e-ISSN: 0975-1556, p-ISSN:2820-2643

Available online on www.ijpcr.com

International Journal of Pharmaceutical and Clinical Research 2023; 15(6); 387-390

Original Research Article

To Derive a Regression Formula between Hand Length and Height of an Individual and to Compare Reliability and Accuracy of Foot Length and Hand Length in Estimation of Height

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Received: 25-03-2023 / Revised: 27-04-2023 / Accepted: 30-05-2023

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Conflict of interest: Nil

Abstract

Background & Method: The aim of the study is to derive a regression formula between hand length and height of an individual and to compare reliability and accuracy of foot length and hand length in estimation of height. As stature attains its maximum at around 21 years of age and senility related changes of stature starts appearing after 30 years.

Result: The mean with SD of the average hand length was 18.6842±0.8176 and 17.5092±0.6697 for males and females respectively. Pearson correlation between foot length and stature was 0.713 in males and 0.681 in females which shows the more reliable and strongly significant correlation index in males in comparison with the females ($p<0.001$**). Pearson correlation between hand length and stature was 0.721 in males and 0.783 in females which shows the more reliable and strongly significant correlation index in females in comparison with the males ($p<0.001$**).

Conclusion: Sample linear regression equations have been derived to estimate stature from foot length and hand length. Both foot length and hand length showed positive correlation with stature as indicated by the regression coefficient (r) in both the sexes. The correlation between foot length and stature was more in males than females and stature indicating foot length to be a better predictor of stature in males.

Keywords: hand length, height, reliability & foot length.

Study Designed: Observational Study

Introduction

Anthropometry is the technique, which primarily consists the measurements of the dimensions of human, whether living or dead. It is the technique of expressing quantitatively the form of the body [1].

There are no similarities between the two persons in all their measurable characters. Every person have tendency to undergo change in measurements in varying degrees from birth to death. An individual living under different conditions and belongs to members of different ethnic groups and their offspring shows interesting differences in varying degrees [2]. The offspring presents some quantitative expression of their traits exhibit. Therefore anthropometry constitutes the means of giving

quantitative expression to the variations which different individuals or traits exhibit [3].

The anthropometry has arisen back as early as ancient Egypt and Greece. The term 'Anthropometry' was first used by German physician Johann Sigismund Elsholtz during seventeenth century for his graduation thesis titled "Anthropometria". He also invented the anthropometer [4].

Johann Friedrich Blumenback (1752-1840) was the founder of Craniometry and began the scientific anthropometry. On the basis of skull-form as seen from above (norma verticalis), he classified the humans into different races:- (i) square, (ii) long, and (iii) laterally compressed. In the same century Peter Camper studied the facial form and developed the facial profile angle to measure the extent of prognathism. A measurement for long bones-osteometry was developed by Charles White and he worked on the upper limbs of the chimpanzees, Negroes and Europeans [5].

Material & Method

The study population comprised of 60 male and 60 female subjects. The study population was divided into three sub-groups. Each subgroup having 40 subjects included both sexes. 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.

In the study population, the subjects included are irrespective of caste, religion, dietary habits and socioeconomic status. The subjects born only in north India were included.

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.

Results

Table 1: 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 2: 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.

Table 3: Comparison and Pearson correlation (r) for correlation between Average FL and Average HL with stature of males and females of all age groups.

Variables	Sex	Range	Mean	SD	r	R^2	P value
FL	Male	23.1-27.9	25.6902	1.1205	0.713	0.508	<0.001**
	Female	21.65-26.45	23.8300	0.9224	0.681	0.464	<0.001**
HL	Male	16.95-20.6	18.6842	0.8176	0.721	0.520	<0.001**
	Female	16.25-19.2	17.5092	0.6697	0.783	0.612	<0.001**

The mean with SD of the average foot length was 25.6908±1.1205 for and 23.830±0.9224 for females.

The mean with SD of the average hand length was 18.6842±0.8176 and 17.5092±0.6697 for males and females respectively. Pearson correlation between foot length and stature was 0.713 in males and 0.681 in females which shows the more reliable and strongly significant correlation index in males in comparison with the females (p<0.001**). Pearson correlation between hand length and stature was 0.721 in males and 0.783 in females which shows the more reliable and strongly significant correlation index in females in comparison with the males (p<0.001**).

Discussion

The males were found to be taller and had longer feet than females with the intersexes difference being statistically significant (p<0.001). These observations were same as the earlier studies [6].

An attempt was made to correlate foot length and hand length with stature and derive regression equations to calculate stature from foot length and hand length [7].

The foot length and stature correlation coefficient (r) in males was 0.713, females was 0.681 and with both sexes put together (pooled sample) the correlation coefficient (r) was 0.831.

The hand length and stature correlation coefficient (r) in males and females were 0.721 and 0.783 respectively. The correlation coefficient (r) was 0.848 with both sexes included [8].

These findings were compared with other similar studies conducted on other population groups.

Regression equations were derived to estimate stature from foot length and hand

length using regression analysis for both males and females separately [9]. Analysis using a pooled sample (sample including both males and females) was done to be used when the sex of the foot or hand was not known as in mass disasters when only foot/hand or its fragments are available for analysis [10].

Conclusion

Sample linear regression equations have been derived to estimate stature from foot length and hand length. Both foot length and hand length showed positive correlation with stature as indicated by the regression coefficient (r) in both the sexes. The correlation between foot length and stature was more in males than females and stature indicating foot length to be a better predictor of stature in males.

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