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Olfactory and Neuropsychological Functioning in Olfactory Reference Syndrome

Channing Sofko, PhD[1,2,3,4], **Geoffrey Tremont, PhD**[1,2], **Jing Ee Tan, PhD**[1,2,5], **Holly Westervelt, PhD**[1,2,6], **David C. Ahern, PhD**[1,3], **William Menard, BA**[2,7], **Katharine A. Phillips, MD**[1,2,8,9]

[1]Department of Psychiatry and Human Behavior, Warren Alpert Medical School of Brown University, Providence, Rhode Island [2]Rhode Island Hospital, Providence, Rhode Island [3]The Miriam Hospital, Providence, Rhode Island [4]Bay Pines Veterans Affairs Health Care System, Bay Pines, Florida [5]The University of British Columbia, Vancouver, British Columbia, Canada [6]Vanderbilt University Medical Center, Nashville, Tennessee [7]Butler Hospital, Providence, Rhode Island [8]Weill Cornell Medical College, New York, New York [9]New York-Presbyterian Hospital, New York, New York

Abstract

Objective: Olfactory reference syndrome (ORS) is an underrecognized, understudied, and often severe psychiatric disorder characterized by a prominent and distressing or impairing preoccupation with a false belief of emitting an offensive body odor. Since this condition has only recently been recognized in the *International Classification of Diseases* (the 11th Edition), no empirical evidence exists about the underlying features and etiology of the disorder.

Purpose: To examine the neuropsychological and olfactory functioning of individuals with ORS and address whether there is central nervous system or sensory dysfunction associated with the condition.

Methods: In this preliminary investigation, nine consecutive participants with ORS completed a structured clinical interview and neuropsychological and olfaction evaluations.

Results: A proportion of individuals with ORS displayed deficits in aspects of cognitive functioning (i.e., processing speed, executive functioning, recognition memory bias for ORS-related words), olfaction functioning (i.e., odor detection and discrimination), and emotional processing.

*Corresponding author: Channing Sofko, PhD, Rhode Island Hospital, Physician's Office Building Suite 430, 110 Lockwood Street, Providence, Rhode Island, 02903. channing.sofko@gmail.com.

Declaration of Interest: None.

Conclusions: Based on these preliminary findings of cognitive, olfaction, and emotional processing deficits in individuals with ORS, further neuropsychological and olfaction studies are needed that better characterize this understudied patient group and address this study's limitations.

Keywords

Olfactory Reference Syndrome; Olfactory Reference Disorder; Neuropsychology; Olfaction; Obsessive-Compulsive and Related Disorders

Olfactory reference syndrome (ORS) is an understudied and often-severe psychiatric disorder characterized by a prominent and distressing or impairing preoccupation with a false belief of emitting an offensive body odor.[1,2] Its prevalence is unclear, and estimates[1] of 0.5% (current) to 2.1% (one year) may not fully account for the true prevalence since patients may be hesitant to describe these symptoms. It has recently been added as a separate disorder to the *International Classification of Diseases-11th Edition* (ICD-11) published by the World Health Organization[3] where it is called "olfactory reference disorder" and classified as a type of "obsessive-compulsive or related disorders." In the *Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition* (DSM-5), ORS is classified as an example of "other specified obsessive-compulsive and related disorders," without full diagnostic criteria.[4]

According to ICD-11 and published literature on ORS, individuals with this disorder have persistent preoccupation with the false belief that they emit an offensive body odor. They also typically experience excessive self-consciousness about the perceived odor, engage in repetitive and excessive behaviors in response to the inaccurate belief (such as repeatedly checking themselves for body odor), attempt to camouflage the perceived odor, and have marked avoidance of social situations.[3,5] ORS beliefs span a range of insight, ranging from good/fair to absent (assessed in various ways across studies), but are usually characterized by poor or absent insight (i.e., delusional beliefs). [5] Ideas or delusions of reference (believing that others take special notice of the person in a negative way because of the supposed body odor) are often present. [3,5] These symptoms lead to significant distress and/or impairment in functioning.

To our knowledge only one case report examined possible underlying features and etiology of this disorder[6], finding frontotemporal hypoperfusion; no prior studies have examined neuropsychological, emotional processing, or olfactory aspects of ORS, even though 85% of individuals with ORS report actually smelling bodily odor.[5] This lack of investigation is problematic, given that preliminary characterizations of this population suggest that ORS usually leads to significant functional impairment and is associated with high rates of suicidality.[5]

Neuropsychological deficits in attention, executive functioning, and processing speed have been identified in conditions that may be related to ORS, such as delusional disorder, obsessive-compulsive disorder, schizophrenia, social anxiety disorder, and body dysmorphic disorder.[7,8,9,10] Problems with olfaction (i.e., deficits in identification, recognition, and discrimination) have been observed in schizophrenia, and there is preliminary evidence to support reduced olfaction-related sensitivity and identification in depression.[11] The

neuropsychological and olfactory functioning of individuals with ORS has not yet been characterized in the literature.

The objective of this preliminary study was to characterize neuropsychological functioning, emotional processing, and olfaction of individuals with ORS. We hypothesized that individuals with ORS would show deficits, compared to normative data, in frontal-subcortical function since such deficits are observed in other conditions with similar presenting concerns[7,8,9,10]. We also hypothesized that individuals with ORS would show abnormalities, compared to normative data, on smell identification and threshold tasks, given ORS's key clinical symptoms and preliminary findings suggesting the presence of olfactory hallucinations in individuals with this condition.[3,5] However, we did not further hypothesize about the type of potential olfactory deficits. Previous research has linked some psychiatric conditions to reduced olfaction-related sensitivity and identification[11]; however, it is possible individuals with ORS manifest enhanced olfaction-related sensitivity and identification, as many report olfactory hallucinations.[5]

Methods

Subjects:

The institutional review board approved the study. Subjects were recruited from March 2012 to March 2013. In all, 15 individuals were screened, and 11 met diagnostic criteria for ORS; 4 did not have ORS or had subclinical symptoms. Participants (see Table A) consisted of a consecutive series of 6 women and 3 men who were recruited and eligible to participate in the study. The mean age was 34.2 (*SD*=10.9), and the mean age of ORS onset was 21.9 (*SD*=8.9). On average, participants were taking 3.33 psychotropic medications at the time of the study (*SD*=4.7). Of the nine participants, seven identified as being single, never married. Four were unemployed, four worked full-time, and one was employed in a part-time role. Participants were recruited via community flyers and internet advertisements. Inclusion criteria were age 18 or older and meeting diagnostic criteria for ORS proposed for the DSM-5.[2] Exclusion criteria were: 1) history of head trauma and loss of consciousness of greater than 5 minutes; 2) epilepsy; 3) severe developmental disorder; 4) other neurologic condition affecting cognitive functioning; 5) lifetime schizophrenia or another psychotic disorder; 6) lifetime bipolar disorder, and 7) active (current) alcohol abuse, given the possible acute global effects on cognition. In all, nine participants met inclusion/exclusion criteria. The procedures were explained, and written informed consent was obtained. As approved by the IRB, participants were compensated $20 for their participation. Participants engaged in a 2-hour diagnostic interview and completed self-report questionnaires followed by 1.5 hours of cognitive testing and olfaction evaluation. None of the participants dropped out of the study.

Measures and Procedures—Impairment on cognitive measures was defined as scores falling at least 1.5 standard deviations below age and/or education-corrected normative data.

Neuropsychological Tests

Beads Task*[17]*: This is a probabilistic reasoning task to assess the tendency to hastily draw conclusions. The number of trials to response was measured across 4 trials, and the participant's certainty of their guess was also recorded.

Memory Bias Task and Recognition: We developed a task to measure selective memory bias for ORS-related words. The words included olfaction-related words (e.g., sniff, mints), and non-olfaction words (e.g., television, desk). A free-recall trial was conducted in which participants were asked to write down all of the words they could recall. Next, participants were provided a recognition format in which they were asked to identify target words and olfaction-related foils.

Stroop Test (Golden Version)*[18]*: This task measures processing speed and response inhibition. In the first two subtests, participants rapidly named colors and color words. In the response inhibition subtest, participants rapidly name the color of the ink of color-words, which was discordant with the color word. The number of correct responses in 45 seconds for each trial was calculated.

Delis-Kaplan Executive Functioning System (DKEFS) Twenty Questions Test*[19]*: This measure of executive functions requires efficient categorical processing and utilization of feedback to guide problem-solving. Participants were shown a page with pictures of 30 common objects. Participants must ask the fewest possible number of yes/no questions to identify the target item.

Rey-Osterrieth Complex Figure Task (ROCFT)*[20] *with Boston Qualitative Scoring System*[21] *(BQSS): This is a measure of visual planning/organization. The task involves participants copying a complex geometric design, and rating is based on fragmentation and planning. Two raters independently scored this measure for quality control.

Tests of Olfaction

Sniffin' Sticks*[22]*: Odor threshold for n-butanol was determined by the staircase method: the participant was presented with increasingly diluted concentrations of n-butanol, and the threshold was determined by the lowest concentration that the participant could reliably distinguish from a blank.

University of Pennsylvania Smell Identification Test*[23]*: This task involves identifying 40 odorants presented on microencapsulated "scratch and sniff" labels using a 4-alternative multiple-choice format.

Test of Emotional Processing

Comprehensive Affect Testing System (CATS) Task*[24]*: This is a measure of facial emotion processing. Participants matched the emotion to the correct facial expression. Data were available for 8 participants because one participant's data was unusable.

Clinical Measures

Structured Clinical Interview (SCID) for DSM-IV[12]: This is a standard, structured, diagnostic interview. It was used to assess current and past Axis I disorders and a Global Assessment of Functioning (GAF) score. An ORS diagnostic module was added based on proposed DSM-5 criteria.[2]

ORS Form: This slightly modified rater-administered version of an instrument used in many studies of body dysmorphic disorder[13] obtained information about demographic and clinical features of ORS.

ORS-Yale Brown Obsessive-Compulsive Scale (ORS-YBOCS): This slightly modified version of the YBOCS for body dysmorphic disorder[14], a reliable and valid 12-item rater-administered scale, assessed past-week ORS severity. Scores range from 0 to 48, with higher scores reflecting more severe ORS symptoms.

Brown Assessment of Beliefs Scale (BABS)[15]: The Brown Assessment of Beliefs Scale is a reliable and valid 7-item rater-administered scale that assesses insight/delusionality of beliefs across a range of psychiatric disorders. Scores range from 0 to 24, with higher scores reflecting poorer insight.

Beck Depression Inventory-Second Edition (BDI-II): This is a 21-item reliable and valid self-report instrument used to assess the presence, and severity, of depression symptoms.[16] Scores range from 0 to 63, with higher scores reflecting greater severity of depressive symptoms.

Results

Sample Characteristics

In total, 77.8% of participants reported that they can actually smell the odor of concern, and 88.9% thought that others could smell the odor. The onset of ORS symptoms was acute (developing in less than one week) in 22.2% of the sample. In total, 77.8% of the sample attributed their depressive symptoms to their ORS symptoms. In terms of past suicide attempts, 33.3% reported a history of attempts, and none reported a history of psychiatric hospitalization. The mean scores on instruments such as the BDI-II and comorbid conditions can be found in Table B. The mean scores revealed poor ORS-related insight on the BABS, moderate depression severity on the BDI-II, and moderate severity of ORS symptoms on the ORS-YBOCS. The mean GAF score was near the lower end of the range indicating moderate global symptoms or impairment in functioning.

Neuropsychological Findings

Deficits were found for some participants in aspects of processing speed, including three individuals for speeded word reading (33%; Stroop Test; Golden Version) and one for speeded color reading (11%; Stroop Test; Golden Version); however, no participants were impaired on an inhibition measure (Stroop Test; Golden Version). Deficits were found in aspects of executive functioning, including four individuals for planning and organization on

the Rey-Osterrieth Complex Figure Task (ROCFT) with Boston Qualitative Scoring System (44%); two (22%) had deficits in abstract reasoning and deduction/reaching conclusions based on general information on the Delis-Kaplan Executive Functioning System (DKEFS) Twenty Questions Test.

On the novel memory bias measure designed for this study (i.e., Memory Bias Task and Recognition), participants correctly recognized more ORS-related words (*M*=8.3, *SD*=1.0) than non-ORS words (*M*=7.0, *SD*=1.1), and they also made more ORS-related false positive errors (*M*=4.3; *SD*=2.3) than non-ORS-related false positive errors (*M*=1.4, *SD*=1.7). On the Beads Task, a reasoning task assessing the tendency to hastily form conclusions, four individuals (44%) were overly-cautious, requiring more draws than normative peers to reach a conclusion. Specifically, in a normative sample [22] the number of draws to reach a decision (*M*=2.6, *SD*=1.2) was substantially lower than the number of draws to reach a decision in the ORS participants in the current study (*M*=20.9; *SD*=13.5).

Olfaction Findings

Three (33%) participants had impairments on threshold testing (i.e., Sniffin' Sticks), indicated decreased ability to detect actual odors when compared to their normative peers. Additionally, two (22%) participants showed impaired odor discrimination on the University of Pennsylvania Smell Identification Test. No participants exhibited hypersensitivity to odors (i.e., no thresholds were greater than 1.5 SD above the mean).

Mood and Emotional Processing Findings

Performance on the Comprehensive Affect Testing System (CATS) Task revealed that two (25%) participants had a deficit in affect recognition, three (38%) had a deficit in prosody recognition, and four (50%) had overall emotion recognition deficits (but recognition of sadness was impaired for eight participants). Of the four participants with olfaction deficits, two had deficits in prosody recognition, and three displayed deficits in emotion recognition.

Discussion

In this preliminary investigation, a notable number of individuals with ORS displayed cognitive deficits in aspects of processing speed and executive functioning. Furthermore, they made approximately three-times more ORS-related false positive word recognition errors compared to false-positive non-ORS recognition errors. These findings suggest that individuals with ORS may be hypervigilant for words associated with olfaction, and it is possible the recall bias may be a function of selectively attending to these words. This finding appears similar to the tendency for individuals with body dysmorphic disorder to more selectively attend to body dysmorphic disorder-related positive words[25] and to the tendency for individuals with depression to recall more negative or unpleasant events compared to their non-depressed peers.[26]

Deficits were also observed in the domain of social-emotional processing, including emotion recognition. Emotion recognition deficits are also observed in disorders such as body dysmorphic disorder[27], which has many similarities to ORS (e.g., excessive concerns about the body), [1] and in experimental inductions of state anxiety in healthy individuals.[28] As

such, it is plausible that individuals with ORS misinterpret benign daily occurrences that others would not interpret as negative or as being related to their body odor.

Deficits in odor detection and discrimination were observed in four of nine participants, but only one participant had deficits in both discrimination and detection. A deficit in odor discrimination ability could contribute to misinterpretations of odors. It is interesting that no individuals with ORS exhibited hypersensitivity to odors (i.e., no thresholds greater than 1.5 SD above the mean), which may be viewed as counterintuitive based on their clinical presentation.

ORS remains an under-studied disorder, and future research is needed to investigate possible neurological mechanisms involved. Specifically, based on existing knowledge of ORS, it is plausible to consider that several brain networks and structures may be involved in ORS. The anterior-dorsal ascending branch of the left superior temporal sulcus (STS) has been shown to be related to executive functioning in a meta-analytic review[29], and the STS and the trigeminal system have been linked to olfactory processing.[30] The STS has also been noted for its role, along with the left dorsolateral prefrontal cortex, in social cognition deficits in individuals with schizophrenia.[31] A preliminary case report suggests frontotemporal hypoperfusion in individuals with ORS.[32]

This preliminary investigation has limitations. One limitation is that the sample size was small, which limits generalizability. In addition, the absence of a control group of age-matched peers limits comparisons. Thus, it is important to not over-interpret these preliminary findings since intra-individual variability can be observed in healthy adults. Also, the mean BDI score indicates depressive symptoms that are at the mild end of the moderate range, which may confound the neuropsychological findings since cognitive deficits are also observed in individuals with major depressive disorder[33]; however, depressive symptoms are common in individuals with ORS, and more than three quarters of the sample attributed these symptoms to their ORS symptoms, suggesting that they are a common feature of ORS.[5] Furthermore, a comprehensive medical evaluation (including an ear-nose-throat evaluation) and assessment of non-psychotropic medications was not done, leaving open the possibility that medications or medical conditions such as hyperhidrosis might have contributed to symptoms; however, all participants met diagnostic criteria for ORS, which requires that no perceptible body odor was present, which was confirmed by multiple study investigators for each participant. The neuropsychological sequelae of illness over time versus more recent-onset illness is another variable for which this study does not account. Finally, nearly all participants were currently taking at least one psychotropic medication, and we cannot rule out the possibility that some medications may have affected study results for some participants. Moving forward, these limitations as well as use of a more comprehensive neuropsychological assessment battery, inclusion of healthy control and depressed control groups, longitudinal investigation of cognition over time, and functional neuroimaging studies may be helpful.

Conclusions

Overall, this study reveals that in a sample of individuals with ORS, a proportion of these individuals ORS have cognitive as well as olfaction and emotional processing deficits. The cognitive deficits are similar to those seen in several other psychiatric conditions that may be related to ORS. [1,8,9,10,11] Additional research is needed on these deficits as well as on possible neurological and structural deficits. Identifying the presence or absence of olfactory aberrations, cognitive impairment, and the cognitive "style" that may be characteristic of the disorder may provide insight into underlying pathophysiology and may also identify future treatment targets.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Acknowledgments

Disclosure

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