

Middle finger length – a predictor of stature in the Indian population

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ABSTRACT

Stature is an important indicator for identification. There are numerous means to establish stature and their significance lies in the simplicity of measurement, applicability and accuracy in prediction. The present study was conducted on 500 north and south Indian subjects in Manipal, India, to establish the stature of an individual using the middle finger length. Measurements were analysed statistically to establish the relationship between a person's middle finger length and their stature. The study shows that the middle finger length bears a significant relation to stature and can be an important tool for stature estimation. Significant differences in measurements and formulae for males and females were found. These differences were insignificant when values were compared between subjects of the same sex in north and south Indians and also between the dominant and non-dominant hand.

INTRODUCTION

The identification of an individual and related issues have assumed importance in almost all spheres of life. In certain situations, such as when the deceased's body is putrefied, mutilated or extensively charred, conventional indicators and routine methods of identification fail to yield results. The situation is worsened when only mutilated and fragmentary remains are available for examination. Complete identification becomes unlikely and

partial identification assumes importance when proceeding with further investigations. Stature estimation is of prime importance in identification under such circumstances.

Every body part bears a more or less constant relationship with stature (Kerley, 1977). Formulae have been derived to calculate stature with good results, even when only parts of bone are available (Simmons et al., 1990). Different hand dimensions have also been used to predict the stature of an individual in different populations (Bhatnagar et al., 1984; Malek et al., 1990) but sometimes an intact hand is not available for examination. Thus, the need arises to derive formulae for stature estimation using a portion of a hand.

In the present study, an attempt has been made to estimate stature from the middle finger length. India is a vast country with varied geographical conditions and stature varies with race, sex and geographical locations (Bhatnagar et al., 1984). Therefore, our study examines the relationship of the middle finger length (MFL) with stature in north Indians and south Indians separately. This study may prove useful in conditions where only part of the hand is brought for post-mortem examination.

MATERIAL AND METHODS

This study was undertaken in the department of forensic medicine and toxicology, Kasturba medical college, Manipal, amongst 500 right-handed medical students, aged between 20-30 years, studying in various institutions. The student population of Manipal comes from all over India. The division of subjects into north and south Indians was based on their region of origin and taking into account the zonal divisions of India (Srinivasan, 2002). The total sample consisted of 230 males (north Indians 120; south Indians 110) and 270 females (north Indians 100; south Indians 170). Non-resident Indians and students from central, western and eastern India were excluded from the study. Students with deformities of the vertebral column and limbs, or students with a poorly defined proximal flexion crease of the middle finger and left-handed individuals were also excluded from the study. Left-handers were excluded to maintain uniformity as earlier studies have suggested the influence of hand dominance on measurements (Means and Walters, 1982).

The standing stature and middle finger length of normal, healthy, north Indian and south Indian male and female students were measured. Stature was measured using a vertical metallic height-measuring instrument (stadiometer) graded in centimetres. The subjects were asked to stand barefooted with the back of the head, the back of the shoulders, the buttocks and the heels touching the vertical rod of the instrument. The subject's head was positioned in the Frankfort horizontal plane, and the head plate was brought into firm contact with the vertex (Mohanty et al.,

2001). The height was measured to an accuracy of 0.5 cm.

Subjects were then asked to place their hands with palms facing upwards and fingers extended on a flat horizontal surface (Okunribido, 2000). The middle finger length (MFL) was measured using Vernier calipers (graded in mm) from the mid-point of the proximal flexion crease of the middle finger to the tip of the finger (Kulkarni and Rajendran, 1992). Measurements were accurate to 0.1 cm.

An analysis was made using SPSS (Statistical Package for Social Sciences) computer programme, version 11.0 to calculate linear regression equations and multiplication factors. For assessing the correlation between the stature and the MFL, the Pearson's correlation coefficient was calculated. The significance of results was tested using student's 't' test, and a p-value of less than 0.05 was considered as significant.

RESULTS

The mean stature of males was significantly ($p < 0.001$) greater than females among both north and south Indians. However, the difference in mean stature between north and south Indians was insignificant ($p > 0.05$) for subjects of the same sex (Table I). Descriptive statistics of MFL in both hands among north Indian and south Indian males and females are presented in Table II. MFL showed significant differences between males and females in the two population groups ($p < 0.001$). The difference in measurements of the right and left MFL is insignificant ($p > 0.05$) for subjects of the same sex.

Table I. Descriptive statistics of stature for the study groups.

Stature (cm)	North Indians (n=220)		South Indians (n=280)	
	Male (n=120)	Female (n=100)	Male (n=110)	Female (n=170)
Minimum	156.00	143.50	149.00	144.00
Maximum	189.00	176.00	192.00	174.50
Mean	171.60	158.66	171.95	158.57
S.D.	6.62	6.06	7.05	5.10

S.D. – standard deviation

Table II. Descriptive statistics of middle finger length for the study groups.

MFL (cm)	North Indians				South Indians			
	Male (n=120)		Female (n=100)		Male (n=110)		Female (n=170)	
	Right	Left	Right	Left	Right	Left	Right	Left
Minimum	6.90	7.00	6.30	6.50	6.80	6.80	6.50	6.20
Maximum	9.30	9.30	8.40	8.40	9.50	9.50	8.80	8.60
Mean	7.98	7.99	7.35	7.35	7.99	8.00	7.31	7.29
S.D.	0.50	0.50	0.45	0.46	0.52	0.52	0.43	0.41

MFL – middle finger length (cm), S.D. – standard deviation

DISCUSSION

In the present study, males had significantly higher values of stature and MFL than females in both south and north Indians, explained by the fact that males are constitutionally taller than females. The age of puberty being two years later in males as compared with females gives them additional time for growth (Malek et al., 1990). This suggests that the formula for one sex cannot be applied to estimate stature for the other sex. No statistically significant differences were found in the mean stature and MFL of the south Indian and north Indian populations when compared for the same sex. This suggests that in persons of different population groups (belonging to the same race) geographical variations do not have much influence on body proportions. Thus, stature can be estimated using any of the mentioned formulae, irrespective of a person being from north or south India.

Linear regression equations and multiplica-

tion factors were derived for the estimation of stature in the study groups for both hands. The correlation coefficient (R) and the coefficient of determination (R^2) were determined. The standard error was lowest (4.269) for south Indian females and highest for north Indian males (5.702). The significant correlation coefficient was evident in all groups, while the coefficient of determination or the predictive value was best for south Indian males (Table II). The correlation coefficient ranged from 0.504 to 0.696 which is nearly the same (0.521 to 0.696) as calculated in an earlier study using proximal phalangeal length (Shintaku and Furuya, 1990). The standard deviation varied from 7.769 in south Indian females to 9.305 in north Indian males for the multiplication factors, when calculated for the estimation of stature for all study groups (Table IV).

In the present study, the MFL of the dominant hand and the non-dominant hand shows

Table III. Linear regression equation for stature estimation.

Group	Gender	Side	Equation	S.E (cm)	R	R^2
North Indian	Males	Right	$H=117.204+6.820MFL$	5.702	0.515	0.259
		Left	$H=113.854+7.223MFL$	5.590	0.542	0.287
	Females	Right	$H=99.548+8.044MFL$	4.875	0.599	0.352
		Left	$H=102.714+7.608MFL$	4.943	0.582	0.332
South Indian	Males	Right	$H=95.901+9.517MFL$	5.100	0.696	0.480
		Left	$H=97.400+9.318MFL$	5.218	0.679	0.456
	Females	Right	$H=110.930+6.517MFL$	4.269	0.549	0.298
		Left	$H=112.516+6.321MFL$	4.413	0.504	0.250

MFL – middle finger length (cm), H–Height (cm), R–correlation coefficient, R^2 – Coefficient of determination, S.E. – standard error

Table IV. Multiplication factor for stature estimation.

Group	Gender	Side	Multiplication factor	S.D
North Indian	Male	Right	21.572	9.305
		Left	21.519	9.022
	Female	Right	21.639	7.817
		Left	21.629	8.143
South Indian	Male	Right	21.568	8.043
		Left	21.536	8.165
	Female	Right	21.744	7.804
		Left	21.812	7.769

S.D. – standard deviation

statistically insignificant variation. Thus, dominance of a hand does not have a significant role to play when estimating stature from the MFL. This supports the study by Bhatnagar et al. (1984) who report no variation in hand dimensions as a result of predominant use. However, our findings are contrary to those of another study which reported that the dominant hand is larger than the non-dominant hand in all dimensions (Means and Walters, 1982).

CONCLUSION

Stature is an important indicator when determining the partial identity of unidentified bodies and dismembered remains. This study reveals that the MFL can be used successfully to predict stature in the Indian population even if only an amputated hand is found and other body parts are unavailable. The results of this study are, however, applicable only when an intact middle finger is examined.

Similar studies are proposed on individual phalanges that may be helpful if the mutilated remains of a hand are brought for examination. We also propose similar studies on other fingers in different population groups.

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