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"Middle Finger Length – a predictor of stature in J&K state"

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ABSTRACT

Introduction: Estimation of stature is based on a principle that every body part bears more or less a constant relationship with height of an individual. Based on this the present study was conducted. As the estimation of stature is vital for the identification of an individual in cases of mass casualties.

Materials and Methods: The present study was conducted on a sample of 200 medical students (100 males and 100 females) within the age group of 18-25 years, studying in Government Medical College, Jammu. Only those students were taken who belong to J&K state and have no obvious deformity that can affect the measurements.

Results: Measurements were analyzed statistically to establish the relationship between middle finger length and stature. The study shows that the middle finger length bears a significant relation to stature and can be an important tool for stature estimation. Linear regression equations were formulated to derive the stature from middle finger length of both sides in males and females.

Conclusion: Estimation of stature forms an important parameter to reach to the partial identification of an unidentified body and dismembered remains. The results of the present study indicate that the middle finger length can be efficiently used for estimation of stature. Most authors have underlined the need for population-specific stature estimation formulae. In this study we derived a separate regression equation to estimate stature from middle finger length for J&K state.

KEYWORDS : Stature, Middle finger length, Correlation, Identification.

INTRODUCTION

To identify an individual, it is necessary to establish a biological profile via the estimation of age, race, sex and stature. Also known as "big four" parameters of anthropology.[1] These form the features of tentative identification.[2]

Among these, stature forms the most important elements in the identification of an individual. The stature reconstruction is important as it provides a forensic anthropological estimate of the height of a person in the living state, playing a vital role in the identification of individuals.[3] Stature estimation is also required for the assessment of growth of children, calculation of nutritional indices of children and adults for prediction and standardization of physiological parameters such as lung volumes, muscle strength, glomerular filtration, metabolic rate and for adjustment of drug dosage in patients.[4]

Establishing the identity of an individual from mutilated, decom posed and amputed body fragments has become an important necessity in recent times due to natural disasters like earthquakes, tsunamis, cyclones, floods and man-made disasters like terror attacks, bomb blasts, mass accidents, wars, plane crashes etc. Among the fragments usually found, it is the peripheral parts i.e., the hands and feet that are mostly discovered at the disaster site.[2,5]

Thus, there is always a need of study which helps in the identi fication of the deceased from fragmentary and dismembered human remains. The study may, in addition, have significance in plastic and reconstructive surgeries of hands and feet, where the available dimensions of extremities can be used in post-traumatic reconstruction of others.[6]

Estimation of stature is based on a principle that every body part bears more or less a constant relationship with height of an individual. Various studies in the past have utilized various body parts such as upper and lower extremities including hand and foot dimensions for the estimation of stature.[7]

Many studies have been done in the past to calculate stature from measurements of hand length, foot length and the length of long bones but very few have been done on the estimation of stature from the measurements of middle finger length. It will be helpful in situations where only hand or middle finger is available for the estimation of stature and hence identification.

What may be true for one race or one region may not be true for other. Even within our vast homeland of India, there are many different ethnic groups and they are having their own variations.[8] Therefore, our study examines the relationship between middle finger length and stature in J & K state and also derives a linear regression equation to predict stature from middle finger length of both sides in males and females.

MATERIALS AND METHODS

The present study was conducted on a sample of apparently healthy, 200 medical students (100 males and 100 females) within the age group of 18-25 years from Government Medical College, Jammu and Indira Gandhi Dental College, Jammu.

The study was conducted in a separate post-graduate room. All measurements were taken at a fixed time of day to eliminate diurnal variation. The instruments used were Sliding Caliper for the measurement of middle finger length and Stadiometer for the measurement of stature.

Stature: It is the vertical distance between the highest point on the vertex and platform of stadiometer. The subject was made to stand erect, bare foot on a level platform against the stadiometer bar with his/her back and hips touching the bar, the feet were close to each other and the heals touching the bar, arms hanging by the side. The

head of the subject was resting without any strain in the eye-ear plane or Frankfurt's plane i.e., trigone and the infraorbital margin of both the sides lie in the same plane.

Middle Finger Length: It is the distance between middle of metacarpo-phalangeal crease (proximal flexion crease) of the middle finger and the extreme projecting point on the tip of middle finger.

AIMS AND OBJECTIVES

To obtain population specific equation for estimation of stature from middle finger length in the population of J & K state.

1. To obtain middle finger length and stature of sample population of males and females from J & K state.
2. To find out the correlation between middle finger length with stature of the individuals.
3. To devise linear regression equation to estimate stature from middle finger length.

STATISTICAL ANALYSIS

Table 1: Distribution of stature (in cms) among study pop ulation.

	Males	Females	Total
Number	100	100	200
Mean	172.77	157.92	165.35
Std. Error of Mean	0.638	0.549	0.673
Std. Deviation	6.384	5.495	9.524
Minimum	157.50	147.00	147.00
Maximum	188.50	175.00	188.50

Table 2: Descriptive statistics of the middle finger length studied in Males and Females.

	Males		Females	
	RMFL (cm)	LMFL (cm)	RMFL (cm)	LMFL (cm)
Number	100	100	100	100
Mean	8.123	8.101	7.606	7.571
SE of Mean	0.048	0.046	0.042	0.040
SD	0.484	0.461	0.422	0.403
Minimum	6.90	7.00	6.60	6.60
Maximum	9.20	9.20	9.00	9.10

RMFL- Right Middle Finger Length LMFL- Left Middle Finger Length

Table 3: Paired sample "t" test showing statistical difference between right and left side in Males and Females.

Paired Samples		Males		Females	
		t-stat	Sig.(2 tailed)	t-stat	Sig.(2 tailed)
Pair 1	Right Middle Finger Length & Left Middle Finger Length	1.5	0.126	2.3	0.022*

*. Statistically Significant (p<0.05)

Table 4: Correlation between the stature of an individual and middle finger length studied in Males and Females.

Parameter	Males		Females	
	Pearson Correlation	Sig. (2-tailed)	Pearson Correlation	Sig. (2-tailed)
Right Middle Finger Length	**0.605**	**0.000***	**0.586**	**0.000***
Left Middle Finger Length	0.591	0.000*	0.628	0.000*

*. Correlation is significant at the 0.05 level (2-tailed)

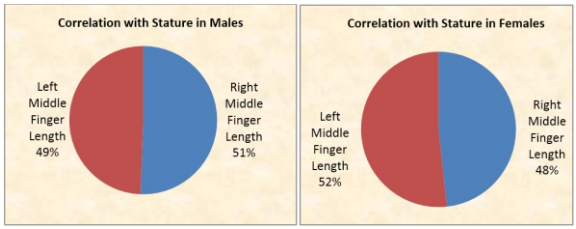

Fig. 1: The above shown figure depicts the correlation of stature in percentage with the middle finger length of both sides in both males and females.

Table 5: Linear regression equation for middle finger length in Males and Females.

Linear Regression Equations in Males		Linear Regression Equations in Females	
Stature = Constant + Regression Coefficient (Dimension) ± Standard Error of Estimate	**Coefficient of Determination(r^2)**	**Stature = Constant + Regression Coefficient (Dimension) ± Standard Error of Estimate**	**Coefficient of Determination(r^2)**
Stature = 108.01 + 7.97(Right Middle Finger Length)±5.10	0.366	Stature = 99.96 + 7.62(Right Middle Finger Length)± 4.47	0.343
Stature = 106.44 + 8.18(Left Middle Finger Length)± 5.17	0.349	Stature = 93.14 + 8.55(Left Middle Finger Length) ± 4.30	0.393

Table 6: Showing the Minimum, Maximum and Mean of the observed value of stature and values predicted by regression equation from middle finger length in Males and Females.

	Males			Females		
	Minimum(cm)	Maximum (cm)	Mean (cm)	Minimum(cm)	Maximum (cm)	Mean (cm)
Observed Value (Actual Stature)	157.50	188.50	172.77	147	175	157.92
Right Middle Finger Length Length	163.02	181.36	172.77	150.26	168.54	157.92
Left Middle Finger Length	163.75	181.76	172.77	149.61	176.23	157.91

RESULTS

The results were prepared on the basis of collected data and the regression equation, Pearson's correlation coefficient and various other statistical parameters were calculated using MS Excel Programme and SPSS software version 18.

Table 1 shows distribution of stature among study population, ranging from 159 – 188.50 cm in males and 147 – 175 cm in females. The mean stature among males is 174.73 cm with the standard deviation of ± 6.372 cm and the mean stature among females is 158.00 cm with the standard deviation of ± 6.065 cm. The overall mean stature of the population is 165.35 cm with the standard deviation of ± 10.43 cm.

Table 2 shows the descriptive statistics of middle finger length of both sides studied in males and females. The mean middle finger length of 8.123 (SD±0.484)cm on right side as compared to 8.101 (SD±0.461)cm on left side indicate that the descriptive parameters are more on right side as compared to left side in males. Similarly in females also the mean middle finger length of 7.606 (SD±0.422) cm on right side and 7.571 (SD±0.403) cm on left side indicates the

same thing that the parameters are more on right side.

In order to assess the statistical differences between the observa tions of Right and Left side in males and females separately, paired sample "t" test was performed.

The statistical analysis in the table 3 indicates that the bilateral variations was statistically significant (P<0.05) for females only, while as in case of males it was statistically insignificant.

Table 4 and Fig.1 shows the correlation of stature with middle finger length studied in males and females. It was observed that in males the right middle finger length (r=0.605) shows greater correlation with stature than left middle finger length (r=0.591). While in case of females it was left middle finger length(r=0.628) that shows greater correlation with stature than right middle finger length(r=0.586). All the parameters exhibit statistically highly significant positive correlation with stature in both males and females.

Table 5 shows linear regression equations predicting stature using middle finger length of both sides in both males and females. The equations also exhibit Standard Error of Estimate (SEE).The SEE predicts the deviation of estimated stature from the actual stature. It ranges between ± 5.10 to ± 5.17 in males and ± 4.30 to ± 4.47 in females. Lower values indicate greater reliability in the estimated stature. Right Middle Finger Length exhibits a lower value in males and Left Middle Finger Length in females and thus gives better reliability in prediction of stature. The table also shows the power of prediction or coefficient of determination (r2), which is a measure of how well the variation in one variable explains the variation of the other. In case of males it is the Right Middle Finger Length which has the higher prediction power (r2 = 0.366) and in case of females it is the Left Middle Finger Length which has the higher prediction power (r2 = 0.393).

Table 6 depicting mean predicted value of stature through the regression equation, which is almost similar to the mean observed value; however the minimum and maximum value indicated that there were differences in the predicted and observed value.

DISCUSSION

The identification of commingled mutilated human remain after a disaster is a challenge to forensic experts and hence demands studies on estimation of stature from various body parts in different population groups. Such studies can help in narrowing down the pool of possible victim matches in cases of identification from dismembered remains.[9]

The mean stature found in our study was 172.77 (SD ± 6.38) cm in males and 157.92 (SD ± 5.49) cm in females. The males having greater stature than females and this difference was found to be statistically highly significant (P<0.001).

These results were comparable with the previous studies conduc ted by Abdul-Malek et al. (1990), [10] Jasuja (2004), [11] Krishan and Sharma (2007), [12] Isurani et al. (2009) [13] and Ishak et al. (2012) [14] - all of them have observed that the mean stature was greater in males than females. These statistical significant differences may be due to the early pubertal growth spurt in girls that stops early, under the influence of oestrogen, which causes early fusion of epiphysis. In males although the growth spurt occurs comparatively later, they continue to grow for a longer period under the influence of testosterone. This reason necessitates different equations for males and females.

In our study we observed that the middle finger length of the males are more than the middle finger length of females and this difference was statistically highly significant (p<0.001). Similar results were observed by Rastogi et al. (2009) [15] in his study.

As far as bilateral asymmetry in length of middle finger is concerned in our study, the bilateral asymmetry in females was statistically significant (p<0.05) while as it was statistically insignificant in case of males (p>0.05). The right sided dominance in middle finger length is related to handedness of individuals. More stress and strain on the dominant hand, depending on the occupation, may cause differences between the sides, often referred to as directional asymmetry (Kanchan et al., 2010). [6]

All the parameters showed statistically significant positive correl ation with stature in the present study and thus can be successfully utilized for the stature estimation. However, in case of males the right middle finger length showed comparatively higher correlation coefficient(r=0.605) than left middle finger length(r=0.591) and in case of females it was the left middle finger length that showed higher values(r=0.628) as compared to right(r=0.586). Thus, in case of male, middle finger length of right side and in case of females middle finger length of left side are the best parameters for the estimation of stature. Our findings were not in accordance with the study conducted by Kuppast N et al., 2014 [16] which depicted that estimation of height from the RMFL in females is more significant than in males where LMFL gives better prediction of height.

The presence of a positive linearity between the study variables and the stature facilitates formulation of regression equations which can be successfully utilized for the stature estimation. Linear regression equations were evolved and it was found that by applying these equations, minimum and maximum actual stature and the stature estimated from bilateral middle finger length among males and females varied but, the mean value of actual stature of males (172.77cm) and stature estimated from bilateral middle finger length (172.77cm) was same. Similarly, the mean value of actual stature of females (157.92cm) and stature estimated from bilateral middle finger length (157.92cm) also was same.

These findings are in accordance to the study conducted by Krishan and Sharma (2007), [12] wherein they also observed greater variation of estimated minimum and maximum stature with respect to the actual minimum and maximum stature, but the mean value estimates were close to each other.

CONCLUSION

After the completion of the present study it was concluded that middle finger length provides good reliability in estimation of stature. By deriving the population specific linear regression equations, this study reveals that the middle finger length can be used successfully to predict stature in the population of J&K state 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.

As the region of Jammu and Kashmir is very prone to mass casualties, so more research work is supposed to be done on this topic for the identification of individuals from their various other body parts like individual fingers, phalanges, dimensions of feet etc.

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REFRENCES

1. Krishan K, Kanchan T and Sharma A. Multiplication factor versus regression analysis in stature estimation from hand and foot dimensions. Journal of Forensic and Legal Medicine 2012; 19: 211–214.
2. Vij K. Textbook of Forensic Medicine, Principles and Practice. 2nd edition, New Delhi: Elsevier India Pvt. Ltd, 2002: 62-134.
3. Chawla M and Rajkumar. The relationship between hand breadth and height in adult males of North Indian Punjabi population. Journal of Evolution of Medical and Dental Sciences 2013; 2 (12): 1880 – 1887.
4. Menezes RG, Kanchan T, Kumar GP, Rao PPJ, Lobo SW, Krishan K, Hunnargi SA, Nagesh KR, Shettigar S. Stature estimation from the length of sternum in South Indian males: a preliminary study. Journal of Forensic and Legal Medicine 2009; 16(8): 441-443.
5. Agrawal J, Raichandani L, Kataria SK and Raichandani S. Estimation of stature from hand length and length of phalanges. Journal of evolution of medical and dental

sciences 2013; 2(50): 9651 – 9656.
6. Kanchan T, Krishan K, Sharma A and Menezes RG. A study of correlation of hand and foot dimensions for personal identification in mass disasters. Forensic science International 2010; 199(1-3): 112-116.
7. Mohanty BB, Agrawal D, Mishra K, Samantsinghar P and Chinara PK. Estimation of height of an Individual from forearm length on the population of Eastern India. Journal of Medical & Allied Sciences 2013; 3(2): 72 – 75.
8. Chikhalkar BG, Mangaonkar AA, Nanandkar SD and Peddawad RG. Estimation of stature from measurements of long bones, hand and foot dimensions. Journal of Indian Academy of Forensic Medicine 2010; 32 (4).
9. Agnihotri AK and Soodeen-Lalloo AK. Estimation of stature from fragmented human remains. Anthropology 2013; 1(2).
10. Abdul-Malek AK, Ahmed AM, EL-Sharkawi SA and EL-Hamid NA. Prediction of stature from hand measurements. Forensic Science International 1990; 46: 181 – 187.
11. Jasuja OP and Singh G. Estimation of stature from hand and phalange length. Journal of Indian Academy of Forensic Medicine 2004; 26(3): 100 – 106.
12. Krishan K and Sharma A. Estimation of stature from dimensions of hand and feet in a North Indian population. Journal of Forensic Legal Medicine 2007; 14(6): 327 – 332.
13. Isurani I, Nanayakkara G and Palahepitiya N. Prediction of personal stature based on the hand length. Galle Medical Journal 2009; 14(1): 15 – 18.
14. Ishak NI, Hemy N and Franklin D. Estimation of stature from hand and handprint dimensions in a western Australian population. Forensic Science International 2012; 216(1-3): 199e1-7.
15. Rastogi P, Kanchan T, Menezes R and Yogamarasimla K. Middle finger length a predictor of stature in Indian population. Medical Science Law 2009; 49(2): 123 – 126.
16. Kuppast N, Kanaki A, Shahina, Jatti VB, Iddalgave S and Mugaldimath A. Estimation of stature from middle fingers length of population in Davangere district. International Journal of Biomedical Research 2014; 5(11): 665 - 667.