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A study of craniofacial parameters and total body height

Ese Anibor, Dennis E. O. Eboh and Mabel O. Etetafia

Department of Human Anatomy and Cell Biology, Faculty of Basic Medical Sciences, Delta State University, Abraka , Nigeria

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ABSTRACT

Craniofacial anthropometry is used for studies of human growth population variation, forensic research, as a guide for clinical treatment and surgical repairs of any anomaly associated with the head region. The purpose of this study was to investigate the relationship between craniofacial parameters and body height. 200 subjects (100 males and 100 females) were selected at random. Nine facial parameters as well as body height were measured. The data were analyzed using regression analysis. The results showed that the mouth width increases with height. Some parameters such as: total head circumference (Tc), cranial base width (t-t) and binocular width (ex-ex) decrease with increase in height. The total cranial length (g-op), total cranial height (v-gn), maximum cranial breadth (eu-eu), minimum frontal breadth (ft-ft) and supraorbital breadth (fz-fz) showed constancy with increase in height. It was observed that males have higher craniofacial parameters such as: mouth width, head circumference, and minimum frontal breadth than the females ($p<0.05$). The females have higher cranial base width than the males. There is a relationship between craniofacial parameters and height. Craniofacial parameters may be useful in determining stature. Craniofacial parameters are sexually dimorphic. Thus craniofacial parameters may be used in identifying an individual's gender.

Key words: Craniofacial parameters, body height, relationship, males, females.

INTRODUCTION

Anthropometry is the taking of measurements of the human body. Craniofacial anthropometry involves measurements of parameters on the skull and face. Some of the parameters are: mouth width, biocular width, minimum frontal breadth, supraorbital breadth, total cranial length, total craniofacial height, cranial base width and maximum cranial breadth. These measurements are for studies of human growth population variation, forensic research, used as a guide for clinical treatment and surgical repairs of any anomaly associated with the head region.

According to Oxford dictionary of current English, height is the measurement of someone or something from head to foot or from base to top [1]. Human height varies according to both "nature and nurture". The particular human genome that an individual inherits is a large part of the "nature". A combination of health and other environmental factors present before adulthood (when growth stops) are a major part of the "nurture" [2]. Hereditary factors include both genes and chromosomes, and are inborn [3]. Environmental factors are events that occur before adult height is reached, such as diet, exercise, disease and living conditions [4].

This research work has been done in England [5]. The correlation between head circumference and total body height was investigated in Southern Dalmatia and Middle Croatia. Njemirovski, et al., did a research on the distribution of craniofacial variables [6]. Also, Buretic – Tomijanovic et al., in 2007 did a research on craniofacial characteristics of Croatian and Syrian populations [7]. They assessed the contribution of particular environmental factors to the body height and craniofacial variability in a small geographical area of Croatia. The result obtained in their research proved that the females have higher head circumference and head length than the males. A significant effect of environmental factors on body height and craniofacial variability was found in a Croatian young adult population. Ngeon and Alumid, in 2009 studied the gender differences in craniofacial anthropometric norms of Malaysian Indians. The males in general have significantly higher measurements than females [8]. Arni et al., in 2010 studied craniofacial changes in Icelandic males and females [9]. In England, a study of the disparity in head circumference between males and females was done [10]. The study showed a significant difference between the head circumference of the males and that of the females.

In Nigeria, Badejo did a study on the relationship between craniofacial parameters and body height among University of Ilorin students [11]. Also Oyinloye showed that there are significant differences in craniofacial dimensions of males and females [12]. Oladipo et al., in 2009 did a similar study to document and compare values for possible gender differences in the Ijaw and Igbo ethnic groups in Nigeria [13]. A curious search of the literature revealed that this research has not been done in Delta State. The gap in literature is what this study intends to fill.

This research will be useful in forensic science, anthropology, orthodontics and maxillofacial surgery. The aim of this study is to investigate the relationship between craniofacial parameters and total body height

MATERIALS AND METHODS

The following materials were used: non-elastic tape rule, digital vernier caliper, spreading caliper, meter rule, pencil, eraser, biro, recording note book, laboratory stool, methylated spirit, cotton wool and disposable hand gloves. This research was conducted in Delta State, Nigeria. 200 subjects (100 males and 100 females) were involved.

In this observational study, each subject was made to sit on a low laboratory stool to allow easy measurement of the cranial and facial parameters. The parameters were mouth width, biocular width, minimum frontal breadth, supraorbital breadth, total cranial length, total craniofacial height, cranial base width, maximum cranial breadth and total head circumference.

Mouth width is the distance between the left and right angles of the mouth. Biocular width is the distance from the outer corner of the right eye to the outer corner of the left eye or vice versa. Minimum frontal breadth is the distance between the right temporal crest of the frontal bone to the left. Supraorbital breadth is the most lateral point of the right frontozygomatic suture to the left frontozygomatic suture. Total cranial length is the distance between the point on the glabella (g) along the median sagittal plane of the supraorbital ridges to the most prominent point on the occipito-opisthocranium (op). Cranial base width is the distance between the left tragus and the right tragus of the ear. Total craniofacial height is the highest point on the head vertex (v) to the lowest point on the lower border of the chin (gn). Maximum cranial breadth is the lateral point on the head from left to right or vice versa. Total head circumference is a measurement of the frontal bone round the occipital protuberance and back to the frontal bone. Total body height (TH) is the distance from the highest point on the skull (vertex) to the level of the foot.

The digital vernier caliper was used to take the facial readings which included mouth width, biocular width, minimum frontal breadth and supraorbital breadth. The spreading caliper was used to take the cranial dimensions which included the total cranial length, total craniofacial height, cranial base width and maximum cranial breadth. The non-elastic tape rule was used to measure the total head circumference.

The measurement of height required a vertical metric rule, a horizontal headboard, and a non-compressible flat even surface on which the subjects stood. The equipment used was portable. The graduations on the metric rule were at 0.1 cm intervals, and the metric rule had the capacity to measure up to 210 cm.

The subjects were measured without shoes (i.e. barefooted). Each subject stood with weight distributed evenly on both feet, heels together, and the head positioned so that the line of vision is at right angles to the body. It was ensured that the correct position for the head is in the Frankfort plane. Each subject's arms hung freely by the sides. The head, back, buttocks and heels were positioned vertically so that the buttocks and the heels are in contact with the vertical board. To obtain a consistent measure, each subject was asked to inhale deeply and stretch to their fullest height. The movable headboard was brought onto the top of the head with sufficient pressure to compress the hair. The measurements were recorded to the nearest 0.1 cm. A repeat measurement was taken for each subject. If the two measurements disagree by more than 0.5 cm, then a third measurement was taken. The subject's measured height was subsequently calculated as the mean of the two observations or the mean of the two closest measurements if a third is taken. When necessary to round the mean value to the nearest 0.1 cm, rounding was to the nearest even digit.

People who have had orthodontic treatment and craniofacial surgery and those with craniofacial anomalies were excluded from this study. It was ensured that the subjects were neither smiling nor laughing when measuring the mouth width. The subjects sat on low laboratory stools to enable easy measurement. Cotton wool and methylated spirit were used to clean the calipers after use on each subject. The data were entered into SPSS package version sixteen. Regression analysis was done.

RESULTS AND DISCUSSION

Table 1: The body height of the subjects

Height interval (meter)	Frequency
1.43 – 1.52	11
1.56 – 1.65	77
1.68 – 1.77	78
1.80 – 1.89	30
1.92 – 2.01	4

Table 2: A summary of the parameters

	TH (m)	Tc (cm)	g-op (cm)	v-g (cm)	ma-ma (cm)	t-t (cm)	eu-eu (cm)	ex-ex (cm)	ft-ft (cm)	fz-fz (cm)
Mean	1.67	55.98	26.59	11.94	5.66	27.18	23.75	12.19	9.17	11.51
S.D. Dev	77.17	310.97	147.6	123.85	9.73	150.96	40.76	68.32	50.92	63.93
Coefficient	3.98	-.068	.140	.084	.597	-.138	.003	.-039	.084	.108
Standard error	1.15	.037	.060	.036	.119	.054	.034	.29	.034	.032
T -Ratio	-1.849	-1.849	2.35	2.022	5.022**	-253	.077	-.927	2.47**	3.41**

*** Regression is significant at the 0.05 level (2 – tailed)*
S.D. Dev = standard deviation
cm = centimeters
m = meters

Table 3: Gender differences in the parameters

MALE	TH (m)	Tc (cm)	g-op (cm)	v-g (cm)	ma-ma (cm)	t-t (cm)	eu-eu (cm)	ex-ex (cm)	ft-ft (cm)	fz-fz (cm)
Mean	1.74	55.25	27.84	23.65	6.17	26.70	24.00	12.60	9.73	11.86
STD. Dev	56.7	21.64	32.92	92.69	24.42	104.71	94.07	49.37	38.34	46.5
Coefficient	4.48	.111	-.001	.107	-1.14	.136	.060	-1.05	.314	.009
Standard error	6.36	.134	.005	.376	.909	.159	.150	.357	.343	.014
T + Ratio	.652	.828	-.266	.284	-1.259	.804	.404	-2.95	-2.959	.668
FEMALE	TH (m)	Tc (cm)	g-op (cm)	v-g (cm)	ma-ma (cm)	t-t (cm)	eu-eu (cm)	ex-ex (cm)	ft-ft (cm)	fz-fz (cm)
Mean	1.59	51.64	26.57	20.93	5.13	27.64	23.47	11.99	8.59	11.15
STD. Dev	50.2	12.22	32.92	82.00	20.17	108.7	92.04	47.00	33.68	43.7
Coefficient	6.44	-1.32	-.154	-.002	.695	3.62	.093	-1.94	5.76	.269
Standard error	34.73	.716	2.01	1.60	.540	0.75	.260	1.83	2.38	1.828
T – Ratio	.185	-1.85	-2.76	-.149	1.28	4.79	.380	-1.06	2.42	.147

N.B: Regression is significant at 0.05 level (2-tailed).
STD Dev. = Standard deviation
cm = centimeters
m = meters

Some craniofacial parameters increased with body height, some decreased while others remain constant. The results showed that parameters like the mouth width increases with body height while other parameters like head circumference, cranial base width and biocular width decrease with increase in body height. There is a significant relationship in the decrease of head circumference, cranial base width and biocular width as the body height increases ($p<0.05$). The

total cranial length, total cranial height, maximum cranial breadth, minimum frontal breadth and supraorbital breadth remain constant with changes in height.

Also this study showed a significant difference between males and females in some craniofacial parameters. It was observed that males have significantly higher craniofacial parameters such as: mouth width, head circumference and minimum frontal breadth than the females ($p<0.05$). The females have significantly higher cranial base width than the males ($p<0.05$).

This study proves that mouth width increases with body height. This conforms to the observation made by Badejo [11]. Badejo [11] suggested that the mouth width increases with body height while cranial base width and biocular width decrease with increase in height. He saw that other parameters like total head circumference, total cranial length, total craniofacial height, maximum cranial breadth, minimum frontal breadth and supraorbital breadth remain constant. In this study, parameters like head circumference, cranial base width and biocular width decrease with increase in height. Other parameters like: total cranial length, total craniofacial height, maximum cranial breadth, minimum frontal breadth and supraorbital breadth remain constant with changes in height.

The result obtained from the present study showed that there is significant difference between males and females ($P<0.05$) in some craniofacial parameters. Males have higher total head circumference which is on the average 3.61 cm higher than that of the females. This study conforms to an extent to the study done by Bushby et al., [10]. They showed that the males have higher total head circumference of average mean difference of 1.33 cm higher than that of the females. This study, like the research conducted by Onyiloye [12], proves that there is significant difference between males and females in craniofacial parameters.

However, this study does not conform to the study done by Buretic – Tomijanovic et al., [7]. That study conducted among Croatian and Syrian populations showed that the females have higher head circumference than the males.

CONCLUSION

There is a relationship between craniofacial parameters and height. Craniofacial parameters may be useful in determining stature. Craniofacial parameters show gender dimorphism. Thus craniofacial parameters may be used in identifying an individual's gender.

There should be research on this topic among different tribes and ethnic groups. This is to foster the practice of anthropology, forensic science and orthodontics.

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