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Richard Bamidele Obe* and Oshiozokhai Eboetse Yama**

***State specialist Hospital, Akure, Owoyemi Specialist Hospital Akure, Nigeria**

****Department of Anatomy, Faculty of Basic Medical Sciences, University of Lagos, Idi-Araba, Lagos, Nigeria**

****Correspondence Author:** E-mail: dro_yama@yahoo.com.

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ABSTRACT:

The ratio of index finger length to ring finger length is called the "2D:4D digit ratio," or more simply, the "digit ratio". This study was to investigate if there are significant differences in the digit ratio (2D:4D) of infertile men attending an infertility clinic and men drawn from the general population in Akure Nigeria; to generate data locally to serve as a source for future referencing in anthropometry as it relates to male fertility assessment.

A total of 84 participants were involved in this study. They include men attending an infertility clinic (n=42), and those drawn randomly from the general population (n=42) with regards to their fertility. Information on 2D:4D and the seminal fluid data from two samples were obtained. Direct digit estimates was done using digital calipers and indirectly by taking measurements from a digital image of the hand. The digit ratios were obtained by dividing the lengths, of the index finger by the ring finger. Semen was collected from each participant by masturbation and examined for count and motility to ascertain their fertility status.

There was a statistically significant ($p < 0.05$) increase in the length of the fourth digit compared to the second digit in fertile men. The 2D:4D ratio in fertile men was significantly lower ($p < 0.05$) compared to infertile men. This study demonstrates an association between 2D:4D ratio and the fertility status in adult men in Akure metropolis Nigeria.

Key words: Digit ratio, Infertility, Index finger, Ring finger, Seminal fluid

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INTRODUCTION

The associations between the second and fourth digits of the hand (the 2D:4D ratio) and fertility-associated traits probably arise from early organizational effects of testosterone rather than from activational effects of current testosterone [1].

The ratio of the lengths of 2D:4D has received considerable attention as a possible marker of the prenatal effects of androgen on the developing fetus [2]. Men average lower on this measure than women. In studies done, it was reported that, for males, the index finger is generally of about 96 % the length of the ring finger. This gives an average digit ratio of 0.96 for males [2]. The digit ratio is equal to 1.00 if length of 2D equal to 4D and greater than 1.00 if 2D were longer than 4D. Males generally have a digit ratio below 1.00 hence they have what is termed a "low digit ratio" that is 4D longer than 2D ring.

The digit ratio is a normal sexual dimorphic anatomic trait [3] determined at the 14th gestational week, and relatively stable throughout development [4 - 6]. The 2D:4D is assumed to be an 'indicator' of circulating prenatal gonadal hormones; smaller ratio reflects higher fetal testosterone and lower fetal estrogen. The suggestion that 2D:4D is a correlate of prenatal testosterone and estrogen was first made in 1998 by Manning, *et al.* [2]. In their study evidence was shown, that higher levels of testosterone during this critical developmental stage facilitates the growth of the ring finger, while higher levels of estrogen facilitates the growth of the index finger. It also appears that the right hand is affected more by these hormonal levels than the left hand such that length differences are more pronounced on the right hand. Averaged across samples from various populations, female values were found to be about 0.25 standard deviations higher than male values [7].

Several investigative methods are being routinely deployed in evaluating male patients with infertility. Notable amongst these are seminal fluid analysis, hormonal profile, and testicular biopsy [8]. These methods are usually met with diverse constraints. For example, the collecting seminal fluids samples require masturbating which has serious cultural/religious biases. The hormonal profile on the other hand is very expensive, testicular biopsy is an invasive procedure and requires expertise. If low digit ratios in men are associated with high sperm counts and testosterone levels and vice versa [2], it therefore follows that its use as a means of assessing infertility is invaluable.

Apart from the fact that the use of anthropometry offers a cheap, simple and easily repeatable means of evaluating fertility in

men, there are scanty literature on this study and almost no data for males in the African continent. This present study was thus designed to determine the association of digit ratio and infertility in Akure men as a possible predictive guide for male fertility.

SUBJECTS AND METHODS:

A total of 84 subjects were recruited for this study. They subject included 42 men attending infertility clinics in Akure metropolis in Nigeria. The sampling sites were randomly selected infertility clinics in Akure. They include the State Specialist Hospital, Hope Specialist Hospital and Owoyemi Specialist Hospital. All the participants attending these clinics did semen analysis to confirm their infertility. Patients were then diagnosed as either azoospermic (absence of sperm cells) or oligospermic (< 20 $x10^6ml^{-1}$) following two separate semen analyses [9]. The normative participants comprised 42 healthy fertile, married men that had no problems with ejaculation and sex life and has been able to father a child. They were contacted via their family doctor. The seminal fluid analysis was done in each of them to confirm the normospermic ranges (> 20-120 $x10^6ml^{-1}$) [9].

Informed consent was obtained from the authorities of the above named hospitals. The participants were duly informed of the purpose of the study and a signed consent was obtained from each of them. The protocol was approved by the local ethical committee.

We excluded inappropriate candidates through history taking and physical examination. The 'disqualified entrants' were those who had a history of cryptochidisms, varicoceles, or testicular injury which can have an influence on semen analysis as well as those who had burns or trauma on hands that can have an influence on finger length [10]. We also excluded the following short comings: males with females co-twin [11]. Since 2D:4D ratios vary greatly between different ethnic groups [12], we excluded other tribes (concentrated on the Yoruba's Western Nigeria where the hospitals were located).

After due counseling was done, informed permission was obtained. The participants were asked to sit comfortably and positioned the dorsum on a flat, smooth surface the right hand was used because relations with right-hand ratio are typically stronger than left hand [2]. The vernier caliper was the instrument used for direct measurement of digital lengths.

First we measured the digit lengths from the ventral crease proximal to the palm to the tip of the finger, using vernier calipers recording to 0.01 mm [13]. A second measurement was taken in order that repeatability of the 2D:4D ratio [12] could be calculated. All the measurements were made by one observer

with right and left hands measured first and this procedure repeated after a period of at least 5 minutes blind to first measurements. The 2D:4D ratio was calculated by dividing the length of the index finger by the length of the ring finger.

The length of the ring and the index finger was also alternatively estimated indirectly by taking measurements from a digital image of the hand [14] and data compared.

Results were expressed as mean ± standard deviation. Analysis was carried out using analysis of variance (ANOVA) with Scheffe's post hoc test. The level of significance was considered at $p < 0.05$.

RESULTS:

The result in Table 1 shows that there was a statistically significant ($p < 0.05$) increase in the length of the fourth digit as compared to the second digit in fertile men in Akure. The digit ratio is less than one, since it is expressed as the ratio of the value of the length of the index finger in centimeters to the value of the length of the ring finger in centimeters. This means that most fertile men randomly sampled in Akure had their fourth fingers longer than the second finger.

Table 2 shows a significant ($p < 0.05$) increase in the length of the ring finger (fourth digit) as compared to index finger (second digit) in infertile men in Akure. In both cases the digit ratio was less than one. The values of 2D, 4D and digit ratio in fertile men were slightly but significantly ($p < 0.05$) lower compared to those of infertile men.

Data in Table 2 also shows that 2D:4D ratio in fertile men was significantly lower compared to infertile men, (unpaired *t*-tests, 2D:4D for infertile men, x = 0.954, 2D:4D for fertile men, x =0.946, *t*-test =2.61, $P\ r > t = 0.011$). There was a significant difference for the digit ratio summary score, with greater digit ratio in infertile men compared to fertile men.

Table 3 shows the correlations between age, index finger, ring finger, and digit ratio of both the fertile and infertile men. The age of the participants were found to be positively correlated with 2D, 4D, and the digit ratio i.e. as the age increases, the values of 2D, 4D, and the relative digit ratio increases.

Table 1: Mean values for fertile (MF) and infertile (MIF) men in Akure

Variables	MIF	MF	MIF	MF	MIF	MF
	Minimum		Maximum		Mean ± SD	
Age	25.00	25.00	53.00	42.00	33.14±0.99	30.83±0.56
2D	6.43	6.13	8.26	8.16	7.63±0.05	7.31±0.07
4D	6.70	6.32	8.79	8.68	8.01±0.06	7.73±0.08
Digit ratio	0.93	0.90	0.98	0.98	0.95±0.002	0.94±0.002

Table 2: Status of 2D, 4D, and digit-ratio in fertile and infertile men in Akure

Status	2 D	4 D	Digit ratio
Infertile	7.63	8.01	0.954
fertile	7.31	7.73	0.946
T-test	3.61	2.71	2.61
P r > t	0.0005	0.0082	0.011
	$p < 0.01$	$p < 0.01$	$p < 0.05$

Table 3: Status of 2D, 4D, and digit-ratio in fertile and infertile men using t-test

	Age	2 D	4 D	Digit ratio
Age	1.00	0.18	0.14	0.13
		0.11	0.21	0.26
2 D	0.18	1.00	0.97	- 0.07
	0.11		< 0.0001	0.52
4 D	0.14	0.97	1.00	- 0.31
	0.21	< 0.0001		0.0042
Digit ratio	0.13	- 0.07	- 0.31	1.00
	0.26	0.52	0.0042	

DISCUSSION

The assessment of fertility in men using relative digit lengths (2D:4D) ratio is not popular in African settings with scanty documentations if any. The efficacy in terms of percentage reliability in evaluating male fertility has been verified to be statistical significant [15]. Findings from our initial unpublished pilot study (before commencement of this current research) were interesting and the data was worthwhile.

The digit ratio is arguably ubiquitous in appraising many anthropometric limits in relation to other clinical conditions. For instance some authors have reported significant correlations between 2D:4D and such diverse traits as psychological, fertility, sexual attitudes and orientation, status, and cognitive abilities [16, 17]. Our study provided further evidence that 2D:4D is a sexually dimorphic trait with the normative 'control' participants having a significantly lower digit ratio compared to their infertile counterparts. The data were less than one as in the fertile men which were in tandem with those described previously in other studies [2, 15].

The overall sample data showed a weak but significant positive correlation between 2D:4D and age, although more data are required to clarify this situation. However, at present it appears that the relationships were either weak or non-existent. This finding provides some support to our prediction concerning a positive association between 2D:4D and male fertility.

However a study has shown an inverse relationship between digit ratio and semen quality [2]. This means that the lower the digit ratio, the higher the sperm count and motility and the more fertile the individual. Our study correctly identified with the variations in the finger ratio in fertile and infertile men and vertical association to their sexual status in the population. Manning *et al.* have presented the negative relationship between the 2D:4D ratio and sperm number, motility and testosterone concentrations [2, 12]. In their study, they had a subset of oligospermic males, which reduced the overall mean sperm numbers accounting for the significant relationship between sperm number and 2D:4D ratio [2]. In the same vein, our study showed meaningful findings where oligospermic males had higher digit ratio. Thus, the 2D:4D ratio is a likely predictive value for men's semen quality in the Yoruba populace of Akure Nigeria.

This study shows that the influence of finger ratio is significant in the evaluation of fertility in men. This means that in addition to semen analysis, hormonal profile and environmental/sex life of an individual [8] a more influencing factor would be the digit ratio.

CONCLUSION

This study demonstrates an association between 2D:4D ratio and the fertility status in adult men in Akure. Our data have provided a fertility predictive information/data on the relative digit lengths (2D:4D) ratio in men in Akure capital city of Ondo state Nigeria. This could serve as a future template for comparative studies on male fertility. However, there still exist controversies over this subject of relation between finger ratio and male fertility. Therefore the need for a larger scale study that requires a greater comparative study design is inevitable; and also to demonstrate further correlations between the finger ratio and male fertility.

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