

CROSS SECTIONAL STUDY OF SECOND AND FOURTH DIGIT RATIO WITH PHYSICAL ATTRIBUTES IN SOUTH INDIAN POPULATION

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ABSTRACT

Background: Study of the index (2D) and ring (4D) digit ratios and their association with some physical characteristics of South Indian Population was done to determine the values of 2D:4D digit ratios and their association with other anthropometric variables.

Materials and Methods: 160 adults (80 males and 80 females) between ages of 18 years and above were randomly selected with exclusion of those with hand deformities. The digit lengths were measured from the basal crease to the tips using vernier calipers. The 2D:4D ratios were determined for each subject while height and weight were used to calculate the body mass index and data analyzed.

Results: The results showed significant difference in 2D:4D ratio between males and females. ($p < 0.001$). Mean height of males exceeded the mean height of females and the mean weight of males exceeded the mean weight of females. Mean BMI of males also exceeded that of females. There was a positive correlation between the second digit length and Height and weight in males and females both on right and left sides. There was also a significant correlation weight and second digit length in males. The 2D:4D ratio for both left and right hand did not show any positive correlation with height, weight or BMI of an individual from people of South India.

Conclusion: The results show a positive correlation between the digit lengths and height in both males and females and between weight and second digit length in case of males but the 2D:4D digit ratio had no relationship to height, weight or BMI. The analysis also demonstrated that the males have greater 2D:4D ratio compared to females. The results of the study can be of importance in the field of forensic anthropology.

KEY WORDS: 2D:4D ratio, anthropometry, finger, height, weight, BMI.

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INTRODUCTION

Recent decades have witnessed an increase in understanding of the importance of prenatal programming on individual's subsequent behaviour, physiology, and phenotype and also on reproductive success. It was also shown that prenatal steroids also play a major role in programming of later life reproductive perfor-

mance [1]. In vertebrate species these effects are inherently difficult to study and manipulate, particularly in humans due to ethical issues. So one non-invasive retrospectively available measure, the ratio of second to fourth digit lengths has been highlighted as a potentially useful phenotypic marker of steroid exposure in utero in vertebrates [2]. The ratio of second to

fourth digit length correlates with in utero testosterone levels because it is sexually dimorphic and is considered as an indicator of prenatal sex hormone exposure [3]. The differences in 2D:4D ratio is set before birth around 14 weeks of gestation [4]. This fact rules out any social influences that can affect the digit growth. All somatic sex differences can either be due to androgenic masculinisation or due to effects of sex chromosomes [5]. Prenatal sexual dimorphism indicates that androgens act before birth to affect digit ratios and the finding of androgen insensitivity syndrome rules out the role of sex chromosomes in the sex differences of digit ratios [5].

There was possible association of 2D:4D ratios with sexual orientation, autism, age at development of myocardial infarction, age at development of breast cancer, musical ability and different aspects of cognitive ability and personality [6]. The skeletal structure and personality are affected by sex hormone levels in the uterus because these hormones carry out their functions by evoking responses from specific organs or tissues that are adapted to react to minute quantities of such hormones [7-8]. It was found that there was a direct relationship between the index and ring finger length ratios and the amount of testosterone in utero [9]. In a study of Manning et al smaller index finger in men have been associated with higher level of physical aggression [10]. This association was proved true only for physical aggression and not any other type of hostile behaviors [11]. The aim of the present study is to investigate the association of the index (2nd) and ring (4th) digit ratios with some physical traits in South Indian population.

MATERIALS AND METHODS

The population of study consisted of 80 males and 80 female students and staff of Yenepoya Medical College, Mangalore. The study was approved by institutional ethical committee. Convenient random sampling method was used to obtain measurements of index and ring finger with the exclusion criteria that the participants do not have any physical anomalies of fingers or had any history of fracture or dislocation of index, middle and ring fingers. The

middle finger was used as the standard reference. At the proximal base of index and ring fingers there were creases. In most of the participants, index finger had only one crease and ring finger a band of creases. The most proximal crease was chosen as a point. With the help Venier Calipers the length of second and fourth digits were measured. All measurements were made carefully with the digits fully extended.

Statistical Analysis: The data collected were used to obtain 2D:4D ratios by dividing 2D by 4D lengths. Data was expressed as mean \pm standard deviation. Student t test was used to determine the level of significance. The relationship between the parameters studied was established using Pearson Correlation to establish the strength of relationship between the lengths of second and fourth digits (2D and 4D), the digit ratios and other anthropometric variables in both sexes. Statistical significance was accepted if p value was less than or equal to 0.001 ($p \leq 0.001$).

RESULTS

Fig 1a: Digit length in females.



Fig 1b: Digit length in males.



The result of the anthropometric study of the differences in index (2D) and ring (4D) and their ratios shows that there was a significant difference between the length of index finger (2D), ring finger (4D) and the ratios of 2D:4D in both males and females. The mean values in males were 7.21, 7.12, 1.01 while in females were 6.72, 6.77, 6.98 for the 2D, 4D lengths and ratios of right hand respectively. The mean values in males were 7.11, 7.21, and 0.97 and in females were 6.67, 6.81 and 0.97 for the 2D,

4D lengths and their ratios for left hand respectively. The mean values of lengths of index finger (2D), ring finger (4D) and R2D:R4D between males and females were statistically significant ($p < 0.001$) as shown in Table 1 and Fig 1a and 1b. L2D:L4D ratio was no significant between males and females.

Table 1: Shows the mean \pm standard deviation of 2D, 4D lengths and the ratios of 2D:4D in males and females.

Parameters	Males	Females	t- value	Sig. Level
	MEAN \pm SD	MEAN \pm SD		
R2D	7.21 \pm 0.46	6.72 \pm 0.36	7.52	$p < 0.001^{**}$
R4D	7.12 \pm 0.59	6.77 \pm 0.39	4.31	$p < 0.001$
L2D	7.11 \pm 0.53	6.67 \pm 0.35	6.07	$P < 0.001$
L4D	7.21 \pm 0.49	6.81 \pm 0.38	5.69	$P < 0.001$
R2D:4D	1.01 \pm 0.06	0.98 \pm 0.11	2.38	$P < 0.001$
L2D:4D	0.97 \pm 0.12	0.97 \pm 0.03	0.34	$p > 0.001^*$

** $p < 0.001$ -statistically significant
* $p > 0.001$ -Statistically not significant

Table 1 & Figure 1a and 1b indicate Males have greater 2D:4D ratio in the right hand compared to females. In both males and females the 2D:4D ratio was equal in left hand. Using t test, in males and females the 2D:4D ratio was not significant for the left with $p = 0.736$. Meanwhile the digit ratio was significant for right hand with $p = 0.001$. Results shows that mean height of males exceeded the mean height of females and the mean weight of males exceeded the mean weight of females. Mean BMI of males also exceeded that of females (Table2).

Table 2: General statistics of the anthropometric parameters used.

Parameters	Sex	Mean \pm SD	Minimum	Maximum	N
Height	Male	166 \pm 9.60	141	187	80
	Female	159 \pm 6.28	147	172	80
weight	Male	63.72 \pm 11.74	32	94	80
	Female	56.56 \pm 10.53	39	90	80
BMI	Male	22.95 \pm 4.39	13.42	39.63	80
	Female	22.28 \pm 4.26	16.4	38.95	80

Table 2 Correlation matrix for the second and fourth digit lengths and the anthropometric variables were done to analyze any association between the digit lengths and the physical attributes. There was a positive correlation between the second digit length and Height and weight in males and females both on right and left sides (Table 3).

Table 3: Correlation matrix of second digit length with anthropometric variables.

Parameter	FEMALE				MALE			
	R2D	P VALUE	L2D	P VALUE	R2D	P	L2D	P
Height	.428**	0	.466**	0	.452**	0	.598**	0
WEIGHT	-0.017	0.883	0.024	0.832	.288**	0.01	0.213	0.058
BMI	-0.191	0.09	-0.17	0.131	0.05	0.657	-0.145	0.199

** Correlation is significant at the 0.01 level

Table 4: Correlation matrix of fourth digit length with anthropometric variables.

Parameter	FEMALE				MALE			
	R4D	P VALUE	L4D	P VALUE	R4D	P	L4D	P
Height	.248*	0.026	.351*	0.001	.498**	0	.444**	0
Weight	-0.166	0.142	-0.93	0.412	.258*	0.021	0.283	0.011
BMI	-.264*	0.018	-0.236	0.035	-0.031	0.786	0.003	0.976

Table 3 Weight and second digit length also showed correlation in case of males. There was also a strong correlation between the fourth digit length and height in both in males and females bilaterally (Table 4).

Table 5: Correlation matrix of R2D:4D with the anthropometric parameters used.

Parameters	Females (R2D:4D)		Males(R2D:4D)	
	Karl Pearson correlation coefficient r Value	P Value	Karl Pearson correlation coefficient r Value	P Value
Height	.235 [*]	0.036	-0.279	0.012
Weight	0.89	0.431	-0.027	0.81
BMI	-0.012	0.917	0.157	0.165

Table 5 shows the correlation matrix of R2D:4D with the anthropometric parameters. There was no positive correlation ($p < 0.001$) between the R2D:4D and height, weight and BMI.

Table 6: Correlation matrix of L2D:4D with the anthropometric parameters used.

Parameters	Females (L2D:4D)		Males(L2D:4D)	
	Karl Pearson correlation coefficient r Value	P Value	Karl Pearson correlation coefficient r Value	P Value
Height	0.135	0.233	0.036	0.75
Weight	0.188	0.095	-0.095	0.402
BMI	-0.126	0.266	-0.106	0.35

Table 6 shows no positive correlation between L2D:4D and height, weight and BMI.

DISCUSSION

Determination of finger length ratio (2D:4D) was done in cross section of sample of South India and the results were compared between males and females. According to previous researches done in the field shows that the digit ratio values are consistently reliable in determination of sexual dimorphism. According to Brown et al, considerable proportions of normal males have low digit ratios compared to females [12]. It was also shown that men had relatively short second digits than fourth digits [13]. In our present study, males had greater 2D:4D for right hand and almost equal digit ratio for the left hand. According to Esther et al, a low 2D:4D ratio in girls is highly predictive of presence of autistic features and a low ratio can be used as a diagnostic predictor in medicine [14]. The present study was done to establish the relationship between the male and female finger length ratios (2D:4D) and to ascertain if it has any correlation with height, weight and BMI. The results showed that there was correlation between R2D:4D and height in females if the p value was less than 0.05. Otherwise there was no significant correlation between the digit ratios and other anthropometric variables. Manning et al reported that there was no significant correlation between height

and weight and digit ratios for 69 men and 62 women with the exception of positive correlation between the weight and 2D:4D ratios for the right hands [10]. According to Tester and Campbell there was a negative association between the height and digit ratio (regression coefficient -.25) which is close to the present data [15]. Present study showed a negative correlation between R2D:4D and height (-.27). On the other hand, Hurt and VanAnders reported a large negative correlation of -.49 between height and digit ratios after controlling the gender [16]. The results of the present study have great practical applications in that it could be useful in the field of forensic anthropology and in forensic medicine as a means of identity.

CONCLUSION

The 2D:4D length ratio in males is greater than in females. Results obtained from the total sample of 160 participants have shown that males have shown to have higher or equal 2D:4D ratios in both right and left hands respectively. The following observations were derived from the study

- The 2D and 4D lengths between right and left hand also showed variations with p value less than 0.001.

- Present study showed that there was a positive correlation between second and fourth digit length and height in males and females bilaterally. There was also a significant correlation between weight and second digit length in males

- Results showed no positive correlation between the 2D:4D ratios and height, weight and BMI of the study population.

Results from the present study indicate that 2D and 4D lengths is a proxy indicator of height when it is difficult to measure height directly. Since the study is limited to South India, further studies are recommended to be carried out with larger population and other ethnic groups for greater utility value of 2D:4D as a indicator for physical attributes.

Conflicts of Interests: None

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