SECOND TO FOURTH DIGIT RATIO(2D:4D) IN NORTH-WEST INDIANS: SEXUAL DIMORPHISM

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ABSTRACT

The index (2D) to ring finger (4D) ratio less than one (2D:4D <1) has been considered as a "male finger pattern" and 2D:4D more than or equal to one (2D:4D≥1) has been considered as a "female finger pattern". The present study was conducted on 100 young adults (m=56, f=44) from northwest population of India to find out the sexual dimorphism and right-left asymmetry in 2D:4D ratio by three different methods namely visual, direct and scan methods. Visual method showed that significantly more number of males were having Type 3 hand i.e. index finger smaller than ring finger compared to females who more often had Type 1 hand i.e. index finger longer than ring finger ($p< 0.001$). The mean 2D:4D ratios in males were observed to be 0.97 by direct method and 0.96 by scan method. In females the ratio was 1.00 and 0.99 by direct and scan methods respectively; sex difference being statistically significant ($p <0.001$).Mean values by direct method were slightly higher than scan method but the difference was statistically insignificant. In both sexes there was no significant right left asymmetry.

Keywords: Digit ratio, bilateral asymmetry, sexual dimorphism

INTRODUCTION:

Besides obvious anatomical differences between males and females, sexual dimorphism occurs in other features also like finger lengths. Digit ratio has been seen to show sexual dimorphism in relative and absolute lengths of the index (2D) and ring finger (4D). The index to ring finger ratio has been reported to be smaller in males as compared to females[1,2]. The 2D:4D ratio is thought to be determined by testosterone exposure during early intrauterine[3]. High concentration of foetal testosterone indicates a low 2D:4D ratio which therefore indicates high prenatal testicular activity. Relative finger length, as a surrogate for prenatal hormonal exposure, has also been shown to be related to a wide range of physical, medical and psychological factors including sexual orientation, fertility, sporting potential etc[4,5]. Ethnic and racial variations in digit ratio have also been reported[6,7].

The purpose of this preliminary study is to extend this research in Indians as to the best of our knowledge, no study has been conducted in Indians especially North-west zone. The aim was to find out sexual dimorphism and bilateral asymmetry as this may guide in choosing the correct hand in relation to epidemiological studies.

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MATERIAL AND METHOD:

Material used for the present study consisted of a total of hundred (56 males and 44 females) North-west Indian adult subjects in the age group of 18-25 years. The subjects were medical and physiotherapy students studying in a College. Subjects with injuries or deformities of digits were excluded from the study. Ventral aspect of both hands of each subject with wrist and digits in neutral position was used to take the measurements. Length of index and ring fingers was measured by the following three methods and 2D:4D was calculated.

1. Visual method:[8] The hands were directly viewed from palmar aspect taking care to remove parallax and were classified into the following three types:

Type1: when index finger is longer than ring finger
Type 2: when index finger is equal to ring finger
Type 3: when index finger is smaller than ring finger.

2. Direct method: Measurements were made directly with the help of scale. For each finger measurements were taken from ventrally located proximal-most metacarpo-phalangeal flexion crease (which separates finger from palm region) to the tip of individual finger (protruding finger nails were excluded). Where there was a band of crease the most proximal crease was used.[9]

(3) Scan method: After marking the point on distal

crease as in direct method palmar aspect of both hands were placed together on scanner
(HP Scanjet. G 1030) to take scans and printouts were taken. Length of each digit was measured with scale. All measurements were made twice and the average of the two measurements was taken. To eliminate bias due to inter-observer error, all digits were measured by the first author.

Statistical evaluation

Analysis of variance was used for blind test-retest of ten individuals at one week interval to see intra-observer variation, which was found to be insignificant for both direct and scan methods ($p > 0.05$). Results were analysed by using paired t-test, unpaired t-test and Z test. All statistical evaluation was done using 'SYSTAT 12' software.

OBSERVATION:

1. Table I shows the occurrence of hand types in males and females on right and left sides by visual method. Type 1 hand was significantly more prevalent in females ($p < 0.001$) while Type 3 was more prevalent in males ($p<0.001$). However, there was no significant difference between right and left sides.
2. Table II shows the mean value of length of 2D, 4D and 2D:4D ratio in right and left hands in males and females obtained by direct and scan methods. The sex difference for all parameters was highly significant ($p<0.001$) for both methods but there was no significant bilateral asymmetry.

Table 1: Prevalence of hand types by Visual method

	Male (n=56)			Female (n=44)			
Hand Type	Right No. (%)	Left No. (%)	Total 112 hands No. (%)	Right No. (%)	Left No. (%)	Total 88 hands No. (%)	Z (p)
Type 1	10(17.86)	11(19.64)	21 (18.75)	22(50.00)	19(43.18)	41 (46.59)	4.20*
Type 2	8(14.28)	14(25.00)	22 (19.64)	8(18.18)	11(25.00)	19 (21.59)	0.34
Type 3	38(67.86)	31(55.36)	69 (61.61)	14(31.82)	14(31.82)	28 (31.81)	4.26*

*=$p<0.001$ for sex difference

Table II: Length of 2D, 4D and 2D:4D in males and females by Direct and Scan methods

Parameter	Scan			Direct		
	Male (n=56)	Female (n=44)	p	Male (n=56)	Female (n=44)	p
2D right	6.68 ±0.39	6.28 ± 0.49	0.000	7.36 ± 0.50	6.79 ± 0.53	0.000
2D left	6.65 ± 0.37	6.26 ± 0.48	0.000	7.39± 0.50	6.84 ± 0.55	0.000
Mean 2D	6.66± 0.38	6.27± 0.48	0.000	7.37± 0.49	6.81± 0.53	0.000
4D right	6.90 ± 0.35	6.14 ± 0.39	0.000	7.60 ± 0.45	6.58 ± 0.66	0.000
4D left	6.92± 0.37	6.05± 0.35	0.000	7.58 ± 0.46	6.61 ± 0.66	0.000
Mean 4D	6.91± 0.36	6.09± 0.38	0.000	7.59± 0.45	6.59 ± 0.65	0.000
2D:4D right	0.97 ± 0.04	0.99 ± 0.05	0.009	0.98 ± 0.04	1.00 ± 0.06	0.001
2D:4D left	0.96 ± 0.03	1.0 ± 0.06	0.000	0.97 ± 0.04	1.00 ± 0.05	0.001
Mean 2D:4D	0.96± 0.04	0.99± 0.06	0.000	0.97± 0.03	1.00± 0.05	0.000

Difference between right and left sides not significant

3. Comparison of direct and scan methods.(Table II): The values obtained by direct method were slightly higher than scan method in both sexes. However, this difference was not statistically significant.

DISCUSSION:

The digit ratio is the ratio of the lengths of different digits measured from the bottom crease where the finger joins the hand to the tip of the finger. The second to fourth digit ratio is lower in men than women; women generally having a digit ratio of about 1.0 while men having digit ratio of about 0.96 [1,2, 6].The observations of present study using both direct and scan methods, correlate well with these observations. Moreover, with visual method also it was observed in present study that 61% males have Type 3 hand while only 32% females showed this type of hand. Our observations are similar to those of Robertson et al[8] who reported 61% of men having Type 3 hand. This means that in females, characteristically the index is either longer or equal to ring finger. A low 2D:4D ratio has been shown to correlate with high testosterone level which is characteristic of males, while a high 2D:4D is correlated with low testosterone level, a characteristic of females[2]. Prenatal testosterone concentrations are thought to modify development rate. Differentiation of gonads and digits is under the common control of HOX genes suggesting pattern of digit development to be related to the function of gonads[2]. An interesting new observation in the present study was that when male and female were compared the mean difference in 2D was much less as compared to 4D. Does this mean that testosterone affects growth of 4D more than 2D? Answer to this requires further study.

Williams et al[10] observed that digit ratio showed more sexual dimorphism in right hand than in left suggesting there is more androgenic effect on right hand than the left. They also reported that relationship between digit ratio and psychological factors showed stronger effects on the right hand. Mayhew et al[11]observed bilateral asymmetry in females in favour of right hand. In the present study although apparently the sex characteristic hand type (Type 3 in males and Type 1 in females) was more often seen on the right side (Table1) but this difference was not statistically significant. Moreover, by direct and scan methods also no statistically significant difference was observed in mean values on right and left sides. Manning et al[12] Robertson et al[8] and Paul et al[13] also did not observe bilateral asymmetry.

In the present study 2D:4D finger ratio was evaluated by three different methods i.e. visual direct and scan methods. The values by scan method were observed to be lower (though not statistically significant) as compared to direct method with mean value 0.96 in male and 0.99 in female in scan method as compared to 0.97 in male and 1.00 in female by direct method. Manning et al[14] also reported that direct values were higher than scan values. The reason for such variation could be that the readings can vary according to the pressure applied on the hands at the time of taking the scan. Also it may not be possible to see the distal-most point on the finger tip in scans. It is, therefore, suggested that direct method may be more useful than scan method particularly for epidemiological studies as it requires much simpler equipment.

There are reports regarding ethnic and racial variations in digit ratio. Manning et al[6,7] reported significant racial and ethnic variations among Caribbean Jamaicans and white Caucasians and they suggested that this variation may be related to latitude, such that more northerly populations have higher digit ratio. Gwunireama et al[15] reported that 2D:4D exhibited variations in two different ethnic populations of Nigeria living within same geographical location suggesting that 2D:4D was inherited. On the other hand, Oladipo et al (16) did not find ethnic variations in digit ratio between Igbos and Yorubas ethnic groups of Nigeria. The digit ratio observed in the present study (with latitude of 28° 35' N) by direct method is 0.97 in males and 1.00 in females. It was higher than that reported for Nigerians (with latitude of 6° 27' N) and is 0.96 in males and 0.97 in females. This can possibly be explained by the difference in latitude[6,7]. However a larger sample would be required to justify the statement.

CONCLUSION:

2D:4D finger ratio shows sexual dimorphism in north-west Indians similar to that reported by other workers. There is no significant bilateral asymmetry but keeping in mind minor differences in right and left ratios same hand may be used for epidemiological studies. Direct method for measurements may be preferred in view of its reliability and the simple equipment required.

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