Original article:

A correlational study between stature and percutaneous tibial length in adult males and females of Rajasthan

*Neha Saini, Sangita Chauhan, Priyanka Katara, Rekha Parashar

Department of Anatomy, S.M.S. Medical College, Jaipur, Rajasthan

*Corresponding author: Dr.Neha Saini

ABSTRACT:

Introduction: "Identification is an individual's birth right". A dismembered body parts are being frequently brought to the Medico-legal expert for generating data for identification, due to incidence of mass disasters like air crash, terrorist attacks etc. These disasters are quiet frequent now a days. The aim of the present study was to estimate the stature from percutaneous tibial length (PCTL) which is very useful in identification of victim or an accused involved in a criminal act is an important task in the field of forensic investigation. The regression equations of the present study could be used to estimate stature in population of Rajasthan.

Material and methods: Study consists of 50 adult males and 50 adult females between the age group of 20 – 30 years, born or brought up in Rajasthan. Measured parameters of subjects are stature and percutaneous tibial length.

Results: On computing the data, it was found that a significant positive correlation exists between the stature and percutaneous tibial length with a correlation coefficient (r= 0.98 in males and r= 0.95 in females) and p value <0.0001. Stature is estimated from percutaneous tibial length using simple regression analysis for males (Stature in cm = 68.9514 + 2.5902 PCTL in cm) and for females (Stature in cm = 85.1460+ 1.9005 PCTL in cm)

Keywords: Stature, percutaneous tibial length, forensic anthropology

INTRODUCTION

Personal identification means determination of individuality of persons. It may be complete (absolute) or incomplete (partial). Complete identify-ication 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.

Stature is one of the various parameters of identification of the individuality of a 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, trunk and lengths of the upper and lower limbs. Assessing the height of an individual, from measurements of different parts, has always been of immense interest to the anatomists, anthro-pologists and forensic medicine experts. Kaore Ashita (2012) measured heights of the subject in standing position and percutaneous length of Tibia was on both sides and found positive correlation between them. Extensive work has been done on correlation of measurements of various body parts with stature of a person in the India and abroad. However they have been conducted in different regions on different races, hence their data and statistical formulae cannot be generalized.

MATERIAL AND METHOD

The present study has been conducted on medical students of Rajasthan in S.M.S. Medical College, Jaipur, consisting of 100 adults which includes 50 males and 50 females Only those students are included who are born and brought up in Rajasthan state with ancestral origin from this region. Age groups of students ranged from 21 to 29 years are selected for measurements only after their consent for giving measurements. Following Measurements were taken-

1. **Stature** - Height is measured from vertex to floor by stadiometer with subject standing barefooted, erect on an even floor, in the Frankfurt's plane. Subject's head is positioned parallel to the floor with heels together and weight evenly distributed between both feet.
2. **Percutaneous tibial length-** is measured with the help of spreading calipers in centimeters, by measuring the distance between the most prominent palpable portion of the medial condyle of the tibia and tip of the medial malleous. The subject is asked to sit with knee placed in the semi flexed position and the foot partly inverted to relax the soft tissues and render bony landmarks prominent. Then, the prominent landmarks are measured with the help of spreading calipers. Further, the measurement is confirmed by using metric tape.

The data thus, collected is then subjected to statistical analysis using computer software named as Med Calc version 12.7, SPS (Smith's Package of Statistics) and Microsoft Excel spreadsheet.

OBSERVATION AND RESULTS

On computing the data, it was found that a significant positive correlation exists between the stature and percutaneous tibial length. Stature is estimated from percutaneous tibial length using simple regression analysis.

1. Showing different parameters of stature and PCTL in males and females:

S.NO.	PARAMETERS	MALE		FEMALE	
		STATURE	PCTL	STATURE	PCTL
1	Range	159.00 - 187.50	35.50 - 46.00	147.70 - 170	32.50 - 43.50
2	Mean	174.91	40.90	157.53	38.09
3	SD (Standard Deviaion)	6.57	2.48	4.77	2.39
4	% Confidence Variation (CV)	173.04 to 176.77	39.50 to 42.50	155.80 to 159.08	37.41 to 38.77
5	SE (Standard Error)	0.9293	0.35	0.6756	0.33
6	Significance level	$p \leq 0.0001$		$p \leq 0.0001$	

www.ijbamr.com P ISSN: 2250-284X E ISSN :2250-2858

** above table shows different values of stature and PCTL considered under various parameters in males and females. These shows that stature and PCTL are more in males than females. The present study revealed that standing height of many individuals were same, but their percutaneous tibial lengths (PCTL) differed, i.e. the contribution of tibial length to the stature of a person varied from person to person, even for a given height. Keeping this in view, mean of stature and PCTL were taken into consideration. The data were analyzed for range, mean, standard deviation, % of co-efficient variation and standard error. Correlation coefficients (r) of height and PCTL were calculated for males and females. All these values are statistically highly significant. (p value≤0.0001)

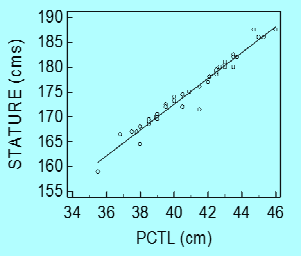

Figure 1: Scatter diagram with regression line in males

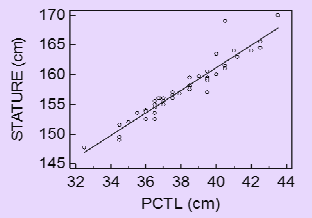

Figure 2: Scatter diagram with regression line in females.

** Both the figures show a linear relationship between stature and percutaneous tibial length in males and females.

Table 2 Regression Analysis between Stature and PCTL in males and females.

Parameter	Male	Female
Linear regression equation	Y = 68.9514 + 2.5902 X	Y=85.1460+ 1.9005 X
SE	3.0653	3.3093
Correlation Coefficient (r)	0.98	0.95
95% Confidence interval of (r)	0.9658 to 0.9890	0.9191 to 0.9735
Coefficient of determination (R^2)	0.960	0.902
Residual standard deviation	1.3024	1.4547
Intercept	68.9514	85.1460
Slope	2.5902	1.9005
Significance level	p≤0.0001	p≤0.0001

www.ijbamr.com P ISSN: 2250-284X E ISSN :2250-2858

Where, Y= Stature in cm, and X = PCTL in cm.

** Table 2 shows descriptive statistics of the study sample. The linear regression equations have been derived along with correlation coefficient in both cases. These analyses depict linear correlation between stature and PCTL in both cases. Since there is high correlation between the height and PCTL, these equations can be used to predict height from PCTL.

DISCUSSION

Estimation of stature from bones plays an important role in identifying unknown bodies, parts of bodies or skeletal remains. In the present study, an attempt has been made to establish the relationship between stature and percutaneous tibial length in males and females of Rajasthan. The study was conducted on 100 individuals born and brought up in Rajasthan. As individuals stop growing in height on completion of union of the epiphysis and the diaphysis, which is usually by the age of 18 to 20 years, all individuals considered for the purpose of study were above the age of 20 years, also after 30 years there is regression of the intervertebral disc, so the subjects below 30 years are included in the study. The present study reveals that standing height of many individuals was same, but their percutaneous tibial lengths (PCTL) differed, i.e. the contribution of tibial length to the stature of a person varied from person to person, even for a given height. Keeping this in view, mean of stature and PCTL were taken into consideration. Trotter and Gleser had designed the most commonly used equations. The lower limb length is the greatest contributor to standing height; hence most of the predictive equations are based on the length of the long bones of the lower limb, the femur, tibia, and fibula. To address the issue of poor preservation and fragmented and incomplete bones, Steele had developed equations for predicting the complete length of the long bone.

Correlation coefficients (r) of height and PCTL were calculated for males and females. The value of 'r' for males was 0.98 and for females 0.95. Both these values were statistically significant. Since there was high correlation between the height and PCTL, a simple regression analysis was done between them for males and females, to predict height from PCTL.

For estimation of height from PCTL, a simple regression formula was derived as follows:

For male Stature in cm = Y = 68.9514 + 2.5902 X

For females Stature in cm = Y=85.1460+ 1.9005 X

Where, Y= stature and X = percutaneous tibial length.

This is comparable to other studies conducted in Eastern and Northern India [6], Germany [8] ,Mauritius [13], Turkey [10] and Korea [6]. Mohanty et.al (1998) found a correlation coefficient (0.952 in males and 0.939 in females, similarly Ozaslan et.al. (2003) derived correlation coefficient (0.740 in males and 0.790 in females). The highest correlations were observed between stature and tibial length, which explains that the weight bearing bones are better indicators of the stature.

The estimated height so derived is acceptable within a range of error and was in close approximation with that of the observed height., Celbis (2001), Pelin et.al (2003) ,Mall (2006) in their study derived regression formulae and found a good correlation .

Bhavna and Surender Nath (2009) in their study on male Shia Muslims in Delhi derived the linear regression equation which is comparable to our study, but exemplifies the fact that the regression equation

www.ijbamr.com P ISSN: 2250-284X E ISSN :2250-2858

derived will be population group/region specific. In our study we broadened the spectrum of assessment by including both males and females which has not been done in the above studies.

Similarly, K.R. Nagesh (2011), estimated the stature from length of tibia, radius and ulna in medical students belonging to South Indian population. In his study, the multiple regression equations involving all the three parameters showed higher correlation coefficients (0.829 in males and 0.747 in females). The regression equations were derived which are helpful in estimating stature from the lengths of tibia, radius and ulna in South Indian population.

Therefore, the derived regression equations are valid and applicable to the population of Rajasthan. However, the derived regression equations for the population of Rajasthan do not match with any of the other races, nations or the religious studied, as these are individually different. These finding substantiates the views expressed by other workers that, state wise and population wise, different regression formulae are required for estimation of stature.

CONCLUSION

There is a linear relationship between the length of bones and body height. It is possible to determine the stature of a deceased person whose only body part available is a mutilated leg, by using the data and formula derived from the present study fairly accurately, within a standard error of estimate which is acceptable from biological consideration in determining the height of a known cross section of population. However the formulae derived cannot be generalized to all population groups, hence it is necessary to derive regression equations which are region wise and population specific.

REFERENCES

1. Pan N. Lengths of long bones and their proportions to body height in Hindus. J Anat 1924; 58: 374-378
2. Siddiqui H, Shah MA. Estimation of stature from long bones of Punjabis. Indian J Med Res 1944; 31: 105-108.
3. Athawale NC. Anthropological study of height from length of forearm bones. A study of one hundred Maharashtrian male adults of ages between twenty five and thirty years. American Journal of physical anthropology 1963;21:105-112.
4. Patel MP, Joshi NB, Dongre AN. Regression equation of height on tibial length. Indian J Med Res 1964; 52: 531-534.
5. Anand N, Nath S. Estimation of stature through percutaneous measures of the upper and lower extremities among Rajputs of Pauri Garhwal. Ind. J. For. Sci., 5: 83-89 (1990).
6. Choi BY, Chae YM, Chung IH, Kang HS. Correlation between the postmortem stature and dried limb-bone lengths of Korean adult males. Yonsei Med J, 1997; 38: 79-85.
7. Mohanty NK. Prediction of height from percutaneous tibial length amongst Oriya population. Forensic Sci Int, 1998;98:137-41
8. De Mendonça MC. Estimation of height from the length of long bones in a Portuguese adult population. Am. J. Phys. Anthropol, 2000;112, 39–48.

9. Mall G, Hubig M, Buttner A, Kuznik J, Penning R, Graw M. Sex stermination and estimation of stature from the long bones of the arm. Forensic Sci Int, 2001; 117: 23-30.
10. Pelin IC and Duyar I. Estimation of stature from tibia length: a comparison of methods. Journal of Forensic Sciences 2003 Jul; 48(4):708-12.
11. Ozaslan A, Can MY , Ozaslan I, Tuocu H, Koc S. Estimation of stature from body parts. Forensic Sci. Int, 2003; 132:40-5.
12. Krishan K, Sharma A. Estimation of stature from dimensions of hands and feet in a North Indian population. J Forensic Legal Med. 2007; 14:327-32.
13. Patel SM, Shah GV, Patel SV. Estimation of height from measurements of foot length in Gujarat region. J Anat Soc India, 2007: 56:25.
14. Agnihotri AK, Kachhwaha S, Jowaheer V, Singh AP. Estimating statute from percutaneous length of tibia and ulna in Indo-Mauritian population. Forensic Science International; May 2009 187 (1), 109.e1-109e3.

Date of submission: 29 September 2013 Date of Provisional acceptance: 22 October 2013
Date of Final acceptance: 20 November 2013 Date of Publication: 04 December 2013
Source of support: Nil; Conflict of Interest: Nil