sample t-test was utilized to assess the racial differences at the 0.05 significance level between the Caucasian and Iraqi population.

3. RESULTS

The resulted values of this study are arranged in three tables. The measurements are arranged in a simplified manner, all the measurements belong to a certain area of the craniofacial region are collected together.

Table 2 demonstrates the descriptive statistics (mean, standard deviation) and gender difference for all elected cephalometric craniofacial variables in Iraqi Arab adult individuals. It is noticeable that a significant difference in the shape and dimensions of the cranial base is present in the Iraqi adult gender. Likewise, the maxilla appears more prognathic and has a larger dimension in Iraqi males than females. Iraqi females show a retrusive mandible when evaluated by SNB angle, and lesser ramus and corpus

dimensions than Iraqi males. Sexual dimorphism was also apparent in facial heights so that the anterior and posterior heights were significantly greater in Iraqi males. In considering the soft tissues, little differences were present between comparisons, lesser nasolabial angle with greater lips thickness was shown in Iraqi males. No gender difference was present in Iraqi adult individuals in dentoalveolar relationships and growth axis.

Table 3 expresses the ethnic difference between adult Iraqi females and Caucasian females. Generally, there was no ethnic difference in cranial base shape, but, the Iraqi females exhibited smaller dimensions of the cranial base than Caucasians. In spite of the Iraqi females had slightly retrusive maxilla and mandible positions when compared with Caucasian females, they still have a more convex profile because of larger ANB value. The jaws dimensions appeared smaller, with the significantly steeper mandibular plane in Iraqi females. Relatively, the upper anterior facial height and posterior facial height had significantly greater values in Caucasian females. Iraqi females showed more downward facial growth axis than Caucasian females. The dentoalveolar segment in Iraqi females had certain characteristics such as proclined upper incisors,

retroclined and protruded lower incisors when compared to Caucasians. Seemingly, soft tissues facial envelop exhibited many ethnic differences between the comparisons, so that in Iraqi females, nasolabial angle appeared smaller, facial convexity and Z-angle was larger, besides the upper lip was shorter. The lips thickness was lesser in Iraqi than Caucasian females.

Table 4 demonstrates the comparison of Iraqi males with Caucasian males. Like the Iraqi females, the cranial base shape showed a non-significant ethnic difference, while the dimensions appeared smaller in Iraqi males. Significant ethnic differences in skeletal anteroposterior jaws pattern with means value of SNA 82.740, SNB 79.460 which were lesser in Iraqi males. Both ANB with 2.230 mean and S-N-Pog with 82.830 mean demonstrated a more

straight skeletal profile in Caucasian males when compared to Iraqi males. The hyper-divergent facial pattern was significantly apparent in Iraqi males by greater MP-SN and MP-PP angles. On the other hands, more downward backward facial growth axis was shown in Iraqi males. Lower incisors appeared in more protrusive position in Iraqi males when compared to Caucasians. Soft tissues parameters demonstrated that the Iraqi males had a less obtuse nasolabial angle, with more soft tissue convexity and shorter upper lip than Caucasians.

4. DISCUSSION

The feminine and masculine characteristics are noticeable in soft tissues as well as in hard tissues of the craniofacial region. This can be noted in the presence of difference in the means

Table 2. Descriptive statistics and gender difference between Iraqi Arab adults male and female

Craniofacial area	Measurement	Total		Males		Females		P value	Sig.
		Mean	SD	Mean	SD	Mean	SD		
Cranial base	S-N	72.03	3.37	74.52	3.43	69.53	3.3	.008	S
	S-Ar	34.79	3.75	36.94	4.36	32.63	3.14	.000	S
	S-Ba	44.89	3.71	46.31	3.13	43.46	2.28	.034	S
	N-Ba	102.54	4.15	106.05	4.46	99.04	3.84	.001	S
	N.S.Ba	128.24	4.85	127.76	4.55	128.72	5.15	.293	NS
	N.S.Ar	123.78	5.33	123.1	5.04	124.46	5.12	.020	S
Maxilla	SNA	82.23	3.25	82.74	3.55	81.71	2.95	.028	S
	ANS-PNS	52.81	3.13	55.03	3.99	50.59	2.62	.000	S
	PP/SN	8.63	2.9	7.89	2.96	9.36	2.83	.000	S
Mandible	SNB	79.06	3.06	79.65	3.31	78.47	2.8	.004	S
	Ar-Go	49.48	4.57	52.21	4.93	46.76	4.2	.000	S
	Go-Me	74.02	4.83	76.49	5.1	71.54	4.56	.004	S
	Ar.Go.Me	124.63	5.59	124.36	5.38	124.89	5.79	.754	NS
	MP-SN	33.28	5.75	32.07	5.89	34.49	5.61	.006	S
	S.N.Pog	79.6	3.69	80.46	4	78.72	3.38	.027	S
Intermaxillary	ANB	2.73	1	2.69	1	2.76	1	.643	NS
	MP/PP	24.78	5.44	24.56	5.73	24.99	5.14	.693	NS
Facial height	N-ANS	52.98	3.36	54.71	3.81	51.25	2.9	.002	S
	ANS-Me	68.54	4.98	71.29	5.43	65.79	4.52	.003	S
	N-Me	122.47	6.63	126.55	7.24	118.39	6.01	.001	S
	S-Go	81.1	5.96	85.37	6.65	76.83	5.26	.000	S
	PFH/AFH	65.73	3.96	66.88	4.05	64.59	3.87	.287	NS
Growth axis	N.S.Gn	68.58	3.85	68.07	3.97	69.1	3.74	.223	NS
Dentition	UI/PP	112.68	5.03	112.0	5.12	112.67	4.94	.976	NS
	LI/MP	93.69	5.28	93.8	5.34	93.56	5.22	.846	NS
	UI/LI	128.96	7.99	129.4	7.37	128.52	8.61	.738	NS
	LI/A-Pog	3.8	1.35	4	1.52	3.6	1.17	.354	NS
	Nasolabial angle	103.31	10.1	100.96	10.78	105.65	9.39	.050	S
Soft tissues	Mentolabial angle	124.61	11.03	122.06	10.77	127.16	11.29	.384	NS
	G-Sn-Pog	14.39	4.66	13.39	4.97	15.38	4.34	.326	NS
	Z-angle	75.98	4.71	74.98	3.98	76.99	5.44	.364	NS
	Sn-Sto	20.81	2.29	21.43	2.44	20.19	2.14	.137	NS
	Sto-sm	18.91	2.64	19.55	2.9	18.27	2.38	.249	NS
	U-lip thickness	13.01	1.73	14.21	2.04	11.8	1.41	.000	S
	L-lip thickness	13.61	1.26	14.82	1.5	12.4	1.02	.000	S

Table 3. Descriptive statistics and ethnic difference between Iraqi Arab females and Caucasian females

Craniofacial area	Parameter	Iraqi Arab females		Caucasian females		P value	Sig.
		Mean	SD	Mean	SD		
Cranial base	S-N	69.53	3.3	71.93 [8]	3.65	.068	NS
	S-Ar	32.63	3.14	33.51 [8]	3.22	.001	S
	S-Ba	43.46	2.28	45.56 [8]	3	.050	S
	N-Ba	99.04	3.84	109 [8]	5.2	.007	S
	N.S.Ba	128.72	5.15	129.3 [8]	4.84	.570	NS
	N.S.Ar	124.47	5.12	124.5 [8]	5.03	.933	NS
Maxilla	SNA	81.71	2.95	82.56 [8]	2.8	.010	S
	ANS-PNS	50.59	2.62	53.1 [44]	2.9	.001	S
	PP/SN	9.36	2.83	7.62 [8]	3.27	.000	S
Mandible	SNB	78.47	2.8	80.03 [8]	2.83	.000	S
	Ar-Go	46.76	4.2	50.5 [8]	4.49	.000	S
	Go-Me	71.54	4.56	76.7 [44]	3.8	.000	S
	Ar.Go.Me	124.89	5.79	126.5 [44]	5	.237	NS
	MP-SN	34.49	5.61	30.68 [8]	4.87	.000	S
	S.N.Pog	78.73	3.38	81.15 [8]	2.79	.001	S
	Intermaxillary	MP/PP	24.99	5.14	23.06 [8]	4.58	.042
ANB		2.66	1	2.52 [8]	1.41	.050	S
Facial height		N-ANS	51.25	2.9	53.11 [8]	2.57	.014
	ANS-Me	65.79	4.52	66.88 [8]	4.16	.380	NS
	N-Me	118.39	6.01	118.72 [8]	4.82	.852	NS
	S-Go	76.83	5.26	80.2 [8]	5.62	.003	S
	PFH/AFH	64.27	3.87	67 [8]	4	.108	NS
	Growth Axis	N.S.Gn	69.1	3.74	65.2 [8]	2.9	.000
Dentition	UI/PP	112.66	4.94	108.7 [44]	5.3	.002	S
	LI/MP	93.57	5.22	95.6 [44]	6.7	.067	NS
	UI/LI	128.52	8.61	132.9 [44]	8.4	.043	S
	LI/A-Pog	3.6	1.17	1.79 [8]	1.68	.027	S
Soft tissues	Nasolabial angle	105.65	9.39	111.9 [44]	8.4	.013	S
	Mentolabial angle	127.16	11.29	127.9 [44]	12.3	.852	NS
	G-Sn-Pog	15.38	4.34	11 [44]	4.8	.033	S
	Z-angle	76.99	5.44	71.3 [45]	7.7	.009	S
	Sn-Sto	20.19	2.14	22.4 [44]	1.6	.025	S
	Sto-sm	18.27	2.38	18.9 [44]	2.1	.568	NS
	U-lip thickness	11.8	1.41	12.6 [46]	1.8	.025	S
	L-lip thickness	12.4	1.02	13.6 [46]	1.4	.001	S

values of many cephalometric parameters between males and females [8]. Therefore, gender is considered as one of the factors which have a considerable impact on facial hard and soft tissues characteristics of an individual. Basing on this, several cephalometric studies have gone on to describe gender specified means values to be depended in cephalometric assessment [46,47]. The findings of this study support this concept, so that, statistically significant differences in many cephalometric parameters were found between Iraqi males and females. The dimensions of cranial base, maxilla, mandible, in addition to the vertical facial heights, show significantly the gender difference, with larger means values in Iraqi males than females. These outcomes come parallel to the results of other studies for Iraqi population [31, 39] and in other ethnic population [12,48], so all

these studies agreed on the one concept that regardless the race, males have statistically larger dimensions of the craniofacial region than females. This can be attributed to the later maturity which let for a longer growth period in males, allowing more growth, and in turn, larger craniofacial dimensions have attained [49].

The cranial base shape, represented by saddle angle, is significantly affected by gender, is more obtuse in females, which goes with other study findings [50]. The configuration of the cranial base has an impact of facial prognathism in individuals with normal occlusion, so that inversely proportional relationship was noted between them [51]. This could explain why Iraqi males have statistically more SNA than females. On the other hands, the backward position of females' mandible, so they have less SNB,

Table 4. Descriptive statistics and ethnic difference between Iraqi Arab males and Caucasian males

Craniofacial area	Parameter	Iraqi Arab males		Caucasian males		P value	Sig.
		Mean	SD	Mean	SD		
Cranial base	S-N	74.52	3.43	78.12 [8]	3.65	.012	S
	S-Ar	36.93	4.36	37.71 [8]	3.76	.073	NS
	S-Ba	46.31	3.13	49.77 [8]	3.79	.043	S
	N-Ba	106.05	4.46	114.5 [8]	4.2	.001	S
	N.S.Ba	127.76	4.55	126.19 [8]	4.92	.156	NS
	N.S.Ar	123.09	5.04	122.58 [8]	4.66	.204	NS
Maxilla	SNA	82.74	3.55	83.81 [8]	3.21	.012	S
	ANS-PNS	55.03	3.99	56.4 [44]	2.7	.013	S
	PP/SN	7.89	2.96	6.61 [8]	2.99	.002	S
Mandible	SNB	79.46	3.31	81.64 [8]	2.7	.000	S
	Ar-Go	52.21	4.93	57.58 [8]	3.99	.000	S
	Go-Me	76.49	5.1	80.3 [46]	3.5	.004	S
	Ar.Go.Me	124.36	5.38	124.9 [44]	5.2	.610	NS
	MP-SN	32.07	5.89	28.54 [8]	4.76	.000	S
	S.N.Pog	80.46	4	82.83 [8]	2.78	.005	S
Intermaxillary	ANB	2.69	1	2.23 [8]	1.75	.008	S
	MP/PP	25.56	5.73	21.93 [8]	4.89	.006	S
Facial height	N-ANS	54.71	3.81	57.98 [8]	3.47	.001	S
	ANS-Me	71.29	5.43	74.54 [8]	5.41	.016	S
	N-Me	126.55	7.24	130.98 [8]	6.46	.009	S
	S-Go	85.37	6.65	91.28 [8]	6.19	.000	S
	PFH/AFH	66.53%	4.05	70% [8]	4	.087	NS
Growth Axis	N.S.Gn	68.07	3.97	64.4 [8]	3.3	.001	S
Dentition	UI/PP	112.7	5.12	110.8 [44]	5.3	.047	S
	LI/MP	93.8	5.34	94.3 [44]	6	.513	NS
	UI/LI	129.4	7.37	135.1 [44]	8.3	.006	S
	LI/A-Pog	4	1.52	1.32 [8]	2.29	.008	S
Soft tissues	Nasolabial angle	100.96	10.78	111.4 [44]	11.7	.000	S
	Mentolabial angle	122.06	10.77	122 [44]	10.1	.989	NS
	G-Sn-Pog	13.39	4.97	10.8 [44]	4.2	.041	S
	Z-angle	74.98	3.98	75.5 [45]	8.3	.792	NS
	Sn-Sto	21.43	2.44	23.9 [44]	2.5	.004	S
	Sto-sm	19.55	2.9	19.3 [44]	2.6	.370	NS
	U-lip thickness	14.21	2.04	14.8 [46]	1.4	.105	NS
	L-lip thickness	14.82	1.5	15.1 [46]	1.2	.298	NS

S.N.Pog angles can be attributed to the possession of females a significantly higher saddle angle.

Posterior jaws rotation is predominant in Iraqi females, represented by a significant increase in the angles of the maxillary and mandibular plane. This could be related to that the females have a reduced posterior facial height relative to anterior, explained in less PFH/AFH ratio in females compared to males.

Iraqi males show more obtuse nasolabial angle than females. Gender difference in upper lip thickness can be blamed on this, males have the thicker upper lip, which accounts for their possession of less nasolabial angle value. Despite the difference was not significant; the Iraqi females showed a more convex facial

profile when compared to males. Similar findings were reported for Iraqis [18] and Saudis [52].

Regarding the ethnic and racial characteristics, the Caucasians have a distinctive craniofacial region, differ in many cephalometric parameters from the individuals belong to other ethnic groups. Many studies revealed this conclusion, Chinese [12], Japanese [53], Mexican [13], and Indian [54] populations showed a difference either in relationship or morphology of one or more of functional units of the craniofacial region from that of Caucasians population. Arabic populations like Jordanian [15] and Saudis [55] also showed a distinctive means value of several cephalometric parameters from the Caucasians. Following above-mentioned studies, the findings of the current study explain that the Iraqi Arab adults' cephalometric norms differ significantly

from that of Caucasians. Such a wide comparison of the present study, involve many hard and soft tissues cephalometric parameters of Iraqi Arab adults, including both genders, to the corresponding Caucasians' values were not done before.

In this study, Iraqi Arab individuals appear to have significantly retrognathic maxilla, both genders show that, as compared to Caucasians counterparts. This disagrees the findings of other studies done on Arabic population [15,55], which found out a similar maxillary skeletal relationship to the Caucasians. Moreover, the maxilla, in Iraqi individuals, appears smaller in the anteroposterior dimension as compared to Caucasians.

Iraqi Cephalometric norms of mandibular skeletal pattern, assessed by SNB, have less mean value reflecting retrognathic mandible position in Iraqi adults. Furthermore, both ramus and corpus have smaller sizes than Caucasians. Also, the present study found that the Iraqis have a less prominent chin.

The significantly larger values of MP-SN, PP-SN, MP-PP angles indicate the clockwise jaws growth pattern in the Iraqi adults. Downward backward growth axis in addition to significantly lesser posterior facial height which characterizes Iraqis, all could support this finding. The facial profile tends to be more convex in Iraqi adults individuals than Caucasians. It seems that a straight facial profile can be considered as a characterized trait for Caucasians, which looks obvious when they compared to other ethnic groups like Iranian [56], Chinese, Korean, Japanese [12], Saudis [57].

The inter-racial differences were clear in the dentition. The lower incisors in Iraqis were significantly forward-positioned relative to A-Pog line than those of Caucasians. The same finding was reported in another study for Iraqis [17]. This study also revealed that inter-incisal angle is significantly reduced in Iraqi adults. This difference might be attributed to a significant increase of upper incisors forwards inclination which seen in Iraqis when compared to Caucasians.

As well as the presence of considerable ethnic differences in hard tissues cephalometric parameters, the parameters of the soft tissue also exhibit the Iraqi-Caucasians ethnic disparities. The Iraqi ethnic group in this study showed certain features of soft tissues envelop

differ significantly, particularly the females, from their counterparts of Caucasians. There is no doubt that the soft tissues closely related to underlying hard tissues. The findings of soft tissues analysis study [46] support the influence of upper incisors position on the nasolabial magnitude, and the change in the location of upper incisors go along with a change of upper lip profile [58]. Iraqi population, males and females, have significantly less obtuse nasolabial angle, this can be attributed to possession of Iraqi a higher UI-PP angle. Similar to Yemeni [59], Saudis [60], the current study reveals that Iraqis an increased soft tissue convexity in comparison to Caucasians.

Z-angle is greatly influenced by lower face soft tissues thicknesses [61]. Upper and lower lip show significant lesser thicknesses in Iraqi females compared to Caucasians, which could lead to the variance in Z-angle values between two ethnic groups. This difference is not considerably appeared between Iraqi and Caucasian males, as the lips thicknesses showed non-significant ethnic variance. Furthermore, the Iraqi individuals appear to have shorter upper lip as compared to Caucasians, which come in agreement with other Iraqi soft tissues study [32] has found fewer norms than arnet standards.

5. CONCLUSION

This wide meta-analysis, which involved much of Iraqi cephalometric studies, demonstrated clear sexual dimorphism in many cephalometric parameters in Iraqi population. Also, it clarified the considerable ethnic differences in much parameters of cephalograms between widely used Caucasian norms and those of Iraqis. Eventually, the current study establishes reliable standards to a large extent for many cephalometric parameters of the Iraqi Arab adult population. Thus, these standards could be applied, instead of those of Caucasians, in the evaluation of cephalograms and putting the objectives of treatment, for all individuals belong to Iraqi Arab race, who seek for orthodontic treatment or need an orthognathic surgery.

CONSENT AND ETHICAL APPROVAL

It is not applicable.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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