Original Article

A Gender Based Comparison to Assess Head Length, Hand Length, Foot Length, Arm Span to Predict Stature of Individual: An Observational Study

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Abstract

Background: Personal identification means determination of individuality of a person. Anthropometry is the study of the measurement of the human body. The present study was used to assess head length, hand length, foot length, arm span to predict stature of individual based on gender. **Subjects and Methods:** In this prospective observational study 600 patients attending in the Outpatient department of medical, dental and other college's students of age group 21-25 years in various colleges at Jaipur, India were selected for the study. The measurement of stature, head length, head breadth, hand length, foot length, arm span. The data collected was compiled, tabulated, analyzed and subjected to statistical tests. Analysis was done using SPSS. **Results:** In the present study total participants were 600 in which 300 were males and 300 were females. Mean age of females was found to be 22.82 and mean age of males was found to be 22.96. 160 persons were aged 21 years i.e. 26.6%, 175 persons were aged 22 years i.e. 29.16%, 91 were aged 23 years i.e. 15.1%, 85 were aged 24 years i.e. 14.1% whereas 89 were aged 25 years i.e. 14.83%. In present study most common age group was found to be 22 years and 24 years was the least common age group. Body height (cm) in male and female was observed to be statistically significant, for head length, significant statistical difference was observed, for head breath significant difference was observed. For hand length, significant statistical difference was observed, for foot length, significant statistical difference was observed, for arm span, significant statistical difference was observed. **Conclusion:** Our study conclude that a significant difference was observed in height, head length, head breadth, hand length, arm span & foot length in between males and females.

Keywords: Head breadth, arm span, stature, head length.

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Introduction

Personal identification means determination of individuality of a person. It's a fact that no two people can have same identity. Growth is measured by measuring the height of a person, which is a sum of the length of certain bones and appendages of the body, represent certain relation with form of proportions to the total stature & cephalic phenotype.[1] Anthropometry is the study of the measurement of the human body in terms of the dimensions of bone, muscle, and adipose (fat) tissue. The word "anthropometry" is derived from the Greek word "anthropo" meaning "human" and the Greek word "metron" meaning "measure" (Ulajaszek, 1994).[2] The field of anthropometry encompasses a variety of human body measurements. Weight, stature (standing height), recumbent length, skinfold thicknesses, circumferences (head, waist, limb, etc.), limb lengths, and breadths (shoulder, wrist, etc.) are examples of anthropometric measures.[3] The historical use of anthropometry has been applied to a wide range of

applications, including:4 Paleoanthropology and human evolution, Biological anthropology, Craniometry and craniofacial attributes,PhylogeoFigurey, Criminology and Forensics, Phrenology, Physiognomy, Personality and mental typology. Anthropometry may conveniently be subdivided in to the following sections: Somatometry– Measurement of living body including head and face, Osteometry– Measurement of the skeletal long and short bones, Craniometry– Measurement of the skeletal brain cavity (Neurocranium) and face (Splanchnocranium).[2] Stature is one of the various parameters of identification for establishing individuality of the person. It is well known that there is a definite relationship between the height of the person and various parts of the body like head length, head breadth, hand and foot length and arm span.[5] The present study was conducted to

1. To assess the head length, hand length, foot length, arm span and stature of the individual.
2. To predict the stature of an individual by measuring the head length, Hand length, foot length and arm span using regression analysis.

3. To correlate the head length, hand length foot length, arm span and the stature of the individual.

Subjects and Methods

In this prospective observational study 600 patients attending in the Outpatient department of medical, dental and other college's students of age group 21-25 years in various colleges at Jaipur, India were selected for the study. Out of 600 patients 300 were females and 300 were males. The study was conducted over the period of 2 years. The study was approved by the ethical committee of, Jaipur, India. An informed consent was obtained from each of the patients to examine the cases for inclusion in this study. Patients with similar socio-economic status, patients with age group of students ranged from 21 to 25 years, students of various colleges at Jaipur were included in the study. Measurements were taken at fixed time between 2 to 5 p.m. to eliminate the discrepancies due to diurnal variation. Patients with age above 25 and below 21 year, persons with abnormal gigantism and dwarfism were excluded from the study. Time other than between 2 to 5 p.m. excluded.

Calculation of Sample Size
- Population size(for finite population correction factor or fpc) (N):100000
- Hypothesized % frequency of outcome factor in the population (p):50%+/-5
- Confidence limits as % of 100(absolute +/- %)(d):5%
- Design effect (for cluster surveys-DEFF):1
- Simple size n=[DEFF*NP(1-p)]/[(d2/Z21-α/2*(N-1)+p*(1-p)]

Sample Size (n) for Various Confidence Levels

Confidance Level (%)	Sample Size
95%	383
80%	164
90%	270
97%	469
99%	660
99.9%	1072
99.99%	1492

Data Collection
1. **Stature:** Standing height of an individuals in cm.
2. **Head length:** Between two craniometric point – Glabella and Inion
3. **Head breadth:** Between the most lateral points on the Parietal bones.
4. **Hand length:** Between midpoint interstyloid line to tip of middle Finger.

5. **Foot length:** Between most prominent point of back of the heel to the tip of hallux.
6. **Arm span:** Tip of the middle finger on one hand to the tip of the middle finger on other hand with both arms abducted to 90 degree, elbows and wrists extended and the palms facing directly forward.

In above methods all the measurements will be done using following materials:-Stature Meter, Spreading Caliper (Blunt ended), Vernier calliper, Flexible steel tape. Measurement of stature was measured as vertical distance from vertex to floor. Head length was measured as straight distance between glabella and Inion. Head breadth was measured between the most lateral points on the Parietal bones. Hand length was measured (B/w midpoint interstyloid line to tip of middle finger) using blunt ended spreading caliper &vernier caliper. Foot length was measured (B/w most prominent point of back of the heel to the tip of hallux) using blunt ended spreading caliper & vernier caliper. Arm span was measured b/w Tip of the middle finger on one hand to the tip of the middle finger on other hand with both arms abducted to 90 degree, elbows and wrists extended and the palms facing directly forward. A detailed case history was obtained from patients. A complete physical examination was carried out. The data collected was compiled, tabulated, analyzed and subjected to statistical tests. Analysis was done using SPSS.

Results

In the present study total participants were 600 in which 300 were males and 300 were females.
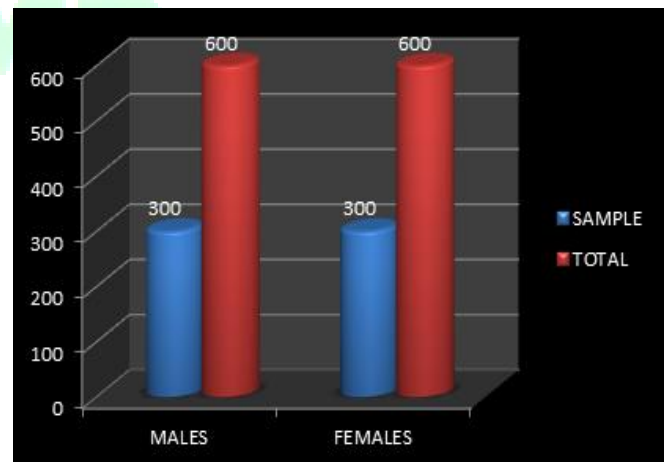

Figure 1: Gender Distribution

In current study mean age of females was found to be 22.82 and mean age of males was found to be 22.96.

Table 1: DemoFigureic Characteristics Of The Study Population.

SEX	Mean	N	SD	Minimum	Maximum	Median
Female	22.82	300	1.415	21	25	23.00
Male	22.96	300	1.419	21	25	23.00
Total	22.89	600	1.418	21	25	23.00

In present study result showed that of the 600 samples 160   persons were aged 21 years i.e. 26.6%, 175 persons were

aged 22 years i.e. 29.16%, 91 were aged 23 years i.e. 15.1%, 85 were aged 24 years i.e. 14.1% whereas 89 were aged 25 years i.e. 14.83%. In present study most common age group was found to be 22 years and 24 years was the least common age group.
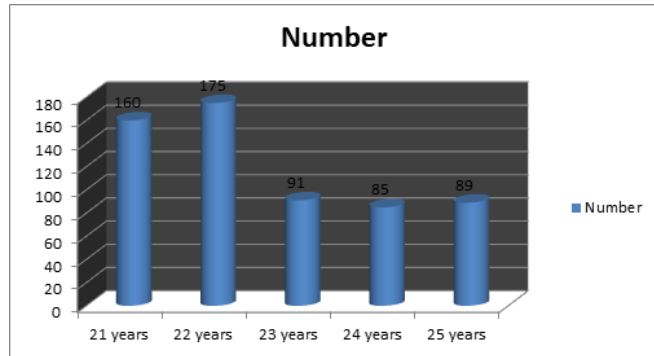

Figure 2: Age Distribution

Body height (cm) in male and female was observed to be statistically significant [Male 169.41 (SD: 0.949) and female 157.19 (SD: 1.108)], For head length, significant statistical difference was observed [Female18.60 (SD: 0.736) and Male 18.86(SD: 0.742)], For head breath significant difference was observed [female14.47 (SD:0.563) and Male 14.69(SD: 0.708)].

Table 2: Comparison For Height, Head Length (HL) And Head Breadth (HB) (In Cm) Among Male And Female and Total

SEX		Total Height	Head Length	Head Breadth
Female	Mean	157.19	18.60	14.47
	N	300	300	300
	Std. Deviation	1.108	.736	.563
	Minimum	155.16	16.41	13.02
	Maximum	159.51	19.89	15.65
	Median	157.075	19.065	14.875
	Variance	1.227	.543	.317
Male	Mean	169.41	18.86	14.69
	N	300	300	300
	Std. Deviation	.949	.742	.708
	Minimum	167.21	16.41	13.03
	Maximum	170.65	20.92	16.88
	Median	168.83	18.73	14.62
	Variance	.901	.552	.501
t test		140.216	4.309	4.404
p value		<0.001*	<0.001*	<0.001*
Total	Mean	163.30	18.73	14.57
	N	600	600	600
	Std. Deviation	6.204	.750	.649
	Minimum	155.16	16.41	13.02
	Maximum	170.65	20.92	16.88
	Median	167.89	19.21	14.99
	Variance	38.490	.563	.422

*: statistically significant

For hand length, significant statistical difference was observed [Male 16.76 (SD:0 .671) and Female 16.72 (SD: 0.538], For foot length, significant statistical difference was

observed [Male 23.56 (SD:0 .514) and Female 22.53 (SD: 0.877], For arm span, significant statistical difference was observed [Male 166.45 (SD: 2.141) and Female 164.23 (SD: 6.675].

Table 3: Comparison For Hand Length, Foot Length And Arm Span Among Male And Female And Total

| SEX		Hand Length	Foot Length	Arm span
Female	Mean	16.72	22.53	164.23
	N	300	300	300
	Std. Deviation	.538	.877	6.675
	Minimum	14.66	21.10	142.24
	Maximum	18.17	24.11	168.56
	Median	16.29	23.01	165.575
	Variance	.291	.770	44.562
Male	Mean	16.76	23.56	166.45
	N	300	300	300
	Std. Deviation	.671	.514	2.141
	Minimum	14.66	22.63	142.24
	Maximum	18.67	24.34	168.56
	Median	16.61	23.07	166.34
	Variance	.451	.265	4.587
t test		0.806	17.535	5.728
p value		<0.001*	<0.001*	<0.001*
Total	Mean	16.74	23.04	165.34
	N	600	600	600
	Std. Deviation	.608	.881	5.075
	Minimum	14.66	21.10	142.24
	Maximum	18.67	24.34	168.56
	Median	16.545	22.837	166.05
	Variance	.371	.777	25.766

*: statistically significant
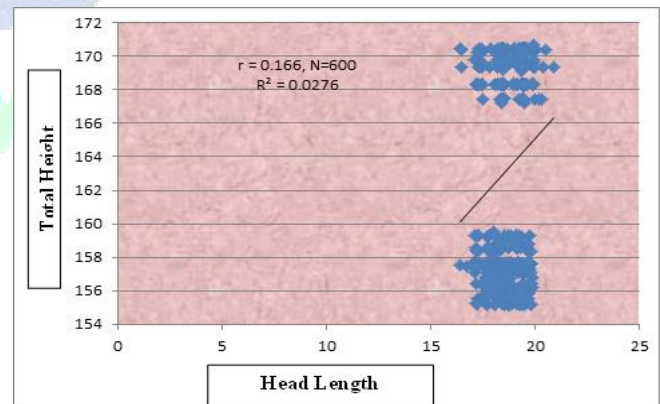
Figure 3: Pearson Correlation Between Head Length And Body Height In Both Male & Female
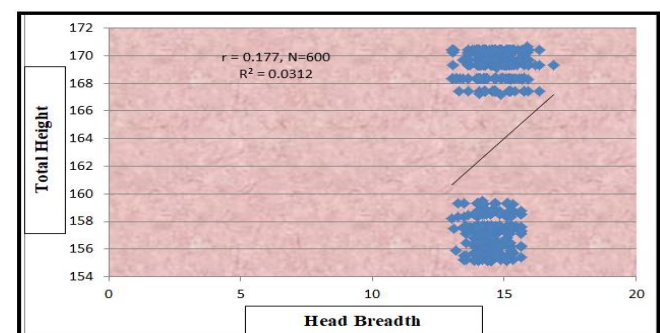

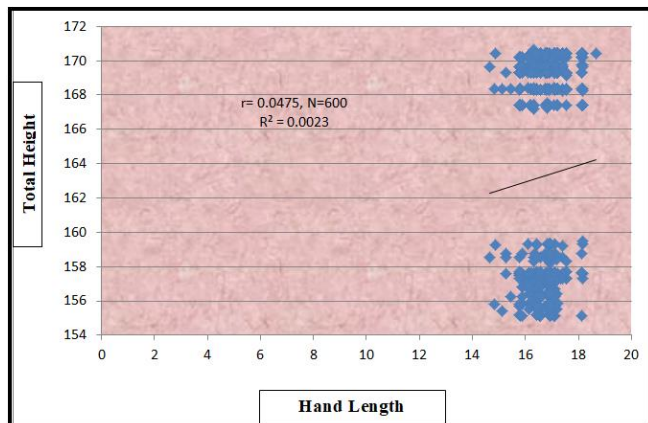**Figure 4: Pearson Correlation Between Head Breadth And Body Height In Both Male & Female**

Figure 5: Pearson Correlation Between Hand Length And Body Height In Both Male & Female
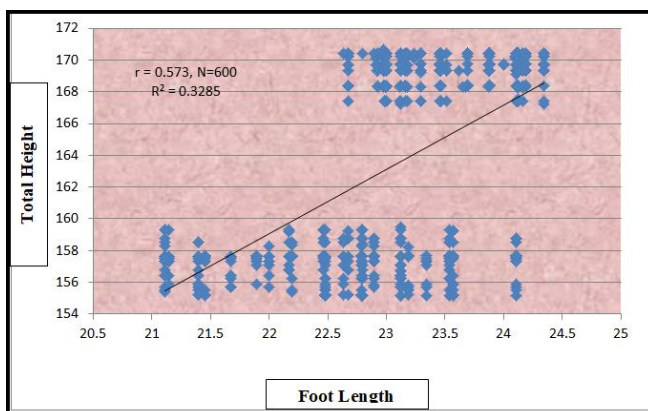

Figure 6: Pearson Correlation Between Foot Length And Body Height In Both Male & Female
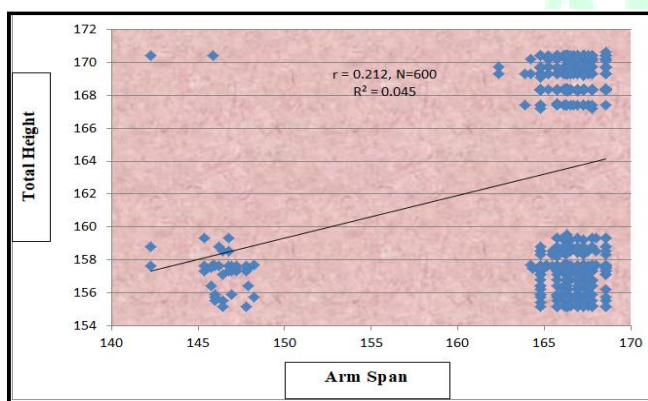

Figure 7: Pearson Correlation Between Arm Span And Body Height In Both Male & Female

Discussion

Bodily proportions and absolute dimensions vary widely with respect to age, sex, within racial groups and between racial groups. In spite of this variation, height has been estimated from measuring various other parameters of the body by refining formulae. The values have become increasingly important in the identification of persons. In present study 600 medical, dental and other college students, 300 male and 300 female was undertaken to evaluate the correlation of body height and head length, head breadth, hand length, arm span & foot length.

In our study mean age of females was found to be 22.82 and mean age of males was found to be 22.96. In our study age group selected was 21 to 25 years where 21 were the minimum age found in our study and 25 being the maximum. In present study result showed that of the 600 samples 160 patients were aged 21 years i.e. 26.6%, 175 patients were aged 22 years i.e. 29.16%, 91 were aged 23 years i.e. 15.1%, 85 were aged 24 years i.e. 14.1% whereas 89 were aged 25 years i.e. 14.83%. in present study most common age group was found to be 22 years and 24 years was the least common age group.

GN Geeta et al. in their study included 200 medical students of age group 20 to 30 years from Kerala. And result shows that there is a definite correlation between hand length & foot length and height of an individual.[6]

B. Dorjee et al. in their study included 240 school students of age group 3 to 11years from west Bengal. The result shows that there is a definite correlation between Arm span and height of an individual. In spite of the racial and ethnical variation, this formula may be applicable to other regions and races, more or less effectively.[7]

In present study statistically significant Comparison for height, head length (HL) and head breadth (HB) (in cm) among male and female.

In present study have shown correlation between head length and height with correlation coefficient +0.039 in male and -0.079 in female. And correlation between head breadth and height with correlation coefficient +0.076 in male and -0.028 in female.

Abdi ozaslan et al. study derived a Regression equation for stature of males using hand length was $92.2 + 4.15 \times HL$ and females are $111.65 + 2.80 \times HL$. In this study showed Mean height $\pm$ SD is 172.37 ± 6.86 in male and 162.01 ± 6.41 in female. And Mean hand length is 19.23 ± 0.932 in male and 17.96 ± 0.697 in female. This study is observed statically significant ($p<0.001$). and have shown correlation between hand length and height with correlation coefficient +0.578 in male and +0.309 in female.[8]

Tejas C. Patel et al. study derived a Regression equation for stature of males using hand length was $66.72 + 5.53 \times HL$ In this study showed Mean height $\pm$ SD is 171.09 ± 5.39 in male. And Mean hand length is $18.89 \pm .76$ in male. This study is observed statically significant ($p<0.001$). And have shown correlation between hand length and height with correlation coefficient +0.783 in male.[9]

In present study derived a Regression equation for stature of males using hand length was $167.62 + 0.11 \times HL$ and females are $154.59 + 0.16 \times HL$. In this study showed Mean height $\pm$ SD is 169.41 ± 0.949 in male and 157.19 ± 1.108 in female. And Mean hand length is 16.76 ± 0.671 in male and 16.72 ± 0.538 in female. This study is observed statically significant ($p<0.001$). and have shown correlation between hand length and height with correlation coefficient +0.076 in male and +0.076 in female.

Dr. Sreyamoitra et al. study derived a Regression equation for stature of males using foot length was $122 + 0.555 \times FL$

and females are $135 + 0.920 \times FL$. In this study showed Mean height ± SD is 167.624 ± 7.059 in male and 157.448 ± 5.556 in female. And Mean Foot length is 26.564 ± 6.634 in male and 24.53 ± 1.71 in female. This study is observed statically significant (p<0.001). And have shown correlation between Foot length and height with correlation coefficient $+0.522$ in male and 0.283 in female.[10]

In present study derived a Regression equation for stature of males using foot length was $167.62 + 0.11 \times FL$ and females are $154.59 + 0.16 \times FL$. In this study showed Mean height ± SD is 169.41 ± 0.949 in male and 157.19 ± 1.108 in female. And Mean foot length is 23.56 ± 0.514 in male and 22.53 ± 0.877 in female. This study is observed statically significant (p<0.001). and have shown correlation between foot length and height with correlation coefficient $+0.026$ in male and $+0.011$ in female.

RP Shah et al. study derived a Regression equation for stature of males using Arm span was $75.07 + 0.68 \times AS$ and females are $68.05 + 0.507 \times AS$. In this study showed Mean height ± SD is 167.39 ± 6.17 in male and 155.61 ± 6.89 in female. And Mean arm span is 168.01 ± 7.659 in male and 159.25 ± 6.362 in female. This study is observed statically significant (p<0.001). and have shown correlation between arm span and height with correlation coefficient $+0.682$ in male and 0.507 in female.[11]

In present study derived a Regression equation for stature of males using Arm span was $171.94 - 0.02 \times AS$ and females are $157.75 - 0.01 \times AS$. In this study showed Mean height ± SD is 169.41 ± 0.949 in male and 157.19 ± 1.108 in female. And Mean arm span is 166.45 ± 2.141 in male and 164.23 ± 6.675 in female. This study is observed statically significant (p<0.001). And have shown correlation between arm span and height with correlation coefficient -0.034 in male and -0.020 in female.

Conclusion

With the limits of current study we conclude that the usefulness of head length, head breadth, hand length, arm span & foot length measurement in the estimation of stature amongst medical students age b/w 21 – 25 years belonging to Jaipur Rajasthan. Regression formulae for stature estimation from head length, head breadth, hand length, arm span & foot length measurements were derived in both males and females. A significant difference was observed in height, head length, head breathe, hand length, arm span & foot length in between males and females.

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