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# RELEVANCE OF SECOND TO FOURTH DIGIT RATIO (2D:4D) IN THE CHOICE OF MALE FOOTBALL AND BASKETBALL PLAYERS IN PORTHARCOURT-NIGERIA

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**Abstract - This study was carried out to investigate any difference in the second to fourth digit ratio (2D:4D) of footballers, basketball players and non-sports participants. Two hundred and eighty nine (289) subjects were drawn from Port Harcourt city, Rivers state in the Niger Delta of Nigeria. These comprised 100 (34.6%) footballers, 89 (30.8%) basketball players and 100 (34.6%) non-sports participants. A digital caliper was used to measure the length of the second digit (2D) and fourth digit (4D) respectively. Observation showed that generally, basketball players had higher values for left second digit (L2D), left fourth digit (L4D), left second to fourth digit ratio (L2D:L4D), right second digit (R2D) and right fourth digit (R4D) than footballers. The differences between the two groups were statistically significant p<0.05. However, no significant difference was observed for the right second to fourth digit ratio (R2D:4D) between the two groups. Results for the mean values of the second digit length, fourth digit length and digit ratio of non-sport males and their t-test comparison showed significant differences in L4D, L2D:4D, R2D, R4D and R2D:4D but not in L2D. The values were significantly higher in R2D:4D and L2D:4D of non sport males than footballers. The values of L4D, R2D and R4D were higher in footballers than non-sport males. No difference was seen in L2D. The digit ratio was significantly higher among non-sport males than basketball players while other parameters showed significant higher values among basketball players. This suggests that 2D:4D is a good determinant on who participates in the sports of football and basketball and who does not.**

**Key Words - Digit ratio, footballers, basketball players.**

## INTRODUCTION

Digit ratio basically, is the ratio of the lengths of different digits or fingers typically measured from the midpoint of the bottom crease where the finger joins the hand to the tip of the finger.

Specifically, second to fourth digit ratio (2D:4D) is the ratio of the length of the second digit (index finger) to the length of fourth digit (ring finger) [1,2,3,4,5,6,7,8]

Football is arguably the most popular sport in the world, both in terms of playing and spectatorship. Football is a field-sport, which involves a moderate amount of physical contact between opposing players in regular competition for possession of the ball and in defense of their territory [9]. Basketball is one of the most internationally played and watched low-contact sports in the world. It is played on a court by two opposing teams of five players, points are scored by throwing the ball through an elevated horizontal hoop [9].

Many scholars have documented results of their research on digit ratios especially the second to fourth digit ratio (2D:4D) and have reported that 2D:4D is lower in men than in women. They have put the mean values at 0.96 and 1.00 in men and women respectively [1,2,3,5,6,7].

Reports have also shown that relative finger lengths are determined before birth, the sex difference in 2D:4D is present in children as young as 2 years, and sex differences in 2D:4D are significant across a number of ethnic groups and races [2,10]. Similar report has also shown that index and ring fingers are affected by prenatal exposure to androgens. This suggest that the ratio of the length of second finger to that of the fourth finger can be used in rough estimate of prenatal androgen exposure with lower 2D:4D suggesting higher androgen exposure [2].

Report by Manning, [4] showed the following digit ratio for amateur, professional and international football players in England, Average '2D:4D digit ratio' in football amateurs (N=533) = 0.98; Average '2D:4D digit ratio' in football professionals (N=267) = 0.95; Average '2D:4D digit ratio' in football internationals (N=37) = 0.94; Average '2D:4D digit ratio' in black football professionals (N=13) = 0.93; and in Brazil he obtained the following result; Average '2D:4D digit ratio' in football professionals (N=99) = 0.93; Average '2D:4D digit ratio' in first team professionals (N=20) = 0.92. From his research it has been observed that in sports such as the sprints, middle distance and long distance races, athletes 'running speed' especially correlated highly with

the '2D:4D digit ratio' of the RIGHT HAND. But in football players 'football ability' especially correlates highly with the '2D:4D digit ratio' of the LEFT HAND

Second to fourth digit ratio (2D:4D) have been implicated with aggression in men [11].But no such correlation has been found in females. Report has equally shown that 2D:4D increases slightly with age in children with the effect less marked for the right hand being the hand which is likely to show the strongest association with pre-natal steroids. [12]

Bull and Benson [13] assert that the digit ratio 2D:4D has a spatial representation as relating to magnitude. Paul *et al*. [14] pointed out the heritability of the second to fourth digit ratio (2D:4D) in a study on twins. This study demonstrated a clear genetic influence on precisely measured 2D:4D in females. They reported that genetic modeling has suggested above 60% of the variance in 2D:4D due to genetic factors.

Oladipo *et al*. [7] made the first report on digit ratio in Nigeria. The results of their study on Igbos and Urhobos showed sexual dimorphism but no ethnic difference between the two ethnic groups (Igbo and Urhobo) investigated. Oladipo *et al*. [8] carried out a study to determine any possible tribal and sexual differences in the second to fourth digit ratio (2D:4D) of Igbos and Yorubas of Nigeria. They observed from the study that 2D:4D was sexually dimorphic in the two tribes. Males demonstrated lower digit ratio (0.96) on the right hand of Igbos and Yorubas and 0.94 on the left hand of the two tribes while females had digit ratio of 0.97 on the right hand and 0.95 on the left hand). The differences observed between males and females in both tribes were significant. However, no significant tribal difference was observed. Similarly Gwunireama and Ihemelandu [15] reported the (2D:4D) digit ratio of Andoni (Obolo) group of Ijaw ethnic nationality. Seven hundred and two subjects between the ages of 15 and 60 years were recruited randomly excluding those with hand deformities. Males had longer digits with lower digit ratio while females had shorter digits with higher digit ratio. This result confirms that digit ratio is sexually dimorphic and presents the original data for people of Niger Delta-Nigeria. Gwunireama *et al*. [16] reported a study seeking to know the influence of geographical location on 2D:4D digit of Andoni and Ikwerre ethnic groups. The result showed strong sexual dimorphism and substantial ethnic variation within the same geographic location.

Van den Berge *et al.* [17] argued that digit ratio (2D:4D), moderates the effects of sexual cues on men's decision in extreme games. Their report showed that sex related cues affect human decision-making in extreme games. Tester [9] carried out a study to establish the extent to which 2D:4D digit ratios is effective predicting achievement rank in team sports. The result showed that digit ratio is a significant discriminator of the sports players' rank and sex. In a similar study, Paul *et al.* [14] assessed the relationship between 2D:4D and romantic jealousy with respect to various dimensions of rival characteristics. The result showed that men with higher, more feminine 2D:4D reacted more jealously toward socially dominant rivals. Women with lower, more masculine 2D:4D reacted more jealously toward physically attractive rivals. These result showed that the level of prenatal testosterone affects which rival characteristics elicit the highest level of jealousy and differently for men and women.

Voracek *et al.* [18] made a concise report using Lithuanian men and women, past and present, using digit ratio to test for sex differences, relations with their eye and hair color, and a possible secular change. They found out that from international perspective the average 2D:4D ratio of the Lithuanian is low, there was a sex difference in 2D:4D, in association of lighter eye and hair colour with higher i.e. more feminized 2D:4D received no support in both samples (past and present), the average 2D:4D in contemporary sample was higher than in historical sample.

Kemper *et al*. [19] reported on the best indirect method to be used in measuring 2D:4D digits. The research compared in terms of general precision and economy between the use of the ruler, vernier caliper and computer software. Generally, measurement precision was acceptable for each method. However, precision estimates were highest for the computer software, indicating excellent measurement precision.

Branas-Garza *et a*l. [20] was of the view that the second to fourth digit ratio has a non-monotonic impact on altruism. They analyzed the association between altruism in adults and the exposure to prenatal hormones, using the second to fourth digit ratio. From the results obtained, they postulated that direct evidence abound that prenatal events contribute to the variation of altruistic behavior and that the exposure to fetal hormones is one of the relevant biological factors.

According to Garbarino *et al.* [21] digit ratio 2D:4D can act as predictors of risky decision making for both sexes. They explored the potential biological basis of variation in risk taking between men and women using an emerging measure of pre-natal androgen, the digit ratio (2D:4D). The result showed that men and women with smaller 2D:4D ratios choose to take significant riskier options. They went further to find out that 2D:4D ratio can partially explain the overall difference in risk taking between men and women.

Longman *et al.* [22] proposed on the effect of rowing ergometer performance on both male and females 2D:4D. Significant negative correlations were observed between 2,000 metres 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.

Sorokowski *et al.* [23] reported on the relationship between the second to fourth digit ratio and when individuals get married. They stated that females and

males with a more masculine 2D:4D were married earlier and were more likely to have a husband or wife. Gwunireama *et al* [24]reported that second to fourth digit ratio can be used as a tool in career choice. They used subjects from Rivers State of Nigeria to carry out this research. They provided the first evidence of a linear relationship between 2D:4D and career choices most especially in Hardcore Sciences and Biological Sciences where their subjects were drawn

Ventura *et al.* [25] carried out a research on digit ratio (2D:4D) in newborns, checking out the influences of prenatal testosterone and maternal environment. They characterized the 2D:4D ratio in newborn infants, in between the pre- and postnatal surges of testosterone and related it to the mother's 2D:4D and to testosterone levels in the amniotic fluid. Based on the results obtained they concluded that sexual dimorphism at birth was only significant for the left hand, in contrast with reports of greater right hand dimorphism, suggesting that postnatal testosterone is determinant for 2D:4D stabilization. The lower 2D:4D ratio in mothers who had sons supported claims that hormone levels in parents are influential for determining their children's sex.

## MATERIALS AND METHODS

The major instrument used in the course of this research was the digital vernier caliper (with a revolution of 0.01mm, an accuracy of 0.03mm and a repeatability of 0.01mm). Data was obtained by carefully measuring the 2D:4D digit lengths on the ventral surface of the hand from the bottom crease of the second and fourth digits respectively to the tip, using digital vernier caliper measuring to 0.01cm. Those with any form of hand deformity were excluded.

A total of 289 male subjects were used (100 footballers, 89 basketball players, 100 non-sport participants).All the sportsmen were either professional footballers or basketball players living in PortHarcourt. The non-sportsmen were selected at random from Port-Harcourt city, Rivers State. Standard method was used to determine digits lengths. For participants with band of crease at the base of the digit, the second most proximal crease was measured [26].

The measurement was done for both left and right second and fourth digits. Values obtained were appropriately recorded and the ratio of the second and fourth digit were calculated and recorded for each subject in the different groups as 2D/4D [26].Statistical analysis was done on the data. Standard descriptive statistics was used for mean, standard deviation and standard error. SPSS 17.0 version was used for T-test analysis to test the level of significant differences between one group and another. The results obtained were tabulated.

## RESULTS

The result of the measurement of second digit (2D), fourth digit (4D) and the determination of second to fourth digit ratio (2D:4D) are presented in tables 1 to 3. All the subjects were males living in Port Harcourt city, Rivers state.

They were in three groups: footballers (100) basketball players (89) and non-sport males (100). Results were analyzed statistically for mean, standard deviation and t-test (test of significance) using SPSS 17.0 version.

Table 1 represents the results of the above parameters in both hands (right and left) of the footballers and basketball players investigated. Observation showed that generally, basketball players had higher values for L2D, L4D, L2D:L4D,R2D and R4D than footballers. The differences between the two groups were statistically significant $p<0.05$. However, no significant difference was observed for the right second to fourth digit ratio (R2D:4D) between the two groups.

Results for the mean values of the second digit length, fourth digit length and digit ratio of non-sport males and their t-test comparison (table 2) showed that significant differences were observed in L4D, L2D:4D, R2D, R4D and R2D:4D but not in L2D. The values were significantly higher in R2D:4D and L2D:4D of non sport males than footballers. The values of L4D, R2D and R4D were higher in footballers than non-sport males. No difference was seen in L2D.

Results from table 3 showed that digit ratio was significantly higher among non-sport males than basketball players while other parameters showed significant higher values among basketball players. Thus from the observation of this study, basketball players had higher values of second digit length, fourth digit length in both hands and digit ratio on left hand.

Sport skills in the present study were associated with lower digit ratio values. This seems to be a good speculation on selecting individuals for these sports.

**Table 1:** Results of mean 2D, 4D and digit ratio (2D:4D) for male footballers and basketball players**.**

| Parameters | Footballers Mean ±SD | Basketball players Mean ± SD | t-values (calculated) | p-values (sig.) | Significant difference |
|---|---|---|---|---|---|
| L2D (mm) | 74.095± 4.960 | 80.690±5.030 | 8.150 | 0.000 | YES |
| L4D (mm) | 77.015± 4.920 | 81.797 ± 5.350 | 5.891 | 0.000 | YES |
| L2D:4D | 0.959±0.035 | 0.987±0.035 | 5.303 | 0.000 | YES |
| R2D (mm) | 73.427±4.604 | 78.544±4.967 | 6.610 | 0.000 | YES |
| R4D (mm) | 76.234±5.182 | 81.672±5.456 | 6.333 | 0.000 | YES |
| R2D:4D | 0.96±0.032 | 0.960±0.365 | 0.385 | 0.701 | NO |
| | n=89 | n=89 | | | |

L- left, R- right, D- digit, SD- standard deviation, n=sample size; confidence interval-95%

**Table 2:** Results of mean 2D, 4D and digit ratio (2D:4D) for male footballers and non sport males.

| Parameters | Footballers Mean ± SD | Non-sport males Mean ± SD | t-values (calculated) | P-values (sig.) | Significant difference |
|---|---|---|---|---|---|
| L2D (mm) | 74.189±4.780 | 74.584±5.260 | 0.502 | 0.617 | NO |
| L4D (mm) | 77.176±4.780 | 75.268±5.550 | 2.329 | 0.022 | YES |
| L2D:L4D | 0.959±0.034 | 0.993±0.003 | 7.047 | 0.000 | YES |
| R2D(mm) | 73.475±4.462 | 72.748±5.040 | 1.009 | 0.315 | YES |
| R4D(mm) | 76.429±5.034 | 75.345±5.058 | 1.448 | 0.151 | YES |
| R2D:4D | 0.961±0.032 | 0.966±0.033 | 1.256 | 0.212 | YES |
| | n=100 | n=100 | | | |

L-left; R-Right; D- digit; SD- standard deviation; n- sample size; confidence interval-95%

**Table 3:** Results of mean 2D, 4D and digit ratio (2D:4D) for male basketball players and non-sport males.

| Parameters | Basketball players Mean ± SD | Non-sport males Mean± SD | t-values (calculated) | p-values (sig.) | Significant difference |
|---|---|---|---|---|---|
| L2D (mm) | 80.690±5.029 | 74.778±5.148 | 7.638 | 0.000 | YES |
| L4D(mm) | 81.797±5.350 | 75.534±5.442 | 8.226 | 0.000 | YES |
| L2D:4D | 0.989 ±0.037 | 0.992± 0.034 | 0.631 | 0.530 | YES |
| R2D (mm) | 78.544±4.967 | 72.991±4.852 | 7.311 | 0.000 | YES |
| R4D(mm) | 81.672±5.456 | 75.585±5.077 | 7.805 | 0.000 | YES |
| R2D:4D | 0.960 ± 0.365 | 0.966± 0.327 | 1.100 | 0.274 | YES |
| | n=89 | n=89 | | | |

L-Left; R- Right ; D- Digit; SD- standard deviation; n- sample size; confidence interval-95%

## DISCUSSION

The results of the present study on Nigerians are in agreement with the reports of earlier researchers [4,9] who reported that second to fourth digit ratio( 2D:4D) is a potential marker for sports participants.

The relationship or variance as expected in the athletes 2D:4D digit ratio was seen in the digit ratio which has been found to be predictor of sports participants [4,27,9].

Our findings support previous reports most especially that of Manning *et al.* [2,27] that 2D:4D digit ratio is an effective predictor of sports participants and non-sport participants. As hypothesized, the present study found out that basketball players have a significantly lower 2D:4D than non-sport participants and footballers also have a significantly lower 2D:4D when compared to non-sport participants. But when the digit ratios of footballers and basketball players were compared, no significant difference was observed in the right second to fourth digit ratio (R2D:4D).

This research to a great extent agrees with Manning *et al.* [27] that a lower 2D:4D ratio indicates athleticism. This view is shared by *Voracek* [28] *that* "football ability" correlates more strongly with low 2D:4D on the left hand.

According to Manning *et al.* [4,1,27] 2D:4D is inherited. Manning *et al.* [3] postulated that 2D:4D ratio is affected by ones geographical location. This was however disproved by Gwunireama et al. [16] In this study we postulate that even if 2D:4D ratio is inherited and not affected by ones geographical location [5, 16] it is greatly affected by the sport- football and basket ball skills.

Manning *et al.* [27] found out that among amateur footballers (low participants) in England the 2D:4D ratio was 0.98, while professionals (high participants) had a ratio of 0.95. International footballers had an even lower ratio with 0.94 and black footballers in England had a ratio of 0.93. Among the 99 Brazilian professional footballers he studied, the average ratio was 0.93, but when restricted to just first team players, the average was 0.92. From our study, however, footballers in Port Harcourt City-Nigeria has an average of 0.96 digit ratio.

## CONCLUSION

It has been proved from this study that 2D:4D digit ratio is a good predictor for sports participants. It has also confirmed that the effect of sports on 2D:4D varies from one sport to another. However, more studies are recommended to further ascertain this.

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