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STATURE ESTIMATION FROM DIGIT RATIO(2D:4D): A STUDY FROM COASTAL REGION OF ANDHRA PRADESH IN INDIA

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ABSTRACT
Estimation of height from different body parts has received great attention in anthropology and forensic science and this study was designed to investigate the ability of estimating stature from digit ratio (2D:4D). **Materials and Methods:** Our study includes 200 (96 males and 104 females) subject between ages of 18 to 25 years were recruited randomly excluding those with hand deformities from Coastal regions of Andhra Pradesh. second and fourth digit lengths were measured from the basal crease to the tips usinga Vernier calipermeasuring to 0.01cm minor reading. The 2D:4D digit ratio were then calculated for each subject on both hands. Descriptive statistics and ANOVA were used to analyze the data. **Results:** The regression equations have been drawn from the data collected. It has been observed that stature can be estimated from the digit ratio. **Conclusion:** In conclusion, our study has provided the first data from coastal region of Andhra Pradesh demonstrating stature estimation from digit ratio. This information is useful in forensic science and anthropology.

KEYWORDS: Digit ratio; 2D:4D; stature estimation, Coastal regions of Andhra Pradesh.

INTRODUCTION
Digit ratio – is the ratio of the lengths of different digits. The ratio of index finger length to ring finger length is called the "2D:4D digit ratio," or more simply, the "digit ratio."Specifically, it is the ratio of the length of the index finger (digit 2, or "2D") and the ring finger (digit 4, or "4D") i.e. 2D:4D ratio that is sexually dimorphic.

As per the observations of various studies, the sexual dimorphism in 2D:4D is influenced by prenatal secretion of testosterone and estrogen. The higher level of testosterone during facilitates the growth of the ring finger, while higher levels of estrogen facilitate the growth of the index finger and thus testosterone negatively correlates with 2D:4D while estrogen correlates positively with 2D:4D.[1,2,3,4] These sexually dimorphic properties of the digit ratio appear to be consistent across all cultures and are independent of age and overall height.[3,5]

Digit ratio has consistently been shown to be more dimorphic on the right hand than on the left in humans, baboons, mice and finches.[6,7,8,9,10,11]

There is speculative evidence that this ratio may be established during early fetal life. It also appears that the ratio is stable during life excepting external factors, that is, arthropathies and traumatic amputation.[12,13]

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.[14,15]

In the present paper an attempt has been made to derive some regression formulae to indicate relationship between height and digit ratio 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 and fourth digits in both right and left hand using Vernier caliper measuring up to .1mm.

From above measurements the following are calculated

Digit ratio: The ratio of the fingers will be calculated by simple mathematical method

2D:4D ratio= length of second digit (2D)/length of fourth digit (4D)

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

RESULT

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).

Table 1: Descriptive Statistics of Variables in Male Subject (HEIGHT AND DIGIT LENGTH) N=96

Variables		Minimum	Maximum	Mean	Std. Deviation
Height		152.00	192.00	172.9271	7.65471
Right	Second digit length	6.50	8.80	7.4740	.49274
	Fourth digit length	6.60	9.40	7.6240	.49710
Left	Second digit length	5.80	8.90	7.4417	.52849
	Fourth digit length	6.60	9.00	7.6698	0.46

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).

Table 2: Descriptive Statistics of Variables in Female Subjects (HEIGHT AND DIGIT LENGTH) N=104

Variables		Minimum	Maximum	Mean	Std. Deviation
Height		140.00	183.00	158.5192	7.87028
Right	Second digit length	5.80	8.20	6.8808	.54720
	Fourth digit length	5.80	8.20	6.9644	.51932
Left	Second digit length	5.80	8.00	6.8385	.51639
	Fourth digit length	5.80	8.20	7.0038	.55195

The objective of the study is to link the estimated stature with that of digit ratio. Table 3 shows descriptive statistics between and digit ratio.

Table 3: Comparison of Means Between Males And Females for Height And Digit Ratio.

Variables		Males (n=96) Mean ± S.D	Females (n=104) Mean ± S.D	t	P
Height		172.92 ±7.65	158.51± 7.87	26.22	<.000
Digit ratio	Right 2D:4D	.981± .042	.989± .044	-2.750	.241
	Left 2D:4D	.973 0.44	.984 .053	-2.996	.272

This table shows there was a significant difference in height between male and female study subjects at p<.05 where as for digit ratio not significant p>.05.

Table 4 include the statistical findings of linear regression equation in male and female respectively. The regression equation for stature estimation for digit ratio in both male and female is derived but observed to be not statistically significant with a p<.05.

Table 4: Linear Regression Equation for Stature Estimation from Digit Ratio in Males and Female.

Sex	Digit side	Digit ratio	Equations	SEE	r	r^2	t	P
Male	Right	2D:4D	Height=152.96+20.34 (right2D:4D digit ratio)	7.64	.112	.013	9.461	.277
	Left	2D:4D	Height=131.614+42.43 (left2D:4D digit ratio)	7.45	.249	.062	10.416	.015
Female	Right	2D:4D	Height=135.81+22.94 (right2D:4D digit ratio)	7.84	.131	.017	9.314	.185
	Left	2D:4D	Height =131.20+27.75 (left2D:4D digit ratio)	7.76	.190	.036	11.326	.053

(SEE- standard error of estimation, r-correlation coefficient, r^2- coefficient of determination) This table shows regression equation for stature estimation from digit ratio in males and females is not significant.

DISCUSSION

This study was designed to see if there is relationship between digit ratio 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.

There are so many studies to estimate stature from digit length but this is the first study to estimate stature from digit ratio.

The result of the present study has shown that the digit ratio be used to estimate height in both males and females and from both right and left hand but not stastically significant, this knowledge is used for forensic scientists. But it should also be realized that there are population variation in anthropometric dimensions, which are influenced by genetics and environmental factors.[16,17,18] India is a vast country with varied geographical conditions and stature varies with race, sex and geographical locations so the regression equations generated from this study may only be very useful in estimating height in Indians.

CONCLUSION

This study has succeeded in establishing stature estimation from digit ratio for this population which will serve as a useful tool in forensic investigation and for anthropologist.

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