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Relationship between Second to Fourth Digit Ratio (2D:4D), Systemization and Empathy in Asholio Ethnic Group of Kaduna State, Nigeria

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ABSTRACT

The ratio of 2nd to 4th digit length (2D:4D), systemizing quotient (SQ) and empathizing quotient (EQ) are commonly put forth as correlates of prenatal testosterone. This present study investigated the relationship between (2D:4D), systemizing quotient (SQ) and empathizing quotient (EQ) of Asholio ethnic group in Kaduna state. Digit lengths of the second and fourth fingers were directly measured from the proximal crease to the tip of the finger using vernier caliper. SQ and EQ were assessed in 300 participants of the ethnic group containing both males and females. All participants consented to the study. SQ and EQ were assessed in 300 participants of the ethnic group consisting of both males and females, using a questionnaire of 120 questions. Digit lengths of the second and fourth fingers were directly measured from the proximal crease to the tip of the finger using vernier caliper. The figures for 2D and 4D were obtained were computed by dividing 2D by 4D. In order to establish the repeatability of measurements taken, each finger of both hands was measured twice. Data were expressed as mean \pm SD, Pearson correlation was used to assess any association. *P* value was set at $P < 0.05$ using Statistical Package for Social Sciences (SPSS) version 20. Questionnaires administered had ethical approval obtained from the university ethical approval committee. Data were expressed as mean \pm SD and association checked using Pearson correlation, *P* value set at < 0.05 using SPSS version 20. Digit ratio was found to be significantly lower in males than females Significant negative correlations exist between. SQ and 2D:4D and this being stronger for right hand 2D:4D (right $r = -0.47$, left; $r = -0.32$, $P < 0.05$). Generated predictive equation is stronger on the right hand. This study has demonstrated the association between 2D:4D, SQ and EQ. SQ could be predicted most especially from the right hand.

Key-words: 2D:4D, Systemizing, Empathizing and Asholio

INTRODUCTION

Digit ratios are determined in utero and will then remain the same without change during individual development.^[9] There are morphological and behavioural traits that may serve as markers for prenatal testosterone (PT). Baron-Cohen proposed two different styles of behavior (thinking) namely, systemizing and empathizing^[3]. Whereas Systemizing is the drive to analyze and explore a system, Empathy is the drive to identify the thoughts and emotions of others and respond appropriately.^{[3] [4]} With regard to behaviour, systemizing (systemizing quotient, SQ) and empathizing (empathy quotient, EQ) have been

reported to correlate positively SQ^[2] and negatively EQ^[6] with PT. The present studies aim at investigating the relationship of 2D:4D ratio to SQ and EQ in sample population of Asholio ethnic group in Kaduna state, Nigeria.

MATERIALS AND METHODS

Data for this study were obtained from 300 student participants of Asholio ethnic group. They are the native of Kaura local government area of Kaduna state, shown in figure 1.

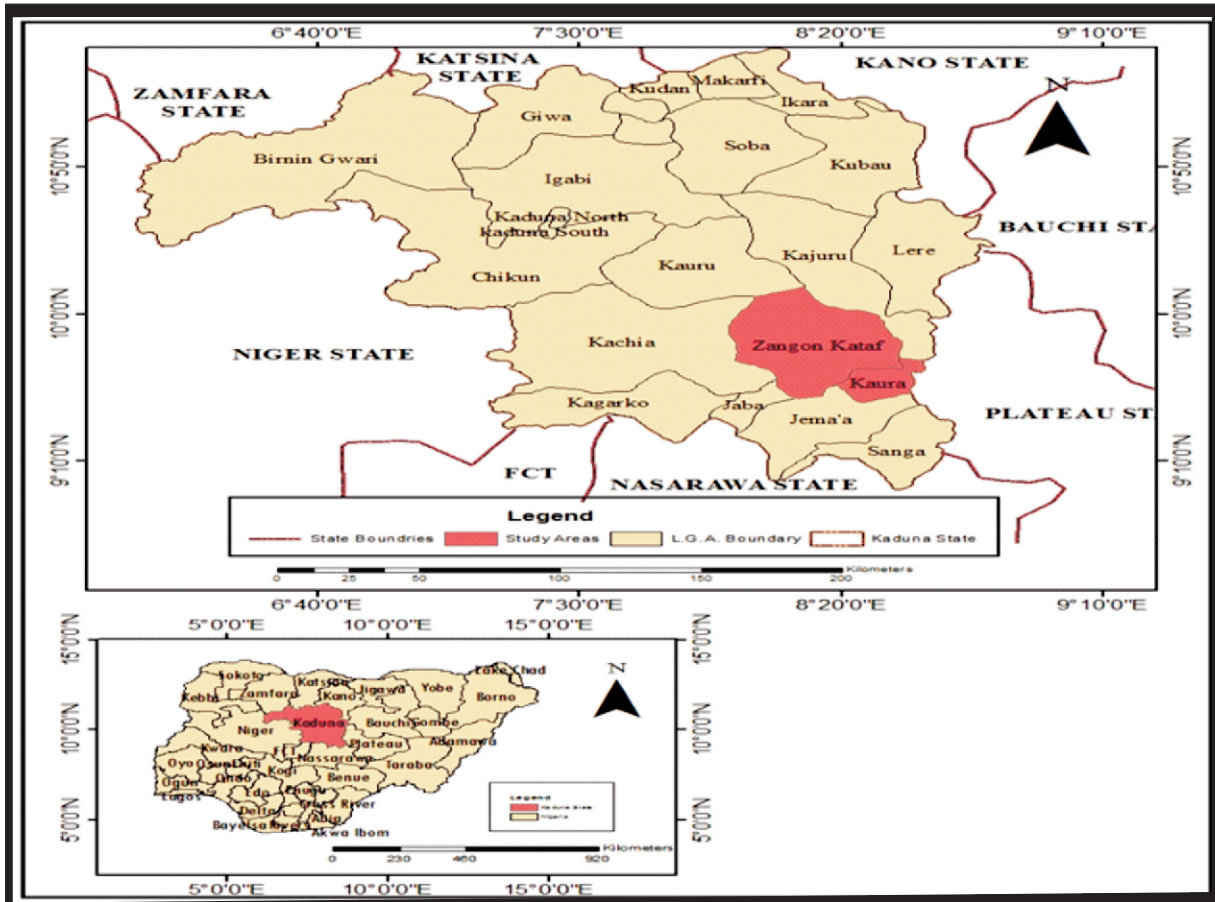


Figure 1: Geographical location of sample population

An informed verbal and written consent was sought from the students who were between eighteen years old and above and willing to participate in the survey. Participants were made to complete a self-administered questionnaire. Systematic sampling method was used to select 300 students of both sexes. Participants who reported injuries to their 2D, 4D digits were excluded from the study. The length of the right and left 2nd and 4th digits was measured from the proximal crease of the palm to the tip of the digit, using Vernier calliper measuring to 0.01 mm. The 2D and 4D digits from these subjects were measured twice. Systemizing quotient (SQ) and empathizing quotient (EQ) questionnaire,^[4] was used to

determine the degree of systemizing and empathizing of participants. Questionnaire consists of 60 items each, taken from the full version of this test by Baron-Cohen was administered to the participants. For the SQ questionnaire, the following items were scored two points for 'strongly agree' responses and one point for 'slightly agree' responses: 1, 4, 5, 7, 13, 15, 19, 20, 25, 29, 30, 33, 34, 37, 41, 44, 48, 49, 53, 55. The following items were scored two points for 'strongly disagree' responses and one point for 'slightly disagree' responses: 6, 11, 12, 18, 23, 24, 26, 28, 31, 32, 35, 38, 40, 42, 43, 45, 51, 56, 57, 60 as shown in Table 1

Table 1. Excerpt of SQ test questionnaire

The Systemizing Quotient

Please tick (?) one box ONLY per line

Questions	Strongly agree	Slightly agree	Slightly disagree	Strongly disagree
1. When I listen to a piece of music, I always notice the way it's structured				
2.I adhere to common superstitions				
3.I often make resolutions, but find it hard to stick to them				
4.I prefer to read non-fiction than fiction.				
5.If I were buying a car, I would want to obtain specific information about its engine capacity.				

For the EQ questionnaire, the following items were scored two points for 'strongly agree' responses and one point for 'slightly agree' responses: 1, 6, 19, 22, 25, 26, 35, 36, 37, 38, 41, 42, 43, 44, 52, 54, 55, 57, 58, 59, 60. The following items were scored two points for 'strongly disagree' responses and one point for 'slightly disagree' responses: 4, 8, 10, 11, 12, 14, 15, 18, 21, 27, 28, 29, 32, 34, 39, 46, 48, 49, 50, as shown in Table 2.

Table 2. Excerpt of EQ test questionnaire

The Empathizing Quotient
Please tick (?) one box ONLY per line

Questions	Strongly agree	Slightly agree	Slightly disagree	Strongly disagree
1. I can easily tell if someone else wants to enter a conversation.				
2. I prefer animals to humans.				
3. I try to keep up with the current trends and fashions.				
4. I find it difficult to explain to others things that I understand easily, when they don't understand it first time.				
5. I dream most nights.				

Based on the total score for the EQ questionnaire, those scoring ranging from 0-32 are categorized as low in empathizing, typical of individuals with high-functioning autism. Scores ranging from 33-52 are described as average, 53-63 are above average, and 64-80 are very high.^[2] Based on the total score for the SQ questionnaire, those scoring between 0-19 are categorized as low in systemizing and 20-39 are average. Scores ranging from 40-50 are categorized as above average, typical of individuals with high-functioning autism. Scores between 51 - 80 are categorized as very high in systemizing. Data were expressed as mean ± SD, Pearson correlation was used to assess any association. *P* value was set at *P* < 0.05 using Statistical Package for Social Sciences (SPSS) version 20.

RESULTS

Table 3 shows right hand digit ratio of participants is lower than the left hand (Males n=150 and Females n=150) with a mean (±SD) age of 25.00 ± 5.19 years. Figure 2 shows sexual dimorphism SQ higher in males than females while EQ is higher in females than males.

Table 3: Descriptives of Asholio ethnic group population

	Overall (n=300)		Min-Max
	Mean	SD	
Right 2D:4D	0.97	0.05	0.80-1.09
Left 2D:4D	0.99	0.04	0.86-1.22
SQ	37.53	10.27	14.00-56.00
EQ	50.88	13.17	23.00-70.00

Empathy quotient (EQ) Systemizing quotient (SQ)

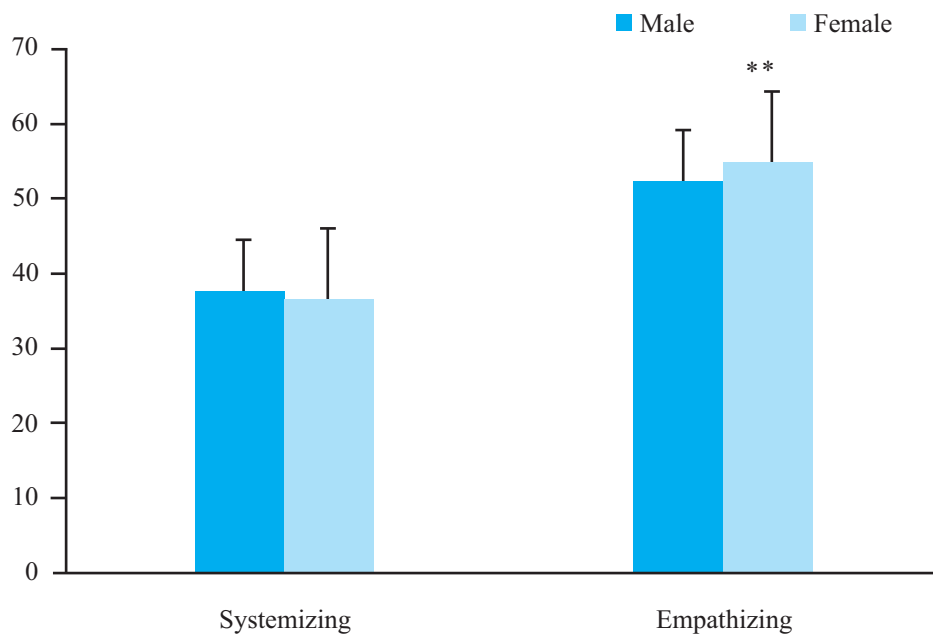


Figure 2. Sexual dimorphism of cognitive styles among Asholio ethnic groups. ** $P < 0.05$

Table 4 shows significant negative correlation between digit ratio and systemizing quotient stronger for the right hand.

Table 4: Correlations of digit ratios and SQ and EQ of Asholio ethnic group

	RDR	LDR
SQ	-0.47*	-0.32*
EQ	0.21	0.30

* $P < 0.05$ RDR= Right digit ratio, LDR= Left digit ratio, SQ= Systemizing Quotient, EQ= Empathizing Quotient

Table 5 shows significant high SQ in males than females, which is reverse in the case of EQ.

Table 5: Comparative parameters between males and females of Asholio ethnic group

Variables	Males (n=150)		Females (n=150)		t	P
	Mean	SD	Mean	SD		
Right 2D:4D	0.95	0.33	0.96	0.16	7.83	0.00
Left 2D:4D	0.97	0.14	0.99	0.04	3.18	0.01
SQ	37.17	10.16	36.13	10.90	10.6	0.00
EQ	51.86	9.84	54.88	13.17	4.18	0.00

Empathy quotient (EQ) Systemizing quotient (SQ)

Table 6 shows predictive equations for systemizing and empathizing quotient, statistics shows significance for estimating systemizing quotient.

Table 6: Predictive Equation for estimating SQ and EQ using digit ratio in Asholio ethnic group

Parameters	Predictive equation	SEE	R	R ²	P
Systemizing quotient					
<i>Asholio</i>					
R2D:4D	SQ = 13.171 + 16.342 * RD	0.868	0.283	0.083	0.0000
L2D:4D	SQ = 75.456 + (-45.231) * LD	0.141	0.432	0.064	0.0001

Empathizing quotients

Asholio

R2D:4D	EQ = 20.675 + 24.567 * RD	0.868	0.283	0.083	0.4570
L2D:4D	EQ = 19.433 + 28.564 * LD	0.941	0.432	0.064	0.3211

SQ = Systemizing quotient, R2D:4D = Right digit ratio, L2D:4D = Left digit ratio, SSE = standard error of the estimate

DISCUSSION

The correlations between 2D:4D, SQ and EQ showed a significant negative relationship between 2D:4D of both hands and SQ. This study agrees with other works that suggested that 2D:4D is negatively related to prenatal testosterone and that the association is particularly strong for the right hand and also shows sex differences.^[9] Males have lower values of 2D:4D than females, thus males tend to have lower values of 2D:4D than females and this arises in utero.^{[9] [8]} Therefore, the ratio between the length of second and fourth digits (2D:4D) is a sexually dimorphic trait,^[13] and it is a cross-cultural trait.^{[11] [6]} Systemizing Quotient and Empathy Quotient showed sex differences such that males had higher systemizing quotient (SQ) and lower EQ while reverse is the case in the females. This could be due to the organizational effect of sex hormones on the brain. The mean 2D:4D's obtained from direct finger measurements (from this Study) were significantly higher than those obtained from indirect finger measurements reported by Voracek and Dressler.^[15] However, mean 2D:4D's of the direct measurements of Swedish participants from the Study did not significantly differ from those reported from direct finger measurements by von Horn.^[14] Studies reporting samples from the USA, UK and Germany have shown that in comparison to 2D:4D from direct measurements the 2D:4D from indirect measurements were distorted downwards.^[11] The contrasting effects of direct and indirect finger measurement may explain why a relationship between 2D:4D and SQ/EQ was found by von Horn^[14] and in this Study, whereas no association was reported by Voracek and Dressler.^[15] It is unlikely that the distortion of 2D:4D by indirect finger measurement is a simple reduction in mean 2D:4D. Therefore this results provide evidence that SQ can be estimated in Asholio population using their right and left 2D:4D but being stronger for right hand 2D:4D. This implies that right 2D:4D is the best estimate of SQ among the measured parameters.

CONCLUSION

There exist a significant negative correlation with Systemizing quotient and digit ratio stronger on the right hand in Asholio ethnic group. 2D to 4D digit length (2D:4D) is sexually dimorphic with males having lower digit ratio than females.

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