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Assessment of the Relationship between Digit Lengths and Circumferences of the Waist and Hip Amongst Ugandans

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Abstract: In human hand the second Digit (2D) and the fourth Digit (4D) present a pattern of approximate symmetry around the central axis of the third digit. Many individuals have longer 2D than 4D ($2D \geq 4D$) and many have longer 4D than 2D ($2D < 4D$). The former ratio is more common in females and the later ratio is more in males. The 2D:4D ratio is fixed at an early age. There is evidence that 2D:4D is negatively associated with prenatal testosterone and positively with prenatal estrogen and that this ratio differs between male and female and different ethnic groups, with low values found in Black populations. This study sought to assess the relationship between sexually dimorphic traits established early in life and those established at puberty amongst Ugandans in Ishaka Bushenyi. One sixty nine males and one fifty four females Ugandans in Bushenyi district were used for this study. Anthropometric tape was used to measure waist and hip circumferences, a digital venier caliper was used to measure the lengths of the digit. Using Pearson's correlation, the lengths of the right index or second finger in females was found to have a positive correlation with the hip circumference while the length of the ring or fourth finger in the males was found to have a positive correlation with the waist circumference. This suggests that the lengths of the digit established early in life are positively correlated with the increased waist circumference in males and increased hip circumference in females that occur at puberty. Implying that the sexually dimorphic traits that appear in life during puberty under the influence of testosterone and estrogen is positively correlated with the sexually dimorphic traits that appear early in life due to prenatal exposure to the androgen.

Keywords: Digit ratio, dimorphic, finger lengths, sexually, traits, waist hip ratio

INTRODUCTION

In human hands the second Digit (2D) and the fourth Digit (4D) present a pattern of approximate symmetry around the central axis of the third digit. However, there is considerable variation in the ratio of the length of the second digit to the fourth digit (2D:4D). Many individuals have longer 2D than 4D ($2D \geq 4D$) and many have longer 4D than 2D ($2D < 4D$), the former ratio is more common in females and the later ratio is more in males and the 2D:4D ratio is fixed at an early age (Manning *et al.*, 2000). Testosterone, particularly prenatal testosterone, has been implicated in the etiology of many extra genital sexually dimorphic traits. It is difficult to test directly for the effect of prenatal testosterone in humans. However, (Manning *et al.*, 1998) showed that the ratio of the length of the second and fourth digits (2D:4D) in right hands negatively predicts testosterone levels in men. As digit ratios are fixed *in utero* it may be that the 2D:4D ratio is associated with many prenatally determined sexually

dimorphic traits. There is evidence that 2D:4D is negatively associated with prenatal testosterone and positively with prenatal estrogen (Manning *et al.*, 2003). The ratio between the length of the second or index finger and the fourth or ring finger (2D:4D) differs between the sexes, such that males have lower 2D:4D than females and shows considerable geographical/ethnic differences, with low values found in Black populations (Stewart *et al.*, 2004). Manning *et al.* (2004) and colleagues in have shown that 2D:4D ratios vary greatly between geographical location and different ethnic groups and that this variation is far larger than the differences between sexes. Similarly during puberty, there is a burst of both testosterone and estrogen that is responsible for sexual maturation. Several body changes accompany puberty in both males and females some of which is broadening of waist and hip in male and female, respectively. All these changes in body configuration are due to presence or absence of testosterone and estrogen, respectively. Males generally have a larger waist circumference than females while

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females have a larger hip circumference than males and these differences are also influenced by testosterone and estrogen at puberty (William and Jack, 2005).

According to (Singh, 2002), the ratio of the circumference of the waist to that of the hip is called the Waist Hip Ratio (WHR). A WHR of 0.7 for women and 0.9 for men have been shown to correlate strongly with general health and fertility. Women within the 0.7 range have optimal levels of estrogen and are less susceptible to major diseases such as diabetes, cardiovascular disorders and ovarian cancers. Men with WHRs around 0.9, similarly, have been shown to be more healthy and fertile with less prostate cancer and testicular cancer.

The aim of this study is to assess the relationship between sexually dimorphic traits established early in life and those established at puberty (since the traits are under the influence of testosterone and estrogen) amongst Ugandans in Ishaka Bushenyi.

MATERIALS AND METHODS

Study design: It is a cross sectional descriptive study with quantitative data which was obtained from data forms used to collate measurement from the study participants.

Study area: The study was carried out among adolescent youth in Ishaka-Bushenyi town council, Igara County; Bushenyi district in western Uganda. It is bordered by Mbarara district in the East, Ntungamo district in the South West, Kasese and Kamwengye districts in the north.

Study population: Bushenyi district has a total population of 25,450 both male and females and 7231 number of youths ranging between 15 to 30 years old (Ugandan Bureau of Statistics, 2008). Therefore 7231 were taken as the study population.

Sampling method: Simple random sampling was used to randomly select 323 participants for this study.

Inclusion criteria: Participants must be within age group 15 to 30. Participants must be Ugandan and consent to the study.

Exclusion criteria: Individuals who were observed to have any injury or deformity in the region of the body concerned were excluded from the study.

Data collection procedure: Materials used for this study include; a digital vernier caliper, anthropometric tape and data forms.

The length of the second Digit (2D) and fourth Digit (4D) of the left and right hand of each subject was measured with the aid of a digital vernier caliper from the tip of the digit to the ventral proximal crease.

Where there is a band of crease at the base of the digit, the most proximal crease was used Manning *et al.* (1998). Using the method used by Singh (2002), Hip circumference was measured with the anthropometric tape at the level of the greater trochanters with the legs close together, the waist circumference was measured with the anthropometric tape at the smallest circumference of the natural waist, usually just above the belly button. For ethical consideration, a female research assistant was responsible for taking measurements on the female participants. All measurements were made twice with digits fully extended and the subject in an anatomic position. The average of the two measurements was taken and statistically analyzed.

The Aim and the justification of the research were explained to participants before their informed consent was sought to participate in the research.

Ethical consideration: This research was conducted in accordance with the local requirements and approved by the school of Post graduate studies and research ethics committee of Kampala International University.

Statistical analysis: The data obtained were statistically analyzed by a statistician using Statistical Package for Social Sciences (SPSS) version 17. The data also were subjected to Pearson's correlation so as to assess the relationship between the lengths of the second digit, fourth digit and waist and hip circumferences.

RESULTS

Table 1 shows a correlation values between the lengths of the second and fourth digits and the hip and waist circumferences in both males and females.

The values of the waist and hip circumferences, the lengths of the second digit and the fourth digit were measured in centimetres and the second to fourth digit ratio and waist hip ratio were determined and expressed as mean \pm standard deviation as shown in Table 2.

Table 1: The coefficient of correlation between Hip circumferences, waist circumferences and lengths of the index and ring fingers for both hands in males and females

Parameter	Females				Males			
	Right finger second	fourth	Left finger second	fourth	Right finger second	fourth	Left finger second	fourth
Waist circumference	+0.16	+0.09	+0.12	+0.12	+0.16	+0.30**	+0.13	+0.30**
Hip circumference	+0.30**	+0.09	+0.14	+0.10	+0.10	+0.19	+0.10	+0.22

** : Indicates a significant correlation

Table 2: Waist and hip circumferences, Waist Hip Ratio (WHR), digit ratio, expressed in mean±standard deviation

Parameters	Waist circumference (cm)	Hip circumference (cm)	WHR	Right 2D:4D	Left 2D:4D
Male	75±6.6	90±6.8	0.85±0.08	0.94±0.08	0.95±0.07
Female	73±9.6	95±9.4	0.76±0.09	1.00±0.69	0.97±0.04

DISCUSSION

The goal of this study was to assess the relationship between sexually dimorphic traits established early in life and those established at puberty amongst Ugandans in Ishaka Bushenyi. Here we used the finger or digit lengths that are established early in life and the increased waist and hip circumferences that are established at puberty. At $p < 0.05$, in Table 1, the right second digit in females were found to have a positive correlation with the hip circumference. This suggests that the longer second digit found in most females is positively associated with the increased size of the hip that occurs at puberty. A very weak positive correlation was seen when the waist and hip circumferences were correlated with the lengths of the right fourth, the left second and fourth digits, suggesting that prenatal estrogen influences the right second digit positively in females (Manning *et al.*, 2003) and that this effect has a positive correlation with the increased circumference of the hip that occurs later in life in the females. In the same line, the right and left fourth digits in males were found to have a positive correlation with the waist circumference, suggesting that the longer fourth digit in males is positively associated with the increased size of waist that occurs at puberty. A very weak positive correlation was seen when the right and left second digits were correlated with the waist and hip circumferences.

Table 2 shows the waist hip ratio of male and female youths in Bushenyi to be 0.85 and 0.76, respectively. This value is slightly lower than the values (0.9) in male and higher than the value (0.7) in females given by Singh (2002).

The waist and hip circumferences were found to be 75 and 90, 73 and 95 cm for male and female, respectively which agree with the findings of Wahrenberg and Hertel (2005).

Comparing the result in Table 1 and 2, suggests that the increase in the circumference of the hip in female is correlated positively with the longer second digit while the higher waist circumference in males is positively correlated with longer fourth digit.

CONCLUSION

The goal of this study was to assess the relationship between sexually dimorphic traits established early in life and those established at puberty amongst Ugandans in Ishaka Bushenyi. Here we used the finger or digit lengths that are established early in life and the increased waist and hip circumferences that are established at puberty. When the length of the right second digit in female, showed a positive correlation with the hip circumference and the fourth digit in the male also showed a positive correlation with the waist circumference. Suggesting that the lengths of the fourth digit that is established early in life has a positive correlation with the increased waist circumference that occur later in life in males for both hands and the lengths of the second digit has a positive correlation with the increased hip circumference that occur at puberty in females.

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