INDEX COPERNICUS INTERNATIONAL

Phenotypic and Genotypic Evaluation of the Bitter Taste Receptor T2R38 in Chronic Rhinosinusitis

Anna Długosz-Karbowska[1ABCDEFG], Aleksandra Auguściak-Duma[2BD], Jarosław Markowski[1BDG], Monika Szymańska-Czerwińska[3EF], Krzysztof Niemczuk[3EF], Krzysztof Jasik[4EF], Aleksandra Markowska[5CEF], Piotr Barnaś[6EF], Jarosław Paluch[1,3ABCDEFG]

[1]Department of Laryngology, Faculty of Medical Sciences in Katowice, Medical University of Silesia, Katowice, Poland
[2]Department of Molecular Biology, Faculty of Medical Science in Katowice, Medical University of Silesia, Katowice, Poland
[3]Institute of Genetics and Animal Biotechnology of the Polish Academy of Sciences, Jastrzebiec, Poland
[4]Department of Medical Sciences, Wladyslaw Bieganski Collegium Medicum Jan Dlugosz University, Czestochowa, Poland
[5]Doctoral School of the Medical University of Warsaw, Warsaw, Poland
[6]Otolaryngology, Head and Neck Surgery Clinic, 4th Military Clinical Hospital in Wroclaw, Wroclaw, Poland

ABSTRACT:

Introduction: Chronic rhinosinusitis (CRS) is a multifactorial disease in which genetic predisposition plays a significant role. The bitter taste receptor T2R38, expressed in nasal and sinus mucosa, supports innate immunity. Single nucleotide polymorphisms (SNPs) in the *TAS2R38* gene affect individuals' ability to perceive its agonist – phenylthiocarbamide (PTC) – as bitter. Carriers of non-functional variants often experience more severe CRS.

Aim: To evaluate the accuracy of the PTC taste strip test in determining the T2R38 phenotype and its correlation with genotype confirmed by molecular analysis. We also assessed associations between T2R38 polymorphisms, surgical outcomes, and COVID-19 incidence.

Material and methods: A total of 50 patients with CRS and 37 controls underwent a PTC taste strip test and completed a clinical questionnaire. *TAS2R38* genotyping was performed using DNA extracted from peripheral blood and mucosal samples.

Results: The functional *PAV* variant strongly correlated with the ability to perceive PTC as bitter. Identified genotypes included *PAV/PAV, PAV/AVI, AVI/AVI*, and rarer forms (*AAV/AVI, PAV/AAV*). The *AVI/AVI* genotype was associated with more severe CRS on CT scans. No significant association was found between genotype and surgical outcomes or COVID-19 incidence.

Discussion: Phenotypic taste testing may help identify individuals with impaired T2R38 function and poorer innate immune responses, allowing for more tailored treatment.

Conclusions: The PTC taste strip test is a simple, non-invasive tool that correlates well with *TAS2R38* genotype and may support clinical decision-making in CRS.

KEYWORDS: chronic rhinosinusitis, COVID-19, T2R38, taste receptor, taste test

ORIGINAL ARTICLE

Received: 18.06.2025
Accepted: 17.07.2025
Published: 19.08.2025

CITE THIS ARTICLE AS:
Dlugosz-Karbowska A., Augusciak-Duma A., Markowski J., Szymanska-Czerwinska M., Niemczuk K., Jasik K. et al.: Phenotypic and Genotypic Evaluation of the Bitter Taste Receptor T2R38 in Chronic Rhinosinusitis; Otolaryngol Pol 2025; 79 (5): 1–8; DOI: 10.5604/01.3001.0055.2373

AUTHORS' CONTRIBUTION:
A. Conceptualization
B. Data Curation
C. Formal Analysis
D. Funding Acquisition
E. Investigation
F. Methodology
G. Project Administration

CORRESPONDING AUTHOR:
Anna Długosz-Karbowska MD PhD; Department of Laryngology, Faculty of Medical Sciences in Katowice, Medical University of Silesia; Francuska street 20/24, 40-027 Katowice, Poland; Phone: +48 322591460;
E-mail: adlugosz@sum.edu.pl

COPYRIGHT:
Some rights reserved: Polish Society of Otorhinolaryngologists Head and Neck Surgeons. Published by Index Copernicus Sp. z o.o.

OPEN ACCESS:
The content of the journal „Polish Society of Otorhinolaryngologists Head and Neck Surgeons" is circulated on the basis of the Open Access which means free and limitless access to scientific data.

CREATIVE COMMONS CC BY:
This material is available under the Creative Commons – Attribution NonCommercial 4.0 International (CC BY-NC 4.0). The full terms of this license are available on: https://creativecommons.org/licenses/by-nc/4.0/Legalcode

COMPETING INTERESTS:
The authors declare that they have no competing interests.

ABBREVIATIONS

AHLs – acyl-homoserine lactones
CRS – chronic rhinosinusitis
CT – computed tomography
EDTA – ethylenediaminetetraacetic acid
FESS – functional endoscopic sinus surgery
GPCR – G protein-coupled receptor
NOSE-POL – Nasal Obstruction Symptom Evaluation Scale, Polish Version
NPV – negative predictive value
PPV – positive predictive value
PTC – phenylthiocarbamide
SCCs – solitary chemosensory cells
SNOT-22 – Sino-Nasal Outcome Test-22
SNPs – single-nucleotide polymorphisms
VAS – visual analog scale

INTRODUCTION

The sense of taste provides essential information about substances in our environment. It allows the evaluation of food quality, warns against spoiled or toxic products, and contributes to the overall sensory experience. Humans can perceive five basic tastes: sweet, salty, sour, bitter, and umami. Taste perception is mediated by chemoreceptors located not only in taste buds on the lingual papillae of the tongue but also in the mucous membranes of the palate and pharynx [1].

Taste receptors are classified into three types: type I, II, and III, differing in morphology and physiological function. Type II receptors are responsible for the detection of sweet, bitter, and umami tastes. In mammals, these receptors belong to the G protein--coupled receptor (GPCR) family [2]. The T2R receptor family is a subfamily of bitter taste receptors [3]. Upon stimulation, T2Rs activate the G protein gustducin, which initiates intracellular signaling cascades. These include calcium ion (Ca^{2+}) release, opening of cation channels, influx of ions, and ATP release via gap-junction-like channels. Released ATP subsequently stimulates adjacent sensory cells and neurons via paracrine signaling [4].

TAS2Rs (taste receptors type 2) have diverse activation thresholds and regulatory mechanisms. They respond to a wide range of structurally diverse compounds, including plant-derived toxins and synthetic chemicals [3]. Importantly, TAS2Rs have also been identified outside the oral cavity – on ciliated epithelial cells and solitary chemosensory cells (SCCs) of the upper respiratory tract [3, 5].

Among the T2R family, T2R38 is one of the most thoroughly studied receptors. Its known agonists include phenylthiocarbamide (PTC) and propylthiouracil. The *TAS2R38* gene is located on chromosome 7 and exhibits single nucleotide polymorphisms (SNPs) at positions 49, 262, and 296. The *PAV* haplotype (Pro49, Ala262, Val296) encodes a functional receptor, while the *AVI* haplotype (Ala49, Val262, Ile296) encodes a non-functional receptor [6].

These haplotypes form three common genotypes: *PAV/PAV* – "supertasters" who perceive PTC as intensely bitter, *AVI/AVI* – "nontasters" who cannot detect bitterness, and *PAV/AVI* – individuals with intermediate sensitivity. Less frequent genotypes such as *AAI*, *AAV*, and *PAI* are associated with moderate bitter taste perception [7].

Studies have shown that T2R38 is expressed in the ciliated epithelium of the nasal and sinus mucosa. It can be activated by acyl-homoserine lactones (AHLs) secreted by *Pseudomonas aeruginosa* and other Gram-negative bacteria [8]. Upon activation, T2R38 increases intracellular Ca^{2+} levels, stimulates nitric oxide (NO) production, enhances ciliary beat frequency, and accelerates mucociliary clearance – all of which are crucial elements of innate immune defense [9].

In a study conducted on a Polish cohort of 50 patients with chronic rhinosinusitis (CRS), the genotype distribution was 22% *PAV/PAV*, 50% *PAV/AVI*, and 28% *AVI/AVI*. Patients with the *AVI/AVI* genotype had the highest average Lund-Mackay CT (computed tomography) scores, indicating more advanced disease [10]. Moreover, "supertasters" (*PAV/PAV*) were less likely to require surgical intervention and tended to experience greater improvement in quality of life following surgery [11, 12].

AIM

The aim of this study was to evaluate whether a simple PTC taste strip test can reliably reflect the functional phenotype of the T2R38 bitter taste receptor and how well it correlates with the *TAS2R38* genotype confirmed by genetic testing. Additionally, we assessed the relationship between T2R38 polymorphisms, the effectiveness of surgical treatment for CRS, and the incidence of COVID-19 infection. The study also aimed to explore whether individuals who perceive the bitter taste of PTC exhibit stronger innate immune responses in the upper respiratory tract and achieve better outcomes following sinus surgery compared to non-tasters.

MATERIAL AND METHODS

Ethical approval

Before initiating the study, approval was obtained from the Bioethics Committee of the Medical University of Silesia in Katowice (Resolution No. PCN/0022/KB1/42/21, dated 18/05/2021). Written informed consent was obtained from all participants at the time of hospital admission.

Study design and participants

A total of 87 patients hospitalized in the Department of Otolaryngology were enrolled in the study. The study group consisted of 50 patients diagnosed with CRS, with or without nasal polyps, according to the EPOS 2020 criteria. All patients in this group underwent a CT scan of the paranasal sinuses prior to hospital admission. The control group included 37 patients hospitalized for conditions other than CRS. These individuals did not report nasal obstruction and had no signs of active allergy or acute/exacerbated upper or lower respiratory tract infections. Exclusion criteria were:

age under 18 years, active SARS-CoV-2 infection, physical or mental inability to complete the survey, and pregnancy.

The overall study population included 40.2% (n = 35) women and 59.8% (n = 52) men. In the control group, 43.2% (n = 16) were women and 56.8% (n = 21) were men, while in the control group, 38% (n = 19) were women and 62% (n = 31) were men. The gender difference was not statistically significant. The mean age of all participants was 49.7 ±14.6 years; in the study group, 48.9 ±12.6 years; and in the control group, 51.0 ±17.1 years. This difference was also not statistically significant.

Sample collection and DNA isolation

Biological material included 5 mL of peripheral blood collected into EDTA tubes (S-Monovette, Sarstedt), and – only in the CRS group – a sample of pathologically altered nasal mucosa obtained during surgery. Blood samples were frozen at –20°C. Tissue samples were immersed in RNA Later (Qiagen) and frozen after complete reagent penetration.

DNA was isolated from 200 µL of blood using the GeneMatrix Quick Blood DNA Purification Kit (Eurx, Poland) and from 7–26 mg of frozen tissue using the GeneMatrix Tissue DNA Purification Kit (Eurx, cat. no. E3553), following the manufacturer's protocols. DNA quality and concentration were assessed spectrophotometrically using the NanoDrop 2000 (Thermo Fisher Scientific, USA).

Phenylthiocarbamide taste test and clinical assessment

Each participant completed a structured questionnaire and underwent a taste test using a cellulose strip impregnated with 5 µg of PTC (Indigo® Instruments, Canada). The test was conducted at the time of questionnaire completion. Participants were instructed to place the strip on the tongue and report whether they perceived a taste, including its type and intensity. Responses were recorded in the questionnaire.

The baseline questionnaire ("survey 0") included: the NOSE-POL questionnaire (0–100 scale, higher score = greater nasal obstruction), A 10-point visual analog scale (VAS) for nasal patency (10 = complete obstruction), sociodemographic data (age, height, weight), comorbidities (allergic rhinitis, asthma, COVID-19), previous surgeries, and use of intranasal steroids or other medications. In addition, CRS patients completed the SNOT-22 questionnaire (score range 0–110) before and 3–6 months after surgery. CT scans of the paranasal sinuses were analyzed using the Lund-Mackay scoring system.

Genotyping

Genotyping of the *TAS2R38* gene polymorphisms was performed using TaqMan SNP Genotyping Assays (Applied Biosystems, USA). The analysis was conducted in duplicate using a LightCycler 480 II real-time PCR system (Roche, Germany). The following SNP-specific probes were used: rs713598: c_88876467_10 (A1), rs1726866: c_9506827_10 (B2), rs10246939: c_9506826_10 (C3).

The reactions were carried out using TaqPath ProAmp Master Mix (Thermo Fisher Scientific, USA), following the manufacturer's protocol. Genotyping results were analyzed using dedicated software provided with the LightCycler system.

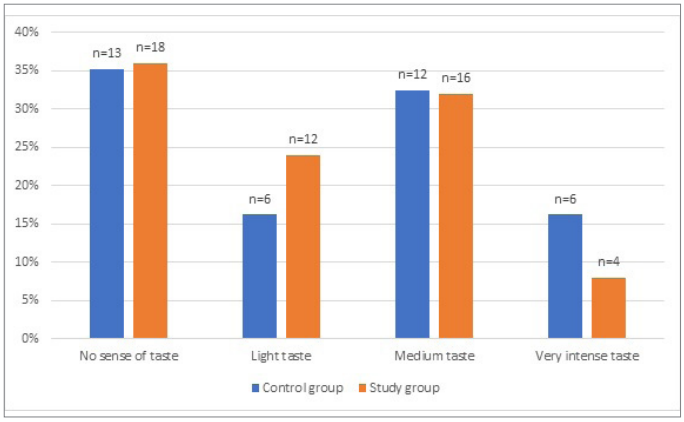

Fig. 1. Assessment of the PTC taste recognition ability with division into the control and study groups.

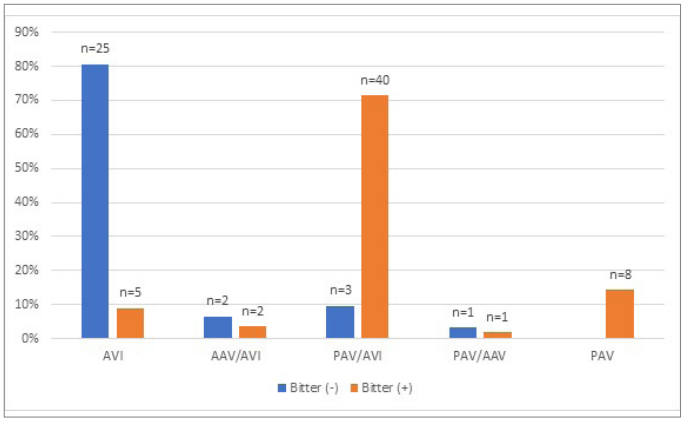

Fig. 2. Genotype frequency and bitter taste perception ability.

RESULTS

Group characteristics

Participants were asked about their smoking habits. Smoking was declared by 24.3% (n = 9) of the control group and 26.5% (n = 13) of the study group; this difference was not statistically significant. However, patients in the control group had a significantly longer and heavier smoking history compared to those in the study group.

The prevalence of allergic rhinitis (32% *vs.* 2.7%) and bronchial asthma (26% *vs.* 0%) was significantly higher in the study group. The use of intranasal corticosteroids was also significantly more common among patients with CRS. Approximately 45% of CRS patients had undergone previous sinus surgery, while no patients in the control group reported prior sinus procedures.

Phenylthiocarbamide taste test and genotype distribution

The ability to perceive the bitter taste of PTC was assessed using a cellulose strip test (Fig. 1.). No statistically significant difference was found in PTC taste perception between the CRS and control groups ($\chi^2 = 1.87$; df = 3; p = 0.5).

Tab. I. Genotype evaluation with extension to the study and control groups.

		GENERAL	CONTROL GROUP	STUDY GROUP	„P" VALUE
Genotype n; %	*AVI/AVI*	30; 34.5%	11; 29.7%	19; 38.0%	$X^2 = 2.32$; df = 4; p = 0.6
	PAV/PAV	8; 9.2%	5; 13.5%	3; 6.0%	
	PAV/AVI	43; 49.4%	19; 51.4%	24; 48.0%	
	AAV/AVI	4; 4.6%	1; 2.7%	3; 6.0%	
	PAV/AAV	2; 2.3%	1; 2.7%	1; 2.0%	

Tab. II. Evaluation of the sensitivity and specificity of the phenylthiocarbamide-impregnated cellulose test in detecting the active T2R38 polymorphism.

GENOTYPE	SENSITIVITY	SPECIFITY	PPV	NPV
AVI	16%	10.5%	8.9%	19.3%
AAV/AVI	50%	34.9%	3.5%	93.5%
PAV/AVI	93%	63.6%	71.4%	90.3%
PAV	100%	39.4%	14.3%	100%
PAV/AAV	50%	35.29%	1.79%	96.7%

PPV – positive predictive value; NPV – negative predictive value.

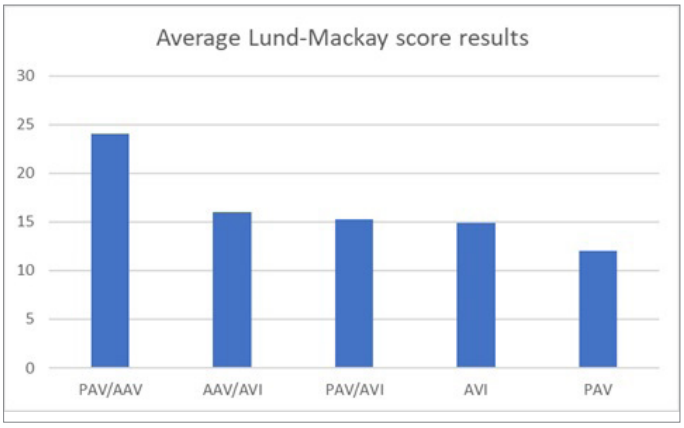

Fig. 3. Averaged Lund-Mackay scale scores for individual genotypes.

The distribution of *TAS2R38* genotypes across the entire population is presented in Tab. I. There were no statistically significant differences in genotype frequencies between the CRS and control groups ($\chi^2 = 2.32$; df = 4; p = 0.6).

Based on phenotype (taste perception) and genotype data, the sensitivity and specificity of the PTC taste test in detecting active T2R38 variants were calculated (Tab. II.). A lack of taste perception was scored as "0", while any bitter taste perception – regardless of intensity – was scored as ">0". For binary classification, each genotype was compared separately against all others.

The test demonstrated high sensitivity for detecting the functional *PAV* allele. The high negative predictive value (NPV) observed for genotypes *PAV*, *PAV/AVI*, *PAV/AAV*, and *AAV/AVI* indicates that a negative test result reliably predicts the absence of the functional receptor. These findings support a strong correlation between PTC taste perception and genotype determined by molecular analysis.

Imaging and symptom assessment

Symptom severity was assessed using the NOSE-POL questionnaire, the SNOT-22 scale, and a 10-point VAS. Radiological evaluation was performed using the Lund-Mackay CT scoring system.

The ability to perceive bitter taste was further analysed according to *TAS2R38* genotypes (Fig. 2.). Detailed genotype-phenotype associations are summarized in Fig. 2. Among those unable to perceive PTC bitterness, 80.6% (n = 25) had the *AVI/AVI* genotype. In contrast, among those who could perceive bitterness, the majority (71.4%; n = 40) had the *PAV/AVI* genotype. None of the participants with the *PAV/PAV* genotype reported a lack of bitter taste perception. The rare *PAV/AAV* genotype (1.8%; n = 1) was also associated with bitter taste perception. This distribution was statistically significant ($\chi^2 = 50.12$; df = 4; $p < 0.001$).

In the CRS group, the mean Lund-Mackay score was 15.1 ±6.5. Average Lund-Mackay scores by genotype are presented in Fig. 3.

Postoperative quality of life improvement

Postoperative symptom assessment (3–6 months after surgery) showed significant improvement across all scales (NOSE-POL, VAS, and SNOT-22), compared to preoperative values (Fig. 4.).

Association between T2R38 polymorphism and surgical outcomes

The impact of *TAS2R38* genotype on postoperative outcomes was analyzed using NOSE-POL, VAS, and SNOT-22 scores (Fig. 5.–7.). While surgery led to significant improvements in quality of life, no statistically significant differences were observed between genotypes in terms of symptom reduction.

T2R38 polymorphism, COVID-19, and CRS symptom duration

COVID-19 infection was reported in 44% (n = 22) of the CRS group and in 21.6% (n = 8) of the control group (Tab. III.). This difference was statistically significant ($\chi^2 = 4.71$; df = 1; p = 0.02). Loss of taste during COVID-19 was reported by 63.6% (n = 14) in the study

Tab. III. Data on the incidence and course of COVID-19 among all study participants and with division into study and control groups.

VARIABLE		GENERAL STUDY POPULATION	CONTROL GROUP	STUDY GROUP	„P" VALUE
Reported COVID-19 n; %	YES	30; 34.5%	8; 21.6%	22; 44.0%	$X^2 = 4.713$; df = 1. p = 0.02
	NO	57; 65.5%	29; 78.4%	28; 56.0%	
Loss of smell during COVID-19 n; %	YES	21; 70.0%	6; 75%	15; 68.2%	$X^2 = 0.12$; df = 1. p = 0.7
	NO	9; 30%	2; 25.0%	7; 31.8%	
Loss of taste during COVID-19 n; %	YES	19; 63.3%	5; 62.5%	14; 63.6%	$X^2 = 0.003$; df = 1; p = 0,9
	NO	11; 36.7%	3; 37.5%	8; 36.4	

group and 62.5% (n = 5) in the control group, the difference being not statistically significant.

No significant association was found between the type of *TAS2R38* polymorphism and the incidence or severity of COVID-19, nor with the duration of CRS symptoms.

The presence of the functional T2R38 receptor (*PAV* haplotype) was significantly associated with the ability to perceive the bitter taste of PTC and with less severe sinus involvement on CT. The PTC taste strip test showed high concordance with genotyping results, demonstrating strong diagnostic value in identifying active receptor forms. Although surgical intervention led to significant improvement in quality of life, this improvement was not influenced by the type of *TAS2R38* polymorphism. No associations were found between *TAS2R38* variants and COVID-19 infection or CRS symptom duration.

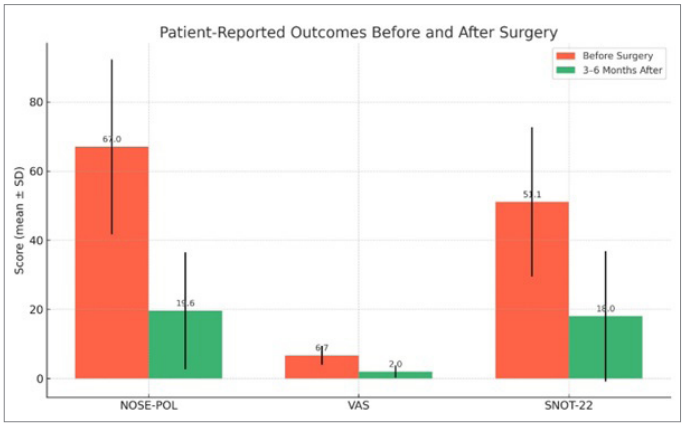

Fig. 4. Assessment according to the Lund-Mackay, NOSE-POL, and SNOT22 scales before and after surgery.

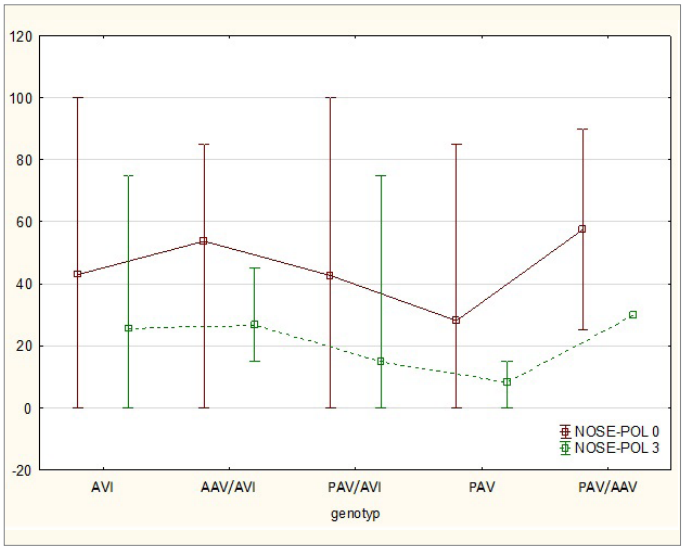

Fig. 5. Assessment of quality of life according to the NOSE-POL scale depending on the type of polymorphism before (red) and after (green) surgery of the paranasal sinuses.

DISCUSSION

The discovery of *TAS2R38* polymorphisms has introduced the potential for identifying prognostic factors that may predispose individuals to CRS. Previous studies have shown that the *PAV/PAV* genotype is less frequent in patients who fail medical therapy and require functional endoscopic sinus surgery (FESS) compared to healthy controls [13].

In our study, despite the relatively small sample size of 87 Caucasian patients, statistically significant results ($p < 0.05$) confirmed a strong correlation between phenotype and genotype: the presence of the PAV polymorphism was associated with the ability to perceive the bitter taste of PTC. The limited sample size was due in part to the high cost of genetic testing.

The PTC taste strip test does not determine the exact *TAS2R38* genotype but allows for the identification of the presence or absence of functional bitter taste receptors. This test is inexpensive, non-invasive, requires no specialist training, and can even be self-administered. The result is obtained immediately, which makes it an attractive tool for potential clinical application. As suggested in previous studies, the *TAS2R38* polymorphism may influence the onset, severity, and treatment response in CRS [8, 10, 11, 13].

Dżaman et al. previously reported in a Polish cohort that the *AVI* haplotype is an independent risk factor for CRS and correlates with a more advanced disease seen on CT scans [10]. Similarly, our study showed that patients with the inactive *AVI/AVI* genotype had higher average Lund-Mackay scores, indicating more severe sinus involvement, compared to those with functional *PAV*-containing genotypes. One patient with the rare *PAV/AAV* genotype had a higher score than the average for all genotypes, but this may be attributed to random variation due to the small sample size. With a larger cohort, the data would likely follow a Gaussian distribution, minimizing the influence of outliers.

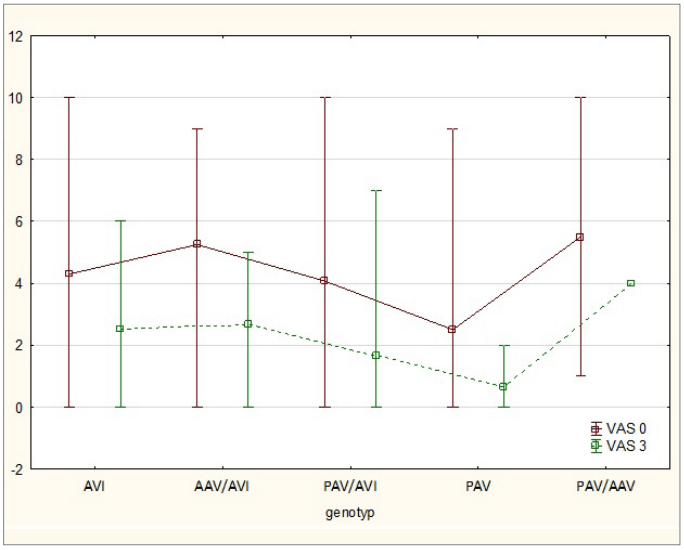

Fig. 6. Assessment of quality of life according to the VAS scale depending on the type of polymorphism before (red) and after (green) surgery of the paranasal sinuses.

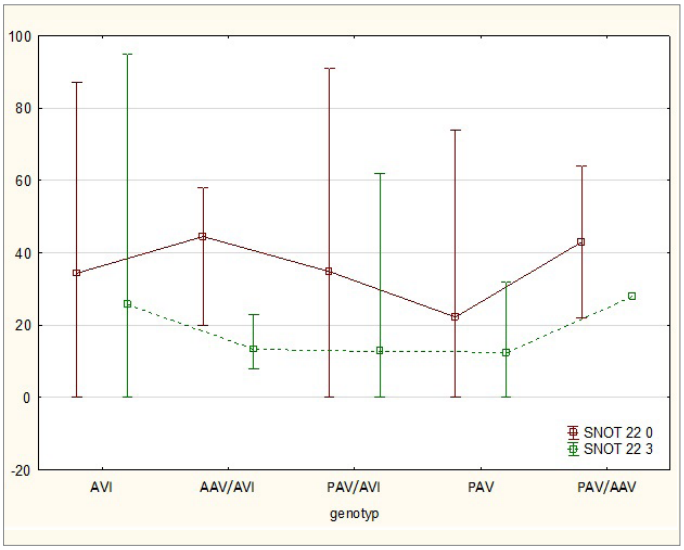

Fig. 7. Assessment of quality of life according to the SNOT22 scale depending on the type of polymorphism before (red) and after (green) surgery of the paranasal sinuses.

No significant differences in genotype or phenotype frequencies were found between the study and control groups. The genotype distribution in our entire cohort was: *PAV* – 9.1%, *PAV/AVI* – 49.4%, *AVI* – 34.4%, which is generally consistent with reported frequencies in the Caucasian population: PAV – 20%, *PAV/AVI* – 50%, *AVI* – 30% [6]. Comparable frequencies were also reported by Jeruzal-Świątecka et al. in a Polish CRS population [14]. The similarity of genotype distributions in both groups supports the multifactorial etiology of CRS. Importantly, patients with CRS more frequently reported comorbid allergic rhinitis and bronchial asthma compared to controls. This suggests that *TAS2R38* polymorphism alone is insufficient as a diagnostic marker, but may still serve as an adjunctive factor in assessing disease severity and treatment planning. Beyond respiratory function, T2R38 polymorphisms have also been associated with oral microbiota alterations and systemic inflammatory diseases such as rheumatoid arthritis [15].

To confirm the reliability of genotyping, samples were collected from peripheral blood in controls and from both blood and sinus tissue in CRS patients. In 10 randomly selected CRS patients, *TAS2R38* genotyping from both blood and mucosal tissue showed 100% concordance, confirming the absence of epigenetic variation in this context.

Two rare genotypes were identified in the study group: *AAV/AVI* (4.5%) and *PAV/AAV* (2.3%). *AAV/AVI* was associated with moderate PTC taste perception, while *PAV/AAV* was unexpectedly associated with no taste perception. The *AAV* haplotype is rare in the general population (approx. 2.5%) and is typically associated with moderate sensitivity to bitter taste [16]. The infrequent detection of genotypes beyond *PAV* and *AVI* may be related to the probe design targeting only the most common polymorphisms.

In another Polish study, Piskadło-Zborowska et al. found increased expression of T2R38 receptors in the sinus mucosa of CRS patients, which correlated with more advanced CT findings based on the Lund-Mackay score [17]. This aligns with more recent data by Dżaman et al., who confirmed that T2R38 plays a role in CRS susceptibility, highlighting the receptor's clinical relevance in Polish patients [18]. Similarly, Jeruzal-Świątecka et al. provided both genotypic and expression-based insights into *TAS2R38* in CRS with nasal polyps in the Polish population [14, 19]. It is likely that chronic inflammation leads to receptor overexpression as a compensatory mechanism to enhance innate immune responses. Due to different methodological approaches, our study could not assess receptor expression directly.

Data on COVID-19 were collected retrospectively via a patient questionnaire. Both study and control groups reported cases of taste and smell dysfunction during SARS-CoV-2 infection, but there were no significant differences between groups in this regard.

There are reports suggesting that the absence of PTC taste perception correlates with more severe COVID-19 outcomes. In one study, 100% of patients who could not perceive PTC bitterness later required hospitalization due to severe disease [20]. This suggests that widespread access to self-administered PTC strip testing could potentially serve as an early screening tool for identifying individuals at risk of severe viral illness. However, caution is warranted, as false-negative results may occur if taste perception is impaired during active SARS-CoV-2 infection.

In the referenced study [20], the taste test was performed before infection onset. On the other hand, Risso et al. reported no significant correlation between *TAS2R38* polymorphisms and the occurrence or severity of COVID-19 [21]. This discrepancy indicates the need for larger, prospective studies to confirm or refute this hypothesis.

The PTC taste strip test demonstrated a strong correlation with *TAS2R38* genotype, particularly in ruling out the presence of functional alleles (high NPV), although its ability to confirm functional receptor variants was more limited (moderate PPV).

The presence of the functional *PAV* haplotype was significantly associated with the perception of bitter taste and with less

severe sinus involvement observed in CT scans. In contrast, the inactive *AVI/AVI* genotype was more frequently found in patients with advanced CRS and may indicate a greater predisposition to a more severe disease course. Despite these associations, surgical treatment (FESS) led to a significant improvement in quality of life across all patients, regardless of their *TAS2R38* genotype. No statistically significant relationship was found between *TAS2R38* polymorphisms and either the incidence or severity of COVID-19, nor with the duration of CRS symptoms.

CONCLUSIONS

Wider use of the PTC strip test in otolaryngology may provide valuable support in the personalized care of patients with CRS, especially in resource-limited settings or outpatient clinics.

ACKNOWLEDGEMENT

The authors thank the medical personnel involved in the treatment of patients included in the study.

FINANCIAL DISCLOSURE STATEMENT

The research was financed entirely from the funds of the SUM Young Scientist Research Contract No. PCN-2-098/N/1/K and partially from the contract No. PCN-1-180/K/1/K.

AUTHORS CONTRIBUTION STATEMENT

Senior autor PhD MD Jarosław Paluch is primarily responsible for the concept of the work.

REFERENCES

1. Iwata S., Yoshida R., Ninomiya Y.: Taste transductions in taste receptor cells: basic tastes and moreover. Curr Pharm Des., 2014; 20: 2684–2692.
2. Drayna D.: Human taste genetics. Annu Rev Genomics Hum Genet., 2005; 6: 217–235.
3. Avau B., Depoortere I.: The bitter truth about bitter taste receptors: beyond sensing bitter in the oral cAVIty. Acta Physiol., 2016; 216: 407–420.
4. Silverthorn D.U.: Fizjologia zmysłów. In: Fizjologia człowieka. Zintegrowane podejście. ed: B. Ponikowska. PZWL Wydawnictwo Lekarskie, Warszawa 2018, 261–264.
5. Verbeurgt C., Veithen A., Carlot S. et al.: The human bitter taste receptor T2R38 is broadly tuned for bacterial compounds. PLoS One, 2017; 12: e0185537. doi: 10.1371/journal.pone.0181302.
6. Kim U.-K., Jorgenson E., Coon H. et al.: Positional cloning of the human quantitative trait locus underlying taste sensitivity to phenylthiocarbamide. Science, 2003; 299: 1221–1225. doi: 10.1126/science.1080190.
7. Boxer E.E., Garneau N.L.: Rare haplotypes of the gene TAS2R38 confer bitter taste sensitivity in humans. Springerplus, 2015; 4: 505. doi: 10.1186/s40064-015-1277-z.
8. Lee R.J., Hariri B.M., McMahon D.B. et al.: Bacterial D-amino acids suppress sinonasal innate immunity through sweet taste receptors in solitary chemosensory cells. Sci Signal., 2017; 10: eaam7703. doi: 10.1126/scisignal.aam7703.
9. Lee R.J., Xiong G., Kofonow J.M. et al.: T2R38 taste receptor polymorphisms underlie susceptibility to upper respiratory infection. J Clin Invest., 2012; 122: 4145–4159. doi: 10.1172/JCI64240.
10. Dzaman K., Zagor M., Sarnowska E., Krzeski A., Kantor I.: The correlation of TAS2R38 gene variants with higher risk for chronic rhinosinusitis in Polish patients. Otolaryngol Pol., 2016; 70: 13–18. doi: 10.5604/00306657.1209438.
11. Adappa N.D., Farquhar D., Palmer J.N. et al.: TAS2R38 genotype predicts surgical outcome in nonpolypoid chronic rhinosinusitis. Int Forum Allergy Rhinol., 2016; 6: 25–33. doi: 10.1002/alr.21666.
12. Adappa N.D., Howland T.J., Palmer J.N. et al.: Genetics of the taste receptor T2R38 correlates with chronic rhinosinusitis necessitating surgical intervention. Int Forum Allergy Rhinol., 2013; 3: 184–187. doi: 10.1002/alr.21140.
13. Adappa N.D., Zhang Z., Palmer J.N. et al.: The bitter taste receptor T2R38 is an independent risk factor for chronic rhinosinusitis requiring sinus surgery. Int Forum Allergy Rhinol., 2014; 4: 3–7. doi: 10.1002/alr.21253.
14. Jeruzal-Świątecka J., Borkowska E.M., Borkowska M., Pietruszewska W.: TAS2R38 Bitter Taste Receptor Polymorphisms in Patients with Chronic Rhinosinusitis with Nasal Polyps Preliminary Data in Polish Population. Biomedicines., 2024; 12: 168. doi: 10.3390/biomedicines12010168. PMID: 38255273; PMCID: PMC10813606.
15. de Jesus V.C., Singh M., Schroth R.J., Chelikani P., Hitchon C.A.: Association of bitter taste receptor T2R38 polymorphisms, oral microbiota, and rheumatoid arthritis. Curr Issues Mol Biol., 2021; 43: 1460–1472. doi: 10.3390/cimb43030103.
16. Farquhar D.R., Kovatch K.J., Palmer J.N. et al.: Phenylthiocarbamide taste sensitivity is associated with sinonasal symptoms in healthy adults. Int Forum Allergy Rhinol., 2015; 5: 111–118. doi: 10.1002/alr.21437.
17. Piskadlo-Zborowska K., Stachowiak M., Sarnowska E., Jowik R., Dzaman K.: Assessment of the effect of inflammatory changes and allergic reaction on TAS2R38 receptor expression in patients with chronic sinusitis (CRS). Otolaryngol Pol., 2020; 74: 17–23. doi: 10.5604/01.3001.0014.1474.
18. Dżaman K., Piskadło-Zborowska K., Czerwaty K. et al.: The impact of the bitter taste receptor on the predisposition to chronic rhinosinusitis. Acta Otorhinolaryngol Ital., 2025; 45: 116–123. doi: 10.14639/0392-100X-N3032.
19. Jeruzal-Świątecka J., Borkowska E., Łaszczych M., Nowicka Z., Pietruszewska W.: TAS2R38 Bitter Taste Receptor Expression in Chronic Rhinosinusitis with Nasal Polyps: New Data on Polypoid Tissue. Int J Mol Sci. 2022; 23: 7345. doi: 10.3390/ijms23137345.
20. Donadoni M., Kaminski R., Liao S. et al.: Coronavirus infection in chemosensory cells. J Neurovirol., 2023; 29: 35–44. doi: 10.1007/s13365-023-01117-3.
21. Risso D., Carmagnola D., Morini G. et al.: Distribution of TAS2R38 bitter taste receptor phenotype and haplotypes among COVID-19 patients. Sci Rep., 2022; 12: 10747. doi: 10.1038/s41598-022-10747-2.