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ORIGINAL ARTICLE

Prevalence of Olfactory Dysfuntion in SARS-COV-2 Positive Patients

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Abstract Severe acute respiratory syndrome coronavirus 2 (SARS-COV-2) is associated with chemosensory symptoms including olfactory dysfunction and dysgeusia. Multiple studies have reported differing prevalence rates of symptoms and recovery rates depending on geographic location. The purpose of the study was to determine the prevalence and features of Covid19 olfactory dysfunction in a developing nation. We conducted a prospective study at a tertiary, high-volume centre in South Africa, to determine the prevalence of olfactory dysfunction in SARS-COV-2 positive patients. The average recovery time of the olfactory dysfunction was also evaluated. The study included patients diagnosed with SARS-COV-2 infection between November 2020 and January 2021. Patients were recruited to participate in a survey which assessed demographic data, date of diagnosis, initial symptoms, presence and recovery time of olfactory dysfunction symptoms. A total of 86 patients with olfactory dysfunction were included and followed up telephonically over 6 weeks in 2 week intervals to determine recovery time. There was a prevalence rate of 40.7% of olfactory dysfunction in patients in our study. A higher proportion of patients with olfactory dysfunction had fever compared to those without and this was a significant finding in our study population. The overall median recovery time in our study was 7 days. Prevalence of olfactory dysfunction in our population is in keeping with European studies and most patients recover their sense of smell within a week.

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Introduction

Severe acute respiratory syndrome coronavirus 2 (SARS-COV-2), colloquially known as COVID-19, was first reported in Wuhan, China in December 2019. The World Health Organisation (WHO) declared COVID-19 a global pandemic on the eleventh of March 2020 [1]. In South Africa the first infection was detected on the 5th March 2020 and by the 8th July 2020 Gauteng had become the epi-centre of the country, accounting for 33.4% of all cases [2, 3]

The most common symptoms associated with COVID-19 include fever, cough, shortness of breath and generalized symptoms such as fatigue and myalgias.

Multiple studies have shown an association between COVID-19 and chemosensory symptoms such as olfactory dysfunction and dysgeusia [4, 5].

Olfactory dysfunction includes a complete loss of smell (anosmia); decreased sense of smell (hyposmia) or a distorted sense of smell (dysosmia). It can occur either in isolation or in the presence of other symptoms [6].

The cause of olfactory dysfunction caused by SARS-CoV-2 has not been fully elucidated. Proposed hypotheses include damage to the nasal mucosal epithelium, as one theory, and the neurotropic nature of coronaviruses which enable them to affect the olfactory neurons directly, as another theory. SARS-CoV-2 is able to enter epithelial cells by directly binding to angiotensin-converting enzyme 2 (ACE2) on the cell surface. Significantly, the potential site of injury determines recovery where neuronal injury takes longer to recover [7].

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Recognition of olfactory dysfunction by members of the public and the significance thereof by healthcare practitioners may assist in future earlier detection of infected individuals, as well as the use of proper personal protective equipment, thereby decreasing the spread of the virus [5].

In a recent systematic review, the pooled prevalence of olfactory dysfunction was 47% [7]. Mullol et al. showed a wide regional variability, unfortunately there were no relevant studies conducted in Africa in this review [8].

We conducted a study to determine the prevalence of olfactory dysfunction in our setting (Chris Hani Baragwanath Academic Hospital, a tertiary teaching hospital in Johannesburg, South Africa).

Literature Review

Since the SARS-COV-2 outbreak, there have been different studies around the world to determine the association between olfactory dysfunction and SARS-COV-2.

Olfactory dysfunction is shown to be a useful tool to hold high suspicion of SARS-COV-2 infection in patients.

In a study by Zayet et al., two groups with symptoms were compared; a SARS-COV-2 positive and negative group, respectively. Anosmia occurred in 60% of the patients who tested positive versus 18% in those that tested negative. This study determined that anosmia as a positive predictive value of SARS-COV-2, is 77% and the PPV of anosmia in combination with taste dysfunction is higher, at 83%. The specificity of anosmia was 85% and sensitivity 63% [9]. In another study done in California of over 200 patients, anosmia was found to be 10 times more common in SARS-COV-2 positive, then SARS-COV-2 negative, patients with flu like symptoms [10]. In a study by Vaira et al., 73.6% of SARS-COV-2 positive patients had olfactory and gustatory dysfunction [11].

The SARS-COV-2 olfactory related symptoms seem less prevalent in the Asian population as compared to the European population [5]. Liechen et al. showed in a European study that 85.6% of confirmed positive patients reported anosmia [12].

Kaye et al. reported 73% in a US study [13]. In a Korean study, 3191 patients were evaluated and approximately 15% had anosmia as a symptom [14]. In a review by El-Anwar et al., 11 studies were analysed; 8 out of 11 were from Asian countries and none reported smell symptoms. The only studies that reported olfactory symptoms were by an Italian study (Vaira et al.) and a study in Switzerland (Speth et al.) [15]. A study in India showed a low prevalence of 10.7% of OD [16].

Possible explanations may be that there was lack of awareness in early studies in these populations or nasal symptoms were under-reported [17]. Another explanation may be that the Asian population actually exhibited less nasal symptoms. It is possible that there may be different frequencies of variant ACE2 entry proteins in different populations [18, 19].

Recovery of SARS-COV-2 related anosmia is important to study, as it can be a disturbing symptom especially in the elderly, as it affects quality of life and can lead to depression, loss of appetite and weight loss [20]. Patients have been found to recover quickly, majority within 9 days and 14 days [10, 12]. In a survey of 382 patients, recovery plateaus after 2 weeks [21]. A quick recovery suggests the virus targets neural epithelium as opposed to neuronal cells themselves [10]. In the study done in California 10% did not have resolution of anosmia however 82% were evaluated at only 2 weeks post infection [10]. It is possible that their anosmia may have resolved at a later stage.

Vaira et al. showed that 66% of patients had reported recovery of anosmia, however, an objective correlation shows that 80% of them still had hyposmia [11]. Subjective studies may under-report anosmia and over-report recovery.

Aim

The primary objective of this study is to determine the prevalence of olfactory dysfunction in SARS-COV-2 positive patients in one centre. The secondary objective is to determine the average recovery time of the olfactory dysfunction.

Methods

Study Population

This study included 101 diagnosed SARS-COV-2 positive patients discharged from designated" wards at Chris Hani Baragwanath Academic Hospital between November 2020 and January 2021. Patients were invited to participate in a survey.

The survey included the patients' demographic data, date of diagnosis, initial symptoms, presence and recovery time of olfactory dysfunction symptoms. Patients with olfactory dysfunction at the time of the survey were followed up telephonically over 6 weeks, in 2 week intervals to determine recovery time.

Participation was strictly voluntary and informed consent was obtained.

Study Sample

Sample sized predicted using the formula for prevalence below is 40, where the confidence interval Z is 95%,

predicative prevalence is 60% (based on other studies [10] and margin of error is ¼.

$$n = \frac{Z_2\ a/2\ P(1-P)}{d_2}$$

However due to variability in other similar studies where prevalence is 33% and sample size would therefore be 133, we decided on a study sample of 100 patients as this will attain reliable results and is feasible for a single researcher.

Inclusion criteria for patients:

Age > 18yrs.

- Laboratory confirmed SARS-COV-2 PCR on nasopharyngeal swabs.

Exclusion criteria:

- Medical diagnosis of allergic rhinitis made by a clinician.
- Ventilated patients during this hospital stay.
- Previous surgery, trauma or radiation to nasal or oral cavity.
- Olfactory symptoms before the current illness.

We also examined the effect of age, sex, use of certain medication on the prevalence of olfactory dysfunction.

Ethics was approved by Wits Research ethics committee (ref R14/49) and permission to conduct the study was provided by Chris Hani Baragwanath medical advisory committee.

Data Extraction and Analysis

Categorical variables were described using frequencies and proportions. Pearson's chi squared test was used to compare proportions or Fisher's exact test where data was sparse (< 5 observations). Continuous variables were described using medians and the interquartile range. The Wilcoxon rank sum test was used to compare median values of continuous variables by sex while the Kruskall-Wallis test compared median values by age group. Analyses were done in Stata 14, and statistical significance was set at 5%.

Results

One hundred and one patients, testing positive for SARS-COV2, were recruited for the study. Fifteen were excluded (previous history of olfactory dysfunction, ICU admission during current admission(proxy for ventilation), medical history of rhinitis, previous surgery, trauma or radiation to nasal or oral cavity.)

A total of 86 patients were included in the study. There were 53 (62%) males and 33 (38%) females. There were 83 (97%) black African patients.

From a sample of 86 patients admitted at a tertiary hospital with SARS-COV-2, 35 presented with olfactory dysfunction (OD), representing a prevalence of 40.7% (Table 1). The only clinical characteristic that was significant between patients with OD and those without was the presence of fever i.e. a higher proportion of patients with olfactory dysfunction had fever compared to those without (p value = 0.039). The overall median age was 48.5 years (IQR: 36.0–60.0) and median ages were similar between the 2 groups. (p value = 0.107).

A significantly higher proportion of females were on treatment for hypertension and diabetes compared to males (p values were 0.018 and 0.037 respectively).

Among participants that experienced olfactory dysfunction; the bivariate analyses showed that there were no significant differences in symptoms/experience between males and females as well as across the age groups. This suggests that both sex and age were not associated with the outcome i.e. olfactory dysfunction or sub- type Of those who had olfactory dysfunction 11/35 were smokers. Only 2 patients experienced blocked nose, of which only one had OD.

The median time to diagnosis for all patients was 5 days. 6 had OD as initial symptom, of which the time to diagnosis was a median of 3 days and an average of 6 days. Of those that had OD, 20 had dysgeusia.

The overall median time to recovery (return of smell) was 7 days (IQR: 4–14-range) Four patients were unavailable for follow-up Tables 2, 3, 4.

There were no significant differences in median time to recovery between males and females or across age groups. This suggests that both sex and age were not associated with the outcome i.e. olfactory dysfunction or sub- type.

Of the 51 patients who did not have OD, 13 were followed up and had no new olfactory dysfunction symptoms at 6 weeks after discharge. Thirty-eight patients could not be reached for follow up.

Discussion

Our prevalence (40.7%) of OD is consistent with the findings of reviews by both Agyeman et al. (41%) and Qiu et al. (47%) [5, 7]. This figure is essentially representative

Table 1 Baseline demographic and clinical characteristics

Variable*	Total (N = 86)	Olfactory dysfunction absent(n = 51)	Olfactory dysfunction present(n = 35)	*P* value
Age (Years)				0.084
Median age	48.5 (36.0–60.0)	46.0 (33.0–56.0)	53.0 (41.0–64.0)	0.107
< 30	13 (15.1%)	10 (19.6%)	3 (8.6%)	
30- < 40	13 (15.1%)	9 (17.7%)	4 (11.4%)	
40- < 50	19 (22.1%)	9 (17.7%)	10 (28.6%)	
50- < 60	17 (19.8%)	13 (25.5%)	4 (11.4%)	
≥ 60	24 (27.9%)	10 (19.6%)	14 (40.0%)	
Gender				0.107
Female	33 (38.4%)	16 (31.4%)	17 (48.5%)	
Male	53 (61.6%)	35 (68.6%)	18 (51.4%)	
Ethnicity				0.308
African	83 (96.5%)	49 (96.1%)	34 (97.1%)	
Coloured	2 (2.3%)	2 (3.9%)	0 (0.0%)	
Indian	1 (1.2%)	0 (0.0%)	1 (2.9%)	
Initial symptoms reported				
Asymptomatic	5 (5.8%)	4 (7.8%)	1 (2.9%)	0.644
Headache	7 (8.1%)	5 (9.8%)	2 (5.7%)	0.696
Fever	21 (21.4%)	8 (15.7%)	13 (37.1%)	0.039
Body ache	6 (7.0%)	3 (5.9%)	3 (8.9%)	0.684
Runny nose	0 (0.0%)	0 (0.0%)	0 (0.0%)	-
Blocked nose	5 (5.8%)	2 (3.9%)	3 (8.6%)	0.393
Loss of taste	10 (11.6%)	4 (7.8%)	6 (17.1%)	0.304
Cough	18 (20.9%)	10 (19.6%)	8 (22.9%)	0.716
Sore throat	7 (8.1%)	5 (9.8%)	2 (5.7%)	0.696
Vomiting	6 (7.0%)	4 (7.8%)	2 (5.7%)	1.000
Shortness of breath	5 (5.8%)	3 (5.9%)	2 (5.7%)	0.975
Loss of appetite	1 (1.2%)	1 (2.0%)	0 (0.0%)	1.000
Diarrhoea	2 (2.3%)	2 (3.0%)	0 (0.0%)	0.512
Hearing loss	1 (1.2%)	1 (2.0%)	0 (0.0%)	0.593
No of days from symptoms to diagnosis				0.288
Median time	*5.0 (2.0–8.0)*	*5.0 (2.0–8.0)*	*4.0 (2.0–10.0)*	*0.784*
< 5 days	28 (32.6%)	14 (27.5%)	14 (40.0%)	
5- < 10	18 (20.9%)	12 (23.5%)	6 (17.1%)	
10- < 20	8 (9.3%)	3 (5.9%)	5 (14.3%)	
≥ 20	4 (4.7%)	2 (3.9%)	2 (5.7%)	
Missing	28 (32.6%)	20 (39.2%)	8 (22.9%)	
Had blocked nose/discharge from nose				0.393
No	81 (94.2%)	49 (96.1%)	32 (91.4%)	
Yes	5 (5.8%)	2 (3.9%)	3 (8.6%)	
Receiving medication for hypertension				0.091
No	58 (67.4%)	38 (74.59%)	20 (57.1%)	
Yes	28 (32.6%)	13 (25.5%)	15 (42.9%)	
Receiving medication for diabetes				0.716
No	56 (65.1%)	34 (66.7%)	22 (62.9%)	
Yes	30 (34.9%)	17 (33.3%)	13 (37.1%)	
Receiving medication for hypothyroidism				0.157

Table 1

No	83 (96.5%)	51 (100.0%)	32 (91.4%)	
Yes	2 (2.3%)	0 (0.0%)	2 (5.9%)	
Missing	1 (1.2%)	0 (0.0%)	1 (2.9%)	
Smoking status				0.348
Non smoker	61 (70.9%)	38 (74.5%)	23 (65.7%)	
Smoker	25 (29.1%)	13 (25.5%)	12 (32.3%)	

*Percentages may not add up to 100% due to rounding off

of the prevalence in Black Africans in our setting, as they comprised 97% of the study population. A study in Somalia shows similar prevalence of 40% [22]. The prevalence may be an underestimate since OD has a higher prevalence in outpatients and mild disease and our study sample was hospital based [10, 23, 24].

OD is a common feature of aging and has been documented in approximately 75% of patients older than 80 years [25]. In COVID-19 however OD is more prevalent in younger age groups [5]. We did not demonstrate any significant differences amongst our various age groups, possibly an effect of the small numbers in each sub-group. In this study there was no difference in the occurrence of OD between males and females. Previous research on the role of gender in patients with OD has been inconsistent. The review by Agyeman et al. found no difference in the frequency of OD between genders however Saniasiaya et al. showed a female predominance of 61% [5, 17]. A significant finding in the study was the higher number of female patients with co-morbidities (diabetes and hypertension). This is consistent with a recently published study examining infectious and non-communicable diseases which concluded that women bear a significant burden of disease in South Africa [26].

We identified the presence of OD as the initial symptom in 6 (7%) patients. This figure is similar to that reported previously (2.9%) by Speth et al. [6]. A recent systematic review concluded that OD occurs early during the course of the disease but was the initial symptom in only a minority of cases [6]. Studies comparing the prevalence of OD have documented underreporting in subjective studies such as ours [27]. In our study only 48.5% reported the OD to be a bother to them.

The overall median recovery time in our study was 7 days. A recent systematic review noted that most studies reported a resolution of OD within 14 days of symptom onset [28]. Recovery rates vary considerably as noted by Salamanna et al. [28]. In their review it varied between 5 and 50%. A noteworthy finding in the review was a relative dearth of information in patients with moderate-severe disease, which our sample represents. During the 6 week follow-up period only 1 (3%) patient did not recover from their OD. In a study by Lechien et al., 15.3% of patients with anosmia did not recover at 6 months [24]. Our study focused on acute OD and therefore we only followed up patients for 6 weeks. It would be of interest in future studies to note if patients who recover their sense of smell, would later develop cacosmia.

Dysgeusia was documented in 10 (11.6%) of our patients. This figure is significantly lower than the pooled prevalence (36.6%) reported in the meta-analysis by Mutiawati et al. [29]. The prevalence in the 16 studies included in their meta-analysis varied between 2.8 and 76.6%. Geographical variations in COVID-19 associated dysgeusia have been noted previously [30]. A previous study from Africa found dysgeusia in 23.3% of patients [22].

Conclusion

From our sample of 86 patients admitted at a tertiary hospital with SARS-COV-2, 35 presented with olfactory dysfunction representing a prevalence of 40.7%. The only clinical characteristic that was significant between patients with OD and those without was the presence of fever i.e. a higher proportion of patients with olfactory dysfunction had fever compared to those without.

Prevalence of OD in our population is in keeping with European studies and most patients recover their sense of smell within a week.

Our study confirms findings of previous studies and further addresses existing knowledge gaps regarding olfactory and gustatory dysfunction in COVID-19 patients in Africa. The prevalence of OD in our hospital based population is consistent with published data, but the

Table 2 Demographic and clinical characteristics at baseline stratified by sex

Variable*	Total (n = 86)	Female (n = 33)	Male (n = 53)	*P* value
Age (Years)				0.738
Median age	*48.5 (36.0–60.0)*	*51.0 (40.0–62.0)*	*45.0 (36.0–59.0)*	*0.320*
< 30	13 (15.1%)	4 (12.1%)	9 (17.0%)	
30- < 40	13 (15.1%)	4 (12.1%)	9 (17.0%)	
40- < 50	19 (22.1%)	6 (18.2%)	13 (24.5%)	
50- < 60	17 (19.8%)	8 (24.2%)	9 (17.0%)	
≥ 60	24 (27.9%)	11 (33.3%)	13 (24.5%)	
Ethnicity				1.000
African	83 (96.5%)	32 (97.0%)	51 (96.2%)	
Coloured	2 (2.3%)	1 (3.0%)	1 (1.9%)	
Indian	1 (1.2%)	0 (0.0%)	1 (1.9%)	
Initial symptoms reported				
Asymptomatic	5 (5.8%)	2 (6.1%)	3 (5.7%)	0.939
Headache	7 (8.1%)	3 (9.1%)	4 (7.6%)	0.799
Fever	21 (21.4%)	10 (30.3%)	11 (20.8%)	0.439
Body ache	6 (7.0%)	2 (6.1%)	4 (7.6%)	1.000
Runny nose	0 (0.0%)	0 (0.0%)	0 (0.0%)	–
Blocked nose	5 (5.8%)	3 (9.1%)	2 (3.8%)	0.367
Loss of taste	10 (11.6%)	5 (15.2%)	5 (9.4%)	0.497
Cough	18 (20.9%)	8 (24.2%)	10 (18.9%)	0.593
Sore throat	7 (8.1%)	3 (9.1%)	4 (7.6%)	1.000
Vomiting	6 (7.0%)	3 (9.1%)	3 (5.7%)	0.671
Shortness of breath	5 (5.8%)	0 (0.0%)	5 (9.4%)	0.069
Loss of appetite	1 (1.2%)	0 (0.0%)	1 (1.9%)	1.000
Diarrhoea	2 (2.3%)	2 (6.1%)	0 (0.0%)	0.144
Hearing loss	1 (1.2%)	1 (3.0%)	0 (0.0%)	0.384
No of days from symptoms to diagnosis				0.872
Median time	5.0 (2.0–8.0)	6.0 (3.0–8.0)	4.0 (2.0–8.0)	0.329
< 5 days	28 (32.6%)	9 (27.3%)	19 (35.9%)	
5- < 10	18 (20.9%)	8 (24.2%)	10 (18.9%)	
10- < 20	8 (9.3%)	3 (9.1%)	5 (9.4%)	
≥ 20	4 (4.7%)	1 (3.0%)	3 (5.7%)	
Missing	28 (32.6%)	12 (36.4%)	16 (30.2%)	
Reported change in sense of smell during current SARS COV-2 infection				0.107
No	51 (59.3%)	16 (48.5%)	35 (66.0%)	
Yes	35 (40.7%)	17 (51.5%)	18 (34.0%)	
Had blocked nose/discharge from nose				0.521
No	81 (94.2%)	30 (90.9%)	51 (96.2%)	
Yes	5 (5.8%)	3 (9.1%)	2 (3.8%)	
Receiving medication for hypertension				**0.018**
No	58 (67.4%)	17 (51.5%)	41 (77.4%)	
Yes	28 (32.6%)	16 (48.5%)	12 (22.6%)	
Receiving medication for diabetes				**0.037**
No	56 (65.1%)	17 (51.5%)	39 (73.6%)	
Yes	30 (34.9%)	16 (48.5%)	14 (26.4%)	
Receiving medication for hypothyroidism				0.139
No	83 (96.5%)	30 (90.9%)	53 (100.0%)	
Yes	2 (2.3%)	2 (6.1%)	0 (0.0%)	

Table 2

Missing	1 (1.2%)	1 (3.0%)	0 (0.0%)	
Smoking status				0.205
Non smoker	61 (70.9%)	26 (78.8%)	35 (66.0%)	
Smoker	25 (29.1%)	7 (21.2%)	18 (34.0%)	

*Percentages may not add up due to rounding off

Table 3 Baseline demographic and clinical characteristics stratified by age

Variable	Total (n = 86)	Age group (Years)					*P* value
		< 30 (n = 13)	30- < 40 (n = 13)	40- < 50 (n = 19)	50- < 60 (n = 17)	≥ 60 (n = 24)	
Reported change in sense of smell during current SARS COV-2 infection							
No	51 (59.3%)	10 (76.9%)	9 (69.2%)	9 (47.4%)	13 (76.5%)	10 (41.7%)	0.084
Yes	35 (40.7%)	3 (23.1%)	8 (30.8%)	10 (52.6%)	4 (23.5%)	14 (58.3%)	
Initial symptoms reported							
Asymptomatic	5 (5.8%)	0 (0.0%)	0 (0.0%)	1 (5.3%)	1 (5.9%)	3 (12.5%)	0.686
Headache	7 (8.1%)	1 (7.7%)	1 (7.7%)	3 (15.8%)	1 (5.9%)	1 (4.2%)	0.769
Fever	21 (21.4%)	4 (30.8%)	2 (15.4%)	6 (31.6%)	5 (29.4%)	4 (16.7%)	0.666
Loss of smell	6 (7.0%)	1 (7.7%)	1 (7.7%)	1 (5.3%)	1 (5.9%)	2 (8.3%)	1.000
Body ache	6 (7.0%)	2 (15.4%)	1 (7.7%)	1 (5.3%)	0 (0.0%)	2 (8.3%)	0.601
Blocked nose	5 (5.8%)	0 (0.0%)	2 (15.4%)	2 (10.5%)	1 (5.9%)	0 (0.0%)	0.203
Loss of taste	10 (11.6%)	4 (30.8%)	1 (7.7%)	2 (10.5%)	0 (0.0%)	3 (12.5%)	0.147
Cough	18 (20.9%)	3 (23.1%)	1 (7.7%)	4 (21.1%)	8 (47.1%	2 (8.3%)	**0.038**
Sore throat	7 (8.1%)	2 (15.4%)	1 (7.7%)	2 (10.5%)	1 (5.9%)	1 (4.2%)	0.821
Vomiting	6 (7.0%)	0 (0.0%)	1 (7.7%)	2 (10.5%)	2 (11.8%)	1 (4.2%)	0.691
Shortness of breath	5 (5.8%)	0 (0.0%)	1 (7.7%)	0 (0.0%)	2 (11.8%)	2 (8.3%)	0.522
Loss of appetite	1 (1.2%)	0 (0.0%)	0 (0.0%)	1 (5.3%)	0 (0.0%)	0 (0.0%)	0.721
Diarrhoea	2 (2.3%)	0 (0.0%)	1 (7.7%)	0 (0.0%)	1 (5.9%)	0 (0.0%)	0.294
Hearing loss	1 (1.2%)	0 (0.0%)	1 (7.7%)	0 (0.0%)	1 (5.9%)	0 (0.0%)	0.294
No of days from symptoms to diagnosis							0.938
Median time	*5.0 (2.0–8.0)*	*3.0 (2.0–5.0)*	*6.5 (2.5–9.0)*	*5.0 (2.0–15.0)*	*4.0 (1.0–8.0)*	*5.0 (2.0–10.0)*	*0.803*
< 5 days	28 (32.6%)	5 (38.5%)	3 (23.1%)	6 (31.6%)	7 (41.2%)	7 (29.2%)	
5- < 10	18 (20.9%)	2 (15.4%)	3 (23.1%)	5 (26.3%)	4 (23.5%)	4 (16.7%)	
10- < 20	8 (9.3%)	1 (7.7%)	2 (15.4%)	1 (5.3%)	1 (5.9%)	3 (12.5%)	
≥ 20	4 (4.7%)	0 (0.0%)	0 (0.0%)	3 (15.8%)	0 (0.0%)	1 (4.2%)	
Missing	28 (32.6%)	5 (38.5%)	5 (38.5%)	4 (21.1%)	5 (29.4%)	9 (37.5%)	

*Percentages may not add up due to rounding off

Table 4 Experiences of olfactory dysfunction

Variable	Gender				Age group (Years)					*P* value
	Total (n = 35)	Females (n = 17)	Males (n = 18)	P value	< 30 (n = 3)	30- < 40 (n = 4)	40- < 50 (n = 10)	≥ 55 (n = 4)	≥ 60 (n = 14)	
Complete loss of smell				0.939						0.724
No	29 (82.9%)	14 (82.4%)	15 (83.3%)		2 (66.7%)	3 (75.0%)	9 (90.0%)	12 (85.7%)	3 (23.1%)	
Yes	6 (17.1%)	3 (17.7%)	3 (16.7%)		1 (33.3%)	1 (25.0%)	1 10.0%)	2 (14.3%)	10 (76.9%)	
↓sense of smell				0.863						0.107
No	9 (25.7%)	4 (23.5%)	5 (27.8%)		2 (66.7%)	0 (0.0%)	4 (40.0%)	0 (0.0%)	3 (21.4%)	
Yes	23 (65.7%)	11 (64.7%)	12 (66.7%)		0 (0.0%)	3 (75.0%)	6 (60.0%)	4 (100.0%)	10 (71.4%)	
Data unavailable	3 (8.6%)	2 (11.7%)	1 (5.5%)		1(33.3%)	1 (25.0%)	0 (0.0%)	0 (0.0%)	1 (7.1%)	
↓sense of smell affects daily activities				1.000						0.411
No	29 (82.9%)	14 (82.4%)	15 (83.3%)		1 (33.3%)	3 (75.0%)	9 (90.0%)	4 (100.0%)	12 (85.7%)	
Yes	6 (17.1%)	3 (17.6%)	3 (16.7%)		2 (66.7%)	1 (25.0%)	1 (10.0%)	0 (0.0%)	2 (14.3)	
↓ sense of smell affects taste				0.225						0.738
No	8 (22.9%)	2 (11.8%)	6 (33.3%)		0 (0.0%)	2 (50.0%)	2 (20.0%)	1 (25.0%)	3 (21.4%)	
Yes	26 (74.3%)	15 (88.2%)	11 (61.1%)		3 100.0%)	2 (50.0%)	8 (80.0%)	3 (75.0%)	10 (71.4%)	
Data unavailable	1 (2.9%)	0 (0.0%)	1 (5.6%)		0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	1 (7.1%)	
↓sense of smell bothers me				1.000						0.257
No	17 (48.6%)	9 (52.9%)	8 (44.4%)		0 (0.0%)	2 (50.0%)	5 (50.0%)	1 (25.0%)	9 (64.3%)	
Yes	17 (48.6%)	8 (47.1%)	9 (50.0%)		3 100.0%)	2 (50.0%)	5 (50.0%)	3 (75.0%)	4 (28.6%)	
Data unavailable	1 (2.9%)	0 (0.0%)	1 (5.6%)		0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	1 (7.1%)	
Sense of smell returned				0.485						0.811
Median time to recovery (Days)	*7 (4–14)*	*12 (4–21)*	*5 (2.5–11)*	*0.158*	*7 (2–48)*	*12.5 (3.5–21)*	*6.5 (4–12)*	*4.5 (2–18)*	*11 (4–14)*	
No	1 (2.9%)	0 (0.0%)	1 (5.6%)		0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (11.1%)	1 (7.1%)	
Yes	32 (91.4%)	17 100.0%)	15 (83.3%)		3 100.0%)	3 (75.0%)	10(100.0%)	4 (100.0%)	12 (85.7%)	
Data unavailable	2 (5.7%)	0 (0.0%)	2 (11.1%)		0 (0.0%)	1 (25.0%)	0 (0.0%)	0 (0.0%)	1 (7.1%)	

documented rate and speed of recovery of OD in this study has no obvious explanation. The limitations of the study are mainly our ascertainment bias, cohort size and the reliability on adequate patient recall and reporting.

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Declarations

Conflict of interest The authors hereby declare that they have no conflict of interest.

Ethical Approval All procedures performed in this study involving human participants were conducted in accordance with the ethical standards of the Helsinki guidelines. Ethics approval was granted by the human research and ethics committee, University of the Witwatersrand.

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