Original Article

DIGIT LENGTH DISPLAYS A SIGNIFICANT FRACTION IN STATURE ESTIMATION: A STUDY FROM COASTAL REGION OF SOUTH INDIA

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ABSTRACT

Relationship that exists between different part of the body and height had been of great interest to anthropologists, forensic and medical scientists for many years. This is because of the increase in the number of catastrophic events causing mass deaths from natural or manmade errors. Such disasters like flooding, tsunamis, earthquakes, plane crashes, train crashes , terrorist attacks usually requires the identification of victims from fragmentary and dismembered human remains. In present paper, study on stature estimation from digit length has been reported. In the present study, 200individuals (96 males and 104 females) belonging to age group of 18 to 25years having no disease or deformity were examined anthropometrically in respect to their height and digit lengths (2D, 3D, 4D, 5D) have been measured. The regression equations have been drawn from the data collected. It has been observed that stature can be estimated from the digit lengths.

KEYWORDS: Digit Length, Stature, Sexual Dimorphism, Estimation, Linear Regression Analysis, Significance.

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Access this Article online		
Quick Response code	**Web site:**	International Journal of Anatomy and Research ISSN 2321-4287 www.ijmhr.org/ijar.htm
	Received: 25 March 2014 Peer Review: 25 March 2014 Published (O):31 May 2014 Accepted: 19 April 2014 Published (P):30 June 2014	

INTRODUCTION

Estimation of stature forms important-criteria for establishing individuality of a person and require special attention. Dimensional relationships between the body segments and the whole body have been of interest to artists, scientists, anatomists, anthropologists and medico legists for long time[1]. Among the various parameters of identification, individual's stature is an inherent characteristic, the estimate of which is considered to be important in those cases where only fragmentary or mutilated remains of an unknown person are recovered. The length of certain long bones and appendages of the body represent certain relationship in the form of proportion to the total stature. The orthodox methods of estimating stature are limited to measuring whole limb bone and correlating living stature and limb bone length. But few studies are reported in which an attempt has been made to estimate stature from fragmentary or mutilated parts of the body [2].

However, the hand bones have been documented as good anthropometric parameters and had proven to exhibit great sexual dimorphism. Bhatnagar *et al* (1984), estimated stature of Punjabi male using three anthropometric measurement of the left and right hands separately. Similarly, Abdel-Malek *et al.* (1990) also estimated the stature of Egyptian subjects using two anthropometric measurement of the hand. The morphometric parameters of the hand show considerable

sexual dimorphism in the Indian population while the hand and palm index were poor sex indicator (Kanchan and Rastogi, 2009) [3].

In the present paper an attempt has been made to derive some regression formulae to indicate relationship between height and digit lengths in healthy adult individuals in both sexes. No particular ethnic groups have been included in the study but combinations of variegated ethnic groups are considered. This information will be highly important to Forensic scientists, human biologists and physical anthropologists for determination of stature from the fragmentary remains of upper limb.

MATERIALS AND METHODS

A cross sectional study was conducted by the department of anatomy, Narayana medical college, Nellore. This study includes 200 subjects (96 males, 104females) from Coastal regions of Andhra Pradesh. The institutional ethical clearance was obtained before commencement of the study.

Inclusion criteria:

1. Subjects with age group of 18 to 25 years.

2. Subjects belong to coastal regions of Andhra Pradesh.

Exclusion criteria:

1. Subjects who didn't give consent

2. Subjects with any abnormality in the digits were not included in the study.

Method of anthropometric measurements:

Height: The stature was measured using standard Stadiometer in a standard standing position with head oriented in ear-eye plane from the standing surface to the highest point on the head.

Digit lengths: Digit lengths was measured on the ventral surface of the hand from the most proximal crease of the digit to the tip of the second , third , fourth , fifth digits in both right and left hand using Vernier caliper measuring up to .1mm (We have excluded the 1st digit or thumb because reliable measurement landmarks are difficult to establish [4])

The data thus obtained was subjected to statistical calculations using SPSS computer programmer to derive linear regression equation.

RESULTS

The observations and statistical outcomes of the study are presented in the tables. The mean height of male population with an age range from 18 to 25 years is 172.92cm, with a minimum height of 152cm and maximum of 192cm (Table 1).   Within the same age range like that of male, the mean height of female was 158.51 showing a 2 fold difference in the height, with an minimum height of 140cm and maximum of 183cm (Table 2). The digit lengths are in proportion with the height individuals in both sexes (Tables 1 & 2). The objective of the study is to link the estimated stature with that of digit length. Tables 3 & 4 include the statistical findings of linear regression equation in male and female respectively. The regression equation for stature estimation for digit length in both male and female is observed to be statistically significant with a p<.001.

Table 1: Descriptive Statistics Of Variables In Male Subjects (Height And Digit Length) N=96.

	Variables	Minimum	Maximum	Mean	Std. Deviation
	Height	152	192	172.9271	7.65471
Right	**Second digit length**	6.5	8.8	7.474	0.49274
	Third digit length	6.9	9.5	8.2063	0.51887
	Fourth digit length	6.6	9.4	7.624	0.4971
	Fifth digit length	5.3	7.8	6.1615	0.47047
Left	**Second digit length**	5.8	8.9	7.4417	0.52849
	Third digit length	6.7	9.6	8.2219	0.52939
	Fourth digit length	6.6	9	7.6698	0.46183
	Fifth digit length	5.2	7.8	6.2177	0.42624

Table 2: Descriptive Statistics Of Variables In Female Subjects (Height And Digit Length) N=104.

	Variables	Minimum	Maximum	Mean	Std. Deviation
	Height	140	183	158.5192	7.87028
Right	**Second digit length**	5.8	8.2	6.8808	0.5472
	Third digit length	6.5	9	7.6154	0.5563
	Fourth digit length	5.8	8.2	6.9644	0.51932
	Fifth digit length	4.4	7.5	5.6942	0.47267
Left	**Second digit length**	5.8	8	6.8385	0.51639
	Third digit length	6.3	9	7.6423	0.55541
	Fourth digit length	5.8	8.2	7.0038	0.55195
	Fifth digit length	4.4	7.8	5.6288	0.49965

Digit side	Digit length	Equations	SEE	r	r^2	t	P
Right	Second	Height=109.11+8.54 (right Second digit length)	6.43	0.55	0.302	23.261	<.000
	Third	Height=107.08+6.80 (right third digit length)	6.82	0.46	0.213	15.587	<.000
	Fourth	Height=115.65+7.51 (right fourth digit length)	6.72	0.488	0.23	16.337	<.000
	Fifth	Height=130.48+6.88 (right fifth digit length)	6.971	0.423	0.179	18.42	<.000
Left	Second	Height =110.77+8.35 (left Second digit length)	6.29	0.577	0.332	19.008	<.000
	Third	Height =114.76+7.07 (left third digit length)	6.71	0.489	0.239	16.148	<.000
	Fourth	Height=113.84+7.70 (left fourth digit length)	6.81	0.465	0.216	14.777	<.000
	Fifth	Height=122.73+8.072 (left fourth digit length)	6.87	0.449	0.202	16.782	<.000

Table 3: Linear Regression Equation For Stature Estimation From Digit Length In Males.

(SEE- standard error of estimation, r-correlation coefficient, r^2- coefficient of determination) Table showing regression equation for stature estimation from digit length in males is significant at p<.001.

Side	Digit length	Equations	SEE	r	r^2	t	P
Right	Second	Height=102.13+8.19 (right Second digit length)	6.49	0.57	0.325	19.645	<.000
	Third	Height =97.77+7.97 (right third digit length)	6.53	0.564	0.318	17.904	<.000
	Fourth	Height =102.45+8.05 (right fourth digit length)	6.7	0.531	0.282	17.871	<.000
	Fifth	Height =123.25+6.30 (right fifth digit length)	7.18	0.419	0.175	20.75	<.000
Left	Second	Height =98.56+8.76 (left Second digit length)	6.46	0.575	0.331	18.746	<.000
	Third	Height =93.51+8.49 (left third digit length)	6.32	0.6	0.36	17.446	<.000
	Fourth	Height =118.63+5.69 (left fourth digit length)	7.25	0.399	0.16	17.446	<.000
	Fifth	Height =119.58+6.916 (left fourth digit length)	7.1	0.439	0.193	20.039	<.000

Table 4: Linear Regression Equation For Stature Estimation From Digit Length In Female.

(SEE- standard error of estimation, r-correlation coefficient, r^2- coefficient of determination)

DISCUSSION

This study was designed to see if there is relationship between digit lengths with height. This was to investigate if these parameters could be used to predict height as different body parts have been used for the prediction of height for the possible identification of individuals in forensic investigation [5, 6, 7, 8].

The present study has demonstrated a significant ability to estimate height from digit length in both males and females and from both right and left hands. Predictive equations generated for heights from digit lengths showed that the predictive values are higher in the males than in the females. This is in agreement with findings of El-Megaly *et al* (2006) [8] reporting

the same phenomena in establishing stature from tibial length and malleolar breadth in an Egyptian sample, and Krishan and Sharma(2007) [5] reporting on estimation of height from hand and foot length in a north Indian population. This implies that the ability to accurately predict height from digit length is greater in the males than the females due to the lower values of standard error of estimates [5].

According to study by Rastogi et al (2009) [9]: Middle finger length – a predictor of stature in the Indian population. The regression equations for stature estimation from middle finger length are estimated. In this study no statistically significant differences were found in the mean stature and middle finger length of the south

Indians and south Indian population when compared for the same sex. This suggests that in persons of different population groups (belonging to same race) geographical variation 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.

According to study by Danborno et al (2009) [6] Estimation of Height and weight from the Lengths of Second and Fourth Digits in Nigerians. Predictive equations generated for heights from digit lengths showed that the predictive values are higher in the males than in the females as in present study.

CONCLUSION

This study has succeeded in establishing stature estimation from digit length for this population which will not only serve as a useful tool in forensic investigation and clinical practice, but also relevance in ergo-design applications of hand tools and devices.

Acknowledgements

Conflicts of Interests: None

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