Section: Anatomy

Original Research Article

ESTIMATION OF STATURE WITH HAND AND FOOT DIMENSIONS - A STUDY AMONGST ADULT POPULATION OF NORTH BENGAL

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Received : 10/08/2023
Received in revised form : 07/09/2023
Accepted : 20/09/2023

Keywords:
Stature, correlation, hand and foot dimensions, height, Identification.

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DOI: 10.47009/jamp.2023.5.5.120

Source of Support: Nil,
Conflict of Interest: None declared

Int J Acad Med Pharm
2023; 5 (5); 619-624

Abstract

Background: Identification in the medico legal sense refers to determination of individuality of a person. It can be complete or partial, complete identification is a proven fact by itself where all the data of the individual is available. The objective is to assess hand length, hand breadth, foot length, foot breadth &stature amongst adult population of different communities of North Bengal, to study correlation between stature and hand dimensions in the study population. **Materials and Methods:** It was a Cross-sectional observational study conducted at the Department of Anatomy, North Bengal Medical College, Sushrut Nagar, Darjeeling – 734012 at Outdoors of different departments of North Bengal Medical College & Hospital. The tenure of the study was one year from July 2014-June 2015. The persons accompanying the patients in the different outpatient departments of North Bengal Medical College were chosen as per inclusion & exclusion criteria. The outdoors were visited once weekly on a fixed day for data collection. **Result:** The out of 193 participants, males were 99 and females were 94 almost. Mean height of males which is 163cm±6.4. Correlation of height with hand and foot dimensions among different communities were seen which shows a positive correlation among them. The study population has negative correlation of -.178 was found between gender and height which is statistically significant. socioeconomic statuses is not significantly correlated with stature in the study population evident from above chart, correlation coefficient .399. P<0.05. **Conclusion:** The mean value of height, hand breadth, hand length, foot breadth and foot length shows higher values in male subjects than female subjects which is normal as in male fusion of epiphysis and diaphysis in bones occurs later than females and so in male the bones get extra time of two years to grow in length, same differences of values is found in studies done earlier also.

INTRODUCTION

Identification in the medico legal sense refers to determination of individuality of a person. It can be complete or partial, complete identification is a proven fact by itself where all the data of the individual is available. Partial identification is one wherein the data available in bits/pieces from which complete individuality of the person has to be framed. The various parameters for incomplete identification are age, sex, race, and stature.[1] Stature provides one aspect of an individual's physiognomy and one piece of information that may prove to be an important aid in individual's partial identification. As per standard dictionary stature is defined as height of a person in natural standing position. Estimation of stature by any means is a part of science is called anthropology. Forensic Anthropology is the "application of the science of physical or biological anthropology to the legal process".[2] Estimation of height of an individual is more compelling concern to forensic anthropologist. The estimation of stature in forensic anthropology is one of several important factors contributing to the identification of missing persons. Many different body parts can be used in the estimation of stature. Certain long bones & appendages can be aptly used in the calculation of height of a person. Many studies have shown the correlation of stature with body appendages & with long bones. But there are inter-racial & inter-

ISSN (O): 2687-5365; ISSN (P): 2753-6556

geographical differences in measurements & their correlation with stature. What may be true for one race or one region may not be true for the other.[3]

Stature is usually estimated from the skeleton in one of two ways: i) measuring all bones constituting the components of stature, summing those measurements and correcting for the missing soft tissue, or ii) employing a regression formula with the measurement of a complete bone or body appendage. Other methods include employing incomplete limb bones, non-limb bones and alternative statistical methods. In selecting the method to be used, consideration of the individual's population, sex and temporal cohort is warranted. Additionally, the method chosen is dependent on the presence and condition of the skeletal remains. Alternate statistical approaches (e.g. Maximum likelihood estimation) exist to estimate stature.[4]

In a country like India, where due to the cultural practices pertaining to the disposal of dead bodies, the skeletal remains are rather scanty and thus only a few ethnic groups have been studied for this purpose due to non-availability of the skeletal remains.[5] To cover this gap, studies have been conducted on various living Indian population by measuring percutaneous bone lengths and to formulate regression equation for prediction of stature.

This study is conducted over adult population of North Bengal attending along with patients in the different Out Patient Departments (OPD) of North Bengal medical college and have been tried to analyze the relation between the stature of the population with different hand and foot dimensions.

MATERIALS AND METHODS

It was a Cross-sectional observational study conducted at the Department of Anatomy, North Bengal Medical College, Sushrut Nagar, Darjeeling – 734012 at Outdoors of different departments of North Bengal Medical College & Hospital. The tenure of the study was one year from July 2014-June 2015. The persons accompanying the patients in the different outpatient departments of North Bengal Medical College were chosen as per inclusion & exclusion criteria.

Inclusion Criteria

a) Adult persons accompanying patients between the age groups 18-50 who came to North Bengal Medical College in different outpatient departments.
b) Adult persons staying in the geographical area of North Bengal for last twenty years.

Exclusion Criteria

a) Those who were not willing to give consent.
b) Persons suffering from musculoskeletal deformities like kyphosis, scoliosis, poliomyelitis, achondroplasia, leprosy, rheumatoid arthritis and genetic disorders like Down's syndrome and endocrinal diseases like gigantism, cretinism which affects normal stature, hand and feet dimensions.

The outdoors were visited once weekly on a fixed day for data collection. The persons accompanying the patients were approached and consent regarding the study was taken. A short history was taken and measurements were done in those who fulfill the eligibility criteria. By this method, a large number of subjects were enrolled. The study subjects, who fulfilled the eligibility criteria, were approached and consent from each subject was taken after explaining about the study. The person interviewed regarding occupation, family income. Then, the height of the person was measured by applying a scale over the topmost position of head (vertex), with the person standing bare footed and head was kept at the level of Frankfurt's plane. The length and breadth of the hands were measured as per procedure described in working definition. Length of hand was taken from inter-styloid line to the anterior most point of the middle finger by measuring tape. Hand breadth was measured from 2nd metacarpo-phalangeal joint to 5th metacarpo-phalangeal joint by Vernier calipers. Foot length was measured by measuring scale from the most posteriorly projecting part of the heel to the most anteriorly projecting part of any toe. Foot breadth was measured by calipers from the head of 1st metatarsal to the head of 5thmetatarsal in standing position (the subject was standing erect in anatomical position) . After obtaining permission from the Department of Anatomy and Ethical Committee of North Bengal Medical College, the data collection was conducted once a week during the hour of Out Patient Departments (9a.m-2p.m). All the persons accompanying the patients, of age group 18-50 years, who satisfied the eligibility criteria were approached for their consent to participate in the study. The relevant history was noted. The different parameters were measured and the data was entered in the data collection sheet.

Statistical Analysis: The sample size became 193. After documenting all these variables, the statistical analysis was undertaken with the help of Statistical package for Social Sciences (SPSS) version 17.0 and Microsoft Excel worksheet version 2013 software for interpretation of result. Detailed statistical analysis is beyond the purview of description. However certain basic methods needs to be mentioned here. Pearson correlation coefficient (r) was calculated in a pair of continuous variables which are normally distributed. Spearman's correlation coefficient (ρ) was calculated for the pair of variable where either or both are not normally distributed. What might be the mode of calculation, statistical significance was customarily confirmed when "p value" less than 0.05.

RESULTS

As per [Table 1] the out of 193 participants, males were 99 and females were 94 almost females :female ratio is 1:1.

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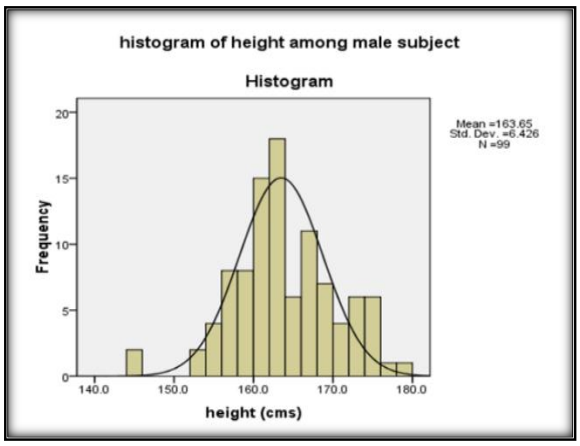

Figure 1: Frequency distribution of height among men

[Figure 1] shows mean height of males which is 163cm±6.4

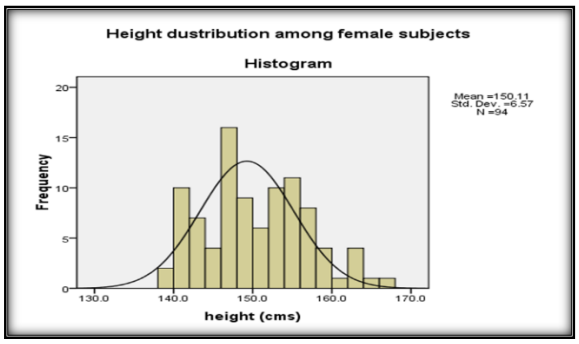

Figure 2: Frequency distribution of height among female subjects

As per table 2 correlation of height with hand and foot dimensions among different communities were seen which shows a positive correlation among them.

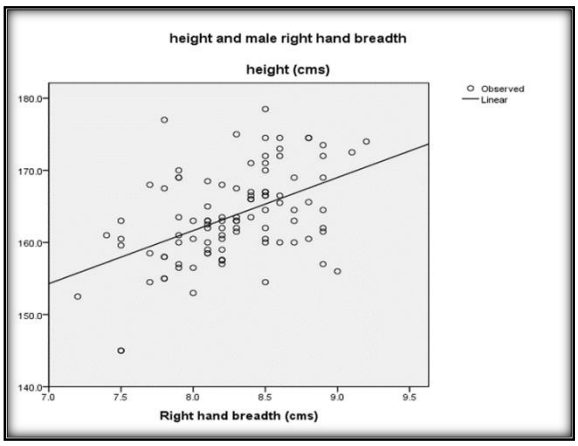

Figure 3: Relation of height with right hand breadth of male subjects

Regression equation
Stature=102.760+7.361*Right hand breadth (male)

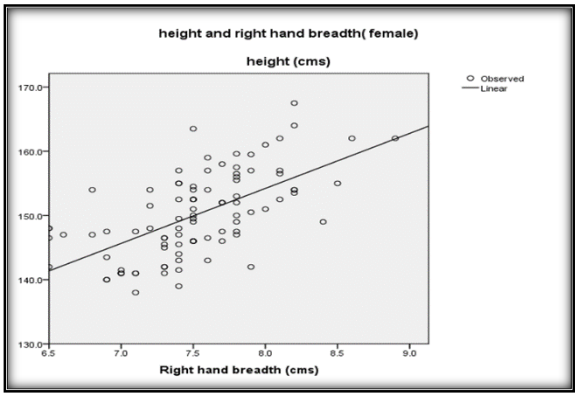

Figure 4: Relation of height with Right hand breadth in female subjects

Regression equation
Stature=85.701+8.564*Right hand breadth (female)

Table 1: Gender distribution among the study population

	Frequency	Percent	Cumulative Percent
Male	99	51.3	51.3
Female	94	48.7	100.0
Total	193	100.0	

Table 2: Correlation of height with hand & foot dimensions in different communities

		Right hand breadth (cms)	Right hand length (cms)	Left hand breadth (cms)	Left hand length (cms)
Height (cms)	Pearson Correlation	.759**	.862**	.783**	.851**
	Sig. (2-tailed)	.000	.000	.000	.000
		Right foot breadth (cms)	Right foot length (cms)	Left foot breadth (cms)	Left foot length (cms)
Height (cms)	Pearson Correlation	.733**	.879**	.738**	.869**
	Sig. (2-tailed)	.000	.000	.000	.000
	Number	81	81	81	81
**. Correlation is significant at the 0.01 level (2-tailed).					

Table 3: Stature with right hand breadth (both gender together)

Equation	Model Summary			Parameter Estimates	
	R Square	df	Sig.	Constant	b1
Linear	.574	191	.000	60.581	12.203

ISSN (O): 2687-5365; ISSN (P): 2753-6556

Table 4: Height and right hand length (both gender together)

Equation	Model Summary			Parameter Estimates	
	R Square	df	Sig.	Constant	b1
Linear	.678	191	.000	32.223	6.909

Table 5: Height with left hand breadth (both gender together)

Dependent Variable:height (cms)					
Equation	Model Summary			Parameter Estimates	
	R Square	df	Sig.	Constant	b1
Linear	.564	191	.000	57.869	12.771

Table 6: Correlation of stature With Age

			height (cms)	Age (years)
Spearman's rho	Height (cms)	Correlation Coefficient	1	-.178*
		Sig. (2-tailed)	.	0.013
	Age (years)	Correlation Coefficient	-.178*	1
		Sig. (2-tailed)	0.013	.
*. Correlation is significant at the 0.05 level (2-tailed).				

Table 7: Correlation of height with gender

			Height (cms)	Male=1, Female=2
Kendall's tau_b	height (cms)	Correlation Coefficient	1	-.611**
		Sig. (2-tailed)		.000
	male=1,female=2	Correlation Coefficient	-.611**	1
		Sig. (2-tailed)	.000	
**. Correlation is significant at the 0.01 level (2-tailed).				

Table 8: Correlation of height with socioeconomic status

			Height (cms)	High Socioecomic=1, Middle socioeconomic=2, Lower socioeconomic=3
Kendall's taub	height (cms)	Correlation Coefficient	1.000	-.049
		Sig. (2-tailed)	.	.399
	High Socioecomic=1, Middle socioeconomic=2, Lower socioeconomic=3	Correlation Coefficient	-.049	1.000
		Sig. (2-tailed)	.399	.

	Author	year	Study done on	Male Mean+sd	Female Mean+sd
1	Qumra SR,[6]	1980	Northwest Indian population	168+0.26	155.7+0.25
2	Bhatnagar DP,[7]	1984	Punjabi males	167.52+3.8	
3	Abdel Malek,[8]	1990	Egyptian students	172.8+7.2	158.9+5.37
4	Giles et al,[9]	1990	Americans	174.52+6.62	162.95+6.52
5	Jasuja op,[10]	2004	Jats, North India	175.2+5.24	159.7+5.17
6	Present study	2015	North Bengal	163.649+6.42	150.107+6.56

Comparison with other study regarding correlation of height with hand breadth

Sl No	Author	Year	Study population	Correlation coefficient & Regression equation	
				Male	Female
1	Ozaslan A[11]	2012	Turks	r=.173 S=1520.76+2.45(HB)	r=.257 S=1298.32+4.25(HB)
2	Chikhalkar BG[3]	2009	Indian BGT	r=0.6004 S=113.561732+7.139216 *HB	
3	Patel PN[12]	2012	Indian Gujrat (BGT)	r=0.467 S=121.69+5.4188*HB	
4	Srivasatava A [13]	2014	Indian Bundelkhand Kayastha	r=0.34 S=126.49+5.43(HB)	r=0.31 S=121.44+4.78(HB)
5	Present Study	2015	India North Bengal(BGT)	RT r=.757 S=60.581+12.203*RHB LT r=.751 S=57.869+12.771*LHB	

So in the present study significant high correlation is found between height and hand breadth in female than in males. In case of male's right hand breadth is better predictor of height and in case of female's left hand breadth is better predictor of height.

ISSN (O): 2687-5365; ISSN (P): 2753-6556

Comparison with other study regarding correlation of height with hand length

Sl no	Author	Year of study	Population	Correlation coefficient & regression equation	
				Male	Female
1					
2	Jasuja OP[10]	2004	Jat Male& Female	S = 169.51 + 5.22(HL)	S = 133.96 + 1.40(HL)
3	Sanli SG[14]	2005	Turks	r=0.72 S= 43.95 + 3.29(HL	r=0.71 S=74.31 + 2.38(HL)
4	Ozaslan A[11]	2012	Turks	r=0.578 S=92.2+.415(HL)	r=0.309 S=111.65+.280(HL)
5	Chikhalkar BG [3]	2008	Indian (Both gender together)	r=0.5902 S= 116.89 + 2.66 *(HL)	
6	Present Study	2015	North Bengal (BGT)	RT r=.823,S=32.223+6.909*RHL LEFT r=.817,S=32.621+6.897*LHL	

So it is found that height is more correlated with hand length in females than in males. Also it is found that between hand length and hand breadth hand length is better predictor of height in both genders.

Comparison with other study regarding correlation of height with foot length

Sl no	Author	Year	Study population	Correlation coefficient &regression equation	
				male	Female
1	Giles E [9]	1991	US army	r=0.68 S=82.21+3.45(FL)	r=0.69 S=75.07+3.61(FL)
2	Sanli SG[14]	2005	Turkey	r=0.72 S=37.23+2.58(FL)	r=0.69 S=74.31+1.73(FL)
3	Patel SM [15]	2007	India	r=0.65 S=75.45+3.64*FL	r=0.80 S=75.41+3.43*FL
4	Ilayperuma I [16]	2009	Srilanka	0.73 S=79.04+3.59(FL)	0.72 S=65.54+3.94(FL)
5	Chikhalkar BG [3]	2009	India Mumbai (BGT)	r = 0.6102 S=79.72379+3.650632 *FL	
6	Present Study	2015	North Bengal India	RT r=.865,S=33.957+5.168*RFL LEFT r=.864,S=32.499+5.236*LFL	

So it is clear from above table that height is positively correlated with foot length in all the studies, in the present study height is more correlated with foot length in case of females than males. In both male and female subjects right foot length is better predictor of height than the left one. Correlation of stature with occupation analyzed in the study population which is a significant one (spearman rank correlation 0.206, $p<0.05$) which cannot be corroborated with previous work as no previous work highlighted the correlation of stature with occupation.

As per [Table 3] both gender shows significant association of stature with right hand breadth,
As per [Table 6] so in the study population has negative correlation of -.178 was found between age and height which is statistically significant.
As per [Table 7] so in the study population has negative correlation of -.178 was found between gender and height which is statistically significant.
As per [Table 8] socioeconomic statuses is not significantly correlated with stature in the study population evident from above chart, correlation coefficient .399. $P<0.05$.

DISCUSSION

The determination of stature is an important step in the identification of dismembered remains. Population variations in anthropometric dimensions do exist and are attributed to genetic and environmental factors. Although stature is partly determined by length of bones in upper limb and lower limb, it is also influenced by many other factors such as genetics, environment, gender, age and physical activity. In addition, the rate of growth in males and females varies during the course of development, as in females epiphysis joins with diaphysis 2 years earlier than in males.

The [Table 9] below shows the variation of mean stature found in different studies done earlier and this. The wide variation of height in same sex but in different geographical location is due to genetic, environmental and racial factors.

CONCLUSION

The present study show lower mean, median for height distribution among both male and female subjects in comparison to studies done on Northern India and Europe and that is normal due to racial and genetic factors variation. The mean value of height, hand breadth, hand length, foot breadth and foot length shows higher values in male subjects than female subjects which is normal as in male fusion of epiphysis and diaphysis in bones occurs later than females and so in male the bones get extra time of two years to grow in length, same differences of values is found in studies done earlier also. Personal identification is the most important part of the investigation and examination in cases of mass disasters, where disintegrated body parts are frequently found. Due to extreme genetic diversity among the Indian population groups, correlation between different body parts with stature is different in different population groups, so separate studies are

ISSN (O): 2687-5365; ISSN (P): 2753-6556

required for each population groups located in different geographical location in our vast country.

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ISSN (O): 2687-5365; ISSN (P): 2753-6556