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ORIGINAL RESEARCH

Minimal Clinically Important Difference of the Taiwan Smell Test in Patients with Bilateral Chronic Rhinosinusitis and Nasal Polyps Post-Sinus Surgery

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Objective: The impairment of smell has become a crucial evaluation in determining disease severity, control status, and therapeutic response in patients with chronic rhinosinusitis and nasal polyps (CRSwNP). This study aimed to evaluate the minimal clinically important difference (MCID) of the Taiwan Smell Identification Test (TWSIT) in patients with CRSwNP undergoing endoscopic sinus surgery (ESS).

Methods: Patients with bilateral CRSwNP who underwent ESS were prospectively enrolled. The 22-item Sino-Nasal Outcome Test questionnaire and TWSIT were utilized to evaluate both subjective and objective olfactory function before surgery and 3 months postoperatively.

Results: Eighty-six patients with bilateral CRSwNP (53 males, 33 females) were enrolled. Moderate-to-high correlations were observed between the subjective smell loss scores and baseline TWSIT scores (r_s = 0.709 before treatment and r_s = 0.413 after treatment, both $P < 0.001$). The change in patient-reported smell loss was also significantly correlated with the change in TWSIT score (r_s = 0.675, $P < 0.001$). A TWSIT change of 6.5 points yielded a sensitivity of 71.6%, specificity of 91.7%, and an AUC of 0.789 ($P < 0.001$). Using the distribution-based method, the MCID was estimated as 7.4 (half the baseline standard deviation, SD) and 6.9 (half the delta SD). Based on both distribution- and anchor-based analyses, a TWSIT change of ≥ 7 points was determined to be the MCID.

Conclusion: This study established that a TWSIT score change ≥ 7 is clinically meaningful for patients with CRSwNP following sinus surgery. Bridging objective test results with subjective perceptions can help clinicians identify patients with suboptimal therapeutic outcomes and guide decisions regarding additional treatments.

Plain Language Summary: Patients with chronic rhinosinusitis and nasal polyps (CRSwNP) usually experience significant olfactory dysfunction. The Taiwan Smell Identification Test (TWSIT) assesses olfactory function olfaction using culturally familiar odors to the Taiwanese population. This study established that a TWSIT score change ≥ 7 is clinically meaningful for patients with CRSwNP following sinus surgery.

Keywords: chronic rhinosinusitis, nasal polyps, endoscopic sinus surgery, Taiwan smell identification test, minimal clinically important difference

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Introduction

Olfactory dysfunction, typically characterized by partial or complete loss of smell (hyposmia and anosmia, respectively), has historically been overlooked due to challenges in its measurement and the underestimation of its impact on patients' quality of life.[1,2] However, it is frequently observed in patients with chronic rhinosinusitis (CRS), with reported prevalence ranging from 30% to 78%, depending on the measurement protocols used.[3] Patients with CRS with nasal polyps (CRSwNP) often experience greater olfactory dysfunction compared to populations with mixed CRS.[1] With the emergence of CRS endotypes and application of biologics in treating type 2 CRSwNP, olfactory function has gained unprecedented attention.[4] The impairment of smell has become an important clinical parameter for assessing disease severity, control status, and therapeutic response.[5]

In general, olfactory testing can be categorized into three types: patient-reported subjective olfactory assessment, psychophysical olfactory assessment, and electrophysiological studies or magnetic resonance imaging.[1] Patient-reported subjective assessments and psychophysical tests are commonly used in clinical practice, whereas electrophysiological and imaging studies are primarily reserved for research purposes.[6] Psychophysical tests, such as the Sniffin' Sticks test and the University of Pennsylvania Smell Identification Test (UPSIT), offer a more reliable evaluation of olfactory function compared to subjective self-reporting.[1] Nonetheless, subjective assessments remain valuable for characterizing the clinical effects of interventions.

The Taiwan Smell Identification Test (TWSIT; Top International Biotech, Taipei, Taiwan), developed by Shen et al in 2015, is a clinically applicable tool that uses odors familiar to Taiwanese populations, including honeypeach, passionfruit, cantaloupe, lemon, smoked plum, garlic, coffee, and jasmine.[7] The TWSIT scores of 47–48, 15–44, and 2–12 correspond to normosmia, hyposmia, and anosmia, respectively. TWSIT has been employed in numerous studies among Chinese patients with CRS to evaluate changes in olfactory function;[8,9] however, no prior evidence has established a correlation between TWSIT results and patient-reported outcomes. Determination of the minimal clinically important difference (MCID)—the smallest change in a measurement that is meaningful to patients—is essential for interpreting clinical data.[10] The aim of this study was to evaluate the MCID of the TWSIT in patients with CRSwNP undergoing endoscopic sinus surgery (ESS), using both distribution- and anchor-based methods,[10] and to assess whether changes in TWSIT scores represent clinically significant improvement.

Materials and Methods

After approval by the Institutional Review Board of the Chang Gung Medical Foundation (IRB numbers: 202102257A3 and 202202075A3), patients diagnosed with bilateral CRSwNP who underwent bilateral ESS were prospectively enrolled after providing written informed consent between 2022 and 2024. CRSwNP was defined according to the European Position Paper on Rhinosinusitis and Nasal Polyps 2020 criteria.[11] Patients with (1) sinonasal neoplasms; (2) concomitant diagnosis of immunologic complications or mucocillary disorder; or (3) history of receiving oral corticosteroids, monoclonal antibodies, or immunosuppressive treatment in the month before enrolment; (4) incomplete TWSIT and questionnaire collection were excluded. After surgery, participants received standard postoperative care, including antibiotic therapy with Curam 875/125 mg/tab (Amoxicillin + clavulanic acid, SANDOZ GMBH, Australia) for three weeks, intranasal corticosteroids, nasal douches, and weekly follow-ups during the first month, followed by monthly visits for the subsequent two months. The Chinese versions of the 22-item Sino-Nasal Outcome Test (SNOT-22) questionnaire and TWSIT were used to assess subjective and objective olfactory function before and 3 months after surgery. The postoperative mucosal recovery usually takes 1–2 months after ESS; therefore, we measured postoperative olfactory function 3 months after surgery. Participants were instructed to score each item in the SNOT-22 from 0 (no problem) to 5 (worst), with a total score ranging from 0 to 110. This score was used to evaluate the nasal symptoms and quality of life of the participants.[12]

All procedures were conducted in accordance with the relevant ethical guidelines and regulations, and the Declaration of Helsinki. Our previous study in this research project characterized the clinical features of comorbid asthma and its impact on the quality of life in patients with chronic rhinosinusitis with nasal polyps.[13] In the current study, we evaluated the MCID of the TWSIT score in patients with CRSwNP undergoing sinus surgery.

Data were presented as mean ± standard deviation (SD) and statically analyzed using GraphPad Prism 5 (GraphPad Software Inc., San Diego, CA, USA) and SPSS Statistics v27.0. (IBM Corp., Armonk, NY, USA). Spearman's rank

correlation coefficient (r_s) was used to evaluate the correlation between subjective and objective olfactory evaluations and changes. Box-and-whisker plots were used to explore the distribution of baseline, post-treatment, and change of TWSIT scores by corresponding subjective categories. The partial eta-squared (η^2) effect size metric was employed to describe the strength of association in the ANOVA analyses. The following general guidelines are used to interpret values for partial eta-squared: 0.01 indicates a small effect, 0.06 indicates a medium effect, and 0.14 or greater indicates a large effect.[14]

The distribution-based MCID was calculated using half the SD of the baseline TWSIT scores and half the SD of the perioperative change (delta) in TWSIT scores. The anchor-based method compared changes in TWSIT scores with self-perceived changes in item 5 (loss of smell or taste) of the SNOT-22 questionnaire. Receiver operating characteristic (ROC) curves were generated, and the area under the curve (AUC) was calculated to determine the optimal cut-off values of MCID. A P value < 0.05 was considered statistically significant.

Results

Eighty-six patients with bilateral CRSwNP (53 males, 33 females) who underwent bilateral ESS were enrolled. Table 1 summarizes the study population characteristics. Comorbid asthma was presented in 22 patients (26%), whereas 27 patients (31%) had a history of prior sinus surgery. The average Lund–Mackay CT score and endoscopic nasal polyp score were 17.5 ± 3.8 and 5.5 ± 1.5, respectively. More than half of the patients (47/86, 55%) reported their pre-treatment sense of smell as "extremely poor". The baseline TWSIT score was 17.5 ± 14.8.

Moderate-to-high correlations were observed between the subjective smell loss scores (patient-reported smell loss score) and baseline TWSIT scores ($r_s = 0.709$ before treatment and $r_s = 0.413$ after treatment, both $P < 0.001$). The change in patient-reported smell loss was also significantly correlated with the change in TWSIT score ($r_s = 0.675$, $P < 0.001$) (Figure 1a–1c). Greater severity of olfactory dysfunction was strongly associated with lower TWSIT scores in the ANOVA analyses. The partial eta-squared η^2 were 0.591, 0.319, and 0.471 for baseline, post-treatment and perioperative change measurements, respectively (all $P < 0.001$) (Figure 2).

Table 1 Description of the Study Population

Characteristic	
Age (years)	48.6 ± 12.5
Sex (Female: male)	33:53
Comorbid asthma	22 (26%)
Allergy	54 (62.8%)
Smoking	25 (29%)
Previous sinus surgery	27 (31%)
Baseline SNOT-22 score	48.8 ± 18.7
Nasal polyp score	5.5 ± 1.5
CT Lund-Mackay score	17.5 ± 3.8
CT ethmoid/maxillary ratio	1.3 ± 0.4
CT olfactory cleft opacification score	4.4 ± 1.9
Serum IgE (KU/L)	279.1 ± 654
Serum ECP (μg/L)	51.2 ± 47.4
BEC (/uL)	398.3 ± 430.4
Baseline TWSIT score	17.5 ± 14.8
Baseline smell loss score	
No problem	3 (3%)
Very mild problem	5 (6%)
Mild or slight problem	9 (10%)
Moderate problem	10 (12%)
Severe problem	12 (14%)
Problem as bad as it can be	47 (55%)

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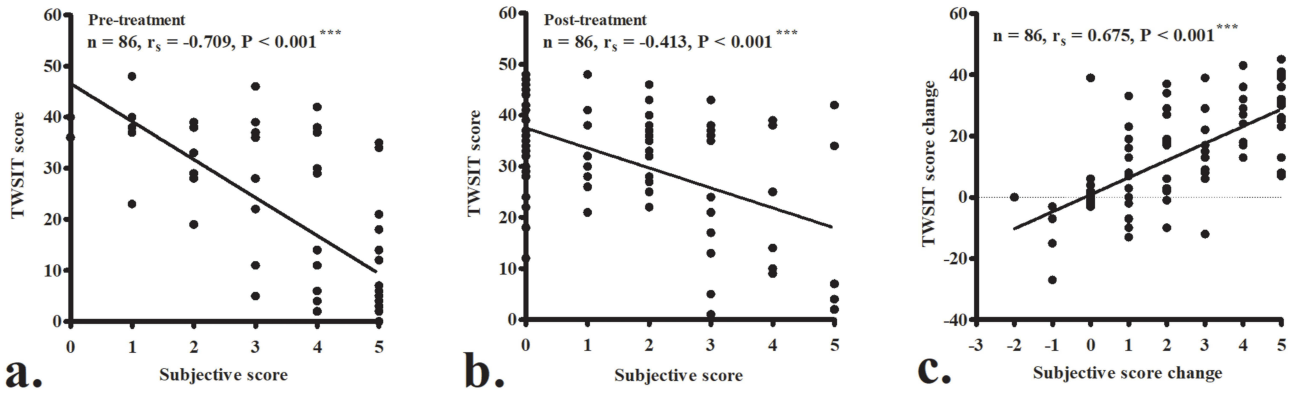

Figure 1 Moderate to high correlations between patient-reported smell loss score and The Taiwan Smell Identification Test (TWSIT) score was observed before (**a**) and after operation (**b**), as well as in the amount of change (**c**). n, case number; r_s, Spearman's rank correlation coefficient; *** P < 0.001.

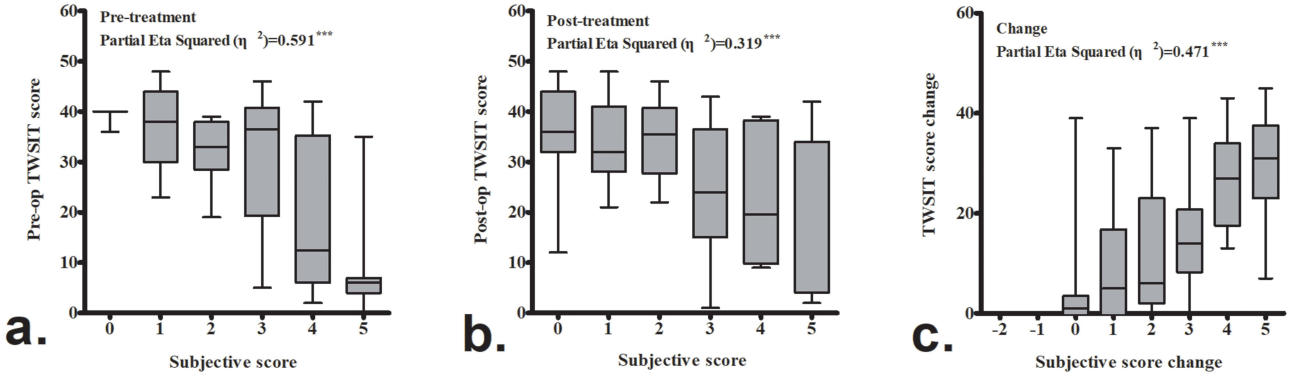

Figure 2 Boxplot comparing patient-reported smell loss score (x-axis) with the Taiwan Smell Identification Test (TWSIT) scores (y-axis) before (**a**), after operation (**b**), and in the perioperative change (**c**). *** P < 0.001.

In ROC curve analysis, a TWSIT change of 6.5 points yielded an optimal discrimination with sensitivity of 71.6%, specificity of 91.7%, and AUC of 0.789 (p < 0.001) (Figure 3). The average change in TWSIT score between baseline and 3 months post-ESS was 13.77 ± 13.8. Using the distribution-based method, the MCID was estimated as 7.4 (half the

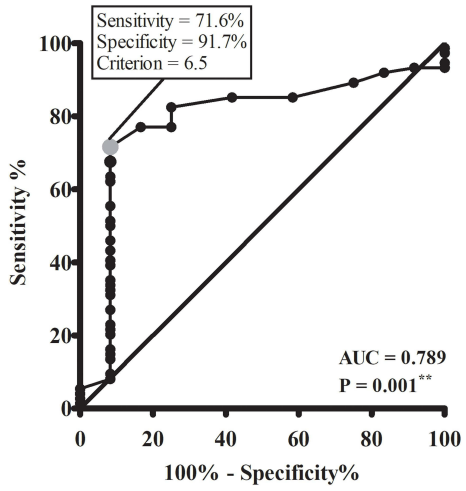

Figure 3 The receiver operating characteristic curve identified a cutoff value of 6.5 points in the Taiwan Smell Identification Test score change, with a sensitivity of 71.6%, specificity of 91.7%, and an area under the curve (AUC) of 0.789. ** P < 0.01.

baseline SD) and 6.9 (half the delta SD). Based on both the distribution- and anchor-based analyses, a TWSIT change of ≥ 7 points was determined as the MCID.

Discussion

Olfactory dysfunction is a hallmark symptom of CRS, particularly in CRSwNP, and persistent loss of smell has been proposed as a criterion for uncontrolled CRS.[15,16] To our knowledge, this is the first study to determine the MCID for the TWSIT in patients with CRSwNP post-ESS. We determined a change of ≥ 7 points as clinically meaningful, suggesting that patients achieving this level of improvement are likely to perceive a functional recovery in olfaction.

Discrepancies between objective and subjective assessments of olfactory function have been reported,[17,18] potentially leading to miscommunication between clinicians and patients. In the current study, both distribution- and anchor-based approaches were employed to determine the MCID of TWSIT as each method has its limitations. For instance, the clinical anchor-based approach is more patient-centered but hindered by the inconsistencies between patient-reported and objective measures of olfactory loss.[17] Therefore, the distribution-based approach was also utilized to establish the MCID without relying solely on patient responses. Importantly, the MCID values derived from both analytical methods were comparable in this study.

The application of MCID in clinical practice and research is essential, because the effect size and clinical significance of outcome measures are more important than statistically significant P-values. P-values do not indicate whether the observed differences are clinically meaningful. Reporting results using the MCID based on clinical significance enhances the precision of result interpretation.[19]

Subjective olfactory self-assessment tends to be unreliable, and poor correlation between self-ratings and measured olfactory function has been demonstrated in patient populations.[17] A study by Delank et al showed that 30–40% of patients with CRS who had impaired olfactory function rated themselves as unimpaired.[20] However, subjective assessment remains valuable for characterizing the clinical effects of interventions, including determining the MCID.[21] Psychophysical tests, such as the Sniffin' Sticks test and the UPSIT, provide a more reliable assessment of olfactory function than subjective self-reporting.[1] The Sniffin' Sticks test measures subjects' threshold, discrimination, and identification abilities. In contrast, the UPSIT assesses only identification but is more convenient for clinical use and is widely used in clinical trials of CRSwNP.[22] Since olfactory dysfunction is a clinical marker of type 2 inflammation and an important treatment outcome in patients with CRSwNP, a comprehensive evaluation of smell function is necessary before and after treatments such as sinus surgery or biologic therapy.[11]

Han et al used data from the LIBERTY NP SINUS-24 and SINUS-52 trials to estimate the meaningful change in the UPSIT for refractory CRSwNP patients treated with dupilumab.[23] They concluded that, based on correlations between changes in anchor measures and target outcomes, the SNOT-22 rhinologic symptoms domain was the most appropriate anchor measure, as we also used in the current study. Using this anchor measure, the threshold for a clinically meaningful within-patient change was determined to be 8 points for UPSIT. Lipworth et al subsequently used this cut-off value to compare the efficacy of currently available biologics regarding olfaction improvement, as measured by UPSIT scores, by synthesizing data from Phase 3 randomized controlled trials.[22] It is worth noting that a much lower threshold was reported in a different study population. A 1997 study involving patients with head trauma reported a MCID of 4 for UPSIT.[24] Mahadev et al further analyzed data from five clinical research studies, which included patients with post-COVID-19 olfactory dysfunction, CRS patients receiving mometasone furoate nasal irrigation, and subjects undergoing transsphenoidal surgery, and determined that a change of 4 or greater is the appropriate MCID for UPSIT.[18] Clearly, different patient groups exhibit varying MCIDs for smell tests due to differences in the extent of sinonasal involvement or symptom burden. In patients with CRSwNP, a greater improvement in smell test scores is required to achieve a significant subjective improvement.

A primary limitation of our study is the relatively small sample size, which consists solely of patients with CRSwNP who exhibit high baseline olfactory dysfunction. Patients with CRS without nasal polyps were included. This narrow focus may limit the generalizability of our findings and further subgroup analysis. Nevertheless, these patients, who experience a significant disease burden and challenges in disease management are the ones who most require comprehensive evaluations, particularly regarding olfactory function.[11] The impairment of smell has emerged as a crucial

clinical parameter for assessing disease severity, control status, and therapeutic response in individuals with CRSwNP.[16] Therefore, further research involving larger and more diverse populations, as well as varying etiologies of olfactory dysfunction, is essential.

Conclusion

Our findings are clinically significant in the context of anticipated olfactory improvement following ESS. Bridging objective test results with subjective perceptions can help clinicians identify patients who experience suboptimal therapeutic outcomes and guide decisions regarding additional treatment. Furthermore, establishing the MCID is essential for designing future clinical trials, especially in determining sample sizes.

Abbreviations

CRS, chronic rhinosinusitis; CRSwNP, chronic rhinosinusitis with (or and) nasal polyps; UPSIT, University of Pennsylvania Smell Identification Test; TWSIT, The Taiwan Smell Identification Test; MCID, minimal clinically important difference; ESS, endoscopic sinus surgery; SNOT-22, sinonasal outcome test-22; SD, standard deviation; r_s, Spearman's rank correlation coefficient; ROC, Receiver operating characteristic; AUC, area under the curve.

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Disclosure

The authors declare no competing interests.

References

1. Whitcroft KL, Altundag A, Balungwe P, et al. Position paper on olfactory dysfunction: 2023. *Rhinology*. 2023;61(33):1–108. doi:10.4193/Rhin22.483
2. Soler ZM, Nash S, Lane AP, et al. Reduced sense of smell in patients with severe chronic rhinosinusitis and its implications for diagnosis and management: a narrative review. *Adv Ther*. 2024;41(12):4384–4395. doi:10.1007/s12325-024-02984-w
3. Kohli P, Naik AN, Harruff EE, Nguyen SA, Schlosser RJ, Soler ZM. The prevalence of olfactory dysfunction in chronic rhinosinusitis. *Laryngoscope*. 2017;127(2):309–320. doi:10.1002/lary.26316
4. Otten JJ, Fokkens WJ, Reitsma S. Olfactory dysfunction in chronic rhinosinusitis with nasal polyps: effect of treatment with emphasis on biological therapy. *Curr Allergy Asthma Rep*. 2024;25(1):6. doi:10.1007/s11882-024-01187-1
5. Hellings PW, De Corso E, Backer V, et al. Remission in chronic rhinosinusitis with nasal polyps (CRSwNP). *Rhinology*. 2025;63(2):239–241. doi:10.4193/Rhin24.457
6. Savic I. Imaging of brain activation by odorants in humans. *Curr Opin Neurobiol*. 2002;12(4):455–461. doi:10.1016/S0959-4388(02)00346-X
7. Hsu NI, Lai JT, Shen PH. Development of Taiwan Smell Identification Test: a quick office-based smell screening test for Taiwanese. *Am J Rhinol Allergy*. 2015;29(2):e50–54. doi:10.2500/ajra.2015.29.4174
8. Liu CN, Yeh TH, Lin CF, Lin YT. The efficacy of dupilumab as an adjuvant treatment after endoscopic sinus surgery for chronic rhinosinusitis with nasal polyps: a retrospective cohort analysis. *Clin Exp Otorhinolaryngol*. 2025;18(3):271–279. doi:10.21053/ceo.2024.00310
9. Chen YS, Hsu CP, Huang CH, Kuan EC, Yang TH, Lin CF. Classification of chronic rhinosinusitis in Taiwan: a comprehensive analysis based on European position paper on rhinosinusitis and nasal polyps (EPOS) 2020. *J Formos Med Assoc*. 2025;1:S0929–6646(25)00214–1.
10. Kallogjeri D, EL S Jr, Piccirillo JF. Importance of defining and interpreting a clinically meaningful difference in clinical research. *JAMA Otolaryngol Head Neck Surg*. 2020;146(2):101–102. doi:10.1001/jamaoto.2019.3744
11. Fokkens WJ, Lund VJ, Hopkins C, et al. European position paper on rhinosinusitis and nasal polyps 2020. *Rhinology*. 2020;58:1–464. doi:10.4193/Rhin20.401
12. Le PT, Soler ZM, Jones R, Mattos JL, Nguyen SA, Schlosser RJ. Systematic review and meta-analysis of SNOT-22 outcomes after surgery for chronic rhinosinusitis with nasal polyposis. *Otolaryngol Head Neck Surg*. 2018;159(3):414–423. doi:10.1177/0194599818773065
13. Wu PW, Chang PH, Huang CC, Lee TJ, Fan YH, Huang CC. Impact of comorbid asthma on life quality of patients with chronic rhinosinusitis and nasal polyps. *J Asthma Allergy*. 2025;18:567–578. doi:10.2147/JAA.S517258
14. Cohen J. *Statistical Power Analysis for the Behavioral Sciences*. 2nd ed. Lawrence Erlbaum Associates, Publishers; 1988.
15. Philpott CM, Wolstenholme CR, Goodenough PC, Clark A, Murty GE. Comparison of subjective perception with objective measurement of olfaction. *Otolaryngol Head Neck Surg*. 2006;134(3):488–490. doi:10.1016/j.otohns.2005.10.041
16. Fokkens WJ, De Corso E, Backer V, et al. EPOS2020/EUFOREA expert opinion on defining disease states and therapeutic goals in CRSwNP. *Rhinology*. 2024;62(3):287–298. doi:10.4193/Rhin23.415

17. Knaapila A, Raittola A, Sandell M, Yang B. Self-ratings of olfactory performance and odor annoyance are associated with the affective impact of odor, but not with smell test results. *Perception*. 2017;46(3–4):352–365. doi:10.1177/0301006616672222
18. Mahadev A, Kallogjeri D, Piccirillo JF. Validation of minimal clinically important difference (MCID) for university of pennsylvania smell identification test (UPSIT). *Am J Rhinol Allergy*. 2024;38(2):123–132. doi:10.1177/19458924231218037
19. Piccirillo JF. Improving the quality of the reporting of research results. *JAMA Otolaryngol Head Neck Surg*. 2016;142(10):937–938. doi:10.1001/jamaoto.2016.2670
20. Delank KW, Stoll W. Olfactory function after functional endoscopic sinus surgery for chronic sinusitis. *Rhinology*. 1998;36(1):15–19.
21. Cook CE. Clinimetrics corner: the minimal clinically important change score (MCID): a necessary pretense. *J Man Manip Ther*. 2008;16(4):E82–3. doi:10.1179/jmt.2008.16.4.82E
22. Lipworth BJ, Greig R, Chan R, Kuo CR. Reappraisal of biologic efficacy from phase 3 trials in refractory chronic rhinosinusitis and nasal polyps. *J Allergy Clin Immunol Pract*. 2025;13(8):1943–1951. doi:10.1016/j.jaip.2025.04.043
23. Han JK, Bachert C, Lee SE, et al. Estimating clinically meaningful change of efficacy outcomes in inadequately controlled chronic rhinosinusitis with nasal polyposis. *Laryngoscope*. 2022;132(2):265–271. doi:10.1002/lary.29888
24. Doty RL, Yousem DM, Pham LT, Kreshak AA, Geckle R, Lee WW. Olfactory dysfunction in patients with head trauma. *Arch Neurol*. 1997;54(9):1131–1140. doi:10.1001/archneur.1997.00550210061014