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## Research on the relationship of the digit ratio and the throwing ability of throwing athlete in sports undergraduate college

Jia Jia

Inner Mongolia Normal University of Physical Education, Huhehaote, 010022, (CHINA)

### ABSTRACT

The analysis of digit ratio data of throwing athlete in sports undergraduate colleges, revealing the connection between the digit ratio and throwing ability, and presents reasonable and effective theoretical basis for throwing athletes. Under the premise of informed consent, randomly selected healthy throwing athlete in sports undergraduate colleges from 17 to 25 years old (shot put discus throwers, etc.) as the research object, while excluding the objects with injury of finger, hand deformity, endocrine and metabolic diseases and its history. The number of throwing athlete under the above requirements is 200 male and 200 female. The relation of throwing ability and digit ratio can be found out under the analysis of digit ratio data. The digit ratio is related to hormones and genes. 2D: 4D is negatively related to male hormone level. Digit ratio is related to gender, race, and throwing ability usually is heritable, which with reveal gender differences. Overall that man is better than woman. The digit ratio is related to throwing ability, the correlation of man is significantly than woman, right than left. The digit ratio of throwing athlete in sports undergraduate college have a certain relationship with throwing ability, which can provide valuable reference for the throwing athlete.

### KEYWORDS

Throwing athlete; Digit ratio; Throwing ability.



## INTRODUCTION

In recent years, domestic and foreign scholars deep extensively explored digit ratio, and made a breakthrough in digit ratio and physiological dysfunction, individual morphological development and exercise capacity. Williams et al<sup>[1]</sup> in Nature magazine article (2000) pointed out: "the study of digit ratio can provide amazing development information". After that, researches on digit ratio slowly become the key focus of physical scientists, anthropologists and sports experts. Digit ratio had basically decided that basically in the embryonic period than three months ago<sup>[2]</sup>, so the digit ratio of athlete can be used as an important indicator of the ability to explore movement.

The digit ratio of athletes refers to the ratio of each finger length, mainly refers to the 2D:3D (second finger length: third fingers length, the same below), 2D:4D etc.. The finger length of athletes is normally sequence into 1 to 5 from the thumb to the little finger. Because the thumb lengths are difficult to determine, digit ratio refers to the 2D:3D, 2D: 4D, 2D: 5D, 3D: 4D, 3D: 5D and 4D: 5 D<sup>[3]</sup>. The paper reviewed the research development of digit ratio; expect to put the digit ratio as a morphological genetic valuable marker, which can provide a new basis for thinking and theory application in the scientific selection for throwing athlete. Excellent material in throwing athletes training is very important in the system, morphological indexes including body mass, height, upper extremity length, shoulder, and chest. But digit ratio is more meaningful for studying because it is formed in the embryo with immutable characteristics<sup>[4,5]</sup>. The study focused on the correlation between exercise capacity and digit ratio under the investigation of digit ratio of throwing athlete in sports undergraduate college, which can provide a more convenient way for throw athlete to select scientific material. At the same time, the mean of the digit ratio of throwing athlete in sports undergraduate college was made clear to accumulated data for the domestic implementation.

## MATERIALS AND METHODS

### Subjects

Under the principle of informed consent, this paper randomly selected 200 male and 200 female at the age of 17 ~ 25 years old as exercise group, within 3 generations are all Han Chinese throwing athlete in sports undergraduate college. Part-time students meet the same conditions as the control group, excluding the students with finger injury, the hand deformity, endocrine and metabolic diseases and its history.

### Research methods

By using the method of direct measurement, put hands in the anatomical position, caliper by electronic vernier (accuracy: 0.01 mm) from the palm side of the finger base proximal annoying wrinkles fingertips measurement points to the left and right second to 5 finger palmar long and records, 4 finger length each hand are measured 3 times to get the average values.

### Statistical processing

Input the direct measurement data to the Excel table, calculate the left and right hand finger length and digit ratio, i.e. 2D:3D, 2D:4D, 2D:5D, 3D:4D, 3D:5D, 4D:5D values, and statistical analysis of ratio of 2D:4D (2D<4D, 2D>4D, 2D=4D), and make t test using SPSS17.0 statistical software.

### Quality control

Prior to the formal measurement, surveyors should made professional training, each surveyor respectively on the same site measuring twice and two surveyors measured in the same site. The training

is qualified if correlation coefficient is above 0.96, which can make the formal measurements. The repeated measurement data of the same parts are averaged, the result is accurate to 0.01m.

## RESULTS AND DISCUSSION

### Digit ratio of throwing athletes

The digit ratio of experimental group and the throwing group were compared, results showed that the two groups were compared by 2D:4D, 2D:4D values of male and female sports group were lower than the control group. There was significant difference ( $P<0.5$ ), in which the 2D:5D values of female group were statistically significant ( $P<0.5$ ), 2D:3D values of male was significant differences ( $P<0.5$ ). The results were shown in TABLE 1 and TABLE 2.

TABLE 1 : Digit ratio of female throwing athletes in sports undergraduate colleges (n=200, x±s)

Group	Digit ratio					
	4D:5D	3D:4D	3D : 5D	2D:3D	2D:4D*	2D:5D*
Control group	1.274±0.088	1.068±0.046	1.341±0.097	0.898±0.057	0.967±0.038	1.217±0.113
The exercise group	1.289±0.085	1.062±0.080	1.403±0.062	0.886±0.022	0.809±0.026	1.243±0.088

\*P<0.05

TABLE 2 : Digit ratio of male throwing athletes in sports undergraduate colleges (n=200, x±s)

Group	Digit ratio					
	4D:5D	3D:4D	3D : 5D	2D:3D*	2D:4D*	2D:5D
Control group	1.261±0.119	1.073±0.034	1.367±0.139	0.895±0.037	0.972±0.032	1.228±0.116
The exercise group	1.284±0.062	1.058±0.56	1.346±0.137	0.885±0.029	0.847±0.042	1.193±0.121

\*P<0.05

After the statistical analysis of the digit ratio 2D:4D between the male and female athletes, the results showed that the left hand and the right hand scale 2D<4D male are higher than female, 2D>4D proportion of female was higher than that of males. The specific proportion of the results was shown in TABLE 3.

TABLE 3 : Percentage of 2D:4D (2D<4D, 2D>4D, 2D=4D) of different gender throwing athletes

Samples	Number of cases	2D:4D					
		Right			Left		
		2D=4D (%)	2D>4D (%)	2D<4D (%)	2D=4D (%)	2D>4D (%)	2D<4D (%)
Female	200	0.48	13.20	86.32	0.47	13.26	86.27
Male	200	0.49	9.98	89.53	0.49	10.19	89.32

After the statistical analysis of percentage of 2D:4D (2D<4D, 2D>4D, 2D=4D) about exercise group and control group with same sex, the results shows that the 2D<4D ratio of left and right hand of male and female exercise groups were higher than that of control group, and the 2D>4D ratio were lower than the control group. The results are shown in TABLE 4.

TABLE 4 : The percentage of 2D:4D (2D<4D, 2D>4D, 2D=4D) of exercise group and control group with same gender

Samples	Number of cases	2D:4D			
		Right		Left	
		2D=4D (%)	2D>4D (%)	2D=4D (%)	2D>4D (%)

			2D=4D (%)	2D>4D (%)	2D<4D (%)	2D=4D (%)	2D>4D (%)	2D<4D (%)
Female	The exercise group	200	0.51	4.02	95.47	0.57	3.88	95.55
	Control group	200	0.48	14.65	84.87	0.49	14.71	84.80
Male	The exercise group	200	0.52	5.07	94.41	0.53	5.12	94.35
	Control group	200	0.51	11.52	87.97	0.49	10.78	88.73

**Relationship of digit ratio and hormones, genes**

Domestic and foreign scholars has done a lot of research on the digit ratio and certain diseases and behavior. Research shows that male throwing athletes with low value of 2D:4D produced more sperm and male hormone. The 2D: 4D of right hand of male athletes and male hormone levels show negative correlation, but the 2D:4D of right hand of male and female athletes and estrogen, luteinizing hormone and prolactin showed a positive correlation<sup>[6]</sup>. Another study found that in two years old of above research object, different age groups of the same sex in digit ratio has no clear respectively. Through these researches, scholars believed that any pre-production of male hormones infection and gender difference in emergence of understanding or character may has an inevitable association with the digit ratio. Even if the 2D:4D express the production period hormone movement situation, but how the hormone can influence the digit ratio, detailed involves which finger still need further study. Manning<sup>[7-9]</sup> pointed out: digit ratio of throwing athletes has been identified in the embryonic period or within two years after birth, and guess is the regulation of HOX gene, which can influence the male hormones in the process of embryonic development, disturb the development of the fingers. If the fetal testosterone concentration is high, then the 2D: 4D will be low<sup>[10]</sup>. Digit ratio is determined by the finger length, and sex hormones can directly affect the length of bone, mainly through estrogen receptor  $\alpha$  and back interference mummification end. As to the male throwers, the effect of testosterone on bone is the experience of some of its fragrance formation mediated. Even though 2D:4D has a chance to replace the prenatal testosterone levels, the relation with postnatal circulating hormone levels in the blood is associated to explore.

**Relationship between digit ratio with sex and race**

Malas discussed the formation style of 2D:4D of 161 fetal (83 males, 78 females) with pregnant from nine to forty weeks. The test results reveal the parameters for the whole hand length, hand width and length of each finger has significant correlation with the gestational age, but the mean value of 2D:4D is not affected by the age of effect. Throwing ability of throwing athletes in sports undergraduate college is usually heritable, and shows a gender difference in overall that boys are higher than girls. Women with low 2D: 4D showed more powerful throwing ability, throwing ability and 2D:4D have distinctive inheriting and gender differences. Kinds of exposure showed the gender and racial differences of 2D:4D. The low 2D:4D refers high right brain prenatal testosterone concentration and strong development, rigorous three-dimensional spatial ability, excellent male character and more distinctive dominance and masculinity, these factors are likely to causes certain effect to throwing ability. The research shows that the ability of throwing may have some relevance between 2D:4D, so that 2D:4D can be used as an important reference in the process of selecting material for female throwing athlete.

**The relationship between throwing results with index finger, ring finger and 2D: 4D**

Manning exploration revealed that athlete has a number of athletic ability (shot put, sprinting and swimming etc.) has low 2D:4D. The correlation coefficients obtained by statistical index and sports performance of 0.631, and the correlation coefficient and the ring finger movement result is 0.530, which indicates that the ring finger and the forefinger has a certain degree of correlation with athletic performance, and the difference reached significant level ( $P < 0.05$ ). The foreign research points out, the index finger and ring finger is usually considered in a reflection of body level in male hormone testis hormone human, from the reproductive ability, sex ability, physical strength, intelligence and other aspects. Male hormones is not only exists in the male body, also in the female body. The female with more male sex hormones may exhibit more competitive and aggressive, may also have more sports talent or more muscles compared to other women. The professor Speck (British) proved that human has been influenced by the male hormone early in the fetal period. In general, the higher the value of the

male hormone, a series of male characteristics including throwing ability will prevail. However, the correlation coefficient of 2D: 4D and the movement result is 0.062 ( $P > 0.05$ ), which may explain the 2D: 4D is not associated with athletic performance. It is not consistent with some research results abroad. Other research pointed out that as women throwing ability slowly increase, their ring finger may be longer compared with the index finger, which can also be regarded as the manifestations of the increasing male hormones. Therefore, the researchers concluded that: a person's throwing ability is already decided by male hormones and other factors when he is a fetal.

### CONCLUSION

After the analysis of the relationship between digit ratio and throwing ability of throwing athletes in sports undergraduate college, results show that the 2D: 4D digit ratio did not correlate significantly with sports performance. This conclusion makes people more difficult, and the research result is not consistent in this field abroad. After the investigation and analysis, the reason may locate the process of measurement; measuring equipment is relatively backward, which was resulting in a large error in measuring data. So, if you want to confirm that 2D: 4D has relationship with throwing ability, longitudinal studies and analysis of more samples and longer times were necessary. Because this inquiry is time-consuming, our country has not confirmed reports of similar studies at present; this is the direction we should do some research.

The digit ratio, especially the 2D:4D, there are many foreign research reports, 2D:4D is related with physiological function, human development, gender and genetic disease and other related. At present, the domestic research in this field is less. Some scholars understand the inquiry for different sports level of athletes throwing 2D:4D, sports level and 2D:4D throwing athletes showed a negative correlation relationship. Lu Hong et.al discovered association between digit ratio of different ethnic groups and digit ratio than with breast cancer on the basis of the study reported abroad. Due to the reports of the digit ratio and throwing ability, Paul et.al discussed profoundly of the digit ratio of female throwers, believed the 2D: 4D and throwing performance is negatively related, and this relationship is more prominent in the shot put, cycling, swimming and the sprint revealed. Pokrywka et.al proposed that the 2D:4D of left hand of outstanding female throwing athletes is clearly low than the ordinary girl, therefore concludes that 2D:4D value can predict the throwing ability for female throwing athletes.

Compared players and generally students, or between different grades of throwing athletes, digit ratio especially the 2D: 4D value usually exist differences. Both the throwing athletes in sports undergraduate college or generally students, the 2D: 4D value has some differences in gender and side. Digit ratios of high level athletes are lower than ordinary level throwing athletes. The 2D: 4D level and movement showed a negative correlation. According to the exploration of 2D: 4D and the throwing ability, the conclusion can be drawn: the correlation of boys is significantly more than girls; right is more prominent than left.

Both at home and abroad have deduced some valuable achievements of the digit ratio and throwing ability, even though these results exists gap between the inquirers. Different sports have its special selection index. But the digit ratio especially the 2D: 4D as an external indicator easy measured can provide a simple and effective reference for the material. There are other useful indicators in selecting material, comprehensive judgment is necessary.

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