Medical Journal of Babylon
Vol. 14- No. 1 : 169 – 179 , 2017
http://www.medicaljb.com
ISSN 2312-6760©2015 University of Babylon

Original Research Article

Maximum Bite Force And Their Relation's To Body Properties In Different Facial Type Among Iraqi Adult Female At Al Ramadi City

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Accepted 27 March, 2017

Abstract

Maximal bite force (MBF) is the utmost force obtainable within the mouth using muscles of mastication .The purpose behind current research was to analyze the link between MBF & body properties (namely age, height, weight, Facial height, Facial Width, and Body Mass Index [BMI]) amongst females.

Dental students & patients attending the Dentistry College \ Al Anbar University & at my private Clinic at AL Ramadi City 49 females fulfilling the inclusion criteria and included in this study. The sample classified according to the facial types into long, normal & short face. For Each participant the name, age, Body height, Body weight, the maximum bite force (M.B.F) were Measured. The Facial type determination was done Directly (Anthropometry). The descriptive statistics for all variable in different facial types had been measured. Short face and then the normal face had the largest bite force value whereas the long face had the smallest MBF value. ANOVA test revealed a very highly significant difference in Facial high, maximum bite force, while the Facial width showed a highly significant. The body mass index showed no significant differences among the three types of face. The Pearson's Correlation of age showed positive correlation with height, facial width in long face, while in short face the height showed positive correlation with facial height, facial width. The weight appeared in positive correlation with the Body Mass Index in all facial types, and with facial width in short face only. The Facial height demonstrated positive correlation with the Facial width in all facial types. Lastly the MBF displayed Positive correlation with Body Mass Index in all facial type.

A mean M.B.F for the total sample ranges from 205 to 657 N. The largest value of bite force were in the short face and the smallest value in long face. There were Positive correlation of BMI with the Maximum Bite Force & with the weight in all facial types.

Key Words: Body mass index, bite force, facial type.

الخلاصة

القوة القصوى للعضة هي القوة القصوى التي يمكن الحصول عليها في الفم مع مساعدة من العضلات الماضغ . الغرض من هذه الدراسة هو تحليل العلاقة بين قوة العظة القصوى وخواص الجسم (العمر، الطول، الوزن، و الوجه ارتفاع، عرض الوجه، مؤشر كتلة الجسم، و قوة عضة القصوى) بين الإناث. تضمنت هذهالدراسة ٤٩ انثى من طلاب ومرضى حضروا الى كلية طب الأسنان جامعة الأنبار والى عيادتي الخاصة في مدينة الرمادي حققوا معايير الانتقاء وضموا الى هذه الدراسة . العينة تم تصنيفها وفقا لأنواع الوجه وجه قصيرة، العادي والطويل . تم اخذ الاسم، العمر، الطول الجسم، وزن الجسم، وقياس أقصى قوة عضة لكل مشارك. وقد تم تحديد نوع الوجه مباشرة (الأنثروبومترية).

تمت إحصاءات وصفية لجميع المتغيرات في أنماط الوجه المختلفة . وكانت أكبر قيمة قوة عضة في الوجه القصير ، ثم وجه طبيعي ، وكانت اصغرها في الوجه الطويل . أظهر اختبار أنوفا فرق كبير جدا جدا في طول الوجه وقوة العظة القصوى، في حين أظهر عرض الوجه فرق كبير . مؤشر كتلة الجسم أظهر عدم وجد فروق ذات دلالة إحصائية بين أنماط الوجه الثلاثة . ارتباط بيرسون أظهر علاقة طردية بين العمر والارتفاع وعرض الوجه في

الوجه الطويل، في حين الوجوه القصيرة الطول اظهر علاقه ايجابيه مع طول الوجه وعرضه . الوزن اظهر علاقة طردية مع مؤشر كتلة الجسم في جميع أنواع الوجه ،ومع عرض الوجه في الوجوه القصيرة فقط. ارتفاع الوجه اظهر علاقة إيجابية مع عرض الوجه في جميع أنماط الوجه . وأخيرا أظهرت القوة القصوى للعضة ارتباط إيجابي مع مؤشر كتلة الجسم في كل نوع الوجه . متوسط أقصى قوة عضة لإجمالي العينة يتراوح ٢٠٥-٦٥٧ ن وكانت أكبر قيمة من قوة عضة في الوجوه القصير و أصغرها قيمة في الوجه الطويل . كان هناك ارتباط ايجابي من مؤشر كتلة الجسم مع قوة عضة القصوى و مع الوزن في جميع أنواع الوجه.

Introduction

Bite force is the force produced by the muscles of mastication when the upper jaw & and lower jaw teeth meet in the course of biting or chewing. Bite force is the consequential of overall forces performing on separate teeth due to several masticatory system elements [1].

Bite force can be separated in two key groups coming under physical or pathological aspect. There are further categories of physiological force into 3 dissimilar subdivisions rendering their positions; anterior, posterior and general (casing the whole arch) portion of arch [2].

Maximal bite force (M.B.F) is the utmost force obtainable within the mouth using muscles of mastication [3]. For many reasons calculations of maximum voluntary bite force (MVBF) has been utilized in dental studies, these include: to comprehend the fundamental mechanisms of chewing [4, 5], to assess the jaw muscles physiognomies [6,7], to examine the influences on occlusal forces by the diverse physical aspects such as height, gender, weight and age [8,9], and to make available values of reference for prosthetic instruments mechanic researches [10].

There exists an argument that there could be two chief elements that avert subjects from producing complete maximum bite forces when biting on solid surfaces using full potential of their jaw occlusion muscles. First, the hesitation & fear of damaging teeth edges & tips and tooth repairs [6, 11]. Secondly, the possible negative modulation initiation of jaw occlusal muscle movement and hence biting forces stimulated by sensory receptors activation inside the periodontium, and the probable deterrence of a major +ive modulation of jaw occlusal muscle movement and therefore chewing forces also activated by such receptors [12, 13, 14].

Moreover, including physical characteristics,, the bite force measurements are open to disparities in relation to the experimental methods, for example numerous recording instrument and strategy [15], the extent of subjects/participants cooperation [16], the methods applied by the examiner throughout bite force recording [17], placement and pose of the head during bite force reading process [18], the recording equipment placement within the dental arch, plus the extent of jaw parting during accommodation of the bite force instrument [19, 20].

Numerous researches have recognized sex variances when measuring maximum bite force, with females having smaller bite force as compare to males (high MBF) [21,22]. Tallness and weightiness are also associated with maximum forces of bite [23, 24].

Numeral literature research studies considered lack of closing muscles power as a probable significant factor on degree of bite force in adults, teenagers and children [25-27].

The inclusive propose behind this research was to investigate the connection amid maximum bite force among females and a few additional factors, viz. weightiness, age, height/tallness, Body Mass Index (BMI), Facial H height, Facial Breadth, and MBF.

There is no published studies covering sane objective as that of the present research of analyzing female‘s bite force. Most of the earlier researches have investigated the degree of bite force in relation to its connection with other factors, together with efficacy of muscles of mastication [23, 28].

Materials and Methods

All participants were well informed of the aim, and methodology of current study while ensuring ethical approval for the research. Seventy three females dentistry students and patients attending the Dentistry College\Al Anbar University and private Clinic at AL Ramadi City were screened and 49 females that were selected as subjects for the study fulfilled the following standard: Iraqi peoples their age from 18-25 years, a clinically harmonious and symmetrical face without any congenital deformity or history of facial trauma. , Bilateral class I molars relation based on Angle's classification [29], without orthodontic appliances or with prior orthodontic treatment or orthognathic surgery history, no posterior cross bite or lacking back teeth except 3rd molar teeth [30], no big cavities or repairs or root canal filling in the permanent first molars, and not complains from tempro-mandibular joint problems.

Each participant was asked to sit in an upright position on a chair while they were questioned for their name, age, origin, documented systemic disease, dental history, habits and history of tempro-mandibular joint problems.

Extra oral examination was carried out and examination of tempromandibular joint was accomplished by pressing against and encircling both condylar heads simultaneously with the middle finger tips as the patient opens and closes her mouth [31].

Intraoral examination was done to ensure the patient is class I molars relation and well fitted to selection criteria considered in this study.

Heights of the subjects were measured in an upright position minus shoes by means of a height meter with an accuracy of 0.1 centimeter while weight was noted in kilograms (kg) using personal scales to the accuracy of 0.1 kilograms. Calculations for BMI of each individual was also carried out.

Facial type determination was done Directly (Anthropometry) by seated The participant on a straight chair, looking frontward, and in an erect position, and then the soft tissue land marks nasion, Gnathion , Zygion were located by fingertip [32, 33, 34].

Measuring of the facial width (F.W) (interzygomatic distance) was measured by Spreading Caliper with the arms on the right and left zygion (zyg) [35]; facial height (F.H) (nasion-gnathion distance) was measured by Sliding Caliper. Where the fixed arm held on the gnathion (gn) and the movable or sliding arm to nasion (n) [36]. All The measurement were repeated several times to reduce possible error. All The measurements were taken to nearest 0.5 millimeter [37] figure 1.

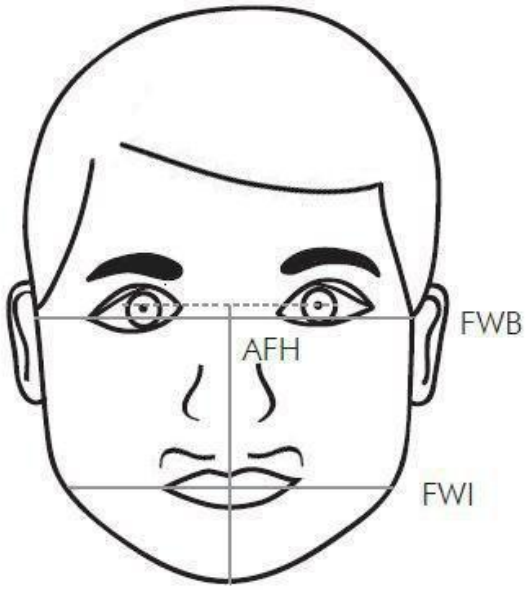

Figure 1: Facial dimensions. FWI: Intergonial width, FWB – bi-zygomatic facial width,AFH - anterior facial height.

The Facial Morphological Index (the ratio between anterior facial height and interzygomatic distance) was calculated directly from the face to determine the subject's facial type as following: Euryprosopic (short face) 80-84.9; Mesoprosopic (normal face) 85-89.9; and Leptoprosopic (long face): with the facial index 90-94.9 [38, 39].

The maximum bite force of each participant was measured as they sat comfortably on a chair resting both hands and back while her feet touching the ground easily. A moveable occlusal force gauge (GM10; Nagano Keiki, Tokyo, Japan, with this specifications: Size: 195 (L) x 29 (W) x 18 (H) mm.), Weight: 70grams, Force range: 0 – 1000 N, Accuracy: ±1 N, was utilized to measure M.B.F digits having a digital display screen. The instrument was made up of vinly material biting portion covered by a disposable plastic tube. Plus it also contained a hydraulic pressure gauge. Instrument tube was used for one measurement at a time. After each reading, the device was cleaning using alcohol dipped clothe. In the 1st molar area the measurements were recorded bilaterally on both the right & left jaw sides. In between the first molars of the participant, the occlusal force gauge was placed & secured by subject's teeth while from bottom weight of the transducer (Figure 1) was supported by the operator's hands

After the placement the participant was then requested to close the jaw quickly & bite on the transducer with maximum force potential. Using the display maximum bite force value was read & noted and then transducer was taken out from the mouth of the participant. Force limiting factor was determined using four questions answered by the participant at that time. These included, dental discomfort or pain in supportive tissues, ache in joint of temporomandibular bone, muscular aching, or absence of extra force. For the M.B.F measurement of other side same procedure was repeated after two to three minutes gap [40] and the utmost value of the two sides was deliberated. If a bite force value was dissimilar compared with others or the tube displaced during force application, the procedure was tried again.

Statistical Analysis

Data analysis was performed employing the Statistical Package for Social Science version 22 (SPSS Inc.®, Chicago, Illinois, USA). Tables are used to display descriptive data. ANOVA test and Pearson's correlation test were used to link and correlate different variables with MBF.

Figure 2: Occlusal force meter.

Results and Discussion:

In the current study sample consisted of females of age 18-25 years old so that impact of any lasting skeletal growth can be minimized [41] as mostly the age for completion of facial growth is 16-17 years & for that of facial pattern maintenance of the very facial growth is till 25 years of age [42].

Based on Angle's classification all of the study subjects were bilateral class I molar relation, since there exists a great significant dissimilarity in the mean findings of M.B.F amid the different groups of dental muscles of closing [43].

The sample was classified according to the types of faces; short, normal and long as they vary particularly in the vertical relationships [44]. The criteria used to classify the subjects into dissimilar facial categories are founded on comparison between the scores of facial index.

To assess the dimensional variations of face's soft tissues with direct measurements, anthropometry is the simplest method. It is a preferred method because it doesn't require complex tools rather it operates on information, practices, and training for the proficiency of this method [34].

The BMI has been examined in prior studies to identify effect of body physique on bite force and by using weight/height2, it can easily be calculated [45-47].

Maximum bite force (M.B.F) can be labelled as the capability of the lower jaw boosting muscles to produce lower teeth highest possible pressure towards maxillary teeth, under favorable circumstances [48].

In the preceding studies an extensive bite force disparity has been measured &reported. The reason for such disparity could be the use of diverse subjects & dissimilar instruments. Furthermore bite force values are also influenced by various physiognomies like sex, weight, height and dental state [39, 49, 50].

The statistics of description (mean; standard deviation (S.D.); minimum; maximum) for different measurements in different facial patterns (short, normal, &long faces) had been measured.

In different facial patterns the mean values of (age and body mass index) were higher in short face (mean=22.81, SD=2.3; mean=25.26, SD=3.62) followed by long face (mean=22.27, SD=2.6; mean=25.25, SD=2.26) and then normal face (mean=21.83, SD=2.53; mean=25.21, SD=3.1) respectively, while the mean values of (height, weight and Facial width and Maximum bite force) were higher in short face (mean=163.5, SD=4; mean=67.63, SD=10.52; mean=131.5, SD=4.57; mean=529.75, SD=78.07) followed by normal face (mean=162.17, SD=3.6; mean=66.28, SD=8.27; mean=127.25, SD=6.14; mean=370.56, SD=72.07) and then long face (mean=161.6, SD=5.24; mean=65.93, SD=6.57; mean=125, SD=5.87; mean=307.93, SD=82.6) respectively and finally the mean values of (Facial high) was higher in long face (mean=116.23, SD=4.61) then normal face (mean=112, SD=4.97) and followed by short face (mean=109.25, SD=3.46).

Our study revealed the mean M.B.F for the entire sample ranges from 205 to 657 N, which comes in disagrees with [39, 49,51].

When bite forces of different facial types were compared, the results revealed that the person with short face showed the largest value of bite force followed by normal face and then long face which was the smallest. This difference comes in accordance with Abu Alhaija et al. who found that maximum bite force significantly varied among participants with dissimilar vertical facial shapes and dimensions [42]. The short face type had the highest maximum bite force, the long-face type the lowest maximum bite force, and the normal face type had a medium maximum bite force value between the two other type .This alteration in maximum bite force is in accordance with several authors [52-57] and the reasons behind these differences might be:

1- Difference in proportions of the chewing muscles (muscle thickness, cross section and total volume).

2- Difference of jaw muscles shape and form; jaw build or muscle fibers sizes & their arrangements.

3- Difference in craniofacial morphology. Long face adults have lesser bite force as compare to those with rectangular craniofacial forms

4- Difference in the body weight and body height.

5- The difference in the degree of the jaw opening.

6- Difference in eating habits (previous study described developed bite forces amid rural adolescences with habits of harder chewing) tables1&2.

Table 1: Descriptive statistic for total sample.

Variable	Total (No.49)			
	Mean	***S.D***	***Mini***	***Maxi***
Age	22.29	2.47	18	25
height	162.43	4.26	152	171
weight	66.61	8.48	49	85
FH	112.4	5.16	103.5	123.5
FW	127.95	6.08	113	140.5
M.B.F	403.37	119.62	205	657
B.W.I	25.24	3	20.07	31.6

F.H=Facial height, F.W=Facial Width, B.M.I=Body Mass Index, M.B.F=Maximum Bite Force, S.D=Standard deviation, Mini=Minimum, Maxi=Maximum.

Table 2: Descriptive statistic for different facial type

Variable	Short face (No.16)				Normal Face (No.18)				Long Face (No.15)			
	Mean	*S.D*	*Mini*	*Maxi*	*Mean*	*S.D*	*Maxi*	*Mini*	*Mean*	*S.D*	*Maxi*	*Mini*
Age	22.81	2.3	19	25	21.83	2.53	25	18	22.27	2.6	25	18
height	163.5	4	154	170	162.17	3.6	170	157	161.6	5.24	171	152
weight	67.63	10.52	49	85	66.28	8.27	81	53	65.93	6.57	78	58
FH	109.25	3.46	154	115.5	112	4.97	121.5	103.5	116.23	4.61	123.5	107
FW	131.5	4.57	126	140.5	127.25	6.14	139.5	119	125	5.87	133.5	113
M.B.F	529.75	78.07	407	657	370.56	72.07	562	272	307.93	82.6	467	205
B.W.I	25.26	3.62	31.6	20.07	25.21	3.1	31.25	21.08	25.25	2.26	29.69	21.3

F.H=Facial height, F.W=Facial Width, B.M.I=Body Mass Index, M.B.F=Maximum Bite Force, S.D=Standard deviation, Mini=Minimum, Maxxi=Maximum.

A comparison of facial high, facial width, maximum bite force, and body mass index between the different facial type patterns was done by using ANOVA test and a comparison between each two facial type patterns was done by using LSD.

One way analysis of variance (ANOVA) among the three facial patterns showed a very highly significant difference in Facial high, & maximum bite force (F=9.8, P=0.000; F=34.4, P=0.000) respectively followed by the Facial width which showed a highly significant (F=5.5, P=0.007), while the body mass index showed no significant differences (F=0.001, P=0.999) among the three facial patterns.

Then the least significant difference (LSD) test was done to liken amid each two facial type, and displayed that there existed very exceedingly significant variance in Facial high among short – long face (P=000), while between normal-long face revealed an extremely significant difference (P=0.009).

In addition to that, there was a very highly significant difference in maximum bite face amid short – normal, & short – long (P=000), however the facial width showed a significant difference between short – long face (P=0.002).

There was extremely significant difference between maximum bite force & different facial type. This difference comes

in accordance with Abu Alhaija et al. who found that maximum bite force significantly varied among participants with diverse vertical face forms [42]. The highest M.B.F was observed in short face kind, while the lowest M.B.F was seen in kind of long face , & the normal kind of face had a medium maximum bite force value between the two other type. This difference in M.B.F is in harmony with several studies [58-60]; table 3.

Table 3: Comparison among the different facial types.

Variable	ANOVA test		Significant level between Each two facial type (LSD)					
	d.f. = 2		*Short - Normal*		*Short - Long*		*Normal - Long*	
	F-Value	*P-Value*	*Mean diff*	*P-Value*	*Mean diff*	*P-Value*	*Mean diff*	*P-Value*
FH	9.8	**0.000*** **	2.75	0.076	-6.98	**0.000*** **	-4.23	**0.009** **
FW	5.5	**0.007** **	4.25	0.032	6.5	**0.002** **	2.25	0.225
M.B.F	34.4	**0.000*** **	159.19	**0.000*** **	221.82	**0.000*** **	62.62	0.025
B.W.I	0.001	0.999	0.05	0.960	0.009	0.993	-0.04	0.968

F.H=Facial height, F.W=Facial Width, B.M.I=Body Mass Index, M.B.F=Maximum Bite Force, $P > 0.05$ Non-significant, $0.05 \geq P > 0.01$ * Significant, $0.01 \geq P > 0.001$ ** highly significant, $P \leq 0.001$ *** Very highly significant

The Pearson's Correlation of (age, Height, Weight, facial high, facial width, maximum bite force, & body mass index) with each other in different facial type patterns revealed Only in long face there were positive correlation between the age with height and facial width, while the height showed positive correlation with facial height and facial width in short face where this in disagree with the finding of several authors [17, 20, 61, 62].

In addition to that, the weight appeared in positive correlation with the Body Mass Index in all facial types, and with facial width in short face only, however the Facial height demonstrated positive correlation with the Facial width in all facial patterns.

Finally the Maximum Bite Force showed Positive correlation with BMI in all facial Patterns The current results are similar to the results of Abu Alhaija and his colleagues, detailed that high BMI values ($r = 0.265$, $p= 0.032$) were linked to a significant upsurge of bite force values in their sample of sixty adult subjects [42]. Likewise, Lemos *et al*. testified a related positive correlation amid BMI and bite force [23].

In contrast, Koc et al. showed via 34 adult sample that BMI variable has no significant link with bite force [43]. Likewise, a non-significant association of BMI with bite force was also reported by Mountain using children sample [41]; table 4.

Table 4: The Pearson's Correlation of different variables with each other in different facial patterns.

Facial types	Variables		B.M.I	M.B.F	F.W	F.H	Weight	Height
Short Face	Age	*r*	0.13	0.003	0.46	0.49	0.25	0.48
		P-Value	0.63	0.99	0.07	0.06	0.35	0.06
	Height	*r*	0.14	0.08	0.6	0.68	0.4	\
		P-Value	0.61	0.78	**0.015***	**0.004****	0.12	\
	weight	*r*	0.96	0.02	0.54	0.22	\	\
		P-Value	**0.000*****	0.94	**0.03**	0.42	\	\
	F.H	*r*	0.02	-0.1	0.87	\	\	\
		P-Value	0.94	0.72	**0.000*****	\	\	\
	F.W	*r*	0.39	-0.06	\	\	\	\
		P-Value	0.13	0.83	\	\	\	\
	M.B.F	*r*	-0.56	\	\	\	\	\
		P-Value	**0.02****	\	\	\	\	\
Normal Face	Age	*r*	0.36	0.24	0.07	0.06	0.37	0.04
		P-Value	0.15	0.33	0.76	0.81	0.13	0.87
	Height	*r*	-0.14	-0.004	0.2	0.31	0.21	\
		P-Value	0.59	0.74	0.43	0.21	0.41	\
	weight	*r*	0.94	0.31	0.19	0.13	\	\
		P-Value	**0.000*****	0.2	0.45	0.62	\	\
	F.H	*r*	0.01		0.97	\	\	\
		P-Value	0.98	0.76	**0.000*****	\	\	\
	F.W	*r*	0.11	-.05	\	\	\	\
		P-Value	0.66	0.84	\	\	\	\
	M.B.F	*r*	0.52	\	\	\	\	\
		P-Value	**0.03***	\	\	\	\	\
Long Face	Age	*r*	0.038	-0.13	0.53	0.46	-0.31	-0.52
		P-Value	0.89	0.44	**0.04***	0.09	0.27	**0.046***
	Height	*r*	-0.22	-0.3	-0.12	-0.2	0.45	\
		P-Value	0.44	0.29	0.71	0.48	0.09	\
	weight	*r*	0.77	0.5	-0.06	-0.1	\	\
		P-Value	**0.001*****	0.058	0.84	0.72	\	\
	F.H	*r*	0.02	-0.26	0.92	\	\	\
		P-Value	0.95	0.35	**0.000*****	\	\	\
	F.W	*r*	0.01	-0.38	\	\	\	\
		P-Value	0.97	0.17	\	\	\	\
	M.B.F	*r*	0.75	\	\	\	\	\
		P-Value	**0.001****	\	\	\	\	\

F.H=Facial height, F.W=Facial Width, B.M.I=Body Mass Index, M.B.F=Maximum Bite Force, P > 0.05 Non-significant, 0.05 ≥ P > 0.01 * Significant, 0.01 ≥ P > 0.001 ** highly significant, P ≤ 0.001 *** Very highly significant

Conclusion

A mean maximum bite force (MBF) for the over-all sample series from 205 to 657 N. The highest value of bite force were in the short face moving on to normal face & then long face which was the smallest. Facial high, and maximum bite force showed a very highly significant difference, but the Facial width showed a highly significant among the three facial patterns. The body mass index showed no significant differences. The Body Mass Index showed Positive correlation with the MBF and the weight in all facial patterns.

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