Indian Journal of Clinical Anatomy and Physiology 2019;6(3):344–347

Content available at: iponlinejournal.com

Indian Journal of Clinical Anatomy and Physiology

Journal homepage: www.innovativepublication.com

Original Research Article

Measurement of 2D:4D ratios in patients with major depressive disorders: A pilot study

Saravanakumar Jeevanandam[1], K Muthu Prathibha[2,*]

[1]*Saveetha Medical College, Theni, Tamil Nadu, India*
[2]*Dept. of Physiology, Saveetha Medical College, Theni, Tamil Nadu, India*

ARTICLE INFO

Article history:
Received 04-11-2019
Accepted 28-08-2019
Available online 12-10-2019

Keywords:
Digit ratio
2D:4D ratio
Prenatal testosterone
Depression
Vernier Caliper
Beck's Inventory

ABSTRACT

Introduction: Digit ratio or 2D:4D ratio is a sexually dimorphic trait. It is a proxy marker of prenatal androgen exposure and is negatively correlated to prenatal androgens especially, testosterone. Literature search revealed significant correlations between digit ratios and various physiological, psychological or performance traits in adulthood**.**

Objectives: The pilot study was conducted to measure 2D:4D ratios of patients with Major Depressive Disorder (MDD) and to compare it with normal (non-depressed) individuals and also to evaluate the correlation between digit ratios & depression scores.

Materials and Methods: The present study was conducted in adults of age group belonging to 25-40 years with MDD (Group 1: n=30), from a tertiary care centre for Psychiatry. Using digital vernier calipers 2D:4D ratio was measured. Diagnosis of depression was done by the psychiatrist using DSM –IV criteria and depression scores were calculated by Hamilton depression rating scale (HDRS). Depression scores using Beck's Depression Inventory and digit ratios were measured in age and sex matched healthy controls (Group 2: n=30).

Results: The Mean ratios of Group 1 (0.9659 ± 0.04161) was found to be lower than Group 2 (0.9788 ± 0.0371). Using standard cutoffs, Group 1 was divided into Low and High digit ratios. The proportion of Group 1 patients with high ratios (84%) was significantly more than those with than low ratios (16%) ($p<0.001$).

Discussion: The outcomes of the present study were synchronous with reports of higher incidence of depression in females, nationally and globally. This was concurrent with the other reports of the previous studies. This would help us to conduct the future studies even on large study population.

© 2019 Published by Innovative Publication.

1. Introduction

A plenitude of recent research has enthralled on, finding out the relationship between digit ratios (an index of prenatal androgen exposure) and various facets of health and disease.[1] The digit ratio or 2D:4D ratio is the ratio of the lengths of different digits or fingers. It is measured, from the midpoint of bottom crease where the finger joins the hand to the tip of the finger.[2] 2D: 4D ratio or the ratio of lengths of 2^{nd} (index finger) and 4^{th} (ring finger) is negatively correlated to prenatal testosterone exposure.[3] Digit ratio or 2D: 4D ratio is independent of adult hormone levels and the ratio constant since birth.[4] Individual's with longer index finger will result in a ratio higher than 1, while with longer ring finger will result in a ratio of less than 1. The fourth digit (Ring finger) tends to be longer in men. On the other hand, in women, the two digits tend to be identical in length or occasionally the index finger is longer.[5,6] Median values of 2D:4D ratios in males and females have been found to be 0.947 ± 0.029 and 0.965 ± 0.026 respectively.[7] In Indian Population, the mean digit ratios were found to be 0.96 and 0.97 in males and females, respectively.[8,9] Thus, digit ratio can be used as an marker of prenatal androgen exposure, to which the developing foetus is exposed. Also, Manning et al have also observed racial and geographic variations.[10,11]

Evidence from the molecular level studies states that, prenatal androgens affect the expression of HOX A genes.

* *Corresponding author.*
E-mail address: drmuthuprathi@gmail.com (K. Muthu Prathibha).

https://doi.org/10.18231/j.ijcap.2019.075
2394-2118/© 2019 Published by Innovative Publication.

The genes, which are primarily responsible for the growth and differentiation of the digits.

Literature search revealed interesting associations between 2D:4D ratio and various physiological, psychological and performance traits in adulthood.[12] Low digit ratio in males is associated with certain characteristics like aggression and showed higher aggression scores, in comparison to feminine (higher) ratio. Similarly, high digit ratio in males is associated with increased sperm counts, increased risk for heart disease, obesity, metabolic syndrome, depression and anxiety.[13–17] However, the outcomes of research, conducted on the relationship between depression and digit ratios are highly variable.

Adolescents comprise one –fifth of the Indian population, this accounts for 20% of the world's population.[18] The present day adolescents are posed with various challenges in their day to day social and physical environments. Symptoms of depression and depressed mood are under-recognized or at times considered to be a familiar part of the adolescent experience. Depression is forecasted to be a huge burden on all nations with projections expecting depression to reach the second place in the ranking of disability-adjusted life years.[15] The impact of depression can range from mood disorders such as anxiety, reduced academic performance, suicidal behaviours, alcohol and drug abuse to significant mortality & morbidity associated with them. Recent reports show that suicide is the highest cause of death among the adolescents of India.[19] Interestingly, studies exploring the association between 2D:4D ratios and various physiological and behavioural measures in the Indian population have been on the rise recently. A cross sectional among urban adolescents of south India reported 60.8% of the study population to be depressed. Further, the prevalence of depression in our country is also on an alarming rise. Hence, we planned to pursue this project to state the importance of 2D:4D ratio as a marker of depression.

2. Objectives

The primary objectives of the present study were

1. To measure 2D:4D ratios in adult patients of 25 – 40 years of age diagnosed with Major Depressive Disorders.
2. To compare 2D:4D ratios between cases (depressed) & controls (non-depressed).
3. To identify an association, if any, between depression and 2D:4D ratios in the study participants.

3. Materials and Methods

3.1. Ethical considerations

The study was initiated after obtaining clearance from both the Institutional Review Board and Institutional Ethics Committee. Information sheet with pertinent information was given to all the participants invited to participate in the study and written informed consent was obtained from all participants of the study.

3.2. Study setting and population

The present pilot study was conducted on thirty adult patients of age 25–40 years, with major depressive disorder (Group 1: n=30) at the SCARF, Schizophrenia Research Foundation, a non-governmental, non-profit organization in Chennai and thirty age & sex matched healthy controls (Group 2 : n=30). SCARF is a center of repute in rehabilitation and research in disorders of the mind and the team comprised of psychiatrists, psychologists, social workers, rehab personnel, administrative and support staff. Adult patients of 25-40 years of age diagnosed with Major Depressive Disorders (mild, moderate, severe) using DSM IV criteria for Major Depressive Disorders. Beck's depression inventory was used to score depression in healthy controls to rule out depression objectively.

3.3. Exclusion criteria

Participants with history of injury in the second and/or fourth digits, organic brain conditions and certain neurological disorders, active suicidal risk, substance abuse and comorbid acute medical conditions were excluded.

3.4. Procedure

Information sheet with pertinent information was given to all the participants/participant's guardians who were invited to participate in the study. And written information consent was also obtained. Basic demographic details name, age, sex and occupation were noted down.

3.5. Measurement of 2D:4D Ratio

The length of the second (Index finger) and fourth digit (Ring finger) was measured from the fingertip to the ventral proximal crease using digital vernier calipers on the right hand only because personality & behavioral traits were reported to correlate more strongly with right sided digit ratio than the left.[14] Two measurements were taken on the right hand by the same examiner. (Duration 5 -7 minutes) The examiner was trained and calibrated prior to the conduct of the experiment. The ratio was calculated by dividing the mean index finger lengths (mm) and mean ring finger lengths (mm) for the right hand.

3.6. Data analysis

All data was double entered into MS excel and checked for data entry errors. Statistical analyses were done using SPSS 16.0. Mean±SD of the 2D:4D ratios of the participants was calculated and compared with healthy controls us ing

student t test. Further the prevalence of depression, based on depression scores subgroups of Group 1 participants (High vs Low digit ratios) were compared using the Z test for single proportions. $p<0.05$ (Highly significant).

4. Results

The sample size of the present study was 60 (cases=30, Controls=30) according to the stratification applied while sampling. The study population were broadly divided into two groups – group 1 (cases=30), group 2 (controls=30)

The mean 2D:4D ratio of Group 1 (0.9659 ± 0.04161) was lower when compared to Group 2 (0.9788 ± 0.0371), although not statistically significant. Based on the standard cutoff values of digit ratios for the Asian population, Group1 participants were categorized into two subgroups – Low & High digit ratios. Participants with high (feminine) digit ratios, were found to be more depressed (84%) in comparison to those with low (masculine) digit ratios (16%). Using the Z test for single proportions, the difference was found to be highly statistically significant ($p<0.001$).

* Cases – Those who are diagnosed with Major Depressive Disorder (MDD), using Hamilton Depression Rating Scale, DSM IV criteria.

*Controls – Age & sex matched healthy population, using Beck's Depression Inventory.

5. Discussion

About one- third of the world population & half of the Indian population has been reported to be at the risk of depression. Depression is forecasted to be the huge burden of all nations in the present & forthcoming years respectively & it is one of the commonest causes of disability adjusted life years (DALY).[20] The impact of depression can range from mood disorders such as anxiety, reduced academic performance, suicidal behaviors, alcohol and drug abuse to significant mortality & morbidity associated with them. Recent reports show that suicide is an increased cause of death in India.

Manning et al hypothesized that all sexually dimorphic traits could be correlated with digit ratios.[20] Digit ratio, has been reported to be a proxy marker of prenatal androgen exposure.[21] The 2D:4D ratio is negatively related to prenatal testosterone and positively related to prenatal estrogen.[3] Individual's with longer index finger (Most of the females and few males) will result in a ratio higher than 1, while with longer ring finger (Most of the males and few females) will result in a ratio of less than 1. Hence, the terms lower and higher ratios are used interchangeably with masculine and feminine ratios, respectively. The findings of existing research conducted on the relationship between depression and digit ratios were highly variable and therefore, the present pilot study was attempted to study the relationship between digit ratios and depression scores.

The mean 2D:4D ratio of the participants with depression was lower than that of healthy controls, though not of statistical significance. Observations of Martin et al were concurrent with the present study, where depression was more common among individuals with low (masculine) 2D:4D ratios.[22] On the contrary, Bailey et al stated the high prevalence of depression among individuals with high (feminine) ratios.[16] Further, it was also reported that men with lower 2D:4D ratios showed higher aggression scores.[16]

Patients with MDD were further divided into two categories – Low (masculine) & high (feminine) ratios. High prevalence of depression (84%) was observed among high (feminine) ratios compared to that of the low (masculine) ratios (16%). Depression being more common in women globally, Bailey et al hypothesised and then reported higher prevalence of depression in individuals with feminine ratios and low prenatal testosterone exposure.[3] The above mentioned finding was similar to the present study. On the contrary, Martin, Manning and Dowrick had attributed the increased risk of clinical depression to high organizational testosterone in men.[20] They have also reported data demonstrating a non-significant trend towards higher depression in men with more masculine finger length ratios.

6. Conclusion

The present study revealed a non- significant correlation between digit ratios & depression scores and a significantly higher prevalence of depression in individuals with higher digit ratios. Based on the results of the pilot study, a large scale study on 269 adolescents was initiated among the study population. The findings of the study could help us to associate a simple measure like 2D:4D ratio to depression. 2D:4D ratio is a non-invasive measure that can predictably forecast the proneness of a child to depression in the future. Based on the digit ratios, one can plan early life style interventions to avoid or delay the onset of the depression or at the least, facilitate its early diagnosis.

The key findings/messages of the present study are as follows:

1. The mean 2D:4D ratio of the depressed individuals (0.9659 ± 0.04161) were lower than that of non-depressed individuals (0.9788 ± 0.0371). However, not statistically significant.
2. The study population with high (feminine) digit ratios were more depressed (84%), in comparison to low (masculine) digit ratios (16%) and was considered to be statistically significant with the p value a of <0.001
3. There was a significant correlation between digit ratio and depression.

7. Source of funding

None.

8. Conflict of interest

None.

References

1. Manning JT, Bundred PE. The ratio of 2nd to 4th digit length: a new predictor of disease predisposition. *Med Hypotheses*. 2000;54(5):855–857.
2. Mayhew TM, Gillam L, Mcdonald R, Ebling FJ. Human 2D (index) and 4D (ring) digit lengths: their variation and relationships during the menstrual cycle. *J Anat*. 2007;211(5):630–638.
3. Bull R, Pj B. Digit ratio (2D: 4D) and the spatial representation of magnitude. *Hormones Behav*. 2006;50(2):194–199.
4. Hnekopp J, Bartholdt L, Beier L, Liebert A. Second to fourth digit length ratio (2D: 4D) and adult sex hormone levels: new data and a meta-analytic review. *Psychoneuroendocrinol*. 2007;32(4):313–321.
5. Phelps VR. Relative index finger length as a sex-influenced trait in man. *Am J Hum Genet*. 1952;4(2):72–72.
6. Manning JT, Scutt D, Wilson J, Di LJ. The ratio of 2nd to 4th digit length: a predictor of sperm numbers and concentrations of testosterone, luteinizing hormone and oestrogen. *Hum Reprod*. 1998;13(11):3000–3004.
7. Bailey AA, Hurd PL. Finger length ratio (2D: 4D) correlates with physical aggression in men but not in women. *Biol Psychol*. 2005;68(3):215–222.
8. Jain M, Dhall U, Pandey S, Jain S. Second to Fourth Digit Ratio (2D: 4D) in North-West Indians: Sexual Dimorphism. *J Anatomical Soc India*. 2012;61(2):242–245.
9. Manning JT, Henzi P, Venkatramana P, Martin S, Singh D. Second to fourth digit ratio: ethnic differences and family size in English, Indian and South African populations. *Ann Hum Biol*. 2003;30(5):579–588.
10. Basker M, Moses PD, Russell S, Russell PS. The psychometric properties of Beck Depression Inventory for adolescent depression in a primary-care paediatric setting in India. *Child Adolesc Psychiatry Mental Health*. 2007;1(1):8–8.
11. Manning JT, Stewart A, Bundred PE, Trivers RL. Sex and ethnic differences in 2nd to 4th digit ratio of children. *Early Hum Dev*. 2004;80(2):161–168.
12. Romano M, Leoni B, Saino N. Examination marks of male university students positively correlate with finger length ratios (2D: 4D). *Biol Psychol*. 2006;71(2):175–182.
13. Wilson GD. Finger-length as an index of assertiveness in women. *Personal Individual Differ*. 1983;4(1):111–112.
14. Manning JT, Bundred PE, Newton DJ, Flanagan BF. The second to fourth digit ratio and variation in the androgen receptor gene. *Evol Human Behav*. 2003;24(6):399–405.
15. Fink B, Manning JT, Neave N. The 2nd-4th digit ratio (2D: 4D) and neck circumference: implications for risk factors in coronary heart disease. *Int J Obes*. 2006;30(4):711–711.
16. Bailey AA, Hurd PL. Depression in men is associated with more feminine finger length ratios. *Personal Individual Differ*. 2005;39(4):829–836.
17. Martel MM, Klump K, Nigg JT, Breedlove SM, Sisk CL. Potential hormonal mechanisms of attention-deficit/hyperactivity disorder and major depressive disorder: a new perspective. *Hormones Behav*. 2009;55(4):465–479.
18. Nagendra K, Sanjay D, Gouli C, Kalappanavar NK, Kumar VC. Prevalence and association of depression and suicidal tendency among adolescent students. *Int J Biomed Adv Res*. 2012;3:714–719.
19. Mohanraj R, Subbaiah K. Prevalence of Depressive Symptoms among Urban Adolescents of South India. *J Indian Assoc Child Adolesc Mental Health*. 2010;6(2):33–43.
20. Manning JT. Digit ratio: A pointer to fertility, behavior, and health. Rutgers University Press ; 2002,.
21. Martin SM, Manning JT, Dowrick CF. Fluctuating asymmetry, relative digit length, and depression in men. *Evol Hum Behav*. 1999;20(3):203–214.
22. Malas MA, Dogan S, Evcil EH, Desdicioglu K. Fetal development of the hand, digits and digit ratio (2D: 4D). *Early Hum Dev*. 2006;82(7):469–475.

Author biography

Saravanakumar Jeevanandam CRRI

K Muthu Prathibha Associate Professor

Cite this article: Jeevanandam S, Muthu Prathibha K. Measurement of 2D:4D ratios in patients with major depressive disorders: A pilot study. *Indian J Clin Anat Physiol* 2019;6(3):344-347.