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COVID-19 infection related olfactory dysfunction in Saudi Arabia: Community-based study

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ABSTRACT

Background: loss of smell is a common symptom of coronavirus infections. Studies have shown that patients following recovery from COVID-19 develop olfactory dysfunction which can persist for an extended period. The purpose of this study is to assess the long-term olfactory dysfunction and its associated factors in individuals with a history of infection COVID-19 infection, as well as the impact of olfactory dysfunction on quality of life in Saudi Arabia. *Methods:* A questionnaire based cross-sectional study was conducted targeting individuals with a history of COVID-19 infection. *Results:* A total of 174 participants were included in this study. The percentage of anosmia, hyposmia, parosmia, and phantosmia among the participants was 11.5%, 37.4%, 40.8%, and 33.3% respectively. Parosmia was significantly associated with olfactory training (P-value= 0.019). Olfactory training and age group from 46 to 55 years were showed significant association with phantosmia (ghost odors) (P-value= 0.008, 0.012) respectively. 28.7% of participants reported that their smell sense problems caused them to eat less than previously, and 21.8% reported that they ate out less. 13.8% stated that their smell sense issues have a negative impact on their daily social activities, and according to 5.2%, changes in the smell sense isolated them socially. *Conclusion:* Long-term olfactory dysfunction was shown to be common among individuals who had a history of COVID-19 infection. The quality of life of those who are affected by olfactory dysfunction is negatively impacted. Further research is recommended to understand the pathophysiology of anosmia, hyposmia, and phantosmia in COVID-19 patients.

Keywords: Covid-19, Olfactory dysfunction, Saudi Arabia, Anosmia, smell loss

1. INTRODUCTION

COVID-19 is an infectious disease that has been recognized as the cause of outbreaks that originated in Wuhan, China, in 2019 and spread to the world,

identified by WHO as a pandemic on 11th March 2020 (Liu et al., 2020). Studies have shown COVID-19 symptoms including fever, dry cough, and headache as common symptoms. However, in severe cases, viral pneumonia and death can happen (Guan et al., 2020). In addition, the European Rhinology Society reported that some of COVID-19 patients between (20-60%) appear to have loss of smell (European rhinologic society, 2020). Studies have clarified that loss of smell can lead to long-term olfactory dysfunction (OD) that can continue for 1 year following the COVID-19 diagnosis (Renaud et al., 2021).

Anosmia is a predominant sign of COVID-19 infection. Patients complain of a sudden onset of anosmia without any other symptoms. Other symptoms might be presented before the onset of anosmia such as a dry cough. A study by Meng et al., (2020) Showed 54 out of 114 COVID-19 patients have anosmia. The mechanism behind anosmia is nasal respiratory epithelial cells and olfactory epithelial support cells are released high levels of ACE2 proteins, that are used by SARS-Cov2 virus that cause the COVID-19 syndrome (Hopkins et al., 2020). Most studies have found that anosmia has a higher rate in outpatients than hospitalized patients, also more in female, young and asymptomatic patients (Meng et al., 2020; Hopkins et al., 2020; D'Ascanio et al., 2020). Variant methods were followed to eliminate olfactory dysfunction, either pharmacological, which includes nasal/oral corticosteroids and olfactory training (OT).

A study done in European Multicenter investigated the influence of early administration nasal/oral corticosteroids in individuals with olfactory dysfunction (OD) add-on to olfactory training related to coronavirus disease 2019 (COVID-19) (Saussez et al., 2021). One hundred fifty-two outpatient participants in the study with olfactory dysfunction were divided into 3 groups. First group: oral corticosteroids (OC) and Olfactory training (OT), Second group: Nasal corticosteroids and Olfactory training (OT), Third group: Olfactory training alone, all with two months evaluation (Saussez et al., 2021).

Accordingly, Oral corticosteroid treatment shows faster recovery and no data regarding the side effect which can discontinue treatment. A larger number of patients they achieved a reduction in the incidence of parosmia. However, regarding olfactory impairment, there was no difference between oral corticosteroid, nasal corticosteroid, and olfactory training without corticosteroids. Although the Olfactory training efficacy is not proved yet a controlled trial is required to evaluate this further (Saussez et al., 2021). On other hand, few studies are available to explain the outcome of recovery time for olfactory dysfunction with COVI-19 patients. Klopfenstein and Hopkins studies showed anosmia is resolved within 1-21 days on average, and after 28 days, 98% of patients were able to recover and did not suffer any long-term consequences (Gamba, 2020).

The specific processes underlying COVID-19 induced olfactory impairment are unknown (Ueha et al., 2020). Olfactory dysfunction (OD) is an annoying symptom that can persist for a long period of time even after the patient has been recovered from COVID-19 (Izquierdo-Dominguez et al., 2020). Several studies have found that olfactory dysfunction can have a negative effect on the patient's quality of life and can contribute to depression (Izquierdo-Dominguez et al., 2020). Smelling is an important sense as it plays a significant function for daily living via impacting food selection, food enjoyment, socialization, and the detection of hazardous substances and food poisoning as safety hazards (Izquierdo-Dominguez et al., 2020).

A cohort study was done at the University Hospitals of Strasbourg followed patients with proven COVID-19 disease over a year until resolution of olfactory dysfunction occurred. At 8 months objective olfactory assessment was performed on 51 participants, 49 (96.1%) reported full recovery while two participants were still having olfactory dysfunction at one year. The study also showed anosmia has a favorable prognosis with complete resolution after a year of olfactory dysfunction caused by COVID-19 (Renaud et al., 2021). Another cohort study was done on 2581 COVID-19 patients from 18 different European hospitals which showed the prevalence of OD among those patients and its correlation to the disease severity where mild forms revealed a higher association with OD (85.9%) in comparison to moderated to critical forms.

A total of 1916 patients reported OD was only 1363 completed the follow-up subjective assessments. 81.6% reported loss smell loss, whereas the remaining 18.4% reported an only partial loss of smell. Upon objective assessments of 233 patients with reported OD at 60 days and six months, only 11 patients did not show full recovery of OD following this period showing a six-month recovery rate of 95.3% (Lechien et al., 2021). A study done in Kantonsspital Aarau has recruited a total of 103 recovered COVI-19 patients, approached after a period of six weeks. The study found that the olfactory dysfunction severity varies among the participants. A minority of participants with a percent of 6.3% experienced mild forms of OD during their disease course, while moderate forms were 12.7%, majority 81% reported severe forms. The study concluded that olfactory dysfunction is common among COVID- 19 with an early and severe occurrence (Speth et al., 2020).

In Saudi Arabia, a retrospective study on COVID-19 individuals with anosmia and hyposmia was been done. In 1022 patients, 53% of them had olfactory dysfunction (OD), 32.7% being anosmic and 20.3% being hyposmic. Anosmia was also linked to being young and being a female. They found that half of the COVID-19 patients had OD (anosmia/hyposmia), which was frequently linked with ageusia and a variety of neurological symptoms (Mubaraki et al., 2021). However, the aim in this investigation is to focus on olfactory dysfunction in Qassim region, which is almost no information on this topic. Olfactory impairment is prevalent

during the acute illness of COVID-19, and many studies found that olfactory impairment tends to continue longer than other symptoms. Since there are no studies regarding olfactory after being infected with COVID-19 in Qassim region, this study purpose is to assess the olfactory dysfunction among people who have been infected with COVID-19 and to assess its influence on quality of life. This study is expected to provide a basis for further studies. Also, it will help to draw attention towards olfactory dysfunction related to COVID-19 among health institutions allowing for long-term measurements to be made.

2. RESEARCH METHODS

Study Design

A questionnaire-based cross sectional study was conducted.

Study Population & Sampling

The target population was the general population who live in Al-Qassim region, Saudi Arabia. Inclusion criteria included both genders aged between 18-75 years old with a history of COVID-19 infection. Also, any participant with chronic disease was included to look for any significant association. The exclusion criteria included participants with no prior history of COVID-19 infection, being under the age of 18 or above the age of 75 or have a history of nasal surgery. Also, participants with other confounding variables (e.g., olfactory dysfunction secondary to normal aging, nasal and paranasal sinus disease, viral infection, trauma, non-traumatic CNS disorders) were excluded. A representative sample size of 377 was required based on the Richard Geiger equation, with a margin of error of 5%, confidence level of 95%, and population of 20,000. Non-probability convenience sampling techniques were used.

Data collection instrument and procedures

This study used a self-administered questionnaire from a previously published study (Lechien et al., 2020). The questionnaire collected the following: demographic data, medical background of the patients, symptoms of COVID-19 they suffered from and duration, olfactory symptoms and their onset and duration, whether she/he did a visit to otolaryngology clinic or not, whether he/she used medications for olfactory symptoms or not and if yes what are they, whether she/he tried smell training using any technique, and current state of the affected participants. Also, the effect of olfactory impairment on participants' quality of life (QoL) has been assessed using the validated short version of olfactory disorders–negative statements questionnaire (QOD-NS) (Mattos et al. 2019). It consists of seven patient-reported outcome questions related to social, eating, irritation, and anxiety elements. The first page was designated for the informed consent.

The study duration was between January 2021 and January 2022. Data was collected through an online questionnaire sent via social media due to social distance, and it focused on the long-term olfactory dysfunction and targeted recovered people from COVID-19. An electronic google form was used to collect response. The questionnaire was distributed on different social media platforms, such as WhatsApp, Twitter, and Telegram. The present study included all the participants who match the inclusion criteria and agree to participate at the time of data collection and excluded any subjects who fulfilled the exclusion criteria. To ensure that no criterion was left unanswered, Google Forms features such as "required to proceed" were employed. Yes/no questions for present/absent criteria were constructed. The participants that do go through criteria for this study would still continue to go through the questions.

Data management and analysis

Data has been entered and coded through Microsoft Excel then transferred to SPSS. It was analyzed using the Statistical Package for Social Science (SPSS) version 23. For descriptive statistics, continuous variables were presented using means and standard deviations (SD), while categorical variables were presented using numbers and percentages. Chi-square test was used to compare categorical variables. P value of < 0.05 was considered significant.

Ethical Consideration

All data were confidential and were only used for scientific research. The data was kept private, and only the researchers can access the information of participants. Moreover, participation in this research was voluntary, and prior to participation, each participant was provided written consent. The data analysis and publication process did not require any identifiable personal information. This research was approved by The Qassim Research Ethics Committee (QREC) with No (607-43-323).

3. RESULTS

Characteristics of the participants

Three hundred ninety-two respondents filled the questionnaire. After applying the exclusion criteria, the remaining sample size was 174. A total of 174 subjects were included in the final analysis in this study (25.3% male and 74.7% female, male: female ratio of approximately 1:3) was obtained. All participants were from Qassim region, Saudi Arabia, and have been infected with the COVID-19. Most of the participants were young aged between 18-25 years (63.8%). The majority of respondents had laboratory-confirmed COVID-19 (n=145), three patients had a presumptive diagnosis based on clinical symptoms done by a specialist through a clinical examination or a teleconsultation, eight participants were diagnosed by their doctors through face-to-face consultation, over the telephone, or via telemedicine and 10.3% of participants diagnosed their self. Detailed demographics and clinical characteristics of the population are summarized in (Table 1).

About two-thirds of participants had no medical problems. One-third of respondents admitted that they had chronic diseases, the most reported diseases were asthma (6.3%) followed by diabetes, allergy, and controlled hypothyroidism. As shown in (Figure 1). There was no significant association between having chronic disease and OD symptoms (anosmia, hyposmia, parosmia, and phantosmia), OD duration, and otolaryngology visit ($P > 0.05$), while there was a significant association between having comorbidities and smell training ($P= 0.028$); the higher percentage of participants with comorbidities doing smell training compared to people who do not have comorbidities (Table 2).

Table 1 Socio-demographic and clinical characteristics of the participants (n = 174)

Variable	Categories	N	%
Gender	Male	44	25.3
	Female	130	74.7
Age (Years)	18-25	111	63.8
	26-35	35	20.1
	36-45	13	7.5
	46-55	12	6.9
	> 55	3	1.7
How were you diagnosed with COVID?	I took an objective test (PCR, blood test, swab) which came back positive.	145	83.3
	A specialist doctor made the diagnosis based on my symptoms through a clinical examination or a tele-consultation.	3	1.7
	My doctor made the diagnosis based on my symptoms during a face-to-face consultation, over the telephone or via telemedicine	8	4.6
	I diagnosed myself	18	10.3
Having chronic disease	Yes	59	33.9
	No	115	66.1

Table 2: Association between having comorbidities and OD symptoms, duration, smell training and seeking for medical attention

Variables	Category	Comorbidities		P value
		With comorbidities	Without comorbidities	
anosmia/hyposmia (Inability to perceive odors)	Yes	29 (49.2)	56 (48.7)	0.947
	No	23 (39%)	47 (40.9)	
	I don't know	7 (11.9)	12 (10.4)	
Parosmia (Odors not smelling as they should)	Yes	21 (35.6)	50 (43.5)	0.547
	No	29 (49.2)	52 (45.2)	
	I don't know	9 (15.3)	13 (11.3)	
Phantosmia (ghost odors)	Yes	18 (30.5)	40 (34.8)	0.122
	No	31 (52.5)	67 (58.3)	
	I don't know	10 (16.9)	8 (7)	
Duration of smell problem	< 1 month	33 (55.9)	44 (38.3)	0.218
	1 – 6 months	5 (8.5)	10 (8.7)	
	6 – 12 months	2 (3.4)	8 (7)	
	> 12 months	3 (5.1)	9 (7.8)	
	Still present	14 (23.7)	31 (27)	
	Still infected	2 (3.4)	13 (11.3	
Doing smell training	Yes	41 (69.5)	60 (52.2)	0.028
	No	18 (30.5)	55 (47.8)	
Otolaryngology visit	Yes	9 (15.3)	10 (8.7)	0.189
	No	50 (84.7)	105 (91.3)	

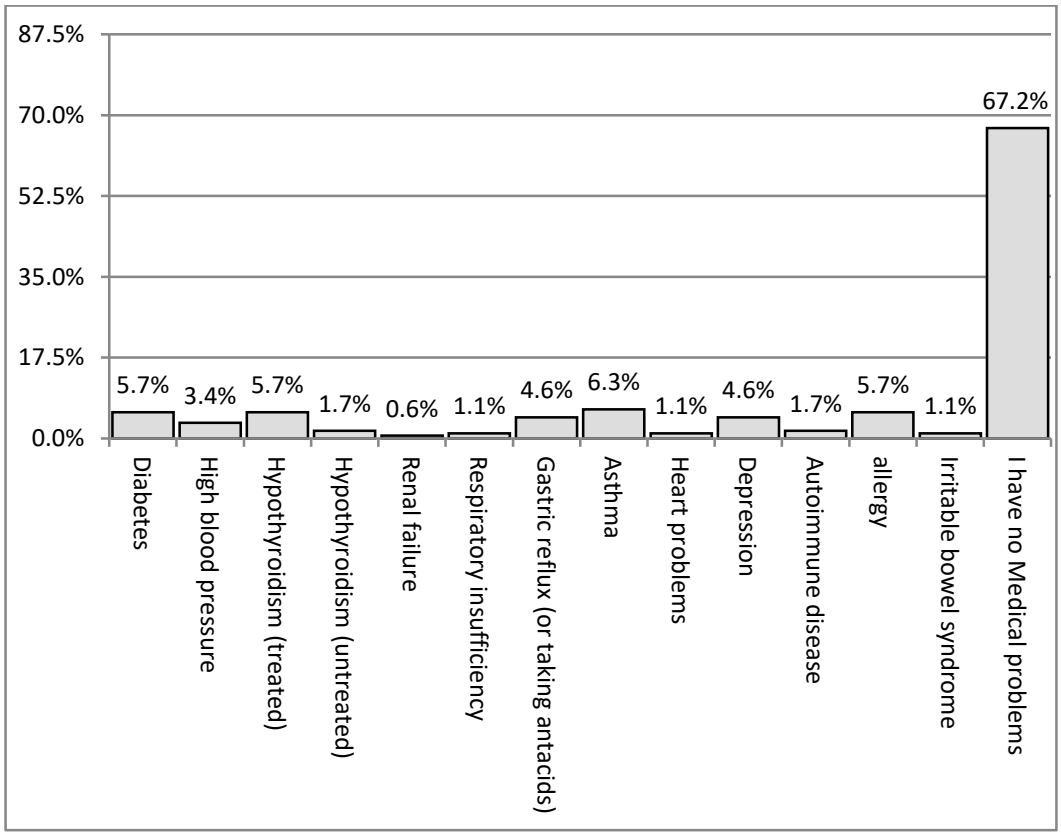

Figure 1 Frequency of chronic disease among the participants (n=174)

Description of COVID-19 infection symptoms

Regarding COVID-19 infection symptoms, the most frequent symptom reported by the participants was headache followed by loss of smell, fever or chills, taste loss and cough. Sticky phlegm and abdominal pain were the least common symptoms reported by the participants (Figure 2). Regarding respondents who were still infected with the virus, the mean duration of symptoms of coronavirus infection was 11.3 ± 29.4 days (range 1 to 365). However, the mean duration of disappearance of general symptoms such as: fever, cough, headache, runny nose, etc. was 158.4 ± 193.9 days (range 1 to 1080).

Prevalence of olfactory dysfunction

Among the 174 participants, the prevalence of total smell loss (anosmia) was 11.5%. Moreover, almost more than one third of participants stated partial loss of smell (hyposmia prevalence = 37.4%). However, the most common smell problem was parosmia, which experienced by 40.8% of participant. Also, we found that 33.3% of respondents had ghost odors (phantosmia). About one third of participant (33.9%) demonstrated that their problems with sense of smell stared after the other symptoms. 33.1% showed that smell problems started at the same time as the other symptoms. However, about one fourth of participants did not know or could not remember when the problems of smell started. 44.3% of participants revealed that their other symptoms were resolved and their problem with sense of smell lasted for less than one month. However, 25.9% reported that they still have problems with their smell sense, but their other symptoms were disappeared. The OD symptoms lasted for mean duration of 64.3 ±110.3 days (range 1 to 545) in participants who still infected with the virus and the others who were still having problems with their smell sense (Table 3).

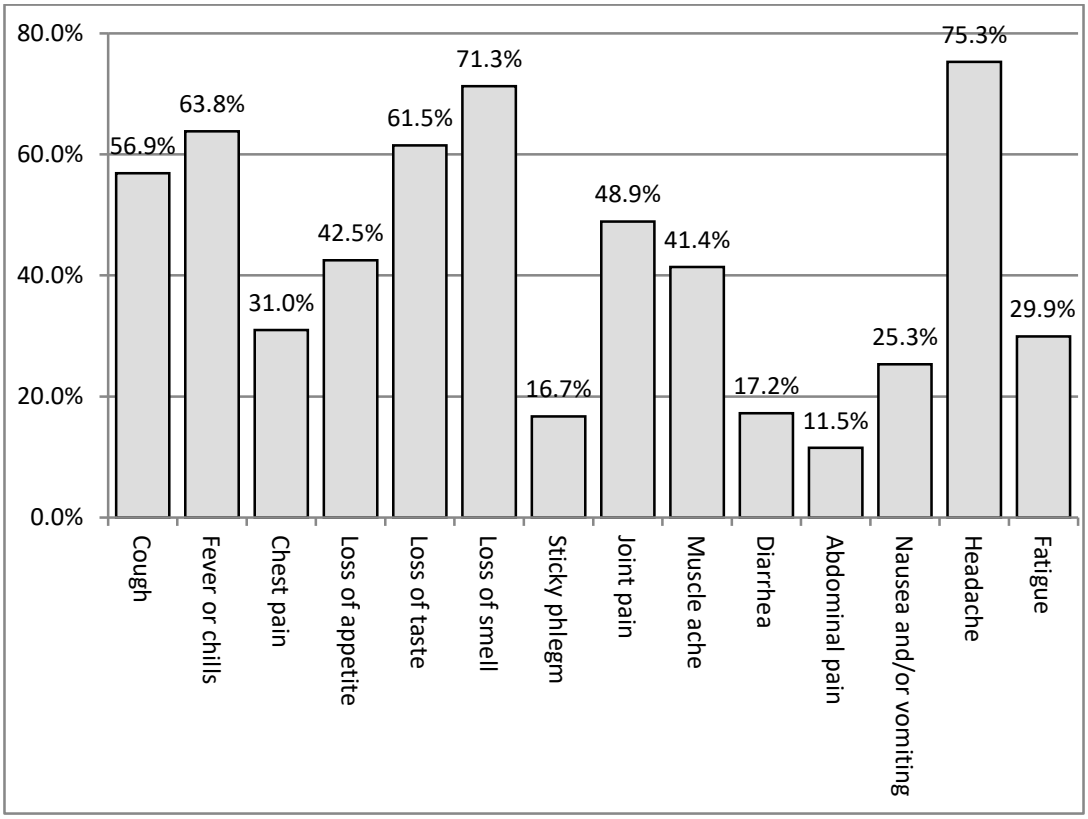

Figure 2 The general symptoms of COVID-19 infection (n=174)

Table 3 Prevalence of olfactory dysfunction among the participants (n=174)

Variable	N (%)
Recently, have you had a problem with your sense of smell, with an inability to perceive odors?	
Yes, partial loss of smell	65 (37.4%)

Yes, total loss of smell	20 (11.5%)
No	70 (40.2%)
I don't know	19 (10.9%)
Recently, have you had a problem with your sense of smell, with odors not smelling as they should?	
Yes	71 (40.8%)
No	81 (46.6%)
I don't know	22 (12.6%)
Recently, have ghost odors appeared (odors that were not actually there, e.g. burning smell, bad smell)?	
Yes	58 (33.3%)
No	98 (56.3%)
I don't know	18 (10.3%)
When did the problems with your sense of smell start?	
Before the other ENT/general symptoms appeared	7 (4%)
At the same time as the other symptoms	55 (31.6%)
After the other symptoms	59 (33.9%)
I don't know / I can't remember	45 (25.9%)
I have no problems with your sense of smell	8 (4.6%)
How many days did the problems with your sense of smell last/ have they lasted?	
I still have problems with my sense of smell, but all my other symptoms are gone	45 (25.9%)
I still have problems with my sense of smell and I'm still ill	15 (8.6%)
All of my symptoms are gone, and the problem with my sense of smell lasted for less than 1 month	77 (44.3%)
All of my symptoms are gone, and the problem with my sense of smell lasted between 1 and 6 months	15 (8.6%)
All of my symptoms are gone, and the problem with my sense of smell lasted between 6 and 12 months	10 (5.7%)
All of my symptoms are gone, and the problem with my sense of smell lasted more than 12 months	12 (6.9%)

The impact of Olfactory Dysfunction in quality of life

Regarding the effect of OD in quality of life of the respondents, 28.7% of participants stated that their problems with sense of smell made them eat less than before and 21.8% of them became eat out less. 17.2% were afraid of that they will never be able to get used to the problems with their smell sense. Moreover, 13.8% demonstrated that the problems with their smell sense have a negative impact on their daily social activities and the percentage declared that the OD symptoms made more irritable. 8% admitted that their problems with sense of smell interfered with their relaxation and made them do more effort to relax. Finally, a small percentage (5.2%) of participants clarified that Changes in their smell sense isolated them socially. However, almost half of participants (46%) did not show any change in their life quality.

Olfactory dysfunction treatment

Only 10.9% of respondents visited Otolaryngology clinic for their problem with sense of smell. Furthermore, about two thirds of participants did not take any medication for their symptoms. Nasal washing with saline solution was the most frequent treatment option (23%). Few percentages of participants used oral and nasal sprays corticosteroids as treatment olfactory dysfunction. More than half of participants used smell training technique to treat their symptoms. About one fourth of respondents demonstrated that their inability to smell fluctuated during the course of symptoms. Regarding the current state of participants, about two thirds of participants thought that they were cured and did not have any symptoms. However, 23% of participants showed that they did not have any general symptoms, but their smell symptoms persisted (Table 4).

Table 4 Olfactory dysfunction treatment and the current status

Variable	N (%)
Have you visit Otolaryngology clinic for your problem?	
Yes	19 (10.9%)
No	155 (89.1%)
Have you taken treatment for the problems with your sense of smell? If so, which?	
Oral corticosteroids (Medrol, Solumedrol, Solupred, Prednisolone, etc.)	8 (4.6%)
Corticosteroid nasal sprays (Mometasone, Nasonex, Dexamethasone, etc.)	13 (7.5%)
Nasal washings with saline solution (Physiomer, Respimer, etc.)	40 (23%)
No	113 (64.9%)
Have you tried smell training using any technique?	
Yes	101 (58%)
No	73 (42%)
Is your inability to smell constant or does it fluctuate (sometimes better or sometimes worse)?	
The loss is constant and remains unchanged	22 (12.6%)
It fluctuates	48 (27.6%)
There is a problem only when my nose is blocked or when it runs	11 (6.3%)
I don't know	49 (28.2%)
This question does not apply to me	44 (25.3%)

Regarding your current state:	
I no longer have any symptoms; I think I am cured	116 (66.7%)
I no longer have any general symptoms, but my taste problem persists	8 (4.6%)
I no longer have any general symptoms, but the problem with my sense of smell persists	40 (23%)
I no longer have any general symptoms, but the problem with my sense of smell and taste problem persists	2 (1.1%)
I am still in the "acute" phase of the disease with many complaints	8 (4.6%)

Factors associated with Anosmia/Hyposmia (Inability to perceive odors)

There was no significant association between anosmia/hyposmia (Inability to perceive odors) and gender, age, having chronic disease, using oral/nasal corticosteroids and olfactory training. But using oral/nasal corticosteroids showed relatively higher association with anosmia/hyposmia (Inability to perceive odors) than the other variables (Table 5).

Table 5 Factors associated with Anosmia/Hyposmia (Inability to perceive odors)

Variable	Categories	anosmia/hyposmia (Inability to perceive odors)			P value
		Yes	No	I don't know	
Gender	Male	17 (38.6)	23 (52.3)	4 (9.1)	0.169
	Female	68 (52.3)	47 (36.2)	15 (11.5)	
Age (Years)	18-25	53 (47.7)	46 (41.4)	12 (10.8)	0.239
	26-35	15 (42.9)	15 (42.9)	5 (14.3)	
	36-45	6 (46.2)	7 (53.8)	0 (0)	
	46-55	10 (83.3)	1 (8.3)	1 (8.3)	
	> 55	1 (33.3)	1 (33.3)	1 (33.3)	
Having chronic disease	Yes	29 (49.2)	23 (39%)	7 (11.9)	0.947
	No	56 (48.7)	47 (40.9)	12 (10.4)	
Use oral/nasal corticosteroids	Yes	15 (71.4)	4 (19)	2 (9.5)	0.074
	No	70 (45.8)	66 (43.1)	17 (11.1)	
Olfactory training	Yes	54 (53.5)	36 (35.6)	11 (10.9)	0.315
	No	31 (42.5)	34 (46.6)	8 (11%)	

Factors associated with Parosmia (Odors not smelling as they should)

Olfactory training was shown to be more frequently associated with parosmia (Odors not smelling as they should) and this difference come to be significant (P value = 0.019). Other variables did not reveal any significant association with parosmia (Odors not smelling as they should) (Table 6).

Table 6 Factors associated with Parosmia (Odors not smelling as they should)

Variable	Categories	Parosmia (Odors not smelling as they should)			P value
		Yes	No	I don't know	
Gender	Male	15 (34.1)	24 (54.5)	5 (11.4)	0.464
	Female	56 (43.1)	57 (43.8)	17 (13.1)	
Age (Years)	18-25	49 (44.1)	50 (45)	12 (10.8)	0.245
	26-35	11 (31.4)	19 (54.3)	5 (14.3)	
	36-45	4 (30.8)	8 (61.5)	1 (7.7)	
	46-55	7 (58.3)	2 (16.7)	3 (25)	
	> 55	0 (0)	2 (66.7)	1 (33.3)	
Having chronic disease	Yes	21 (35.6)	29 (49.2)	9 (15.3)	0.547
	No	50 (43.5)	52 (45.2)	13 (11.3)	
Use oral/nasal corticosteroids	Yes	10 (47.6)	8 (38.1)	3 (14.3)	0.708
	No	61 (39.9)	73 (47.7)	19 (12.4)	
Olfactory training	Yes	49 (48.5)	38 (37.6)	14 (13.9)	0.019
	No	22 (30.1)	43 (58.9)	8 (11)	

Factors associated with Phantosmia (ghost odors)

Higher percentage of phantosmia (ghost odors) was observed among 46 to 55 age group and among participants who were doing olfactory training (P value = 0.012, 0.008 respectively). Other factors did not reveal any significant association with phantosmia (ghost odors). More information is provided in (Table 7).

Table 7 Factors associated with Phantosmia (ghost odors)

Variable	Categories	Phantosmia (ghost odors)			P value
		Yes	No	I don't know	
Gender	Male	11 (25)	26 (59.1)	7 (15.9)	0.215
	Female	47 (36.2)	72 (55.4)	11 (8.5)	
Age (Years)	18-25	42 (37.8)	61 (55)	8 (7.2)	0.012
	26-35	9 (25.7)	21 (60)	5 (14.3)	
	36-45	1 (7.7)	11 (84.6)	1 (7.7)	
	46-55	5 (41.7)	5 (41.7)	2 (16.7)	
	> 55	1 (33.3)	0 (0)	2 (66.7)	
Having chronic	Yes	18 (30.5)	31 (52.5)	10 (16.9)	0.122

disease	No	40 (34.8)	67 (58.3)	8 (7)	
Use oral/nasal corticosteroids	Yes	5 (23.8)	13 (61.9)	3 (14.3)	0.565
	No	53 (34.6)	85 (55.6)	15 (9.8)	
Olfactory training	Yes	42 (41.6)	47 (46.5)	12 (11.9)	0.008
	No	16 (21.9)	51 (69.9)	6 (8.2)	

Factors associated with duration of olfactory dysfunction

There was no significant association between duration of olfactory dysfunction and gender, age, having chronic disease, using oral/nasal corticosteroids and olfactory training (Table 8).

Table 8 Factors associated with duration of olfactory dysfunction

Variable	Categories	No. of days for the problems of smell to be lasted						P value
		< 1 month	1 – 6 months	6 – 12 months	> 12 months	Still present	Still infected	
Gender	Male	20 (45.5)	2 (4.5)	3 (6.8)	4 (9.1)	12 (27.3)	3 (6.8)	0.856
	Female	57 (43.8)	13 (10)	7 (5.4)	8 (6.2)	33 (25.4)	12 (9.2)	
Age (Years)	18-25	52 (46.8)	8 (7.2)	5 (4.5)	7 (6.3)	29 (26.1)	10 (9)	0.605
	26-35	14 (40)	4 (11.4)	4 (11.4)	2 (5.7)	9 (25.7)	2 (5.7)	
	36-45	6 (46.2)	0 (0)	0 (0)	1 (7.7)	4 (30.8)	2 (15.4)	
	46-55	2 (16.7)	3 (25)	1 (8.3)	2 (16.7)	3 (25)	1 (8.3)	
	> 55	3 (100)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	
Having chronic disease	Yes	33 (55.9)	5 (8.5)	2 (3.4)	3 (5.1)	14 (23.7)	2 (3.4)	0.218
	No	44 (38.3)	10 (8.7)	8 (7)	9 (7.8)	31 (27)	13 (11.3)	
Use oral/nasal corticosteroids	Yes	8 (38.1)	2 (9.5)	1 (4.8)	3 (14.3)	3 (14.3)	4 (19)	0.269
	No	69 (45.1)	13 (8.5)	9 (5.9)	9 (5.9)	42 (27.5)	11 (7.2)	
Olfactory training	Yes	45 (44.6)	12 (11.9)	6 (5.9)	7 (6.9)	26 (25.7)	5 (5)	0.240
	No	32 (43.8)	3 (4.1)	4 (5.5)	5 (6.8)	19 (26)	10 (13.7)	

4. DISCUSSION

In this cross-sectional study, the aim is to assess olfactory dysfunction among people with history of COVID-19 in Qassim region, Saudi Arabia from 2021-2022. One of the most prevalent long-term consequences of SARS-CoV-2 infection is OD (olfactory dysfunction) (Nguyen et al., 2022; Boscolo-Rizzo et al., 2021). This is the first study to assess the prevalence of OD among people

recovered from COVID-19 in Qassim region. In the current study, more than two-thirds of participants were females and the majority of them compromised a young age group (18-25) with good health status prior to contracting COVID-19. This is consistent with another study was conducted in Saudi Arabia (Alshami et al., 2020). The most common reported general symptom of COVID-19 was a headache, followed by smell loss, and fever or chills. Unlike another study in China which demonstrated that the most reported symptoms was fever, cough, and myalgia or fatigue, while sputum production and headache were the less prevalent symptoms (Huang et al., 2020). Symptoms of coronavirus infection lasted for 11.3 ± 29.4 days (mean). Only 10.9% of respondents seek medical care for their OD in the Otolaryngology clinic and this is explained by another finding which clarified that only 13.8% of participants demonstrated that their smell problem made a negative impact on daily social activities.

The current study found that the prevalence of anosmia and hyposmia was 11.5% and 37.4% respectively. This finding is lower than results from another study in Taif, Saudi Arabia, which demonstrated the prevalence of anosmia was 32.7%. However, it showed similar results regarding hyposmia, which was experienced by about one-third in both studies (Mubaraki et al., 2021). Another previous study conducted in Saudi Arabia revealed that loss of smell of marked severity was reported by 64% among respiratory symptoms (Alshami et al., 2020). Furthermore, a study was carried out in UK showed relatively the same prevalence of anosmia, 12.8% (Tan et al., 2022). Regarding parosmia, the results of this study revealed the prevalence of 40.8% which is considered the most common reported OD among the participants. This is further supported by another study, which revealed the prevalence of 40.3% (Ugurlu et al., 2021). However, it is higher than the findings of another German study, 23.5% (Ercoli et al., 20221). However, a recent meta-analysis of 8438 COVID-19 patients from 13 countries found a pooled prevalence of 38.2 percent (95% CI 24.0 percent to 53.6%), which is lower than the prevalence found in this study (Agyeman et al., 2020).

Persistent phantosmia has recently been described in several patients as a long-term symptom (Ercoli et al., 20221). The results of the current study showed that phantosmia was found in 33.3% of participants. This finding is higher than several studies (Tan et al., 2022; Ercoli et al., 20221; Schambeck et al., 2021). This high occurrence indicates that qualitative changes (parosmia and phantosmia) are common long-term consequences in COVID-19 patients. The disparities observed between studies may be due in part to inherent biases in the composition of sampled populations.

The results of the current study found that symptoms of OD lasted for 64.3 ± 110.3 days (mean duration). This is consistent with another study in Europe, which determined 60 days as the duration for persistence of OD symptoms (Lechien et al., 2021). However, it was higher than another study in Taif region (Mubaraki et al., 2021). The protracted duration of OD in certain patients may be explained by increased protein expression and more extensive olfactory cell damage. Olfactory cell neurogenesis is possible, but it may take several months (Lazarini and Lledo, 2011). 23% of participants have a problem with their smell sense without having other general symptoms. On the other side, about two-thirds of participants were cured. This proportion is remarkable, mainly because the data of this study refer to a population with mild COVID-19. This is confirmed by an Italian study (Fortunato et al., 2022).

Regarding treatment options, oral and nasal corticosteroids were taken by a limited number of participants 4.6% and 7.5 respectively. However, the most common treatment options were nasal washings with saline solution (23%). This is similar to another research conducted in Europe which stated that 9% of patients using a nasal corticosteroid spray, 8% used oral steroids, and 20% use nasal saline irrigation (Chiesa-Estomba et al., 2020). A higher percentage of parosmia was observed among participants who were doing olfactory training. Moreover, a higher percentage of phantosmia was observed among 46 to 55 age group and among participants who doing olfactory training. A previous study in Taif region found that female gender and young age are significantly associated with anosmia, which is inconsistent with this study (Mubaraki et al., 2021).

The study's limitations include a small proportion of older patients, a larger percentage of female respondents, and recruitment from ear, nose, and throat clinics, which may have initiated a selection bias. The absence of objective testing to establish OD is another limitation. Furthermore, the lack of assessment for concomitant use of steroids for preexisting comorbidities as well as the lack of assessment for Hx of COVID-19 treatment setting as inpatient vs. outpatient.

5. CONCLUSION

In conclusion, Long-term olfactory dysfunction was found to be relatively common in those with a history of COVID-19 infection in Qassim region in Saudi Arabia. Parosmia and phantosmia showed significant association with olfactory training. In addition, the age group (46-55) was significantly associated with phantosmia. The quality of life of individuals who suffer from olfactory impairment is negatively affected. Future research is recommended to assess the long-term OD in patients who recovered from COVID-19 infection, as well as more research to properly examine the frequency of anosmia, hyposmia, phantosmia, and parosmia in COVID-19 patients and characterize their etiology, it could aid in the start-up of a management strategy.

Authors' contributions

We certify, as authors, that we have participated sufficiently in the intellectual content, conception and design of this work or the analysis and interpretation of the data (when applicable), as well as the writing of the manuscript, to take public responsibility for it and have agreed to have our name listed as a contributor. All persons who have made substantial contributions to the work reported in the manuscript.

Research ethics

This research was approved by ethics comiitte in Al-Qassim province (607-43-323).

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Conflicts of interest

The authors declare that there are no conflicts of interests.

Data and materials availability

All data associated with this study are present in the paper.

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