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Original Research Article

To derive a regression formula between hand length and height of an individual & reliability and accuracy

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Abstract:
Background & Method: The aim of the study is to derive a regression formula between hand length and height of an individual & reliability and accuracy. Bertillon system is based on the principle that after the age of 21 years, the dimensions of the skeleton remain unchanged and also that the ratio in size of different parts to one another varies considerably in different individuals.
Result: The study groups included the equal number of individuals of both the sexes aged between 21-30 years. Estimation of height from foot length of female subjects exhibits lower values of Standard Error of Estimation than from foot length of male subjects. It means the reliability of stature from foot length of female subjects is more than male subjects.
Conclusion: The correlation between hand length and stature was more in females than males and stature indicating hand length to be a better predictor of stature in females. In a pooled sample (sample including both males and females) hand length showed better correlation with stature. On the whole hand length can be considered as a better predictor of stature than foot length. Sample linear regression equations have been derived to estimate stature from foot length and hand length.

Keywords: regression, length, height, reliability and accuracy.

Study Designed: Observational Study.

1. INTRODUCTION

Personal identification is the determination of individuality of a person. The exact fixation of personality of an individual can be done on the basis of certain physical characteristics. Identification may be complete (absolute) or incomplete (partial)[1]. Complete identification means absolute fixation of individuality of a person. Partial identification implies ascertainment of only some facts about the identity of the person while others still remains unknown. Age, sex and stature are the primary characteristics of identification. Identification is necessary in living persons, recently dead persons, decomposed bodies, mutilated bodies and skeleton. It is necessary in both criminal and civil cases[2].

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Stature is one of the most important elements in the identification of an individual. It is well known that there is a definite relationship between the height of the person and various parts of the body like head, trunk and lengths of the upper and lower limbs. Height is vertical distance from the bottom to the top of an organ or structure. Stature means the height of the body in standing position[3].

Estimation of stature has a significant importance for the anthropologist, anatomist and forensic scientist[4]. It is important for medico legal and humanitarian reasons. It is useful for the identification of an individual, when mutilated, decomposed, amputed body parts and diseased body parts are available. It has become an important necessity in recent times due to natural disaster like earthquakes, tsunamis, cyclones, floods and man-made disasters like terror attacks, bomb blast, mass accidents wars, plane crashes etc. Many different body parts can be used in the estimation of stature such as long bones, head length, hand & foot dimensions, and their segments, percutaneous length of tibia & ulna, forearm length, etc. Like other parts of the body, the foot, hand and its segments also displays a definite biological correlation with stature[5].

2. MATERIAL & METHOD

The present study was conducted at Kakatiya Medical College Warangal, Telangana & Osmania Medical College, Hyderabad from May 2022 to Nov 2022, study population comprised of 90 male and 90 female subjects. The study population was divided into three sub-groups. Each subgroup having 30 subjects included both sexes. The subjects were within the age group of 21 to 30 years. As stature attains its maximum at around 21 years of age and senility related changes of stature starts appearing after 30 years.

Bertillon system is based on the principle that after the age of 21 years, the dimensions of the skeleton remain unchanged and also that the ratio in size of different parts to one another varies considerably in different individuals. As such, this is applicable only to adults.

INCLUSION CRITERION

1. The age of study population was within the range of 21-30 years.
2. In the study population only healthy individual was considered.
3. Subjects born in North India were studied.

EXCLUSION CRITERION

1. The age of study population below 21 years and above 30 years.
2. An individual having congenital skeletal deformity.
3. An individual having skeletal deformity due to trauma and orthopedic surgeries.

3. RESULTS

Table No. 1: Age and sex distribution of the subjects.

Group	Age range in yrs.	Male	Female	Total
A	21 – 24	30	30	60
B	24 – 27	30	30	60

ISSN: 0975-3583,0976-2833 VOL13, ISSUE8, 2022

C	27 – 30	30	30	60
Total		90	90	180

The study groups included the equal number of individuals of both the sexes aged between 21-30 years.

Table No. 2: Regression equation for prediction of stature by RFL, LFL, RHL and LHL for both sexes in all age groups.

Variables	Sex	Regression equation	SEE	t-test	P value
RFL	Male	78.131+3.487 RFL	3.9517	6.709	<0.001**
	Female	74.596+3.538 RFL	3.3309	6.411	<0.001**
LFL	Male	78.110+3.472 LFL	3.9925	6.569	<0.001**
	Female	86.974+3.020 LFL	3.4830	7.934	<0.001**
RHL	Male	82.082+4.575 RHL	4.0567	6.991	<0.001**
	Female	68.842+5.146 RHL	2.9632	6.905	<0.001**
LHL	Male	76.342+4.877 LHL	3.8737	6.681	<0.001**
	Female	66.621+5.270 LHL	2.8636	6.904	<0.001**

Table No. 3: Regression equation for prediction of stature from average FL & HL for both sexes in all age groups.

Variables	Sex	Regression equation	SEE	t-test	P value
FL	Male	76.586+3.539 FL	3.9381	6.509	<0.001**
	Female	78.642+3.369 FL	3.3663	6.941	<0.001**
HL	Male	75.847+4.906 HL	3.8906	6.547	<0.001**
	Female	65.612+5.329 HL	2.8632	6.728	<0.001**

The reliability of estimation of stature from foot length was determined with the help of Standard Error of Estimation (SEE). The SEE predicts the deviations of estimated stature from the actual stature.

Estimation of height from foot length of female subjects exhibits lower values of Standard Error of Estimation than from foot length of male subjects. It means the reliability of stature from foot length of female subjects is more than male subjects. Sexual differences in the studied parameters were assessed with the help of "t" test. Higher values of "t" test shows the more reliable index for estimation of height.

4. DISCUSSION

Sunil et al who have concluded that hand length is a precise tool to estimate stature of an unknown person[6]. A positive correlation between stature and hand length and have found multiplication factor to be a more reliable tool than the regression equation for estimation of height with the help of hand length in Eastern Indian population. Jitendra P Patel et al have reported that hand length strongly correlated with stature and linear regression equations derived can be used for estimation of stature reliably and accurately[7].

Sahana et al[8] have concluded in their study that the right hand length was the most reliable and accurate hand dimension to estimate stature in population found that hand length can be used to predict height and the parameters used show a 2-tailed significant correlation between hand length and height indicating that the parameter used to predict height can also be used to determine hand length. They have also reported that height of any age group is nine times

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more than the length of hand. MS Supare[9] have found hand length measurements more reliable than hand width measurements in stature estimation. In the present study, there was a weak positive correlation between height and hand length of both sides (r= 0.25,0.26; p<0.001) which was statistically significant.

The relationship that exists between different part of body and height has been of great interest to anthropologists, for many years. So various parameters of long bones have been studied by many workers & their use in measurement of stature has been attempted. However a practical difference arises in a situation where only dismembered body part is available for medical examination like in mass disasters. Therefore we made an effort to find out correlation between hand length & stature. In the present study, a high degree of correlation is seen between heights of individual with hand length for both the sexes. The correlation coefficient was found to be statistically significant indicating a strong relationship between hand length and stature for Males (r=0.6994right, r=o.6571left) and for females (r=0.6935right, r=o.6538left).

5. CONCLUSION

The correlation between hand length and stature was more in females than males and stature indicating hand length to be a better predictor of stature in females. In a pooled sample (sample including both males and females) hand length showed better correlation with stature. On the whole hand length can be considered as a better predictor of stature than foot length. Sample linear regression equations have been derived to estimate stature from foot length and hand length.

The anthropometric measurements differ in different sex and ethnic groups which are determined by genetic and environmental factors suggesting the need for different normograms for each endogamous group.

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