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The Study of 2D:4D Ratio and Facial Asymmetry Using Eye-Mouth-Eye Angle among the Student of College of Medicine and Health Sciences, Federal University Dutse

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Abstract

Deviations of physical characteristics from bilateral symmetry, in otherwise symmetric individuals, are supposed to result from environmental perturbations during development. One cause of such perturbations may be sex steroids such as testosterone and oestrogen. The study examined the relationship between second to fourth digit ratio (2D:4D), a putative negative correlate with prenatal testosterone and a positive correlate with prenatal estrogen, and asymmetry. The hand of the participants was place on a flat surface with the palm facing upward fore arm in line with the middle finger. Finger should be extended maximally and dose to each other measurement technique was followed for measuring 2D:4D digit length which can be define as a distance between the proximal flexion crease of the digit length was measured in centimeters. Table 1 shows descriptive analysis of 2D and 4D right and left distance. The minimum and maximum ages are 18 and 35 years respectively. The mean of 2D:4D right length was 0.98 ± 0.015 and the mean of 2D:4D left length 0.97 ± 0.022 this shows there is higher mean value in right 2D:4D length. Our data show that both low 2D:4D (a marker of high prenatal testosterone) and high 2D:4D (a marker of high prenatal estrogen) are associated with elevated levels of asymmetry and this relationship applies particularly to finger asymmetry.

Keywords: 2D:4D ratio, facial asymmetry, eye-mouth-eye angle, students

INTRODUCTION

Many human body parts undergo development with bilateral symmetry. This implies that the right and left sides can be divided into identical mirror images. However, due to biological factors inherent to processes of development as well as environmental disturbances, perfect bilateral symmetry is rarely found. The term asymmetry is used to make reference to dissimilarity between homologous elements, altering the balance between structures. Facial asymmetry is common in the overall population and is often presented sub-clinically [1]. Facial asymmetries manifest themselves very early in human development and remain during lifetime [2]. Randomly distributed deviations from perfect symmetry in paired traits such as ear height and wrist width are thought to reflect perturbations during development [2].

2D:4D is the study of finger length patterns, namely the length of the second relative to the length of the fourth digit (digit ratio, 2D:4D). Eye-mouth-eye angle is a quantitative and face size independent trait that is sexually dimorphic and a good indicator of masculinity and face symmetry [3]. Using frontal photographs of both male and female faces [4]. Facial asymmetry is the condition that one half of the face is not equivalent as the other half [5].

MATERIAL AND METHOD

Study Area

The study will be conducted in Federal University Dutse, Jigawa State.

Study Population

The study population will comprise of all the students of College of Medicine and Health Science of about 750 students in the Faculty of Basic Medical Science and Faculty of Clinical Science.

Student Design

The study was a descriptive cross sectional study using Anthropometry.

Sample size determination

The subjects for the study were the student of Faculty of Basic Medical Science, Federal University Dutse. The sample size was determined using standard formula that recognizes the total population precision level, confidence interval and standard deviation.

N≥Z2a2S/d2

Where n=Sample size, Z=Normal distribution value, d=Detection level considered S=Standard deviation of the sample database on previous knowledge.

Inclusion criteria

The following subject are included in the research

i- Subject that are within the Faculty of Basic Medical Sciences and Faculty of Clinical Sciences, Federal University Dutse.

ii- Subject that are within the age range of 18-35years

iii-Subject that are physically fit without any form of deformity

Exclusion criteria

The following are excluded in the research

i- Subject with craniosynostosis

ii- Subject that are symbrachydactyly

iii- Subject that are oligodactyly

Ethical consideration

A letter of introduction was collected from the department of Human Anatomy Federal University Dutse, and was taken to the ethical committee of Faculty of Basic Medical Sciences Federal University Dutse. The aim and objectives of the study were explained to the committee and their permission were obtained. The explanations of the procedure as well as the intended use of the research were properly addressed to the subject and their consents for the participation were obtained.

Methods

Step 1

Sample size and participant 150 participants of student (79 male and 71 female) of Federal University Dutse, particularly from Faculty of Basic Medical Science (Human Anatomy, Human Physiology and MBBS). Were recruit for the research study, Participants range in age from 18 to 35 years. Research study was conduct in only one faculty in the university, each participant was required to fill the questionnaire contain basic demographic profile (e.g., sex, age, ethnicity, etc.). Participant were giving information regarding the research study and measurement, procedure and were assure about the confidentiality of the data, they provide and are require to a sign a consent form before participant in the study. Participants with any hand, face, diseases, injury, and deformity were excluding from the research study.

Step 2

The hand of the participants was place on a flat surface with the palm facing upward fore arm in line with the middle finger. Finger should be extended maximally and dose to each other measurement technique was followed for measuring 2D:4D digit length which can be define as a distance between the proximal flexion crease of the digit length was measured in centimeters with help of both the right and left hands and repeat three (3) time tor accuracy and mean value Was taken for statistical analysis with 0.002.302 as measurement error.

All the measurements were performed during the time period 9:00am-12:00pm to eliminate durational variations and under the same conditions to avoid inter-observer errors.

Morphometric Measurements

Two (2) morphormetric measurements are record for each hand.

2DL (Length of index finger) It is measurement as the distance between the mid-point of metacarpo-phalangeal crease at the base of index finger of index to the tip or most forwardly placed point of the index finger.

4DL (Length of the ring finger) It is measured as the distance between the mid-point of metacarpo-phalangeal crease at the base of ring finger to the tip or most forwardly place point of the ring finger.

2D:4D Digit Ratio Measures

2D:4D digit ratios are computed by during length of the index finger with the length of the ring finger.

$$\text{2D:4D Digit Ratio} = \frac{\text{2D Length of index finger}}{\text{4D Length of ring finger}}$$

Facial Measurement

The use of FA as a measure of developmental stability and variation may be an important way in the assessment of level of stress in a given population. This information is scanty in cited literature among Hausa population. Exploring sexual dimorphism in FA may be considered as the rate limiting step in determining which group between males and females is more prone to developmental stress among Hausa population [6].

For each trait, FA was calculated by subtracting the left from the right-side value. The repeatability of the two independent FA measurements was tested using a one-factor, repeated measures ANOVA [7]. Measures were accepted as being repeatable if there was a significantly greater variance between individuals than between the repeated FA measurements of the same individual. Repeatability estimates, based on the interclass correlation of the variance component of the repeated measures ANOVA, were also determined.

Trait that showed significant repeatability can only be accepted as showing FA if the signed asymmetries are normally distributed (as determined by a Shapiro-Wilk test) around a mean of zero (determined by a one-sample t-test with the null hypothesis set to a mean of zero). Absolute mean FA were scaled according to trait size by dividing each one by the average value of the trait measurements. Composite FA was then calculated as the sum of the individual scaled Fas [6].

Step 3

The third part of our study we establish sexual dimorphism of the eye-mouth-eye angle using men's faces (Age of 18 to 35years) and women's faces (Age of 18 to 35years). They were student from college of medicine and health sciences Faculty of Basic Medical Science and Clinical Science of Federal University Dutse between 2018 and 2022. Eye-Mouth-Eye angle are measure with the protractor in the middle of the mouth and arms crossing the center of the pupils. It is measure by the protractor with the accuracy of one degree.

Step 4

The fourth part of our study investigates the relationship between2D 4D ratio, and eye-mouth-eye angle value and eye-mouth-eye bilateral asymmetry. We used the student of Federal University Dutse, Faculty of Basic Medical Science, and clinical Science. The entire student they were also asked to have a neutral expression on their faces. Participants sat on a stool, 150 students measured the angle to assess the level of

asymmetry between the right and left part of the angle. The right part of the angle was measured between the line that started in the midline define by two anthropological point stomiom (middle of the mouth) and nasion similarly, but with the line that ended in the middle of the pupil. Measured the left part of the eye-mouth-eye angle.

Asymmetries were calculated by the difference between the left and the right part of the eye-mouth-eye angle. Whether the distribution of asymmetry is skewed to one of the facial halves (because of the possibility of facial lateralization), subtracted the right part of the angle from left one rather than using the absolute values of this difference, obtain plus value if the right is larger. The facial height and width and the right and left width of the nose and length of the nose were measured. The right and left eye width were also measured. The width and height of the mouth were also measured.

Statistical analysis

The data obtained was transported from Microsoft application (word and excel). Data were expressed as mean ± standard deviation (SD). Student's t-test was used to test for the difference in height, weight, 2D, 4D between female and males. Linear and multiple linear regressions were applied to test the predictive ability of 2D and 4D on height and weight. Statistically significant difference was deemed acceptable at $P < 0.05$. Sigma Stat 2.0 for Windows (Systat Inc., Point Richmond, CA) was used for the statistical analysis.

RESULTS

Table below shows the descriptive analysis of 2D and 4D right and left length. The minimum and maximum ages are 18 and 35 years respectively. The mean of 2D:4D right length was 0.98 ± 0.015 and the mean of 2D:4D left length 0.97 ± 0.022 this shows there is higher mean value in right 2D:4D lengths.

Table 1: Descriptive analysis of 2D:4D ratio among the student of College of Medicine and Health Sciences, Federal University Dutse

Variable	Minimum	Maximum	Mean±SD
Right 2D:4D	0.945	1.032	0.9851± 0.01519
Left 2D:4D	0.933	1.022	0.97706± 0.02213

Table below shows the variation of sexual dimorphism in 2D:4D digit ratio, there is higher mean value in 2D:4D right and there is clear significant differences in both the right and left 2D:4D digit ratio.

Table 2: Sexual Dimorphism in 2D:4D among the student of College of Medicine and Health Sciences, Federal University Dutse

	Mean ± SD			
Variable	Male	Female	t-value	p-value
Right 2D:4D	0.990±0.0156	0.98±0.0121	5.032	0.01
Left 2D:4D	0.978± 0.0141	0.975±0.0285	0.608	0.544

The table below shows the sexual dimorphism in facial asymmetry using eye-mouth-eye angle and there is higher mean value in ASYM-1 of male from the combination of R.EME and L.EME, and there is slightly lower mean value in ASYM-2 of female from the combination of R.EME and L.EME.

Table 3: Sexual dimorphism in facial asymmetry using eye-mouth-eye angle among the student of College of Medicine and Health Sciences, Federal University Dutse

	Mean ± SD			
Variable	Male	Female	t-value	P-value
ASYM	1.0102±0.0385	1.0017±0.0191	1.68	0.094

The table below shows the significant relationship between 2D:4D digit ratio and facial asymmetry which determine that, there is negative or no correlation differences between ASYM and 2D:4D digit ratio.

TABLE 4: Relationship between facial asymmetry (eye-mouth-eye angle) and 2D:4D ratio among the student of College of Medicine and Health Sciences, Federal University Dutse

	ASYM	R. 2D:4D	L. 2D:4D	SEX CD
ASYM	1	0.251	-0.018	-0.137
		0.0021	0.824	0.094
R. 2D:4D		1	0.097	-0.382
			0.239	0
L. 2D:4D			1	-0.05
				0.544
SEX CD				1

DISCUSSION

Digit lengths (the length of 2nd digit otherwise known as index finger and that of the 4th digit also known as ring finger) was measured on the ventral surface of the hand from the basal crease of the digit to the tip of the finger using a digital venier caliper measuring to 0.05mm. In order to reduce observation errors, Digit length measurements were read twice independently and the mean of the two measurements was taken as the actual value. Students with a history of fractures in the fingers or any form of deformity on the digits that could hinder accurate measurement [8].

In a related study by Else vier Churchill Livingstone; 2005 conducted among forensic marker 2D:4D ratio derived from the index and ring finger length in males varied from 0.89 to 1.03 (mean 0.9678 and S.D 0.02224) hand and 0.89 to 1.02 (mean 0.9689 and S.D 0.02582) for the left hand. In female 2D:4D ratio varied from 0.92 to 1.09 (mean 1.0145 and S.D 0.02896) for right hand and 0.92 to 1.09 (mean 1.0142 and S.D 0.02986) for the left hand. Depicts the descriptive statistics range, mean, standard deviation, standard error for2D:4D ratios for both hands and for both sexes. The derived 2D:4D ratio show statistically significant sexual dimorphism at level P <0.001. However no significant difference was found for right and left hands for both the sexes. As found in previous studies [9-10], males had a lower average 2D:4D ratio than females both on the right hand and on the left hand and the mean differences were significant both with a parametric t-test

(2D:4D right hand; males 0.969G0.036, females 0.983G0.034, Tzk2.16, pZ.032, two-tailed; 2D:4D left hand, males 0.965G0.038, females 0.985G0.040, tZK2.89, pZ.004, two-tailed) and a non-parametric permutation test (right hand; pZ.016, left hand; pZ.003).

In related study ratio of 2D:4D (Index finger: Ring finger) has been shown to be more sensitive, despite other digit ratios (3D:5D) displaying sexual dimorphism and relationship to various human phenotypic traits. Existing literature also shows accumulating evidence on 2D:4D ratio showing correlations with various traits in humans.

It is thus considered to be a proxy marker of prenatal androgen exposure. A longer index finger will result in a ratio higher than 1, while a longer ring finger will result in a ratio of less than 1. The second digit is typically shorter in both males and females, while the difference in length of the two digits is greater in males than in females.

In related study Gray, 2004 they examined whether there were any age differences between two sexes. The Mann-Whitney U testevealed no significant age differences between sexes (U=2.278.0, p=0.08). The mean value of the EME angle for women was 50.16◦ (SD=2.71, n=71), and for men it was 47.68◦ (SD=2.42, n=79), and this difference between sexes was significant, (146) = 5.58, p=0.0001. Using Cohen's effect size criterion for interpreting mean differences, (i.e., 0.2=small, 0.5=medium, 0.8=large, we found that this difference was quite large (Cohen's d=0.970).

In previous study we confirmed the results of Frackiewiczs [11] that men and women are sexually dimorphic on the EME angle character, and this difference was quite large (d=0.97). We found that male faces with relatively smaller EME angles Frackiewicz [11] were perceived by women as more attractive. These findings suggest that EME is valuable even in a highly homogenous population.

In accordance with previous reports [10], males had a significantly lower 2D:4D ratio than females on the right hand but no significant sex difference was found on the left hand 2D:4D right hand; males x=0.95F0.02, females x=0.99F0.02, t=7.82, P <.05, 2D:4D left hand, males x=0.96F0.03, females x=0.99F0.02, t=4.92, P <.05. We found that 2D:4D ratio was significantly correlated with facial asymmetry scores in both sexes. Male right-hand 2D:4D ratio corrected significantly negatively with facial asymmetry (r=.260; P=.029). Female right hand 2D:4D ratio correlated significantly positively with facial asymmetry, (r= .228; P=.031). Left hand 2D:4D and facial asymmetry were significantly negative correlated in males (r=.319; P= .009), but there was no significant correlation in females (r= .020; P= .436).

The aim of the previous study was to examine possible relationships between finger length ratio and facial asymmetry in males and females. Male facial asymmetry was negatively correlated with 2D:4D in both hands, but only in

the right hand in females. These relationships probably reflect in utero organizational effects of sex steroids on facial asymmetry rather than adult hormone effects [12].

CONCLUSION

The correlation between 2D:4D digit ratio was observed that the mean value in right 2D:4D of both male and female were higher.

The correlation between the variable was positively higher between 2D:4D ratio of the right and negatively higher between 2D:4D ratio of the left and there was statistically significant difference in both right and left ratio ($p< 0.05$) of both genders.

There was statistically significant different ($p< 0.05$) in the right and left 2D:4D digits ratio and asymmetry (eye-mouth-eye angle) of both gender male and female.

REFERENCES

1. Cheong, Y.W. Facial Asymmetry; Etiology, Evolution, and Management. Chang Gung medical journal, 2011; 34,341.

2. Thornhill R, & Møller AP. (1997). Developmental stability, disease and medicine. Biol Rev. Camb Philos Soc.72:497-548. https://doi.org/10.1017/S0006323197005082 PMid:9375532

3. Danel D, Pawlowski B. Eye-mouth-eye angle as a good indicator of face masculinization, asymmetry, and attractiveness (Homo sapiens). Journal of Comparative Psychology. 2007; 121(2):221. https://doi.org/10.1037/0735-7036.121.2.221 PMid:17516801

4. Langner O, Dotsch R, Bijlstra G, Wigboldus DH, Hawk ST, Van Knippenberg AD. Presentation and validation of the Radboud Faces Database. Cognition and emotion. 2010; 24(8):1377-88. https://doi.org/10.1080/02699930903485076

5. Kowner R. Facial asymmetry and attractiveness judgement in developmental perspective. Journal of Experimental Psychology: Human Perception and Performance. 1996 Jun; 22(3):662. https://doi.org/10.1037/0096-1523.22.3.662 PMid:8666958

6. Adamu LH, Ojo SA, Danborno B, Adebisi SS, Taura MG. Sex differences in Facial asymmetry indices among Hausa ethnic group of Nigeria. Anthropological Bioanthropology, 2016; 4:105-10. https://doi.org/10.4103/aoba.aoba_32_16

7. Palmer AR, Strobeck C. Fluctuating asymmetry analysis revisited. In: Polak M, editor. Developmental stability: Causes and consequences. New York: Oxford University Press. 200; 279-319.

8. Rayyan MK, Ramatu S, Ibrahim AA. DUJOPAS4, 2018; (1)446-455.

9. Manning JT, Fane BA, Breedlove S. The second to fourth digit ratio and variation in the androgen receptor gene. Evol Hum Behav, 1998; 24:399-405. https://doi.org/10.1016/S1090-5138(03)00052-7

10. Manning JT. Digit ratio: A pointer to fertility, behavior and health. New Brunswick, NJ: Rutgers University Press. 2002.

11. Frackiewicz W. The aesthetics of the eyes and mouth position in three- spoint face schema. Prze glad Anthropologic-Anthropological R., 2001; 64:93. https://doi.org/10.18778/1898-6773.64.07

12. Fink B, Manning JT, Neave N, Grammer K. Second to fourth digit ratio and facial asymmetry. Evolution and Human Behavior. 2004; 25(2):125-32. https://doi.org/10.1016/S1090-5138(03)00084-9