REVIEW ARTICLE

VISUAL PROCESSING DEFICITS IN OBSESSIVE-COMPULSIVE DISORDER: A INTEGRATIVE REVIEW

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Highlights: (1) OCD patients present impacts visual processing. (2) These effects are shown by more errors and longer latency in antisaccade tasks. (3) Inhibitory control can be related to these differences.

PRE-PROOF
(as accepted)
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ABSTRACT

Objectives: The mechanisms underlying visual processing impairment in Obsessive-Compulsive Disorder are still insufficiently understood. The present study aimed to conduct an integrative review regarding how visual processing is affected in individuals with Obsessive-Compulsive Disorder, as well as the implications of these alterations for executive functions. **Method:** The review used the PRISMA normative guidelines, including studies published between 2015 and 2024, indexed in the PubMed, Scopus, Lilacs and PsycINFO databases. The selection and data extraction process was performed independently and blindly by two authors,

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following predefined eligibility criteria. **Results:** The final sample included 14 studies, most of which identified significant impairment in antisaccade tasks in individuals with Obsessive-Compulsive Disorder. **Conclusions:** These studies provide evidence that specific attentional biases are linked to Obsessive-Compulsive Disorder symptomatology and that these alterations may be associated with deficits in inhibitory control, contributing to symptomatology persistence.

Keywords: Obsessive-Compulsive Disorder; Visual Processing; Executive Function.

DÉFICITS NO PROCESSAMENTO VISUAL NO TRANSTORNO OBSSESSIVO-COMPULSIVO: UMA REVISÃO INTEGRATIVA

RESUMO

Objetivos: Os mecanismos subjacentes ao comprometimento do processamento visual no Transtorno Obsessivo-Compulsivo ainda são insuficientemente compreendidos. O presente estudo objetivou realizar uma revisão integrativa acerca de como o processamento visual é afetado em indivíduos com Transtorno Obsessivo-Compulsivo, bem como as implicações dessas alterações para as funções executivas. **Método:** A revisão utilizou as diretrizes normativas PRISMA, incluindo estudos publicados entre 2015 e 2024, indexados nas bases de dados PubMed, Scopus, Lilacs e PsycINFO. O processo de seleção e extração de dados foi realizado de forma independente e cega por dois autores, seguindo critérios de elegibilidade predefinidos. **Resultados:** A amostra final incluiu 14 estudos, a maioria dos quais identificou comprometimento significativo em tarefas antisacadas em indivíduos com Transtorno Obsessivo-Compulsivo. **Conclusões:** Esses estudos fornecem evidências de que vieses atencionais específicos estão ligados à sintomatologia do Transtorno Obsessivo-Compulsivo e que alterações podem estar associadas a déficits no controle inibitório, contribuindo para a persistência da sintomatologia.

Palavras-chave: Transtorno Obsessivo-Compulsivo; Processamento visual; Função Executiva.

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INTRODUCTION

Obsessive-Compulsive Disorder (OCD) is a chronic and debilitating mental disorder characterized by the presence of obsessions and compulsions. Obsessions are repetitive, intrusive, and unwanted thoughts, images, or impulses that cause significant anxiety or discomfort [(1)]. Furthermore, compulsions are repetitive behaviors or mental acts that the person feels compelled to perform in order to try to reduce the anxiety caused by the obsessions or to prevent something bad from happening[(2)].

Eye tracking makes it possible to obtain precise data on participants' eye movements, allowing the analysis of how visual attention is distributed across different stimuli. This analysis is especially valuable in psychological research, where visual focus can provide significant insights into cognitive processes such as attention, memory, and perception[(3,4)].

After exposure to a visual stimulus in the eye tracker, the disintegration of a complex object into fundamental subunits occurs in the retino-geniculo-striate pathway (that connects the retina to the striate visual cortex via the lateral geniculate nucleus)[(5)]. In this pathway, each cell activates in response to certain aspects of the image.

Basic pro- and antisaccade tasks, which require participants to make a saccade toward or away from the location of a suddenly appearing target, have proven to be a particularly useful tool for investigating the neurocognitive consequences of several psychiatric disorders[(6)]. The antisaccade task, in particular, provides a reliable measure of factors related to the resolution of the conflict between volitional and reflexive behavioral responses[(7)].

Studies suggest that individuals with OCD exhibit differences in visual processing, including increased attention to specific details, difficulty processing information, and sensitivity to threatening stimuli[(8,9)]. Specifically, visual search in OCD patients is characterized by abnormal subliminal processing of obsession-related information, as well as an impaired ability to inhibit irrelevant stimuli[(10)].

In this sense, the present study aimed to conduct an integrative review regarding how visual processing is affected in individuals with Obsessive-Compulsive Disorder, as well as the implications of these alterations for executive functions. It is expected that the insights obtained can contribute to the advancement of knowledge about the interaction between OCD and visual functions, providing a solid basis for the improvement of diagnostic, treatment and monitoring strategies for these patients. In addition, it can serve as a reference for future studies on visual processing and OCD.

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METHOD

The present review had the following research question: how is visual processing affected in individuals with OCD?

Eligibility Criteria

To this review, we considered articles published in the last ten years (2015-2024), written in English, Spanish or Portuguese, that aimed to evaluate visual processing in individuals with OCD. Articles that did not present empirical data, such as literature reviews and theoretical articles, as well as those using an animal model as the basis for the results were excluded.

Search Strategy

After analyzing the possible descriptors, the terms “OCD AND visual processing OR eye-tracking” were selected for the searches. These descriptors should appear in the title, abstract or keywords of the study (this was specified in the filters present in the databases, according to availability).

The search was conducted in the Pubmed, Scopus, Lilacs and PsycInfo databases between April 16 and 20, 2024. In each platform, specific filters were applied to select the studies according to the established eligibility criteria (see Table 1). In total, 126 studies were initially identified, of which 14 were selected to compose the final sample (retention rate: 11.11% (see Figure 1).

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Table 1. Database Search Details.

Database (Period)	Search Strategy	Initial Results (Only basic filters)	Results after Abstract Analysis (Duplicates)
Pubmed (04/16/2024–04/17/2024)	OCD AND visual processing OR eye-tracking → 2015–2024 → additional filters: species = human, language = portuguese, english, spanish, exclude preprints.	27	13 (N/A)
Scopus (04/17/2024–04/19/2024)	OCD AND visual processing OR eye-tracking → 2015–2024 → additional filters: document type = article, language = language = portuguese, english, spanish.	78	1 (17)
Lilacs (04/19/24 – 04/20/24)	OCD AND visual processing OR eye-tracking → 2015–2024 → additional filters: document type = article, language = language = portuguese, english, spanish.	20	0 (8)
PsycInfo (04/20/24)	OCD AND visual processing OR eye-tracking → 2015-2024 → additional filters: document type = article.	1	0

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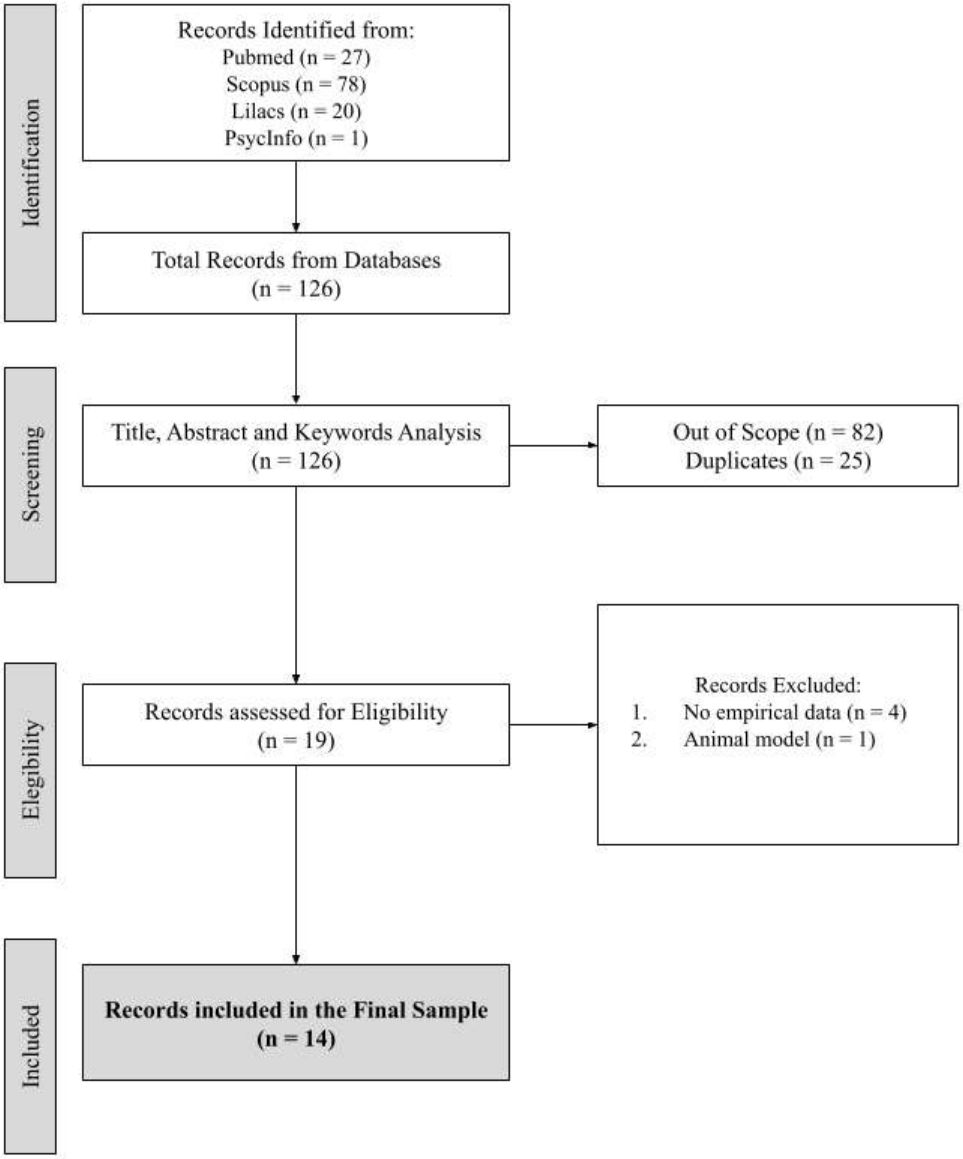
Figure 1. Prisma Diagram.



Data Analysis

Initially, the articles on the final sample were organized by bibliometric data (e.g., author, year) and research details (e.g., objective, sample). This information was tabulated. Next, the sample underwent a qualitative synthesis, focusing on two main questions: does OCD impact visual processing? Do other executive functions are involved in this relationship?

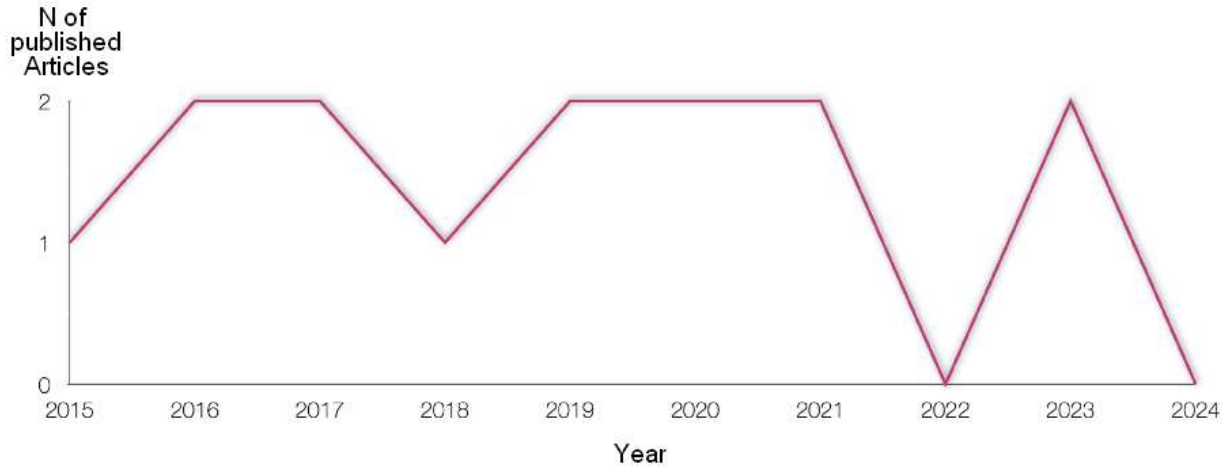
In addition to these analyses, abstracts were analyzed using Voyant Tools[11]. This is a free, online software that enables textual analysis. Specifically, frequency analysis (and the

resulting word cloud) was used to highlight important words and concepts from the selected studies.

RESULTS

The sample consisted of 14 studies, published between 2015 and 2024 (Table 2), with a higher number of publications in the first five years (8 compared to 6 between 2020-2024) (Figure 2). All studies were published in English. The sample size varied significantly, ranging from 21 and 218 participants.

Figure 2. Published studies, by Year.



In most studies (92.86%), the Yale-Brown Scale (Y-BOCS) was used to assess the severity of obsessive-compulsive symptoms, except for one[12]. In addition to this measure, the OCI-R questionnaire was applied in three studies[8,13-14] to assess OCD symptoms. The OCI-R consists of 18 items that assess different areas of obsessions and compulsions, such as fear of contamination, checking, order, and symmetry.

To assess visual processing, the Eye Link and iView X eye trackers were the most commonly used[3, 7-8, 13]. Both offer high accuracy and sampling rates to capture eye movements in detail.

Table 2. Bibliometric Data.

Authors (Year)	Title	Aim	Sample	Results	OCD measure / Eye Tracker
Chapman et al. (2023)	Early visual perceptual processing is altered in obsessive-compulsive disorder	To investigate the visual processing flow in OCD compared to age-matched HC.	25 OCD patients, and 35 HC	OCD patients present alterations in visual perceptual processing, indicating a possible neurobiological basis for symptoms observed in OCD.	Y-BOCS/ BioSemi
Khayrullina et al. (2023)	Increased error rate and delayed response to negative emotional stimuli in antisaccade task in obsessive-compulsive disorder	To investigate the neurophysiological correlates of cognitive control and emotional regulation in OCD using a new modification of the antisaccade task.	32 OCD patients, and 30 HC	OCD patients showed more errors and slower antisaccades to negative stimuli compared to HC, indicating that an attentional bias toward these negative stimuli impairs inhibitory control in OCD.	Y-BOCS/ EyeLink Portable Duo
Narayanaswamy et al. (2021)	Antisaccade task performance in obsessive-compulsive disorder and its clinical correlates	To examine the parameters and relationship between antisaccade eye movement parameters of OCD patients compared with HC.	65 OCD patients, and 57 HC	OCD patients, compared to HC, showed a significantly higher number of errors and final eye position errors in the antisaccade task.	Y-BOCS e CGI-S/ Eye Link
Kim et al. (2021)	Eye movement as a biomarker of impaired organizational strategies during visual memory encoding in obsessive–compulsive disorder	To identify biomarkers of impaired organizational strategies during visual encoding processes in OCD patients.	104 OCD patients, and 114 HC	OCD patients exhibited impaired organizational strategies, evidenced by less efficient and less exploratory fixation patterns compared to HC.	Y-BOCS/EyeLink
Hu et al. (2020)	Investigating behavior inhibition in obsessive-compulsive disorder: Evidence from eye movements	To investigate the role of inhibition failure in OCD through an eye-tracking experiment.	25 OCD patients, 25 GAD patients, and 25 HC	Latency and antisaccade error rates for OCD were significantly higher than those observed in GAD patients and HC.	Y-BOCS/ iView X- RED

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Tümkaya et al. (2020)	Impaired Spontaneous Attention to Gaze Cueing in Obsessive- Compulsive Disorder: Eye Tracking Study	To determine whether OCD patients differed from HC in paying spontaneous attention to visual cues.	10 OCD patients, and 11 HC	OCD patients are less likely to spontaneously follow gaze cues compared to HC.	Y-BOCS/ ViewPoint eye tracking
Ray et al. (2019)	Eye movement tracking in pediatric obsessive compulsive disorder	Identifying a potential biomarker in pediatric OCD using eye tracking.	36 OCD patients, and 31 HC	There was no significant difference between OCD patients and HC in error rate, peak velocity, position gain, and latency measures.	EyeLink 1000/ -
Claudius et al. (2019)	Attentional biases of vigilance and maintenance in obsessive-compulsive disorder: An eye-tracking study	Measuring attentional biases in patients with various OCD subtypes using eye tracking.	28 OCD patients, and 21 HC	Patients with checking-related OCD symptoms showed a maintenance bias but no vigilance bias in regard to checking-related compared to neutral stimuli.	Y-BOCS e OCI-R/ iViewX RED-II
Botta et al. (2018)	Visual search for verbal material in patients with obsessive–compulsive disorder	To investigate attentional mechanisms in OCD by analyzing how visual search processes are modulated by normal and obsession-related distracting information in OCD patients.	36 OCD patients, and 36 HC	OCD patients required more fixations on non-target words and more time than HC to perform visual search.	Y-BOCS/ TOBII 1750
Liu et al. (2017)	Pathophysiology of refractory obsessive-compulsive disorder: A study of visual search combined with overactive performance monitoring	To evaluate whole-brain neuroanatomical abnormalities and visual processing in patients with refractory OCD.	21 OCD patients, and 13 HC	Patients with refractory OCD showed a significantly higher number of saccades and prolonged latencies compared to HC.	Y-BOCS, OCI-R/ EyeLink 1000

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Stern et al. (2017)	Switching between internally and externally focused attention in obsessive-compulsive disorder: Abnormal visual cortex activation and connectivity	To investigate behavior, brain activation, and functional connectivity to test the hypothesis that patients with OCD will show altered neural processing of external information compared to HC.	18 OCD patients, and 18 HC	OCD patients made more errors and showed reduced activation of the superior and inferior occipital cortex, thalamus, and putamen, indicating an OCD-related impairment in visual processing of external stimuli.	Y-BOCS/ Magnetic resonance imaging
Domilou et al. (2016)	Shared and distinct oculomotor function deficits in schizophrenia and obsessive-compulsive disorder	To examine whether schizophrenia and OCD share the same oculomotor function profile or whether there is a clear distinction for the two psychiatric conditions.	34 OCD patients, 44 schizophrenia patients, and 45 HC	A specific deficit in fixation stability was observed only for OCD patients, pointing to a deficit in the frontostriatal network controlling fixation.	Y-BOCS/ N/A
Toffolo et al. (2016)	Patients With Obsessive-Compulsive Disorder Check Excessively in Response to Mild Uncertainty	Investigate whether general checking is specific to OCD when only mild uncertainty is induced.	31 OCD patients, 26 anxiety patients, and 31 HC	Patients with OCD spent more time on visual search and performed more fixations than anxiety patients and HC.	Y-BOCS, OCI-R/ EyeTech TM3
Bradley et al. (2015)	Obsessive Compulsive symptoms and attentional bias: An eye-tracking methodology	Explore attentional biases in relation to obsessive-compulsive symptoms.	85 OCD patients	OCD severity moderately predicted higher frequency and duration of corrections to OCD-related stimuli, reflecting a maintenance attentional bias.	Y-BOCS/ View X Remote

Notes: BAI: Beck Anxiety Inventory; BDI: Beck Depression Inventory, Second Edition; CGI-S: Clinical Global Impressions Scale; GAD: Generalized Anxiety Disorder; HC: Healthy Controls; HAM-A: Hamilton Anxiety Rating Scale; HAM-D: Hamilton Depression Rating Scale; IUS: Intolerance of Uncertainty Scale; MINI: Mini International Neuropsychiatric Interview; MINI-KID: International Neuropsychiatric Interview for Children and Adolescents; N/A: not applicable; OCI-R: Obsessive–Compulsive Inventory-Revised; YBOCS: Yale-Brown Obsessive-Compulsive Scale; YBOCS-SR: Yale-Brown Obsessive-Compulsive Scale - Self-Report

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OCD Impacts on Visual Processing

Overall, results indicated that OCD patients experience impacts on visual processing. Furthermore, five studies[7-8, 15-17] suggested that these individuals had a significantly higher number of errors and longer latency in antisaccade tasks compared to other groups, which can help to better understand OCD and its clinical variability.

On the other hand, it is important to note that a study[11] that aimed to identify a potential biomarker for pediatric OCD comparing 36 diagnosed patients and 31 healthy controls, showed no significant differences between the groups in error rates, peak velocity, position gain, and latency measures. This indicates that these eye movement parameters cannot be used as diagnostic biomarkers for pediatric OCD.

Executive Functions' Role

Some studies have also addressed executive functions. For example, one study[15] indicates that OCD patients face challenges in their ability to inhibit behaviors, which plays a crucial role in the presentation of obsessive-compulsive symptoms. In addition, it is suggested that these patients have greater visual sensitivity to peripheral stimuli.

Similarly, another study[3] found a relationship between the intensity of OCD symptoms and participants' propensity to direct their attention to specific stimuli associated with the disorder. These findings are consistent with another research's data[18], which suggests that certain attentional aspects can be compromised in OCD patients, especially in specific eye movement tasks.

Text Analysis

A predominance of different terms in the text corpus was observed in the word cloud (Figure 3). In particular, terms such as "OCD", "visual", "anti-saccades" and "patients" stood out for their frequency. The image indicates that OCD is constantly associated with visual processing in these studies.

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Figure 3. Word Cloud.

DISCUSSION

The present study aimed to conduct an integrative review regarding the relationship between visual processing and OCD. In addition, we investigated the role of executive functions in this relationship. To achieve these objectives, 14 studies published in the last decade were analyzed and synthesized.

Most studies used the Y-BOCS as a measure to assess OCD. This scale is currently validated in the Brazilian context[19] and is widely recognized as the standard tool to assess the severity of obsessive-compulsive symptoms and their impact on the patient's life, on a scale ranging from 0 to 40[20]. A previous review supported the suitability of this measure based on 51 studies across multiple cultures and contexts[21].

On the other hand, to assess visual processing, the most common systems were EyeLink and iView X, both known for their high temporal resolution. These systems employ near-infrared technology to detect eye position and record eye movements while participants observe visual stimuli on a computer screen or other presentation device[6,22]. Eye-tracking as a data collection method in general shows adequate psychometric properties[23-25], and has been used to understand visual processing in other psychological disorders, such as generalized attention disorder and major depressive disorder [26,27].

Main results indicated a relationship between OCD and visual processing. Individuals with OCD demonstrated a significantly higher rate of errors in antisaccade tasks compared to healthy controls. The antisaccade task requires participants to inhibit the automatic impulse to direct their gaze toward a sudden visual stimulus and instead move their eyes in the opposite direction. This finding is consistent with the results of a previous study[28], which observed a significant increase in antisaccade latencies and antisaccade error rates among OCD patients.

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These deficits, such as increased latency and error rates, may indicate impaired inhibitory control in individuals with OCD, as well as issues with attention and emotion-related variables[16]. Therefore, further research is necessary to understand the factors involved in this result and the role of variables such as symptomatology intensity and treatment specificities.

The results also suggest that OCD patients not only have difficulty suppressing automatic eye movements toward a stimulus, but also face challenges in correcting these movements when they make mistakes. These difficulties may be related to the inability to control impulses associated with OCD, as discussed by a previous study[29].

Furthermore, these findings expand our understanding of how OCD can influence not only visual processing but also executive functions, including inhibitory control, cognitive flexibility, and memory. These results corroborate data from a previous literature review[30], who observed deficits in executive functions related to OCD.

CONCLUSIONS

The present study emphasizes the relevance of considering not only the manifest symptoms of OCD, but also the deficits in more intricate cognitive processes, which may improve the treatment of this disorder. These observations have significant implications for the understanding of OCD's underlying mechanisms, thus highlighting the present study's contributions: the main one was to provide a summarized review of the neuropsychological mechanisms underlying OCD. This includes the elucidation of the neurobiological bases of OCD and the identification of specific biomarkers that distinguish individuals with OCD from healthy controls.

However, it is also important to present the study's limitations, since there were restrictions on the languages and publication period of the studies that composed our sample. Furthermore, the selected studies may also have their own limitations, such as lack of confounding variable control, use of subjective measures or lack of replicability. Considerable methodological variation was observed, which may make direct comparison of results and synthesis of findings difficult.

In summary, the results suggest that OCD is associated with specific changes in the functioning of both visual and cognitive systems. Thus, although the results show a relationship between the variables of interest, it is still necessary to further empirically investigate the proposed research question, especially in the Brazilian context (where no previous studies were identified).

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