

Study of Digit Ratio and its Relation with Cognitive Ability in Children

Mutalik Ashwini Mohan Rao*, Begum Naseema**

Abstract

Digit ratio is the ratio of the length of second and fourth digits typically measured from the bottom crease where fingers join the hand, to the tip of the fingers. This ratio is said to be affected by the exposure to the androgens while in womb. In our study digit ratio is used to predict the cognitive ability of the children. Usually 2D: 4D ratio is lower in males than in females implying greater exposure to androgens. In the present study, we found the average 2D: 4D ratio of girls to be 0.94 and boys 0.95 respectively. Hence we are of the opinion that this is just a crude indicator of the cognitive ability in children. Therefore, further research is needed to gain insight in this aspect.

Keywords: Digit Ratio; Androgens; Cognitive Ability.

Introduction

People are eager to learn palmistry since fate reading is an amazing study that entices everyone across the globe. Then came the study of Dermatoglyphics, a scientific study of finger prints, lines, mounts and shapes of hands. The latest of all these is the study of fingers length, which is known as digit ratio.

It is known through several studies that the ways in which men & women differ in their behavior and health like verbal, mathematical, musical and other abilities like strength, running, swimming speed, prevalence of heart disease and the probability of heart attacks, predisposition to cancers, depression etc., all show different intensities of development, manifestations and rates of progression in one sex compared to the other. This may sound bizarre but our fingers, more precisely ring & index finger can throw some light on this issue. These fingers provide us with evidence of how men & women differ and how they are programmed before birth to show certain sex related behavior patterns and disease

predispositions.

In the present study we have measured the length of ring finger and index finger to calculate the digit ratio and then we correlated the digit ratio with the children's performance in Mathematics and Language.

Methods

Using the digital Vernier's Caliper, we measured the length of index finger and ring finger of right hand in the school children aging between 11 to 15 years. Their digit ratio was calculated i.e 2D / 4D. We also made record of the marks obtained by each pupil in mathematics and language in their annual exams. In our study the number of pupils were 68, out of which 32 were girls and 36 were boys. We excluded the deformed hands. We also took the consent of students, parents and teachers.

To measure the digit ratio, the proximal most crease near to the palm of the index and ring finger were selected and a mid-point of the crease was taken till the tip of the respective fingers using digital Vernier calipers. Then the length of the index finger was divided by ring finger to get the digit ratio. If the 2D / 4D value is less than 1, it implies that the ring finger is longer than the index finger. This type is called Casanova pattern which is usually seen in males. If the value is equal to 1, then the fingers are equal in length and are usually seen in females. If the 2D/4D

Author's Affiliation: *Associate Professor, **Assistant Professor, Department of Anatomy, S. Nijalingappa Medical College, Bagalkot.

Corresponding Author: Ashwini M. Mutalik, Associate Professor, Department of Anatomy, S. Nijalingappa Medical College, Navanagar, Bagalkot - 587102 Karnataka.
E-mail: drashwinimutalik@gmail.com

ratio is greater than 1, it implies that the index finger is longer than the ring finger. This is known as Meng's pattern [1].

Results

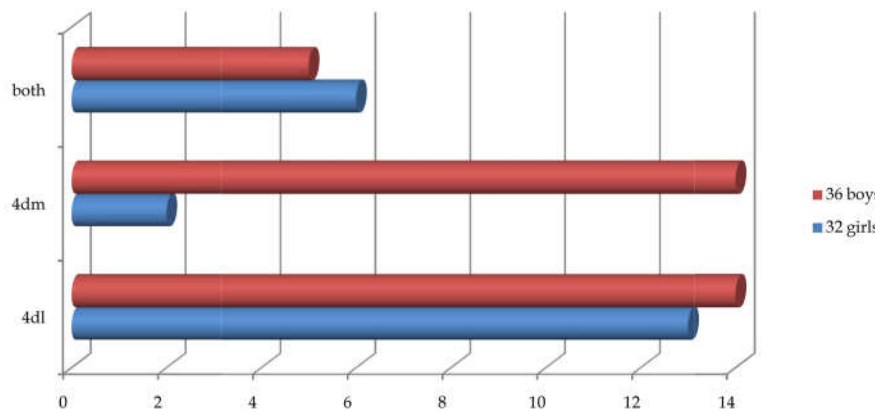
In our present study among 32 girls, 13 girls had increased 4D length and excelled in language. Only 2 girls with increased 4 D length did well in mathematics. Further 6 girls scored same marks in language and mathematics. We noted that, of the above 6 girls, 4 girls had increased 4D length. There were around 12 girls whose 2D/4D ratio was equal to 1. Of these, 7 did well in language. The average of

2D/4D ratio was 0.94. There were 22 girls whose 2D/4D ratio was above 0.94.

In the 36 boys, 14 had increased 4D length and excelled in mathematics. In the language also, there were 14 boys with increased 4D length. Further 5 boys scored same marks in language and mathematics. There were 4 boys whose 2D/4D ratio was equal to 1 and of these 3 excelled in language. The average 2D/4D ratio was 0.95. We had 13 such boys whose 2D/4D ratio was above 0.95.

Outcome of the study was that, of the 68 children 45 had increased 4D length and they excelled in their academics either in numeracy or literacy and not exactly in mathematics with increased 4D and in literacy with increased 2D.

Increased 4D length in language, mathematics and both

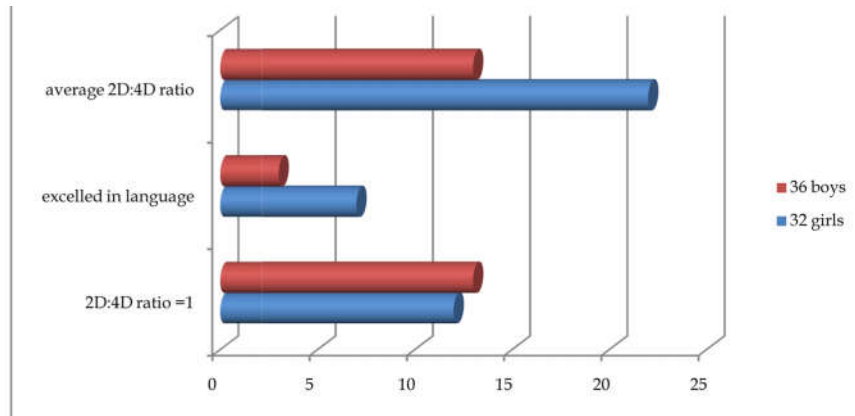


Number of students

4Dl= 4D length in language, 4Dm= 4D length in mathematics, both= 4Dl and 4Dm

Chart 1: Illustrating increased 4D length in language, mathematics and both in girls and boys

2D:4D=1, excelled in language and average 2D:4D ratio



Number of Students

Chart 2: Illustrating 2D:4D=1, excelled in language and average 2D:4D ratio in girls and boys

Discussion

The digit ratio is the ratio of the length of index and ring fingers, measured from the midpoint of the bottom crease to the tip of the fingers. This ratio is said to be affected by the exposure to the androgens in the intrauterine life. This 2D/4D ratio can be considered as a crude measure for prenatal androgen exposure [2,3]. The formation of digits in humans in the intrauterine life is thought to occur by 13 weeks and the bone to bone ratio is consistent from this point in to an individual's adulthood [4]. During this period, if the fetus is exposed to androgens the exact level of which is thought to be sexually dimorphic, the growth rate of fourth digit is increased. This is analyzed by 2D/4D ratio of opposite sex dizygotic twins where the female twin is exposed to excess androgens from her brother in utero and thus has a significantly lower 2D/4D ratio [5].

Compared to females, males tend to be less neurotic and less intuitive when guessing the emotional state of others. Males tend to display large muscle movements and physical aggression, but are also prone to hyperactivity, short attention span and language problems such as dyslexia, poor verbal fluency and stammering. However high ability in spatial judgment, problem solving, competitive sports, some aspects of mathematics, writing and performing music are more likely to be found in males than in females [6].

There is evidence that testosterone in the womb reduces language ability but favours the development of abilities in music, drawing and perception of shapes. High prenatal testosterone may also be important in influencing carrier choices like mathematics, physics and engineering [7].

In a study done by Noam Chomsky and his colleagues, the ability to learn language appears early in children developments. They learn the vocabulary and rules of sentence construction for their particular language with ease and usually without formal instruction. Thus the brain is programmed so that children simply infer the rules of sentence construction appropriate for their particular language. In order to explain this and other features of language acquisition they argued that there is within the brain a deep structure which is universal to all languages and is a fundamental aspect of the brain of modern humans [8].

However, linguistic ability is not uniform across all humans. There is sexual dimension, many aspects of language showing female superiority. In a Verley's Verbal test conducted to recall words associated with

groups such as musicians, animals, politicians & sports people, it was found that this semantically based fluency shows the female advantage. Hence those who have on average been exposed to high prenatal estrogen, tend to excel word fluency [9].

In another study done on 100 women and 100 men it was found that high semantically based fluency was indeed related to female type finger ratios and it seems that high prenatal estrogen is associated with aspects of language in the individual and to the evolution of language in the human species [10].

A study done in UK on 75 school children of age 7 concluded that numeracy rate was good for males indicating higher prenatal testosterone exposure in intrauterine life and females excelled in literacy indicating lower prenatal testosterone exposure in intrauterine life [11].

British international school did a study on 136 men and 137 women were of the opinion that if a low 2D/4D ratio is indeed due to testosterone exposure in the womb (which is not confirmed), then that raises the question as to why testosterone exposure should affect mathematical ability. And if it is not connected between digit ratio and mathematical talent? Does the relationship still hold for when we look at algebraic skills rather than numeracy or is algebraic talent distinct from numeracy talent? [12].

In a study done by Stefen on 100 young males and females explores association between 2D/4D ratio on the one hand and age, life history and BMI on the other hand. They found a decrease in 2D/4D ratio from typically feminine to typical masculine in the right hand of women. In men, they found negative association between 2D/4D ratio and BMI [13].

Many studies are of the opinion that the levels of sex hormones fluctuate during growth and development. Various sexually dimorphic traits differentiate at different ages which obscure associates between 2D/4D ratio and traits affected by sex hormones [14].

Trivers found a variation of 60% in 2D/4D ratio of the right hand, in children between seven and thirteen years four years later [15]. Hence MC Intyre says that sex differences in fingers of children are highly correlated with adult finger length ratios and the digit ratios have the potential to change during development and do not uniquely reflect fetal exposure to sex hormones [16].

From all the above studies we feel that 50% studies are agreeing with the 2D/4D ratio and its relation with exposure to androgens in intrauterine life, while other 50% studies don't hold good with the 2D/4D ratio and the concept of androgen exposure.

Conclusion

In our study, we found the girls and boys 2D/4D ratio to be 0.94 and 0.95 respectively. These findings question the validity of 2D/4D ratio as a predictor of human sexual behavior which in turn is related to prenatal exposure to androgens. Hence our study which is done on small sample size may show some contrast and may not support the 2D/4D ratio totally. More research is needed to gain insight which can correlate the different components of human behaviors with the 2D/4D ratio.

References

1. Manning JT. A tale of two fingers. The finger book. Faber and faber; 2008; 2-5.
2. Zheng, Zhengui, Cohn, Martin J. Developmental basis of sexually dimorphic digit ratios. *ProcNatlAcadSci*; 2011; 108(39): 16289-94.
3. Honekopp, Johannes, Bartholdt, et al. second to fourth digit length ratio (2D: 4D) and adult sex hormone levels: new data and a meta analytic review. *Psyneuen*. 2007; 32(4): 313-21.
4. Garn S m ,Burdi A R, Babler W J et al. Early prenatal attainment of adult metacarpal- phalangeal rankings and proportions. *Am JphysAnthropol*. 1975; 43(3): 327-32.
5. Van Anders SM, Vernon PA, Wilbur CJ. Finger-length ratios show evidence of prenatal hormone-transfer between opposite-sex twins. *Horm Behav*. 2006; 49(3): 315-9.
6. Collaer, M.L, and Hines, M. Human Behavioral Sex Differences, A role for gonadal hormones during early development. *Psychological Bulletin*. 1995; 118: 55-107.
7. Baron-Cohen, S. The extreme male brain theory of Autism. *Trends in cognitive sciences*. 2002; 6: 248-54.
8. Chomsky, N. The minimalist program. Hong Kong: MIT Press 1995.
9. Varley, R. Lexical semantic deficits following right hemisphere damage : Evidence from verbal fluency tasks. *European journal of disorders of communication*. 1995; 30: 362-71.
10. Manning, J.T Digit Ratio : A pointer to fertility, behavior and health. New Jersey : Rutgers University Press 2002.
11. Brosnan. Digit ratio as an indicator of numeracy relative to literacy in 7 year old British school children. *BrJPsychol*. 2008; 99(1): 75-85.
12. Mark Brosnan. Digit ratio and faculty membership: implications for the relationship between prenatal testosteroneand academia. *Br J Psychol*. 2006: 97(4); 455-66.
13. Stefan Van Dongen. Second to fourth digit ratio in relation to age, BMI and life history in a population of young adults : a set of unexpected results. *J Negat Results EcolEvolBiol*. 2009; 6: 1-7.
14. Putz D A, Gaulin, spotter S J C. sex hormones and finger length. What does 2D: 4D indicate?. *Evol Hum Behav*. 2004; 25; 182-99.
15. Trivers R, Manning S J C and Jacobson A. a longitudinal study of digit ratio (2D:4D) and other finger ratios in Jamaican children. *HormBehav*. 2006; 49: 150-6.
16. McIntyre M H, Ellison P T, Lieberman D E et all. The development of sex differences in digital formula from infancy in the fels longitudinal study. *Proc R Soc B*. 2005; 272: 1473-9.