Original Communication

**THE RATIO OF SECOND FINGER TO FOURTH FINGER IN CHILDREN AND ADOLESCENTS WITH OBSESSIVE COMPULSIVE DISORDER**

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**ABSTRACT**

Objectives: The ratio of the index finger (2D) to the ring finger (4D) is different in males and females. This ratio (2D:4D) has been investigated in a variety of diseases, including autism, schizophrenia, attention deficit hyperactivity disorder, and anxiety disorders. The aim of this study was to investigate the 2D:4D ratio in children and adolescents with obsessive compulsive disorder and to detect any differences in that ratio between participants with obsessive compulsive disorder and a healthy control group. Material and Methods: The study included 30 children and adolescents diagnosed with obsessive compulsive disorder between ages 7-17 and 90 age-sex matched controls. Although there was no statistically significant difference, the 2D:4D ratio in the right hand was greater in the obsessive compulsive disorder group than in the control group.

Conclusion: With relation to obsessive compulsive disorder, some differences were detected in 2D:4D ratios of patients with obsessive compulsive disorder and control groups but there were no statistically significant results except for that of girls with obsessive compulsive disorder. Further studies are needed to fully understand the relationship between obsessive compulsive disorder and the 2D:4D ratio.

**Key Words**: 2D:4D ratio; obsessive compulsive disorder; gender differences; gonadal hormones.

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INTRODUCTION

Obsessive compulsive disorder (OCD) is a disorder composed of repetitive and intrusive thoughts, ideas, or images (obsessions) and repetitive behaviors or ideational actions (compulsions) aimed to relieve associated anxiety, both leading to marked limitation of daily activities (Kalra and Swedo, 2009). Its lifetime prevalence is 1.6% (Kessler et al, 2005). In childhood, its male/female ratio is 3:2, though some studies have reported contradictory results. Gender differences in OCD equalize by adolescence (Walitza et al, 2001). It has been reported that OCD has an earlier onset and a more insidious course in males whereas, in females, it mostly has an episodic course and an acute onset that is more related to life events (Bogetto et al, 1999). Also, alterations in sex hormones may affect the course of OCD (Flaisher-Grinberg et al, 2009).

The ratio of the index finger (2D) to the ring finger (4D), (2D:4D), differs between genders. The fourth finger tends to be longer than the second in males whereas the second finger tends to be longer than the fourth in females (Manning et al, 2000). The mean 2D:4D ratio has been reported as 0.98 in males and 1 in females. This difference is reportedly more prominent in the right hand (Hönekopp et al, 2010). It can be detected starting from the prenatal period (Malas et al, 2006) and is determined by in utero factors (Ronalds et al, 2002). A negative correlation has been reported between amniotic fluid fetal testosterone/fetal estradiol ratios and 2D:4D ratios by Lutchmaya et al (2004). In addition, it has been suggested that the difference in 2D:4D ratios between males and females may be secondary to perinatal androgens (McIntyre, 2006). Manning et al (1998) showed that an inverse relationship exists between 2D:4D ratio, sperm count, and blood testosterone concentration in males. The same study also demonstrated that luteinizing hormone, estrogen, and prolactin levels in males and females are proportional to 2D:4D ratio. Fink et al (2004) reported a negative correlation between waist-to- chest ratio and 2D:4D in females. Manning et al (2003) investigated the relationship between 2D:4D and offspring number, reporting a negative relationship between 2D:4D ratio and offspring number in males and a positive relationship between 2D:4D ratio and offspring number in females.

Studies have investigated the relationships between 2D:4D ratio and a number of conditions: congenital adrenal hyperplasia (Brown et al, 2002; Okten et al, 2002), breast cancer (Muller et al, 2012), prostate cancer (Muller et al, 2011), and atherosclerotic plaque progression (Ozdogmus et al, 2010). In addition, various studies have investigated the relationship between 2D:4D and sexual orientation (Manning et al, 2003; Schneider et al, 2006) personality characteristics (Austin et al, 2001), sportive success (De la Cruz-Sanchez et al, 2015), fine motor skills and the speed of fine motor activity (Wang et al, 2016) and behavioral characteristics (Benderlioglu and Nelson, 2004; Millet and Dewitte, 2006). Furthermore, 2D:4D ratio has been examined in relation to some psychiatric disorders.

Figure 1- The length of index finger and ring finger, 2d: The length of index finger, 4d: The length of ring finger.
boys with attention deficit hyperactivity disorder had a more masculine 2D:4D ratio than controls; they also reported that symptoms of attention deficit hyperactivity disorder were higher in children with a more masculine right hand 2D:4D ratio. Manning et al (2001) found a lower 2D:4D ratio in children with autism, their healthy siblings, and their parents than that in controls. That study also reported higher 2D:4D ratios in children with Asperger Syndrome (AS) than children with autism, although the level was lower than that of controls. Al-Zaied et al (2015) also reported lower 2D:4D ratio in boys with autism. Bruin et al (2006) reported a lower 2D:4D ratio in males with autism and AS than in males with anxiety disorders. In the same study, a lower 2D:4D ratio was reported in males with attention deficit hyperactivity disorder and oppositional defiant disorder than in males with anxiety disorders. A meta-analysis has shown that patients with autistic spectrum disorder tend to have more masculine 2D:4D ratios than those without (Teatero and Netley, 2013).

Although 2D:4D ratio has been investigated in relation to several psychiatric disorders, research investigating the relationship of prenatal androgens and testosterone with the development of OCD and 2D:4D ratio in OCD patients is scarce. The aim of this study was to investigate 2D:4D ratio in children and adolescents with OCD and to detect if any differences were present in the 2D:4D ratios of children and adolescents with OCD when compared to those of healthy controls.

**MATERIAL AND METHODS**

This study included 30 children and adolescent patients aged 7–17 years and diagnosed with OCD and 90 age- (p=0.780) and sex-matched (p=1.000) healthy controls. The mean ages of the patient and control groups were 12.9±2.7 and 12.7±2.7 years, respectively. This study was a case control study and there were 17 males and 13 females in the patient group and 51 males and 39 females in the control group. OCD diagnosis was based on Diagnostic and Statistical Manual of Mental Disorders IV Text Revision (DSM IV-TR) diagnostic criteria (American Psychiatric Association, 2000; Amerikan Psikiyatri Birliği, 2001) after obtaining patient history from each family, interviewing each patient and investigating their psychiatric status. Two expert child psychiatrists made the diagnosis. The patient group included child and adolescents who applied to Gazi University Faculty of Medicine Child and Adolescent Psychiatry Department and who were diagnosed with OCD for the first time without co-morbidities between December 2011 and November 2012. The control group consisted in children and adolescents attending a primary school and a high school in Ankara, respectively, who had not been diagnosed with any physical and psychiatric disorders. Hand length, hand width, and finger length were measured with a digital compass after the evaluation. All measurements were performed twice by different researchers. The length of index finger and ring finger had shown in Figure 1.

Data analysis was performed by using SPSS for Windows, version 11.5 (SPSS Inc., Chicago, IL, United States). The Kolmogorov-Smirnov test was used to determine whether the continuous variables were normally distributed. Data were shown as the mean ± SD or the number of cases, where applicable. Meanwhile, the mean differences between the case and control groups were compared using Student’s t-test. Pearson’s chi-squared test was used for nominal data. A p value of less than 0.05 was considered statistically significant. For all possible multiple comparisons, the Bonferroni correction was applied for controlling Type I errors.

![Graphic 1](image.png)

**RESULTS**

Although the 2D:4D ratio was higher in the OCD group, there was no statistically significant difference between the OCD and control groups with respect to right (p=0.054) and left hand 2D:4D ratio (p=0.219). Comparison of 2D:4D ratios between the control and OCD groups is shown in Graphic 1.

Analysis of 2D:4D ratio in boys and girls separately revealed that right hand (p=0.724) and left hand (p=0.932) 2D:4D ratios were not different between males in the patient and control
But right (p=0.008) and left hand (p=0.010) 2D:4D ratios were significantly higher in females in the patient group than in females in the control group. Comparison of 2D:4D ratios between the control and OCD groups in boys and girls is shown in Graphic 2. Table 1 shows the 2D:4D ratios and statistical evaluation results for all groups.

Table 1 - 2D:4D ratios in patient and control groups. ¶ Student’s t test. † According to the Bonferroni correction p <0.025 was considered as statistically significant. ‡ According to the Bonferroni correction p<0.0125 was considered as statistically significant.
DISCUSSION

The 2D:4D ratio has been investigated in various disorders or characteristics in which gender differences are present. Psychiatric diseases, autism, schizophrenia and attention deficit hyperactivity disorder have been reportedly associated to a lower ratio (Venkatasubramanian et al, 2011; Martel et al, 2008; Manning et al, 2001; Teatero and Netley, 2013). In depression, on the other hand, this ratio is reversed (Bailey and Hurd, 2005). Bruin et al (2006) reported that anxiety disorder was associated more with a “feminine type” of finger ratio than other pediatric psychiatric disorders. Williams et al (2003) demonstrated that boys experiencing anxiety, fears, somatic complaints, and emotional problems had a higher 2D:4D ratio. Our findings showed that 2D:4D ratio in female children diagnosed with OCD was higher than that of the control group and, although there was no statistically significant difference between the OCD and control groups, 2D:4D ratio in the OCD group tended to be higher. Although the small sample size and the lack of statistical significance in OCD and control groups, the results of our study seem more similar to the anxiety disorders. This results may be interpreted that OCD has a similar etiology with anxiety disorders in terms of 2D:4D ratio.

Abramson et al (2005) found significant links between a specific kind of repetitive behavior in probands with autism and the Y-BOCS (Yale-Brown Obsessive Compulsive Scale, an OCD index) scores of their parents. Bejerot (2007) proposed that OCD is related to autism spectrum disorders and is on a continuum from normal personality to severely autistic personality. Several studies have investigated 2D:4D ratios in autism (Manning et al, 2001; Bruin et al, 2006; Teatero and Netley, 2013) and they showed a lower 2D:4D ratio in patients with autism. Although there are some similarities between autism and OCD, we did not detect similar tendencies in the 2D:4D ratios of patients with OCD and healthy controls.

Our findings showed that the 2D:4D ratio in female children diagnosed with OCD was higher than that of female children in the control group. Male patients in both groups, on the other hand, had statistically similar 2D:4D ratios and finger length. Fink et al (2006) reported a directly proportional relationship between neurotic personality characteristics and 2D:4D ratio in females, whereas such a relationship did not exist in males. Lutchmaya et al (2004) reported an inverse relationship between fetal testosterone/fetal estrogen ratios and 2D:4D. The results of our study may be interpreted that a lowered fetal testosterone/fetal estrogen ratio may be playing an important role in the etiology of OCD especially in female patients.

We did not detect a difference in 2D:4D ratio in male patients diagnosed with OCD. A study with adult healthy females and males had showed that 2D:4D ratio increased as trait anxiety level increased in males (Evardone and Alexander, 2009). This result suggests that there may be a relationship between 2D:4D ratio and anxiety level in males. Similarly, 2D:4D may be expected to rise in men with severe OCD symptoms. However, this could not be clarified in our study because the study did not employ any severity-related scales. Moreover, there was no difference between 2D:4D ratio in male children diagnosed with OCD and those in the control group, whereas a significant increase was observed in female children. This may suggest a different etiopathogenesis of male OCD than that of its female counterpart. It is well known that there are differences between the clinical characteristics of OCD in males and females: the disorder has an earlier onset and a more chronic course in males, and sexual and religious obsessions are more common in men (Torresan et al, 2009; Mathis et al., 2011). When such differences are taken into account, it may be hypothesized that OCD in male and female children may be childhood reflections of disorders with different pathways. Large-scale studies are needed to confirm this difference.

The most important limitation of our study was the small size of the patient group. In addition, our study lacked a structured interview scale and a disease severity assessment. Future large-scale studies using a structured interview scale will expand our knowledge of this condition. Allaway et al (2009) reported that the computer assisted analysis of 2d:4d ratio is more reliable that the other measurement techniques. We used digital compass for the measurements and we made two measurements by different researchers. These techniques could reduce the reliability and repeatability of our measurements.

As conclusion; in our study we found that females with OCD had a higher 2D:4D ratio than the females in the control group, but we could not detect the same difference between boys and OCD-healthy control groups. The results of our study showed that there may be a similar tendency between OCD and anxiety disorders in terms of 2D:4D ratio. Novel studies with larger samples and disease severity assessment scales are needed to fully understand the effect of prenatal androgens and the causes of the gender differences observed in OCD.
Conflict of Interest
None

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Ethical approval
This study was approved by Gazi University Ethical Committee

Informed consent
Informed consent of the children and parents’ were obtained.

Contributions
This paper has not been submitted/published elsewhere in the same form, in English or in any other language. This paper is the original work of the authors. The data collection was done by Dr. H.A.T. and Dr. M.B., the statistical analysis was done by Dr. H.A.T., Dr. E.I. and Dr.M.B and all of the authors contributed to the study planning, interpretation of the data and paper writing.

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