

Relationship between Digit Ratio (2D:4D) and Birth Weight in Nigerians

B. Danborn^{1*}, S. S. Adebisi¹, A. B. Adelaiye² and S.A. Ojo³

¹Department of Anatomy, ²Department of Physiology, Faculty of Medicine, ³Department of Veterinary Anatomy, Faculty of Veterinary Medicine, Ahmadu Bello University, Zaria, Nigeria
*Telephone: 08020655284; *E-mail: sbdanborn¹@abu.edu.ng

KEYWORD 2D:4D Ratio. Birth Weight. Regression Analysis. Nigerians

ABSTRACT Recently the subject of 2D:4D ratio has been receiving great attention from investigators. This present study investigated the association between 2D:4D ratio and birth weight in Nigerians. Subjects consisted of 215 males and 190 females with mean age (20.64 ± 6.94). Finger lengths were measured from the basal crease to the tip of the finger and second digit (2D) was divided by fourth digit (4D) to obtain 2D:4D ratio. 2D:4D ratio were categorized according to three birth weights categories and correlated with digit ratio in both males and females. In males only left 2D:4D showed significant difference within the 3 birth weight group s ($F=5.94$ and $P = 0.003$) a similar result was also seen in the females ($F = 3.75$ and $P = 0.03$). Overall in males there was a significantly negative relationship between right and left 2D:4D with birth weight ($r = -0.15$, $P<0.05$ and $r = -0.21$, $P<0.01$) respectively. In females positively significant relationship was obtained in both right and left hands ($r = 0.16$, $P<0.05$ and $r = 0.24$, $P<0.01$) respectively. Regression analysis of 2D:4D and birth weight yielded a positive result, but the predictive ability lies more in the left hands in both males and females: $BW = 7.767 - (4.669 \times \text{left } 2D:4D)$ and $BW = 0.627 + (2.746 \times \text{left } 2D:4D)$. This study has demonstrated the association between 2D:4D and birth weight and birth weight could be predicted most especially from the left hands.

INTRODUCTION

Digit ratio have been reported by many investigators to be sexually dimorphic (Manning et al. 1998; Manning et al. 2002; Putz et al. 2004; McIntyre et al. 2006; Trivers et al. 2006). This difference has also been reported to exist in other animals and primates (Burley and Foster 2004; Brown et al. 2002). Digit ratio has been associated with many biological traits including the in utero levels of testosterone (Lutchmaya et al. 2004), aggression (Bailey and Hurd 2005; Millet and Dewitte 2006), spatial ability (van Anders and Hampson 2005; Bull and Benson 2006) and academic performance (Romano et al. 2006). Some disease conditions like autism, depression and developmental psychopathology, congenital adrenal hyperplasia, polycystic ovarian syndrome have also correlated with digit ratio (Manning et al. 2001; Brown et al. 2002; Okten et al. 2002; Catrall et al. 2005; Fink et al. 2007). Low birth weight has tremendous consequences and has been associated with a number of adulthood diseases like type II diabetes, hypertension, cardiovascular diseases, obesity and others (Baker 1998; Huxley et al. 2000; Anazawa et al. 2003). Ronalds et al. (2002) have shown that 2D:4D ratio is associated with body size and proportion

at birth in men, and that men who had higher 2D:4D were shorter at birth.

Since digit ratio is correlated to traits that are putatively link to testosterone, a few studies have reported the association of 2D:4D with birth weight. In this study we seek to investigate if there is any relationship between birth weight and 2D:4D ratio.

SUBJECTS AND METHODS

Data on age, sex and birth weight were obtained from subjects who are students and staff of the Ahmadu Bello University, Zaria through a questionnaire as part of another study. The number of subjects who participated were males ($n = 215$) and females ($n = 190$) after given informed consent with mean age (20.64 ± 6.94). Subjects were classified according to 3 birth weight categories (Group I $<3.0\text{kg}$, Group II $3.1 - 3.4\text{ kg}$ and Group III $>3.6\text{ kg}$).

Finger Length Measurements

Digit length was measured on the ventral surface of the hand from the basal crease of the finger to the tip, according to Manning et al. (1998) using an Avenger digital caliper (MicroMak USA) measuring to 0.01mm.

Statistical Analyses

Data were expressed as mean $\pm$ standard deviation (SD). One way analysis of variance was used to test for the difference in 2D, 4D and 2D:4D in the right and left hands of subjects in the 3 birth weight groups. Pearson correlation was applied to test the relationship between 2D, 4D, 2D:4D and birth weight. Linear and multiple regressions were used to investigate the ability of 2D:4D to predict birth weight. Statistical significant difference was deemed acceptable at $P < 0.05$. SigmaStat 2.0 for Windows (Systat Inc., Point Richmond, CA) was used for the statistical analyses.

RESULTS

In Table 1 subjects were classified according to birth weights. In both males and females only left 2D:4D digit ratio showed significant difference. In males, higher birth weight showed lower left 2D:4D (0.95 ± 0.03) and lower birth weight (0.97 ± 0.03) with statistical significant difference ($P = 0.003$) a contrary observation was seen in the females, with lower birth weights having lower right and left digit ratios and higher birth weights having higher 2D:4D digit ratios with significant statistical difference ($P = 0.03$).

Table 2 shows the significant correlations that were established in right and left 2D:4D ($r = 0.15$, $P < 0.05$ and $r = -0.21$, $P < 0.01$) respectively in males. In females, apart from the significant correlation seen in the right and left 2D:4D ratio ($r = 0.16$, $P < 0.05$ and $r = 0.24$, $P < 0.01$) respectively, another significant correlation was established between left 2D and birth weight ($r = 0.22$, $P < 0.01$).

Table 3 presents the regression equations of 2D:4D ratio and birth weight. A multiple linear regression comprising of birth weight (dependent variable) and right and left digit ratios (independent variables) shows that only the left 2D:4D digit ratio significantly predicts birth weight

Table 2: Correlation between 2D and 4D digit lengths and ratios with birth weight of subjects.

	Males n=215	Females n=190
Right 2D (mm)	0.02	0.17
Right 4D (mm)	0.13	0.05
Left 2D (mm)	0.00	0.22**
Left 4D (mm)	0.12	0.05
Right 2D:4D	-0.15*	0.16*
Left 2D:4D	-0.21**	0.24**

* $P < 0.05$ ** $P < 0.01$

in males ($P = 0.02$) and females ($P = 0.009$). This regression is graphically presented in Figures 1 and 2.

DISCUSSION

Birth weight in newborns is sexually dimorphic (Danborno and Afegbua 2006) and has been associated with a number of other outcomes in child and adulthood (Baker 1998). If this is true then testosterone must be responsible for the birth weight difference in males and females, and it is expected that at least there should be some kind of relationship between birth weight, 2D, 4D and 2D:4D ratio, since testosterone has been known to increase somatic growth.

So far only a few studies (Ronalds et al. 2002; McIntyre et al. 2006) have attempted to correlate birth weight and 2D:4D ratio. The present study further confirms a positive association between birth weight and 2D:4D ratio. For males a negative correlation in both right and left hands were obtained as expected due to the effect of fetal testosterone. In females a positive relationship was recorded. This means that where as testosterone increases fetal growth and reduces 2D:4D ratio estrogen increases both. The observation for this study tends to deviate slightly from previous reports of the right 2D:4D ratio associating with traits more than the left (Manning 2002; Putz et al. 2004; Ronamo et al. 2006).

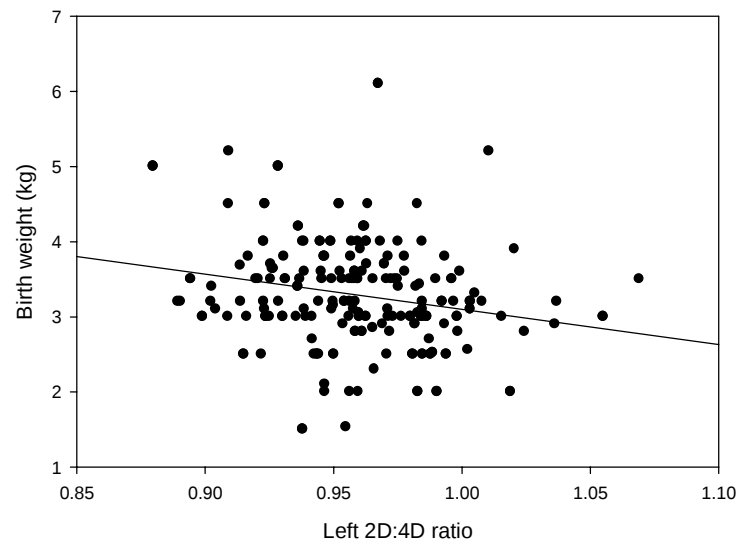
Table 1: 2D:4D ratios in right and left hands of subjects according birth weight categories in male and females subjects.

	Group A <3.0 kg	Group B 3.1 – 3.5 kg	Group C >3.6 g	F	P
Females	n = 29	n = 133	n = 28		
Right 2D:4D	0.96 ± 0.04	0.96 ± 0.05	0.98 ± 0.07	1.80	0.17
Left 2D:4D	0.96 ± 0.04	0.97 ± 0.04	0.99 ± 0.04	3.75	0.03
Males	n = 51	n = 101	n = 63		
Right 2D:4D	0.96 ± 0.04	0.94 ± 0.05	0.94 ± 0.04	2.53	0.08
Left 2D:4D	0.97 ± 0.03^a	0.96 ± 0.04	0.95 ± 0.03^b	5.94	0.003

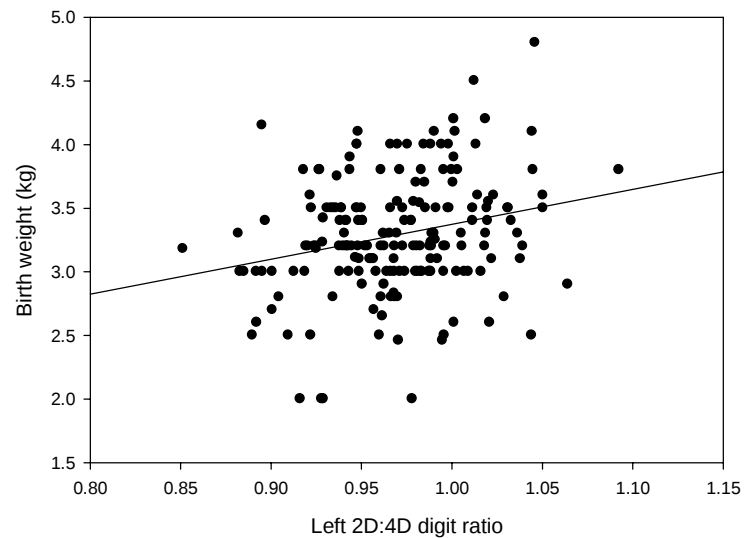
Table 3: Regression equations for predicting birth weight from 2D:4D digit ratios in male and females.

Sex	n	Predictive Equations	r	r ²	SEE
Males	215	BW= 7.950 – (0.780 x right 2D:4D) - (4.091 x left 2D:4D)	0.22	0.05	0.71
Females	190	BW= 0.396 + (0.578 x right 2D:4D) + (2.411 x left 2D:4D)	0.25	0.06	0.45

r = correlation coefficient, SEE= standard error of estimate



**Fig. 1. Regression of birth weight on left 2D:4D digit ratio in males (n = 215).
BW = 7.767 – (4.669 x left 2D:4D), r = 0.21 and P = 0.002.**



**Fig. 2. Regression of birth weight on left 2D:4D digit ratio in females (n = 190).
BW = 0.627 + (2.746 x left 2D:4D), r = 0.24 and P<0.001.**

The relationship of birth weight and left 2D:4D ratio subjected to regression analysis produced an ability to predict birth from 2D:4D. Further studies to validate this association can be deduced from the result of the 2D, 4D and 2D:4D ratio in classified birth weight groups. The results of the 2D and 4D in males presented a pattern with an increasing length in 2D and 4D from Group A (birth weight < 3.0 kg) to Group C (birth weight > 3.6 kg) in both right and left hands. This is contrary to the observation made on 2D:4D ratio, in this case 2D:4D decreases from lower birth weight group (< 3.0 kg) to higher birth weight group (> 3.6 kg) which is more significant in the left hand ($P = 0.003$) than the right hand ($P = 0.08$) both for males and females. This finding disagrees with report of Ronalds et al. (2002), whose data fail to show significant relationship between birth weight, placental weight, birth length and head circumference. Following the suggestion of Ronalds et al. (2002), subjects with higher birth weight and lower 2D:4D ratio would have lower risk of developing cardiovascular diseases as reported earlier by Manning and Blundred (2000).

We conclude that 2D:4D ratio could serve as a means to obtain an estimate of birth weight for individuals who do not know their birth weight to help prevent adverse health problems in adult life.

ACKNOWLEDGEMENTS

The authors are grateful to Mr. James Timbuak, Miss. Juliet Oyibo, Mr. Godwin Ngedu, Mr. Kuma Yandev, Miss Patience Nuhu and Mr. Abraham Elukpo for their help during the data collection. In the same vein we are thankful to Gershom Usman who entered the data into Microsoft Excel.

REFERENCES

- Anazawa S, Atsumi Y, Matsuoka K 2003. Low birth weight and development of type 2 diabetes in a Japanese population. *Diabetes Care*, 26: 2210-2211.
- Bailey AA, Hurd L 2005. Finger length ratio (2D:4D) correlates with physical aggression in men but not in women. *Biol Psychol*, 68: 215-222.
- Barker DJP 1998. *Mothers, Babies and Health in Later Life*. Edinburgh: Livingstone.
- Brown WM, Hines M, Fane BA, Breedlove SM 2002. Masculinized finger length patterns in human males and females with congenital adrenal hyperplasia. *Horm Behav*, 42: 380-386.
- Bull R, Benson PJ 2006. Digit ratio (2D:4D) and the spatial representation of magnitude. *Horm Behav*, 50: 194-199.
- Burley NT, Foster VS 2004. Digit ratio varies with sex, egg order, and strength of mate preference in zebra finches. *Proceedings of the Royal Society of London Series B, Biol Sci*, 271: 239-244.
- Cattrall FR, Vollenhoven BJ, Weston GC 2005. Anatomical evidence for in utero androgen exposure in women with polycystic ovary syndrome. *Fert Ster*, 84: 1689-1692.
- Danborno B, Afegbua A 2006. Ethnic differences in birth weight and cesarean deliveries in Zaria, Nigeria. *J Experim Clin Anat*, 5: 21-24.
- Fink B, Manning JT, Williams JHG, Podmore-Nappin C 2007. The 2nd to 4th digit ratio developmental psychopathology in school-aged children. *Pers Indiv Differ*, 42: 369-379.
- Huxley RR, Shiell AW, Law CM 2000. The role of size at birth and postnatal catch-up growth in determining systolic blood pressure: a systemic review of literature. *J Hyperten*, 18: 815-831.
- Lutchmaya S, Baron-Cohen S, Raggatt P, Knicmeyer R, Manning JT 2004. 2nd to 4th digit ratios, fetal testosterone and estradiol. *Early Hum Dev*, 77: 23-28.
- Manning JT, Bundred PE 2000. The ratio of 2nd to 4th digit length: a new predictor of disease predisposition? *Med Hypoth*, 54: 855-857.
- Manning JT, Scutt D, Wilson J, Lewis-Jones DI 1998. The ratio of 2nd to 4th digit length: a predictor of sperm numbers and concentrations of testosterone, luteinizing hormone and oestrogen. *Hum Reprod*, 13: 3000-4.
- Manning JT 2002. *Digit Ratio: A Pointer to Fertility, Behaviour and Health*. New Brunswick, NJ: Rutgers University Press.
- Manning JT, Baron-Cohen S, Wheelwright S, Sanders G 2001. The 2nd to 4th digit ratio and autism. *Devl Med Child Neurol*, 43: 160-164.
- McIntyre MH, Cohn BA, Ellison PT 2006. Sex dimorphism in digital formulae of children. *Am J Phys Anthropol*, 129: 143-150.
- Millet K, Dewitte S 2007. Digit ratio (2D:4D) moderates the impact of an aggressive music video on aggression. *Pers Indiv Differ* doi:10.1016/j.paid. 2006.11.024.
- Okten A, Kalyoncu M, Yaris N 2002. The ratio of second- and fourth-digit lengths and congenital adrenal hyperplasia due to 21-hydroxylase deficiency. *Early Hum Dev*, 70: 47-54.
- Putz DA, Gaulin SJC, Sporter RJ 2004. McBurney, D. H.: Sex hormones and finger length: What does 2D:4D indicate? *Evol Hum Behav*, 25: 182-199.
- Romano M, Leoni B, Saino N 2007. Examination marks of male university students positively correlate with finger length ratios (2D:4D). *Biol Psychol*, 71: 175-82.
- Ronalds G, Phillips DI, Godfrey KM, Manning JT 2002. The ratio of second to fourth digit lengths: a marker of impaired fetal growth? *Early Hum Dev*, 68: 21-26.
- Trivers R, Manning JT, Jacobson A 2006. A longitudinal study of digit ratio (2D:4D) and other finger ratios in Jamaican children. *Horm Behav*, 49: 150-156.
- van Anders SM, Hampson E 2005. Testing the prenatal androgen hypothesis: measuring digit ratios, sexual orientation, and spatial abilities in adults. *Horm Behav*, 47: 92-98.