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Estimation of Stature from Facial Dimensions

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Abstract

Whenever unknown or decomposed or mutilated dead bodiesor isolated body parts or skeletal remains are found, first step of police investigation is to establish identity of deceased. Determination of stature from dismembered body parts can play vital role for identification of person. Present study was done to derive regression formula and multiplication factor to estimate stature from facial dimensions for population in and around Rajkot region of Gujarat. Total 100male cases and 100 female cases randomly selected from cadavers brought for post-mortem examination at mortuary of P. D. U. Govt. Medical College and Hospital, Rajkot. Stature was measured with measuring tape and Facial dimensions were measured by Spreading caliper after breaking Rigor mortis, if developed.Collected data were statistically analysed using software like Epi info 7 and Microsoft excel. Mean stature as well as mean Facial dimensions were significantly higher for male than for female ($p<0.05$). Regression formula and multiplication factor derived in present study are useful to estimate stature from Facial dimensions for population in and around Rajkot region of Gujarat.

Keywords: Identification; Stature; Facial Height; Facial Breadth.

Introduction

"Everyone has the right to recognition everywhere as a person before the Law." - Article 6 of the Universal Declaration of Human Rights [1].

As stated above, for the existence of society identity is utmost important. Identification is a prime component of Corpus Delicti i.e. essence of crime in medico-legal cases [2]. Identification means determination of individuality of a person. Identification is based on availability of facts about individual. It is known as complete when all facts about individual are available and partial when only some facts about the individual are available [3]. In disastrous conditions such as earthquake, landslides, aircraft-road-railway accidents, explosions, stampede, building collapse, fire, mining accidents etc., isolated body parts are found. Nowadays in events of murders for the purpose to destroy all evidences related to dead bodies, criminals mutilate them and body parts are made isolated. During legal investigations when such isolated body parts are recovered by investigating agencies, the medical professional is often required to give an opinion regarding personal identification of deceased by collecting data for partial identification like race, age, sex, stature etc. which, in the course, help for absolute identification and thus to serve the justice.

Face is the important physiognomic feature in humans. Facial dimensions are among the most important cephalometric parameters used in the descriptions of human morphology, identification of individuals and classification of sex and races. However, different population exhibits variation in their body proportions as they are affected by race, diet, genetics of a person, geographical location and climatic conditions [4]. Due to which, results of a study conducted on one population cannot be applied on other population. Even results of a study

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conducted on one generation of a population cannot be applied on next generation as they are affected by secular changes in physical growth. With this view, present study was carried out to derive regression formula and multiplication factor to determine stature from Facial dimensions for population in and around Rajkot region.

Material and Method

This study was carried out on 100 male cases and 100 female cases randomly selected from cadavers brought for post-mortem examination at mortuary of P. D. U. Govt. Medical College and Hospital, Rajkot during the period of January 2015 to May 2016. Age group selected for the study was 21 years and above.The cadavers with any injury, disease or anomaly that affects Facial dimensions were excluded from the study. The bodies that were decomposed, charred or mutilated were also excluded from the study. Measurements were taken up to nearest 0.1 cm as below after breaking rigor mortis, if developed.

Stature: The body was placed in supine position on a flat, hard surfaced autopsy table. Head was fixed in such way that Frankfort plane remains at right angle to autopsy table. Frankfort plane is defined as plane adjoining the upper margin of the ear openings and lower margin of the orbit of the eyes. Knee and hip joints were kept extended, and the neck and feet were kept in neutral position. If rigor mortis was present, it was broken down. Stature (Total Body Length) was measured between the vertex of the head and the heel using a measuring tape up to nearest of 0.1 cm.

Facial Height: It was measured as straight distance between nasion (the midpoint of the nasofrontal suture) and gnation (in the midline, lowest point on the lower border of the chin) .It was measured by spreading caliper with scale as follows: one tip of the caliper was placed at subject's gnation and the movable part was moved and placed on nasion.

Facial Breadth: It was measured as straight distance between the two zygomatic prominences. It was measured by spreading caliper with a scale as follows: after palpation by fingers to locate the most lateral point of zygomatic arch (arcuszygomaticus) on both sides of the face, the ends of spreading caliper were placed at these points, with enough pressure to feel the bone under caliper.

Statistical Analysis: All the measurements were statistically analysed using software like Epi info 7 and Microsoft Office Excel 2007.The data was analysed for male and female cases separately as well as for total cases i.e. both sexes together. Result of data analysed for total cases can be applied to determine stature from Facial dimensions, when sex is unknown. Pearson correlation coefficient (r) was calculated to assess the correlation of stature with facial dimensions. Independent samples T-test was applied to determine statistical significance of gender differences in stature and facial dimensions. P-value of less than 0.05 was considered significant. Regression formula and multiplication factors were derived to estimate stature from Facial dimensions.

Observation

Table 1 is showing descriptive statistics of all the cases. It is evident from the table that mean of stature and facial dimensionsare higher for male than for female.Gender difference in stature and facial dimensionsarestatistically confirmed by applying t-test as shown in Table 2 ($p < 0.001$).

Table 1: Descriptive statistics (MEAN ± SD)

Parameter	Male	Female	Total Cases
Stature	167.59±4.47	151.39±4.55	159.49±9.28
Facial Height	10.63±0.64	9.52±0.43	10.08±0.78
Facial Breadth	11.55±0.67	10.41±0.49	10.98±0.82

All Measurements are in centimeters

Table 2: Comparison for gender difference in stature and facial dimensions

Parameter	Mean		T Value	p value*
	Male	Female		
Stature	167.59	151.39	25.391	0.000 (S)
Facial Height	10.63	9.52	14.264	0.000 (S)
Facial Breadth	11.55	9.52	13.663	0.000 (S)

* S=Significant

*p Value<0.05 is significant and p Value<0.001 is highly significant.

Table 3: Correlation of facial dimensions with stature

Parameter	Pearson Correlation Coefficient (r)*	
	Male	Female
Facial Height	0.209	0.399
Facial Breadth	0.190	0.167

*p Value is less than 0.05 for all.

Table 3 is showingcorrelation of Facial dimensions with stature. Facial Height and Facial Breadthare showing positive and significant correlation with stature in male as well as female cases.

Simple Regression Formula When Sex is Known:

• *For Male*

1. From Facial Height

Stature= 152.187 + 1.449 x Facial Height

2. From Facial Bredth

Stature= 153.008 + 1.262 x FACIAL BREADTH

• *For Female*

1. From Facial Height

Stature= 111.552 + 4.183 x Facial Height

2. From Facial Breadth

Stature= 112.106 + 3.773 x Facial Breadth

Simple Regression Formula when Sex is Unknown:

1. From Facial Height

Stature= 73.369 + 8.545 x Facial Height

2. From Facial Breadth

Stature= 71.512 + 8.011 x Facial Breadth

Mean Multiplication Factor When Sex is Known:

• *For Male*

1. From Facial Height

Stature= **15.81** X Facial Height

2. From Facial Breadth

Stature= **14.54**X Facial Breadth

• *For Female*

1. From Facial Height

Stature=**15.92** X Facial Height

2. From Facial Breadth

Stature= **14.56** X Facial Breadth

Mean Multiplication Factor When Sex Is Unknown:

1. From Facial Height

Stature=**15.86** X Facial Height

2. From Facial Breadth

Stature = **14.55** X Facial Breadth

Table 4 is showing comparison of stature estimated by regression formula with stature estimated by mean multiplication factor. Standard deviation (SD) measures amount of dispersion from mean value.

Table 4: Comparison of stature estimated by regression formula and by mean multiplication factor (MEAN ± SD)

Parameter	Male	Female	Total Cases
Measured Stature	167.59±4.47	151.39±4.55	159.49±9.28
Stature Estimated by Regression Formula			
Facial Height	167.59±0.93	151.36±1.82	159.49±6.67
Facial Breadth	167.59±0.85	151.39±1.86	159.49±6.55
Stature Estimated By Mean Multiplication Factor			
Facial Height	168.09±10.18	151.62±6.91	159.84±12.37
Facial Breadth	167.95±9.76	151.62±7.18	159.79±11.91

mean multiplication factor (Mean ± SD)
SD=Standard Deviation

From Table 4, it is evident that mean stature estimated by regression formula as well as multiplication factor are very nearer to mean measured stature.

However, SD of stature estimated by mean multiplication factor are higher than SD of stature estimated by regression formula, which means stature estimated by mean multiplication factor is showing more dispersion from its mean value.

So, regression formula measures stature more precisely than mean multiplication factor.

Discussion

The main objective of this study is to find out correlation between Facial dimensions with stature and to use result of this study as a basis for developing stature estimation standards specifically for population in and around Rajkot region of Gujarat. Several such studies have been carried out in past for different population of India.

Swami S et al [5]. studied 800 Hariyanvi adults (400 males and 400 females) of aged above 18 years to establish anthropometric relationship between stature and facial dimensions. They found positive correlation between stature and facial length (r=0.177 for Male and 0.150 for female, p<0.001). They found positive correlation between stature and facial breadth (r=0.164 for Male and 0.116 for female, p<0.001). They found statistically significant gender difference in stature as well as facial dimensions (p<0.001). They concluded All measurements were found to be more in males than in females, The most reliable facial measurement to estimate stature using regression analysis among males is morphological facial length andEstimation of stature from facial measurements is a supplementary approach when useful samples like extremities and other body parts are not available for examination.

Mounika S et al [6]. studied 30 dental students (11 males and 19 females) belonging to South Indian population of age group between 25 to 30 years. They took facial breadth only for the study. They concluded that there was linear relationship between stature and facial breadth in both sexes in their study (r=0. in males and 0. in females, p<0.05).

Agnihotri AK et al [7]. studied 150 Indo-mauritian adults (75 males and 75 females) of age group between 20 to 28 years to establish anthropometric relationship between stature and facial dimensions. They found positive correlation between stature and facial length (r=0.164 for Male and female, p<0.001) and facial breadth (r=0.276 for Male and female, p<0.001). They found statistically significant gender difference in stature as well as facial dimensions (p<0.001). They concluded that all measurements were found to be more in males than in females and the most reliable facial measurement to estimate stature using regression analysis among males is morphological facial length and among female is physiognomic facial length.

Krishan K et al [9] studied 996 males of age group between 18 to 30 years from Chandigarh city of north India. They found that age had no correlation with stature. They found positive correlation between facial length and stature (r=0.455, p<0.05). They concluded that, like other parts of human body, the cephalo-facial dimensions can also be used for estimation of stature

Ekezie J et al [9] studied 211 subjects (88 males and 123 females) of age above 21 years to establish anthropometric relationship between stature and facial dimensions. They found positive correlation between stature and facial length in both sexes (r=0.203 for male and r=0.012 in females, p<0.05). They concluded that, like other parts of human body, the cephalo-facial dimensions can also be used for estimation of stature.

From comparison of these studies, it is evident that all the studies have found positive correlation between Facial dimensions and stature, which means Facial Height and Facial Breadth are useful parameter to estimate stature. All the studies show significant gender difference mean stature as well as Facial Height and Facial Breadth. Table 5 shows comparison of mean stature and mean facial height and mean facial breadth with other similar studies.

It is evident from the table that all the studies have found different mean stature as well as mean facial

Table 5: Comparison of present study with other similar studies

Author	Mean Stature* (MEAN ± SD)		Facial Dimensions			
			Mean Facial Height		Mean Facial Breadth	
	Male	Female	Male	Female	Male	Female
Swami S et al.[5]	168.17 ± 5.46	155.18 ± 4.62	11.07 ± 0.70	10.21 ± 0.94	11.45 ± 1.10	10.33 ± 0.75
Mounika S et al.[6]	161.30 ± 10.30		----	---	9.432±5.72	
Agnihotri AK et al.[7]	173.40±7.70	157.36±6.17	11.58±0.71	11.00 ± 0.58	14.39±0.95	14.01±1.00
Krishan K et al.[8]	172.31±6.83	-----	10.81 ± 0.74	----	13.92 ± 0.62	-----
Ekezie J et al.[9]	173.66±7.30	163.17±7.64	14.71±1.57	14.08±1.35	21.69±2.21	24.25±1.43
Present Study	167.59±4.47	151.39±4.55	10.63±0.64	9.52±0.43	11.55±0.67	10.41±0.49

height and mean facial breadth. This findingsubstantiate well known fact that different population shows difference in stature as well as in body proportions, so population and sex specific regression formula and multiplication factor are required for accurate stature reconstruction from facial dimensions.

Conclusion

In present study, mean stature estimated from regression formula as well as multiplication factor are similar to mean measured stature in both sexes, however, regression formula measures stature more precisely than mean multiplication factor. So, regression formula and multiplication factor derived from present study can be used to determine stature of deceased person from facial dimensionswhen mutilated head is found.

Mean stature as well as mean facial height and mean facial breadth are significantly higher for male than for female, so sex specific regression formula and mean multiplication factor should be derived. Present study has derived regression formula and multiplication factors for male and female cases separately as well as for total cases i.e. both sexes together. Regression formula and multiplication factor derived for total cases can be applied to determine stature from facial dimensions, when sex is unknown. However, sex specific regression formula and multiplication factors can estimate sex more accurately.

Asdifferent population show difference in stature as well as in body proportions, results of present study are applicable to population in and around Rajkot region.

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