

Estimation of Stature from the Length of Index Finger (2DL) and Ring Finger (4DL) in Nepalese Adults

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Abstract

Original Research Article

Establishing the identity of an individual in cases of mass disasters or when dismembered body parts are found is one of the significant Forensic investigations. Stature is a very important factor helping identity establishment in all cases of identification. With the aim to help cases of forensic identification, this study attempts to estimate the stature of an adult Nepalese from the length of index finger (2DL) and the ring finger (4DL). The study was carried out on a randomly selected cross sectional sample of 250 adult Nepalese students of third and fourth year MBBS and BDS studying in Universal College of Medical Sciences Teaching Hospital (UCMSTH), Bhairahawa, Nepal. Stature, left and right 2DL and 4DL were measured and statistically analyzed. Pearson's correlation coefficient was computed and Simple Linear Regression equations were derived to estimate stature from left and right 2DL and 4DL. The mean stature (171.06 cm) of males exceeds the mean stature (160.67 cm) of females. The Pearson correlation was higher between left and right 2DL and stature in males (Left 2DL $r = 0.7$ and Right 2DL $r = 0.64$) whereas it was higher between left and right 4DL in females (Left 4DL $r = 0.8$ and Right 4DL $r = 0.8$). Linear regression equations were derived for estimating stature in males and females from their left and right 2DL and 4DL. Scatter diagrams were plotted to see the association between the variables. Stature and body parts ratio being a population specific trait, we formulated simple linear regression equations to ascertain stature from 2DL and 4DL in Nepalese population.

Keywords: Finger Length, Forensic, Index finger, Identification, Ring finger, Stature.**Copyright @ 2020:** This is an open-access article distributed under the terms of the Creative Commons Attribution license which permits unrestricted use, distribution, and reproduction in any medium for non-commercial use (NonCommercial, or CC-BY-NC) provided the original author and source are credited.

INTRODUCTION

Establishing the identity of an individual in cases of mass disasters or when dismembered/ mutilated body parts are found is one of the most significant parts of Forensic investigation. Minor observations can play a vital role to help build the bigger picture.

Estimating stature from measuring various body parts has been endeavored by many Anthropologists, Anatomists, and Forensic experts. Such computations are based on a principle that body parts have more or less consistent ratios comparative to the stature of a person [1, 2] For that purpose researchers have utilized various body parts like upper limb, lower limb, and dimensions of hand and foot [2].

Like other body parts, the length of index and ring fingers also has more or less consistent ratios comparative to the stature of a person. The index finger is the second digit (2D) and the ring finger is the fourth digit (4D) of the hand [3].

We found many studies conducted to estimate stature using finger lengths [1, 4-16] but none of them were done in Nepal.

Owing to the variations in morphology of different populations, the formula for stature estimation has to be population specific [13]. In view of lacking literature on the estimation of stature from length of index finger (2DL) and length of ring finger (4DL), the present research was taken up to report the correlation between index and ring finger length and stature in Nepalese population. The aim of this study was to derive simple linear regression equations from the index and ring finger lengths in males and females to help estimate the stature in this population.

MATERIAL AND METHODS

The study was carried out on a randomly selected cross sectional sample of 250 adult Nepalese students (150 males and 100 females) of third and

fourth year MBBS and BDS studying in Universal College of Medical Sciences Teaching Hospital (UCMSTH), Bhairahawa, Nepal from October 2018 to March 2019. These students belonged to various places of Nepal.

Ethical clearance was taken from the Institutional Review Committee (IRC) of UCMSTH, Bhairahawa, Nepal (IRC number 70/18). Participants were informed regarding the research study and measurement procedures and were assured about the confidentiality of the data and measurements provided. Participation was voluntary after taking informed consent. Participants with any history and clinical evidence of hand disease, injury, deformity were excluded from the study.

Measuring procedure

1. Measuring 2DL and 4DL: - The hands of the subjects were placed on a flat surface with the palm facing upward and forearm in line with the middle finger. Fingers were extended maximally and kept close to each other. Digit length was measured in centimeters with the help of sliding caliper from both left and right hands of each subject. (Weiner and Lourie measurement technique [17] was employed)
 - a. Length of Index finger (2DL) was measured as the distance between the mid-points of metacarpo-phalangeal crease at the base of index finger to the tip of the index finger.
 - b. Length of the Ring finger (4DL) was measured as the distance between the mid-

points of metacarpo-phalangeal crease at the base of ring finger to the tip of the ring finger.

2. Measuring stature: - Stature was measured in centimeters to the nearest millimeter by making the subject stand erect and barefooted in anatomical position with the head in Frankfort Horizontal Plane from crown to heel with standard height measuring instrument.

The measurements were taken twice to avoid intra-personal variation and by two persons to avoid inter-personal variance. The mean of the measurements were then taken as final measurement.

Statistical Analysis

The obtained data was tabulated and statistically analyzed using the SPSS® for Windows, Version 12.0. Pearson's correlation coefficient was computed to understand the relationship between stature and 2DL and 4DL. Simple Linear Regression equations were derived to estimate stature from 2DL and 4DL, using stature as the dependent and 2DL and 4DL as independent variables. $P < 0.05$ was considered to be statistically significant.

RESULTS

The descriptive statistics of age, stature, length of left index finger (Lt. 2DL), length of right index finger (Rt. 2DL), length of left ring finger (Lt.4DL) and length of right ring finger (Rt.4DL) in males and females are shown in Table 1.

Table-1: Descriptive statistics of age, stature, 2DL and 4DL in males and females

Variables	Males (n=150)				Females (n=100)			
	Min	Max	Mean	St.dev	Min	Max	Mean	St.dev
Age (years)	20	24	22.28	1.03	21	24	22.13	0.97
Stature (cm)	164.3	180.9	171.06	3.13	157.1	165.6	160.67	2.06
Left 2DL (cm)	6.46	7.95	7.36	0.34	6.24	7.45	6.76	0.24
Right 2DL (cm)	6.43	7.98	7.37	0.33	6.23	7.48	6.78	0.25
Left 4DL (cm)	6.57	8.04	7.49	0.32	6.25	7.42	6.7	0.23
Right 4DL (cm)	6.71	8.14	7.54	0.32	6.21	7.41	6.69	0.22

The mean age of males was 22.28 years while the mean age of females was 22.13 years. The mean stature (171.06 cm) of males exceeds the mean stature (160.67 cm) of females.

The correlation observed between length and stature was statistically significant in all observations (Table 2, 3). The Pearson correlation obtained linking finger length and stature was found to be higher in

females as compared to males. The correlation was higher between left and right 2DL and stature in males (Left 2DL $r = 0.7$ and Right 2DL $r = 0.64$) whereas it was higher between left and right 4DL in females (Left 4DL $r = 0.8$ and Right 4DL $r = 0.8$). Linear regression equations were derived for estimating stature in males (Table 2) and females (Table 3) from their left and right 2DL and 4DL.

Table-2: Pearson’s correlation coefficient, coefficient of determination, P-value and the regression equation derived in Males

Parameter	Pearson correlation coefficient (r)	Coefficient of determination (R ²)	P	Regression equation derived
Lt. 2DL vs Stature	0.7	0.49	< .00001*	$\hat{y} = 6.56387X + 122.75125$
Rt. 2DL vs Stature	0.64	0.41	< .00001*	$\hat{y} = 6.04474X + 126.50727$
Lt. 4DL vs Stature	0.62	0.38	< .00001*	$\hat{y} = 6.03719X + 125.84531$
Rt. 4DL vs Stature	0.56	0.31	< .00001*	$\hat{y} = 5.51927X + 129.41204$

*The result is significant at p < 0.05.

Table-3: Pearson’s correlation coefficient, coefficient of determination, P-value and the regression equation derived in Females

Parameter	Pearson correlation coefficient (r)	Coefficient of determination (R ²)	P	Regression equation derived
Lt. 2DL vs Stature	0.77	0.61	< .00001*	$\hat{y} = 6.69036X + 115.40969$
Rt. 2DL vs Stature	0.78	0.62	< .00001*	$\hat{y} = 6.59166X + 115.93308$
Lt. 4DL vs Stature	0.8	0.64	< .00001*	$\hat{y} = 7.22648X + 112.19402$
Rt. 4DL vs Stature	0.8	0.64	< .00001*	$\hat{y} = 7.37984X + 111.24131$

*The result is significant at p < 0.05.

The association between stature and left 2DL, right 2DL, left 4DL, right 4DL among males and females are shown in scatter diagrams (Figure 1-8).

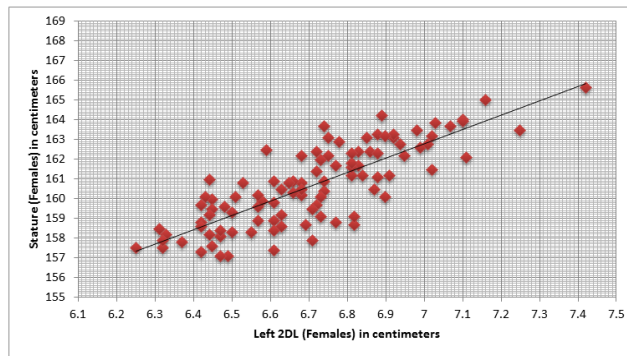


Fig-1: The association between stature and left 2DL among females

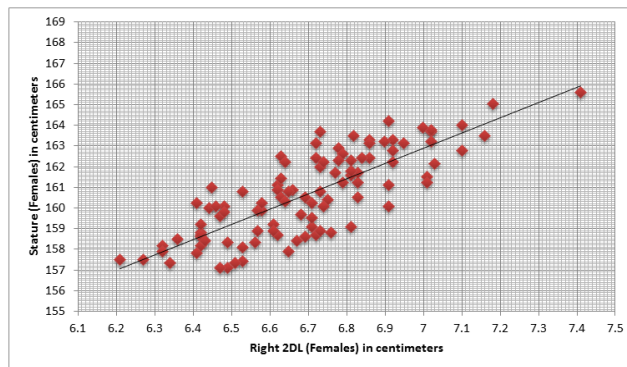


Fig-2: The association between stature and right 2DL among females

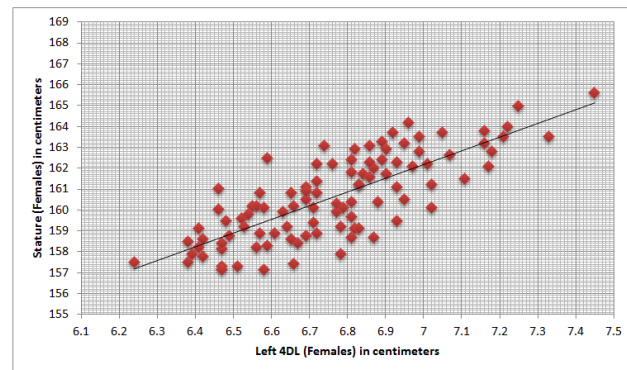


Fig-3: The association between stature and left 4DL among females

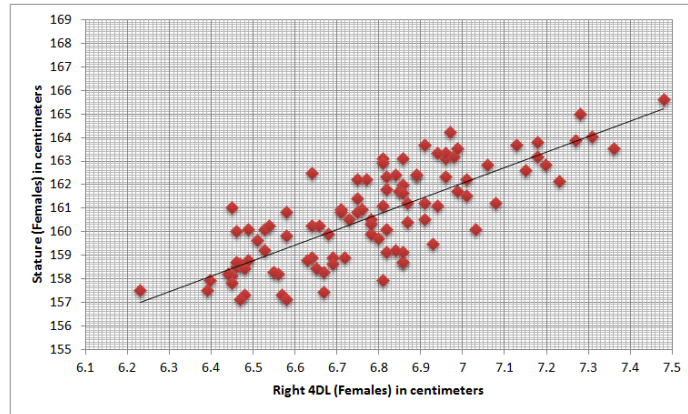


Fig-4: The association between stature and right 4DL among females

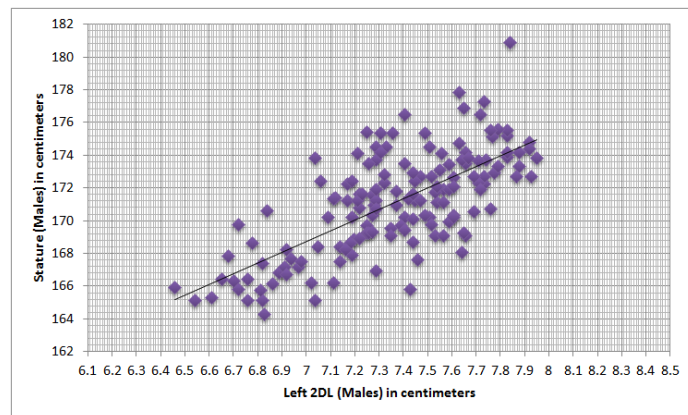


Fig-5: The association between stature and left 2DL among males

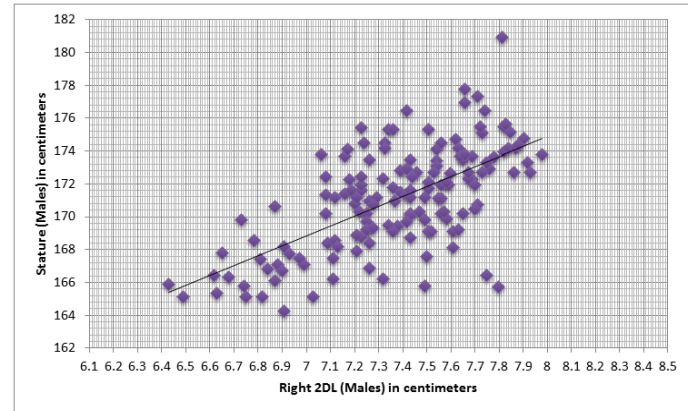


Fig-6: The association between stature and right 2DL among males

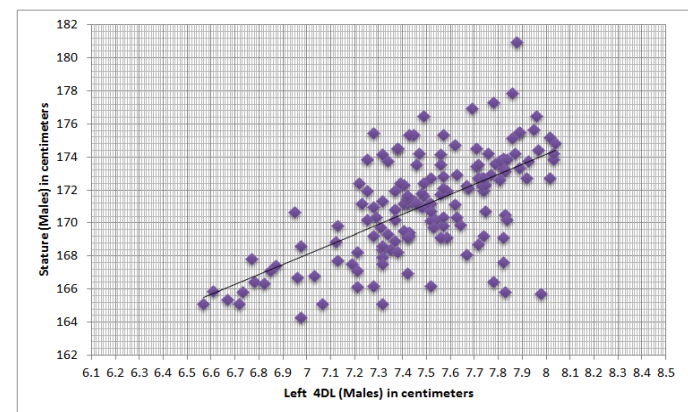


Fig-7: The association between stature and left 4DL among males

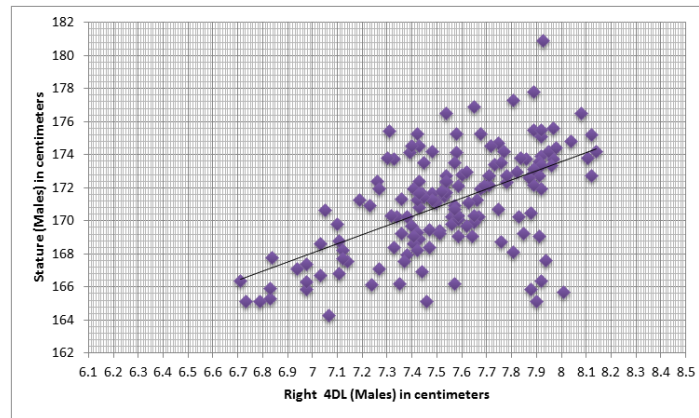


Fig-8: The association between stature and right 4DL among males

DISCUSSION

Forensic experts are investigating various body parts like head, face, hand, foot, phalanges, finger length etc to estimate the stature of a person [1] because there are circumstances where only dismembered or mutilated body parts are available for medical examination. In mass disasters like airplane crash, earthquake, tsunami etc. parts of dead bodies are brought for identification of individuals and if stature estimation can be done from that particular part, time required for identification and possible victim matches will be lessened [14]. In situations where sophisticated methods are not available or where such methods have limitations, simple anthropological methods can have much usefulness [1]. Many studies have revealed the usefulness of finger measurements in stature estimation [1, 4-16].

In a study involving five hundred Nigerians, Oladipo *et al.* found the mean stature in males and females to be 171.53 cm and 161.81 cm respectively [4]. In our study the mean stature of males was 171.06 cm and that of the females was 160.67 cm.

Singh B *et al.* Studied the Kinnaur population of Himachal Pradesh and came up with conclusion that 2D provided the best stature estimates [14] which was also found in our study for males. A study on stature estimation from 2DL and 4DL in North Indian population by Krishan et al showed that stature can be estimated with reasonable accuracy from 2DL and 4DL [7] which was also observed in our study. However, the correlation coefficient obtained for males was 0.67 to 0.74 and for females was 0.36 to 0.53 which was lesser as compared to our finding. This disparity may be because that study was conducted on adolescents with age ranging from 14 to 18 years whereas the age range for our study was 20 to 24 years.

The hand-related measurement variables of males in Slovakia [18], Turkey [19], Egypt [20], Mauritius [21], North India [7, 9, 14] and South India [5] have been found to be larger than those of females which were also found in our study. When comparing

the parameters with gender difference, Bardale RV *et al.* [1] found correlation coefficient to be higher in females than males while estimating stature from 2DL and 4DL which was also found in our study. However, a study by Oladipo *et al.* [3] and another study by Krishan *et al.* [7] found higher correlation coefficient in males as compared to females. This variation may be owed to the population difference, as those studies [3, 7] were done in Nigerian and North Indian population respectively but our study was done in Nepalese population.

It has been stated by Myung MK and Yun H that the shapes of hands differ according to the gender and race, and thus is of immense significance to devise an equation in consideration of variances to estimate stature [22]. Our attempt to find correlation between length of index and ring finger with the stature of males and females showed statistically significant positive correlation between them, which was valuable in estimating the stature of a Nepalese adult. Similar findings have been documented by many researchers [1, 4-16, 22] but stature and body parts ratio being a population specific trait we pioneered to formulate a simple linear regression equation to ascertain stature from 2DL and 4DL in Nepalese population.

CONCLUSION

Estimation of human stature to ascertain identity from various body parts is an important task. This being a quantitative trait affected by genetics and environment, population specific studies is indispensable. The outcomes of our present study show that lengths of index and ring finger can be used fruitfully to envisage the stature of a Nepalese adult. However, we recommend further specific studies involving different ethnic groups and races in Nepal for stature estimation.

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