ESTIMATION OF STATURE FROM HAND LENGTH

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ABSTRACT

Introduction: Estimation of stature from hand length is considered as an important parameter in medico-legal and forensic examinations. When highly decomposed and mutilated dead bodies with fragmentary remains are brought for postmortem examination, it becomes difficult to identify the deceased. Therefore, an attempt has been made in this study to derive a linear regression equation for estimation of stature from the length of hand.

Material & Methods: The present study was conducted on 506 medical students (255 males and 251 females) of age group 18-25 years, at Index Medical College Hospital and Research Center, Indore. The measurements were taken by using standard anthropometric instruments.

Results: The observed data was subjected to statistical analysis. The 't' test applied for correlation coefficient. The value of 't' was found to be statistically significant. Simple linear regression equation derived was used for estimation of height.

Conclusion: It was concluded that the hand length provides good reliability in estimation of stature in forensic examinations and in medico-legal cases and the correlation between present parameters would be helpful in medico-legal cases for identification of individuals.

Regression equation derived can be of help in artificial limb centers for construction of prosthesis required in cases of amputations following gangrene, trauma, frostbite etc.

Keywords: Anthropometry, hand length, stature.

INTRODUCTION

Various factors such as nutritional status, environment, age, race and gender affects human growth [1]. The stature prediction occupies relatively a central position in the anthropological research and in identification necessitated by medico-legal experts [2]. Whenever the body is recovered in mutilated or fragmented state, the problem of identification of the person is difficult even by the most experienced forensic experts. The mutilation of dead body is done by a criminal who wants to destroy all the traces of identity and to facilitate the disposal of dead body [3]. Height is fundamental to assess growth, nutrition, calculating body surface area and predicting pulmonary function in childhood [4]. The following study was conducted to estimate the stature from hand length and to find out

the correlation between hand length with the stature of the individuals of different sex.

Ascertaining sex and estimation of stature from incomplete skeletal and decomposing bodies is a recurring theme in physical anthropology and forensic science. This has become useful in recent times due to mass disasters like train and plane accidents, mass suicide, tsunamis, forest fires, earthquakes and cyclones. Identification in forensic investigation, the relationship between different body parts especially the limbs is being used to establish sex and stature. Specifically hand and foot have been used by many investigators to determine sex and to estimate stature.

Stature estimation of an individual from skeletal material, mutilated, amputated limbs and parts of limb

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has obvious significance in personal identification in events of murders, accidents or natural disasters mainly concerning with forensic identification analysis. Estimation of stature from hand, finger and phalangeal length has been reported by many authors [5-8].

MATERIAL AND METHODS

The present study was conducted on 506 medical students including 255 males and 251 females of age group 18-25 years old, at Index Medical College Hospital and Research Center, Indore between August 2012 to July 2013. The subjects were selected irrespective of their caste, religion, dietary habits and socio-economic status. The subjects were apparently healthy and without any craniofacial deformity.

Parameters for measurement

Height of the individual- Height was taken from the vertex of subject to the standing surface, bare footed by Standard flexible measuring steel tape (Fig. 1a,b).

Hand Length- was measured from the distal crease of wrist joint to the tip of middle finger, on the palmar surface when dorsal surface of hand rested over the table by using Vernier Caliper (0-200 mm) (Fig. 1c).

All the measurements were taken in millimeters (mm).

Fig. 1: Photographs showing: a. Flexible measuring steel tape; b. Measurement of height; c. Measurement of hand length.

The calculations was done using regression formula.

Regression: It is used to express the functional relationship between two variables. In the most basic form of this technique (simple linear regression), the value of one variable (X) e.g. age or diameter is used to predict the value of the other variable (Y) e.g. diameter. In simple linear regression equation, X is an independent variant and y is a dependent variant. It is particularly useful in generating curves for various diameter parameters.

Simple Linear Regression

The relationship between two variables may be one of functional dependence of one on the other. That is, the magnitude of one of the variables (the *dependent variable*) is assumed to be determined by i.e., is a function of the magnitude of the second variable (the *independent variable*). The independent variable is also called the “predictor” or “regressor” variable and dependent variable the “response” or “criterion” variable. The term “dependent” does not imply a cause-and-effect relationship between the two variables.

The simple linear regression equation:

$$Y = a + bX$$

X = Independent variable

Y = Dependent variable

Where a = Intercept, b = Slope

Such a dependent relationship ($Y = a + bX$) is termed as regression, the term simple regression refers to the fact that only two variables are being considered. The regression coefficient intercept (a), generally represent the background value of the dependent variable (Y) and thus, intercept has the same units as of Y, the dependent variable. The regression coefficient (b), generally called slope, expresses what change in Y is associated, on the average, with a unit change in X. The units of b are the units of Y divided by the units of X.

OBSERVATIONS AND RESULTS

Total 506 medical students including 255 males and 251 females of age group between 18 - 25 years old were included in this study.

The total height (Mean $\pm$ SD) in males was 1709.05 ± 113.39 mm. Right hand length (Mean $\pm$ SD)

was 193.19 ± 10.34 and left hand length (Mean $\pm$ SD) was 193.49 ± 10.28 in males. The total height (Mean $\pm$ SD) in females was 1533.74 ± 205.44 mm. Right hand length (Mean $\pm$ SD) was 178.11 ± 9.55 mm and left hand length was 177.84 ± 9.82 mm in females (Fig. 2).

Fig. 2: Bar diagram showing right hand length (RHL) and left hand length of male and female

Regression analysis was done for various parameters and total height versus right and left hand length for both male and female (Tables 1-4). The value of 't' was found to be statistically significant.

Regression equation formula for males:

Height of male = $940.0 + 3.9805 \times$ right hand length of male

Height of male = $974.1 + 3.7981 \times$ left hand length of male

Regression equation formula for females:

Height of female = $948.42 + 3.4442 \times$ right hand length of female

Height of female = $968.95 + 3.3339 \times$ left hand length of female

Table 1: Regression analysis of various parameters in male & female

Parameter	Sex	Coefficient	SE coefficient	t	p
Constant	Male	508.4	158.3	3.21	0.001
	Female	726.01	95.48	7.60	0.000
Right hand length (mm)	Male	4.890	2.985	1.64	0.103
	Female	1.032	1.624	0.64	0.525
Left hand length (mm)	Male	-4.137	2.994	-1.38	0.168
	Female	0.810	1.571	0.52	0.607

Table 2: Regression analysis of total height (mm) versus right and left hand length (mm) in male & female

Parameter	Sex	Coefficient	SE coefficient	T	P
Constant	Male	940.0	124.3	7.56	0.000
	Female	948.42	58.66	16.17	0.000
Right hand length (mm)	Male	3.9805	0.6427	6.19	0.000
	Female	3.4442	0.3289	10.47	0.000
Left hand length (mm)	Male	3.7981	0.6509	5.83	0.000
	Female	3.3339	0.3204	10.41	0.000

Table 3: Correlation of total height in relation to other parameter in male & female

Parameter	Sex	Pearson correlation	p value
Right hand length and total height	Male	0.632	0.000
	Female	0.553	0.000
Left hand length and total height	Male	0.620	0.000
	Female	0.551	0.000

Table 4: Regression analysis of total height versus other parameters in both males and females combined

Parameter	Co-efficient	SE coefficient	t	p	Significance	
Constant	252.40	43.33	5.83	0.000	P<.001	High significance
Right hand length	0.980	1.058	0.93	0.355	P>.05	Non significance
Left hand length	0.765	1.043	0.73	0.464	P>.05	Non significance

DISCUSSION

The present study of estimation of stature from hand length in 506 cases (255 males, 251 females), age group ranging from 18 – 25 years were compared with other studies. The various measurements include

estimation of total height, right and left hand length. The findings of present study i.e. the mean value of the right hand length 19.31 ± 1.03 cm and left hand length 19.34 ± 1.02 cm in males correlates with that of previous studies [2,9-12] (Table 5).

Table 5: Comparison of hand length in males of present study with previous studies

S. No.	Authors	Sex	Sample Size	Side	Mean	SD
1.	Ilayperuma et al. (2009) [9]	Male	140	- -	19.01	0.86
2.	Sunil et al. (2005) [10]	Male	75	Rt.	19.6	1.3
				Lt.	19.5	1.2
3.	Oommen et al. (2005) [11]	Male	50	Rt.	19.06	.737
				Lt.	19.06	.719
4.	Danborno & Elukpo (2008) [12]	Male	250	Rt.	19.85	0.86
				Lt.	19.93	0.93
5.	Jasuja & Singh (2004) [2]	Male	30	Rt.	19.80	0.73
				Lt.	19.79	0.76
6.	Present study (2013)	Male	255	Rt.	19.31	1.03
				Lt.	19.34	1.02

The findings of present study i.e. the mean value of the right hand length 17.81 ± 0.96 cm and left hand length 17.78 ± 0.98 cm in females correlates with that

of previous studies [2,9,11] while slightly differ from other studies [10,12] (Table 6).

Table 6: Comparison of hand length in females of present study with previous studies

S. No.	Authors	Sex	Sample Size	Side	Mean	SD
1.	Ilayperuma et al. (2009) [9]	Female	118	- -	17.62	0.93
2.	Sunil et al. (2005) [10]	Female	75	Rt.	18.1	1.0
				Lt.	18.1	1.0
3.	Oommen et al. (2005) [11]	Female	50	Rt.	17.32	0.89
				Lt.	17.24	0.87
4.	Danborn & Elukpo (2008) [12]	Female	150	Rt.	18.51	0.66
				Lt.	18.52	0.77
5.	Jasuja & Singh (2004) [2]	Female	30	Rt.	17.51	0.81
				Lt.	17.47	0.80
6.	Present study (2013)	Female	251	Rt.	17.81	0.96
				Lt.	17.78	0.98

CONCLUSION

It was concluded that the hand length provides good reliability in estimation of stature in forensic examinations and in medico legal cases and the correlation between present parameters can be helpful in medico-legal cases for identification of individuals.

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