


ORIGINAL RESEARCH

Reliability and validity of the Polish version of the Questionnaire of Olfactory Disorders

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Abstract

Background: The comprehensive counseling of patients with olfactory dysfunctions requires accurate diagnosis. The recommendations include subjective assessment. The Questionnaire of Olfactory Disorders (QOD) is a disease-specific questionnaire for the subjective evaluation of olfactory dysfunctions.

Material: The study included 54 patients with olfactory dysfunctions, who were recruited to the study group (SG). The other 47 patients without the history of olfactory dysfunction and nasal cavity pathology were voluntarily allocated to the control group (CG). The protocol of the study was introduced to each patient and included: olfactory testing with Sniffin' Stick test, fulfillment of the Polish version of World Health Organization Quality of Life brief questionnaire and completing of the Polish version of the QOD. All participants (101) were invited for refilling the QOD questionnaire after 2 weeks for the test-retest statistics.

Results: The Polish QOD statements were significantly correlated and met the requirement by having test-retest correlation larger than 0.7. We found that internal consistency of the test measured by Cronbach's alpha coefficient was very high. The mean scores of the QOD test in normosmic SG patients were compared with corresponding scores in normosmic CG patients using U Mann-Whitney test. The analysis revealed statistically significant differences on mean QOD scores for each domains except QOD-S between both groups.

Conclusions: The Polish version of the QOD demonstrated high rate of the validity and the reliability. This instrument may be widely used in research projects and clinical practice concerning olfactory disorders in Polish patients.

Level of Evidence: NA.

KEYWORDS

disease-specific questionnaire, olfactory dysfunctions, quality of life, subjective assessment

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1 | INTRODUCTION

Olfactory dysfunctions are diagnosed in 5%–20% of the population.^{1,2} This wide range of cases may be related to different definitions of the data collection. Olfactory dysfunctions can be presented as quantitative disorders with hyposmia or anosmia and qualitative cases classified as parosmia or phantosmia.

The olfactory dysfunctions have negative effect on daily activities like eating, cooking, self-hygiene, evaluation of properties of the food, hazard recognition and detection of dangerous compounds.^{3–5} Other important functions of olfaction relate to maintaining proper nutrition status, sensation of pleasure, and interpersonal behavior.⁶ The olfactory impairment will therefore result in deterioration of social life and higher risk of depression.^{3–10} The olfactory dysfunctions are also considered as an early biomarker in neurodegenerative disorders and as a negative prognostic factor of the 5-year mortality in older adults.^{11,12} Nasal cavity obstruction due to chronic rhinosinusitis is one of the most common cause for the olfactory dysfunction together with others nasal cavity pathologies like allergic rhinitis, septal deviation with hypertrophic mucosal changes. The post infections impairment of olfactory nerve or cortex, trauma or surgery of anterior skull base, neurological diseases are among others most common causes of olfactory dysfunctions. Only about 10% of cases appear to be idiopathic in nature.¹³ The comprehensive counseling of patients with olfactory dysfunctions requires accurate diagnosis and impairment monitoring. Appropriate testing is crucial. Most commonly used protocols are not universal and homogenous but the recommendations include four test categories: subjective assessment, psychophysical olfactory assessment, imagining, and electrophysiology.²

The Questionnaire of Olfactory Disorders (QOD), introduced and developed by Johannes Frasnelli and Thomas Hummel,⁷ is a disease-specific questionnaire for subjective evaluation of olfactory dysfunctions. It has been validated across different countries^{14,15} and proved high reliability in the clinical assessment of self-reported severity of smell impairment. The original QOD version consisted of 52 questions, but later was reduced to the modified prevalent version to structured four-scale 29 statements on life quality (LQ), parosmia (P), sincerity (S), and accompanied by five visual analog scale (V) questions. The olfactory-specific quality of life can be currently measured also using modified QOD test, called, the Questionnaire of Olfactory Disorders Negative Statements. This test consists of 17 questions from the QOD-LQ domain with two positive statements QOD-PS removed.^{16–21}

The English version of QOD together with the instructions for summary and score calculations were obtained from Johannes Frasnelli on request in order to develop a Polish version of this questionnaire and assess its validity and reliability in this study.

2 | PATIENTS AND METHODS

This prospective study was approved by the institutional review board (AKBE/69/2020). The patient's informed consent to participate in the study was confirmed by voluntarily completing questionnaires.

2.1 | Patients

The study included 54 patients who visited Otorhinolaryngology Head and Neck Surgery Department of Medical University of Warsaw with olfactory dysfunction as a one of the major complain and who were recruited to the study group (SG). The other 47 patients without the history of olfactory dysfunction and nasal cavity pathology were voluntarily allocated to the control group (CG). The etiology of olfactory dysfunctions in the SG was chronic sinusitis in 31 patients (57%), post-infection olfactory dysfunction in 8 patients (15%); allergic rhinitis in 8 patients (15%) and septal deviation in 7 patients (13%).

Table 1 presents the basic characteristic of both groups of patients in the study. The protocol of the study was introduced to each patient and included: olfactory testing with Sniffin' Sticks test, fulfillment of the Polish version of World Health Organization Quality of Life brief questionnaire (WHOQOL-BREF) and completing of the Polish version of the QOD. All information was collected by the same researcher, who was available to help in answering the questions, and was responsible for testing, collection of the questionnaires and checking them for omissions. Moreover, all participants were invited for refilling the QOD questionnaire after 2 weeks for the test–retest statistic.

2.2 | Olfactory function assessment

Olfactory abilities were evaluated in each participant using standard Sniffin' Sticks olfactory test kit.^{22,23} This set consists of three different tests for quantitative assessment of odor detection threshold (T), discrimination (D), and identification (I). The combined total score of those tests is summarized as the TDI score. This total result gives the opportunity for quantitative assessment of olfactory abilities in terms of normosmia (TDI score ≥ 30.75), hyposmia ($16 < \text{TDI} < 30.75$) and anosmia ($\text{TDI} = < 16$).^{23,24}

Sniffin' Sticks olfactory test is commonly used in European population^{25–29} and its validity was confirmed in the Polish population in the study by Sorokowska and Hummel.²⁷ In Table 2, we present the results of olfactory evaluations in both groups in the study. Odor detection threshold, discrimination, identification, and total score are given with mean values in groups with standard deviation.

	Age (Mean \pm SD) (years)	Median (years)	Range (years)	Sex F/M (n)
SG (n = 54)	42 \pm 16,6	37	21–82	28/26
CG (n = 47)	25 \pm 7,56	22	21–51	36/11
Total (n = 101)	33,9 \pm 15,5	26	21–82	64/37

TABLE 1 Demographical data of all study participants and by the study group (SG) and control group (CG).

TABLE 2 Results of Sniffin' Sticks olfactory test in study group (SG) and control group (CG).

	SG	Range	CG	Range	Total
T	6 ± 2,95	1–12,5	12,79 ± 2,45	8,25–16	8,65 ± 4,32
	F 6,25 ± 3,01		F 12,96 ± 2,64		F 9,76 ± 4,39
	M 5,77 ± 2,94		M 12,05 ± 1,25		M 6,93 ± 3,66
D	10,4 ± 2,6	2–15	13,7 ± 1,5	10–16	11,97 ± 2,72
	F 11,23 ± 2,15		F 13,65 ± 1,37		F 12,62 ± 2,11
	M 9,59 ± 2,77		M 14 ± 1,9		M 10,94 ± 3,25
I	11,03 ± 3,18	1–16	14,1 ± 1,23	11–16	12,5 ± 2,91
	F 11,88 ± 2,87		F 14,22 ± 1,26		F 13,22 ± 2,39
	M 10,22 ± 3,3		M 13,91 ± 1,24		M 11,35 ± 3,30
TDI	27,08 ± 7,25	4–39,25	39,85 ± 3,05	34,25–45	32,21 ± 8,68
	F 28,97 ± 6,8		F 40,17 ± 2,72		F 34,82 ± 7,57
	M 25,27 ± 7,35		M 38,62 ± 4,18		M 28,09 ± 8,84

Note: Mean values with standard deviation are provided.

Abbreviations: CG, control group; D, discrimination; F, female; I, identification; M, male; SG, study group; T, odor detection threshold.

TABLE 3 Results of the Polish version World Health Organization Quality of Life brief questionnaire test in the study.

	SG	CG	Total
D1	22,24 ± 3,42	22,12 ± 3,09	22,18 ± 3,26
	F 21,76 ± 3,36	F 22,21 ± 3,4	F 22,03 ± 3,36
	M 22,67 ± 3,48	M 21,8 ± 1,54	M 22,44 ± 3,09
D2	21 ± 3,25	22,36 ± 2,13	21,71 ± 2,84
	F 21,19 ± 3,18	F 22,45 ± 2,25	F 21,93 ± 2,72
	M 21,1 ± 3,37	M 22 ± 1,63	M 21,34 ± 3,01
D3	11,6 ± 1,95	12,61 ± 1,59	12,07 ± 1,84
	F 11,46 ± 2,26	F 12,59 ± 1,64	F 12,12 ± 1,98
	M 11,75 ± 1,71	M 12,7 ± 1,49	M 12 ± 1,69
D4	29,31 ± 4,61	32 ± 2,87	30,56 ± 10,08
	F 29,11 ± 5,17	F 32,18 ± 2,9	F 30,92 ± 4,24
	M 29,5 ± 4,1	M 31,3 ± 2,7	M 29,97 ± 3,85
Total	84,31 ± 11,06	88,89 ± 8,28	86,44 ± 10,08
	F 83,53 ± 11,51	F 89,18 ± 8,9	F 86,85 ± 10,36
	M 85,03 ± 10,78	M 87,8 ± 5,61	85,76 ± 9,69

Note: The mean values with standard deviation in four domains are provided.

Abbreviations: CG, control group; D1, physical; D2, psychological; D3, social; D4, environment; SG, study group.

2.3 | Quality of life assessment

All patients in the study received the validated Polish version of WHOQOL-BREF test.³⁰ This research tool was designated and developed in order to evaluate the quality of life of healthy people and persons with various diseases for scientific researches and clinical applications. In the present study, we used BREF (short) version of the original WHOQOL-100. The WHOQOL-BREF questionnaire consists of 26 questions and enables researchers to

assess quality of life in four domains: Domain 1 (D1): describes physical health and consists of 7 questions; Domain 2 (D2): describes psychological health and consists of 6 questions; Domain 3 (D3): describes social relations and consists of 3 questions; and Domain 4 (D4): describes social environment of patient and consists of 8 questions. There are also additional two questions describing general perception of life and health. Those questions are analyzed separately. The answers to those questions are given on a five point scale from 1 to 5 with lower number corresponding to larger difficulty or severity of the problem. Specific results in four domains can be transferred to scale 0–100 (with the higher number corresponding to the higher quality of life).^{31,32} In Table 3, we gathered information obtained from the patients in the study and the CGs.

2.4 | Adaptation of the QOD

The English versions of the QOD with the scoring instructions was obtained from the author Johannes Frasnelli via e-mail. First, it was translated into Polish by the authors and then presented to otorhinolaryngologists and general public for checking its easy understanding. Next, the original and Polish version of the questionnaire were presented to a professional translator for the correction and acceptance. The Polish version follows the structure of the original QOD and consists of 29 statements collected in 3 domains: LQ—19 items (1, 4, 11, 13, 15, 19, 22, 26, 27, 28, 32, 33, 34, 35, 37, 39, 42, 49, and 50); sincerity (S)—6 items (14, 17, 23, 31, 36, and 48); parosmia (P)—4 items (P1, P2, P3, and P5). The response to each statement is provided by selecting one of the following: agree; partially agree; partially disagree; disagree. The scoring for each domain is presented in Supplementary Material 1. The QOD includes also five visual analog scales (QOD-V) statements concerning olfactory dysfunction problems and scored on a scale of

	SG	Range	CG	Range	Total
P	3,85 ± 3,32	0–12	0,70 ± 1,08	0–5	3,84 ± 6,07
	F 5,03 ± 3,32		F 0,78 ± 1,18		F 3,73 ± 5,83
	M 2,82 ± 2,99		M 0,4 ± 0,51		M 4,02 ± 6,52
LQ	9,12 ± 9,90	0–39	0,63 ± 1,67	0–10	4,97 ± 8,31
	F 10,74 ± 11,51		F 0,70 ± 1,85		F 4,36 ± 8,37
	M 8,21 ± 8,56		M 0,4 ± 0,69		M 5,97 ± 8,22
S	6,48 ± 4,13	0–18	9,63 ± 14,50	0–14	7,00 ± 3,65
	F 6,37 ± 3,73		F 10,45 ± 16,25		F 7,31 ± 3,40
	M 6,46 ± 4,53		M 6,6 ± 2,22		M 6,5 ± 4,02
V	10,38 ± 11,26	0–46	0,96 ± 2,13	0–9	6,07 ± 9,58
	F 12 ± 12,31		F 1,18 ± 2,20		F 5,41 ± 9,44
	M 9,46 ± 10,54		M 0,8 ± 1,93		M 7,18 ± 9,84
Total	30,05 ± 21,28	7–100	10,10 ± 5,78	0–29	20,77 ± 18,87
	F 7,25 ± 3		F 10,59 ± 6,20		F 19,98 ± 19,08
	M 6,48 ± 4		M 8,3 ± 3,52		M 22,07 ± 18,70

TABLE 4 Results of the Polish version Questionnaire of Olfactory Disorders test in the study.

Note: The mean values with standard deviation are provided.

Abbreviations: CG, control group; LQ, life quality; P, parosmia; S, sincerity; SG, study group; V, visual analog scales.

0–10. In Table 4, we present results of the QOD test for the SG and the CG.

2.5 | Statistical methods

Internal consistency of the Polish version of the QOD test was assessed with Cronbach's alpha coefficient^{33–36} with the value larger than .7 indicating for an acceptable internal consistency. Investigation the population assumption about normal distribution of scores is implicit. One of the prerequisites for using Cronbach's alpha as a reliability coefficient in the normal distribution of data. Additionally, test-retest reliability of the questionnaire was analyzed using Spearman's correlation methods. Spearman's rank correlation test is more resilient to strong outliers in a sample than the Pearson's test. It indicates for arbitrary monotonic relationship between two variables not only on linear as in the Pearson's case. Test-retest reliability of the questionnaire was also measured using Pearson correlation coefficient. The value of the correlation coefficient larger than .7 is interpreted as strong correlation. In order to statistically analyze differences between various groups and sub-groups in the study, the Mann-Whitney U test for independent samples was used. It is a standard nonparametric test for comparison of two populations. The *p*-value <.05 was considered statistically significant.

3 | RESULTS

All included patients had the olfactory testing with Sniffin' Sticks and completed the Polish version of QOD and WHOQOL-BREF during a clinical visit. None of the participants claimed problems answering the QOD questionnaire.

3.1 | Reliability analysis of QOD

3.1.1 | Test-retest reliability

All the participants in the study filled QOD test twice. First, during their test session and again 2–3 weeks later. This gave us data to establish test-retest reliability of the Polish version of QOD test. Using Spearman's correlation analysis we performed test-retest correlation and results are gathered in Table 5. All the entries of the QOD test showed significant correlation with *p* < .0001. The test-retest correlations for the QOD-Quality of life statements (QOD-LQ), QOD- Sincerity (QOD-S), and QOD-Parosmia (QOD-P) and QOD-V total were 0.882, 0.785, 0.877, and 0.954, respectively, and for all the items corresponding values of the significance were *p* < .0001. The four parts of the Polish QOD were significantly correlated and met the requirements by having test-retest correlations larger than .7. Additionally, we used Pearson correlation coefficient for test-retest in the SG and CG and confirmed in both groups high correlation with *R* = 0.941, and *R* = 0.925, at the very high significance level <.00001. On Figures 1 and 2, we present the test-retest reliability of the QOD test where a slope of the straight line on figures is the Spearman's correlation coefficient. Additionally, we performed test-retest reliability for all participants in the study based on Bland-Altman plot presented in Figure 3 with mean values 2.21 and 2.19 as the 95% CI.

3.1.2 | Internal consistency

The Cronbach's alpha values of the Polish version of QOD test calculated for the four domains corresponding to parosmia (QOD-P), life

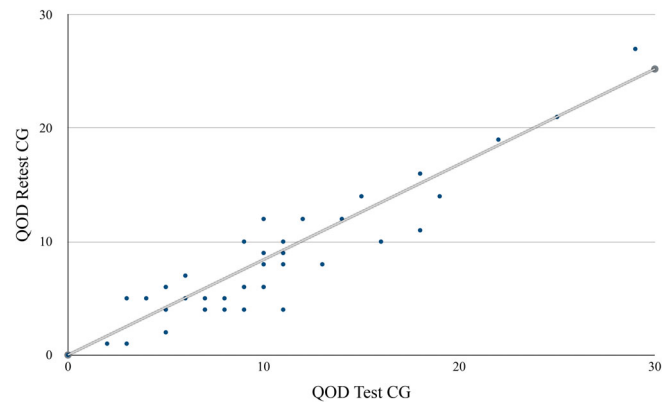
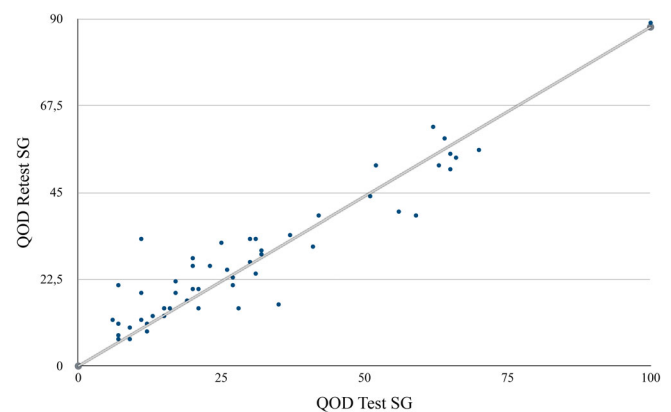
TABLE 5 Test-retest reliability for the Polish Questionnaire of Olfactory Dysfunction (QOD) ($n = 101$).

Item of QOD test	<i>r</i>
P1	0.931
P2	0.776
P3	0.771
P5	0.751
Q1	0.539
Q4	0.843
Q11	0.842
Q13	0.911
Q14	0.868
Q15	0.810
Q17	0.893
Q19	0.943
Q22	0.857
Q23	0.782
Q26	0.690
Q27	0.769
Q28	0.788
Q31	0.764
Q32	0.815
Q33	0.936
Q34	0.580
Q35	0.811
Q36	0.757
Q37	0.807
Q39	0.767
Q42	0.876
Q48	0.881
Q49	0.911
Q50	0.871
QOD-P	0.877
QOD-S	0.785
QOD-LQ	0.882
V 1	0.950
V 2	0.935
V 3	0.844
V 4	0.914
V 5	0.998
V-Total	0.954

Note: All the correlation coefficients are at statistically significant level of $p < .0001$. $p < .0001$.

Abbreviations: QOD-LQ, life quality statements; QOD-P, parosmia statements; QOD-S, sincerity statements; QOD-V, visual analog scales; *r*, Spearman correlation coefficient.

quality (QOD-LQ), sincerity (QOD-S), and visual analog scale (QOD-V) and the combined total score for all the patients were 0.608, 0.885, 0.743, 0.559, and 0.887 respectively. The alpha values concerning the SG

**FIGURE 1** Test-retest reliability of the Questionnaire of Olfactory Disorders (QOD) test in the control group (CG). Slope of the straight line is the Spearman's correlation coefficient .841.**FIGURE 2** Test-retest reliability of the Questionnaire of Olfactory Disorders (QOD) test in the control group (CG). Slope of the straight line is the Spearman's correlation coefficient .897.

and the CG were comparable excluding the parosmia factor in the CG which was relatively low 0.283. Such low value of the coefficient can be explained by random distribution of the answers in the CG group. The questions concerning parosmia do not apply in the CG group. The values of the Cronbach's alpha coefficients are presented in Table 6.

Given the results of the internal consistency and test-retest correlation coefficients we can infer for high reliability of the Polish version of the QOD questionnaire.

3.2 | Criterion-related validity analysis of QOD test

In self administered questionnaires, there is no standard scale for determining patients' quality of life. Introducing new scale, we need to effectively adjust it to known and widely used one. Correlation analysis between two scales, the old and the new one, enables us to establish criterion-related validity of the test.

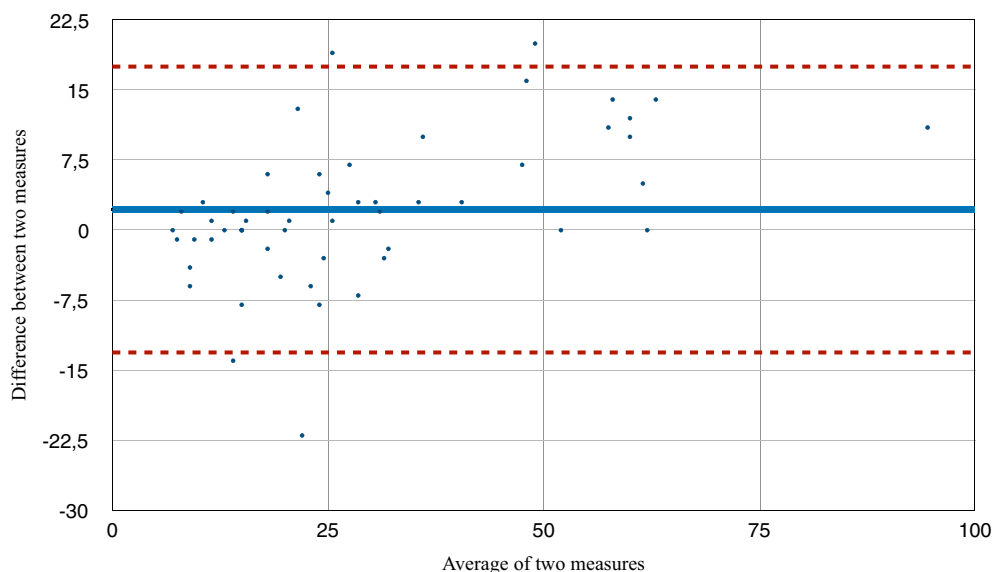


FIGURE 3 The Bland-Altman plot for test-retest reliability of the Questionnaire of Olfactory Disorders test for all participants. Mean value is 2.21.

TABLE 6 Internal consistency analysis with Cronbach's alpha coefficients of the Polish Questionnaire of Olfactory Dysfunction (QOD) in the study group (SG), control group (CG) and in all participants (SG + CG).

	QOD-P	QOD-LQ	QOD-S	QOD-V	Total
SG	0.969	0.868	0.575	0.734	0.871
CG	0.283	0.672	0.524	0.638	0.731
SG + CG	0.608	0.885	0.743	0.559	0.887

Abbreviations: QOD-LQ, life quality statements; QOD-P, parosmia statements; QOD-S, sincerity statements; QOD-V, visual analog scales.

3.3 | Correlation between QOD questionnaire and WHOQOL-BREF test

We found no correlation between each QOD domain and D1- physical domain of WHOQOL-BREF. However, QOD-QoL, QOD-P, and QOD-V were significantly related to D2—psychological, D3—social relationship and D4—environment domains. The data are presented in Table 7.

Additionally, we performed multivariable analysis with WHOQOL-BREF as the outcome variable and the age of patients, Sniffin' Sticks test and the QOD results as the explanatory variable. The results for both groups in the study are gathered in Table 8.

3.4 | QOD scores comparison for patients with normosmia and hyposmia in Sniffin' Sticks test

The Sniffin' Sticks test analysis revealed in the SG 19 patients with normosmia (TDI result >30.5) and 32 with hyposmia (15 < TDI < 30.5). All patients in the CG were normosmic. Spearman's correlation analysis revealed no statistically significant correlation between each QOD domain (QOD-LQ, QOD-P, QOD-S, and QOD-V) and the Sniffin' Sticks test results in normosmic and hyposmic SG patients. For

normosmic CG patients, the results showed statistically significant positive correlation between TDI score and parosmia (QOD-P) domain and QOD-V with p -value .017 and .002 respectively. All the results are summarized in Table 9.

The mean scores of QOD-P, QOD-S, QOD-LQ, QOD-V in normosmic SG patients where compared with corresponding scores in normosmic CG patients using U Mann-Whitney test. The analysis revealed statistically significant differences on mean QOD scores for each domain except QOD-S between both groups, although the ranges of TDI with Sniffin' Sticks were the same. Results are presented in Table 10. Additionally, in Table 11 we present comparison of QOD scores of hyposmic/anosmic people with normosmic people, regardless of their belonging to the CG or SG. The results indicate statistically significant differences in quality of life between normosmic individuals and people with an actual smell problems. Based on these results, we have to emphasize the importance of combined assessment with subjective tools for example, QOD and objective tests for example, Sniffin' Sticks for comprehensive and detailed olfactory testing.

4 | DISCUSSION

The ethnical and geographical variations may influence the validity and reliability of questionnaires constructed for clinical assessment. Widely applicable questionnaires for evaluation of general health-related quality of life such as the 36-Item Short Form Health Survey (SF-36) or World Health Organization (WHOQOL) questionnaire, are not so precise when evaluating particular interest comparing with the disease-specific QOL tools.

The QOD was primarily developed and used by Frasnelli and Hummel to investigate parosmia, however occurred also appropriate and valid instrument for evaluation of the olfactory dysfunction on daily life.^{7,14,19,37,38} The standard QOL questionnaires

TABLE 7 Spearman's correlations analysis between the Questionnaire of Olfactory Dysfunction (QOD) and the World Health Organization Quality of Life brief questionnaire (WHOQOL_BREF) for all participants ($n = 101$).

	QOD-P		QOD-LQ		QOD-V	
	<i>r</i>	<i>p</i> -value	<i>r</i>	<i>p</i> -value	<i>r</i>	<i>p</i> -value
D1	-0.134 ± 0.195	.178	-0.140 ± 0.196	.162	-0.056 ± 0.189	.5741
D2	-0.325 ± 0.193	.001	-0.487 ± 0.213	<.00001	-0.421 ± 0.185	.00001
D3	-0.293 ± 0.193	.003	-0.413 ± 0.181	.00001	-0.389 ± 0.194	.0001
D4	-0.363 ± 0.190	.0002	-0.510 ± 0.223	<.00001	-0.428 ± 0.188	.00001

Note: All the correlation coefficients are given with 95% confidence levels.

Abbreviations: Correlations of QOD-S, sincerity statements were not included in the table since they do not correspond to olfactory quality; D1, physiology domain; D2, psychological domain; D3, social relationship domain; D4, environment domain; QOD-LQ, life quality statements; QOD-P, parosmia statements; QOD-V, visual analog scales; *r*, correlation coefficient.

TABLE 8 Multivariable linear regression analysis of factors influencing results of the World Health Organization Quality of Life brief questionnaire (WHOQOL-BREF) test.

	Age, <i>p</i> -value			QOD, <i>p</i> -value			Sniffin' Sticks, <i>p</i> -value		
	SG	CG	Total	SG	CG	Total	SG	CG	Total
WHOQOL-BREF	0.459	0.426	0.007	0.601	0.531	<0.001	0.497	0.025	<0.001

Abbreviations: CG, control group; SG, study group.

TABLE 9 Spearman's correlation analysis of Questionnaire of Olfactory Disorders (QOD) test in patients with normosmia and hyposmia based on Sniffin' Sticks test.

	Normosmia				Hyposmia			
	SG	<i>p</i> -value	CG	<i>p</i> -value	SG	<i>p</i> -value	CG	<i>p</i> -value
QOD-LQ	0.311 ± 0.469	.195	0.031 ± 0.271	.834	-0.156 ± 0.353	.393	-	-
QOD-P	-0.167 ± 0.468	.494	0.348 ± 0.286	.017	-0.118 ± 0.350	.519	-	-
QOD-S	0.223 ± 0.470	.358	0.267 ± 0.289	.07	-0.029 ± 0.330	.873	-	-
QOD-V	-0.088 ± 0.459	.720	0.45 ± 0.285	.002	-0.077 ± 0.343	.673	-	-

Note: All the correlation coefficients are given with 95% confidence levels.

Abbreviations: QOD-LQ, life quality statements; QOD-P, parosmia statements; QOD-S, sincerity statements; QOD-V, visual analog scales.

TABLE 10 U Mann-Whitney test analysis between study group (SG) patients with normosmia and control group (CG).

	<i>p</i> -value
QOD-LQ	<.00001
QOD-P	<.00001
QOD-S	.23014
QOD-V	.0002

Abbreviations: QOD-LQ, life quality statements; QOD-P, parosmia statements; QOD-S, sincerity statements; QOD-V, visual analog scales.

TABLE 11 U Mann-Whitney test analysis between hyposmic/anosmic patients and normosmic patients.

	<i>p</i> -value
QOD-LQ	.00804
QOD-P	<.00001
QOD-S	.0001
QOD-V	.05486
QOD-Total	<.00001

Abbreviations: QOD-LQ, life quality statements; QOD-P, parosmia statements; QOD-S, sincerity statements; QOD-V, visual analog scales.

cannot be particularly adequate in measuring the effect of olfactory dysfunction on quality of life. Neuland et al proved higher efficacy of the QOD in assessment of olfaction-related QOL comparing to the SF-36.⁸

Currently in the post Covid era, it is utmost important to address medical need of self administered questionnaire in providing subjective information about olfactory dysfunctions. The reliable and validated Polish version of the QOD test meets this requirement.

Previously, reliability and validity studies of the QOD test have been performed in Chinese,¹⁴ Korean,¹⁵ and English.³⁹

Our investigation showed that the Polish version of the QOD questionnaire has very good validity and reliability, confirmed both by Spearman's and Pearson's correlation coefficients analysis. All QOD domains showed very high and statistically significant test-retest correlation. Internal consistency of the Questionnaire measured by

Cronbach's alpha coefficient for the total test was 0.887, and the overall reliability of the Polish version of QOD test is very good. Moreover, the validity analysis revealed that the relationship between the QOD and WHOQOL-BREF was statistical significant, except for the physical domain.

Various studies emphasize importance of complementary use of subjective and objective measures of olfactory dysfunctions.^{7,8,15,39} In accordance with previous studies¹⁵ we found that QOD-P, QOD-LQ, QOD-V results of patients in the SG but qualified as normosmic based on Sniffin' Sticks test were significantly higher than those of CG. These results suggest that subjective assessment of olfactory abilities may be influenced by olfactory related quality of life. We can argue that subjective assessment does not fully correspond to psychophysical olfactory abilities. Patients with subjective olfactory dysfunctions but normosmic on the Sniffin' Sticks test may have underestimate their abilities to report their olfactory dysfunctions. Other studies also reported on similar findings.³⁹⁻⁴¹ Since December 2019 and the wide spread of severe acute respiratory syndrome coronavirus-2 (SARS-CoV-2) the frequency of olfactory dysfunctions rapidly increased worldwide. The smell impairment is the early marker of this viral infection, with the prevalence reaching 50% of cases, and the current research indicate that significant part of patients will have long-lasting olfactory dysfunctions as a result of this infection.⁴² Additional extended observations for prolonged smell impairment related to COVID-19 are required.⁴³⁻⁴⁹

We have to mention limitations of our study. One can point to a small number of the participants, however, it must be stressed, that in our study, all participants were tested with the objective method for the comparison, not only the selected group, what is usually practiced. The Sniffin' Stick testing is time consuming; however we find the comparison of both subjective and objective methods especially valuable not only for the validation but also for most reliable diagnosis assessment. Additionally, one can cast doubts on our findings based on the mean age differences between SG and CG, as it was shown that demographic and disease factors influence the QOD values.⁵⁰ We can understand this age difference as in general population the olfactory dysfunction is usually age related condition.

5 | CONCLUSIONS

The Polish version of the QOD demonstrated high rates of the validity and the reliability. From now, this instrument may be widely used in research projects and clinical practice concerning olfactory disorders in Polish patients.

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none declared.

CONFLICT OF INTEREST STATEMENT

The authors declare no conflicts of interest.

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SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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