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Association between digit ratio (2D: 4D) and coronary artery disease

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KEYWORDS heart diseases, 2D: 4D, sexually dimorphic	ABSTRACT: Background- artery diseas and fourth of between 2D: investigate w disease. Method-This females. Ler calipers. Stud Result-In the without CAE to patients w ratio then ma Conclusion-T in males but	There is several predisposing risk fact e is sexually dimorphic, being more p digit (2D: 4D) is a sexually dimorphic 4D and cardiac disorders have been whether 2D: 4D can be used as a tool study includes 210 individuals, out of agths of 2nd and 4th finger were m dent t test was used to find the difference e present study, there was a significa D. 2D: 4D ratio was higher in both the without CAD. No such difference was les for right hand in patients without C. There is an association between high 21 there is no association seen in females.	tors of getting heart diseases. Coronary prevalent in males. The ratio of second nic biometric marker. The association a reported. The aim of the study is to for early diagnosis of coronary artery of which 127 were males and 83 were easured for both hands using vernier ee of 2D: 4D among different groups. nt difference in males with CAD and hands in males with CAD as compared seen in females. Females have higher AD. D: 4D ratio and coronary artery disease

INTRODUCTION

The prevalence of Heart Disease is increasing rapidly across the world. Identification of heart disease at early stages of life by a simple and reliable indicator is necessary for appropriate medical interventions. Various studies have been conducted by medical professionals and scientists to rule out the reason for heart diseases. Effects of testosterone are seen on insulin resistance, myocardium, obesityand vasodilation.Increased levels of androgen was linked with increased risk of coronary artery disease (CAD).¹

Around 14th week of gestation, Digit ratio is established and by 2 years of age gender differences in digit ratio becomes apparent. During development there is continuous growth of digits but the ratio between them remains unchanged throughout their life.²

When 2D:4D ratio is low, it indicates high prenatal testosterone exposure, and when 2D: 4D ratio is high, it indicates high prenatal estrogen exposure.³

Sexual dimorphism is seen in digit ratio with males having longer 4th digit as compared to 2nd digit than females (2D:4D in males < 2D:4Din females).Prenatal unbalanced exposure to testosterone or estrogen may lead to various sexually dimorphic abilities like (speed, stamina, strength), disorders of development like (autism, dyspraxia, attention deficit hyperactivity disorder) and major diseases like (heart disease, many cancers, osteoarthritis).⁴

CAD is sexually dimorphic, being more prevalent in males. Testosterone and estrogen is sensitive to the formation and maintenance of the cardiovascular system in men.⁵

The ratio of the lengths of different fingers measured from the midpoint of bottom crease of the finger where it joins the hand to the tip of that finger is called Digit Ratio. Amongst all the ratios, 2D: 4D i.e. the ratio between the index finger and the ring finger is the most studied digit ratio.⁶

In both males and females, the second digit is typically shorter, but in males, the difference between the

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lengths of the two digits is greater than females. In other words, females have a higher ratio compared to males. 6

MATERIALS AND METHOD

The study population consists of 210 individuals out of which 127 were males and 83 were females. The subjects recruited were divided into 2 groupsindividuals with CAD and individuals without CAD. Written informed consent was obtained. Our institutional review committee approved the study.

MEASUREMENTS OF THE DIGITS

The length of index finger and ring finger of both hands were measured on palmer surface from basal crease proximal to palm to the tip of the finger. The ratio between 2^{nd} and 4^{th} finger (2D: 4D) in terms of their length was obtained by dividing the length of 2^{nd} finger by length of 4^{th} finger. The ratio values for both right and left hand were calculated separately.



Figure 1- Measurements of the digits

STATISTICAL ANALYSIS

The presentation of the Categorical variables was done in the form of number. The quantitative data with normal distribution were presented as the means \pm SD. The data normality was checked by using Shapiro-Wilk test. The following statistical tests were applied for the results:

- 1. The comparison of the variables, which were quantitative and normally distributed in nature, was analyzed using Independent t test.
- 2. Receiver operating characteristic curve was used to assess cut off point, sensitivity, specificity, positive predictive value and negative predictive value of 2D:4D {Right hand} and 2D:4D {Left hand} for predicting CAD.

The data entry was done in the Microsoft EXCEL spreadsheet and the final analysis was done with the use of Statistical Package for Social Sciences (SPSS) software, IBM manufacturer, Chicago, USA, ver 25.0.For statistical significance, p value of less than 0.05 was considered statistically significant.

RESULT

The study subjects consist of 210 individuals with amean age of 58.72 ± 9.6 years, out of which 127 were males and 83 were females. Out of 127 males, 80 males were with coronary artery disease (CAD) and 47 were without CAD. Out of 83 females, 40 were with CAD and 43 without CAD.

Table 1: -Comparison of 2D:4D between male and female in patients with CAD.

1	1				
	2D: 4D	Male (n=80)	Female (n=40)	P value	
	Right hand	0.99 ± 0.05	0.98 ± 0.03	0.181*	
	Left hand	0.99 ± 0.05	0.98 ± 0.04	0.09^{*}	

* Independent t test

In patients with CAD, there was no significant difference observed in the 2D:4D ratio for both the

right hand (p value=0.181) and the left hand (p value=0.09) between males and females.

Table 2:-Comparison of 2D:4D between male and female in patients without CAD.

2D: 4D	Male (n=47)	Female (n=43)	P value
Right hand	0.96 ± 0.03	0.98 ± 0.03	0.002^{*}
Left hand	0.96 ± 0.02	0.97 ± 0.04	0.259*

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* Independent t test

In patients without CAD, there was no significant difference observed in the 2D:4D ratio for the left hand (p value=0.259) between males and females.A

significant difference was noted in the 2D: 4D ratio for the right hand between males and females (p value= 0.002). Females have higher ratio then males.

Table 3:-Comparisor	of 2D:4D between	males with a	and without CAD.
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2D: 4D	With CAD (n=80)	Without CAD (n=47)	P value
Right hand	0.99 ± 0.05	0.96 ± 0.03	0.0003*
Left hand	0.99 ± 0.05	0.96 ± 0.02	0.0001*

* Independent t test

There was a significant difference observed in the 2D:4D ratios for both the right hand and left hand between males with and without CAD with p value

=0.0003 and 0.0001 respectively. The digit ratio is higher in males with CAD as compared to males without CAD.

Table 4:-Comparison of 2D:4D between females with and without CAD.

2D: 4D	With CAD (n=40)	Without CAD (n=43)	P value
Right hand	0.98 ± 0.03	0.98 ± 0.03	1.0^{*}
Left hand	0.98 ± 0.04	0.97 ± 0.04	0.258^{*}

*

Independent t test

There was no significant difference observed between females with and without CAD.









ROC curves above the diagonal line are considered to have reasonable discriminating ability to predict CAD. Discriminatory power of 2D:4D {Left hand} (AUC 0.635; 95% CI: 0.565 to 0.700) and 2D:4D {Right hand} (AUC 0.578; 95% CI: 0.508 to 0.645) was acceptable. Among both parameters, 2D:4D {Left hand} was the best predictor of CAD at cut off point of >0.9697 with area under curve of 0.635 for correctly predicting CAD.2D:4D {Left hand} had sensitivity of 49.17% followed 2D:4D {Right hand} (47.50%). Also, 2D:4D {Left hand} had specificity of 74.44% followed by 2D:4D {Right hand} (70.00%). Highest positive predictive value was found in 2D:4D {Left hand} (72.00%) and highest negative predictive value was found in 2D:4D {Left hand} (52.30%). Maximum area is under curve so overall 2D:4D {Left hand} was best predictor of CAD.

DISCUSSION

The association between digit ratio and coronary artery disease have been reported earlier.

In the present study, 2D: 4D in males is positively correlated with CAD. Studies by Manning and Ozdogmus also states that males with low 2D: 4D ratio tends to have MI's later in life as compared to males with high digit ratio. Fink and Kyriakidis also found a correlation between 2D: 4D and neck

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circumference.^{7,8,9,10} A similar correlation between 2D: 4D and CAD in males was seen in this study.

In this study there was a significant difference between individuals with CAD and without CAD. Similar results were seen in a study conducted on Greek population where 2D: 4D ratio was higher in males with CAD than males without CAD in both the hands with p value < 0.001. But no significant difference was observed in females.⁹

The relation between digit ratio and coronary artery disease is not clear. Prenatal sex hormones are believed to be the reason for different observations among the genders. These hormones are also believed to affect multiple organ system in human body including cardiovascular system.¹¹ A positive relation with prenatal estrogen and a negative relation of 2D: 4D with prenatal testosterone was reported in a study conducted by Robinson et al.¹²

There is a set of genes called as Homeobox genes (HoxA and HoxD), which are believed to form a common factor responsible for prenatal androgen synthesis, urogenital system differentiation and digit development. Testosterone regulates another gene in utero called SMOC 1 gene, which is believed to be responsible for regulation of limb growth.⁶ Prenatal testosterone also increases sensitivity of beta-adrenergic receptors towards catecholamine, which induce lipase and decrease adiposity. Due to low exposure to androgens in intra uterine life, it predisposes to adiposity in adult life, leading to increased risk for CAD.¹³

The individuals with high digit ratio doesn't mean that they will definitely have heart diseases in early stages of life as compared to the individuals with low digit ratio.^{14, 15}

CONCLUSION

This study suggests that there is a positive correlation between 2D: 4D ratio and coronary artery disease in males. Males with higher digit ratio have more chances of having CAD at early stages of life. This study also suggest that low androgen exposure in intra uterine life may lead to increased adiposity in adulthood, hence increasing the risk for CAD.

This study concludes that 2D: 4D ratio can be used as a parameter for providing quick and inexpensive information in screening from early stages of life. It can also create awareness among the students that how to lead a better lifestyle by having a balanced diet and doing exercise regularly.

REFERNCES

- Wu, X. L., Yang, D. Y., Chai, W. H., Jin, M. L., Zhou, X. C., Peng, L., & Zhao, Y. S. (2013). The ratio of second to fourth digit length (2D: 4D) and coronary artery disease in a Han Chinese population. *International journal of medical sciences*, 10(11), 1584-1588.
- Garn S.M.,,Burdi.A.R., Babler.W.J. &Stinson.S. (1975) Early Prenatal Rankings and Attainment of Adult Metacarpal-Phalangeal Proportions. American Journal of Physiology and anthropology, 43, 327-332.
- Wang, L., Huo, Z., Lu, H., Bai, C., Li, K., & Ma, W. (2018). Digit ratio (2D: 4D) and coronary artery disease in north Chinese women. *Early Human Development*, 116, 64-67.
- Manning, J. T., Fink, B., Trivers, R., Shackelford, T. K., & Weekes-Shackelford, V. A. (2018). Digit ratio. *Encyclopedia of Evolutionary Psychological Science. Cham: Springer.*[https://doi. org/10.1007/978-3-319-16999-6_3829-1].
- 5. KM, E. (2000). Men with coronary artery disease have lower levels of androgens than men with normal coronary angiograms. *Eur Heart J.*, *21*, 890-894.
- Gillam, L., McDonald, R., Ebling, F. J., & Mayhew, T. M. (2008). Human 2D (index) and 4D (ring) finger lengths and ratios: Cross-sectional data on linear growth patterns, sexual dimorphism and lateral asymmetry from 4 to 60 years of age. *Journal of anatomy*, 213(3), 325-335.
- 7. Manning, J. T., & Leinster, S. J. (2001). re: The ratio of 2nd to 4th digit length and age at presentation of breast cancer: a link with prenatal oestrogen?. *The Breast*, *4*(10), 355-357.
- Fink, B., Manning, J. T., &Neave, N. (2006). The 2nd–4th digit ratio (2D: 4D) and neck circumference: implications for risk factors in coronary heart disease. *International Journal of Obesity*, 30(4), 711-714.
- Kyriakidis, I., Papaioannidou, P., Pantelidou, V., Kalles, V., &Gemitzis, K. (2010). Digit ratios and relation to myocardial infarction in Greek men and women. *Gender medicine*, 7(6), 628-636.
- Ozdogmus O, Cakmak YO, Coskun M, Verimli U, Cavdar S, Uzun I. The high 2D:4D finger length ratio effects on atherosclerotic plaque devel-

www.jchr.org

JCHR (2023) 13(6), 675-679 | ISSN:2251-6727



opment. Atherosclerosis. 2010 209: 195-6. [SEP]

- Buck, J. J., Williams, R. M., Hughes, I. A., &Acerini, C. L. (2003). In-utero androgen exposure and 2nd to 4th digit length ratio comparisons between healthy controls and females with classical congenital adrenal hyperplasia. *Human Reproduction*, 18(5), 976-979.
- 12. Robinson, S. J., & Manning, J. T. (2000). The ratio of 2nd to 4th digit length and male homosexuality. *Evolution and Human Behavior*, 21(5), 333-345.
- 13. De Pergola, G. (2000). The adipose tissue metabolism: role of testosterone and dehydroepiandrosterone. *International journal of obesity*, *24*(2), S59-S63.
- Roger, V. L., Go, A. S., Lloyd-Jones, D. M., Adams, R. J., Berry, J. D., Brown, T. M., ... & Wylie-Rosett, J. (2011). Heart disease and stroke statistics—2011 update: a report from the American Heart Association. *Circulation*, 123(4), e18-e209.
- Wu, X., Yang, D., Zhao, Y., Lu, C., & Wang, Y. (2013). Effectiveness of percutaneous coronary intervention within 12 hours to 28 days of STelevation myocardial infarction in a real-world Chinese population. *PloS one*, 8(3), e58382.