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Estimation of Stature Using Lower Limb Dimensions among Maring Males of Manipur

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ABSTRACT In the present study, an attempt has been made to formulate multiplication factors and regression equations for estimation of stature using percutaneous dimensions of lower limb bones. A total of 500 (five hundred) male individuals belonging to the age range of 18- 40 years were measured for percutaneous lengths of femur, tibia and fibula besides stature. Out of the three lower limb measurements, tibial length reveals the highest correlation coefficient (r) of 0.86 which is followed by femur length (r= 0.85). Fibular length exhibits the lowest 'r' value of 0.83. As of multiplication factor (M.F), tibial length shows the highest with 4.79, while femur length indicates the least (4.30) of all. Regression equations are formulated separately for three lower limb dimensions and it is found that the intercept value and regression co-efficient in each regression equation varies from each other.

INTRODUCTION

Estimation of stature based on anthropometric measurements may be used in the identification of mutilated and skeletal remains of victims related with criminal matters and it has great significance in the investigation of the identity of victims of mass disasters and fatal assault. Forensic anthropologists, anatomists and forensic scientists have adopted the percutaneous bone measurements of living individuals which was recommended by Allbrook (1961) for the purpose of estimation of stature. He worked among the British and East African males for estimation of stature using the methods of multiplication factor and regression equation. A multiplication factor is the ratio between stature and the respective body dimensional measurement. Various scientists (Nath and Routray 1996; Nath 1997; Sachdeva et al. 1998; Devi and Nath 2005; Bhavna and Nath 2005; Jain et al. 2006; Jibonkumar and Lilinchandra 2006; Krishan and Sharma 2007; Menezes et al. 2009; Kanchal et al. 2010) have undergone research works on the aspect of estimation of stature using different body measurements among different population groups. Owing to genetic and sex variations observed in different population groups, an attempt has been made to compute multiplication factor, correlation coefficient and regression equation for estimation of stature among Maring males of Manipur.

The Marings are one of the 36 recognized scheduled tribes of Manipur. The total population of the Maring tribe was 17,361 (Census of India 2001) . They have contributed 2.43 per cent of the total population of Manipur. They are mainly concentrated in Machi and Tengnoupal sub-divisions of the Chandel district, but the Maring households are also found to be distributed in small pockets in Ukhrul and Senapati districts of Manipur.

MATERIAL AND METHODS

Data of the present study consists of 500 Maring males belonging to different Maring villages. The age of the subject ranges from 18- 40 years. Each subject was measured for the percutaneous lower limb measurements of femur length (FEML), tibial length (TIBL), fibular length (FIBL) and stature (S) after Martin and Saller (1959).

Data analysis was done using SPSS/ PC Package for computation of multiplication factors, correlation and regression equations for estimation of stature from three percutaneous dimensions of lower limb measurements. Other statistical constants such as mean, standard error of mean, standard deviation were also computed using SPSS/PC.

RESULTS AND DISCUSSION

Table 1 displays mean values, their respective standard deviation (SD) and standard error

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of mean (SE) for three lower limb measurements and stature among Maring males of Manipur. It is evident that Maring males have an average stature of 159.54 ± 0.21 which ranges from 146.10 - 171.20 cm. Among the three lower limb measurements, femur length shows the highest mean with 37.28 ± 0.08 cm, while the least mean (33.26 ± 0.07 cm) is for tibial length. Further, femur length shows the highest standard deviation (1.84) whereas the least (1.68) is represented by tibial length.

Table 2 represents the multiplication factor (MF) values for three lower limb measurements of femur, tibia and fibula. It is observed that the highest value of MF is represented by tibial length that is, 4.799 ± 0.01 whereas femur length indicates the least MF value of 4.281± 0.007. The M.F value for fibular length is 4.536± 0.006 which is intermediate between the MF values of femur length and tibial length. From the distribution of different M.F values, it is seen that there is inverse relationship which indicates that smaller the body dimension, the larger is the MF value in the present finding.

Table 2: Multiplication factors of three lower limb measurements for estimation of stature

S. No.	*Body dimensions*	*MF (Mean)*
1.	Femur length (FEML)	4.281 ± 0.007
2.	Tibial length (TIBL)	4.799 ± 0.011
3.	Fibular length (FIBL)	4.536 ± 0.006

Table 3 depicts coefficient correlation (r) values of each lower limb measurement with stature. Different correlation values indicate that there is high positive correlation between stature and each lower limb measurement. Although, the highest correlation value (r=0.863) is found in between tibial length and stature. Correlations of femur length with stature (r=0.842) and fibular length with stature (r=0.835) are also comparatively high. However, out of the three lower limb measurements, tibial length provides the best estimate of stature as it indicates the overall highest "r" value. The highest 'r' value of tibial length with stature is in conformity with earlier studies (Sethi and Nath 1998; Bhavna and Nath 2007).

Table 3: Correlation values of three lower limb dimensions with stature

S. No.	*Body dimensions*	*' r'*
1.	Femur length (FEML)	0.842
2.	Tibial length (TIBL)	0.863
3.	Fibular length (FIBL)	0.835

Table 4 highlights the linear regression equations for estimation of stature from three lower limb measurements. These linear regression equations are formulated based on the correlation values as given above. Tibial length provides the best estimate of stature as it indicates the highest correlation (0.863) with lowest SE (± 3.17). Femur length, however, provides the next best estimate of stature. Among three lower limb measurements, fibular length reveals the highest standard error of estimate (±3.29) with having lowest 'r' value with 0.835. This fibular length should be used only in the absence of femur and tibial length measurements. The highest 'r' value of stature with tibial length is in conformity with earlier studies (Sethi and Nath 1998; Bhavana and Nath 2007). It has also been suggested that for estimation of stature, regression equation provides greater reliability than multiplication factor (Bhavna and Nath 2007; Jibonkumar and Lilinchandra 2006). Therefore, the present regression equations derived from Maring males could be safely used for estimation of stature by taking the relevant measurement.

Table 4: Linear regression equation for estimation of stature from three lower limbs

S. No.	*Regression equations*	*SE*
1.	S = 80.155 + 2.13 (FEML)	± 3.17
2.	S = 81.998 + 2.33 (TIBL)	± 3.08
3.	S = 80.366 + 2.25 (FIBL)	± 3.29

Table 1: **Mean and other statistical constants of stature and three lower limb measurements**

S. No.	*Parameters*	*Range*	*Mean (cm)*	*SD*
1.	Stature (S)	146.10 – 171.20	159.54 ± 0.21	4.71
2.	Femur length (FEML)	35.50 – 45.30	37.28 ± 0.08	1.84
3.	Tibial length (TIBL)	30.10 – 3 7.30	33.26 ± 0.07	1.68
4.	Fibular length (FIBL)	31.50 – 39.40	35.18 ± 0.08	1.83

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