

Original article

Relationship between second toe length and androgen-linked behaviours among students of Delta State University, Abraka, Nigeria

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Abstract:

Background: During the formation of the limbs, a simultaneous production of androgens occurs. It has also been noticed that when genetic process is inhibited, it can lead to complications affecting the limbs. It is therefore believed that testosterone influences the development of the limbs. **Aim:** This study therefore looked at the association between second toe length and androgen linked behaviours. **Materials and Method:** Three hundred (166 males and 134 females) subjects who were students of Basic Medical Sciences, Delta State University, Abraka aged 18 and above, were selected using the cross-sectional descriptive study design. Second toe length was observed, standardize questionnaire on handedness, competition and aggregation was administered to students. Data obtained were analyzed with Statistical Package for Social Sciences. **Results:** This study established a significant association between 2nd toe length and some androgen linked behaviours. Significant association between subjects with longer 2nd toe and competitiveness was observed ($p < 0.05$) as well as aggressive behavior. **Conclusion:** From this study, it was deduced that androgens influence 2nd toe length and 2nd toe length also influences androgen linked behaviours such as competition and aggression.

Keywords: Androgen; limbs; toe; intrauterine; competitive

*Bangladesh Journal of Medical Science Vol. 20 No. 04 October '21. Page : 779-783
DOI: <https://doi.org/10.3329/bjms.v20i4.54134>*

Introduction

Feet development which begins in-utero is derived mainly from mesenchyme which is a basic embryological tissue.¹ The buds of the lower limb appear around the 4th embryonic week, slightly later than the upper limb buds.¹

At about eight to thirteen weeks of intrauterine life, the fingers, toes and genitalia are formed,^[2] with the regulation of homeobox gene complex.² It has been noticed that when this genetic process is inhibited, it can lead to complications affecting the limbs and genitalia.³

Another critical event taking place at this period of formation of the limbs and genitalia is the production of testosterone.^{4,5} It is therefore deduced that

testosterone influences the development of the limbs and genitalia.⁶ Therefore, testosterone related events such as behaviours, traits and cognitions may have a direct effect on the finger and toe length⁷. Studies have shown that second and fourth digit ratios are mostly affected by being exposed to testosterone in-vivo.

Androgens especially testosterone in-utero has been noticed to influence handedness, fingers development, lengthening of fourth finger (in males) and lengthening of second finger (in females).^{6,8} Several literatures have established the influence of fetal androgens in neurobehavioural development and sexual dimorphism.^{9,10,11} It has also been deduced that digit ratios can be used to determine the performance of music, sports and other behaviours.⁵

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There is therefore a possible link between prenatal androgen and second toe length as evidence has shown, which means that a longer toe length will be very much related to characteristics and behaviours which has been previously linked to androgens (testosterone).⁷ However, this present study focused on the association between second toe length and androgen-linked behaviours among students of Basic Medical Science, Delta State University, Abraka.

Materials and Methods

The study involved 300 (166 males and 134 females) subjects who are students in the Faculty of Basic Medical Sciences, Delta State University, Abraka, aged 18 and above. They were selected using the cross-sectional descriptive study design. Only students with no visible deformity of the foot, no history of trauma, fractures or surgery in the foot were allowed to participate in the study. Data collection sheet bore record of subjects' sex, age and 2nd toe length. Also, a well detailed questionnaire was used to obtain self-reports of diverse behaviours and traits that were related to androgen linked behaviours, such as left handedness, competition, aggression and exercise.

- In determining length of the second toe, participants were asked if their second toe is longer than all their other toes. They were provided with a graphical description, for them to understand the question properly before answering. The researcher also made personal observation of their toes.
- On handedness, the study adopted the Edinburgh handedness inventory Oldfield method of 1991 (hand preference in writing, throwing, brushing teeth and eating).
- Competition was tested using competitiveness orientation inventory.¹²
- On Aggregation, questionnaire constructed by Buss and Perry¹³, was adopted

Data obtained from the study were analyzed using International Business Machine software, Statistical Package for Social Sciences (SPSS) version 23. The percentage frequency distribution and Chi-square were used to show results. Tables were used to explain the results from the study.

Ethical approval: Ethical approval was sort and obtained from the Ethical Committee, Faculty of

Basic Medical Sciences, Delta State University, Abraka, with Ref no: DELSU/CHS/ANA/18/23.

Results

It was revealed from this study that of the three hundred (300) subjects involved in the study, one hundred and sixty-six (166) were males while one hundred and thirty-four (134) were females. Among all subjects, 142 (47.3%) subjects had longer 2nd toe length. The respondents fall into the following age group in descending order: 18-22 years (40.0%), 23-28 years (26.7%), 29-33 years (13.3%), below 18 years (11.7%), and >33 years (8.3%).

Table 1 showed that most of the respondents had no hand preference in writing (50.0%), throwing (50.7%), brushing teeth (44.3%) and eating 133(44.3%).

From table 2, it is seen that most of the respondents (34.3%) agreed that they like competition, have a competitive nature (35.0%), enjoy competition (30.3%), get satisfaction from competition (28.0%), dread competition (23.0%), outperform others (36.0%). Furthermore, only a few of the respondents (34.3%) strongly agreed that they avoid competition. However, most of the respondents strongly disagreed that they hate competition (25.0%) and unpleasant competitive environment (24.7%).

From table 3, it was deduced that most of the respondents (34.3%) said that their friends do not think they are hot headed, fairly often resort to violence in order to protect their rights (30.3%), from time to time they openly tell their friends when they disagree with them (50.0%), they often get into arguments with people when they disagree with them (30.3%), they fairly often wonder why sometimes they feel bitter about things (36.7%), they fairly often can't control the urge to strike another person once in a while (35.7%), they are fairly often even tempered(40.7%), they fairly often flare up but they get over it quickly (31.7%), they fairly often have trouble controlling their temper (31.7%), and they fairly often are frustrated when their irritation shows (36.7%).

A significant association existed between subjects with a 2nd toe that is longer and competitive behaviour ($p=0.001$, table 4). Also, a significant association was seen between subjects with extended 2nd toe length and aggressive behaviour ($p=0.001$, table 5).

Table 1: Left hand preferences in writing, throwing, brushing teeth and eating

Statements	Strong preference (%)	Preference (%)	No preference (%)	Total (%)
Hand Preference in Writing	78(26.0)	72 (24.0)	150(50.0)	300(100.0)
Hand Preference in Throwing	73(24.3)	75 (25.0)	152(50.7)	300(100.0)
Hand Preference in Brushing Teeth	65(21.7)	102(34.0)	133(44.3)	300(100.0)
Hand Preference in Eating	71(23.7)	96(32.0)	133(44.3)	300(100.0)

Table 2: Prevalence of competitiveness among respondents

Statements	Strongly Disagree (%)	Disagree (%)	Neither Disagree nor Agree (%)	Agree (%)	Strongly Agree (%)
Like Competition	50 (16.7)	67(22.3)	20 (6.70)	103(34.3)	60 (20.0)
Has a Competitive Nature	42 (14.0)	63(21.0)	28 (9.30)	105(35.0)	62 (20.7)
Enjoy Competition	53 (17.7)	57(19.0)	38 (12.7)	91 (30.3)	61 (20.3)
Hate Competition	75 (25.0)	72(24.0)	33 (11.0)	74 (24.7)	46 (15.3)
Gets Satisfaction from Competition	53 (17.7)	51(17.0)	38 (12.7)	84 (28.0)	74 (24.7)
Unpleasant Competitive environment	74 (24.7)	62(20.7)	42 (14.0)	70 (23.3)	52 (17.3)
Dread Competition	62 (20.7)	80(26.7)	62 (20.7)	80 (26.7)	16 (5.30)
Avoids Competition	61 (20.3)	60(20.0)	62 (20.7)	69 (23.0)	48 (16.0)
Try to Outperform Others	28 (9.30)	40(13.3)	54 (18.0)	108(36.0)	70 (23.3)

Table 3: Prevalence of aggression among respondents

Statements	No (%)	Rarely (%)	Often (%)	Fairly Often (%)	Yes (%)
Friends think I'm hot headed	83(27.7)	48(16.0)	53(17.7)	63 (21.0)	53(17.7)
Will result to Violence to protect my right	59(19.7)	55(18.3)	47(15.7)	91 (30.3)	48(16.0)
Openly disagree with friends	17 (5.7)	35(11.7)	150 (50)	54 (18.0)	44(14.7)
Always get into argument	32(10.7)	91(30.3)	50(16.7)	90 (30.0)	37(12.3)
Wonder why I feel bitter about things	34(11.3)	52(17.3)	57(19.0)	10 (36.7)	47(15.7)
Can't control the urge to strike another person	71(23.7)	90(30.0)	32(10.7)	107(35.7)	31(10.3)
I'm even tempered	51(17.0)	70(23.3)	26 (8.7)	122(40.7)	31(10.3)
Flare up quickly but get over it quickly	50(16.7)	70(23.3)	25 (8.3)	95 (31.7)	60 (20.0)
Trouble controlling temper	61(20.3)	57(19.0)	3 (11.0)	95 (31.7)	54 (18.0)
Frustrated when irritation show	40(13.3)	51(17.0)	30(10.0)	110 (36.7)	69 (23.0)

Table 4: Relationship between 2ndToe length and competitive behaviour

Longer 2 nd toe	No (%)	Rarely (%)	From time to time (%)	Fairly often (%)	Yes (%)	P-Value
Yes	51 (100.0)	70(100.0)	21 (80.8)	0 (0.0)	0(0.0)	
No	0 (0.0)	0 (0.0)	5 (19.2)	122(100.0)	31(100.0)	0.001
Total	51 (100.0)	7(100.0)	26 (100.0)	122(100.0)	31(100.0)	

Table 5: Relationship between 2ndToe length and aggressive behaviour

Longer 2 nd toe	No (%)	Rarely (%)	From time to time (%)	Fairly often (%)	Yes (%)	P-Value
Yes	61 (100.0)	57 (100.0)	24 (72.7)	0 (0.0)	0 (0.0)	
No	0 (0.0)	0 (0.0)	9 (27.3)	95 (100.0)	54 (100.0)	0.001
Total	61 (100.0)	57 (100.0)	33 (100.0)	95 (100.0)	54 (100.0)	

Discussion

As regards competitive behavior in this present study, most of the respondents agreed that they like competition, have a competitive nature, enjoy competition, get satisfaction from competition, dread competition and try to outperform others. Furthermore, a few of the respondents strongly agreed that they avoid competition. However, most of the respondents strongly disagreed that they hate competition and unpleasant competitive environment (table 2).

The findings of this study as regards competitive behavior is not in line with that of Millet et al.,¹⁴ who reported that low digit ratio has been correlated to a number of fitness related factors including high status in competitive sports. Honekopp et al., also reported that 2nd:4th digit has been negatively associated to physical fitness in both men and women.¹⁵ whereas, a study by Umarani¹⁶ showed that majority of the students responded that they always ask with their friends whenever they don't understand in class and thus makes it competitive in their learning process.

From table 3, it is shown that most of the respondents said that their friends do not think they are hot headed, fairly often fall back to violence to protect their rights, from time to time they openly tell their friends when they disagree with them, rarely can't help getting into arguments when people disagree with them, fairly often wonder why sometimes they feel bad about things, fairly often can't control the urge to strike another person once in a while, fairly often even tempered, fairly often flare up but they get over it quickly, fairly often they have trouble controlling their temper, and fairly often are frustrated when their irritation shows. These findings were not similar with that of Wilson¹⁷, who found that women with low 2nd digit:4th digits are likely to rate themselves as more competitive and assertive

than women with high ratios; Bailey and Hurd¹⁸, also reported that men with more masculine finger length ratio had higher trait of physical aggression scores. These differences seen could have been due to differences in the population studied.

This study showed that the relationship between subjects with an extended 2nd toe and competitive behavior is statistically significant ($p < 0.05$, table 4). This research also showed that there was a significantly significant correlation between subjects with 2nd toe that is longer and aggressive behaviour ($p < 0.05$, table 5). These findings were similar to that of Marissa,⁷ who reported that there was a statistical relationships between a longer 2nd toe and a competitiveness; Evardone and Alexander,¹⁹ reported that there is no statistical significant association between digit ratio and anxiety ($p > 0.05$); Manning and Hill,²⁰ reported that associations between 2nd digit:4th digit and sprinting speed were not as strong as those reported for endurance running; Kilduff et al., also reported that right 2nd digit:4th digit was negatively correlated with coaches' ratings and the competition result.²¹

Conclusion

This study establish an association between the length of second toe and some behaviors that are linked to androgen since there was a significant association between subjects with a longer 2nd toe and competitive behavior ($p < 0.05$). This study also showed that the association between subjects with aggressive behavior and second longer toe is statistically significant ($p < 0.05$).

Source of Fund: Nil

Conflicts of Interest: Nil

Authors' contribution

All authors read and contributed to the manuscript.

References:

1. Evans A. Paediatrics; the pocket podiatry guide; Churchill Livingstone Elsevier. ISBN 2010; 978-0-7020-3031-4.
2. Zakany J, Fromental-Ramain C, Warot X, DuBoule D. Regulation of number and size of digits by posterior Hox genes: A dose-dependent mechanism with potential evolutionary implications. *Proceedings of the National Acad of Sci.* 1997; **94**:13695-13700. <https://doi.org/10.1073/pnas.94.25.13695>
3. Innis J. Hand-foot-genital syndrome. In R. Pagon et al. (ed.), Gene reviews. Seattle, WA: University of Washington 2006; Retrieved from <http://www.ncbi.nlm.nih.gov/ezaccess/libraries/psu.edu/bookshelf/br.fcgi?bookgene&part=hfg>.
4. Garn S, Burdi A, Babler W, Stinson S. Early prenatal attainment of adult metacarpal phalangeal rankings and proportions. *American J of Phys Anthropol.* 1975; **43**:327-332. <https://doi.org/10.1002/ajpa.1330430305>
5. Manning JT. Digit ratios: a pointer to fertility, behavior, and health. Rutgers University Press, New Brunswick. 2002; 4:1201-1207.
6. Manning J, Scutt D, Wilson J, Lewis-Jones DI. The ratio of the 2nd and 4th digit length: A predictor of sperm numbers and concentrations of testosterone, luteinizing hormone and oestrogen. *Human Reprod.* 1998; **13**: 3000-3004. <https://doi.org/10.1093/humrep/13.11.3000>
7. Marissa A. Harrison. An exploratory study of the relationship between second toe Length and androgen linked behaviors. *J of Social, Evol, and Cult Psych.* 2010; **4**(4); 1933-5377. <https://doi.org/10.1037/h0099286>
8. Manning JT, Taylor RP. Second to fourth digit ratio and male ability in sport: implications for sexual selection in humans. *Evol and Hum Behav.* 2001; **22**: 61-69. [https://doi.org/10.1016/S1090-5138\(00\)00063-5](https://doi.org/10.1016/S1090-5138(00)00063-5)
9. Phoenix CH, Goy RW, Gerall AA, Young WC. Organizing action of prenatally administered testosterone propionate on the tissues mediating mating behavior in the female guinea pig. *Endoc.* 1959; **65**:369-382. <https://doi.org/10.1210/endo-65-3-369>
10. Morris JA, Cynthia LJ, Marc B. Sexual differentiation of the vertebrate nervous system. Neuroscience Program, Michigan State University, East Lansing, Michigan 48824, USA Published online 27 September 2004; doi:10.1038/nm1325. <https://doi.org/10.1038/nm1325>
11. Hines M, Mihaela C, Debra S. Early androgen exposure and human gender development. *Bio of Sex Differ.* 2015; **6**:3. <https://doi.org/10.1186/s13293-015-0022-1>
12. Gill DL, Betty C, Jeffery, JM. A Comparison of Competitive-Orientation Measures. *J of Sport & Exer Psych.* 1986; **8**:266-280. <https://doi.org/10.1123/jsep.13.3.266>
13. Buss AH, Perry, M. The Aggression Questionnaire. *J of Persona and Social Psycho.* 1992; **63**:452-459. <https://doi.org/10.1037/0022-3514.63.3.452>
14. Millet K, Dewitte S. Second to fourth digit ratio and cooperative behavior. *Biolog Psycho.* 2006; **71**:111-115. <https://doi.org/10.1016/j.biopsycho.2005.06.001>
15. Honekopp J, Manning J, Muller C. Digit ratio (2nd Digit:4th Digit) and physical fitness in males and females: Evidence for effects of prenatal androgens on sexually selected traits. *Horm and Behav.* 2006; **49**:545-549. <https://doi.org/10.1016/j.yhbeh.2005.11.006>
16. Umarani J. Do the students have attitude to seek academic help? - a study among undergraduate students. *Bangladesh J of Med Sci.* 2020; **19**(4):717-721. <https://doi.org/10.3329/bjms.v19i4.46631>
17. Wilson G. Finger length as an index of assertiveness in women. *Persona and Individual Differ.* 1983; 4:111-112. [https://doi.org/10.1016/0191-8869\(83\)90061-2](https://doi.org/10.1016/0191-8869(83)90061-2)
18. Bailey AA, Hurd PL. Finger length ratio (2nd Digit: 4th Digit) correlates with physical aggression in men but not in women. *Biological Psychology* 2005; Available on line at www.sciencedirect.com. <https://doi.org/10.1016/j.biopsycho.2004.05.001>
19. Evardone M, Alexander GM. Digit length ratios predict anxiety in women, but not in men. *Horm Behavi.* 2007; **49**:161-174.
20. Manning JT, Hill MR. Digit ratio (2nd Digit:4th Digit) and sprinting speed in boys. *American J of Hum Biol.* 2009; **21**:210-213. <https://doi.org/10.1002/ajhb.20855>
21. Kilduff LP, Cook CJ, Manning JT. Digit Ratio (2nd Digit:4th Digit) and performance in male surfers. *J of Strength Conducting Res.* 2011; **25**:3175-3180. <https://doi.org/10.1519/JSC.0b013e318212de8e>