

# Gender differences in the symptoms and physiological basis of Obsessive-Compulsive Disorder

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**Abstract.** Obsessive-compulsive disorder (OCD) is an anxiety disorder related to repetitive behaviors and intrusive thoughts. Individuals with OCD experience conscious, self-imposed compulsions and counter-compulsions, which result in high levels of anxiety and difficulties in social interactions. OCD is a common mental disorder with onset often in adolescence. Gender differences in OCD exist, with males reporting earlier symptom onset, and females experiencing symptoms during adolescence, pregnancy, or postpartum, particularly related to contamination and/or aggressive obsessions. Neurobiological factors play a role in OCD etiology. Genetic studies show hereditary tendencies, with gender differences observed. Brain structure research identifies differences between male and female patients. Dopamine and plasma norepinephrine are implicated in OCD pathogenesis. Understanding gender differences is crucial for OCD diagnosis and treatment. Further research is needed to validate and explain these differences in order to inform advancements in OCD treatment approaches. This paper summarizes and discusses the relationship between OCD and gender, focusing on epidemiological characteristics, symptoms, and physiological basis of OCD, emphasizing gender differences. Future research directions in the field of OCD are presented.

**Keywords:** Obsessive-Compulsive Disorder, Gender Differences, Compulsive Behavior, Obsessive-Compulsive Circuitry.

## 1. Introduction

Obsessive-compulsive disorder (OCD) is a prevalent mental disorder that has a significant impact on individuals' lives and functioning. The Diagnostic and Statistical Manual of Mental Disorders (DSM-5) provides an overview of OCD, which can be summarized as follows [1]: OCD is a mental disorder characterized by recurrent obsessions and/or compulsions. Obsessions are intrusive, persistent, and meaningless thoughts, impulses, or images that are uncontrollable, while compulsions are repetitive behaviors aimed at reducing or preventing the distress and anxiety associated with obsessions.

Under the diagnostic context of DSM-5, OCD is diagnosed based on additional details and specific criteria for different subtypes of OCD (e.g., contamination, checking compulsions). These criteria provide clinicians with guidance for diagnosing and classifying OCD.

However, there remain many mysteries regarding its etiology and mechanisms. Previous research has mainly focused on exploring psychological factors, genetics, and neurobiological mechanisms, but the specific causes and pathological mechanisms of OCD remain incompletely understood. Over the past few decades, numerous studies have attempted to elucidate the brain morphological characteristics

and functional abnormalities of OCD using techniques such as neuroimaging, genetics, and neurochemistry, aiming to better understand its pathophysiology. However, there are still numerous controversial and inconsistent research findings regarding whether there are gender differences in brain structural and functional changes among OCD patients and the associations between gender factors and symptoms.

Therefore, this paper aims to provide an in-depth exploration of the research progress on gender differences in OCD from the perspectives of epidemiological factors and main symptoms, summarize the gender differences in brain morphological characteristics and relevant brain structures and circuits among male and female OCD patients, and explore the relationship between these research findings and clinical symptoms. By examining the conclusions drawn from studies utilizing advanced neuroimaging techniques and systematic analysis methods, this paper aims to enhance the understanding of the neurobiological mechanisms of OCD and provide a more accurate and effective basis for clinical diagnosis and treatment.

## **2. Overview of Obsessive-Compulsive Disorder (OCD)**

### *2.1. Epidemiological Characteristics of OCD*

Based on epidemiological surveys, OCD is a relatively common mental disorder, with a global prevalence rate estimated to be around 2-3%. In a statistical study conducted in China from 2012 to 2019, researchers led by YUEQIN HUANG observed a lifetime prevalence rate of 2.4% for OCD [2].

The onset of the disorder commonly occurs during adolescence, and there are some differences between males and females. However, when considering the overall prevalence rates, there is no significant disparity between males and females in terms of the frequency or occurrence of OCD. A study conducted by Shaista Jabeen et al. in 2020 also found no substantial gender difference in the frequency of OCD [3].

### *2.2. Major Symptoms of OCD*

OCD is a mental disorder defined by obsessions and compulsions. Obsessions refer to intrusive, uncontrollable, irrational, and unnecessary thoughts, ideas, or impulses. Compulsions are repetitive, ritualistic, and compelled behaviors performed by individuals to alleviate the anxiety associated with obsessions, such as repeated cleaning, checking, or counting [4]. The symptoms used to characterize OCD are diverse and may include various intrusive thoughts, obsessions, rituals, and compulsions. The symptom patterns can vary widely among OCD patients and may not overlap between two individuals [5]. Researchers have conducted in-depth investigations into many aspects of OCD. Among them, the study of etiology and pathogenesis is an important research direction. Neuroimaging studies have found structural and functional abnormalities in the brains of OCD patients, particularly in the cortical and subcortical areas. Additionally, studies focusing on neurotransmitters have indicated that changes in plasma norepinephrine and dopamine levels are related to the occurrence of OCD symptoms.

Besides functional abnormalities and neurotransmitter changes, psychological and social factors, as well as genetic factors, have also received significant attention. Many studies highlight the importance of psychological and social factors such as individual environments, life events, and coping strategies in the occurrence and maintenance of OCD. Furthermore, research indicates a contribution of familial genetics to OCD, with a higher risk of OCD among certain family members. Lin Liangjun et al. in their review of genetic and epigenetic factors in OCD proposed that family, twin, and large-scale population studies have shown that genetic factors have an influence on the occurrence of OCD. Susceptibility genetic factors related to OCD include large chromosomal structural variations, de novo mutations, and common single-nucleotide polymorphism sites. Environmental factors, such as childhood trauma and stress, may also play a significant role in the development of OCD [6].

In addition to functional abnormalities and neurotransmitter changes, psychological and social factors, as well as genetic factors, are also important areas of research. Further investigations can help

enhance our understanding of the mechanisms of OCD and provide more effective approaches for diagnosis and treatment.

### *2.3. Current Research on Gender Differences in OCD*

According to the research conducted by Mathes et al., gender differences in the prevalence of OCD have been observed across different stages of life. During childhood, OCD is more commonly reported in males, while in adolescence and adulthood, it becomes more prevalent in females. In terms of symptom onset, it is observed that males usually experience symptoms at an earlier age, whereas females often describe symptoms emerging during or after puberty, pregnancy, and are more prone to obsessions related to contamination and/or aggression. Additionally, females frequently report higher levels of depression and anxiety. However, when it comes to outcomes of treatment in OCD research, there are no reported gender differences [7].

Similar patterns have been observed in studies focusing on adult OCD patients, where no significant gender differences in the proportion of OCD patients are found [8]. Subsequent research by Kenyon et al. [9] supports the classification of early-onset OCD as a predictor of the severity of symptoms, with males tending to have an earlier onset and therefore more severe symptoms.

Regarding the clinical features of OCD, Labad et al. [10] proposed that there are sex-related differences in OCD dimensions. Male OCD patients are more likely to have obsessions related to sexuality, religion, and symmetry/order, while females are more likely to exhibit compulsions related to contamination and cleaning. The study also found that OCD symptoms have a greater negative impact on male patients. This clinical phenomenon may involve complex interactions between different environmental and biological factors.

## **3. Biophysical Basis of Obsessive-Compulsive Disorder (OCD) Symptoms**

### *3.1. Overview of Biophysical Basis of OCD Symptoms Research*

Obsessive-Compulsive Disorder (OCD) is a multifaceted mental disorder with diverse biophysical factors at play. Neuroimaging techniques, such as structural magnetic resonance imaging (MRI) and diffusion tensor imaging (DTI), have unveiled variances in brain structure and function among individuals diagnosed with OCD. A recent study conducted by Zhang et al. provided a comprehensive overview of the brain changes associated with OCD, encompassing alterations in brain volume, cortical changes, and disruptions in white matter integrity and fiber trajectories [11].

Studies have consistently demonstrated abnormal brain activity in specific regions, including the prefrontal cortex and cingulate gyrus, during the execution of compulsive behaviors in individuals with OCD. Dysfunction within the basal ganglia and the related cortico-basal ganglia circuits, as highlighted by Graybiel et al., has emerged as a common neurobiological characteristic of both OCD and OC spectrum disorders, which encompasses conditions such as Tourette syndrome. This suggests that the primary symptoms of OCD likely have a physiological and brain structural basis [12]. Additionally, a study conducted by Zhang et al. observed irregular spontaneous activity in the cerebellum of individuals with OCD. They also found decreased functional connectivity between the cerebellum and a brain circuit called the cortico-striato-thalamo-cortical (CSTC) loop, and these observations were associated with the severity of symptoms. The researchers suggested that the cerebellum plays a significant role in the underlying mechanisms of OCD, and changes in the connectivity between the cerebellum and CSTC loop might contribute to the development of the disorder [13].

Furthermore, studies have implicated the involvement of neurotransmitters such as serotonin, dopamine, glutamate, and gamma-aminobutyric acid (GABA) in OCD. A study by Biria et al. revealed associations between OCD and clinical OCD symptoms with neurochemical markers in the anterior cingulate cortex and supplementary motor area, indicating an imbalance in excitatory/inhibitory neurotransmitters in these regions. The balance of glutamate and GABA metabolism in particular was found to be linked to the occurrence of OCD [14].

OCD is a condition that is affected by a combination of genetic and environmental influences. Scientific studies have demonstrated that genetic variations, including both common and rare ones, contribute to the development of OCD. However, pinpointing the exact genetic locations associated with OCD has been difficult due to limitations in the size of the sample used in research.

### *3.2. Gender Differences in OCD Based on Biophysical Basis*

Neuroimaging studies have detected atypical brain activity in specific regions, such as the prefrontal cortex, when individuals with OCD engage in compulsive behaviors. However, the structural causes of gender differences in OCD remain a subject of debate. Some studies have reported variations in the volume of the cingulate gyrus among male patients, but no consistent conclusions have been reached.

Gender and the variability shown in neuroimaging investigations were the focus of a research by den Braber et al. Inconsistent results from earlier studies have shown that people with OCD may have anomalies in the cortico-striato-thalamo-cortical (CSTC) loop. The dimensions of the dizygotic twins' OCD symptoms were used to classify the 24 pairs of MRI images that the researchers examined. Using voxel-based morphometry, they looked at how the presence of OCD symptoms in various genders interacted with gray matter volume. In the left middle temporal region, right middle temporal gyrus, and right anterior cingulate gyrus, gender interaction-induced changes in symptoms were detected in the research [15].

A research by Khramtsova et al. revealed two genes (GRID2 and GPR135) that showed distinct connections with females, although no such relationships were seen in men. There were no appreciable differences between males and females in the overall genetic correlate of OCD at the level of the individual variation, though. Estimates of OCD heredity also showed no discernible gender differences [16]. There may be a connection between underlying genetic inequalities and the observed gender variations in the onset and presentation of symptoms. This study also suggests that, despite the strong link between male and female OCD, there is little evidence to support a sex-dependent liability hypothesis. It is noteworthy that the two genes (GRID2, GPR135) linked to female OCD did not show links to male OCD [16]. These gender-specific OCD-related genes may help explain why symptoms differ between genders, laying the groundwork for further study into the genetic causes of OCD symptoms, which is still an active field of research.

## **4. Conclusion**

Research on the gender differences in the epidemiological characteristics, main symptoms, and physiological basis of Obsessive-Compulsive Disorder (OCD) provides us with a deeper understanding of this disorder. While many studies have explored the sex differences and physiological basis of OCD, the field is still evolving, with conflicting results, a lack of consistent conclusions, and the need for further research to elucidate the mechanisms underlying these differences. There are limitations to the current research on gender differences in OCD, as well as prospects for further investigation.

Firstly, the research on gender differences is limited to the current understanding of the physiological basis of OCD. Given that the etiology of OCD is still not fully understood, it is important to further investigate the mechanisms behind these differences. Further understanding is needed regarding the relationship between gender differences and the pathogenesis of OCD, including the interaction between neurobiological factors such as genetics, brain structure, and neurotransmitters.

Secondly, there are limitations in the research methods employed. Existing studies often use cross-sectional designs, which do not explore the dynamic changes of gender differences in the development of OCD. Introducing longitudinal studies can better understand how gender differences evolve over time. Future research can delve into the relationship between gender differences and clinical manifestations, treatment response, and prognosis of OCD. This can help improve personalized interventions and treatment strategies to meet the needs of patients of different genders.

Additionally, gender differences in OCD may be influenced by cultural, social, and psychological factors. Therefore, combining psychosocial factors with neurobiological factors can provide a more comprehensive understanding of the role of gender differences in the onset and course of OCD.

While there have been many studies focused on gender differences in the epidemiological characteristics, main symptoms, and physiological basis of OCD, there are still limitations. Future research should focus on investigating the mechanisms behind gender differences and employ more comprehensive and longitudinal study designs to better understand the role of gender in OCD and provide more accurate guidance for personalized interventions and treatments.

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