

Second to Fourth Digit Ratio Is a Predictor of Sporting Ability in Elite Indian Male Kabaddi Players

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Background: To determine the 2D:4D ratio in elite Indian male kabaddi players and compare them with non-athletes.

Objectives: Our study was undertaken to find out a possible relation between digit ratio and sporting ability of male kabaddi players. This study also gives an insight into the possible ethnic differences between Indian sports personnel and other populations.

Patients and Methods: Both right and left hands of 33 male kabaddi players attending training camp at the Bangalore regional centre of Sports Authority of India were scanned. Lengths of second and fourth digits were measured and their ratio calculated. Age, weight, height and body mass index matched subjects (25 males) who did not participate in any sports formed the control group.

Results: A highly significant difference was found in 2D:4D ratios of both the hands with Kabaddi players having a lower ratio compared to their controls. There was no statistically significant difference in 2D:4D ($\Delta r-l$) between Kabaddi players and controls.

Conclusions: Kabaddi is an intermediate sport not requiring a high level of endurance but at the same time requires masculine traits because of combating nature of the game. 2D:4D ratios can be used as reliable additional criteria when screening for prospective players to be inducted into the team.

Keywords: Digit Ratio; Athletic Performance; Kabaddi; Sport

1. Background

Kabaddi is a strenuous outdoor intermittent sport which requires great stamina, intelligence, power in both upper and lower limbs and co-ordination with fellow players. It is basically a combative sport, played between two teams for a period of 40 minutes with a 5 minute break and requires 7 players in each team. It requires a small field area of 12.5 × 10 m which is divided into two equal halves one for the raiders and another for the defenders and interestingly this sport requires no equipment to play.

Playing Kabaddi involves a raider moving to the defenders area continuously uttering the word 'kabaddi' and trying to touch the defending players and come back to the raiders area. The defenders try to catch the raider and hold him back in their area. Points are awarded to the raiding team if the raider is successful in coming back to his area after touching the defender. The defending team gets points if they hold back the raider in their area. Kabaddi is played in many countries of Asia and was introduced as a regular sport discipline in the 11th Asian games held at Beijing in 1990. Many countries are evincing interest in this sport and Kabaddi is now expanding as a serious sport outside the Asian continent.

Sportsmen need to be physically strong to excel in their field. The role of testosterone in development of a greater physique is well documented. Fetal and adult testosterone is known to play an important role in the establishment and maintenance of sex-dependent abilities associated with male physical competitiveness. It has been shown that digit ratio (2D: 4D) is negatively associated with prenatal testosterone with lower values seen in males compared to females (1). Sex differences in 2D: 4D ratios develop prenatally and remain relatively stable across the life span of an individual (2). Measure of 2D:4D ratio as a non-invasive retrospective bio marker for prenatal androgen exposure is widely adopted by researchers since there are practical difficulties in measuring testosterone exposure in a developing fetus (3).

Several studies indicate that the digit ratio is related with a wide range of physiological and psychological characteristics like alcoholism (4), attention deficit disorder (5), eating disorder (6), fertility (7), myocardial infarction (8), visuo-spatial ability (9), susceptibility to coronary artery disease (10, 11), assertiveness and aggression (12, 13), with the onset of menarche (14), with homosexuality (15), and depression (16). A low 2D:4D ratio is found in sports-

men compared to the general population. A significant number of studies done in a variety of sports have yielded varying results with the majority of the studies showing a lower digit ratio among sportsmen; however few studies have shown no difference between sportsmen and general population. Low right 2D:4D and low right-left 2D:4D difference ($\Delta r-l$) is known to be predictors of high performance in rugby players (14). Football players also had lower 2D:4D ratio than controls (17). Similar findings were seen in skiers and the relationship between 2D:4D and skiing times were independent of sex, age and performance (18). Digit ratio is found to be a predictor of ability in rowing, a sport which requires both cardiovascular efficiency and high power output. A recent meta-analysis study done involving 24 studies comprising of 2810 participants related to 2D:4D and sports have shown that the measures of athletic prowess are negatively related to 2D:4D in both hands, but this relationship shows considerable heterogeneity (19).

However, few studies have shown that not all sportsmen have a lower digit ratio and the results may vary depending on the type of sports. Studies done in athletes have found that they have a similar 2D:4D ratio as their controls (20). 2D:4D ratio is also known to vary substantially by ethnicity with more variability in 2D:4D accounted for by ethnic differences than sex differences. However the magnitude of sex differences in 2D:4D is similar across ethnic groups (21). Though much research has taken place over the last decade in this field, controversies still exist regarding the effect of prenatal testosterone on athletic performance.

2. Objectives

Our study was undertaken to find out a possible relation between digit ratio and sporting ability of male kabaddi players. This study also gives an insight into the possible ethnic differences between Indian sports personnel and other populations.

3. Patients and Methods

The study was conducted at the Bangalore regional centre of Sports Authority of India, the official organization under Ministry of Youth Affairs and Sports, Government of India which trains sportsmen for national and international competitions. The study was approved by institutional ethics committee. A written informed consent was obtained from all the participants. 33 male kabaddi players participated in the study. Kabaddi players in the age group of 21-30 years who were practicing regularly 30 hours/week for at least 5 years and have participated in national and international competitions formed the study group. Age, weight, height and body mass index (BMI) matched subjects (25 males) who did not participate in any sports formed the control group. The control group was recruited from a university where students pursued their undergraduate/postgraduate degree course. These

students volunteered for the study after being briefed about the purpose and nature of the study. They did not regularly participate in any of the sport activity either in the college or outside.

Both the hands of subjects were scanned with a HP scan jet scanner. Participants placed their relaxed hands slightly on the surface of the scanner with second to fifth fingers held parallel and the tip of the middle finger aligned with the wrist and elbow. Scanned hand images were scaled and later printed by a HP laser jet printer. Measurements of second and fourth fingers were taken from printouts with the use of vernier calipers (Quasmo - Range 0 - 150 mm, accuracy ± 0.05 mm). These measurements were taken from the tip of the finger to the basal crease. Where two creases were visible at the base of the digit the proximal crease was chosen. A single reader who had done similar measurements in our earlier studies conducted all the measurements. The reader was blinded for the groups. The 2D:4D was calculated as the length of the second digit divided by the length of the fourth digit. ($\Delta r-l$) was calculated as the difference between right and left 2D:4D.

3.1. Statistical Analysis

Data obtained in this study was analyzed statistically by using SPSS V.11.0. The results are expressed as mean, standard deviation. The data was analyzed using student t test. The difference was considered statistically significant whenever $P \leq 0.05$.

4. Results

Anthropometric parameters were similar in the study and control group (Table 1). Our study indicates that the ratio of 2nd to 4th digit is lower in kabaddi players compared to the controls both in right and left hands (Table 2). A highly significant difference was found in 2D:4D ratios of both the hands with Kabaddi players having a lower ratio compared to their controls. However there was no statistically significant difference in 2D:4D ($\Delta r-l$) between kabaddi players and controls. Cohen's d value and effect size correlation was done using mean and standard deviation. For the left hand the d value was 0.67 and r was 0.38 and for the right hand the values were 0.59 and 0.28 respectively.

Table 1. Anthropometric Parameters of Controls and Study Groups^a

Parameters	Control (n = 25)	Kabaddi (n = 33)	r value
Age, y	22.52 \pm 4.29	25.48 \pm 3.52	0.35
Height, cm	173.92 \pm 4.65	177.6 \pm 5.2	0.35
Weight, kg	69.45 \pm 5.39	78.7 \pm 4.75	0.67
Body mass index, kg/m ²	23.01 \pm 2.11	24.25 \pm 4.62	0.17

^a Data are presented as mean \pm SD.

Table 2. Comparison of 2D:4D Ratio of Both Hands Between Kabaddi Players and Controls ^a

Parameter	Kabaddi (n = 33)	Control (n = 25) ^a	t Value	P Value	r Value
2D:4D Left	0.950 ± 0.028	0.969 ± 0.026	2.526	0.01	0.38
2D:4D Right	0.948 ± 0.025	0.964 ± 0.030	2.217	0.03	0.28
2D:4D (Δ r-l)	0.002 ± 0.029	0.005 ± 0.018	0.333	0.7	0.05

^a Data are presented as mean ± SD.

5. Discussion

Published data on sporting ability and 2D:4D ratios have shown a lower value in 2D:4D ratio in majority of the sports in males. Professional players had significantly lower digit ratios (derived from right and left 2D:4D) compared with controls. International players had a significantly lower mean 2D:4D than non-international players (17). However this finding is not the same in all sports personnel and is found to vary widely among different types of sports.

Results obtained in sports like rugby, rowing, skiing and fencing has shown a significant correlation between digit ratio and performance. A study performed to examine the relationship between 2D:4D and performance in elite rugby players has shown that low right 2D:4D and low right-left 2D:4D difference are predictors of high rugby performance (14). A similar study done to assess rowing performance over 2,000 m using the Concept 2 rowing ergometer found significant negative correlations between 2,000 m ergometer performance and male digit ratios, which persisted following adjustment for rowing experience and height. However, no such significant association was found in females despite a comparable sample size (22). An Austrian study conducted on a sample of 54 tournament fencers has shown negative right-left differences in 2D:4D in men which corresponded significantly to better current as well as highest national fencing rankings, independent of training intensity and fencing experience (23). Male Skiers have been shown to have lesser 2D:4D ratios compared to controls as well as female skiers. The 2D:4D ratio was positively related to skiing times i.e. participants with low 2D:4D recorded the fastest times. The relationship between 2D:4D and skiing times were independent of sex, age and performance (18). Results of our study have shown a lower 2D:4D ratio in kabaddi players compared to their controls. Our results are similar to those obtained in the majority of the endurance sports.

However, studies have shown that not all sports show similar trends. Studies done in sprinters have shown that associations between 2D:4D and sprinting speed were much weaker than those reported for endurance running (24). Another study comparing different types of sports has shown significant differences among the different groups with significantly lower ratios between football and controls and gymnastics and controls but no significant differences between the athletes and non-athletes (20). These findings suggest that 2D:4D is a relatively weak predictor of strength and a stronger predictor of efficiency in aerobic exercise. 2D:4D ratio is moderate

to severely relate to performance in various endurance sports in young adults. In contrast, very little evidence is found for the relationship between 2D:4D and speed and acceleration in sprinters and gymnasts. This suggests that the relationship between 2D:4D and performance in sports is related more with aerobic efficiency than with speed and acceleration. Kabaddi is an intermediate sport and not a typical endurance sport as it requires a combination of both aerobic efficiency and speed. This is substantiated by our results which show no statistically significant difference in 2D:4D (Δ r-l) which is found in a typical endurance sport like rugby (14). The effect size obtained for the right hand in our study is the same as the average obtained in a meta-analysis done using 24 studies for 2D:4D ratio ($r = 0.26$) (19). However our results have shown a slightly greater effect size in the left hand ($r = 0.38$) when compared to the average value of the Meta analysis study ($r = 0.28$). Limitations of the study include involvement of a single rater to measure the values due to which intra observer or inter observer variations could not be calculated. Secondly, this study was done only in males and therefore sex differences in Kabaddi players could not be established.

Present study indicates that male kabaddi players have a significantly lower 2D:4D ratio compared to non-athlete population among Indians. Kabaddi is an intermediate sport not requiring a high level of endurance but at the same time requires masculine traits because of combatting nature of the game. 2D:4D ratios can be used as reliable additional criteria when screening for prospective players to be inducted into the team.

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Authors' Contributions

All the authors have contributed in all aspects of the study.

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