

Digit ratio, 2D:4D (Index finger: Ring finger) in the right and left hand of males and females in Malaysia.

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Abstract: The digit ratio is the ratio of the lengths of different digits or fingers measured from the midpoint of bottom crease where the finger joins the hand to the tip of the finger. An Anthropometric survey was conducted among local students (150 males and 150 females) of SEGi University Malaysia to determine and compare the index finger length with ring finger length (2D:4D ratio) using middle finger as the standard reference point. The data collected by random sampling method were used to calculate the 2D:4D ratio. Statistical Package for the Social Sciences (SPSS) and Students t- test were used to determine the level of significance. From the analysis, the data exhibited females have greater average difference in the 2D:4D ratio compared to males. Meanwhile, 2D:4D ratio of right and left hand were not significant in males ($p=0.209$) but significant in females ($p=0.024$). On the other hand, the 2D: 4D difference between males and females for both hands were found not significant ($p=0.527$ in males, $p=0.835$ in females). The analysis also demonstrated that males have greater 2D:4D ratio for both hands compared to females. The digit ratio can be correlated with health, behavior and sexuality.

Keywords: Digit ratio, 2nd digit - 4th digit ratio, 2D:4D, 2D/4D, Digit length.

1. Introduction

There are many parameters correlated with 2D:4D finger length ratio. Studies show that by measuring the length of index and ring finger, it helps predict intelligence, homosexuality [1], cancer, musical ability, aggressive behavior. Even the results of mathematics and literacy test for children could be predicted with correlation to 2D:4D ratio. Reports are available that boys tend to do better in math and girls do better at writing, reading and verbal test. Hormone (testosterone) is associated to have a direct relationship with the length of index and ring finger [2]. Men have been found to have a smaller ratio between index and ring finger than in women [3]. Finger length ratio to sexual orientation [4] physical aggression [5] variation and relationship during menstrual cycle [6] has been reported. Sex dependent behaviors and autism are correlated with 2D:4D ratio and males have shown to be associated with low value digit ratios [7].

Assessment of the index and ring finger ratio (2D:4D) in adults is associated with sporting ability [8]. Bernd Kraemer et al [2] reported that finger length ratio 2D:4D in adults correlated with gender identity disorder. Men with smaller 2D:4D ratios are perceived as being more masculine and dominant by female observers [9] Stronger effect are seen on the right hand, or found on the right hand only when both right and left hand digit ratios have been used to investigate relationships between digit ratio and psychological factors [10,11,12]. Several authors have proposed that androgenisation affects the right hand more than the left hand [11, 13].

Finger length ratio (2D:4D) is associated with left and right handedness [14] and the risk of knee and hip osteoarthritis [15]. In addition, there are reports on the correlation between 2D:4D ratio and site specific radiographic osteoarthritis of the knee [16]. Atherosclerotic plaque development is also being correlated with high 2D:4D finger length ratio [17]. Short and long term relationship orientation is also being associated with 2D:4D finger length ratio [18]. It has been found that low index-to-ring finger length ratio in sporadic amyotrophic lateral sclerosis supports prenatally defined motor neuronal vulnerability [19].

Lengths of ring finger are also linked to male attractiveness [20]. The ratio of the lengths of the second and fourth manual digits (2D:4D) reliably differs by sex, having a lower 2D:4D in males [21]. Brown et al [22] Okten et al [23] offer evidence that congenital adrenal hyperplasia (CAH) is associated with lower (more masculine) 2D:4D in both sexes, although the effect was not consistently observed in both hands. However, Buck et al [24] examined 2D:4D using radiographs of the left hand of control boys and girls, and girls with CAH (approximately 70 subjects per group) found no difference in 2D:4D between control girls and those with CAH.

Rahman and Wilson [25] found that both sexes of homosexuals have masculinized 2D:4D compared to same sex heterosexuals. McFadden and Shubel [13] agree regarding females but found that male homosexuals had feminized 2D:4D, whereas Williams et al [4] found no significant relationship between 2D:4D and male sexual orientation. Robinson and Manning [26] found that the 2D:4D measures of male homosexuals were significantly masculinized. In the present study an attempt is made to evaluate the 2D:4D length and ratio between men and women in the Malaysian population.

2. Materials and Methods

An Anthropometric survey was conducted among 150 male and 150 female students of SEGi University Malaysia to determine and compare the index finger length with ring finger length (2D:4D ratio).

Convenient random sampling method was used to obtain the measurements of the index and ring fingers with the exclusion criteria that the participants do not have any physical anomalies of fingers nor had any history of fracture or dislocation of the index, ring or middle finger. Extra precautions were taken to measure in certain conditions such as those with long fingernails or those wearing accessories.

The middle finger was used as the standard reference. At the proximal base of their index and ring finger there are creases. Their index finger is likely to have one crease, the ring finger a band of creases. The most proximal crease was chosen as a point on the crease midway of the base of the finger. Then, the point was marked with a pen. A vernier caliper was used to measure from the mark to the distal end of the finger. Digital cameras were used to take digital images as visual evidences for any prominent differences in the 2D:4D ratio of the length of the fingers.

3. Statistical Analysis

The data collected were used to obtain the 2D:4D ratios by dividing 2D by 4D lengths and the 2D and 4D differences by subtracting 4D from 2D. Statistical Package for the Social Sciences (SPSS) and Student's t- test was used to determine level of significance.

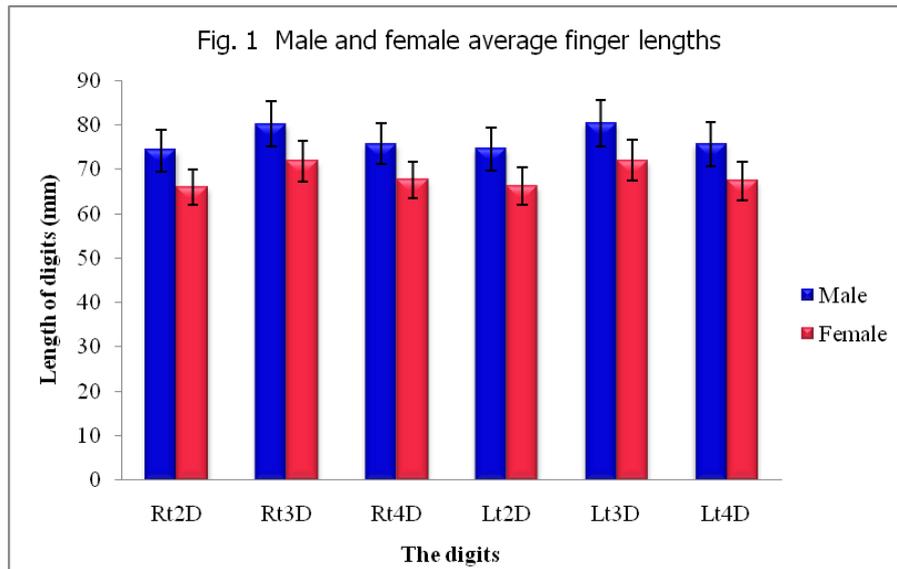
4. Results and Discussion

The average finger length of male and female for both hands is given in Table 1.

TABLE 1: Average finger length of male and female.

Gender	Right hand (RH) (mm)			Left hand (LH) (mm)		
	Rt2D	Rt3D	Rt4D	Lt2D	Lt3D	Lt4D
Male	74.278	80.172	75.715	74.61	80.421	75.697
Female	65.894	71.807	67.541	66.192	71.987	67.344

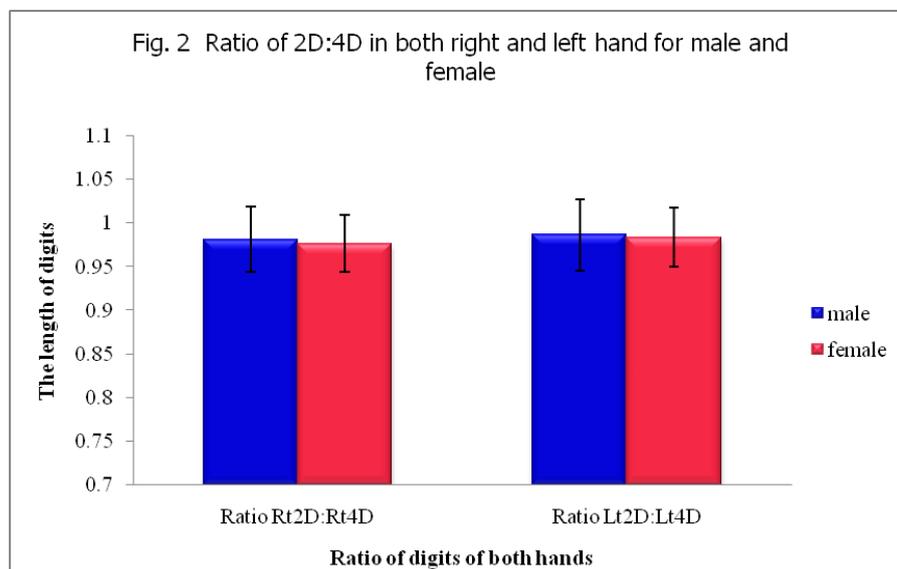
Males show greater 2D, 3D and 4D finger lengths for both hands compared to females (Fig.1).



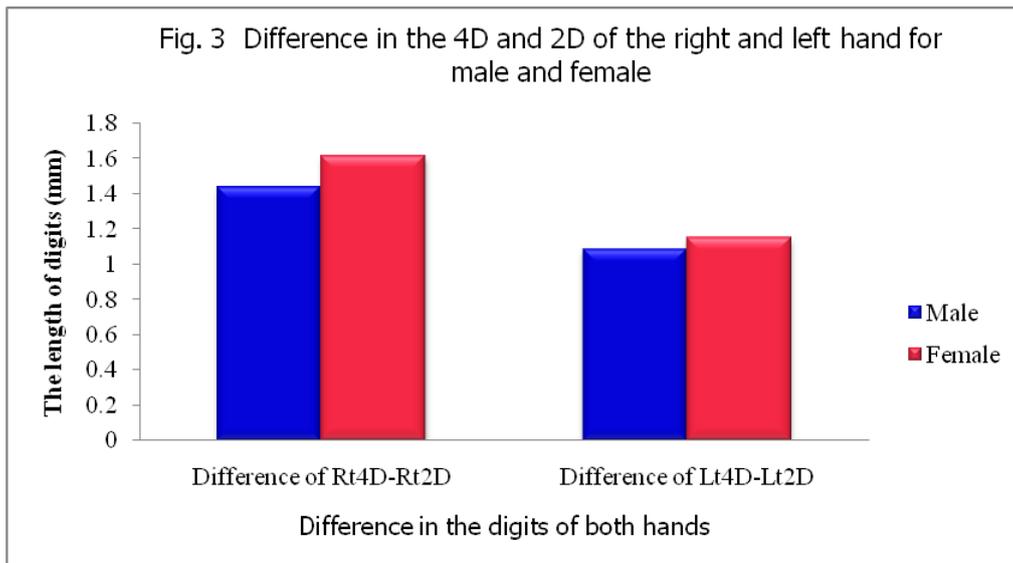
Ratio of 2D:4D in right and left hand of males and females is given in Table 2.

TABLE 2: Ratio of 2D:4D of male and female.

Gender	Ratio Rt2D:Rt4D (mm)	Ratio Lt2D:Lt4D (mm)
Male	0.982	0.987
Female	0.977	0.984

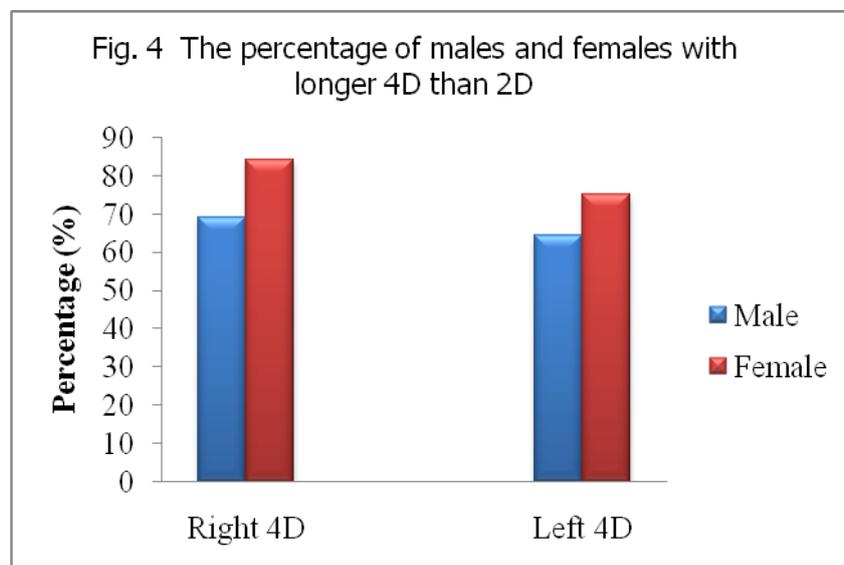


Males have a greater 2D:4D ratios in both the left and right hand compared to females (Figure.2). In both males and females the 2D:4D ratio was greater in the left hand than the right hand. Using t-test, in males and females the 2D:4D ratio was not significant for the right with $p=0.212$. Meanwhile, the ratio of males and females was also not significant for the left hand with $p=0.468$.

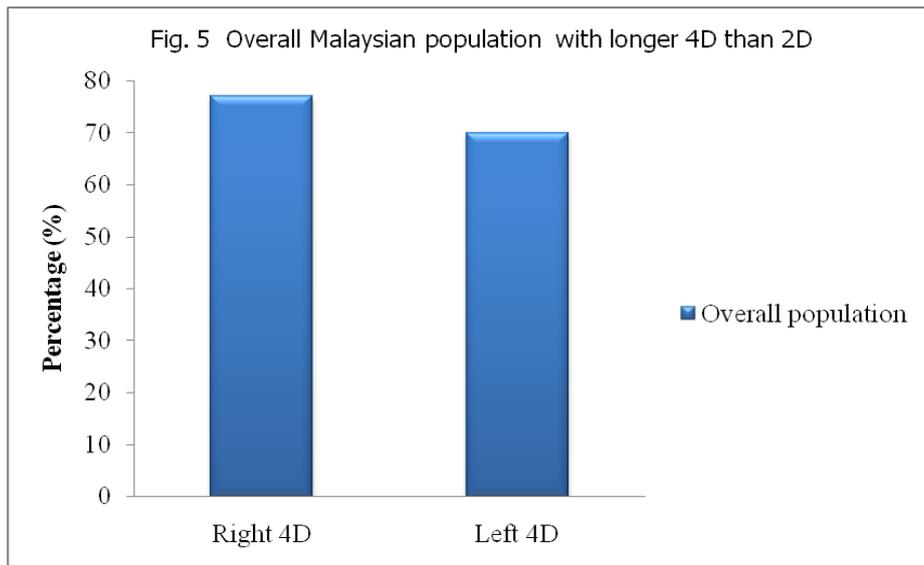


The difference of 4D and 2D of the right and left hand for male and female is shown in Figure 3.

Females show greater average differences in the 4D and 2D length compared to males. The difference between males right hand and left hand was not significant with $p=0.209$ while the difference between females right and left hand was significant with $p=0.024$. The difference between males and females right hand and left hand was not significant with $p=0.527$ and $p=0.835$ respectively.



In right hand, the females have a longer ring finger (4D) compared to males. Approximately 85.33% of females and 69.33% of males have longer 4D length for their right hands. Meanwhile, our findings also showed that females have a greater ring finger length for the left hand (75.33%) compared to males (64.66%) (Fig. 4).



From the total of 300 cases, 77% of them have a longer ring finger (4D) than index finger (2D) for the right hand. Meanwhile, 70% of 300 participants have a longer 4D than 2D for the left hand (Fig. 5).

Manning et al [21], Mc Fadden and Shubel [13], Williams et al (4) observed digit ratio to be more prominently dimorphic on the right hand compared to the left hand. We report, females ring finger (4D) tend to be longer than the index finger in both hands of females. Males relatively have a longer index finger [27]. In, finger length ratio (2D:4D) correlated with physical aggression in men, men have a shorter index finger (2D) than ring finger. According to De Bruin et al [28] Children with autism have a relatively shorter index finger (2D) compared with their ring finger (4D).

Esther et al [29] reports a low 2D:4D ratio in girls which is highly predictive of the presence of autistic features and a low ratio could possibly be used as a diagnostic predictor in clinical practice. Choi et al reports [30] the digit ratio can predict adult penile size and that the effects of prenatal testosterone may in part explain the differences in adult penile length. The digit Ratio (2D:4D) is correlated with male facial attractiveness [31]. Finger length ratio (2D:4D) is a sexually dimorphic trait. Men have relatively shorter second digits (index fingers) than fourth digits (ring fingers) [5]. Manning and Bundred [32] proposed that the 2D:4D ratio could be used as an indirect indicator of a predisposition to certain diseases such as autism, heart disease, or certain types of cancer.

The index finger (2D) to ring finger (4D) ratio (2D:4D) shows the most prominent dimorphic feature compared to all human digit ratio combinations [13] and males have a greater 2D:4D ratio compared to females. The ratio of index finger to ring finger is smaller for males compared to females [10, 13, 33, 34] and a greater 2D:4D ratio established in males. However, according to William et al [4], the index finger (2D) is shorter compared to the ring finger (4D) in men and a greater 2D:4D ratio in females and Bailey et al [5] men have shorter 2D than 4D. In our present study, males have a greater 2D:4D ratios in both the left and right hand compared to females.

5. Conclusion

The 2D:4D finger length ratio in males is greater than in females. Results obtained from a total sample size of 150 males and 150 female, males have shown to have higher 2D:4D ratios in both right and left hands. The 2D:4D finger length between right and left hand show variations. In females the difference is significant with $p=0.024$ and in males it is shown not to have any significant difference with $p=0.209$. The 2D:4D difference between

males and females for both hands were not significant in males ($p=0.527$) and females ($p=0.835$). Males have greater 2D:4D ratio for both hands compared to females.

Conflict of interests

The authors declare that there is no conflict of interests regarding the publication of this paper.

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