Original Article

Estimation of Stature from the Percutaneous Length of Ulna among the People of Odisha

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Abstract

Stature is one of the primary identifying features helpful in both living and dead. In this study we determined the stature from the percutaneous length of ulna in living population of Odisha. The study was conducted in Hi-Tech Medical College and Hospital, Bhubaneswar during Oct-2013 to Sept.-2015 for two years. Stature was measured as the crown to heel length of the person in standing position. Percutaneous length of ulna measurement as the straight distance from most proximal point of olecranon process to the most distal point of ulnar tuberosity with forearm fixed to 90^0angle. The finding were studied for establishing the co-relation of percutaneous ulnar length to that of the body height and a suitable mathematical formula established to estimate the body height. The estimated heights so found in both sexes are accepted within a range of error and are in very close approximation with each other.

Keywords: *Stature, percutaneous length of ulna, living population, mathematical formula, Odisha*

Introduction

Identification means establishing the individuality of a person. Many factors are taken into consideration for this purpose one of them is stature of the person. When whole body is available living or dead measurement of the height of a person is easy. The importance of estimating, the stature of a person from the upper extremity has been felt and appreciated by all the leading forensic experts of the world.

These workers after carrying out measurements have published multiplication factor for the length of long bones and stature proportion and regression formulae from which the stature of an individual can be calculated. All of them agree that long bones of body have got or have a definite correlation with stature of the individual and can help in estimation of stature of an individual with accuracy. Some of the authors from foreign countries worked in this field are: Pearson (1899)[1], Dupertuis and Hadden (1951)[2], Trotter and Glesser (1951, 52, 58)[3] and Albrook (1961)[4]. In India also research work has been carried out and the name of Indian workers are Pan (1927) [5], Siddiquet and Shaha (1944)[5], Athawala (1963)[6], Patel (1963-65)[7].

However there is a drawback that the data of one country or one race or even one religion cannot be applicable to other country or race or religion. Further it has been correctly observed by Trotter and Glessor[3] that a regression formula for calculation of stature from bone length derived for a particular group of persons in a particular zone even though found to be accurate for a period yet cannot be a permanent value and fit for a greater span of years.

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Aim and Objective

1. Determination of stature from percutaneous length of ulna from living Odia population

2. To determine the variations among male and female in living Odia population.

3. To determine the variations among left and right forearms of male and female.

Materials & Method

The study was conducted in Hi-Tech Medical College and Hospital, Bhubaneswar during Oct-2013 to Sept.-2015 for two years. It was consist of equal number of male and female who came to the Casualty for injury examination, their relatives and students, where their age is above 20 years. People below 20 years and any physical deformity were excluded. The people who denied consent for measurement were also excluded.

In this study, the height of 300 living Odia males and 300 living Odia females had been recorded by direct measurements. The length of ulna was also measured in living persons. This bone was chosen because it is easy to identify their anatomical ends on the surface and to take their measurements in the living persons, making the necessary corrections for the skin thickness which is not much thick in respect to the end of the bones.

In the present study, data regarding the height of the Odias had been collected from living people and the lengths of ulna had been recorded. Prior to proceeding for the study the permission of hospital ethical committee was taken. From these data, formulae had been derived for estimating the total stature from the ulna bone.

Stature was measured as the crown to heel length of the person in standing position. Percutaneous length of ulna measurement as the straight distance from most proximal point of olecranon process to the most distal point of ulnar tuberosity with forearm fixed to 90^0angle. Instruments used were Standiometer, Standard metric scale, Measuring tape, Wooden or metal scale, Spreading caliper.

All data were collected, complied and subjected to statistical analysis. Results were presented using charts, tables and diagrams. Finally the finding were studied for establishing the co-relation of percutaneous ulnar length to that of the body height and a suitable mathematical formula established to estimate the body height from the percutaneous ulnar length when available in working process.

Results

Table-1: Showing Group number with number of cases per group, body height, percutaneous length of ulna of left and right side in cm of male and female individuals.

MALE/ FEMALE

Group No Male	No of Male cases Per Group	Body Height Male in CM	Percutaneous length of Left Ulna of Males in CM	Percutaneous length of Right Ulna of Males in CM	Group No Female	No of Female cases Per Group	Body Height of Females in CM	Percutaneous length of Left Ulna of Females in CM	Percutaneous length of Right Ulna of Females in CM
1	2	146	25	25	1	4	135	22.4	22
2	4	148	25	25	2	15	136	24	24
3	15	150	26	26	3	2	138	22.8	22
4	15	151	24.2	24	4	15	139	22.2	22
5	20	152	25.7	25	5	15	140	22.8	22.6
6	15	153	25.3	25	6	20	141	23	23
7	7	154	25.9	25	7	15	142	24	24
8	10	155	27	27	8	7	143	23.6	23
9	15	156	26.8	26	9	10	144	23.3	23
10	18	157	26	26	10	15	145	24.1	24

Cont... **Table-1: Showing Group number with number of cases per group, body height, percutaneous length of ulna of left and right side in cm of male and female individuals.**

11	10	158	26.5	26	11	18	146	24	24
12	6	159	26.4	26	12	10	147	24	24
13	15	160	26	26	13	6	148	24.4	24
14	7	161	26.5	26	14	15	149	24	24
15	12	162	27	27	15	7	150	24.7	24
16	12	163	27.5	27	16	12	151	25.4	25
17	3	164	26	26	17	12	152	24.6	24
18	10	165	27.4	27	18	3	153	25.5	25
19	15	166	28	28	19	10	154	24	24
20	11	167	27.5	27	20	15	155	24	24
21	12	168	28.4	28	21	11	156	25	25
22	20	169	27	27	22	12	157	26	26
23	10	170	28.4	28	23	20	158	25.9	25.8
24	5	171	28	28	24	10	159	26	26
25	4	172	28	28	25	4	160	26	26
26	10	173	28	28	26	10	161	25.9	25.7
27	10	174	27.5	29.5	27	1	162	26	26
28	2	175	29.5	29	28	1	163	27	27
29	5	176	29.6	29.7	29	5	164	27	27

The data in the above tables further discussed below in relation to mean standard deviation and coefficient of variation with a view to study in detail variability and inter relationship of the characteristics.

Table- 2: Showing range, mean, standard deviation, coefficient of variation, standard error of body height, left and right ulna length in centimeter for both male and female

Character	Body Height in Cm					Left Ulna Length in Cm.					Right Ulna Length in Cm.				
	Range	Mean	S.D.	C.V.	S.E.	Range	Mean	S.D.	C.V.	S.E.	Range	Mean	S.D.	C.V.	S.E.
Male	146- 176	160.9	7.712	29.33	0.445	24.2- 29.6	26.74	1.15	24.86	0.066	24- 29.7	26.56	1.318	26.57	0.076
Female	135- 164	148.61	7.64	19.957	0.4414	22.4- 27	24.31	1.155	17.48	0.066	22- 27	24.17	1.188	22.97	0.068

Correlation Co-efficient

The Correlation Co-efficient (r) value between each bone length and height in both the sex are highly significant.

Simple regression formula

Since there is a high correlation between the bone lengths and the height, the simple regression analysis is done between each bone length and height for the sex to establish the relationship between the height and bone

length. Regression equations are also fitted to predict the height when either one of the bone length is available within the range of observed bone length and has been given in the Table No- 4. It is revealed that regression coefficient which represented as a change in height per unit change in ulna length is highly significant for both the sexes. Thus indication thereby that the predicted height could be approximated when bone length is given within the observed length in which the present investigational data corresponded to.

Working Formula

Y= a + bx

Y= height

x= percutaneous ulna length (P.C.U.L.)

b= Slope of the line

a= Intercept

Table No- 3: Showing regression analysis between the bone length and body height and body height in both sexes.

Character	Bone Length	Correlation (r)	Slope (b)	Standard Error of Slope b	Intercept (a)	Standard Error of estimated	Simple regression equation Y= a+bx
Male	P.C.U.L.	0.933	5.881	0.0756	3.674	±3.63	Y= 3.674+ 5.881 x P.C.U.L.
Female	P.C.U.L.	0.923	5.915	0.0766	4.767	±3.57	Y= 4.767+ 5.915 X P.C.U.L.

Table No- 4: Showing the estimated Body height by simple regression equation using percutaneous left ulna length in Male

Group No	No of cases Per Group	Body Height in Cm	Percutaneous length of Left Ulna in CM	Predicted Height from Left Ulna Length
1	2	146	25	150.699
2	4	148	25	150.699
3	15	150	26	156.58
4	15	151	24.2	145.9942
5	20	152	25.7	154.8157
6	15	153	25.3	152.4633
7	7	154	25.9	155.9919
8	10	155	27	162.461
9	15	156	26.8	161.2848
10	18	157	26	156.58

CTable No- 4: Showing the estimated Body height by simple regression equation using percutaneous left ulna length in Male

11	10	158	26.5	159.5205
12	6	159	26.4	158.9324
13	15	160	26	156.58
14	7	161	26.5	159.5205
15	12	162	27	162.461
16	12	163	27.5	165.4015
17	3	164	26	156.58
18	10	165	27.4	164.8134
19	15	166	28	168.342
20	11	167	27.5	165.4015
21	12	168	28.4	170.6944
22	20	169	27	162.461
23	10	170	28.4	170.6944
24	5	171	28	168.342
25	4	172	28	168.342
26	10	173	28	168.342
27	10	174	27.5	165.4015
28	2	175	29.5	177.1635
29	5	176	29.6	177.7516

Table No- 5: Showing the estimated Body height by simple regression equation using percutaneous left ulna length in Female

Group No	No of cases Per Group	Body Height in Cm	Percutaneous length of Left Ulna in CM	Predicted Height from Left Ulna Length
1	4	135	22.4	137.263
2	15	136	24	146.727
3	2	138	22.8	139.629
4	15	139	22.2	136.08
5	15	140	22.8	139.629
6	20	141	23	140.812
7	15	142	24	146.727
8	7	143	23.6	144.361
9	10	144	23.3	142.5865

Cont... **Table No- 5: Showing the estimated Body height by simple regression equation using percutaneous left ulna length in Female**

10	15	145	24.1	147.3185
11	18	146	24	146.727
12	10	147	24	146.727
13	6	148	24.4	149.093
14	15	149	24	146.727
15	7	150	24.7	150.8675
16	12	151	25.4	155.008
17	12	152	24.6	150.276
18	3	153	25.5	155.5995
19	10	154	24	146.727
20	15	155	24	146.727
21	11	156	25	152.642
22	12	157	26	158.557
23	20	158	25.9	157.9655
24	10	159	26	158.557

Discussion

Usually by 20th years the Odiyas reach their maximum height and further Linear growth contributing to height stops due to the union of epiphysis of long bones.

Other Indian workers have also determined the height of living males and females and have given their mean height values with the minimum and maximum figures. It has been seen that the data of the present study is in close conformity with the findings covering the population of different zones of India. Whatever variations are found they are negligible both statistically and biologically and can be explained on the ground of nutritional and climate variation.

The height of a living person is also subjected to diurnal variation. The height measured in the supine position in bed after a full night's rest will be more than the height measured in standing the same person in the evening after the full day's tiring activity. In the present work, this difference of diurnal variation in the living has not been taken into account as it was not possible to taken such measurement in large number of cases covered. In superior extremity, ulna is the bone whose length can suitably be measured on percutaneous palpation of the bony landmarks in the living people.

Pearson[1](1898) and Trotter & Glesser[3](1951-58) all have measured isolated recovered well macerated ulna bones along with other four long limb bones and established the "Stature reconstruction formulae from these bones in the form of 'Regression equations'. Allbrook[4] measured ulna and tibia in the same way.

In India also, workers have worked on this stature reconstruction problem taking the long bone lengths into account. Amongst them Pan[5] (1924) and Siddiqui & Saha[5] (1944) worked on all the six long limb bones and presented the formulae in the form of proportion (% of bone length to body height) and " multiplication factor". In the year 1963 Athawale[6] worked on the same thing using radius and ulna and derived a multiplication factor for the said bones to estimate the height. Joshi & Patel[7] in the year 1963-65 worked on tibial and ulnar length of living persons of Gujrat and tried to derive both "simple regression equation" and "multiple regression equation" formulae. Bhatnagar[11] worked it on Punjab population. Many other authors have conducted such anthropometric study over long bones to calculate stature[9-14] within and outside India.

Many workers have work with ulna bones, hence it is accepted by most of the workers that ulna is most suitable bone in superior extremity and their lengths can be used for deriving of formula for stature reconstruction. So the selection of ulna bone from superior extremity and in the present study for deriving the formulae for stature reconstruction in both sexes among Odiya population is fully justified and correct.

It is quite problematic to establish the height from the length of long bones since the proportional relationship of the length of a long bone to the body height is variable from individual to individual. In mathematical problem although the total number remains constant the proportion of the additive digits to the total varies widely. Such is a problem which is also seen in the study of biological data of this nature. Hence in the study of such biological data one is forced to take into account a mean height and a mean bone length (in the present work the man PCUL) for the type of work.

Since workers have used regression equation formula for the estimation of height from surface bony length of ulna. The present study used only PCUL to develop a simple regression equation for both sexes. It has already been noted that the estimated height values by using the regression equation formula can never be accepted as the exact value since variation from this are always expected and to avoid this difficulty a standard error of estimate has also been calculated.

Lastly an attempt has also been made to verify whether there is any difference between the percutaneous bone length of right ulna and left ulna and statistically it has been proved that the is no significant difference between mean , SD,CV,SE of percutaneous ulna length of left and right side. So I have chosen the left side ulna because the left hand is used less, there is less chance of fracture or other deformity.

Conclusion

The average height of males was found to be 160.9 cm and of females was found to be 148.61 cm. The average percutaneous length of left ulna of males was observed to be 26.74 cm. and of females was observed to be 24.31 cm. For estimation of height for both sexes from percutaneous length of ulna the regression equation have been calculated by using the data collected in present work. The estimated heights so found in both sexes are accepted within a range of error and are in very close approximation with each other. Hence it is possible to determine the height of a person by using the data and the formula derived from the present work fairly accurately with in standard error of estimate which is acceptable from biological consideration in determining the height of a known cross section of population.

Conflict of Interest : None declared

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