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Research Paper: Estimating Stature and Gender by the Length of the Third, Fourth, and Fifth Fingers of Dominant Hand in Iranian Adults

Seyed Reza Saadat Mostafavi[1], Azadeh Memarian[2*], Siamak Soltani[3], Leyla Abdolkarimi[4], Farrokh Taftachi[4]

1. Department of Radiology, Faculty of Medicine, Iran University of Medical Sciences, Tehran, Iran.
2. Department of Forensic & Legal Medicine, Faculty of Medicine, Mazandaran University of Medical Sciences, Sari, Iran.
3. Department of Forensic & Legal Medicine, School of Medicine, Iran University of Medical Sciences, Tehran, Iran.
4. Shahid Rajaei Cardiovascular Medical and Research Center, Tehran, Iran.

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ABSTRACT

Background: Stature and gender are essential parameters of forensic anthropology. Moreover, their estimation is critical for medico-legal investigations to identify unknown remains. The present study aimed to estimate stature and gender by the anthropometric dimensions of the Iranian population's third, fourth, and fifth fingers.

Methods: In this cross-sectional study, 199 individuals (99 men & 100 women) were included. Individuals' demographic information was recorded. A caliper measured the length of the fingers. An anthropometer was used for the measurement of stature. The obtained data were analyzed using SPSS. A multivariate linear regression test was used to predict the stature of individuals based on finger length.

Results: In males and females, a solid and positive direct relationship was observed between the length of the third, fourth, and fifth fingers of the hand with the stature of individuals and between the length of the fingers with each other. In the coefficient table of the regression model of this study, in males, the length of the fingers was not predictive of stature, and only the length of the third finger in females had a predictive effect on stature (P=0.007).

Conclusion: According to the obtained results, stature is predictable in women through the third finger length using the derived regression equation.

*** Corresponding Author:**
Azadeh Memarian, PhD.
Address: *Department of Forensic & Legal Medicine, Faculty of Medicine, Mazandaran University of Medical Sciences, Sari, Iran.*
E-mail: *a.memarian@mazums.ac.ir*

1. Introduction

The forensic investigation mainly aims to confirm the identity of the victims via the remains of the body [1]. In forensic research, anthropometric indices are used as a valuable tool to estimate a person's physical characteristics using the dimensions of the body parts [2]. Stature is one of an individual's most critical biological profiles for identification [3].

There are two anatomical and mathematical procedures for estimating stature in forensic research. The anatomical process includes the direct restoration of stature through calculating and adding the lengths and heights of several contiguous skeletal sections from the skull to the foot. The mathematical process uses regression formulae correlation of persons' skeletal parts to stature [4].

The importance of this issue is highlighted when only a small part of the human body is found after an accident. In this case, it will be complicated to predict stature using anatomical methods to reconstruct the height of the whole body by combining major body parts [5, 6]. Mathematical methods based on linear equations can be a logical solution in these cases. A variety of regression models can predict individuals' stature using mathematical methods. This phenomenon allows researchers to calculate stature with more tremendous success and accuracy [6].

Pelin et al. used head and face dimensions for estimation of stature [7]. Ozden et al. estimated stature by measuring the foot [8]. Habib et al. estimated stature according to the hand's length and the phalanges of fingers [9]. Rastogi et al. evaluated stature estimation of middle finger length and reported a direct and significant association between stature and middle finger length [10]. Krishan et al. estimated stature in the adolescent via their index and ring fingers length [11].

Previous studies used hand length and width, or hand and foot length as a variable to derive a regression equation from estimating height. However, in some forensic investigations, it is impossible to use the length and width of the hand to predict stature due to injury. However, suppose predictive regression equations are available for different parts of the hand in addition to hand length and width. In that case, using these models for various hand components can increase the success rate of height estimation. Besides, ethnic differences and environmental situations do not allow the equations derived from one population for other populations. Therefore, this study aimed to estimate stature by anthropometric dimensions of the Iranian population's third, fourth, and fifth fingers.

2. Materials and Methods

In this cross-sectional study, using a random sampling method, 199 individuals aged 18-49 years were included (99 men & 100 women). The sample size was determined according to Ishak et al.'s and Uhrová et al.'s studies [3, 5]. Individuals' demographic information, including gender was recorded. The length of the fingers was measured by a caliper from the midpoint of the proximal crease of the finger to the tip of the finger. An anthropometer was used for the measurement of stature. The technical error of measurement measured Intra-observer error for variables.

The study was approved by the Ethics Committee of the Iran University of Medical Sciences (Code: IR.IUMS.FMD.REC.1398.487). The study was performed according to Helsinki principles of ethics. All study participants signed a written informed consent form.

The obtained data were analyzed using SPSS. Percentages, mean, and standard deviation were used to describe the variables. Pearson correlation test was used to examine the relationship between the lengths of the fingers (since the number of data in each group is higher than 30, the data distribution is considered normal). A multivariate linear regression test was used to predict the stature of individuals based on finger length.

3. Results

The Mean±SD stature of the male in the study was 172.59±6.89 cm. The Mean±SD stature of the female in the study was 165.2±5.06 cm (Table 1).

Table 1. The gender-wise stature of the study subjects

Stature (cm)	No.	Min.	Max.	Mean±SD
Male	99	156	190	172.59±6.89
Female	100	156	180	165.25±5.06

Table 2. The gender-wise lengths of the third, fourth, and fifth fingers

Finger Length (cm)	Gender	Min.	Max.	Mean±SD
Third	Male	6.5	11	8.78±0.88
	Female	6.5	11	8.21±0.87
Forth	Male	6	10.5	7.85±0.90
	Female	5.5	10	7.24±0.91
Fifth	Male	5	9	7.74±0.92
	Female	4.5	8.5	6.06±0.99

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The Mean±SD lengths of each individual's third, fourth, and fifth fingers by gender are presented in Table 2. In males and females, a strong and positive direct relationship was observed between the length of the third, fourth, and fifth fingers of the hand with the stature of individuals and between the fingers lengths with each other (Tables 3 & 4).

In the output of the regression model calculated by SPSS, the correlation coefficient (R) in males and females was 0.618 and 0.678, in sequence. Additionally, the coefficient of determination (R squared) in males was 0.382 and in females was 0.459. Moreover, the Durbin–Watson was 1.79 in males and 1.73 in females. These results suggest that the regression model is appropriate.

Per the ANOVA data, the F value in males was 19.58, and P equaled <0.001. Moreover, in females, F was 27.16, and the P was <0.001. These findings also mean that the regression model is appropriate.

The multivariate linear regression formula is as follows: $Y = B0 + B1X1 + \ldots + BpXp + E$

Where X is the symbol of the independent variables, Y is the symbol of the dependent variable, B indicates the regression model coefficient for the corresponding variables, and B0 reflects the constant value of the dependent variable without considering the independent variables.

In the regression model of this study, the rate of B0 in males was 132.97 and in females was 134.79.

Table 3. Relationship between the length of the third, fourth, and fifth fingers of the hand and the stature of the study participants

Relationships	Pearson Correlation Coefficient	P
Between male's third finger length and stature	0.612	<0.001
Between male's fourth finger length and stature	0.601	<0.001
Between male's fifth finger length and stature	0.588	<0.001
Between female's third finger length and stature	0.675	<0.001
Between female's fourth finger length and stature	0.646	<0.001
Between female's fifth finger length and stature	0.624	<0.001

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Table 4. Relationship Between the lengths of the third, fourth, and fifth fingers

Relationships	Pearson Correlation Coefficient	P
Between males' third and fourth fingers length	0.954	<0.001
Between males' fourth and fifth fingers length	0.934	<0.001
Between males' third and fifth fingers length	0.897	<0.001
Between female's third and fourth fingers length	0.932	<0.001
Between female's fourth and fifth fingers length	0.959	<0.001
Between female's third and fifth fingers length	0.881	<0.001

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Table 5. Coefficients related to predictor variables in males and females

Predictive Variables		B	SE	Beta	T	P	Results
Males	Consent	132.97	5.93	-	22.38	0.0001	ADJ.R^2=0.363, R^2=0.382, R=0.618
	Third finger	3.24	2.11	0.416	1.538	0.127	
	Fourth finger	0.203	2.55	0.027	0.079	0.937	
	Fifth finger	1.41	1.67	0.190	0.840	0.4	
Females	Consent	134.795	4.04	-	33.328	0.0001	ADJ.R^2=0.442, R^2=0.459, R=0.678.
	Third finger	3.279	1.198	0.569	2.736	0.007	
	Fourth finger	-0.141	1.922	-0.026	-0.073	0.942	
	Fifth finger	0.752	1.371	0.147	0.548	0.585	

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In the coefficient table of this regression model, the length of the fingers was not predictive of stature in males. Moreover, only the length of the third finger in females had a predictive effect on stature (Table 5).

Therefore, the formula for estimating the stature of a female based on the length of the third finger is possible based on the following equation:

Stature = 134.8+ (3.28 * middle finger length)

However, using the multiple linear regression formula to estimate stature in males is not applicable due to P>0.05.

4. Discussion

The current study evaluated the possibility of estimation of stature using the lengths of the third, fourth, and fifth fingers. Among all the subjects in the study, there was a strong positive relationship between the length of the third, fourth, and fifth fingers with the stature of the individuals. There was also a strong positive correlation between the lengths of the fingers. In the excluded regression model, i.e., calculated separately for males and females, the R-value in females was 0.678, and the R^2 value equaled 0.459. Among the male, R was 0.618, and R^2 was 0.382. These findings indicate the appropriateness of the regression model. In the regression model of estimating stature by the length of the third, fourth, and fifth fingers in men, the P for all fingers was above 0.05. Therefore, it is impossible to use the regression model to estimate the stature of men using the length of the fingers. Among women, only the P of the third finger was less than 0.05. In other words, only women's third finger length can be used to estimate their stature.

In a study by Mojaverrostami et al. on the estimation of stature based on anthropometry of fingers in 159 Iranian students, third finger length showed higher correlation coefficients with stature in both genders. Regression analysis proposed a lower Standard Error of Estimate in women than men. Their result indicated that the accuracy in predicted stature would be greater among women than men [12]. Their result about third finger length was consistent with the present study. However, in the present study, the length of the third finger was not a predictor of stature in men.

In Rastogi et al.'s study on middle finger length (third finger), the middle finger length was significantly related to stature. Moreover, significant gender-wise differences were reported in measurements and formulae [10].

In Rhiu et al.'s study on estimation of stature via figure length in Korean adolescents, simple linear regression analysis revealed that second and fourth fingers were the highest determining variables in the regression equation in adolescent men. Moreover, in adolescent women, third and first fingers were defined as the highest determining variables [13].

In another study by Kirshan et al. in the North Indian adolescent population, a significant correlation was found between stature, ring finger length, and Index finger length in both hands. Pearson correlation was higher in men than women. The correlation coefficient was higher for the Index finger length in both genders. Linear regression models were driven, and it was found that the stature can be predicted from the Index finger length and ring finger length in that population [11]. In Sen et al.'s study in Northeastern India, it was found that the correlation coefficient between index and ring fingers length and stature was significant. The Linear and multiple regression models were defined to estimate the stat-

ure from the index and ring finger. Similar to this study, females showed a higher predictive accuracy of correlation coefficient estimation than males [14].

In another study by Singh et al., for men, when both the second and fourth fingers were taken together, the maximum correlation with stature was observed, and the lowest correlation was observed for the 4th finger. Likewise, the highest correlation with stature in women was seen with the second finger and the second and fourth fingers together. The lowest correlation was observed for the fourth finger [15].

In a study by Akhlaghi et al., the correlations between height and index and ring fingers length were significant in males and females. They concluded that index and ring finger lengths might be beneficial in predicting height and gender [16].

5. Conclusion

Estimation of stature from finger length measurements can be a proper attitude when part of a hand is brought for investigation when more reliable parts such as long bones or other parts of the body do not exist for forensic examination. The stature is predictable in women through the third finger length using the derived regression equation.w

Ethical Considerations

Compliance with ethical guidelines

The study was approved by the Ethics Committee of the Iran University of Medical Sciences (IR.IUMS.FMD.REC.1398.487). The study was performed according to Helsinki principles of ethics. All study participants signed a written informed consent form.

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Author's contributions

All authors equally contributed to preparing this article.

Conflict of interest

The authors declared no conflict of interest.

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