

Morphometric significance of 2d/4d (second digit/fourth digit) ratio in a sample of Medchal town, Telangana state

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Abstract

Introduction: In both sex the length of 2nd and 4th digit (2D:4D) differs. Hence 2D:4D ratio of male is lower than female. In medico legal examination this finding plays a key role in determining sex. **Aim:** To estimate 2D:4D ratio in Medchal, Telangana region and evaluate difference in both male and females in both right and left digits. **Materials and Methods:** The sample consisted of 124 individuals (63 men and 61 women), residents of Medchal town & Dist, aged between 21 to 41 years. The subjects were randomly selected among students and public of Medchal town. Personal, behavioral and medical history data were obtained in a structured interview. All participants were in good general health and presented homogeneous socio-economic characteristics. **Results:** The final result of the analysis shows that 63.48% in males and 63.93% in females were sexed correctly with an overall accuracy of 64%. **Conclusion:** Sexual dimorphism exist in different population and age groups in right and left digits (2D:4D) ratio.

Key words: 2D:4D ratio, sexual dimorphism, HOX genes, fetal hormones.

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Introduction

Forensic study plays vital role for identification of age, sex and stature[1]. From many years forensic experts deal with morphological and anthropometric association between different parts of body and sex[2]. Mostly whenever mortality rate is high, may be due to explosions, accidents or any other fatal disasters, this co-relation is helpful for determination of sex[3]. Establishing identity of an individual, there are many studies which helps to know the importance of hand and foot measurements[1]. Dermatoglyphic pattern like ridge, whorls and length of fingers and their ratios are helpful for analysis of hand[4]. Along with length of 2nd and 4th digits, finger ratios are helpful in determining sex which is a sex – dimorphism biometric population marker[5,6]. In neonatal life finger length ratio is under the control of HOX genes. In prenatal period ratio is negatively related to testosterone and positively to estrogen, as differentiation of Urogenital system is also under the control of HOX genes which influence the development of testicular androgen and digits[7,8,9]. Parental hormones such as oestrogen and androgen are responsible for sexual dimorphism which starts from 13th and 14th weeks of gestation [10]. The study helps in determining sex by using measurements and 2D:4D as postnatal biomarker[10]. Many studies suggest sexual dimorphism depends on prenatal sex hormone when finger length is measured on ventral side[11]. Prenatal testosterone level varies, congenital adrenal hyperplasia, autism when compared with sex chromosomal disorders[12]. Digit ratio depends on bone length, as it is an important factor for assessing the growth of bone. There are wide differences in sexual dimorphism when digit ratio taken from phalangeal bone than metacarpal bone. Ratio obtained from phalangeal bone showed great sex difference than others. Both ventral and dorsal finger length measurement studies

were carried, where dorsal digit length is considered more reliable as the dorsal digit measurements does not include finger flexion creases, which might be the reason for measurement errors[13]. In the present study the length of the finger is the distance between the proximal metacarpo-phalangeal flexion crease and the finger tip.

Materials and methods

The sample consisted of 124 individuals (63 men and 61 women), residents of Medchal town, R.R, Dist, aged 21 to 41 years. The subjects were randomly selected among students and public of Medchal town. Personal, behavioral and medical history data were obtained in a structured interview. All participants were in good general health and presented homogeneous socio-economic characteristics.

The following variables were considered:

- Length of the hand
- Breadth of the hand
- Size of the palm
- Span size
- Length of the fingers
- Length of the nails
- Width of the digits
- Dorsal distribution of hair over the digits.

The hand measurements were taken to the nearest millimeter with a sliding caliper according to methods reported. The length of the hand is the distance between the distal wrist creases to the tip of the 3rd digit. Breadth of the hand is measurement of the width of the palm along with the thumb. Span size is the distance from the tip of the thumb to the tip of the little or index finger. The length of the finger is the distance between the proximal metacarpo-phalangeal flexion crease and the finger tip. The digital formula« was used to indicate the relative lengths of the fingers: the fingers are indicated by numbers 1 (thumb) to 5 (little finger) and listed in order of decreasing length. The digit ratio (2D:4D) between the length of the 2nd and 4th fingers were also calculated.

Statistical Evaluation

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Data obtained was compiled, tabulated and analyzed statistically on Word Excel and SSP software's. Descriptive statistics (mean ± standard deviation) of the 2D:4D for the left and right hands were tabulated for both males and females. Analysis of variance and discriminant function analysis were also done on the data.

Results

Table 1 and 2 shows the mean value of lengths all digits in the right and left hands in males and females obtained by measuring dermatoglyphics lengths using Vernier calipers. The sex differences for all parameters were highly significant.

The Graph 1 compares the 2D:4D ratio in the right and left hands of both males and females with mean 2D:4D ratio of 0.98 – 0.99 in males as compared to 2D:4D ratio of 1.01 in females.

Statistical calculations of males and females have been summarized in Table 3, which shows comparison of mean of 2D:4D ratio in the right and left hands of both males and females which were highly significant in terms of sexual differences.

With this functional analysis it was found that 2D:4D ratio could be used to study sexual dimorphism with an overall accuracy of 64%.

The final result of the analysis shows that 63.48% in males and 63.93% in females were sexed correctly.

Discussion

The 2D:4D ratio is lower in men than women. Lower “index” and “ring finger” ratio is considered as masculine and higher as feminine. This feature is in line with the present study. In this study, 2D:4D ratio in females is significantly higher than males in both hands. This observation is similar with earlier reports. This study confirms the observations of other researchers that the sex differences in the index and ring finger ratio can be a useful sex indicator[8,9].In this study, males show higher mean values in each anthropometric dimension than females. This statistically significant difference may be attributed to the early maturity of girls than boys. Consequently, the boys have 2 more years of physical growth. This study is consistent with the early hypothesis that fetal hormones affect 2D:4D ratios10.

Conclusion

Whenever other parts of body are not available then determination of sex using 2D:4D ratio is a better way to analyze. The study did not include any particular community or group of people.



Fig 1:How to measure '2D-4D DIGIT RATIO'

Table 1:Values for men

Men	Right hand(mean length)	Standard deviation	Left hand(mean length)	Standard deviation
Hand length	18.4	2.15	18.51	1.66
Width of the hand	9.4	0.396	9.4	0.46
Palm size	7.6	0.569	7.61	0.554
Span size	19.98	2.49	20.3	2.5
Length of thumb	6.38	0.319	6.4	0.4
Length of 2 nd digit	7.6	0.302	7.6	0.346
Length of 3 rd digit	8.13	0.682	8.2	0.242
Length of 4 th digit	7.55	0.596	7.61	0.2
Length of 5 th digit	6.13	1.025	6.2	0.295

Table 2:Values for women

Women	Right hand(mean length)	Standard deviation	Left hand(mean length)	Standard deviation
Hand length	15.972	0.505	15.89	1.092
Width of the hand	8.505	0.33	8.3	0.482
Palm size	6.819	0.293	6.68	0.351
Span size	17.554	1.383	17.59	1.435
Length of thumb	5.501	0.168	5.41	1.38
Length of 2 nd digit	6.708	0.333	6.64	0.318
Length of 3 rd digit	7.216	0.32	7.25	0.378
Length of 4 th digit	6.581	0.302	6.64	0.438
Length of 5 th digit	5.242	0.761	5.12	0.782

Table 3:Comparison of males and females

2D/4D RATIO	Males		Females	
	Right	Left	Right	Left
0.93 – 0.97	9(14.28%)	9(14.28%)	07(11.47%)	09(14.75%)
0.98 – 0.99	31(49.20%)	30(47.61%)	15(24.59%)	18(29.50%)
1.0	11(17.46%)	12(19.04%)	13(21.31%)	12(19.67%)
1.0 – 1.05	12(19.04%)	12(19.04%)	26(42.62%)	22(36.06%)

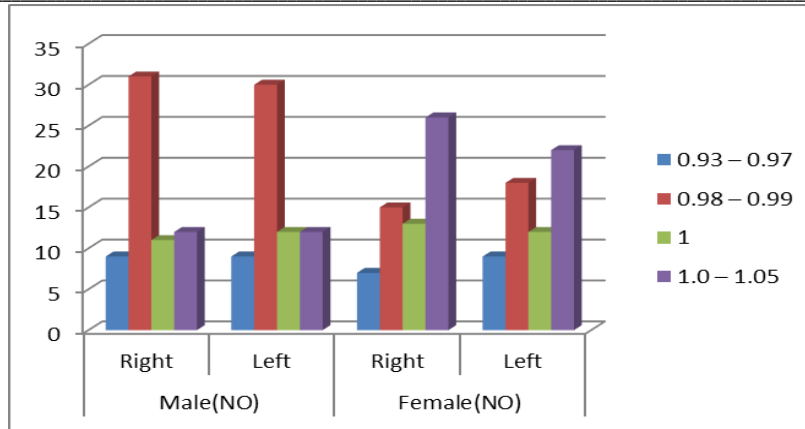


Fig 2: Comparison of man and woman

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