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Olfactory Disorders Questionnaire: Scaling severity of quality-of-life impact

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Abstract

Background: The Olfactory Disorders Questionnaire (ODQ) is widely used for patients suffering from olfactory disorders to depict the impact on quality of life. The aim of this study was to scale and produce reference values for patients ODQ score according to Becks Depression Inventory (BDI) severity.

Methods: In this prospective study, a cross-sectional anonymous survey was created, which combined EQ-5D-5L, BDI and ODQ. Correlation was calculated between the three questionnaires. Receiver operator characteristic curves were created to produce cut-off values for ODQ scores based on three BDI categories (mild, borderline clinical and moderate-to-severe depression).

Results: Of the 578 who responded to the survey, 445 completed all sections and were included in the study. Majority were female ($n = 327,73.5\%$), median age group 55–70 years ($n = 193,43.4\%$). There was a strong correlation between BDI score and total ODQ score. There was a clear gradient in total ODQ score for each BDI classification; those with mild depression had the lowest mean ODQ score (101.8, range 39–168), those with moderate-to-severe depression had the highest (138.24, range 74–177). Due to overlapping of confidence intervals we were unable to grade the ODQ score.

Conclusion: The study was unable to generate reference values for the ODQ due to lower numbers of patients with borderline clinical to extreme depression. However, we were able to appreciate the general trend, that the higher the ODQ score, the higher the risk of depression. These findings should guide clinical practice to ensure appropriate care and support is provided for those with olfactory dysfunction.

KEYWORDS
Becks Depression Inventory, depression, mental health, olfactory disorders, Olfactory Disorders Questionnaire

1 | BACKGROUND

European studies show varying prevalence of smell and taste disorders depending on the study methods undertaken; persistent symptoms of anosmia affect 1%–5% of the population while hyposmia and other smell disturbances affect about 20%, increasing over the age of 60.[1–3] These estimates[4] suggest anosmia is more prevalent than profound hearing loss or blindness in the UK. True taste loss is rare but 60% of smell and taste disorder patients report loss of flavour.[5] The most common causes of smell and taste disorders are sino-nasal disease (62%) and post-infectious olfactory dysfunction (11%), others include head trauma, neurological pathology and idiopathic causes.[6] The prevalence has changed in recent years, due to the Severe Acute Respiratory Syndrome-Coronavirus 2 (SARS-CoV-2) pandemic; with 10%–15% of those with Coronavirus disease 2019 (COVID-19)-induced post-infectious olfactory dysfunction not having spontaneous recovery.[7,8] Consequently, growing infection rates across the world are likely to mean olfactory dysfunction will become more common amongst the general population.

The sequelae of a reduced sense of smell are often unappreciated and not taken seriously. Recent evidence shows that anosmia is an independent risk factor for a shortened life span.[9,10] In addition, olfactory disorders have a significant impact on daily quality of life[11]; such as loneliness, fear, anxiety, depression, isolation and relationship issues.[12–14] Taste dysfunction is a common consequence, reducing enjoyment in food and often contributing to further social isolation.[15] Another key issue is the inability to detect danger, such as gas leaks or soiled food, which is particularly significant for professions such as fireman and chefs.

It is important we have measures available to carefully evaluate olfactory disorders, as highlighted in the publication of the Position Paper of Olfactory dysfunction.[5] This paper emphasises the need to evaluate patients' olfactory performance beyond subjective reporting. The Olfactory Disorders Questionnaire (ODQ), created by Frasnelli et al.,[16] was the first questionnaire that specifically addresses olfactory dysfunction and its impact on daily life. This questionnaire, created in Germany, consists of various statements of different domains of daily life that can be rated. Since its creation, the questionnaire has been utilised by several studies,[15,17–19] including being adapted into a brief version.[20] It has been translated and validated in multiple languages, including for use in English-speaking patients with olfactory disorders.[21] However, currently reference values to categorise patients' scores have yet to be established.

2 | OBJECTIVES

2.1 | Primary objective

1. To scale the ODQ to produce reference values for patients' ODQ scores according to Becks Depression Inventory (BDI) severity

Key points

1. The aim of this study was to scale the ODQ to produce reference values for patients ODQ scores according to BDI severity.
2. There was a strong correlation between BDI score and total ODQ score and the EQ-5D-5L score.
3. A clear gradient in total ODQ score for each BDI classification was noted; those with mild depression had the lowest mean ODQ score and those with moderate-to-severe depression had the highest.
4. We were unable to scale and produce reference values for the ODQ score.
5. These results should be used to ensure appropriate care and support is provided to those with olfactory disorders, especially those with high ODQ scores.

2.2 | Secondary objective

1. To correlate quality of life impairment with psychophysical testing of olfaction.

3 | METHODS AND MATERIALS

3.1 | Study design

This study used prospective data collection using a cross-sectional anonymous survey that combined three questionnaires: EQ-5D-5L, BDI and the ODQ. The survey ran online and was available for a period of 1.5 weeks; it was promoted via the charity Fifth Sense's links, newsletter and website.

Retrospective data were also collected from the database of the Smell and Taste clinic at James Paget University Hospital. Part of the routine assessment during clinic attendance is to ask patients to complete the ODQ and undergo Sniffin' Sticks test to determine their threshold, discrimination, identification score.

Ethical approval for this study was not sought according to the UK Health Research Authority Decision Tool (http://www.hra-decisiontools.org.uk/ethics/EngresultN1.html) and participants were anonymous. STROBE reporting guidelines were utilised in the preparation of this research.

3.2 | Setting and participants

The survey was open to anyone with access to the internet and declaring themselves as someone affected by disorder of their smell or taste. Due to the membership base of the

charity, the survey was widely available in the UK and other countries. Participants were able to access the survey themselves free of charge via the web-based platform SurveyMonkey. Participants were self-selecting but from experience they represent the patients that present to clinicians due to their smell or taste disorder.[11,22]

The Smell & Taste clinic database included patients attending the tertiary clinic at James Paget University Hospital over a 10-year period between 2010 and 2020 meeting the following eligibility criteria:

Inclusion criteria:

1. Subjects aged 18 or over.
2. Outpatient setting: any patient reporting an olfactory disorder regardless of cause.

Exclusion criteria:

1. Subjects with an incomplete data set, including no recorded ODQ or threshold, discrimination, identification score.

3.3 | Data sources and variables

The prospective survey asked for basic demographics including age and sex in addition to the three aforementioned questionnaires; the questionnaire asked participants about which range best described their age, so specific age data were collected.

3.3.1 | Becks Depression Inventory

The BDI is a widely used self-scoring questionnaire for measuring the severity of depression; the BDI-I is a 21-item scale (score range 0–60). Studies have been conducted in a variety of settings and

populations to evaluate its use, including investigation of depression in those with chemosensory disorders.[23,24]

3.3.2 | EQ-5D-5L

The EQ-5D-5L consists of two sections: the EQ-5D descriptive system and the EQ visual analogue scale (EQ VAS). The descriptive system is comprised of five dimensions (mobility, self-care, usual activities, pain/ discomfort and anxiety/depression) which can be scored on a five-level severity scale. The EQ VAS score is out of 100.

The retrospective data set from James Paget University Hospital used to conduct this analysis contained patient demographics, ODQ score, threshold, discrimination, identification score for the extended Sniffin' Sticks test and any diagnosis received.

3.4 | Sample size

No formal sample size calculation was made. The data collected from the survey aimed to reflect the opinions of active members of the charity. The retrospective analysis used a pre-collected data set; all eligible patients were selected for inclusion.

3.5 | Statistical methods

The number and percentage of individuals in each category were used to summarise the categorical variables. For questionnaire-based variables, the mean and SD were used to summarise the questionnaire-based outcome measures. To measure the association between the questionnaire-based variables, Pearson correlation coefficients were used with $p < 0.05$ used to indicate statistical significance. The classification of ODQ to indicate if an individual had signs of depression was based on the area-under the receiver operator characteristic (ROC)

TABLE 1 Baseline demographic data of participants

Variable	Cross-sectional survey		JPUH Smell & Taste clinic	
	Frequency	Percentage (%)	Frequency	Percentage (%)
Gender				
Female	327	73.5	143	59.3
Male	116	26.1	95	39.4
Missing	2	0.4	3	1.2
Age				
<18	6	1.4	8	3.3
18–25	11	2.5	5	2.1
26–40	40	9.0	28	11.6
41–55	97	21.8	59	24.5
55–70	193	43.4	102	42.3
≥70	97	21.8	39	16.2
Missing	1	0.2	0	0

TABLE 2 Aetiology of participants from JPUH Smell & Taste clinic

Diagnosis	Frequency	Percentage (%)	Mean ODQ score	SD
Post-viral olfactory loss	62	25.7	106.98	27.58
Idiopathic olfactory loss	50	20.8	100.88	28.94
Rhinosinusitis[a]	60	24.9	108.88	30.65
Post-traumatic olfactory loss	16	6.6	89.94	23.93
Olfactory Cleft Stenosis	11	4.6	110.00	28.49
Metabolic olfactory loss	10	4.2	93.30	22.65
Congenital anosmia	11	4.6	88.00	23.72
Iatrogenic olfactory loss	8	3.3	107.88	23.44
Olfactory cleft disease	4	1.7	85.50	25.44
Other[b]	9	3.7	100.00	24.25

[a]Allergic fungal rhinosinusitis/allergic rhinitis (perennial allergic rhinitis)/chronic rhinosinusitis without nasal polyps/chronic rhinosinusitis with nasal polyps.
[b]Cerebrovascular accident/cerebral oedema/deviated nasal septum/hypopituitarism/hypothyroidism/no pathology/presbyosmia.

TABLE 3 Summary of questionnaire scores.

Questionnaire	Mean	SD	Min	Max
BDI	13.38	9.36	1	48
EQ-5D-5L	0.79	0.20	−0.14	1
EQ-5D-5L VAS	73.36	19.56	4	100
ODQ QoL	63.90	17.23	26	100
ODQ Quant	19.16	6.06	0	30
ODQ QoL rating	28.76	12.11	0	50
Total ODQ	111.82	30.47	39	177

Abbreviations: BDI, Becks Depression Inventory; ODQ, Olfactory Disorders Questionnaire; QoL, quality of life; VAS, visual analogue scale.

curve. The sensitivity and specificity were estimated at a chosen cut-point.

4 | RESULTS

4.1 | Participants

4.1.1 | Cross-sectional survey

Five hundred and seventy-eight individuals responded to the survey. Of these, 445 individuals completed all questions of the BDI, EQ-5D-5L and ODQ, and were included in the analyses. The majority of participants were female ($n = 327, 73.5\%$), the most common age group was 55–70 years ($n = 193, 43.4\%$). The summary demographic data are described in Table 1.

4.1.2 | Retrospective clinic data

Two hundred and forty-one patients reporting olfactory dysfunction had a complete ODQ score entered into the database. The summary demographic data are described in Table 1; the majority were female ($n = 143, 59.3\%$) and the most common age group was 55–70 years

($n = 102, 42.3\%$). The aetiology of the 241 participants is characterised in Table 2.

4.2 | Main results

4.2.1 | Cross-sectional survey

Table 3 summarises the results of the 445 questionnaire responses from the cross-sectional survey. There was a wide range in total scores from all three questionnaires. The mean total ODQ score was 111.8 (range 39–177). The mean BDI score was 13.4; range from 1 (ups and downs/normal mood) to 48 (extreme depression). The mean EQ-5D-5L score was 0.79 (range 0.14–1), with 1 indicating no issue with health and scores <0 considered to be worse than death.

Table 4 presents the correlation between questionnaire scores and Graph 1 presents the correlation between ODQ and BDI scores. There is a strong correlation between BDI score and all other scores ($r > .5$, $p < .001$), except the total quantitative ODQ score ($r = .17$, $p < 0.001$). The EQ-5D-5L is not strongly correlated with any other measures except BDI.

4.2.2 | Retrospective clinic data

Subgroup analyses of the 241 patients attending clinic at James Paget University Hospital, as shown in Table 2, demonstrated that mean ODQ scores were not statistically significant different depending on diagnoses. Patients suffering from rhinosinusitis had the highest mean ODQ score (108.88), followed by those with iatrogenic olfactory loss (107.88) and post-viral olfactory loss (106.98).

4.2.3 | Correlation of the ODQ score

In clinical practice, the BDI score is used to classify depression into six categories. The distribution of the classification of BDI score in

TABLE 4 Correlation between questionnaire scores the correlation is given in the lower diagonal and the *p*-value in the upper diagonal.

	BDI	EQ-5D-5L	EQ-5D-5L VAS	ODQ QoL	ODQ Quant	ODQ QoL rating	Total ODQ
BDI	1	<.001	<.001	<.001	<.001	<.001	<.001
EQ-5D-5L	−.65	1	<.001	<.001	<.001	<.001	<.001
EQ-5D-5L VAS	−.54	.58	1	<.001	.001	<.001	<.001
ODQ QoL	.63	−.40	−.29	1	<.001	<.001	<.001
ODQ Quant	.17	−.20	−.16	.24	1	<.001	<.001
ODQ QoL rating	.53	−.33	−.23	.82	.39	1	<.001
Total ODQ	.60	−.39	−.28	.93	.49	.94	1

Abbreviations: BDI, Becks Depression Inventory; ODQ, Olfactory Disorders Questionnaire; QoL, quality of life; VAS, visual analogue scale.

participants completing the cross-sectional survey is shown in Table 5. The BDI classification was split into three key groups; score 1–16 were classed as mild depression, score 17–20 as borderline clinical depression and score greater than or equal to 21 as moderate-to-severe depression. ODQ scores were summarised for each BDI classification, as shown in Table 6. There was a clear gradient in total ODQ scores for each classification of BDI; those in the mild depression category had the lowest ODQ score (101.77, range 39–168), while those classed as having moderate-to-severe depression had the highest ODQ score (138.24, range 74–177). However, there is significant overlapping of confidence intervals.

ROC curves were used to create cut-points for the three categories, Table 7 summarises the area under the ROC curve for each component of the ODQ. The ROC curve for total ODQ for the borderline (or more) versus mild (or less) suggests that a cut-point of 123 would be appropriate (sensitivity 68.75%, specificity 77.74%.) The ROC curve for total ODQ for the moderate (or more) versus borderline (or less) suggests that the cut-point of 125 would be appropriate (sensitivity 80.46%, specificity 75.42%). Using the data from the cross-sectional survey, we have been able to identify a strong correlation with BDI and EQ-5D-5L scores.
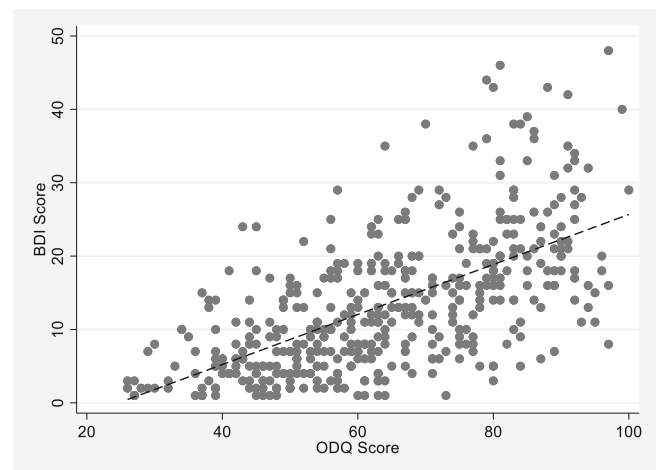

GRAPH 1 Correlation between Becks Depression Inventory (BDI) and Olfactory Disorders Questionnaire (ODQ) scores.

reflected in the general population. Due to this, instead of grading the ODQ as mild, moderate and severe, using the data from the cross-sectional survey, we were able to make a binary correlation as to whether the presenting patient was at high or low risk of depression, that is, lower the score, lower the risk of depression and vice-versa.

5 | DISCUSSION

5.1 | Key results

As reflected from many previous studies in olfactory dysfunction,[5,11,22] our study also shows a female preponderance in both participation of the survey and attendance in clinic (68.5% pooled analysis). As 63% of all participants were aged 55 or above, this demonstrates that pre-COVID-19, this is the most common age group that seek help for olfactory dysfunction irrespective of the cause.

Our data shows that the mean scores for the most numerous diagnostic groups; post-viral (infectious) olfactory loss, idiopathic olfactory loss and chronic rhinosinusitis are all very similar and do not appear to have differing impacts on quality of life.

Unfortunately, due to the overlapping confidence intervals in our sample population, we were unable to grade ODQ score into mild, moderate and severe. This is due to the lower number of patients with borderline clinical, moderate, severe and extreme depression as also

6 | LIMITATIONS

The cross-sectional survey was only promoted on the Fifth Sense website, newsletter and links, perhaps reducing the generalisability of participants; however, different aetiologies of the Fifth Sense members have previously been shown to match that of those attending the Smell and Taste clinic at James Paget University Hospital.[22] By conducting this as an online survey, there was also reduced access to those without internet access, which is likely to affect the older population more. As this is an optional online survey, the study will be subject to selection bias as reflected in the gender and age distribution of our study. It is, however, encouraging that 21.8% (n = 97) of respondents to the survey were 70 years or over.

A further limitation, is that the cause of smell and taste disorder was self-reported in the cross-sectional survey. Smell and taste disorders feature a range of symptoms of anosmia (total smell loss), parosmia

TABLE 5 Classification of depression of participants responding to cross-sectional survey.

BDI score	Classification of depression	Frequency	Percentage (%)
1–10	Ups and downs normal	202	45.4
11–16	Mild mood disturbance	99	22.3
17–20	Borderline clinical depression	57	12.8
21–30	Moderate depression	62	13.9
31–40	Severe depression	19	4.3
>40	Extreme depression	6	1.4

Abbreviation: BDI, Becks Depression Inventory.

TABLE 6 Classification of participants into three BDI groups

BDI score	ODQ QoL		ODQ Quant		ODQ QoL rating		Total ODQ	
	Mean (SD)	Min, max	Mean (SD)	Min, max	Mean (SD)	Min, max	Mean (SD)	Min, max
1–16	57.81 (15.59)	26, 97	18.64 (6.22)	0, 30	25.32 (11.44)	0, 50	101.77 (28.06)	39, 17
17–20	71.91 (13.60)	41, 96	19.33 (4.64)	7, 30	33.30 (10.56)	15, 50	125.54 (24.16)	70, 16
≥21	79.72 (11.79)	43, 10	20.83 (6.07)	1, 30	37.69 (9.61)	14, 50	138.24 (22.32)	74, 18

Abbreviations: BDI, Becks Depression Inventory; ODQ, Olfactory Disorders Questionnaire; QoL, quality of life.

TABLE 7 Area under ROC curve for each ODQ component

Measure	Classification of BDI score 1–16 vs. ≥ 17	Classification of BDI score 1–20 vs. ≥ 21
ODQ QoL	0.82 (0.78,0.86)	0.83 (0.79,0.88)
ODQ Quant	0.57 (0.51,0.62)	0.60 (0.53,0.67)
ODQ QoL rating	0.75 (0.71,0.80)	0.77 (0.71,0.82)
Total ODQ	0.80 (0.75,0.84)	0.81 (0.77,0.86)

Abbreviations: BDI, Becks Depression Inventory; ODQ, Olfactory Disorders Questionnaire; QoL, quality of life; ROC, receiver operator characteristic.

(smell distortion), phantosmia (smell hallucination) and parageusia (taste distortion). In hindsight, collecting this data may have allowed for further analysis of how different disorders affect mood. The analysis of the retrospective clinic data did however indicate there was no statistically significant difference in ODQ score depending on diagnosis (Table 2).

6.1 | Interpretation

As mentioned in the introduction, a number of studies have now looked at the ODQ or derivations of it. Zou et al.[25] studied 372 participants with olfactory dysfunction and included threshold, discrimination, identification scores from the Sniffin' Sticks along with results of the brief version of the ODQ. They showed that olfactory function was found to be associated with parosmia, quality of life and VAS subsections of the questionnaire. Choi et al.[15] found similar findings with the Korean version of the ODQ.

However, despite the wide use of ODQ in other studies, no acceptable severity scaling for ODQ has been created to correlate the mental health impact. Through our previous work,[21] we were able to validate the ODQ originally developed by Frasnelli et al. in German into the English language and were able to identify difference in reported outcome measures versus the objective psychophysical smell testing. This study showed poor correlation between Sniffin' Sticks threshold, discrimination, identification score and the total ODQ score; indicating that they measure two different things and as such are affected by different variables, that is, the Sniffin' Sticks test is a psychophysical test and the ODQ is a patient-reported health-related quality of life questionnaire. The threshold, discrimination, identification score has accepted scaling for anosmia, hyposmia and functional parosmia, an equivalent of which is lacking for the ODQ.

6.2 | Generalisability

Although we set out to try and achieve this scaling for the ODQ, statistically it was challenging because of the overlapping confidence intervals between the groups. However, in this process, we have been able to confirm the correlation of ODQ with BDI and EQ-5D-5L scores and have been able to make a binary correlation with regards to the presence or absence of potential risk of clinical depression.

7 | CONCLUSION

The study was unable to generate reference values for the ODQ due to lower numbers of patients with borderline clinical to extreme depression. We were able to appreciate the general trend, that the higher the ODQ score, the higher the risk of depression.

These findings should guide clinical practice to ensure appropriate care and support is provided for those with olfactory dysfunction. In future we hope that increasing levels of psychological support will be possible through the work of Fifth Sense.

CONFLICT OF INTEREST

Carl Martin Philpott is a trustee of Fifth Sense.

PEER REVIEW

The peer review history for this article is available at https://publons.com/publon/10.1111/coa.14017.

DATA AVAILABILITY STATEMENT

Data file is available to access on request.

ETHICS STATEMENT

Ethical approval for this study was not sought according to the UK Health Research Authority Decision Tool (http://www.hra-decisiontools.org.uk/ethics/EngresultN1.html).

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