Smell and taste: 8 years of experience from a Tertiary Center

Review Article

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Abstract

Introduction: Olfactory dysfunction (OD) affects up to 20% of the population. Despite significant progress in olfactory function testing, the diagnosis and treatment of OD remains a challenge.
Aim: To conduct a descriptive and statistical analysis of patients undergoing follow-up for olfaction and taste dysfunction.
Methods: Retrospective study including patients evaluated for olfaction and taste dysfunctions at a tertiary hospital between 2016 and 2023. We collected data on demographics, associated comorbidities, initial severity of OD, symptom duration, other sinonasal symptoms, and therapeutic approach. We used the Sniffin' Stiks®, validated for Portuguese, to assess olfaction and presented the results as the TDI score. A melhoria do olfato após instituição terapêutica foi tida por um aumento mínimo de 5 pontos no TDI score.
Results: 133 patients were included (81 females, mean age of 54.55 years). According to statistical analysis, the most common presumed etiology was sinonasal disease (60%), presenting worse results in the threshold assessment test than in the odour discrimination and identification tests. Post-infectious OD (12%) had satisfactory results in threshold and discrimination and lower results in odour identification. Patients with neurodegenerative pathology (10%) showed a good result in the threshold assessment but a lower result in odour identification and discrimination. Post-traumatic OD (8%) presented an overall low TDI score. Treatment was according to the presumed etiology. Post-infectious was the etiology with better outcome in terms of TDI score improvement.
Conclusion: Identifying the etiology through the assessment of various presentations and psychophysical patterns of olfaction is essential to develop targeted treatment strategies. However, the correct categorization of etiologies remains a challenge and highlights the need to improve diagnostic strategies.

Keywords: Olfactory dysfunction, anosmia, hyposmia, smell, sinonasal, neurosensory, post-infeccious, post-traumatic

Introduction

The sense of smell, though often underestimated, is essential for human life and influences behaviors related to food, safety, and sexual and social interactions.[1]

Olfactory dysfunction is a common condition that affects 10–20% of the population.[2,3] It encompasses both qualitative changes, such as partial or total loss of olfactory function (anosmia and hyposmia), and quantitative alterations, known as parosmia, which affect odor perception (cacosmia, euosmia, and phantosmia).[1,2] To determine the etiology of dysfunction, clinical evaluation should include the patient's clinical history, physical examination, and psychophysical olfactory tests. These tests measure three key aspects: odor detection threshold (T), odor discrimination (D), and odor identification (I). D and I are suprathreshold tests that evaluate a patient's nonverbal ability to distinguish between or recognize different odors, respectively. The composite TDI score is derived from the sum of these subtests and categorizes olfactory dysfunction into anosmia (score < 16), hyposmia (16–30), and normosmia (> 30).[3] The most common presumed etiologies of olfactory dysfunction, in descending order of frequency, are related to sinonasal, sensorineural, post-traumatic, postinfectious, idiopathic, and congenital disorders. Despite the advances in evaluating olfactory function, determining the etiology of dysfunction remains a challenge.[2]

Objective

To perform a descriptive analysis of patients who were followed up in smell and taste appointments, particularly the etiological characterization, progression, and prognosis.

Materials and methods

This retrospective and cross-sectional study analyzed the clinical records of all patients who were treated in smell and taste appointments at the otorhinolaryngology service of the Unidade Local de Saúde de Lisboa Ocidental between 2016 and 2023. The records were individually evaluated by the principal investigator. The analyzed parameters included sex, age, olfactory complaints (hyposmia, anosmia, dysosmia), associated comorbidities, presence of other sinonasal symptoms, history of sinonasal surgery, symptom onset context, and temporal progression of symptoms. Psychophysical olfactory evaluation was conducted using the Sniffin' Sticks® test, validated for European Portuguese. Additionally, anterior rhinoscopy results and ancillary diagnostic tests, including computed tomography (CT) of the paranasal sinuses and magnetic resonance imaging (MRI) of the head, were reviewed. The initiated treatment and patient's response to it were documented, with clinical improvement defined as a TDI increase of at least 5 points.

The otorhinolaryngology service included in this study follows no specific smell and taste evaluation protocol. During the appointment, the physician records the patient's clinical history, performs a physical examination, and conducts a psychophysical olfactory test. Patients eligible for olfactory rehabilitation were re-evaluated after 12 weeks.

The data were stored in a database (Microsoft Excel®), and statistical analysis was performed using IBM SPSS® 29. 0 software for MacOS. Descriptive statistics and normality tests (Kolmogorov-Smirnov) were employed, with a p-value < 0.05 being considered statistically significant.

Results

Of the 145 patients initially considered, 12 were excluded due to incomplete clinical data or resolution of olfactory complaints by the time of the appointment.

The final sample consisted of 133 participants, including 81 women and 52 men. The average age was 54.55 years. The most common reasons for appointments were hyposmia (78 patients) and anosmia (55 patients), with no statistically significant difference between the sexes (p = 0.87).

A comprehensive evaluation of the clinical history, physical examination, imaging tests,

and TDI scores helped in identifying the cause of olfactory dysfunction. The response patterns observed in the psychophysical olfactory test were consistent with the presumed etiology.

The initial TDI scores were higher in participants with sinonasal olfactory dysfunction, while participants with sensorineural olfactory dysfunction had the lowest initial TDI scores (Figure 1). However, the distribution of initial TDI scores across different etiologies was not statistically significant (p = 0.67).

The participants were classified into eight groups according to the presumed etiology of olfactory dysfunction:

1. Sinonasal olfactory dysfunction: 82 participants (60%)
2. Postinfectious olfactory dysfunction: 16 participants (12%)
3. Sensorineural olfactory dysfunction: 13 participants (10%)
4. Post-traumatic olfactory dysfunction: 11 participants (8%)
5. Idiopathic olfactory dysfunction: five p articipants (4%)
6. Toxin-induced olfactory dysfunction: three participants (2%)
7. Congenital olfactory dysfunction: two participants (1.5%)
8. Mixed-cause olfactory dysfunction: two participants (1.5%)

1.Sinonasal olfactory dysfunction

Sinonasal disorders were the most common presumed etiology of olfactory dysfunction, identified in 82 participants (47 women and 35 men) with an average age of 56.16 years.

In this group, 54 participants reported hyposmia and 28 reported anosmia. Concomitantly, 13 participants reported parosmia, with eight cases of cacosmia and five cases of phantosmia.

Olfactory symptoms were predominantly progressive (68 patients), had a fluctuating course (45 patients), and average duration of 6.85 years (0.33–25 years). Nasal obstruction and rhinorrhea were reported by 65% of the participants.

The Sniffing' Sticks® psychophysical olfactory test revealed lower average T scores (2.5), while D and I scores were satisfactory (9.73 and 10.47, respectively).

Peak nasal inspiratory flow (PNIF) was measured in 18 participants, with an average value of 66.17. All participants underwent anterior rhinoscopy, and 45 showed abnormalities. The most common findings on physical examination were inferior turbinate hypertrophy and nasal septum deviation.

Paranasal sinus CT scans often revealed nasal septum deviation, inferior turbinate hypertrophy, concha bullosa, sinus obliteration,

Figure 1
Distribution of the mean TDI scores by etiology

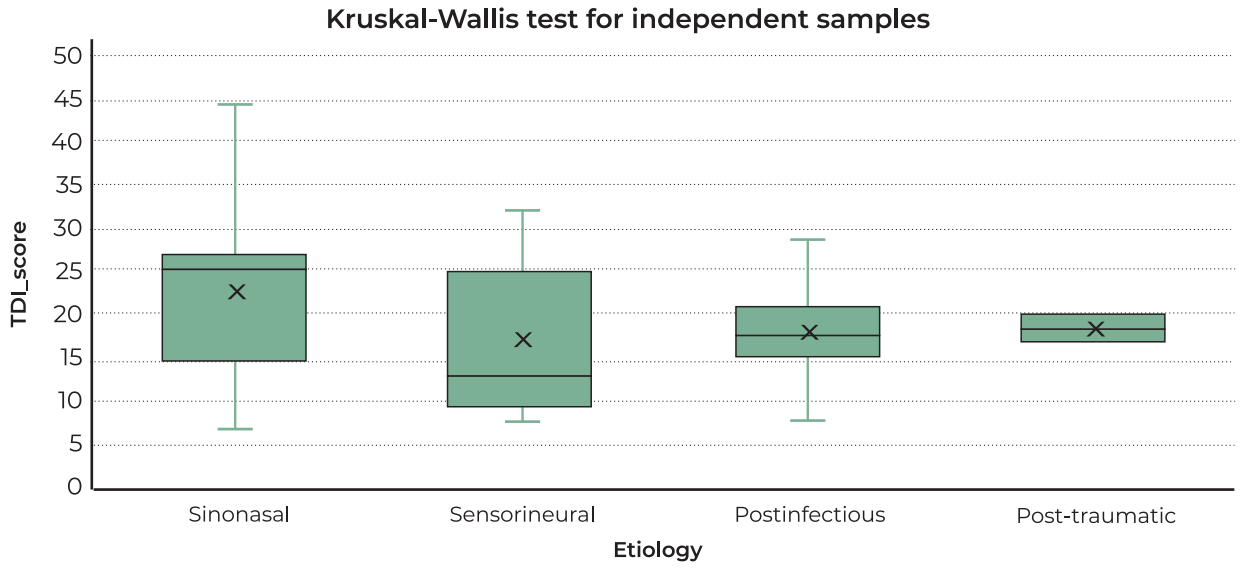
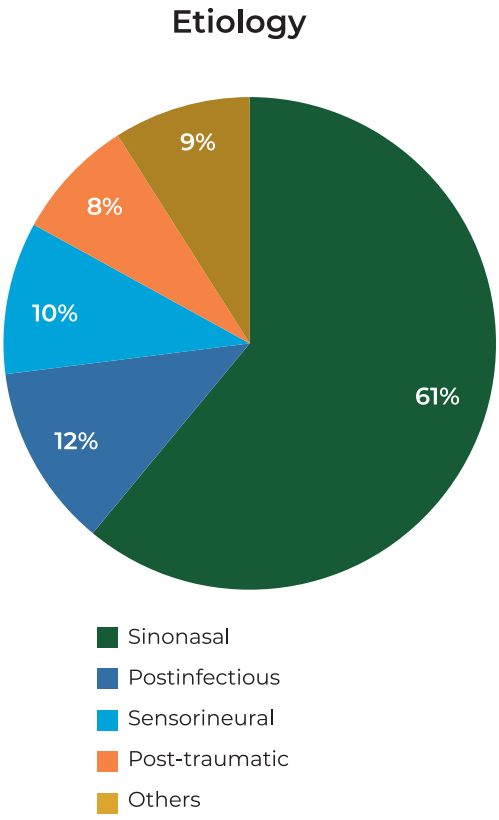


Figure 2
Sample distribution by the etiological group



and signs of chronic rhinosinusitis.
The most commonly prescribed treatment was nasal corticosteroids along with a short course of systemic corticosteroids (deflazacort 60 mg for five days), followed by nasal corticosteroid monotherapy and a combination of nasal corticosteroid and olfactory training with rose, lemon, clove, and eucalyptus scents. Septoplasty with inferior turbinate reduction and endoscopic sinonasal surgery were recommended in selected cases.
At follow-up, 51% of participants who underwent medical or surgical treatment showed improvement.

2. Postinfectious olfactory dysfunction
The second most common etiology of olfactory dysfunction was postinfectious, with a prevalence of 12% and affecting 16 participants (12 women and four men) with an average age of 55.68 years. All participants reported an episode of upper respiratory tract infection before the onset of olfactory symptoms, and six of them reported infection with severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2).
In this group, nine participants had hyposmia and seven reported anosmia. Two participants complained of concomitant parosmia, with one having cacosmia and one phantosmia.
Olfactory symptoms were predominantly progressive, with an average duration of 2.10 years (0.16–8 years), and 62.5% of participants reported no symptom fluctuation.
The psychophysical olfactory test revealed decreased average I scores (7.78), with average T and D scores of 3.45 and 7.72, respectively.
All participants were referred for olfactory rehabilitation with rose, lemon, clove, and eucalyptus scents. A combination of nasal corticosteroid and olfactory training was prescribed for six participants. At follow-up, 80% of the participants showed improvement.

3. Sensorineural olfactory dysfunction
The third most common presumed cause of olfactory dysfunction in our sample was sensorineural disorders, which were present in 13 participants (all women) with an average age of 61.00 years (13–83 years). In this group, nine participants reported anosmia and five had hyposmia. Only one participant reported parosmia (phantosmia). Olfactory symptoms were predominantly progressive (10 participants), showed no fluctuation, and had an average duration of 3.32 years (0.41–10 years).
Comorbidities included two cases of essential tremor, one case of Parkinson's disease, one case of temporal lobe epilepsy, and one case of subjective complaints of memory loss. The average T, D, and I scores were 2.25, 9.4, and 6.2, respectively.
Only seven participants underwent head MRI scans, and six of them exhibited abnormal findings. Olfactory bulb thinning was observed in five participants, and one participant had a meningioma in the right olfactory groove, which was the cause of olfactory loss. Except for the case with the meningioma, all participants were referred for olfactory rehabilitation. At

follow-up, 70% of the participants showed improvement.

4. Post-traumatic olfactory dysfunction

This group consisted of 11 participants (six men and five women) with an average age of 41.73 years (18–79 years); seven participants complained of anosmia, four presented with hyposmia, and one reported parosmia (cacosmia).

Symptom onset was sudden in 45.5% of the patients, and all participants linked symptom onset with a history of traumatic brain injury, which included four cases of car accidents and one case of a pedestrian being run over.

The psychophysical olfactory test revealed decreased average T, D, and I scores (3.75, 9.0, and 5.14, respectively). Only five participants underwent head contrast-enhanced (CE) MRI scans, and four of them showed signs compatible with blunt trauma to the olfactory bulbs and tracts. All participants were referred for olfactory rehabilitation. At follow-up, 50% of the participants showed improvement.

5. Idiopathic olfactory dysfunction

The presumed etiology could not be determined in five participants, and was classified as idiopathic olfactory dysfunction. This group comprised three women and two men with an average age of 54 years (45–65 years). Among them, three participants reported hyposmia, one anosmia, one left unilateral anosmia, and two reported phantosmia.

All participants described progressive symptom onset with no fluctuation over time. The average duration of symptoms was 9.4 days. None of the participants associated symptom onset with a specific event or context, and physical examination was normal in all participants.

The average I score was 4.25. The patient with unilateral left anosmia had an average I score of 0 when the right nostril was occluded and 13 when the left nostril was occluded. A head MRI scan revealed a right occipital cavernoma measuring 1 cm, which was unrelated to the loss of olfactory function. The other participants had normal findings in head MRI. All participants were referred for olfactory rehabilitation.

6. Toxin-induced olfactory dysfunction

Toxin-induced olfactory dysfunction was presumed in three participants, comprising two men and one woman, with an average age of 58.3 years. In this group, two participants reported onset of hyposmia after starting antifungal therapy with terbinafine, while the third participant experienced it after commencing treatment for human immunodeficiency virus (HIV) infection.

The Sniffing' Sticks® psychophysical olfactory test indicated that the participant with HIV infection had normosmia, with a TDI score of 36.5 (normal), leading to the assumption of antiretroviral-induced parosmia. However, the other two patients had decreased scores (11 and 7), and both were treated with zinc chloride mouthwash.

7. Congenital olfactory dysfunction

This group consisted of two male participants (aged 19 and 10 years). Both reported long-term anosmia, with no history of trauma, association with sinonasal symptoms, or any specific event related to symptom onset. Head MRI scans showed olfactory bulb atresia in the 10-year-old boy, and genetic testing confirmed Klinefelter Syndrome (Mosaic 47, XXY [10]/46, XY[23]). In the 19-year-old participant, head MRI revealed the absence of both olfactory bulbs, but genetic testing results were normal, leading to a diagnosis of non-syndromic congenital idiopathic anosmia.

8. Mixed-cause olfactory dysfunction

In two participants, the etiology of olfactory dysfunction was presumed to be sinonasal, which was exacerbated by an upper respiratory tract infection. They were both treated with nasal corticosteroids and a short course of systemic corticosteroids, but only one of them showed clinically significant improvement.

Outcomes

Improvement after treatment was defined as a TDI score increase of at least 5 points, which was observed in 58% of participants in this study. The etiology with the best outcomes was postinfectious olfactory dysfunction, with clinically significant improvement observed in 80% of the patients, followed by sensorineural olfactory dysfunction, with 70% patients showing improvement.

Sinonasal and post-traumatic etiologies had the poorest outcomes, with improvement in 51% and 50% of the participants, respectively. However, the sinonasal group had an evident selection bias, as many participants were referred to the smell and taste appointments from the general otorhinolaryngology service, and many of them had already undergone clinical or surgical treatment. Additionally, these participants had a prolonged symptom duration, and probably experienced neuronal remodeling, leading to the olfactory epithelium being replaced by respiratory epithelium. Another notable factor was their initial TDI score, which was higher than that observed in the other etiological groups.

Discussion

Epidemiology

In this study, olfactory complaints were more prevalent in women than in men (61% vs. 39%). However, Yan and Pinto revealed that men may experience loss of olfactory function earlier in life due to greater occupational exposure to hazardous substances.[5]

Presumed etiology

Olfactory dysfunction should be classified based on the underlying cause rather than as a conductive or sensorineural disorder, because dysfunction resulting from chronic rhinosinusitis often involves both conductive and sensorineural components .[4]

Sinonasal olfactory dysfunction

In this study, the most common etiology of olfactory dysfunction was sinonasal disorders, which corroborates with the findings in the existing literature. Hummel et al. reported that sinonasal conditions account for 67% of the causes of olfactory dysfunction,[4] as they obstruct the passage of odor to the olfactory cleft either due to anatomical obstruction (polyps) or edema. Inflammation can also lead to neuroepithelial remodeling with replacement of the olfactory epithelium by respiratory epithelium, resulting in a more significant impact on the T score than D and I scores.[3]

Postinfectious olfactory dysfunction

Postinfection causes were the second most common source of olfactory dysfunction, accounting for 14% of the cases.[4] In these cases, viral agents lead to atrophy of the olfactory sensory neurons, and the olfactory epithelium is replaced by respiratory epithelium.[3] While the T and D scores are often satisfactory, I scores tend to be lower. The olfactory system exhibits significant plasticity, allowing for a more pronounced improvement in T and D. However, I is a more complex process and associated with a more challenging recovery.[3]

Sensorineural olfactory dysfunction

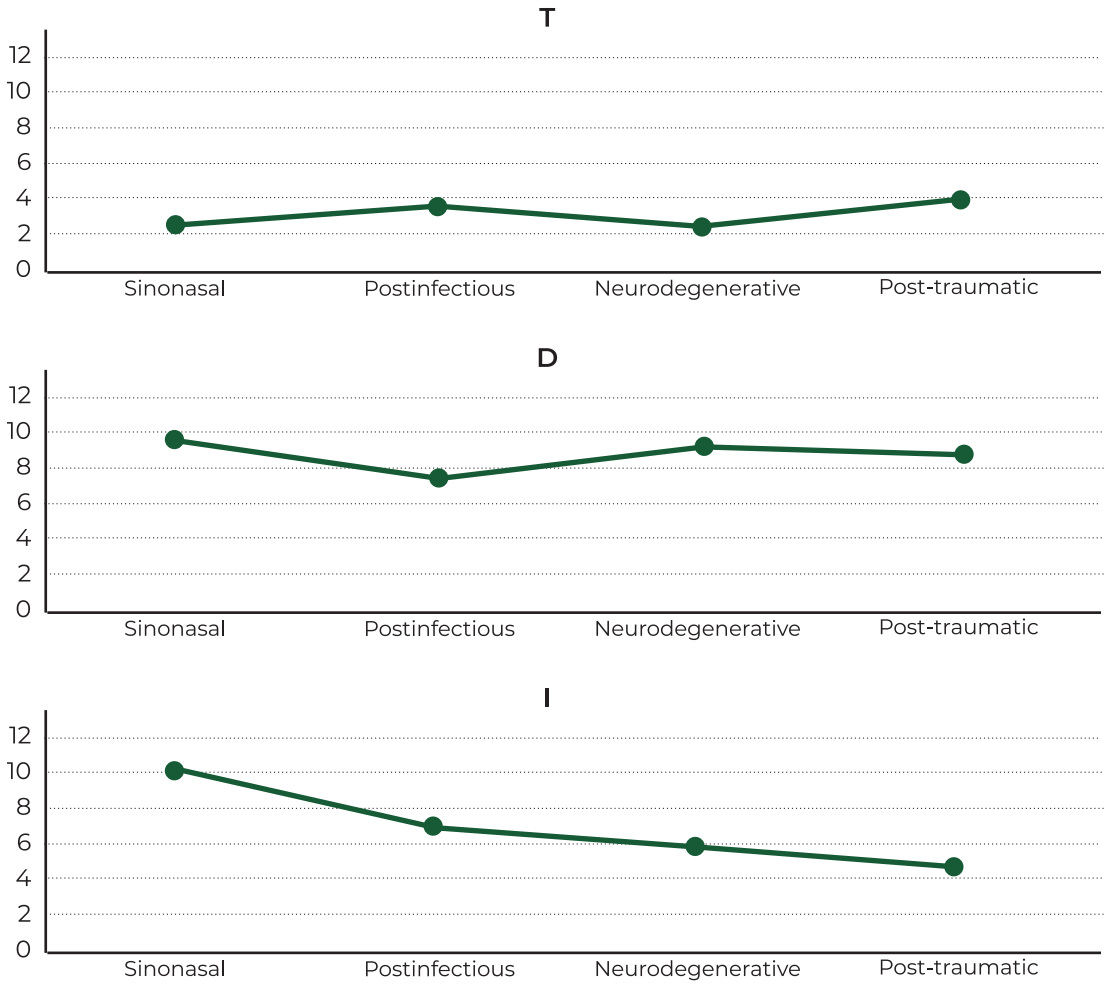
The existing literature is inconclusive regarding the prevalence of olfactory dysfunction of sensorineural etiology. This dysfunction is associated with neurological and neurodegenerative conditions such as Parkinson's disease, Alzheimer's disease, multiple sclerosis, and temporal lobe epilepsy. In many of these conditions, olfactory dysfunction is an initial symptom, indicating its potential as an early disease marker.[3-5]

According to Hedner et al., olfactory dysfunction is caused by a central processing impairment in these patients, which affects suprathreshold discrimination and identification tasks, but not the threshold for odor detection.[3]

Post-traumatic olfactory dysfunction

Traumatic brain injury accounts for approximately 6% of the cases of olfactory dysfunction[4], and can result from three main mechanisms: sinonasal obstruction,

Figure 3
Response patterns observed in the psychophysical olfactory test were consistent with the presumed etiology. The graphs show the individual average scores for hyposmia due to sinonasal, postinfectious, neurodegenerative, and post-traumatic causes. The group with a presumed sinonasal etiology demonstrated decreased TDI scores due to a decreased T score, with preserved D and I scores. Participants with postinfectious hyposmia showed decreased TDI scores due to decreased I, with reasonable T and D scores. Neurodegenerative causes resulted in significantly decreased I scores. Post-traumatic hyposmia led to reduced TDI scores, with a decrease observed in all three subtests: T, D, and I.



disruption of the olfactory nerve fibers in the cribriform plate of the ethmoid bone, and damage to the central olfactory pathways. Head MRI is the investigation of choice for evaluating these patients, with a particular focus on the olfactory bulb and brain areas associated with olfactory perception.[6] Patients with post-traumatic olfactory loss retain the ability to discriminate and identify odors, but have a lower threshold detection capacity.[3] Complete recovery is rare; however, olfactory training may be effective in restoring olfactory function.[6]

Idiopathic olfactory dysfunction

Olfactory dysfunction is considered idiopathic after all presumed etiologies have been ruled out. According to the literature, this etiology accounts for 8% of the cases.

Congenital olfactory dysfunction

The estimated prevalence of congenital olfactory dysfunction in the general population is 0.01–0.002%, and it can be categorized as syndromic or isolated.

Kallmann syndrome, characterized by hypogonadotropic hypogonadism, is the

most common cause of congenital syndromic olfactory dysfunction, and may present as either hyposmia or anosmia.

Most patients with isolated congenital anosmia do not have identifiable genetic alterations, and are often diagnosed later in life. In both syndromic and isolated cases, head MRI reveals structural changes, including atrophy of the olfactory sulci and aplasia or hypoplasia of the olfactory bulbs.

Treatments

Sinonasal olfactory dysfunction can be treated with systemic and topical corticosteroids, although their use remains controversial for treating olfactory dysfunction of other etiologies. The potential side effects of systemic corticosteroids should also be considered before prescription. In selected cases, sinonasal surgery may be indicated according to the guidelines of the European Position Paper on Rhinosinusitis and Nasal Polyps (EPOS 2020). A combination of corticosteroids, vitamin B, and zinc may provide additional therapeutic benefits.[7] Olfactory rehabilitation is effective in improving hyposmia of postinfectious, post-traumatic, and sensorineural etiologies. The exact mechanism behind this improvement remains unclear, but it may be related to the regenerative capacity of the olfactory neurons through adjacent totipotent glial cells, facilitated by repeated odor exposure.

The primary benefits of olfactory rehabilitation are seen in the discrimination and identification of odors. A reduced olfactory detection threshold is associated with peripheral dysfunction, while discrimination and identification deficits reflect changes in higher cognitive functions.[8]

Several studies have shown an improvement in identification and discrimination of odors with olfactory rehabilitation in patients with dysfunction of postinfectious and post-traumatic etiology.[8,9] In Parkinson's disease, olfactory rehabilitation is associated with improved sensitivity to the odors used in therapy, with 20% patients showing improved olfactory function after 12 weeks of treatment.[9]

Outcomes

Until recently, no targeted treatment was available for patients with olfactory dysfunction. This paradigm has shifted, as shown by our study results, with 58% of the patients experiencing a clinically significant improvement in TDI scores. Postinfection dysfunction had the best outcomes, with 80% patients showing improvement, which is consistent with the evidence in the literature.

Historically, post-traumatic cases of olfactory dysfunction have the worst outcomes, concurrent with the results of this study, with only 50% of these patients showing improvement. In sinonasal dysfunction, 51% of the patients demonstrated clinically significant olfactory improvement, which was lower than expected. This outcome reflects a selection bias, as many of these patients were referred to the smell and taste appointments from the general otorhinolaryngology service after undergoing clinical or surgical treatment. Additionally, these participants reported a prolonged symptom duration, and probably underwent neuronal remodeling, with the olfactory epithelium being replaced by respiratory epithelium. Another notable factor was their initial TDI score, which was higher than that observed in the other etiological groups.

Limitations

Isolated taste disorders are extremely rare, and thus taste alterations were not the primary focus of this study. However, the article is titled "Smell and Taste: Eight Years of Experience in a Tertiary Center" to reflect the study objective of evaluating patients who were followed up in smell and taste appointments.

Conclusion

The early identification and treatment of olfactory dysfunction is crucial because of its prevalence and impact on the quality of life and safety. Identifying the etiology through careful evaluation of the clinical presentation and psychophysical olfactory patterns is essential to develop targeted treatment strategies.

In this study, more than 50% of the patients showed improvement, which highlights the potential for recovery and enhanced quality of life, a trend that will continue to increase with further studies in this area.

Conflict of Interests

The authors declare that they have no conflict of interest regarding this article.

Data Confidentiality

The authors declare that they followed the protocols of their work in publishing patient data.

Human and animal protection

The authors declare that the procedures followed are in accordance with the regulations established by the directors of the Commission for Clinical Research and Ethics and in accordance with the Declaration of Helsinki of the World Medical Association.

Privacy policy, informed consent and Ethics committee authorization

All the processed data were based in published reports that fulfilled privacy policy and ethical considerations.

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Scientific data availability

There are no publicly available datasets related to this work.

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