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KEYWORDS: stature; observed height; calculated height; hand length

PREDICTION OF STATURE FROM HAND LENGTH IN UNDERGRADUATE STUDENTS OF COLLEGE OF MEDICAL SCIENCE AND TEACHING HOSPITAL, CHITWAN.

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ABSTRACT:

Introduction: The identification of deceased is essential during legal investigations, such as crimes resulting in fatality or discovery of unclaimed human body. Stature of an individual plays vital role in determining the identity of unknown person. Over the past decades, several anthropometric measurements of body segments had been used to compute the stature of an individual with variable degree of accuracy.

Aim: To formulate the regression equations to estimate the stature from hand length.

Materials and Methods: The cross-sectional analytical study was conducted in 197 students consisting of 100 females and 97 males, in College of Medical Science, Bharatpur, Nepal. Height and length of both hands were measured in each student with Stadiometer and spreading caliper respectively. The data was analysed using SPSS version 16.0.

Results: The mean values of height and length of both hands were statistically higher in males than in females ($p<0.05$). A significant positive correlation was observed between the height and length of right and left hands in both males and females, ($p<0.05$). The coefficients of determination were 0.39 in males for both hands and that in females were 0.51 for right hand and 0.49 for left hand. The calculated height (derived using regression equations) revealed no significant difference from the observed height in both male and female students ($p>0.05$).

Conclusion: This study provides regression equations to estimate stature from the hand length measurements, as hand length relates well with stature.

INTRODUCTION

Stature is defined as natural height of a person in upright position. Stature occupies a pivotal position in identifying obscured deceased bodies during mass catastrophes particularly when putrefied, disfigured or only fragmentary remnants of body part are recovered [1].

The height of an individual also plays a crucial role in adjusting drugs dosage particularly in children and geriatric patients [2]. The deformities affecting the vertebral column (lordosis, kyphosis and scoliosis) and excision of lower limb may complicate the accurate measurement of height in erect position in these patients, thus, emphasizes the need for establishment of the alternative reliable methodologies for estimation of stature.

Various body segments (head, trunk and extremities) has been proportionately related with height of an individual [3]. Many studies have been conducted in which an attempt is made to estimate stature from the length of long bone [4], but, few studies are reported which correlate stature with fragmentary remains of the body part [5].

We conducted this study in an attempt to generate the regression equation to calculate stature from the length of hand which will be immensely useful to the forensic pathologist in the identification of a living or deceased individual.

MATERIALS AND METHODS

We conducted a cross sectional analytical study in Department of Anatomy, College of Medical Sciences and Teaching Hospital, Bharatpur, Nepal. It is KU affiliated medical school which runs undergraduate courses in various discipline (MBBS, BDS and BSc Nursing) apart from postgraduate courses. After obtaining clearance from institutional ethical committee, we collected data from 197 students of first and second year MBBS from March to May 2017. Students with physical debilities, skeletal defects and past history of diseases affecting bones and joints and subjects who are on any form of hormonal medications were excluded from the study. All the subjects were briefed about the purpose of study and informed and written consent was obtained.

The parameters measured were:

Hand length measurement was taken as a direct distance from the level of tip of the most distal point on the styloid process of the radius to the tip of the middle finger by using the spreading caliper. The student was asked to place the palmar aspect of hand flat on the table with the thumb abducted and fingers adducted.

Stature/ height of the student was determined by stadiometer. It is measured as a distance from vertex to heel while standing in Anatomical position with bare foot on flat platform of stadiometer. All the measurements were taken to the nearest 0.1 cm

All the measurements were taken by principle author in order to minimize bias and error of identification of the landmarks involved in measurement. The measurements were taken twice, and an average of the two readings was calculated.

The data was entered in Epidata and analysed with Statistical Package for Social Sciences (SPSS) version 16.0. Kolmogorov-Smirnov test (Normality of distribution) showed normal distribution both anthropometric variables (stature and hand length). Means and standard deviations (SD) were calculated. The relationship between body height and hand length was determined using simple correlation coefficients. Then a linear regression analysis was performed to formulate an equation which predicts body height from hand length. Estimated height of students was calculated implementing the derived regression equations and the former was compared with the observed height using paired t test. Statistical significance was set at $p<0.05$.

RESULTS

Of the total 197 undergraduate students, 100 were females (50.76%)

and 97 were males (49.24%). Mean and standard deviation of observed height for males and females were 170.53±5.65 cm and 157.29±6.21 cm respectively. The length of right hand in males varied from 17.20 cm to 21.80 cm with mean and standard deviation of 19.59±0.97 cm; whereas, that of left hand ranged from 16.90 cm to 21.70 cm with mean and standard deviation of 19.64±0.99 cm. On the other hand, the length of right hand in females fluctuated between 15.8 cm and 20.4 cm with mean and standard deviation of 17.70±0.92 cm; whereas, that of left hand ranged from 16.00 cm to 20.80 cm with mean and standard deviation of 17.76±0.91 cm. An Independent t-Test confirmed that the differences of observed height and hand length between males and females were statistically significant ($p<0.05$), mean values of length of both right and left hands and height being higher in males than in females.

Table 1: Stature and arm-span in males and females.

Measurements		Male (97)		Female (100)		P value
		Range	Mean±SD	Range	Mean±SD	
Observed height		157.60-185.20	170.53±5.65	141.70-175.20	157.29±6.21	<0.05
Hand length	Right	17.20-21.80	19.59±0.97	15.80-20.40	17.70±0.92	<0.05
	Left	16.90-21.70	19.64±0.99	16.00-20.80	17.76±0.91	<0.05

A simple linear regression was calculated to predict height (calculated height) based on hand length measurements as shown in Table 2. The significant regression equations were formulated with R2 (coefficient of determination) of 0.39 for males on both sides and 0.51 and 0.49 for females on right and left hand respectively.

Table 2: Regressing equations for the estimation of stature from hand length in males and females.

Gender	Side	Correlation coefficient (r)	r2 (coefficient of determination)	Regression equation	P values
Male	Right	0.63	0.39	98.86+(3.66*HL)	<0.05
	Left	0.63	0.39	100.15+(3.58*HL)	<0.05
Female	Right	0.71	0.51	72.00+(4.82*HL)	<0.05
	Left	0.70	0.49	72.83+(4.76*HL)	<0.05
HL- hand length					

Height of each student was calculated by adopting these regression equations, as shown in Table 3. The mean and standard deviation of height (calculated height) computed using the regression equations derived from length of right and left hands in males were 170.55±3.53 cm and 170.45±3.56 respectively, whereas, that in females were 157.31±4.42 cm and 157.35±4.35 cm respectively. A paired t test revealed that there is no significant difference in the calculated height derived from regression equations using length of right and left hands in both sexes, $p>0.05$.

Table 3: Calculated height using regression equations in males and females.

Gender	Measurements	Minimum	Maximum	Mean±SD	t	p
Male	Right hand length	161.81	178.65	170.55±3.53	-0.67	0.50
	Left hand length	160.65	177.84	170.45±3.56		
Female	Right hand length	148.16	170.33	157.31±4.42	0.64	0.52
	Left hand length	148.99	171.84	157.35±4.35		

The calculated height was compared with the observed height of the students using Paired t test. The test revealed that there was no significant difference between observed and calculated height of both male and female students, $p>0.05$.

Table 4: Comparision between the observed and calculated height of males and females.

Gender	Measurements	Calculated	Observed	t	P value
		Mean±SD	Mean±SD		
Male	Right hand length	170.55±3.53	170.53±5.65	0.27	0.98
	Left hand length	170.45±3.56		-0.19	0.85
Females	Right hand length	157.31±4.42	157.29±6.21	0.37	0.97
	Left hand length	157.35±4.35		0.13	0.89

DISCUSSION

The identification of deceased in legal investigations, such as crimes resulting in fatality or discovery of unclaimed human body, is utmost important [6]. Stature of an individual plays vital role in determining the identity of unknown person. Several anthropometric measurements of body parts had been used to compute the stature of an individual over the past decades with variable degree of success [7].

Patel et al conducted a study on 150 students (72 males and 78 females) of Gujrat and observed that the mean and standard deviation of stature was 175.95 ± 5.92 cm in males and 160.86 ± 5.60 cm in females and that of hand length for males were 18.89 ± 1.12 cm and 18.86 ± 1.12 cm on right and left side respectively and for females were 17.11 ± 1.03 cm and 17.08 ± 1.03 cm on right and left respectively. The mean values of stature and hand length on both sides in males were statistically higher than that in females ($P < 0.001$) [8]. Similar findings were observed in the current study, in which, the mean and standard deviation of stature was 170.53±5.65 cm in males and 157.29±6.21 cm in females. The measurements of hand length for males were 19.59±0.97cm and 19.64±0.99 cm on right and left respectively and for females were 17.70±0.92 cm and 17.76±0.91cm on right and left respectively, with males having greater values of hand length on both sides and height than females ($p<0.05$). The findings of our study was also supported by the other study [9].

In a study by Wakode et al, the stature was found to correlate positively with hand length in both sexes, correlation coefficient in males being 0.69 and 0.66 for right and left hands respectively and that in females being 14.9 on right and 15.2 on left hand [9]. Likewise, Ilayperuma conducted a study on 258 medical students (140 male and 118 female) in University of Ruhuna, Sri Lanka and observed a significant correlation between stature and hand length of both males and females [10]. All these findings support the result of the current study in which, a significant positive correlation was noted between stature and hand length in both the sexes; correlation coefficient being 0.63 and 0.71 on both sides in males and females respectively.

According to Pal et al, the coefficient of determination for regression equations (to estimate height from hand length) in medical students of Kolkota was 58.3% and 48.7% for both hands in male and female respectively [11]. In our study, predicting stature, when taking into account hand length was 39% in males for both hands and 51% for right hand and 49% for left hand in females. In addition, no significant difference was observed in calculated height derived from regression equations using length of right and left hands in

both sexes, $p>0.05$, indicating that the stature of an individual may be calculated from length of either hand available. Similar findings were noted in study conducted by Wakode et al [9]. However, regression equation of one sex cannot be implied to compute the stature of next in population with same ethnicity [12].

Furthermore, we calculated the height of an individual from the hand length using regression equations and their accuracy was checked by comparing observed and calculated heights. The study revealed that the calculated height and the observed height showed no significant difference in both sexes, $p>0.05$ which is in concurrence with the findings of Ilayperuma et al [10].

LIMITATION

The present study was undertaken in students of MBBS first and second years with relatively small sample size (comprising of 197 students). Other traits such as age, race and ethnicity were not considered. Hence, result of the study may not be generalized to overall Nepalese population.

CONCLUSION

Hand length is a reliable parameter in reconstructing the stature of an individual. These regression equations may be immensely useful to the forensic pathologist when stature is to be determined from fragmentary remains of body parts to identify a living or deceased.

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