

Association of Digit Ratio With Depression and Hopelessness in Females

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Abstract

Introduction: Depression is regarded as the main cause of individual's incapacity. One of the component of depression is hopelessness. This study was planned to examine if the digit ratio associates with depression and hopelessness status in the Iranian women.

Methods: This cross-sectional study sample included 358 women aged between 20 to 32 years old. The palm side of both hands of individuals was photographed and then the length of index and ring fingers was measured by ImageJ. The Beck's depression inventory II and Beck's hopelessness scale (BHS) were used to measure the levels of depression and hopelessness respectively. ANOVA and Student's *t* test was applied to compare the study groups in respect to the continuous data.

Results: The results showed that the means of 2D:4D ratio of neither right nor left hands were significantly different between the depression study groups. The same insignificant results were derived with hopelessness status too. However, reanalyzing the data, while combination of depression and hopelessness was considered, showed a significantly lower digit ratio of the right hand in the women with neither depression nor hopelessness (group 1) compared to the women with moderate/severe depression while holding a degree of hopelessness (group 2) (ratio mean for group 1: 0.978 ± 0.003 and for group 2: 0.992 ± 0.005 ; $t = -2.417$, $P = 0.017$).

Conclusion: Our data suggested that the 2D:4D ratio of the right hand in the women associates with the severity of depression when accompanied by hopelessness.

Keywords: Women, Depression, Hopelessness, Hand, Digit ratio

Introduction

According to WHO reports, mental disorders are highly common in the world. Globally 4.4% of the population are estimated to suffer from depression. Depression is regarded as the main cause of individual's incapacity and the major risk factor to suicide death.¹ Depressed patients generally suffer from chronic medical diseases such as hypertension, arthritis, diabetes, backache, and heart disorders.² The result of a Meta-analysis performed by Abate in 2013 showed that the prevalence of depression in women was higher than men.³ One of the component of depression is hopelessness which is described as a state of pessimistic attitude about the future and regarded as a predictor of suicide in patients with mental disorders. Although this cognitive factor is considered as a symptom of depression, evidence indicates that this

trait could be distinct from depression and behave independently as it associates with hypertension, mortality, and cancer free of depression.⁴⁻⁶

There is strong evidence which confirmed the effect of prenatal androgens on the ratio of the index into the ring finger length (2D:4D).⁷ This ratio in the right hand has been shown to be negatively associated to prenatal ratio of testosterone to estrogen; that is, higher level of prenatal testosterone compares to estrogen results in children with lower ratio of 2D:4D.⁸ Digit ratio has been found as a trait with sexual and ethnical variation⁹ and suggested to be a putative biomarker by much recent evidence, since it has been found to correlate with various physiological, psychological, and pathological features.¹⁰ It has been found that the lower right hand 2D:4D associate with lung cancer and

earlier onset of the disease in women.¹¹ Also, the right and left hands 2D:4D have been reported to be higher in the women with the breast cancer.¹² In men with higher 2D:4D, the neck circumference which is positively correlated with the factors of the metabolic syndrome, has been shown to be higher.^{13,14} The lower digit ratio has been indicated to increase the risk of knee osteoarthritis, and the risk was higher in the females compared to the males.¹⁵ In a study of self-measured finger lengths and self-reported of age at menarche (AAM) and rate of pubertal development (RPD), the right 2D:4D was showed to be positively and negatively correlated with RPD and AAM respectively.¹⁶ In both human sex, mental rotation task scores revealed a significant negative association with the right and left hands digit ratio.¹⁷ It has been shown that homosexual women have significantly lower right-hand digit ratio compared to the heterosexual women.¹⁸ In order to declare the potential association between the prenatal testosterone and mood disorders, many studies have explored the link of the digit ratio with these diseases.¹⁰ Our present study was planned to examine if the digit ratio, as a sign of antenatal testosterone exposure, associates with depression and hopelessness status in the Iranian women.

Materials and Methods

Subjects

This is a cross-sectional study. The study sample included 358 women aged between 20 to 32 years old. All of the participants were Persian from Fars province, south west of Iran. Exclusion criteria were smoking or alcohol habit, any of disease, and being in menstruation. Sampling was performed in Shiraz city from October through December 2019 and three hundred twenty of individuals participated in our previous study too.¹⁹

Procedure and Questioners

To obtain the 2D:4D ratio, the palm side of both hands of all subjects were photographed using the same camera and with the same magnification. All hand photos were taken from the same distance. Then the length of the index and ring fingers (from the tip of the fingers to the bottom line in each finger's basal crease where the fingers join the palm) were measured on the photos using Image J software, and to calculate the 2D:4D ratio, the index finger (2D) length was divided into the ring finger (4D) length.

To evaluate the levels of depression and hopelessness, the Persian version of Beck's depression inventory II (BDI-II) and Beck's hopelessness scale (BHS) were used respectively. BDI-II is a 21- question multiple-choice self-report scale with scores ranged from 0 to 63. Higher scores indicate more severe depressive symptoms. BHS is a 20-item true or false self-report questionnaire with scores ranged from 0 to 20. Higher scores reflect greater

degree of hopelessness. The cut-off scores suggested for depression are as follows: 0 to 13, no depression; 14 to 19, mild depression; 20 to 28, moderate depression; and 29 to 63, severe depression, and the four hopelessness groups according to the score range are as follows: 0 to 3, no hopelessness; 4 to 8, mild hopelessness; 9 to 14, moderate hopelessness; and 15 to 20, severe hopelessness.^{20,21} The BDI-II-Persian as a measure of depressive symptoms in nonclinical samples from Iran has been showed to have acceptable test-retest reliability ($r=0.74$) and high internal consistency (Cronbach's alpha of 0.87).²² Also BHS has been reported to have a sufficient reliability (Cronbach's alpha of 0.89) and its construct validity was supported through significant correlations with the Patient Health Questionnaire-9, the General Health Questionnaire-12, and the Rosenberg Self-Esteem Scale.²³

Statistical Analysis

As the number of participants with severe hopelessness was just 3, this group was pooled to the moderate hopelessness one. The Student's *t* test and ANOVA was applied to assess the contrast between the study groups in respect to the continuous data. Statistical analysis was done using the SPSS version 22 at a $P < 0.05$ significant level.

Results

The study sample included 358 women aged between 20 to 32 years old (mean \pm SD: 23.2 ± 2.8). They were university graduated or student or at least achieved the high school diploma. Three hundred twenty-three of the individuals were single and 35 of them were married. The digit ratio means of the right and left hands in the depression and hopelessness study groups were given in Table 1. According to the ANOVA results, the means of 2D:4D ratio of neither right nor left hands were significantly different between the depression study groups. The same insignificant results were derived with the hopelessness study groups too.

To examine if the digit ratio associates with the severity of depression when accompanied by hopelessness, we reanalyzed the data with the following condition: we selected the individuals with neither depression nor hopelessness as group 1 and compared their digit ratio with that of individuals who had moderate or severe depression while holding a degree of hopelessness too as group 2. The difference between the digit ratio means of these two groups was examined and the results showed a significantly higher digit ratio of the right hand in the group 2 compared to the group 1, while we did not find any association with the digit ratio of the left hand (Table 2).

It should be mentioned that the score mean of depression in single participants compare to the marrieds was significantly higher (mean \pm SE for singles: 11.42 ± 0.48 , mean \pm SE for marrieds: 7.60 ± 1.04 , $t=2.565$, $P=0.002$). Therefore, to delete the possible effect of marital status, all above analysis were repeated with the sample excluded for

Table 1. The Mean of Digit Ratio in the Depression and Hopelessness Study Groups

	Variables	n	R2D:4D, Mean ± SE	L2D:4D, Mean ± SE
Depression	None	230	0.980 ± 0.002	0.976 ± 0.003
	Mild	73	0.977 ± 0.005	0.973 ± 0.004
	Moderate	40	0.981 ± 0.006	0.966 ± 0.006
	Severe	15	1.000 ± 0.006	0.983 ± 0.009
	F (df)		1.475 (3, 354)	1.048 (3, 354)
	P value		0.221	0.371
Hopelessness	None	195	0.977 ± 0.003	0.976 ± 0.003
	Mild	122	0.982 ± 0.003	0.971 ± 0.004
	Moderate/severe	41	0.990 ± 0.006	0.975 ± 0.006
	F (df)		2.317 (2, 355)	0.606 (2, 355)
	P value		0.100	0.546

2D:4D = division of the index finger length into the ring finger length (R, right hand; L, left hand).

Table 2. Association of the Digit Ratio With the Severity of Depression When Accompanied by Hopelessness

Parameters	Group 1 n=160	Group 2 n=46	t (df)	P
R2D:4D, mean ± SE	0.978 ± 0.003	0.992 ± 0.005	-2.417 (204)	0.017
L2D:4D, mean ± SE	0.978 ± 0.003	0.974 ± 0.005	0.658 (204)	0.511

Group 1: individuals with neither depression nor hopelessness, Group 2: individuals with moderate/severe depression while holding a degree of hopelessness, 2D:4D = division of the index finger length into the ring finger length (R, right hand; L, left hand).

married individuals, and no substantial difference from the above results was observed.

Discussion

In the present study the association of the digit ratio with depression and hopelessness status in women was investigated. Now there is enthralling evidence indicating relationship of psychiatric disorders with 2D:4D ratio. The digit ratio of the right and left hands was reported to be significantly differed in males and females with attention deficit and hyperactivity disorder compared to that in healthy individuals.²⁴ Children with autism spectrum disorders showed to have lower right hand digit ratio compared to the normal children.²⁵ The patients with schizophrenia showed to have significantly higher right hand digit ratio compared to the control group in both sexes; and the same association was found with the left hand too in females.²⁶ Individuals with bipolar disorder showed higher 2D:4D ratio in the right hand compared to the healthy individuals.²⁷ In this study, we did not find relation of the digit ratio with each of depression and hopelessness scores in the women; however, the data indicated the association of 2D:4D ratio of the right hand with the severity of depression when accompanied by hopelessness. Whereas there is no any report on hopelessness, a body of studies explored the relationship between depression and 2D:4D, though the findings were indecisive. Lautenbacher and Neyse reported no link between depression and digit ratio in a large German sample,²⁸ while some other studies found either positive

or negative associations.²⁹⁻³² In a study conducted on the female cynomolgus monkeys, the digit ratio of the right and left forelimb hands was significantly higher in the depressed group than that in the normal group.²⁹ Higher right hand 2D:4D ratio was reported to correlate with higher scores of depression in the women but not men.³⁰ Other study found that the scores of trait depression was higher in the men with higher digit ratio of the right hand while did not find any association in the women.³¹ In contrast, Vermeersch et al reported a negative association of the digit ratio of the right hand and depression in the males while they did not detect any association in the females.³² It is noteworthy that according to the reported evidence, the right hand seems to be more affected by androgenic outcomes for undiscovered reasons.⁷ There was a limitation to the present study. Since the study was conducted on apparently healthy individuals, the frequency of participants with severe depression and hopelessness was very low which may lead to lose the significant results when these two mood states were analyzed separately.

Conclusion

In conclusion, our data support the idea of more reactivity of the right hand to the androgen, and suggest the association of the right-hand digit ratio with the severity of depression when accompanied by hopelessness in the women. If these preliminary results are approved by further investigations, the 2D:4D ratio may use as a marker of susceptibility to the depression in the Iranian

women. As far as we know, this study is the first of its kind from Iran, although because of small sample size of the group 2, the results demand to be confirmed in larger surveys. Further inspections are required to clarify the equivocal relation between depression and digit ratio as a sign of antenatal testosterone exposure.

Ethical Approval

This study was authorized by ethics committee of Shiraz University, Iran (ECBDE-SU-9-6177616), and all participants declared their consent to participate in the study.

Competing Interests

The authors have no conflict of interest to declare.

Authors' Contribution

Obtaining the data, statistical analyses, and drafting of the manuscript, SA; Study design, revising the manuscript and approving the final manuscript, ZZ.

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