



## ORIGINAL ARTICLE

# Assessment of the impact of post-COVID-19 olfactory dysfunction on quality of life: Comparison of specific questionnaires



Carlota Rovira-Martínez,<sup>a</sup> Mariana Campos-Motamayor,<sup>a</sup> Aina Sansa-Perna,<sup>a</sup> Elios Yuste,<sup>a</sup> Laura Gelabert,<sup>a</sup> Josep de Haro-Licer,<sup>b,c</sup> Alda Cardesín-Revilla,<sup>a</sup> Miguel Caballero-Borrego<sup>d,e,\*</sup>

<sup>a</sup> Unidad de Rinología y Trastornos del Sueño, Departamento de Otorrinolaringología, Hospital ParcTaulí, Sabadell, Spain

<sup>b</sup> Departamento de Otorrinolaringología, Hospital Municipal Badalona, Badalona, Spain

<sup>c</sup> Director del Grupo Investigación Interdisciplinar de Asesoramiento de la Percepción (GIIASP), Spain

<sup>d</sup> Departamento de Otorrinolaringología, Hospital Clínic de Barcelona, Barcelona, Spain

<sup>e</sup> Departamento de Cirugía y Especialidades Médico-quirúrgicas, Facultat de Medicina i Ciències de la Salut, Universitat de Barcelona, Barcelona, Spain

Received 3 July 2025; accepted 5 November 2025

## KEYWORDS

Olfactory dysfunction;  
COVID-19;  
Quality of life;  
Specific questionnaires;  
BAST-24;  
SNOT-22

## Abstract

**Background and objectives:** Post-COVID-19 olfactory dysfunction persists in many patients and significantly affects quality of life. The primary objective was to evaluate olfactory function using psychophysical tests (BAST-24) and quality-of-life questionnaires. Secondary objectives included analysing correlations between questionnaires and the relationship between subjective and psychophysical measures.

**Materials and methods:** A prospective study was conducted including 86 adults with olfactory dysfunction  $\geq 6$  months after SARS-CoV-2 infection. Clinical and demographic data and scores from the Visual Analog Scale for smell (VAS-smell) and the SNOT-22, svQOD-NS, and QVOLF questionnaires were collected. Olfactory function was assessed using the BAST-24 (detection, identification, and olfactory memory). Descriptive statistics, Spearman's correlation coefficient, and the Mann-Whitney U test were used ( $p < 0.05$ ).

**Results:** Mean age was 49 years (SD = 14); 76.7% were women. According to the VAS, 90.7% had hyposmia and 8.1% anosmia. Mean scores (SD) were: VAS 6 (2), SNOT-22 26 (20), svQOD-NS 4 (4), and QVOLF 127 (50), suggesting a moderate impact on quality of life. BAST-24 scores: detection 91% (22), identification 52% (25), and memory 35% (20). QVOLF and svQOD-NS showed a strong correlation ( $\rho = 0.797$ ;  $p < 0.001$ ), while SNOT-22 correlated moderately with both. No significant correlations were found between any questionnaire and BAST-24.

\* Corresponding author.

E-mail address: [mcaba@clinic.cat](mailto:mcaba@clinic.cat) (M. Caballero-Borrego).

*Conclusions:* QVOLF and svQOD-NS questionnaires are more sensitive than SNOT-22 for assessing olfactory dysfunction. The lack of correlation with psychophysical tests highlights the need to combine both approaches for a comprehensive evaluation.

© 2025 The Author(s). Published by Elsevier España, S.L.U. on behalf of Sociedad Española de Otorrinolaringología y Cirugía de Cabeza y Cuello. This is an open access article under the CC BY license (<http://creativecommons.org/licenses/by/4.0/>).

## PALABRAS CLAVE

Disfunción olfativa;  
COVID-19;  
Calidad de vida;  
Cuestionarios  
específicos;  
BAST-24;  
SNOT-22

## Evaluación del impacto de la disfunción olfativa post-COVID-19 en la calidad de vida: comparación de cuestionarios específicos

### Resumen

*Antecedentes y objetivo:* La disfunción olfativa post-COVID-19 persiste en muchos pacientes y afecta significativamente la calidad de vida. El objetivo principal fue evaluar la función olfativa con pruebas psicofísicas (BAST-24) y cuestionarios de calidad de vida. Como objetivos secundarios, se analizó la correlación entre los cuestionarios y explorar la relación entre medidas subjetivas y psicofísicas.

*Material y métodos:* Se realizó un estudio prospectivo en 86 adultos con disfunción olfativa  $\geq 6$  meses tras infección por SARS-CoV-2. Se recogieron datos clínico-demográficos, y puntuaciones de la Escala Visual Analógica para el olfato (EVA-olfato) y de los cuestionarios de calidad de vida SNOT-22, svQOD-NS y QVOLF. La función olfativa se evaluó con el BAST-24 (detección, identificación y memoria olfativa). Se usaron estadísticos descriptivos, coeficiente de correlación de Spearman y prueba de Mann-Whitney U ( $p < 0,05$ ).

*Resultados:* La edad media fue 49 años (DE = 14; IC95% 46,0–52,0); el 76,7% eran mujeres. Según la EVA, el 90,7% presentó hiposmia y el 8,1% anosmia. Las puntuaciones medias (DE) fueron: EVA 6 (2), SNOT-22 26 (20), svQOD-NS 4 (4) y QVOLF 127 (50), sugiriendo impacto moderado en la calidad de vida. BAST-24: detección 91%, (22) identificación 52% (25) y memoria 35% (20). QVOLF y svQOD-NS mostraron fuerte correlación ( $\rho = 0,797$ ;  $p < 0,001$ ) mientras que SNOT-22 correlacionó moderadamente con ambos. No hubo correlaciones significativas entre cuestionarios y BAST-24.

*Conclusiones:* QVOLF y svQOD-NS son más sensibles que SNOT-22 para evaluarla disfunción olfativa. La ausencia de correlación con pruebas psicofísicas resalta la necesidad de combinar ambas para una evaluación integral.

© 2025 Los Autores. Publicado por Elsevier España, S.L.U. en nombre de Sociedad Española de Otorrinolaringología y Cirugía de Cabeza y Cuello. Este es un artículo Open Access bajo la CC BY licencia (<http://creativecommons.org/licenses/by/4.0/>).

## Introduction

Olfactory dysfunction has a major impact on a person's quality of life and emotional well-being because it affects essential aspects such as social relationships, eating and the sensory enjoyment of food, together with personal safety (since peoples' ability to detect environmental hazards such as smoke, gas leaks or damaged food is compromised). It has also been associated with a higher prevalence of psychiatric disorders such as depression and anxiety,<sup>1,2</sup> as well as increased mortality.<sup>3</sup>

According to the OLFACAT (OLFAction in CATalonia) survey, the prevalence of olfactory dysfunction in the general European population is around 20%, representing approximately 82 million citizens in the EU.<sup>4</sup> Similarly, a 2021 meta-analysis estimated that olfactory dysfunction affects approximately 22% of the world's population.<sup>5</sup>

The main causes of acquired olfactory dysfunction include inflammation of the upper respiratory tract (especially chronic rhinosinusitis with nasal polyposis, in the

context of type 2 inflammation), upper respiratory viral infections, head trauma, and neurodegenerative diseases (such as Parkinson's and Alzheimer's). Other less frequent causes include intracranial or sinus tumours, certain medications, exposure to toxic substances, radiotherapy, or iatrogenic factors.<sup>6–8</sup> Olfactory dysfunction is a common (>60%) and generally transient (3–7 days) symptom of the common cold and acute rhinosinusitis. However, postviral olfactory dysfunction is the leading cause of permanent olfactory dysfunction, accounting for 39% of the global incidence.<sup>3,9,10</sup>

COVID-19, the disease caused by SARS-CoV-2, has been associated with a high incidence of olfactory dysfunction since the first waves of the pandemic, becoming a distinctive sign and of great diagnostic value. A European multicentre study (Spain, France, Italy, Belgium) published in 2020, which included 417 patients with mild to moderate forms of COVID-19, revealed an 85% prevalence of olfactory alterations and an 88% prevalence of gustatory alterations.<sup>11</sup> Both quantitative alterations, such as hyposmia (decreased

olfactory capacity) and anosmia (total loss of smell), and qualitative alterations, including parosmia (distorted and usually unpleasant perception of real odours) and phantosmia (perception of odours in the absence of stimuli), have been described. Despite the progressive decrease in incidence in the post-pandemic phase, persistent olfactory dysfunction continues to affect a considerable number of patients, with significant implications for their quality of life, mental health, and daily functioning, including their work performance. A better understanding of this sequela, its mechanisms, and its impact remains a priority, both due to its high frequency and the lack of specific and effective treatments.

The recommended diagnostic approach for olfactory dysfunction includes a complete otolaryngological examination and medical history, a subjective assessment using validated tools such as the Visual Analogue Scale (VAS) and quality of life questionnaires such as the SNOT-22 and the svQOD-NS (recently validated in Spanish), as well as a standardised psychophysical test, such as the Barcelona Snell Test-24 (BAST-24), to determine odour discrimination. In selected cases, imaging tests may be indicated depending on the suspected aetiology.<sup>12-16</sup>

The main objective of this study was to evaluate persistent olfactory dysfunction in post-Covid-19 patients using a VAS and psychophysical tests (BAST-24) and its impact on quality of life using three validated subjective questionnaires: two specific to olfactory function (QVOLF and svQOD-NS) and one general nasal and sinus questionnaire (SNOT-22). As secondary objectives, correlations between the different questionnaires and the relationship between subjective and psychophysical measures were analysed to assess their complementarities in clinical practice.

## Material and methods

A prospective observational study was designed with a population comprising adult patients ( $\geq 18$  years) with persistent olfactory impairment ( $\geq 6$  months) secondary to COVID-19, who consulted for this reason and were referred to an otolaryngologist for evaluation. The study was conducted in accordance with the principles of the Declaration of Helsinki and was approved by the Clinical Research Ethics Committee of our institution.

### Inclusion criteria

- Adult patients ( $\geq 18$  years), classified by age group and sex.
- Diagnosis of SARS-CoV-2 infection by viral detection via PCR, rapid antigen test (RAT), or positive serology for past infection (excluding cases with vaccination).
- Alteration of the sense of smell beginning at the time of COVID-19 diagnosis (confirmed by PCR or RAT) or with clinical symptoms compatible with the disease and subsequently confirmed by serology.
- Persistence of olfactory symptoms (whether mild, moderate, or severe) for a period  $\geq 6$  months.
- Signed informed consent by the patient to participate in the study.

### Exclusion criteria

- Patients with olfactory dysfunction prior to COVID-19 infection, attributable to other causes.
- Presence of pre-existing nasal pathology (rhinitis and/or chronic rhinosinusitis) that may interfere with the results.
- Patients with exclusively gustatory alterations.

### Subjective assessment of olfactory dysfunction

To subjectively assess the impact of olfactory dysfunction on patients' quality of life and emotional state, the following were used: the Visual Analogue Scale for Olfactory Loss (VAS-Olfactory),<sup>13</sup> the Nasosinus Symptoms Questionnaire SNOT-22 (Appendix 1),<sup>14</sup> the short version of the Questionnaire of Olfactory Disorders-Negative Statements (svQOD-NS) (Appendix 2)<sup>15,17</sup> and the Olfactory Quality of Life Test (QVOLF). The order of administration of the questionnaires was the same for all participants, and randomisation was not performed. Completion was carried out in a consultation supervised by the research team to ensure the homogeneity of the process. The questionnaires were self-administered, and the evaluators were blinded to their results.

The QVOLF test consists of 34 items, each scored from 0 to 10, distributed across four sections:

- Seventeen items on olfactory quality of life, representing the QOD-NS (Questionnaire of Olfactory Disorders - negative statements),<sup>18</sup> which is a reduced version of the QOD (Questionnaire of Olfactory Disorders), where a higher score indicates greater impairment.<sup>19</sup>
- Three items on social desirability or approval, also taken from the QOD, where a higher score suggests a tendency to give socially desirable responses, which may compromise the validity of the results.<sup>18</sup>
- Nine items on taste perception, nasal sensitivity, and the presence of parosmia, developed by the Interdisciplinary Group for Research and Consulting on Sensory Perception.
- The QOD Visual Analogue Scale (QOD-VAS), which consists of 5 questions about the impact of olfactory dysfunction in the workplace, family, and social settings, as well as the degree of discomfort and awareness caused by the olfactory dysfunction. A higher score on the QOD-VAS indicates greater impairment.<sup>18</sup>

### Psychophysical evaluation of olfactory dysfunction

The Barcelona Smell Test-24 (BAST-24),<sup>16</sup> a psychophysical tool consisting of olfactometry and gustatory testing, was used to diagnose olfactory dysfunction. Olfactometry evaluates 24 odours and provides quantitative and qualitative information about olfactory function. The test assesses three main aspects: 1) Odour detection (a suprathreshold test in which patients indicate whether they perceive (yes/no) each of the 24 stimuli); 2) Spontaneous identification (patients attempt to name each odour without response options); and 3) Forced-choice identification (patients select the correct odour from four alternatives). There are no pub-

**Table 1** Characteristics of the patients included in the study.

Patient characteristics		Mean/ <i>n</i>	SD/%
Age		49	14
Sex	Man	20	23.26
	Woman	66	76.74
	No	47	54.65
Previous conditions	Yes	39	45.35
	Asthma	3	3.5
	HTA	11	12.8
	Cardiovascular diseases	4	4.6
	Endocrine diseases	7	8.1
	Autoimmune diseases s	8	9.3
	Depression	7	8.1
Smoker	Fibromyalgia	3	3.5
	No	54	62.79
	Yes	20	23.26
	Ex-smoker	12	13.95

lished data on the minimal clinically important difference (MCID) for the BAST-24. Normal olfactory function is defined as the detection or identification of more than 70% of the odours; olfactory dysfunction, when between 1% and 70% are recognised; and anosmia, when no odour is detected or identified.

### Statistical analysis

Statistical power was calculated a priori to detect a moderate minimum correlation ( $\rho = .30$ ), in accordance with the magnitude of the effect sizes described in previous studies on post-viral and post-COVID olfactory dysfunction.<sup>18,20</sup> With a significance level of  $\alpha = .05$  and a power of 80%, the required sample size was at least 84 subjects. The final cohort of 86 patients met this criterion.

Descriptive analyses were performed to calculate the means, standard deviations, and frequencies of the different parameters of the study population, as well as the results obtained in the various subjective and psychophysical tests. No missing data were recorded for the analysed variables, resulting in all patients being included in the statistical analyses.

The statistical assumptions of normality were assessed using the Shapiro-Wilk test and of homoscedasticity using Levene's test. Since most variables did not meet these assumptions, nonparametric tests (Spearman's rank correlation coefficient and Mann-Whitney *U* test) were used.

Spearman's rank correlation coefficient was used to assess the relationship between BAST-24 scores and olfactory-related quality of life questionnaires (SNOT-22, QVOLF, and svQOD-NS). This test was also used to analyse the correlation between the questionnaires themselves.

To compare olfactory quality of life questionnaire scores between men and women, the non-parametric Mann-Whitney *U* test was used. No age-matching procedure was performed between groups, as all participants belonged to the same post-COVID-19 cohort. Comparisons between subgroups (sex, severity of olfactory dysfunction) were conducted using non-parametric tests, which do not require a

normal distribution and allow for comparison of groups even if their ages are not exactly the same.

Data processing and statistical analysis were performed using Python (version 3.11). The Pandas library was used for managing and manipulating the tabulated data. Statistical tests were performed using functions available in the *scipy.stats* module, and data visualisation was carried out using the *matplotlib* library. All analysis was performed in an isolated computing environment without internet access, thus ensuring data integrity and control. Statistical significance was set at *p*-values  $<0.05$ .

### Results

A total of 86 patients with post-COVID olfactory dysfunction were included in the study, with a mean age of 49 years ( $SD = 14$  years), ranging from 18 to 83 years. 23.26% were men ( $n = 20$ ) and 76.74% were women ( $n = 66$ ). Regarding tobacco, 62.79% were non-smokers ( $n = 54$ ), 23.26% were current smokers ( $n = 20$ ), and 13.95% were former smokers ( $n = 12$ ).

54.65% of the patients had no pre-existing comorbidities ( $n = 47$ ), while 45.35% had at least one comorbidity ( $n = 39$ ). The most frequent comorbidities were: hypertension in 12.8% ( $n = 11$ ), autoimmune diseases in 9.3% ( $n = 8$ ), depression in 8.1% of cases ( $n = 7$ ), endocrine diseases in 8.1% ( $n = 7$ ), cardiovascular diseases in 4.6% ( $n = 4$ ), asthma in 3.5% ( $n = 3$ ), and fibromyalgia in 3.5% ( $n = 3$ ), as shown in [Table 1](#).

According to the VAS scale, 8.13% ( $n = 7$ ) of the patients were classified as anosmic (VAS 10) and 90.69% ( $n = 78$ ) as Hyposmia (VAS 1-9). Of these, 11.62% ( $n = 10$ ) presented with mild hyposmia (VAS 1-3), 41.86% ( $n = 36$ ) with moderate hyposmia (VAS 4-6), and 37.20% ( $n = 32$ ) with severe hyposmia (VAS 7-9). Only one patient (1.16%) was considered normosmic (VAS 0), as shown in [Table 2](#).

Regarding the results of the subjective tests, the mean score on the VAS for loss of smell was 6 ( $SD = 2$ ; 95% CI 5.57–6.43) on the SNOT-22 of 26 ( $SD = 20$ ; 95% CI 21.71–30.29), in the svQOD-NS of 4 ( $SD = 4$ , 95% CI 3.14–4.86), and in the QVOLF of 127 ( $SD = 50$ ; 95% CI

**Table 2** Classification of olfactory dysfunction according to the Visual Analog Scale (VAS).

Category	n	%	95% CI (%)
Normosmia (0)	1	1.6	[0.03, 6.31]
Hyposmia (1–9)	78	90.70	[82.49, 95.90]
Mild (1–3)	10	11.63	[5.72, 20.35]
Moderate (4–6)	36	41.86	[31.30, 52.99]
Severe (7–9)	32	37.21	[27.02, 48.30]
Anosmia (10)	7	8.14	[3.34, 16.05]

**Table 3** Mean scores obtained on the subjective tests: SNOT-22 (including the breakdown of question 21, specific to smell), VAS, QVOLF (with its different descriptive groups), and svQOD-NS. The percentage impact of the score obtained with respect to the maximum possible score.

Subjective tests	Mean	SD	95% CI (mean)	% of the maximum
VAS sense of smell (0–10)	6	2	[5.57, 6.43]	60
SNOT-22 (0–110)	26	20	[21.71, 30.29]	23.63
Question 21 (Smell)	3	1	2.79, 3.21	60
QVOLF Total (0–340)	127	50	[116.28, 137.72]	37.3
Taste and Touch (0–30)	23	7	[21.50, 24.50]	76.6
Characteristics of olfactory impairment (0–50)	24	12	[21.43, 26.57]	48
Impact on eating habits (0–50)	17	15	[13.78, 20.22]	34
Problems regarding oneself (0–70)	23	18	[19.14, 26.86]	32.8
Problems regarding others (0–50)	4	8	[2.28, 5.72]	8
Self-concept (0–30)	11	6	[9.71, 12.29]	36.6
Positive aspect (0–10)	8	3	[7.36, 8.64]	80
Discomfort/awareness (0–20)	12	5	[10.93, 13.07]	60
Interference (0–30)	7	8	[5.28, 8.72]	23.3
svQOD-NS (0–21)	4	4	[3.14, 4.86]	19

116.27–137.73). **Table 3** presents a detailed breakdown of the QVOLF by descriptive groups. In the ‘‘Taste and Touch’’ and ‘‘Positive Aspects’’ sections, a higher score reflects a better outcome. Conversely, in the other descriptive groups, a lower score indicates less impact on quality of life.

In the BAST-24 psychophysical olfactory test, the mean detection rate was 91% (SD = 22; 95% CI 86.28–95.72), with an identification rate of 52% (SD = 25; 95% CI 46.64–57.36) and a recall rate of 35% (SD = 20; 95% CI 30.71–39.29).

### Correlation between the 3 quality-of-life questionnaires (SNOT-22; QVOLF; svQOD-NS)

The relationship between the three quality-of-life questionnaires was analysed: the SNOT-22 (range 0–110), the QVOLF (range 0–340), and the svQOD-NS (range 0–21). Spearman’s rank correlation coefficient ( $\rho$ ) was used for the analysis. The analysis was performed in pairs: SNOT-22 vs. QVOLF; SNOT-22 vs svQOD-NS; QVOLF vs svQOD-NS.

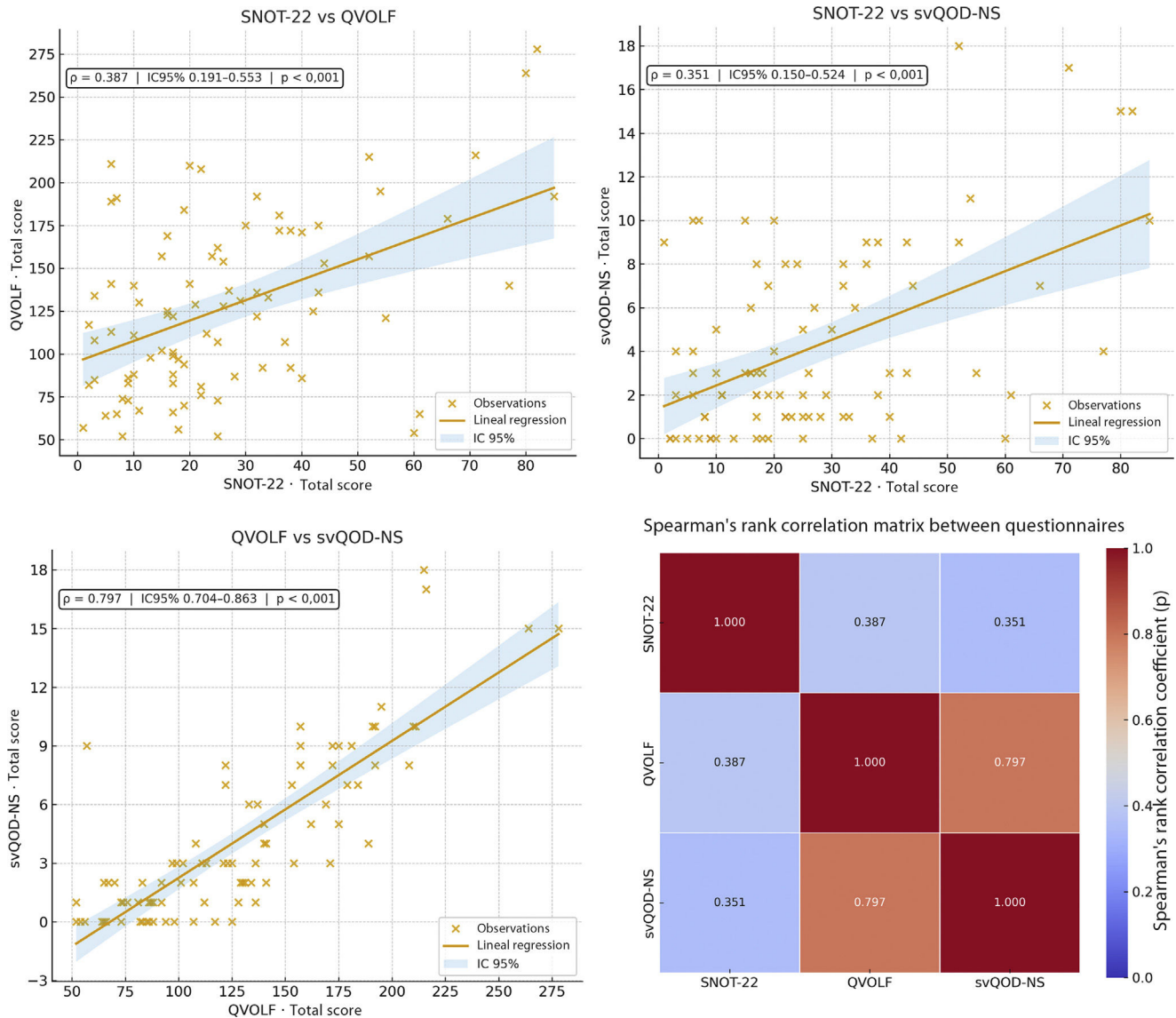
All correlations were statistically significant ( $p < 0.001$ ). The strongest correlation was observed between QVOLF and svQOD-NS ( $\rho = 0.797$ ; 95% CI 0.704–0.863), higher than the moderate correlations observed between either of these questionnaires and SNOT-22 (SNOT-22 vs. svQOD-NS  $\rho = 0.351$ ; 95% CI 0.150–.524; and SNOT-22 vs. QVOLF  $\rho = 0.387$ ; 95% CI 0.191–0.553), as shown in **Fig. 1**. This sug-

gests that QVOLF and svQOD-NS capture similar dimensions of olfactory impact, possibly due to a shared focus on functional and psychosocial aspects of olfactory dysfunction. In contrast, SNOT-22, while useful, addresses a broader range of nasosinus symptoms, not exclusively the olfactory component.

### Correlation between the quality-of-life questionnaires and the BAST-24 Psychophysical test

The correlation between the parameters of the BAST-24 olfactory test (with its three domains: Detection - DT, Identification - ID, Memory - ME) and the SNOT-22, QVOLF, and svQOD-NS quality-of-life questionnaires was analysed using Spearman’s rank correlation coefficient ( $\rho$ ). All associations were weak, and none reached statistical significance (**Table 4**), suggesting that, in this sample, olfactory function is not strongly correlated with the subjective perception of quality of life. **Fig. 2** shows the correlations with the Identification parameter of the BAST-24. Correlations with Detection and Memory are presented in Appendices 4 and 5.

**Fig. 2.** Correlation between the Identification (ID) parameter of the BAST-24 and the SNOT-22, QVOLF, and svQOD-NS quality of life questionnaires.



**Figure 1** Correlation between the three quality-of-life questionnaires: SNOT-22 and QVOLF (top left image), SNOT-22 and svQOD-NS (top right image), QVOLF and svQOD-NS (bottom left image), and Spearman's rank correlation matrix between the three questionnaires (bottom right image).

### Differences between sexes in the quality-of-life questionnaires

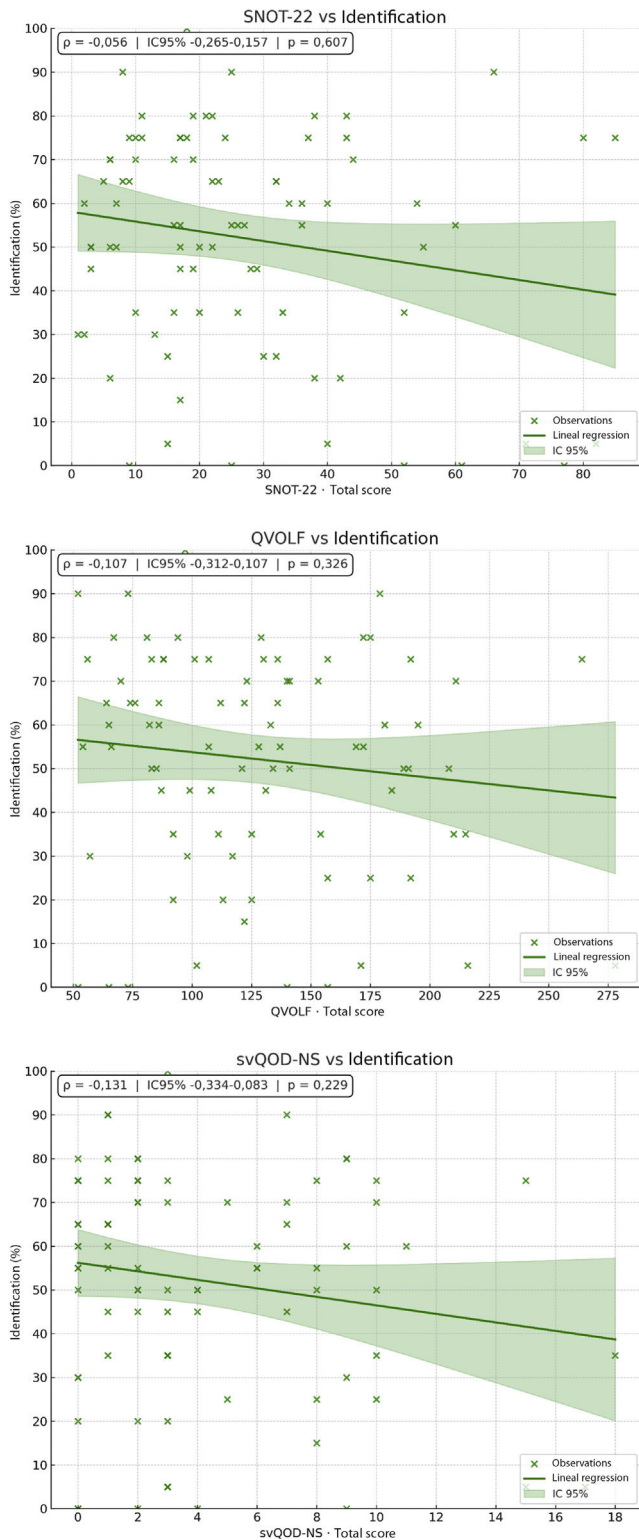
No statistically significant differences were found between men and women in the scores of the QVOLF (total or subgroups), svQOD-NS, or SNOT-22, as shown in Table 5. This indicates that, in this sample, the perceived impact of olfactory dysfunction on quality of life was similar in both sexes.

### Discussion

In this observational study of 86 patients with persistent olfactory dysfunction for more than 6 months following SARS-CoV-2 infection, we observed that mean scores on the QVOLF, svQOD-NS, and SNOT-22 questionnaires reflect a moderate impact on olfactory-related quality of life.

A strong correlation was found between the two olfactory-specific questionnaires (QVOLF and svQOD-NS), and moderate correlations were found between both and the SNOT-22 questionnaire. This suggests that the QVOLF and svQOD-NS capture dimensions of olfactory impact that are more closely related to each other, possibly due to a shared focus on functional and psychosocial aspects. In contrast, the SNOT-22, while useful, addresses a broader range of nasosinusal symptoms and not exclusively the olfactory component. No significant association was observed between any of the three questionnaires and the BAST-24 domains (Detection, Identification, Memory), reinforcing the known disconnect between subjective perception and psychophysical assessment and suggesting differential mechanisms that explain this discrepancy.

From a mechanistic perspective, the discrepancy can be explained by (i) peripheral alterations with aberrant regen-



**Figure 2** Correlation between the BAST-24 Identification (ID) parameter and the SNOT-22, QVOLF, and svQOD-NS quality of life questionnaires.

eration of olfactory neurons and the onset of parosmia, which distort hedonic valence without necessarily being reflected in thresholds; (ii) persistent central changes (e.g., bulb reduction/connectivity and involvement of olfactory and orbitofrontal regions) that impact identification and

memory more than simple detection; and (iii) psychosocial factors (depression/anxiety, selective attention, expectations, and coping strategies) that amplify the perceived burden on quality of life. Specifically, this divergence can be attributed to three complementary mechanisms: (1) sensory adaptation, which attenuates the salience of stimuli and reduces the perceived discrepancy without necessarily modifying psychophysical performance; (2) perceptual recalibration after post-viral injury, with changes in the central integration and interpretation of olfactory signals that disproportionately affect identification and memory; and (3) parosmia linked to aberrant regeneration, which impairs quality of life even with relatively preserved detection. This framework is consistent with the pattern observed in our cohort, good detection with reduced identification/recall, and helps to explain why impact questionnaires do not always correlate with the BAST-24.

The lack of correlation between subjective and psychophysical olfactory tests has been previously described in the literature, although most of these studies have focused on patients with chronic rhinosinusitis. Post-COVID-19 anosmia affects an unprecedented number of patients and presents a different functional pattern, characterised by relatively preserved detection but markedly impaired identification. In this context, our study aimed to determine whether quality-of-life questionnaires validated in other diseases maintain their validity and sensitivity in post-COVID-19 olfactory dysfunction, since an accurate assessment of the functional and emotional impact is key to optimising the diagnostic and therapeutic approach for these patients.<sup>21</sup>

In terms of clinical relevance and MCID, in our cohort, the mean SNOT-22 score was 26 points, consistent with a moderate impact. The published MCID for this questionnaire is approximately 9 points. Since our study was cross-sectional, longitudinal changes were not assessed, but this threshold is useful for interpreting the clinical relevance of differences between groups in future studies. In the case of QOD-NS, with a proposed MCID of 5.2 points, this threshold is not directly transferable to svQOD-NS. Therefore, although the mean svQOD-NS score was 4 points, the absence of a specific MCID for svQOD-NS and QVOLF limits the clinical interpretation of point differences. It is important to remember that the MCID applies to changes over time and not necessarily to cross-sectional comparisons.

The demographic profile of the sample was characterised by a female predominance and a mean age of 49 years. Our findings corroborate that post-COVID olfactory dysfunction remains highly prevalent, especially in women. These data coincide with the European multicentre series by Lechien et al.,<sup>11</sup> which included 417 cases, of which 85.6% presented with olfactory dysfunction, with women being the most affected. At 6 months, more than 60% of the patients in that cohort continued to have abnormalities, a percentage similar to that of our sample and to that observed in subsequent studies on prolonged evolutions.<sup>20</sup>

Regarding quality of life, Otte et al.<sup>22</sup> demonstrated, using the 29-item QOD questionnaire and the 5-item QOD-VAS, that even patients with recovery of olfactory function to normosmia levels maintained significant subjective impairment, exacerbated by the presence of parosmia. This finding could explain why, in our sample, despite having a 91% detection rate on the BAST-24, the subjective olfactory

**Table 4** Correlation between the SNOT-22, QVOLF, and svQOD-NS quality of life questionnaires and the three domains of the BAST-24 psychophysical test (Detection, Identification, and Memory).

Comparison of QOL questionnaires		Rho	95% CI	<i>p</i>
SNOT-22	Detection	−0.151	[−0.352, 0.063]	0.165
	Identification	−0.056	[−0.265, 0.158]	0.607
	Memory	−0.003	[−0.215, 0.209]	0.979
QVOLF	Detection	−0.044	[−0.254, 0.169]	0.687
	Identification	−0.107	[−0.312, 0.107]	0.326
	Memory	−0.163	[−0.362, 0.051]	0.133
svQODNS	Detection	−0.132	[−0.335, 0.082]	0.225
	Identification	−0.131	[−0.334, 0.083]	0.229
	Memory	−0.171	[−0.369, 0.042]	0.116

**Table 5** Differences between sexes in the responses to the 3 quality-of-life questionnaires (QVOLF, svQOD-NS, and QVOLF), breaking down the QVOLF into descriptive subgroups. The results of the U statistic, *p*, and 95% CI of the effect size  $A = U / (n_1 \times n_2)$  are presented.

Questionnaires	Statistic	<i>p</i>	$A = U / (n_1 \times n_2)$	95%CI (A)
<i>QVOLF total</i>	545.5	0.281	0.413	[0.268, 0.559]
Taste and touch	565.5	0.428	0.331	[0.283, 0.574]
Characteristics of olfactory impairment	684.3	0.518	0.724	[0.373, 0.664]
Impact on eating habits	515.0	0.390	0.162	[0.245, 0.535]
Regarding oneself	540	0.409	0.256	[0.264, 0.554]
Regarding others	609	0.461	0.623	[0.316, 0.607]
Self-concept	604.5	0.458	0.631	[0.313, 0.603]
Positive aspects	634.5	0.481	0.871	[0.335, 0.626]
Discomfort/awareness	527	0.399	0.203	[0.254, 0.544]
Interference	613.5	0.465	0.697	[0.320, 0.610]
<i>svQOD-NS total</i>	565.5	0.382	0.428	[0.283, 0.574]
<i>SNOT-22</i>	749	0.365	0.567	[0.422, 0.713]

dysfunction scale (VAS) scored high (6/10). Furthermore, Luong et al.<sup>23</sup> compared patients with olfactory dysfunction secondary to COVID-19 and chronic rhinosinusitis, observing that the former had worse scores on the 19-item QOD questionnaire, but better results on the overall SNOT-22, unlike in chronic rhinosinusitis, probably due to the lower nasosinus inflammatory burden in COVID-19. These findings are consistent with the results of our study (low svQOD-NS, moderate SNOT-22) and reinforce the hypothesis that olfactory dysfunction in COVID-19 presents a distinct pattern compared to other nasosinus diseases, characterised by good detection but poor identification of odours. This functional dissociation could be influenced by the presence of parosmia, which, although not systematically assessed in this study, is reported by many post-COVID patients, ultimately leading to a greater impact on their quality of life.

In our cohort, no significant differences were observed in the quality-of-life questionnaires between the sexes, unlike the study by Zou et al.,<sup>18</sup> which included 760 participants and found that women had poorer olfactory quality of life than men.

The lack of correlation between the BAST-24 and the questionnaires was also described by Vandersteen et al.,<sup>20</sup> who demonstrated a mismatch between subjective

complaints and the TDI (threshold, discrimination, and identification) classification of the Sniffin' Stick Test, with the identification domain being the only one that maintained an association with impaired quality of life. This finding supports the need to use subjective tools in addition to psychophysical ones, since the latter do not always reflect the impact perceived by the patient.

The systematic review by Han et al.<sup>24</sup> confirmed the validity of the svQOD-NS, the QOD, and other specific quality-of-life assessment scales such as the QVOLF, recommending their combined use with psychophysical tests to encompass all dimensions of the disease. The strong correlation found in our study between the QVOLF and the svQOD-NS supports their conceptual overlap and their usefulness as screening tools sensitive to functional and psychosocial impairment.

Several studies have indicated that a smaller, but not negligible, proportion of patients develop depression and anxiety associated with olfactory dysfunction.<sup>7</sup> Jacobson et al.<sup>25</sup> demonstrated that avoidant coping strategies may predict poorer quality of life and greater affective symptoms in post-COVID olfactory dysfunction, highlighting the need to integrate psychological support and active coping techniques with olfactory training.

## Limitations

The main limitations of the study include its single-centre, cross-sectional design, the absence of a control group, and the lack of longitudinal follow-up to assess the evolution of the subjective impact. Despite these limitations, the study provides relevant evidence on the discrepancy between subjective and psychophysical measures, and on the need for olfactory-specific tools in post-COVID-19 clinical assessment.

Another important limitation is the lack of a systematic assessment of parosmia, which could be a modulating factor in quality of life. Identifying vulnerable subgroups, such as patients with parosmia or those employing avoidant coping strategies, who may require early psychological intervention, is also a concern. Further studies comparing olfactory dysfunction across different aetiologies are needed to select appropriate therapeutic strategies and follow-up tools.

## Conclusions

Olfactory dysfunction secondary to COVID-19 has a significant impact on quality of life, both functionally and emotionally. Our results show that specific questionnaires, such as the QVOLF and the sVQOD-NS, are more sensitive than the SNOT-22 for assessing this impact.

Combining these questionnaires with psychophysical tests, such as the BAST-24, allows for a more comprehensive patient assessment. Many patients with post-COVID-19 olfactory dysfunction present with impaired odour identification, even when olfactory detection is normal, which is not always reflected in general questionnaires like the SNOT-22. This finding underscores the need to address olfactory deficit from a multidimensional perspective, integrating subjective and psychophysical tools, and considering factors such as parosmia, perceptual adaptation, and emotional impact.

Combining these tools and incorporating them into our routine clinical practice will allow us not only a more precise assessment of the degree of impairment but also the identification of vulnerable patients. This will allow for the design of personalised therapeutic strategies that address both olfactory rehabilitation and the necessary psycho-emotional support in certain cases.

## CRedit authorship contribution statement

All authors have made substantial contributions in accordance with the standards of the International Committee of Medical Journal Editors (ICMJE).

- Design: AC;
- Acquisition of data: MC, AS, EY, LG;
- Analysis: JH;
- Writing and drafting: CR;
- Critical Revision: MCB

## Ethical approval and consent to participate

This study was approved by the Ethics Committee of Hospital Parc Taulí (reference: 2022/5011). All procedures were carried out in accordance with the principles of the 1964 Declaration of Helsinki and its subsequent amendments. Informed consent was obtained, and the collected data were protected from disclosure.

## Consent for publication

Not applicable.

## Funding statement

The authors declare that they have not received any financial support and have no related financial interests.

## Availability of data and materials

The data sets generated and/or analysed during this study are not publicly available due to our institutional protocols, but may be provided by the corresponding author upon reasoned request.

## Appendix A. Supplementary data

Supplementary material related to this article can be found, in the online version, at doi:<https://doi.org/10.1016/j.otoeng.2025.512312>.

## Declaration of competing interest

The authors have no conflict of interest to declare

## References

1. Frasnelli J, Landis BN, Heilmann S, Hauswald B, Hüttenbrink KB, Lacroix JS, et al. Clinical presentation of qualitative olfactory dysfunction. *Eur Arch Otorhinolaryngol.* 2004;261:411–5, <http://dx.doi.org/10.1007/s00405-003-0703-y>.
2. Garden EM, Kumaresan K, Clark A, Philpott CM. Olfactory disorders questionnaire: scaling severity of quality-of-life impact. *Clinical Otolaryngol.* 2023;48:206–12, <http://dx.doi.org/10.1111/coa.14017>.
3. Mullol J, Alobid I, Mariño-Sánchez F, Izquierdo-Domínguez A, Marin C, Klimek L, et al. The loss of smell and taste in the COVID-19 outbreak: a tale of many countries. *Curr Allergy Asthma Rep.* 2020;20:61, <http://dx.doi.org/10.1007/s11882-020-00961-1>.
4. Mullol J, Alobid I, Mariño-Sánchez F, Quintó L, De Haro J, Bernal-Sprekelsen M, et al. Furthering the understanding of olfaction, prevalence of loss of smell and risk factors: a population-based survey (OLFACAT study). *BMJ Open.* 2012;2:e001256, <http://dx.doi.org/10.1136/bmjopen-2012-001256>.
5. Desiato VM, Levy DA, Byun YJ, Nguyen SA, Soler ZM, Schlosser RJ. The prevalence of olfactory dysfunction in the general population: a systematic review and meta-analysis. *Am J Rhinol Allergy.* 2021;35:195–205, <http://dx.doi.org/10.1177/1945892420946254>.
6. Hummel T, Whitcroft KL, Andrews P, Altundag A, Cinghi C, Costanzo RM, et al. Position paper on olfactory dys-

- function. *Rhinology*. 2017;54:1–30, <http://dx.doi.org/10.4193/Rhino16.248>.
7. Croy I, Nordin S, Hummel T. Olfactory disorders and quality of life—an updated review. *Chem Senses*. 2014;39:185–94, <http://dx.doi.org/10.1093/chemse/bjt072>.
  8. Hummel T, Liu DT, Müller CA, Stuck BA, Welge-Lüssen A, Hähner A. Olfactory dysfunction: etiology, diagnosis, and treatment. *DtschArztebl Int*. 2023;120:146–54, <http://dx.doi.org/10.3238/arztebl.m2022.0411>.
  9. Henkin RI, Levy LM, Fordyce A. Taste and smell function in chronic disease: a review of clinical and biochemical evaluations of taste and smell dysfunction in over 5000 patients at the Taste and Smell Clinic in Washington, DC. *Am J Otolaryngol*. 2013;34:477–89, <http://dx.doi.org/10.1016/j.amjoto.2013.04.006>.
  10. Seiden AM. Postviral olfactory loss. *Otolaryngol Clin North Am*. 2004;37:1159–66, <http://dx.doi.org/10.1016/j.otc.2004.06.007>.
  11. Lechien JR, Chiesa-Estomba CM, De Siati DR, Horoi M, Le Bon SD, Rodriguez A, et al. Olfactory and gustatory dysfunctions as a clinical presentation of mild-to-moderate forms of the coronavirus disease (COVID-19): a multicenter European study. *Eur Arch Otorhinolaryngol*. 2020;277:2251–61, <http://dx.doi.org/10.1007/s00405-020-05965-1>.
  12. Whitcroft KL, Altundag A, Balungwe P, Boscolo-Rizzo P, Douglas R, Enecilla MLB, et al. Position paper on olfactory dysfunction: 2023 Executive Summary. *Rhinology*. 2023;61:1–108, <http://dx.doi.org/10.4193/Rhino22.483>.
  13. Alobid I, Calvo-Henríquez C, Viveros-Díez P, López-Chacón M, Rojas-Lechuga M, Langdon C, et al. Validation of Visual Analogue Scale for loss of smell as a quick test in chronic rhinosinusitis with nasal polyps. *J Investig Allergol Clin Immunol*. 2023;34:377–84, <http://dx.doi.org/10.18176/jiaci.0937>.
  14. de los Santos G, Reyes P, del Castillo R, Fragola C, Royuela A. Cross-cultural adaptation and validation of the sino-nasal outcome test (SNOT-22) for Spanish-speaking patients. *Eur Arch Otorhinolaryngol*. 2015;272:3335–40, <http://dx.doi.org/10.1007/s00405-014-3437-0>.
  15. Chiesa-Estomba CM, Lechien JR, Calvo-Henríquez C, Mayo M, Maldonado B, Maza J, et al. Translation and validation of the short version of the Questionnaire of Olfactory Disorders–Negative Statements to Spanish. *Am J Otolaryngol*. 2021;42:102775, <http://dx.doi.org/10.1016/j.amjoto.2020.102775>.
  16. Cardesín A, Alobid I, Benítez P, Sierra E, de Haro J, Bernal-Sprekelsen M, et al. Barcelona Smell Test-24 (BAST-24): validation and smell characteristics in the healthy Spanish population. *Rhinology*. 2006;44:83–9.
  17. Mattos JL, Edwards C, Schlosser RJ, Hyer M, Mace JC, Smith TL, et al. A brief version of the questionnaire of olfactory disorders in patients with chronic rhinosinusitis. *Int Forum Allergy Rhinol*. 2019;9:1144–50, <http://dx.doi.org/10.1002/alar.22392>.
  18. Zou LQ, Hummel T, Otte MS, Bitter T, Besser G, Mueller CA, et al. Association between olfactory function and quality of life in patients with olfactory disorders: a multicenter study in over 760 participants. *Rhinology*. 2021;59:164–72, <http://dx.doi.org/10.4193/Rhin20.403>.
  19. Frasnelli J, Hummel T. Olfactory dysfunction and daily life. *Eur Arch Otorhinolaryngol*. 2005;262:231–5, <http://dx.doi.org/10.1007/s00405-004-0796-y>.
  20. Vandersteen C, Payne M, Dumas L-E, Metelkina-Fernandez V, Plonka A, Chirio D, et al. Persistent olfactory complaints after COVID-19: a new interpretation of the psychophysical olfactory scores. *Rhinol Online*. 2021;4:66–72, <http://dx.doi.org/10.4193/rhinol/21.010>.
  21. Liu ZY, Vaira LA, Boscolo-Rizzo P, Walker A, Hopkins C. Postviral olfactory loss and parosmia. *BMJ Med*. 2023;2:e000382, <http://dx.doi.org/10.1136/bmjmed-2022-000382>.
  22. Otte MS, Haehner A, Bork ML, Klusmann JP, Luers JC, Hummel T. Impact of COVID-19-mediated olfactory loss on quality of life. *ORL*. 2023;85:1–6, <http://dx.doi.org/10.1159/000523893>.
  23. Luong T, Jang SS, Said M, DeConde AS, Yan CH. Impact of COVID-19 versus chronic rhinosinusitis/rhinitis associated olfactory dysfunction on health utility and quality of life. *Laryngoscope Investig Otolaryngol*. 2022;7:1299–307, <http://dx.doi.org/10.1002/lio2.921>.
  24. Han P, Su T, Qin M, Chen H, Hummel T. A systematic review of olfactory related questionnaires and scales. *Rhinology*. 2021;59:133–43, <http://dx.doi.org/10.4193/Rhin20.291>.
  25. Jacobson PT, Vilarello BJ, Snyder C, Choo T-H, Caruana FF, Gallagher LM, et al. COVID-19 olfactory dysfunction: associations between coping, quality of life, and mental health. *Rhinology*. 2024;62:526–36, <http://dx.doi.org/10.4193/rhin23.356>.