

Estimation of Stature from Hand Length in the Tribal Population of Gujarat Region

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Abstract

Background: Estimation of an individual's stature is an important parameter in forensic examination and anthropological studies. Only few studies of other racial groups, exists which emphasis the need to establish standard in different ethnic populations. There fore this study was carried out in the 249 male and female above 23 years of tribal community from Aslona area of Gujarat region. **Materials & Method:** The height of the individuals was measured standing erect in anatomical position, using a standing height measuring instrument. The hand length (direct linear distance between the distal wrist crease and the distal end of the most anterior projecting point of the middle finger) was measured using the sliding caliper capable of measuring to the nearest 0.01mm and to investigate the relationship between personal stature and hand length among a group of male or female. **Results:** The differences of hand length between the sexes were found to be highly significant. A positive correlation between height and hand length was observed in both the sexes and it was statically significant. Regression equation for stature has been estimated using the hand length for both sexes. **Conclusion:** The result indicates that hand length provides precise means of estimating the stature of an unknown individual. The regression formula derived in this study will be useful for anatomists, archeologist, anthropologist and forensic scientist.

Keywords: Standard Deviation (SD), Ethnic populations, Regression equation, Stature.

Introduction

Dimensional relationship between body segments and the whole body has been the focus of forensic scientists, anatomists and anthropologists for many years. Furthermore, the relationship between body segments has been used to compare and highlight variations between different ethnic groups and to relate them to locomotors pattern, energy expenditure and lifestyle [1-2]. Prediction of the dimensions

of body segments is useful in many areas of modern science. For example, in growth and development the use is made of the relationships between body segments in the assessment of normal growth as well as in specific syndromes [3]. Body Proportions and the dimensions of various body segments, including the long bones of the limbs and the bones of the hand and foot have been used to estimate stature. The long bones of the limbs, however, have been the most widely studied [4-5].

Estimation of stature from incomplete skeletal and decomposing human remains is particularly important in personal identification. The relationship between specific body dimension / proportion can be used to solve crimes in the absence of complete evidence. For example, it has been proved that stature can be estimated from imprints of the hand, foot or footprints or from a shoe left at the scene of a crime [6]. Similarly stature of a

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victim can be estimated when a part of body, such as long bone, or hand, is all that remains [7].

Despite the relationships between body parameters that have been determined, it has been emphasized that these vary from population to population and ethnic origin to ethnic origin due to differences in nutrition and levels of physical activity [8].

Material and Method

This study was conducted on 249 adult individuals (125 male and 124 female) above 23 years, of tribal community. The subjects were mainly from Aslona which is in Gujarat state and they are mainly of Warlli and Mahadev koli community who perform all the activities needed for their existence. The subjects having Pathological defect in hand were excluded from study.

Hand length was defined as the linear distance between the distal wrist crease and the distal end of the most anterior projecting point i.e. tip of middle finger. The subjects were asked to place their hands supine on a flat, hard horizontal surface with fingers extended and adducted following which the hand length was measured. Care was taken to see that there was no abduction or adduction at the wrist joint i.e. the fore arm was directly in line with the middle finger.

Hand lengths were taken independently on left and right sides of each individual using a sliding caliper capable of measuring to the nearest 0.01mm (Mitutoyo - Japan).

The height of the individual was measured between the vertex and floor, when the person is standing erect in anatomical position and the head in the Frankfurt plane, using a standing height measuring instrument. The measurements were recorded by the same person to minimize the errors in methodology and during 2 to 5 pm, to avoid any diurnal variation. Results were analyzed using statistical calculations.

Ethnographic Profile

All the subject of this study belongs to Aslona. Aslona is a village in Kaparda Taluka of Gujarat. It is a beautiful village place in between the forest and Hills. Total 4554 persons living in 741 household and they are mainly from Warlli and Mahadev koli community.

These tribes have a rich heritage of culture that is distinctly different from other social groups and can be easily identified by their dress, dialect, folklore, customs and practices. They still practice old traditions like worship of nature in different forms, animal sacrifices during religious ceremonies, adorning head with horn etc.

Their life style and the profession display these characteristic in every social encounter. From generation to generation, these tribes have had wandering tradition and they have hardly been integrated in the society

These tribes have wandering tradition, which resulted in lack of education, which makes their survival difficult, and this didn't allow them to fit into the settled society and they are forced to continue with tradition of moving from place to place in search of work. Thousands of families belonging to these tribes wander from place to place and stay in temporary structures.

Result

Statistical analysis indicated that bilateral variation was insignificant for the measurements of hand length in both sexes. Various important parameters of the study are summarized in Table - I. Gender differences with respect to hand length and height were found to be highly significant ($P > 0.01$). The mean hand lengths of the male were significantly larger than that of the females ($P > 0.01$).

The table-I showed that the total individuals studied were 125 males and 124 females, the Mean height among the males was 151.77(\pm 4.59) and in females, 147.87 (\pm 5.51) while the Mean Hand length was 17.53 (\pm 0.96) for male and 16.26 (\pm 0.85) for Female. The correlation

Table I. Various Statistical parameters in Male and Female

Gender	Male	Female
Total No. (249)	125	124
Mean height \pm SD (cm)	151.77 \pm 4.59	147.87 \pm 5.51
Mean hand length \pm SD (cm)	17.53 \pm 0.96	16.26 \pm 0.85
Correlation coefficient	0.68	0.53
Regression coefficient	3.25	3.43
Value of constant	94.80	92.10

coefficient was found to be 0.68 for males and 0.53 for females. Regarding the regression coefficient the value is 3.25 for males and 3.43 for females. The value of constant is 94.80 for males and 92.10 for females.

Regression equation for stature estimation was derived as Follows:-

For Male: Height=94.80+3.25 (hand length)

For Female: Height=92.10+3.43(hand length)

For Both (combined): Height=80.54+4.32 (hand length)

Discussion

Estimation of an individual's stature is an important parameter in forensic examinations and anthropological studies. Morphometry of the hand provides important evidence in a crime scene, investigation which helps in the estimation of stature of a criminal. The available data usually apply to Caucasians and Tribal areas of Gujarat region mainly at the border of Maharashtra and Gujarat state. Only few studies of other racial group exist which emphasize the need to establish standards in different ethnic populations [4, 6].

The assessment of the physical dimensions of the human hand provides a metric description to a certain human - machine compatibility in the design of manual systems for the bare and gloved hand (e.g. Design of hand tools, knobs and controls, personal equipment, consumer appliances in the home and industry). Primarily adapted for reaching, grasping and manipulating the hand functions include activities such as pushing adjusting objects, striking blows and supporting the body in space. The hand may be used as a fist or forces may be transmitted through the fingers extended in close pack positions. Prehensile

movements of the hand have been variously described as cylinder, ball, ring, pliers and pincer grips and all such grips are the variants of precision and power grips.

The dimensional and anatomical features of the human hand and the factors such as the size, shape, texture of object being held etc, influence the functional aspect of hand use. The occupational disorder associated with the improper use and cumulative exertion of the wrist and hand, include oncoarthritis, dislocation or sublimations, sinusitis, ligament strains and ganglia [9].

The correlation coefficient and stature hand length was found to be statically significant and positive indicating a strong relationship between the two parameters. Regression equation for stature estimation was formulated using hand lengths and checked for their accuracy by comparing the estimated stature and the actual stature. The results indicate that hand length provides an accurate and reliable means in reconstructing the stature of an unknown individual.

The present study shows a correlation coefficient of + 0.68 for male and + 0.53 for females which is very significant. These formulae are valid for the age group above 23 years i.e. fully grown adult of the tribal community of Gujarat region which is around the Aslona because this study is geographically limited only for this area. It is shown in earlier studies that various hand measurements tend to differ in various ethnic groups [10]. Consequently the formulae designed to estimate stature from various anatomical dimensions in one population do not apply to another [11-12]. Furthermore, the need for the alternative formula for gender is also proved as the rate of skeletal maturity in males and females vary during the course of development [12].

Significant and positive correlation coefficient has been shown to exist between stature and measurements of hand length. The result of the current study further highlight the ethnic differences in the anatomical dimensions and its relation to stature which were described earlier [13,10,4]. Taken together, the evidence suggests that the relationship between hand length and stature is of practical use in medico-legal, anthropology and archaeological studies when such evidence provides the investigator the only opportunity to gauge that aspect of an individual's physical description.

References

1. Muncie HL, Sobal J, Hoopes JM, Tenney JH and Warren JW: - A practical method of estimating stature of bedridden female nursing home patient. *J American Geriatrics Society* 1987; 35: 285-289.
2. Chiba M and Terazawa K. Estimation of stature from somatometry of skull. *Forensic Science International* 1998; 97: 87-92.
3. Hintz RL. Final height prediction in constitutional growth delay. *J Pediatric Endocrinology and Metabolism* 2001; 14: 1535-1540.
4. Bhatanagar DP, Thapar SP and Batish MK. Identification of personal height from somatometry of hand in Punjab males. *Forensic Science International* 1984; 24: 137-41.
5. Mall G, Hubig M, Buttner A, Kuznik J, Penning R and Graw M. Sex determination and estimation of stature from the long bones of the arm. *Forensic Science International* 2001; 117: 23-30.
6. Saxena SK. A Study of correlation and estimation of stature from hand length, hand breadth and sole length. *Anthropology Anz* 1984 ; 42: 271-276.
7. Ozaslan A, Iscan MY, Ozaslan I, Tugcu H and Koc S. Estimation of stature from body parts. *Forensic Science International* 2003; 132: 40-45.
8. Malina RM. Physical activity and training: effect on stature and adolescent growth spurt. *Med Science and Sport Exercise* 1994; 26: 759-766.
9. Anjli Nag , PK Nag and Iiina Desai. Hand Anthropometry of Indian woman. *Indian J Medical Res* 2003; 117: 260-269.
10. Davies BT, Benson AK, Courtney A and Minto I. A comparison of hand anthropometry of females in the three ethnic groups. *Ergonomics* 1980; 23: 183-184.
11. Athawale MC. Anthropological study of height from length of forearm bones. A study of one hundred Maharasrian male adults of ages between twenty five and thirty years. *American Journal of Physical Anthropology* 1963; 21: 105-12.
12. Williams PL, Bannister LH, Berry MM, Collins P, Dyson M and Dussek JE. *Grays Anatomy; The anatomical basis of medicine and surgery*, 38th Ed. New York; Churchill Livingstone. New York, 2000; 425-436.
13. Kanchan T and Rastogi P. Sex determination from hand dimensions of North and South Indias. *J Forensic Science* 2009; 54: 546-550.