PRINT: ISSN 0972-0073 ONLINE: ISSN 2456-6802
Anthropologist, 38(1-3): 17-21 (2019)
DOI: 10.31901/24566802.2019/38.1-3.2049

A Correlational Analysis of Sexual Dimorphism, 2d:4d, Age, and Weight among the Ikwo Population in Nigeria

Obaje Godwin Sunday*, Nwachukwu Sylvia Chinwendu and Egwu Augustine Ogugua

Department of Anatomy, Faculty of Basic Medical Sciences, College of Medicine, Federal University Ndufu Alike Ikwo, Ebonyi State, Nigeria

KEYWORDS Analysis. Anthropometry. Correlation. Dimorphism. Prediction. Regression

ABSTRACT Digit ratio (2d:4d) study is generating research concerns in medical sciences. Finger length determination is a known predictor to health status, behaviours and obesity. Aim of this study was to determine the dimorphism, 2d:4d, and weight differences of Ikwo population. Sample population was four hundred and one (n=401) with 181 males and 220 females within the age of 12-18 years of urban secondary school in Ebonyi State, Nigeria. Measurement was done with digital vernier caliper to measure digit lengths from the crease of the palm to the tip, where 2d was divided by 4d to give 2d:4d ratio. Also, the stadiometer was used to measure height and weight, and all measurements were in millimeters (mm) except body weight was in kilogram (kg). Mean height was higher in males (161.64 ± 11.07) than females (159.14 ± 6.34) while weight of females was higher (48.18 ± 9.84) than males (49.71 ± 7.02) but not significant (P<0.07). Right finger (2d:4d) of males was lower than females (0.95 ± 0.04 and 0.96 ± 0.04) and not significant (P<0.090) while the left finger (2d:4d) was higher in males (0.96 ± 0.04) than females (0.95 ± 0.04) and significant (P<0.047). Height negatively correlated with both left and right of 2d:4d (r = -0.09, p<0.05, r=0.07, p<0.05). Also, the association between right and left 2d:4d were r=0.07, P<0.07 and r= -0.09, p<0.05. In conclusion, digit ratio (2d:4d) evaluated weight and age for population, dependent and independent variables were predictive models to establish that height and sexual dimorphic features existed in digit lengths.

INTRODUCTION

The study was to investigate sexual dimorphism of 2d:4d among Ikwo population, to establish correlation between age, weight and digit ratio, and to predict model for Ikwo when height and weight are known. Many studies have shown that the ratio of the lengths of second finger (2D) to the fourth (4D) is an indicator of foetal exposure to hormonal activities (Kajantie 2006). Sexual dimorphismn and link between 2d:4d and physical activities among human performances have been consistent. Apart from sport activities, behaviors, autism has been fingered putative biomarker which suggest association of 2d:4d and prenatal testosterone (Al-Zaid et al. 2015). Also, many anthropometric measurements have linked pubertal height, weight, and BMI reference to be aligned for onset of puberty (Albertsson-Wikland et al. 2018). There are reports on other tribes that implicated effects of age, gender, height, and body fat on the functional muscle-bone unit in children and adults (Duran et al. 2018), prenatal testosterone, visual-spatial memory, and numerical skills in young children (Bull et al. 2010), and men with coronary artery disease with lower levels of androgens than men with normal coronary angiograms (English et al. 2000). Again, that second to fourth digit ratio and facial asymmetry established an association (Fink et al. 2004) and measurement of 2d:4d ratio and neck circumference in adolescents expressed sexual dimorphism implicated in obesity (Jeevanandam and Prathibha 2018).

MATERIAL AND METHODS

The anthropometric setting and design of this study was cross-sectional and 401 subjects (males=181 and females=220) aged 12-18 years were randomly recruited from Urban Secondary School Ikwo, South East in Ebonyi State, Nigeria. The instruments used were stadiometer and digital vernier caliper for height, weight and finger lengths. Also, the weight and height were measured with subject standing erect (Frankfurt plane), bare-footed with the scale mounted in millimeters (mm) and kilogram (kg). The length was measured from creases of tip to base while

*Address for correspondence:
Obaje Godwin Sunday
Telephone: +2348068638121,
E-mail: obaje199@gmail.com

the distance between these two points indicate the length of finger indices. Ethical report was obtained (ERC/P01/20) from Alex Ekwueme Federal University Ndufu Alike Ikwo. All participants expressed joy when briefed of the objectives and methodology of the study before filling the consent forms, where measurement was taken.

Statistical Analysis

SPSS (Statistical Package for Social Sciences) version 16.0 (SPSS Inc., IL) was used for the study. Data were expressed as mean ± standard deviation (SD) for both right and left hands of subjects. Pearson correlation was applied to test the relationship between 2d, 4d, 2d:4d, age, height and sex. Linear regressions were used to investigate the ability of 2d:4d to test age, sex, weight and height. Statistical significant difference was considered acceptable at P<0.05.

RESULTS

The study of the Ikwo samples have been expressed in Table 1 which shows that mean age was the same for both sexes and significant (P<0.015). The mean height was higher in male than female, with the level of significance at P<0.05 and also mean weight higher in female than male but not significant (P<0.7). Also, mean right (2d:4d) was higher in female than male while mean left (2d:4d) higher in male than female and significant (P<0.05). Table 2 shows simple correlation matrix that age positively correlated with right and left (2d:4d), (r = 0.07, p<0.05 and r=0.08, p<0.05). Table 3 expressed the predictive equations of height using weight and digit ratio. A multiple linear regression consisting of weight (dependent variable) for both right and left digit ratios (independent variables) expressed that only the left 2d:4d digit ratio significantly predicts height and weight (P = 0.000, P = 0.004) while that of right 2d:4d ratio was P<0.06.

Table 1: Age, height, weight and digit ratios of urban secondary school students in Ebonyi State, Nigeria

	Mean ± SD	*Min – Max*	*Mean ± SD*		*T*	*P*
	(n=401)		*Male (n=181)*	*Female (n=220)*		
Age	16.27 ± 2.04	13 – 21	16.55 ± 2.02	16.05 ± 2.03	2.44	0.015
Height	160.27 ± 8.87	130 –185	161.64 ± 11.07	159.14 ± 6.34	2.82	0.005
Weight	49.02 ± 8.43	25 – 70.5	48.18 ± 9.84	49.71 ± 7.02	1.81	0.07
RF2	67.91 ± 5.17	51.0 – 94	68.43 ± 5.97	67.48 ± 4.37	1.84	0.067
RF4	70.85 ± 5.80	53.5 – 90	71.81 ± 6.49	70.05 ± 5.05	3.06	0.002
RF2:RF4	0.96 ± 0.04	0.85– 1.20	0.95 ± 0.04	0.96 ± 0.04	2.49	0.090
LF2	68.74 ± 5.41	53.0 – 85.5	69.34 ± 6.21	68.24 ± 4.60	2.04	0.042
LF4	72.25 ± 5.77	56 – 91	73.21 ± 6.58	71.45 ± 4.89	3.07	0.002
LF2:LF4	0.95 ± 0.04	0.82 – 1.16	0.96 ± 0.04	0.95 ± 0.04	1.99	0.047

Table 2: Correlation matrix of anthropometric variables to investigate between birth weight, height and digits ratio of urban secondary school students in Ebonyi State, Nigeria

	Age	*HHT*	*WHT*	*RF2*	*RF4*	*RF2:RF4*	*LF1*	*LF2*	*LF4*	*lf2:lf4*
AGE	-	0.58**	0.60**	0.33**	0.268**	0.07	0.34**	0.36**	0.33**	0.08
HHT		-	0.77**	0.68**	0.679**	-0.09	0.66**	0.69**	0.70**	-0.07
WHT			-	0.57**	0.523**	0.02	0.53**	0.58**	0.57**	0.04
RF2				-	0.85**	0.16**	0.77**	0.95**	0.84**	0.16**
RF4					-	-0.39**	0.72	0.84**	0.96**	-0.39**
R2:RF4						-	0.003	0.07	-0.33**	0.15**
LF2								-	0.86**	0.16**
LF4									0.89**	-0.39**
LF2:LF4										-0.09*

*Right finger (RF), left finger (LF), height (H) and weight (W)

Table 3: Predictive equation of height, weight and digit ratio of urban secondary school in Ebonyi State, Nigeria

Variables	*Predictive equation*	*R*	R^2	*SEE*	*P*
Height	HT = 120.34 + (0.815 × W)	0.77	0.600	5.620	0.000
RF2	HT = 81.41 + (1.16 × RF2)	0.677	0.459	6.536	0.000
RF4	HT = 86.68 + (1.04 × RF4)	0.679	0.462	6.517	0.000
RF2:RF4	HT = 178.61 + (-19.10 × RF2:RF4)	0.09	0.006	8.84	0.06
LF2	HT = 82.77 + (1.13 × LF2)	0.687	0.47	6.45	0.000
LF4	HT = 82.70 + (1.07 × LF4)	0.699	0.489	6.35	0.000
LF2:LF4	HT = 170.03 + (10.25 × LF2:LF4)	0.047	0.002	8.87	0.004

*Right finger (RF), left finger (LF), height (H) and weight (W)

DISCUSSION

Understanding and documenting digit ratio study involves the collection of data from minority people like the indigenous Ebonyians in the South-East Nigeria. Hence, this study discussed 2d, 4d and 2d:4d of the Ikwo population. In this study, important of digit ratio (2d:4d), age, weight, and height has been added to the body of knowledge in anthropology.

Previous report has described the effect of age, gender, height, different stages of human life, and functional muscle-bone unit (Duran et al. 2018), which agreed with present study. Predictions accuracy correlates negatively with age and height at certain level (18 years) while prediction accuracy at age 0-6 years for height is better (Shmoish et al. 2018), as reported in Table 1 and Table 3 and sciatic neurosteatosis expressed relationship with age, gender, obesity and height (Ratner et al. 2018). Apart from Honekopp and Watson (2010), who reported differently on higher 2d:4d to be higher in right fingers, study Belgian registry agreed that adult height after growth hormone treatment at pubertal showed positive correlation (Thomas et al. 2018). On weight and height, Albertsson-Wikland et al. (2018) reported a novel type of pubertal height, weight, and BMI reference, aligned for onset of puberty. Self-reported height and weight may lead to inaccurate estimates of associations between BMI and health indicators (Lipsky et al. 2019), and Neyzi et al. (2015) reported reference values for weight, height, head circumference, and body mass index in Turkish children. All these reports agreed with the researchers' findings of weight, height and age. For digit ratio, as criminology has become more interdisciplinary in recent years, biosocial criminology and forensic science have earned a place at the table. One important proposition that has gained increasing attention is the 2d:4d finger digit ratio linking to behaviours (Pratt et al. 2016). In this study, tables for correlation and prediction supported previous study. Index to ring finger reported autism, a neurodevelopment disorder with a strikingly higher prevalence in boys than girls, as prenatal exposure to high levels of fetal testosterone (Al-Zaid et al. 2015). Also, Turanovic et al. (2017) reported exposure to fetal testosterone, aggression, and violent behavior as meta-analysis of the 2d:4d digit ratio reported in sexual dimorphism in 2d:4d (Tables 1 and 2).

The results show a positive correlation between the digit lengths and height in both males and females and between weight and second digit length in case of males but the 2d:4d digit ratio had no relationship to height and weight. This agreed with Jacob et al. (2015) study which reported that the second and fourth digit ratio with physical attributes in South Indian population appeared dimorphic and correlational. Maternal age, maternal body mass index, maternal smoking during pregnancy, maternal alcohol consumption during pregnancy, birth weight, and gestational age expressed relationships with digit ratio (2d/4d) as biomarker (Mitsui et al. 2016).

Fels Longitudinal Study on the White Americans reported no sexually dimorphic relationship between digit ratios in children (Fink and Manning 2018). Also, early appearance of sexual dimorphism in 2d:4d for both finger lengths which differs slightly on the age was found in English and Scottish children as young as 2

years (Turanovic et al. 2007; Fink et al. 2004) . In anatomy, once ossification sets in adults, the metacarpo-phalangeal growth also stops. Relationship between 2d, 4d and 2d:4d existed through prenatal testosterone exposure and has existed in other ethnic groups, with report that 2d:4d is also negatively associated with prenatal testosterone (Bull et al. 2010; Jeevanandam and Prathibha 2018). Right and left finger 2d:4d correlated in this study, which agreed with previous work on the effects of sex, ethnicity, and sexual orientation on self-measured digit ratio (Manning et al. 2011). Again, the fact is that the role of prenatal sex steroids in the development of digit ratio (McIntyre 2006) serves as factor during development of the length of fingers. This study will predict weight, age and height when 2d:4d records are known, and can be useful in forensic science, behavioral education and developmental biology.

CONCLUSION

The study concluded that digit ratio (2d:4d) served as means for evaluation of birth weight and age for population who do not know their weight and age, which would provide solutions to basic health issues. Again, the study concluded that both dependent and independent variables served good predictive models in establishing height and sexual dimorphic features that existed in digit lengths.

RECOMMENDATIONS

The researchers' recommendation report is designed to provide useful information about finger lengths ratio of Ikwo population in Nigeria that may be a good fit for nutrition, forensic and genetic sciences. Here, digit ratio (2d:4d) research should be broadened in health education as its serves as prenatal biomarker for early development in life. The sample size should be increased so as to accommodate population and avoid sample errors. Also, both right and left 2d:4d be determined with sophisticated anthropometric tool instead of digital Vernier caliper that will better predict sex-behaviour relationship

Anthropologist, 38(1-3): 17-21 (2019)

ACKNOWLEDGMENTS

The researchers thank Provost of the College of Medicine, Prof Edward Nwachi for administrative contributions and Prof A.O. Ibegbu for suggesting journal for the manuscript.

REFERENCES

Al-Zaid FS, Alhader AA, Al-Ayadhi LY 2015. The second to fourth digit ratio (2d:4d) in Saudi boys with autism: A potential screening tool. *Early Human Development*, 91(7): 413-415.

Albertsson-Wikland K, Niklasson A, Gelander L, Holmgren A, Aronsson AS, Sjöberg A et al. 2018. A novel type of pubertal height, weight, and BMI reference, aligned for onset of puberty. *Horm Res Paediatr*, 90: 422-423.

Bull R, Davidson WA, Nordmann E 2010. Prenatal testosterone, visual-spatial memory, and numerical skills in young children. *Learn Individ Differ*, 20: 246-250.

Duran I, Martakis K, Hamacher S, Stark C, Semler O, Schoenau E 2018. Are there effects of age, gender, height, and body fat on the functional muscle-bone unit in children and adults? *Osteoporosis International*, 29(5): 1069-1079.

English KM, Mandour O, Steeds RP, Diver MJ, Jones TH, Channer KS 2000. Men with coronary artery disease have lower levels of androgens than men with normal coronary angiograms. *Eur Heart J*, 21: 890-894.

Fink B, Manning JT, Neavec N, Grammer K 2004. Second to fourth digit ratio and facial asymmetry. *Evol Hum Behav*, 2: 125-132.

Fink B, Manning JT 2018. Direct versus indirect measurement of digit ratio: New data from Austria and a critical consideration of clarity of report in 2D: 4D studies. *Early Human Development*, 127: 28-32.

Hönekopp J, Watson S 2010. Meta analysis of digit ratio 2D: 4D shows greater sex difference in the right hand. *American Journal of Human Biology*, 22(5): 619-630.

Jeevanandam S, Prathibha KM 2018. Measurement of 2d:4d ratio and neck circumference in adolescents: Sexual dimorphism and its implications in obesity – A cross-sectional study. *Indian J Endocrinology and Metabolism*, 22: 724-727.

Jacob M, Avadhani R, Nair B, Nallathamby R, Soman MA 2015. Cross sectional study of second and fourth digit ratio with physical attributes in South Indian population. *Int J Anat Res*, 3(2): 1133-1137.

Kajantie E 2006. Fetal origins of stress related adult disease. *Annals of the New York Academy of Sciences*, 1083(1): 11-27.

Lipsky LM, Haynie DL, Hill C, Nansel TR, Li K, Liu D et al. 2019. Accuracy of self-reported height, weight, and BMI over time in emerging adults. *American Journal of Preventive Medicine*, 56(6): 860-868.

McIntyre MH 2006. The use of digit ratios as markers for perinatal androgen action. *Reproductive Biology and Endocrinology*, 4(1): 10.

Manning JT 2011. Resolving the role of prenatal sex steroids in the development of digit ratio. *Proceeding of National Academy of Sciences*, 108(39): 16143-16144.

Mitsui T, Araki A, Goudarzi H, Miyashita C, Ito S, Sasaki S et al. 2016. Effects of adrenal androgens during the prenatal period on the second to fourth digit ratio in school-aged children. *Steroids*, 113: 46-51.

Neyzi O, Bundak R, Gökçay G, Günöz H, Furman A, Darendeliler F, Bas F 2015. Reference values for weight, height, head circumference, and body mass index in Turkish children. *Journal of Clinical Research in Pediatric Endocrinology*, 7(4): 280.

Pratt TC, Turanovic JJ, Cullen FT 2016. Revisiting the criminological consequences of exposure to fetal testosterone: A meta analysis of the 2d:4d digit ratio. *Criminology,* 54(4): 587-620.

Ratner S, Khwaja R, Zhang L, Xi Y, Dessouky R, Rubin C, Chhabra A 2018. Sciatic neurosteatosis: Relationship with age, gender, obesity and height. *European Radiology,* 28(4): 1673-1680.

Shmoish M, German A, Devir N, Hecht A, Butler G, Niklasson A, Albertsson-Wikland K 2018. Prediction of Adult Height by Artificial Intelligence (AI) through Machine Learning (ML) from Early Height Data. In: *57th Annual ESPE (European Society for Paediatric Endocrinology),* 27-29 September, Athens, Greece.

Thomas M, Beckers D, Brachet C, Dotremont H, Lebrethon MC, Lysy P et al. 2018. Adult height after growth hormone treatment at pubertal onset in short adolescents born small for gestational age: Results from a Belgian registry-based study. *International Journal of Endocrinology*, Article ID #6421243, 8 pages.

Turanovic JJ, Pratt TC, Piquero AR 2017. Exposure to fetal testosterone, aggression, and violent behavior: A meta-analysis of the 2d:4d digit ratio. *Aggression and Violent Behavior,* 33: 51-61.

Paper received for publication in January, 2019
Paper accepted for publication in April, 2019