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CORRELATION BETWEEN TOTAL BODY HEIGHT AND PERCUTANEOUS ULNAR LENGTH IN BUNDELKHAND REGION (PART OF M.P. & U.P., INDIA)

Anatomy

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ABSTRACT

Introduction- stature is nature height a person in a upright position. Stature or body height is very important anthropometric parameter by which physical identity of an individual can be done when where is a unknown dead body found or dead body with destroy face or a mummified/ putrefied body in which face is unrecognizable. **Aim-** human body height marked from long bones humerus, radius ,ulna, femur , tibia. If total body height is more than long bone of that human body also have more length so there is a relation more length of human body more length of bones. So by this relation if somewhere found a singled bone or a single extremity as in natural disaster – tsunami earthquake or a criminal case/ bomb-blast we can get identity of little individual. **Material And Method** - 204 individual (102 male and 102 female) were material of this study we estimate total body height and individual bone (in this study tibia) length and in between these two measurements we found a relation and we derived a formula (regression equation formula) which is population (found in particular area – region)specific . For this a regression equation derived by this study In the Jhansi (U.P. ,INDIA) can be helpful.

KEYWORDS

Anthropometry total body height, percutaneous tibial length, regression equation formula

INTRODUCTION-

Stature is an important and useful anthropometric parameter by which we determine physical identity of an individual [1]. Stature mainly forms by limb bones (upper & lower limb bones). It means human bones not provide only a frame for flesh ,they also frame our identity.

Uses of anthropometry in the field of forensic science begin in 'criminal identification' since 1882. A French Police expert 'Alphonse Beritillon' invented a identification system based on anthropometric measurements .

3 fundamental ideas of this identification system –
1. The skeleton system of adult person (age more then 20 years) is gain maximum maturity. Means fixed length of long bones.
2. Skeleton structure of one person is always differ form Skeleton structure of other person. Means extreme diversity of dimension present .
3. Certain dimension of bone –structure of a living person can be measured by a simple expandable vernier calipers.

But it is very difficult to establish accurate height from length of long bones, since the proportional relationship of length of a long bone to total body height is different from one to another person .For example to have a total number of 10, one can have any combination of 5+5,1+9 ,2+8,3+7,4+6. In this mathematical example although total number '10' is constant but proportion of additive digits is different .Same type of problem also seen in estimation of biological data of nature (measurement of total body height length of a long bone from).

But identity of a victim of after a mass disasters [2,3] as in case of earth quick or a train accident ,when isolated extremities found very commonly ,is done by long bones [4].

Determination of stature is very necessary in personal identity of victim after a criminal case .if only fragment of dead body found [5,6].

Krishan et al [7] studied limb a symmetry and its effect on estimation of stature .In 2007 Krishan &Sharma studied estimation of stature from dimensions of hand &feet in north Indian population. In 2008 Krishan estimate stature from cephalo-facial anthropometry and foot segments in a north Indian population.

In 2009 Ryan & Bidmos studied evaluation of accuracy of direct &indirect methods in Stature reconstruction . In 2009 Menezes et al studied the estimation of stature from length of sternum in south Indian males .Kanchan et al established relationship between hands &feets and its value in personal identification in mass disasters.

Anthropologists observe and compare relationship between body segments to highlight variations between ethnic origins. Anthropologist and forensic expert have more importance to various methods of stature estimation .Even group specific works can be done when stature can not be measured directly due to deformity (kyphosis, scoliosis, lordosis, contractures or missing legs).In these cases original stature of people can be estimated by multiplying dimension of hand length with respective multiplication factor of related ethnic group. Multiplication factor derived by obtained ratio of stature to hand length.

MATERIAL AND METHOD-

Present study carried out on 204 living subject adult individual (102 male and 102 female) of bundelkhand region (Jhansi and Gwalior district) of age 22 to 42 years. Subjects taken for study were asymptomatic ,healthy medically ,physically fit (no kyphosis ,scoliosis ,lordosis ,contractures or missing legs)).Individuals were measured for their percuteneous ulnar bone length and for standing body height as after 20 year union of epiphysis and diaphysis has occurred in Indian population and no height further increase which studied by several workers8,9.

PCTL is measured by spreading calipers having blunt end.

Position For Measuring PCUL –

We asked each individual to sit on a stool with knee is fixed at 90 degree with thigh and foot kept inverted. Because in this position soft tissue relaxes in bony point become more prominent. Upper bony point - most prominent upper palpable bony part of tibia at medial side of leg and lower bony point – where maximum convexity of medial mallelous found.

Standing height is measured by a stadiometer. Horizontal sliding bar is foot on vertex. Subject stand bare footed with both feet in contact with each-other. Eye looking straight forward, arms keep along side of trunk.

We calculate regression equation formula (y=a+bx) for both male and female separately to estimate total body height by using PCUL. Left PCUL was approximately similar to right PCUL in both gender. No significant difference ($p>0.05$) found in PCUL both side .

We observed difference between actual (measured by a stadiometer) and estimated body height by regression formula.

Since past regression formula of *Trotter and Glese* [10,11] for long bone were used to estimate stature of an individual.

OBSERVATION –

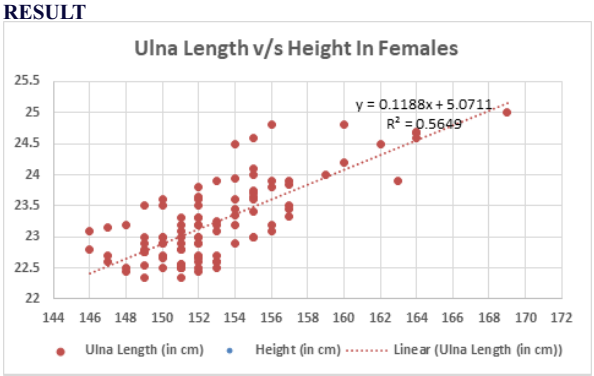
Observed height and their PCUL have also plotted into graphs to find-out graph

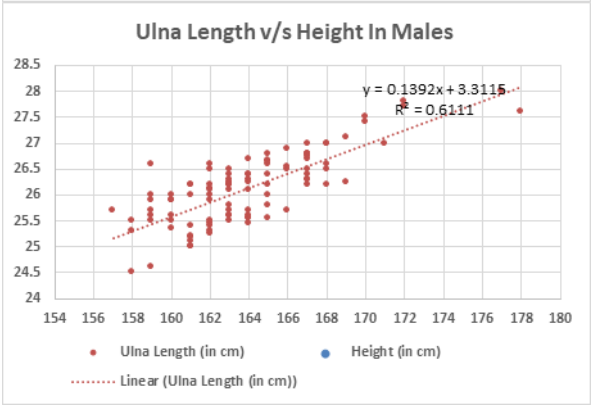
Height (cm)	Ulnar length (cm)	Gender
157	25.7	MALE
158	25.5	MALE
158	25.3	MALE
158	24.5	MALE
159	26	MALE
159	26.6	MALE
159	25.9	MALE
159	25.7	MALE
159	25.6	MALE
159	25.5	MALE
159	24.6	MALE
160	26	MALE
160	25.9	MALE
160	25.6	MALE
160	25.9	MALE
160	25.5	MALE
160	25.35	MALE
161	26.2	MALE
161	26.2	MALE
161	26	MALE
161	25.4	MALE
161	25.2	MALE
161	25	MALE
161	25.1	MALE
161	25	MALE
161	25.17	MALE
162	26.6	MALE
162	26.5	MALE
162	26.2	MALE
162	26.12	MALE
162	25.5	MALE
162	25.46	MALE
162	25.4	MALE
162	25.3	MALE
162	25.9	MALE
162	26.1	MALE
162	26	MALE
162	25.25	MALE
163	26.4	MALE
163	26.2	MALE
163	26.3	MALE
163	26.2	MALE
163	25.8	MALE
163	25.7	MALE
163	25.6	MALE
163	25.6	MALE
163	26.5	MALE
163	25.5	MALE
163	26.1	MALE
163	26.25	MALE
163	26.2	MALE
164	26.7	MALE
164	26.4	MALE
164	26.3	MALE
164	26.1	MALE
164	25.55	MALE
164	25.7	MALE
164	25.6	MALE
164	25.56	MALE
164	26.25	MALE
164	26.4	MALE
164	25.46	MALE
165	26.8	MALE
165	26.4	MALE
165	26.6	MALE
165	26.2	MALE
165	26	MALE
165	25.8	MALE
165	26.65	MALE
165	25.55	MALE
165	26.66	MALE
166	26.9	MALE
166	26.5	MALE
166	26.55	MALE
166	25.7	MALE
167	27	MALE
167	26.8	MALE
167	26.8	MALE
167	26.5	MALE
167	26.3	MALE
167	26.4	MALE
167	26.3	MALE
167	26.2	MALE
167	26.8	MALE
167	26.7	MALE
167	26.75	MALE
168	27	MALE
168	27	MALE
168	26.5	MALE
168	26.2	MALE
168	26.6	MALE
169	27.1	MALE
169	26.25	MALE
170	27.4	MALE
170	27.5	MALE
171	27	MALE
172	27.8	MALE
172	27.7	MALE
177	28	MALE
178	27.6	MALE

Height (cm)	Ulnar length(cm)	Gender
150	23.6	FEMALE
155	24	FEMALE
152	23.6	FEMALE
154	23.95	FEMALE
153	23.9	FEMALE
152	23.8	FEMALE
149	23.5	FEMALE
146	23.1	FEMALE
160	24.8	FEMALE
156	23.9	FEMALE
152	23.65	FEMALE
155	24.1	FEMALE
152	23.5	FEMALE
150	23.5	FEMALE
148	23.2	FEMALE
147	23.15	FEMALE
151	23.2	FEMALE
152	23.3	FEMALE
149	23	FEMALE
146	22.8	FEMALE
154	23.6	FEMALE
156	23.8	FEMALE
151	23.3	FEMALE
157	23.85	FEMALE
159	24	FEMALE
155	23.75	FEMALE
155	23.7	FEMALE
162	24.5	FEMALE
164	24.6	FEMALE
157	23.9	FEMALE
164	24.7	FEMALE
169	25	FEMALE
164	24.68	FEMALE
155	23.65	FEMALE
160	24.2	FEMALE

152	23.2	FEMALE
149	22.9	FEMALE
147	22.7	FEMALE
149	22.8	FEMALE
150	23	FEMALE
151	23.1	FEMALE
153	23.25	FEMALE
149	22.75	FEMALE
154	24.5	FEMALE
156	24.8	FEMALE
155	24.6	FEMALE
147	22.6	FEMALE
149	22.75	FEMALE
150	22.9	FEMALE
150	23	FEMALE
151	23	FEMALE
154	23.45	FEMALE
155	23.6	FEMALE
152	23.2	FEMALE
152	23.3	FEMALE
150	22.9	FEMALE
151	22.9	FEMALE
149	22.75	FEMALE
154	23.35	FEMALE
155	23.4	FEMALE
152	23	FEMALE
153	23.1	FEMALE
154	23.2	FEMALE
148	22.5	FEMALE
163	23.9	FEMALE
157	23.5	FEMALE
148	22.45	FEMALE
149	22.55	FEMALE
157	23.45	FEMALE
152	22.9	FEMALE
151	22.8	FEMALE
153	23.2	FEMALE
150	22.7	FEMALE
150	22.65	FEMALE
152	23	FEMALE
151	22.8	FEMALE
152	22.9	FEMALE
150	22.5	FEMALE
149	22.35	FEMALE
151	22.56	FEMALE
152	22.67	FEMALE
151	22.5	FEMALE
153	22.7	FEMALE
153	22.5	FEMALE
153	22.6	FEMALE
154	22.9	FEMALE
155	23	FEMALE
156	23.1	FEMALE
152	22.7	FEMALE
151	22.5	FEMALE
151	22.35	FEMALE
152	22.6	FEMALE
156	23.2	FEMALE
157	23.32	FEMALE
155	23	FEMALE
152	22.5	FEMALE
151	22.5	FEMALE
153	22.6	FEMALE
152	22.45	FEMALE
151	22.57	FEMALE
151	22.5	FEMALE
152	22.65	FEMALE

RESULT





	Range	Mean	Standard Deviation	Number
Male	24.5-28	25.87	0.67	100
Female	22.35-25	23.01	0.64	100

Average Ulna Length (in cm)

	Range	Mean	Standard Deviation	Number
Male	157-178	162.31	3.81	100
Female	146-169	151.45	4.085	100

Average Body Height (in cm)

Regression Statics Of Ulna	Male	Female
Intercept (a)	20.61	9.76
Regression Coefficient (b)	5.48	6.16
Independent Variable (x) - Ulna Length	25.87	23.01

Gender	Ulna Length	Actual Height	Estimated Height	Difference
Male	25.9	162	162.54	+0.54
Male	26.4	165	165.28	+0.28
Male	27	168	168.57	+0.57
Female	23	152	156.98	+0.98
Female	23.9	156	156.98	+0.98
Female	22.5	148	148.36	+0.36

Regression Equation for Male
Height = 20.61 + (Ulna Length × 5.48)

Regression Equation for Female
Height = 9.76 + (Ulna Length × 6.16)

DISCUSSION –

It is very difficult to calculate height from length of long bones ,since proportional relational of total body height to the length of long bone is variable from person to person .Stature of an individual mainly depend on genetically inherited character from his /her mother –father.

Allbrook D(1961)[12] estimate stature from ulna by formulating regression equation formula –stature =88.94+3.06 (ulnar length) .+/- 4.4 SE.

Ahawale MC observed a definite correlation between stature of an individual with length of long bones . [from ulna by formulating regression equation formula –stature =56.9709+3.9613 (ulnar length) .+/- 3.64 SE].

Sarojini Devi et al also found a correlation coefficient (r =0.619 for

male &0.584 for female) and formulated regression equation formula for estimating stature by upper arm length among Maring tribes in chandel ,Manipur. In present study correlation coefficient (r) of total body height and length of ulna is *Mondal et al(2009)* derived regression equation formula for estimating stature by ulnar length in males of west Bengal in age 20-50 years of age .Estimation of height from right ulna $Y_1=50.642+4.189X_1$ & for left ulna $Y_2=76.289+3.256X_2+/-9.082$.

Agnihotri et al(2009)performed a study in an Indo- Mauritian population to estimate stature from percutaneous ulna length and stated that PCUL can be efficiently used for stature estimation .

Ilayeruma et al(2010) also derived regression equation formula for estimating stature by ulnar length in both males & females in Srilankan population.

Akhmed (2013) studied in Sudanes adult and found a relation between upper limb dimensions (upper arm length , ulna length wrist breadth ,hand length & breadth) and stature and derived regression equation formula for estimating stature

Mukta rani et al [13]estimated the stature in students of delhi to be 169.5 cm in male and 159.5 cm in female. It means in Delhi region height of peoples is more than the Jhansi region.

Akhilesh trivedi, S. saxena[14] estimated stature of student of Gwalior to be height is 164.5 cm in PCUL 27.09 cm in male and in female 155.3 cm & 24.79 cm in females. Which is slightly more in comparison to Jhansi population .

Pertovecki et al [15]test a new radiographic approach to stature prediction that could be used in adult cadaver were measured 24 hours death and considered equal to living stature. Anterio-posterior radiograph of all limbs were taken and maximum length of 6 long bone measured from radiograph. He stated that correlation between height and maximum length of long bone was best for tibia in male and best for humerus in female in a study of Croatian population.

According to *Kate & Mazumdar*[16] after comparing derived regression equation for maharastrian and punjabies with that of Pearson's (English scientist) regression formula derived From English bone, concluded that Pearson's regression equation does not give exacts result in Indian population. Same view of Karoreet al , They suggested that the regression formula derived by *Albrook12* for estimating the stature in the British population is not suitable to estimate the stature in Indian population.

CONCLUSION

Estimated height by using regression equation formula never be accepted as the accurate value. Variations are always there. To avoid this difficulty slandered error of estimation also always calculated.

Standard deviation in males -2.66690469
Standard deviation in Females -2.3787811

It was observed that although standing height two individual were found same but there PCUL differ. And if PCUL of two individual were found same yet there total body height different.

There was very - very slightly difference in the right and left ulna in both genders total body height of body by regression formula is very - very similar to actual measured to body height. Mean calculated body height were similar to measured body height.

So conclusion is it is possible to determine stature of a deceased person (whose only remains found) accurately to some extent. But this formula is population specific.

Scope For Further Research – For better understanding ,similar study can be conducted in other regions and a comparison can be made.

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