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Estimation of Stature from Craniofacial Dimensions

Nazma Farhat[1], Humaira Naushaba[2], Lubna Shirin[3], Navajyothi Dalayi[4], Mallika Karmakar[5]

Abstract

Context: *Anthropometric studies provide a quantitative description of different parts of human body and these studies in different populations have also stated the proportional correlations among different measurements. Stature is one of the most important parameters in the identification of an individual living or dead. Identification of an individual from fragmented remains is still a very challenging task for forensic experts in spite of many studies carried out across the globe including Bangladesh because regression equations or multiplication factors formulated in a particular population group do not fit elsewhere. Several studies have shown that values of stature and craniofacial dimensions are race, ethnicity, age, gender, diet and climate sensitive. Stature can be estimated from head circumference and bigonial breadth by using linear regression equations and multiplication factor.*

Materials and Method: *This is a cross sectional, analytical type of study conducted in the Anatomy Department of Sir Salimullah Medical College, Dhaka, from January 2010 to June 2011. One hundred Bangladeshi 25 to 45 years old women were selected for the study. Fourth class female employees of Sir Salimullah Medical College and Mitford Hospital and part time housemaids of Mitford area were selected by purposive sampling as study subjects.*

Results: *The mean values of stature, head circumference and bigonial breadth were 148.46 ± 5.6901 cm, 53.27 ± 1.3151 cm and 9.18 ± 0.6528 cm respectively. Multiplication factor for measuring stature from head circumference and bigonial breadth were 2.79 ± 0.1056 (Mean ± SD) and 16.26 ± 1.2629 (Mean ± SD). Regression equations were calculated for estimating stature(S) from head circumference(HC) and bigonial breadth(BB) which are S=71.416 + 1.448(HC) and S=144.656 + 0.418(BB). No significant difference was found between the measured and estimated stature by using 't' test. Regression equation calculated for measuring stature from head circumference showed high degree of reliability and accuracy.*

Conclusion: *The result indicates the effectiveness of measuring stature from head circumference and bigonial breadth by using linear regression equation and multiplication factor.*

Key words: *Stature, head circumference, bigonial breadth.*

Introduction

Relationships between the dimensions of individual body segments and the whole body have been of interest to artists, anthropologists and scientists for many years. Artists use dimensional relationships (Canons) depicting the ideals of beauty and this has created the rule of body proportions. The earliest evidence of the use of such rules comes from the ancient Egyptians. In contrast, anthropologists observe and compare the relationships between body segments to highlight variations between ethnic origins[1,2].

In many areas of modern science prediction of the body dimensions from one to another or relations in between body parts are extremely useful.The nutritionists, clinicians assess growth and development of patients by measuring relationship between body segments and categorize normal growth as well as specific syndromes. Studies on human stature and craniofacial morphology can impact various areas, including plastic and dental

1. Lecturer, Unit of Anatomy, faculty of Medicine, AIMST University, Malaysia.
2. Professor and Head, Department of Anatomy, Sir Salimullah Medical College, Dhaka.
3. Lecturer, Unit of Anatomy, Faculty of Medicine, AIMST University, Malaysia.
4. Lecturer, Unit of Anatomy, faculty of Medicine, AIMST University, Malaysia.
5. Assistant Professor, Department of Anatomy, Shaheed Monsur Ali Medical College, Dhaka.

Correspondence: Dr. Nazma Farhat

surgery, facial anatomy, reconstruction as well as studies on genetics[3].

Stature has a definite and proportional biological relationship with each and every part of the human body, i.e. head, face, trunk, extremities. This is an important tool for estimation of stature in forensic examination when dealing with disintegrated and amputed human remains found in mass disasters. Forensic scientists can calculate stature from craniofacial dimensions which will be helpful to identify an unknown individual[4,5]. Craniofacial anthropometric studies provide a quantitative description of craniofacial complex and these studies in different populations have also stated the proportional correlations among different measurements of head, face and stature[6].

Stature and craniofacial dimensions has become an important tool for genetic counselors and in reconstructive surgeon. In genetic counseling it is necessary to identify dysmorphic syndromes in the early stage as accurately as possible. Dysmorphic characters are usually reported by clinicians in descriptive terms such as “very tall, big head”. However, such description is subjective. Anthropometric measurements can overcome these problems. The diagnosis of many dysmorphic syndromes is based on advanced cytogenetic and molecular techniques and also on recognition of subtle morphological anomalies in stature and craniofacial region[8,9]. In diagnosing certain anomalies and syndromes, abnormal features such as gigantism, dwarfism, macrocephaly, microcephaly, wide jaw are taken under consideration by many clinicians, geneticists and maxillofacial surgeons[10].

Measurements taken from a patient can be compared with the values obtained from the normal population and deviation from normal values can be evaluated. For evaluation of deviations in stature and craniofacial morphology, standards of anthropometrical measurements should be established for a particular population.

This study was also aimed to establish standards for stature and craniofacial dimensions of Bangladeshi women which will be useful in designing various clothing and equipment like helmets, spectacles, goggles etc. by formulating standardized sizes[11].

Craniofacial proportions are used to estimate stature in different populations by different researchers. For such calculations two methods, i.e. regression method and multiplication method have been extensively used by the scientists all over the world and it has been concluded that the regression analysis provides best estimates for stature reconstruction. In the present study conducted on a group of Bangladeshi women both methods were used and their effectivitywas established[4]. This convenient and cost effective method can be used together with CT scan, 3-D data collected by laser scanning, MRI for further study.

Materials

The study was a cross sectional, analytical type of study which was carried out from January 2010 to June 2011 in the Anatomy Department of Sir Salimullah Medical College, Dhaka. One hundred Bangladeshi female were selected. Age of the subjects ranged from 25 to 45 years. Fourth class female employee of Sir Salimullah Medical College and Mitford Hospital and part time housemaids of Mitford area were selected by purposive sampling.

Methods

The stature was taken by using stadio meter. At first the subject was requested to take off her foot wears. Then the subject was requested to stand with her heels together and the back as straight as possible so that the heels, buttocks and back touch the stand. The arms were hung freely by the sides with the palm facing the thighs.[12] After asking the subject to take a deep breath and holding it, a wooden plate was placed gently against the head to determine maximum height on the scale. The stature was then measured in cm from the mark on the wooden scale (Fig. 1(a).

After measuring stature, the subject was requested to sit on a chair comfortably with her head in anatomical position. At first the landmarks of the variables were located on her face and head by careful inspection or palpation and were marked

by a point on the surface by chalk then the measurements were taken. The head circumference was measured by placing the non-stretchable flexible measuring tape on the occipital protuberance behind and supraorbital ridge in front and it was wrapped around the occiput to the anterior portion of the skull Fig. 1:(b). Then the measurement was recorded in cm [13,10]. The bigonial breadth(the straight distance between the two angles of the mandible/gonia of the face)was measured by using spreading caliper, each end of the spreading caliper was placed from one gonion to another gonion gently and then the reading was taken from the calibration of the caliper and was recorded in cm[14] Fig. 1: (c).

Before starting the measurements, each of the subjects was greeted politely. Then her national identity card was checked to confirm her age. After a short briefing on the objective of the present study, the subjects were asked to give a voluntary consent on the consent form.

Calculation of multiplication factor[15,16,17]:

Multiplication factor (MF) is the ratio between two measurements which is used to estimate value of one variable from another.

Formula for calculating multiplication factor stature

MF = Head circumference/ bigonial breadth

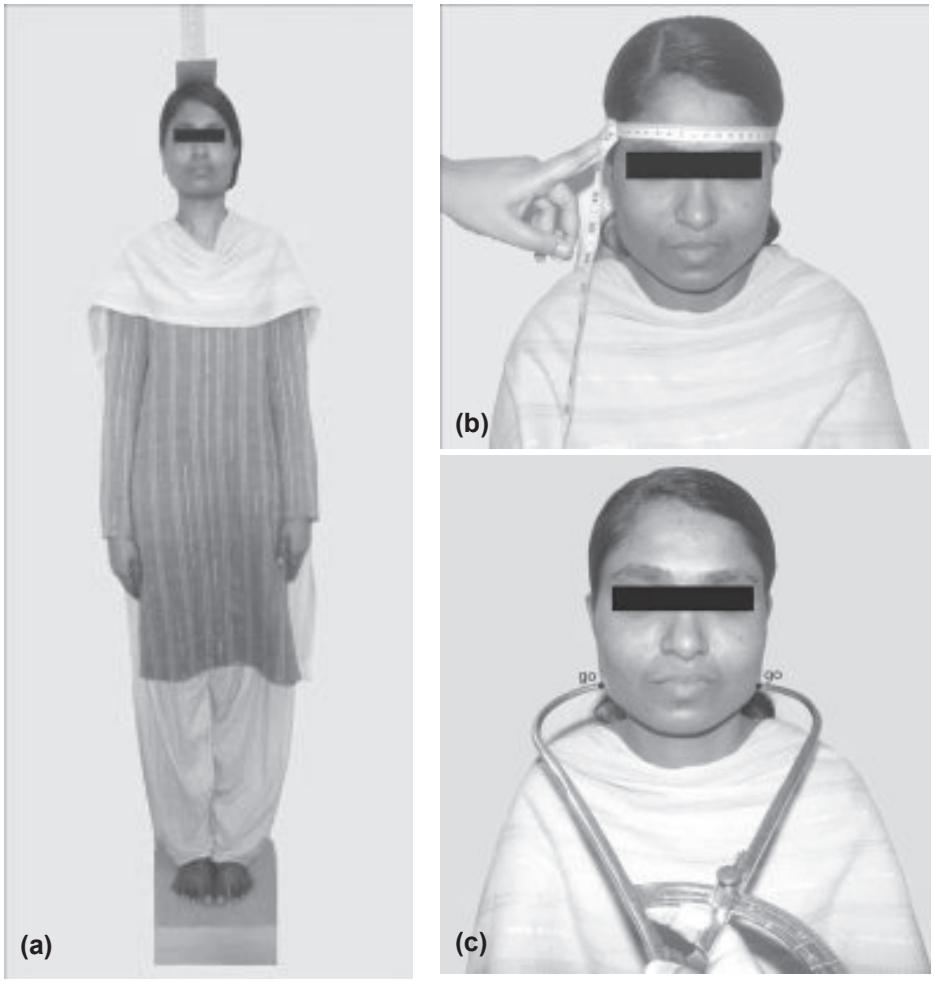

Fig.1: (a) Procedure for measuring stature by stadiometer.
(b) Procedure for measuring head circumference using flexible measuring tape.
(c) Procedure for measuring bigonial breadth (go-go) using spreading caliper

Ethical Clearance

The study was approved by the Ethical Review Committee of Sir Salimullah Medical College, Dhaka.

Results

Table I shows the mean (± SD) of stature, head circumference, bigonial breadth of the subjects. Table II shows the regression equations to estimate stature from head circumference and bigonial breadth of the subjects. The purpose of calculating multiplication factor and regression equations was to estimate stature from head circumference and bigonial breadth. The results indicate the effectiveness of the corresponding regression equations over multiplication factors when stature was measured from head circumference and bigonial breadth. Significant positive correlation was found between stature and head circumference, also between stature and bigonial breadth.

Table-I

Stature, head circumference and bigonial breadth, multiplication factor and comparison between measured and estimated stature, correlation between stature and head circumference and between stature and bigonial breadth.

Variables	Mean ±SD (cm)	Multiplication factor for estimating starure Mean ± SD (cm)	Estimated stature Mean ± SD (cm)	Significance of difference (p value) between measured and estimated stature	Significance of correlation of stature with head circumference, and bigonial breadth
Stature	148.466 ± 5.6901				
Head circumference	53.27± 1.3151	2.79 ± 0.1056	148.50 ± 5.6725	P=0.050 (NS)	p=0.000(S) r=0.345
Bigonial breadth	9.18± 0.6528	16.26 ± 1.2629	148.52± 5.6732	P=0.075 (NS)	p=0.001(S) r=0.330

n: 100 subjects, NS= Non-significant at 5% level of significance on two-sample Z test,S: Significant at 5% level of confidence in regression analysis, SD: Standard deviation.

Table-II

Linear regression equations for measuring stature from head circumference and bigonial breadth

Variables	Linear regression equations
Head circumference (HC)	71.416 ± 1.448
Bigonial breadth (BB)	144.656 ± 0.418

Discussion

The present study was carried out among a group of adult Bangladeshi female to measure stature, head circumference and bigonial breadth. The two craniofacial measurements were positively and significantly correlated with stature of the study group. The results indicate that stature can be effectively estimated from craniofacial dimensions like head circumference and bigonial breadth by using multiplication factors and regression equations. However it must be kept in mind that precise prediction of stature from craniofacial dimensions may be unachievable; there would always be an estimation error of a few centimeters[4].

The findings of the present study are supported by Krishan[4], Akhter[15], Ilayperuma[18], Ormeci[19],

Jibonkumar and lilinchandra[14], who successfully estimated stature from craniofacial dimensions in different population groups by using regression equation or multiplication factors or both.

Values of anthropometric studies reflect inherited genetic potentials, environment, secular trends, childhood stress of malnutrition and disease, available nutrients in diet and physical labor[19].In the present study the mean+SD stature, head circumference and bigonial breadth were measured as follows 148.46 ± 5.6901 cm, 53.27 ± 1.3151 cm and 9.18 ± 0.6528 cm respectively. The value of stature found in this study coincides with the Rajasthani women[20], Bangali of West Bengal[21] and Nepalese[22].The stature and head circumference of the Greek[19], Chinese[11], Turkish[10], Nigerian[13,23] ,were significantly ($p<0.01$) higher than that of the present study. But in Garo Bangladeshi[15]though stature were significantly ($p<0.01$) higher head circumference were lower than that of the present study. The mean value of stature and head circumference of the Andaman[24] women was significantly ($p<0.01$) lower than that of the present study. The values of the bigonial breadth of the Czech, Japanese, Iranian, German, Italian, Portugese and Afro-American[25] were significantly ($p<0.01$) higher than the present study.

These similarities and dissimilarities might be due to geographical orientation, nutritional status, ethnicity and racial differences[1].

Conclusion

The present study confirms that stature can be estimated by using both multiplication factor and regression equations because there was no significant difference between measured and estimated stature. As regression equations are population specific more study should be done in different population which can be useful to anatomists, anthropologists and especially to forensic scientists to estimate stature even from fragmented human remains and mutilated bodies for examinations.

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