

Journal of Anatomical Sciences Email: anatomicaljournal@gmail.com

J. Anat Sci 13(2)

An Investigation into the Relationship between Second and Fourth Digit (2D:4D) Ratio in Multiple Births Women - A Case Study of Igbo-Ora, Nigeria.

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ABSTRACT

Prenatal exposure to Testosterone and Oestrogen predicts human finger length and the ratio of 2D:4D reflects sexual differentiation at an early age. Women with high 2D:4D ratio were found to have high reproductive success and this prompted us to find out if any, the relationship between digit ratio (2D:4D) and multiple births. Two hundred and One hundred voluntary female subjects from Igbo-Ora and Ogbomosho respectively, aged 25-50 years who had given up on childbearing were grouped into four: Group I: Mothers who had given birth to Twins in Igbo-Ora (Identical and Non-Identical Twins, n=105). Group II: Mothers who had never given birth to Twins / Single birth mothers in Igbo-Ora, n=95. Group III: Mothers who had given birth to Twins in Ogbomosho (Identical and Non-Identical, n=50). Group IV: Mothers who had never given birth to Twins / Single birth mothers in Ogbomosho, n=50.The relaxed adducted fingers were flexed at metacarpo-phalageal joint at an angle 90° and placed on the table edge, after which the length of the second (2nd) and fourth (4th) fingers were measured from the second (2nd) and fourth (4th) mid metarcarpo-phalangeal joints to the tips of the second (2nd) and fourth (4th) fingers respectively for both hands and their ratio gave the Anatomical 2D:4D ratio while for Conventional measurements, the relaxed adducted fingers were placed in supine position on the table and the length of the second (2^{nd}) and fourth (4th) fingers were measured from the middle of the ventral proximal phalangeal crease to the tip of the second (2nd) and fourth (4th) fingers respectively of each hands of all the subjects and the ratio gave the Conventional 2D:4D ratio. The 2D:4D ratio of 800 fingers (2 fingers from each hand of 200 subjects) of Igbo-Ora subjects were compared with the 2D:4D ratio of the 400 fingers (2 fingers from each hand of 100 subjects) of Ogbomosho subjects both anatomically and conventionally. Measurements were done by two research assistants with vernier caliper at different times and the mean values were recorded as the reading. The digit ratio (2D:4D) was greater in single births women than in multiple births women in both Igbo-Ora and Ogbomosho subjects. This study showed that women with low 2D:4D digit ratio had high reproductive success which was contrary to previous belief. It is recommended that the research be carried out in a larger population.

Keyword: Testosterone, Oestrogen, 2D:4D ratio, Igbo-Ora, Multiple births.

INTRODUCTION.

Previous studies have shown that prenatal exposure to the hormone Testosterone and Oestrogen predicts the length of our fingers, thus by measuring the length of our fingers we have an idea of the amount of testosterone and oestrogen someone was exposed to in utero ¹. The Second to Fourth (2D:4D) digit ratio reflects sexual differentiation early in life and is a sexually dimorphic trait with males having a fairly large fourth (4th) digit and as such lower second to fourth digit ratio which could be a potential indication of greater androgen exposure during fetal development ^{2, 3} while females have a large second (2nd) digit with a subsequent high digit ratio (2D:4D). Numerous methods are available to assess 2D:4D digit ratio including: calipers, physical measurements, digital photographs or measurement from photocopies ⁴. In this study we will use physical measurement with caliper because it has shown a high degree of reproducibility ⁵.

Prenatal development of digit ratio has a long lasting influence on biological condition and health outcomes such as sexual orientation, physical performance, male fertility and autism as reported by ⁶.The ratio of second to fourth finger length (2D:4D) is determined during early fetal period and becomes stable across the life span from 2years of age, ². Accordingly typical male traits such as aggression ⁷ reproductive access and socio sexuality dominance ⁸ have been shown to be inversely correlated with second to fourth finger digit ratio.

Klimek *et al.*, ⁹ also reported that women with a high second to fourth digit ratio have a higher number of children or reproductive success. Twin studies have also shown that genetic factors contributed to this digit ratio ¹⁰. However, multiple births occur when more than one fetus results from a single pregnancy ¹¹. Multiple births can be Monozygotic or Dizygotic in nature ¹². Igbo-Ora in Nigeria was reputed to have the highest number of surviving twins worldwide ¹³ although there is now global incidence of multiple births due to increase number of pregnancies as a result of Assisted Reproduction Technology (ART) such as ovulation induction and invitro fertilization ¹⁴. The aim of this study was to establish if any, the relationship between digit ratio (2D:4D) and multiple births.

MATERIALS AND METHODS

Two hundred (200) voluntary female subjects of Igbo-Ora descent were recruited through random sampling meaning 2,000 fingers (10 fingers from each subject), of which 800 (2 fingers from each hand) were measured, compared and evaluated in this study. The control of One hundred (100) voluntary female subjects of Ogbomosho descent were equally recruited meaning 1,000 fingers (10 fingers from each subject), of which 400 (2 fingers from each hand) were measured, compared and evaluated. The purpose of this study was explained to the volunteers and they were given an opportunity to ask questions prior to participation.

The subjects without any finger deformity who have lived in either Igbo-Ora or Ogbomosho since birth were included in the study while those with any form of finger deformity and who have not lived in either towns since birth were excluded from the study.

The voluntary female subjects aged 25-50years who had given up on childbearing were grouped into four:

Group I: Mothers who had given birth to Twins in Igbo-Ora (Identical and Non-Identical Twins) n=105.

Group II: Mothers who had never given birth to Twins/Single birth mothers in Igbo-Ora, n=95. Group III: Mothers who had given birth to Twins in Ogbomosho (Identical and Non-Identical), n=50.

Group IV: Mothers who had never given birth to Twins / Single birth mothers in Ogbomosho, n=50.

The Anatomical and Conventional Second to Fourth digit ratio (2D:4D) were taken for mothers with Single and Twins births in both Igbo-Ora and Ogbomosho respectively.

The Anatomical and Conventional lengths were measured with vernier caliper in (cm). centimetres For Anatomical measurements, relaxed adducted fingers were flexed at 90° and placed on the table edge, after which the length of the second (2nd) and fourth (4th) fingers were measured from the second (2^{nd}) and fourth (4^{th}) mid metarcarpo-phalangeal joints to the tips of the second (2nd) and fourth (4th) fingers respectively for both hands and their ratio gave the Anatomical 2D:4D ratio while for Conventional measurements, the relaxed adducted fingers were placed in supine position on the table and the length of the second (2nd) and fourth (4th) fingers were measured from the midline of ventral proximal phalangeal crease to the tip of the second (2^{nd}) and fourth (4^{th}) fingers respectively of each hands of all the subjects [as described by 15] and the ratio gave the Conventional 2D:4D ratio. The 2D:4D digit ratio of 800 fingers of Igbo-Ora subjects were compared with the 2D:4D digit ratio of the 400 fingers of Ogbomosho subjects both anatomically and conventionally. These measurements were done by two experienced research assistants at different times using vernier caliper and the mean gave the value to be used for 2D and 4D of each finger. Right index finger was measured first followed by right ring finger, left index then left ring finger

The study was carried out over a period of six months (February to August, 2016) after the ethical approval had been obtained from the ethical review committee of Ladoke Akintola University Teaching Hospital, Ogbomosho, Nigeria.



Plate 1: Photoplate of the conventional measurement of the Right 2nd Digit (index) of a multiple birth woman



Plate 1: Photoplate of the Anatomical and Conventional measurement of the right 4th (ring) finger of a multiple birth woman.

RESULTS

In this study, it was observed that in Table 1.0 (for conventional measurements of Igbo-Ora and Ogbomosho which served as control) the mean values of the second to fourth digit ratio in the right hand of single births women was greater than the digit ratio of the right hand of multiple births women of Igbo-Ora and Ogbomosho descent, although the difference was not statistically significant in Igbo-Ora women difference but statistically significant (p<0.005) was observed in Ogbomosho women, whereas similar observation was made on the left hand but the difference was not significant in both hands of Igbo-Ora and Ogbomosho women.

However, in Table 2.0 (Anatomical measurement for Igbo-Ora and control, Ogbomosho), the mean values of the right hand second to fourth digit ratio in single births women was greater than the digit ratio of multiple births women of Igbo-Ora and Ogbomosho descent and the difference was not statistically significant. Observation was the same on the left hand statistically but the difference was significant in Igbo-Ora women (p<0.005) unlike the Ogbomosho women.

Table 1:Conventional 2D:4D Ratio for Single and Twins mothers in Igbo-Ora and
Ogbomosho.

	Right Hand				Left Hand				
	Igbo-Ora		Ogbomosho		Igbo-Ora	Ogbomosho			
Subjects	n	Mean+/-	n	Mean+/-	Mean+/-	Mean +/-			
Twins births	(105)	0.98+/-0.09	(50)	1.01 + -0.08	0.98 ± -0.08	1.01+/-0.09			
Single births	(95)	0.99+/-0.11	(50)	1.05+/-0.09	1.04+/-0.46	1.08+/-0.90			
P -value		0.455^{*}		0.028	0.202	**0.330			
* - Right Hand			** - Left Hand						

Table 2:Anatomical 2D:4D Ratio for Single and Twins mothers in Igbo-Ora and
Ogbomosho.

	Rig	ght Han	d	Left Hand		
	Igbo-Ora	Ogbomosho		Igbo-Ora	Ogbomosho	
Subjects	n Mean+/-	n	Mean+/-	Mean+/-	Mean +/-	
Twins births	(105) 0.97+/-0.05	(50)	1.01 + -0.09	0.95 ± -0.07	1.02+/-0.09	
Single births	(95) 0.98+/-0.06	(50)	1.97+/-6.50	0.99+/-0.10	1.03+/-0.12	
P -value	0.199^{*}	0.303		0.001^{**}	0.655	
	* - Right	Hand	** - Left Hand			

There are four tables which were compressed into two for ease of comparison between the Conventional Right and Left hand with the Anatomical Right and Left hands of both Igbo-Ora and Ogbomosho(control) women.

DISCUSSION

It has been established that the ratio of the second to fourth digit (2D:4D) ratio is a sexually dimorphic trait with the male second to fourth finger (2D:4D) ratio lower than in females. In the Zulu and Sardinian ethnic group, the second to fourth finger digit (2D:4D) ratio of 0.95 and 0.98 respectively were found to be equal in men and women ¹⁶ this contradicts the reported sexual dimorphism and are contrary to findings in our study and most previous studies in which the second to fourth digit ratio is sexually dimorphic ¹⁷.

Anthropometric traits probably deserve attention by anthropologist, scientist, and clinicians since these digit ratios have continued to show promise as biomarkers of health diseases ¹⁸. Our findings in this study is consistent with the second to fourth digit ratio as a dimorphic trait in that women with multiple births in Igbo-Ora and Ogbomosho had a lower second to fourth digit ratio compared to single birth women in both towns who had a higher second to fourth digit ratio, and this contradicted the previous report by Klimeck et al.,⁹. Tabachnik et al., ¹⁹ reported that lower 2D:4D in our population is characteristic of a more masculine digit ratio. which was associated with earlier age at menarche.

This may mean the twin births women with low 2D:4D will be more masculine than the single births women and may also suggest that multiple births women had more androgen exposure than single births hence the lower digit ratio, ⁸ and this was in tandem with the previous studies that second to fourth digit ratio is sexually dimorphic with the stronger having a low digit ratio (2D:4D). This may be associated with testosterone concentration as suggested by earlier investigations ^{15, 17}.

Jamison *et al.*, ²⁰ have found that dermatoglyphic asymmetry and

testosterone concentration are positively correlated in adult males.

CONCLUSION

This study showed that the 2D:4D digit ratio in multiple births women is lower than single birth women and since people with low 2D:4D digit ratio have been observed to be stronger it may mean that the twin births women were stronger than the single births women as observed in Igbo-Ora and Ogbomosho respectively, because of their low values for second to fourth digit ratios and thus can be reasonably concluded that low digit ratio (2D:4D) is closely associated with multiple births as against the reported high 2D:4D digit ratio.

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