Iranian Smell Diagnostic Test in Covid-19 Disease; Report of Covid-19 Center of North of Iran

Abstract

**Background:** SARS-CoV-2 is a pandemic coronavirus that causes the COVID-19 syndrome. In the pandemic of COVID-19 many patients were affected to new onset olfactory dysfunction. Since there is a dearth of research studies regarding the standard smell test, the present study was conducted to fill this gap.

**Methods:** The present retrospective cohort study was conducted on 250 clients with or without diagnosis of Covid-19 disease who referred to Covid-19 centers of North of Iran. Two groups were matched for age and sex. Data were collected by examination, demographic and clinical information questionnaire and Iranian smell diagnostic test. The binary logistic regression to estimate the odds ratio value in SPSS version 23.0 was used.

**Results:** One-hundred cases (42.2%) had hyposmia and 20 cases (8.4%) were found to have anosmia. Type of covid-19 sign and symptom were statistically significant with olfactory dysfunction (41 cases, 31.8%), fever (28 cases, 21.7%), weakness and dyspnea (15 cases, 11.6%), (p=0.0001). The urban residency equal OR=6.42 (3.04-13.53) to rural residency for olfactory dysfunction (p=0.0001). Covid-19 patients’ OR=61.25 (27.36-137.11) chance to be affected by the olfactory dysfunction in compare to control group (p=0.0001). Also, with increasing age, chance of olfactory dysfunction changed from OR=0.61(1.16-0.13) to OR=1.89 (0.82-4.33). Furthermore, female chance OR=1.21 (0.72-2.03) and employee patients was OR=2.29 (1.30-4.04) to olfactory dysfunction.

**Conclusion:** All the patients were affected by olfactory dysfunction. Furthermore, Covid-19 patients, urban residency, lower age, female and employee were the prognostic factors for olfactory dysfunction. The standard olfactory tests such as IR-SIT is suggested for screening and detecting the clients probably affected by covid-19 especially in younger ages.

**Keywords:** COVID-19; Olfaction Disorders; Coronavirus; Coronavirus Infections.

**Citation:**

Aljaniapur S, Saadat P, Shkri M, et al. Iranian Smell Diagnostic Test in Covid-19 Disease; Report of Covid-19 Center of North of Iran. Caspian J Intern Med 2022; 13(Suppl 3): 204-210.
Also, olfactory epithelial cells express the CoV-2 receptor, angiotensin-converting enzyme 2 (ACE2); yet, the precise cellular subtype that may mediate anosmia in COVID-19 remains unclear (7). In the medical literature, COVID-19-related anosmia is a new terminology. Half of the clients with COVID-19 were affected by anosmia. In more than 80% of cases, it is associated with dysgeusia (8). These clients are exposed to injury because of dysfunction due to smelling dangerous odors such as gas or spoiled food. Furthermore, nutritional and psychiatric status can be altered(9). Academy of Otolaryngology of America suggests that olfactory dysfunction should be used in screening of COVID-19 clients(10).

For this work, standard criteria seem to be useful. Due to limited studies which used standard criteria vs. many studies which use questionnaire and self-report for screening the olfactory dysfunction, the present study was conducted. The purpose of this study is to assess the olfactory dysfunction status in COVID-19 clients with standard Iranian Smell Identification Test (IR-SIT). To the best of our knowledge, this study is the first survey with standard test for screening the OD in the north of Iran.

### Methods

#### Study Population:
This retrospective cohort study was conducted on 250 clients with covid-19 who referred to COVID-19 center (Ayatollah Rouhani Hospital of Babol, Mazandaran, North of Iran, during the years 2020-2021 after approval by Ethics committee of Babol University of Medical Sciences (IR.MUBABOL.HRI.REC.1399.095). The informed written consent was obtained from patients to participate in the study.

The control group included individuals without covid-19 disease in screening test who referred to other departments of Ayatollah Rouhani Hospital of Babol. Two groups matched based on the age and sex. Inclusion criteria included patients aged 15 or upper that consented to participate to current study. After specialist examination, "COVID-19 detection protocol" of National Ministry of Health was used which includes PCR test or CT imaging with positive findings to enroll patients in the present study. The risk factor for OD such as head trauma, nasal or sinus diseases (polyps, rhinitis, rhinosinusitis, rhinoplasty), neoplasm of nasal or brain, smoking, neurodegenerative diseases (Alzheimer, Multiple sclerosis, Epilepsy, etc.), mental disorders (Schizophrenia, Depression, etc.), recent adult cold, migraine, pregnancy and exposure to chemical substances were excluded. Demographic information with clinical parameters such as past surgery history, family history of olfactory dysfunction, time of admission, clinical manifestation, screening place of covid-19 were also recorded. Age and sex were matched in two groups.

#### Assessment of olfactory function:
The case and control groups were assessed by IR-SIT that was adopted by the efforts of Taherkhani et al (15). This well-validated quick IR-SIT determines normosmia, mild hyposmia, severe hyposmia and anosmia (11) by 6 odors (banana, rosewater, cinnamon, garlic, mint, and melon) as sticker with high accuracy in differentiating anosmia, hyposmia and normosmia. The researcher had the clients smell the scratched sticker form 2-cm distance and select from the 4-alternative test sheet. Clients with 5 or 6 correct answers were considered normosmia, 1 to 4 hyposmia, and zero anosmia(12).

#### Statistical Analysis:
We used Pearson correlation coefficient, Chi-square, t-test and Binary logistic regression to estimate the odds ratio (OR) value in SPSS version 23 and p < 0.05 was set as the significant level.

### Results

After inclusion and exclusion criteria, 240 patients were enrolled in the current study. The age and sex were matched in two groups. The mean age in control and COVID-19 groups was 51.13±12.81, 51.95±16.66, respectively. Distribution of gender was 104 (43%) males vs. 136 (56.7%) females. Fifty-two males (50%) were both in control and COVID-19 groups vs. 68 females (50%) were in two groups. Table 1 shows the demographic characteristics of COVID-19 and control groups. One-hundred thirty-six cases (56.7%) were female and the mean age was between 51.54±14.84 years. 205 patients (86.5%) were residents of Babol and 32 cases (13.5%) lived in other cities(p=0.17).

Regarding the admission time 64 cases (58.2%) referred to the hospital in the evening, 24 cases (21.8%) in the morning and finally 22 cases (20%) were admitted at night(p=0.09). The chief symptoms reported (41 cases, 37.3%) were fever and weakness (33 cases, 30%). The mean day period of fever, as the main symptom of the disease, was 10±16.66, weakness, as the second main symptom, was 7.5±5.78 and myalgia was 3.5±2.12.

After OD test, 117 patients (49.4%) were diagnosed as normal, 100 cases (42.2%) had hyposmia and 20 cases (8.4%)
suffered from anosmia. The relationship between the type of covid-19 symptoms and the OD was statistically significant with 41 cases (31.8%) having fever, 28 cases (21.7%) having weakness and 15 cases (11.6%) having dyspnea (p=0.0001). As shown in Table 2, the difference in age, marital status, education, occupation and residential status was statistically significant between the two groups (p<0.05).

As shown in Table 3, after olfactory test, patients were divided into normal and OD (hyposmia and anosmia). In binary regression, logistic results showed that urban residency (OR=6.42, 3.04-13.53) equal to rural residency for olfactory dysfunction (p=0.0001). Covid-19 patients with OR=61.25(27.36-137.11) had a high of chance of being affected by the OD in comparison with the control group (p=0.0001). Also, with increasing age from middle age to elderly the chance of OD changed from OR=0.61(1.16-0.13) to OR=1.89 (0.82-4.33). Furthermore, female chance to get olfactory dysfunction was OR=1.21 (0.72-2.03). Also, difference in job showed that the chance of employee patients was OR=2.29 (1.30-4.04) (p=0.004) to non-salary patients while the chance of freelance work was OR=0.64 (0.28-1.47) in comparison with the non-salary patients (p=0.3).

Table 1. Frequency distribution of demographic characteristics in covid-19 and control groups.

| Variable                | Category          | Normal (%) | Olfactory function | Total | P value |
|-------------------------|-------------------|------------|--------------------|-------|---------|
|                         |                   | Normal (%) | Hyposmia (%)       | Anosmia (%) |       |         |
| Gender                  | male              | 48(46.6)   | 44(42.7)           | 11(10.7) | 103(43) | 0.50    |
|                         | female            | 69(51.5)   | 56(41.8)           | 9(6.7)  | 134(57) |         |
| Age (year)              | 14-40             | 24(45.3)   | 79(57.2)           | 14(30.4) | 53(22.3)| 0.004   |
|                         | 40-64             | 28(52.8)   | 46(33.3)           | 26(56.5) | 138(58.2)|         |
|                         | 65 to upper       | 1(1.9)     | 13(9.4)            | 6(13)   | 14(5.9) |         |
| Marital status          | Married           | 101(47)    | 94(43.7)           | 20(9.3) | 215(90.7)| 0.050   |
|                         | Single            | 9(60)      | 6(40)              | 0(0)    | 15(6.3) |         |
|                         | Divorced          | 7(100)     | 0(0)               | 0(0)    | 7(3)    |         |
| Education               | Under diploma     | 40(37.7)   | 54(50.5)           | 13(12.1) | 107(45) | 0.007   |
|                         | Diploma           | 29(51.8)   | 23(41.1)           | 4(7.1)  | 56(24)  |         |
|                         | Upper diploma     | 48(69.4)   | 23(31.1)           | 3(4.1)  | 74(31)  |         |
| Occupation              | Without salary    | 40(34.2)   | 55(55.6)           | 13(65)  | 108(46) | 0.004   |
|                         | employed          | 23(19.7)   | 11(11.1)           | 0(0)    | 34(14)  |         |
|                         | freelance         | 54(46.12)  | 33(33.3)           | 7(35)   | 94(40)  |         |
| Residential status      | Rural             | 10(18.2)   | 36(65.5)           | 9(16.4) | 55(23)  | 0.0001  |
|                         | Urban             | 107(58.8)  | 64(35.2)           | 11(6)   | 182(77) |         |
| Cardiovascular disease  | no                | 3(4.3)     | 49(70)             | 18(25.7) | 70(90)  | 0.19    |
|                         | yes               | 0(0)       | 8(100)             | 0(0)    | 8(10)   |         |
| Diabetes mellitus       | no                | 2(3)       | 49(73.1)           | 16(23.9) | 67(86)  | 0.59    |
|                         | yes               | 1(9.1)     | 8(72.7)            | 2(18.2) | 11(14)  |         |
| Diagnose of Covid-19    | clinic            | 1(4.3)     | 16(69.6)           | 6(26.1) | 23(20)  | 0.36    |
|                         | hospital          | 10(11.1)   | 66(73.3)           | 14(15.6) | 90(80)  |         |
| Group                   | control           | 105(87.5)  | 15(12.5)           | 0(0)    | 120(50.6)|         |
|                         | Test              | 12(10.3)   | 85(72.6)           | 20(17.1) | 117(49.4)| 0.0001  |
Table 2. Evaluation of rapid Iranian olfactory Test in covid-19 disease and control group

| Variable       | Category | Sense of Smell      | Covid-19 (%) | Control (%) | Total (%) | p-value |
|----------------|----------|---------------------|--------------|-------------|-----------|---------|
| Age (year)     | 14-40    | Olfactory dysfunction | 27(93.1)     | 2(6.9)      | 29(54.7)  | 0.0001  |
|                |          | Normosmia           | 6(25)        | 18(75)      | 24(45.3)  |         |
|                | 40-65    | Olfactory dysfunction | 5(6.3)       | 8(13.6)     | 79(57.2)  |         |
|                |          | Normosmia           | 5(6.3)       | 74(93.7)    | 79(57.2)  |         |
|                | 65 to upper | Olfactory dysfunction | 27(84.4)    | 5(15.6)     | 32(69.6)  |         |
|                |          | Normosmia           | 1(7.1)       | 13(92.9)    | 14(30.4)  |         |
| Marital status | Married  | Olfactory dysfunction | 100(87.7)   | 14(12.3)    | 114(53)   | 0.0001  |
|                |          | Normosmia           | 12(11.9)     | 89(88.1)    | 101(47)   |         |
|                | Bachelor | Olfactory dysfunction | 5(83.3)      | 1(16.7)     | 6(40)     |         |
|                |          | Normosmia           | 0(0)         | 9(100)      | 9(60)     |         |
|                | Divorced | Olfactory dysfunction | 0(0)         | 0(0)        | 0(0)      |         |
|                |          | Normosmia           | 7(100)       | 0(0)        | 7(100)    |         |
| Education      | Non-diploma | Olfactory dysfunction | 57(85.1)    | 10(14.9)    | 67(62.6)  | 0.0001  |
|                |          | Normosmia           | 6(15)        | 34(85)      | 40(37.4)  |         |
|                | Diploma  | Olfactory dysfunction | 27(100)      | 0(0)        | 27(100)   |         |
|                |          | Normosmia           | 3(10.3)      | 26(89.7)    | 29(51.8)  |         |
|                | Upper diploma | Olfactory dysfunction | 21(80.8)   | 5(19.2)     | 26(35.1)  |         |
|                |          | Normosmia           | 3(6.3)       | 45(93.8)    | 48(64.9)  |         |
| Occupation     | Without salary | Olfactory dysfunction | 63(92.6)   | 5(7.4)      | 68(63)    | 0.0001  |
|                |          | Normosmia           | 6(15)        | 34(85)      | 40(37)    |         |
|                | Employed   | Olfactory dysfunction | 8(72.7)     | 3(27.3)     | 11(32.4)  |         |
|                |          | Normosmia           | 1(4.3)       | 22(95.7)    | 23(67.6)  |         |
|                | Freelance   | Olfactory dysfunction | 33(82.5)   | 7(17.5)     | 40(42.6)  |         |
|                |          | Normosmia           | 5(9.3)       | 49(90.7)    | 54(57.4)  |         |
| Residential status | urban | Olfactory dysfunction | 61(81.3)    | 14(18.7)    | 75(41.2)  | 0.003   |
|                |          | Normosmia           | 6(5.6)       | 101(94.4)   | 107(58.8) |         |
|                | rural     | Olfactory dysfunction | 44(97.8)    | 1(2.2)      | 45(81.8)  |         |
|                |          | Normosmia           | 6(60)        | 4(40)       | 10(18.2)  |         |

Table 3. Binary Regression Logistic In Covid-19 and Control Groups.

| Variable       | OR  | 95 CI for OR | P       | OR  | 95 CI for OR | P       |
|----------------|-----|--------------|---------|-----|--------------|---------|
| Test group     | 61.25 | 27.36-137.11 | 0.0001  | 71.26 | 24.99-203.14 | 0.0001  |
| Residential status | 6.42 | 3.04-13.53  | 0.0001  | 1.33  | 0.36-3.52  | 0.83    |
| Gender         | 1.21 | 0.72-2.03   | 0.45    | 1.77  | 0.63-4.99  | 0.27    |
| non-salary     | -    | -            | 0.001   | -    | -            | 0.68    |
| employee       | 2.29 | 1.30-4.04   | 0.004   | 1.61  | 0.54-4.76  | 0.38    |
| freelance      | 0.64 | 0.28-1.47   | 0.3     | 1.23  | 0.34-4.43  | 0.74    |
| adult          | -    | -            | 0.007   | -    | -            | 0.07    |
| Middle age     | 0.61 | 0.32-1.16   | 0.13    | 1.42  | 0.48-4.16  | 0.51    |
| old            | 1.89 | 0.82-4.33   | 0.13    | 4.44  | 1.12-17.55 | 0.03    |
Discussion

Covid-19 as a pandemic disease has rapidly spread all over the world. OD is one of the complications of covid-19 that has been considered by researchers, recently. The result of the present study revealed that 50.6% of patients were affected by olfactory dysfunction, 100 cases (42.2%) had hyposmia, and 20 cases (8.4%) suffered from anosmia. In Saniasiaya et al.’s meta-analysis, OD was observed in 54.40% of European and 31.39% of Asian COVID-19 patients(13). In Klopfenstein et al.’s study, 54 COVID-19 patients (47%) had anosmia. Also, 67% of the hospitalized cases were female and 37% were male(8). Kaye et al. found anosmia in 73% of the subjects prior to COVID-19 diagnosis and it was the initial symptom in 26.6%(14) of the cases. In Lechien et al.’s study, 86% of mild-to-moderate COVID-19 disease patients had anosmia and in 11.8% cases it started before other symptoms (6). Bayesian et al., reported that in 70.2% of clients, anosmia was a key symptom in COVID-19 (6).

In Tabari et al.’s study where IR-SIT was used to detect the OD in Iran, it was found that 60% of the patients with COVID-19 had hyposmia(12). On the other hand, Mao et al.’s study reported that 5% of the patients had hyposmia (15). The results of various studies are different and the gap between them can be attributed to some factors. First, some clients cannot diagnose hyposmia, especially older individuals. so, self-reported study of anosmia or hyposmia may be unreliable in detection(16). Second, studies showed that the methodology used to investigate the olfactory function had a deep impact on smell performance prevalence rate identification: the pooled prevalence estimate of smell loss was 77% when assessed through objective measurements and 45% with subjective measurements, suggesting that subjective measures may underestimate the true prevalence of smell loss(17). Third, anosmia is more detectable compared to hyposmia (12). Therefore, many confirmed clients may not report hyposmia. With this regards, performing a standard OD test vs. self-report for covid-19 is desirable.

The relationship between type of covid-19 symptoms and OD was statistically significant with41 cases (31.8%) having fever, 28 cases (21.7%) having having weakness and 15 cases (11.6%) dyspnea. In Borah et al.’s study, the most common symptoms were fever (93%) and cough (85%). The malaise, generalized body ache and abdominal symptoms like diarrhea were the least common symptoms. The most common ear, nose, and throat (ENT) manifestations were sore throat (80%) and headache (76%). Also, hyposmia was seen in 44% of patients (18). In Ermis et al.’s study, hyposmia (26 %), pain and general muscle weakness (32%), and headache 21% were observed(19). Also, in Ermis et al.’s study, they were only able to neurologically characterize 38.4% of the patients. In Tabari et al.’s study, 28 cases (41%) had a normal sense of smell and 40 cases (59%) were found to have hyposmia by IR-SIT. The most common symptoms were cough 45(66%), dyspnea 40(58%), fever 37 (54%), myalgia 33(48%) and sore throat 17(25%). Fifty-eight percent of inpatients with COVID-19 were measured for OD and had hyposmia according IR-SIT test; 10 cases (25.0%) had severe smell dysfunction and 30 patients (75.0%) had mild to moderate OD, while there were no pure anosmic subjects. Generally, 60.7% of the patients who did not report hyposmia, by IR-SIT test were detected as having some degrees of OD. Inpatients with hyposmia under-reported their loss of sense of smell by 70%(12) with objective olfactory testing(12).

In binary regression logistic result showed that urban residency equal OR=6.42 to rural residency for olfactory dysfunction. Covid-19 cases with an OR=61.25 had a higher chance to be affected by the OD compared to the control group. In D’Ascanio et al.’s study, COVID-19 patients showed an increased risk of olfactory dysfunction in comparison with the control groups (OR, 77.2; P =0.003)(20). Also, with increasing age from middle age to elderly, the chance of OD changed from OR=0.61to OR=1.89. In Talavera et al.’s study, age is another significant confounder, given the fact that older age is associated with lower OD rates and poor outcomes(21).

Siso-Almirall et al. concluded that multivariate analyses were conducted after adjusting for age and it was found that OD was a predictor of better outcomes (22). Tabari et al. reported that the mean age in normal sense patients was 43.32±14.74 vs. 44.43±17.20 in hyposmic patients which was not significant(12). In Carigman et al.’s study, the OR for the association of anosmia with SARS-CoV-2 positivity was 20.0(23). It seems that OD could be attributed to aging or covid-19, physiologic changes and the probability of worsening condition. On other hand, detection of OD in these patients is difficult. More surveys are recommended to elucidate whether the association between COVID-19 and OD outcomes is age dependent.

Furthermore, female chance to get olfactory dysfunction was OR=1.21. In Andrews et al.’s study, the prognosis of OD among patients was negatively influenced by female sex (P =
0.02)(24). On the other hand, Carignan et al.’s study, showed that the difference between male and female was not significant(23). In D’Ascanio et al.’s study, women had no significant risk of smell loss compared to men (OR, 1.22; P = 0.8) (20). However, in Andrews et al.’s study, there was a male to female ratio of 1:3 which can affect this relation. On other hand, the total sample volum in D’Ascanio et al.’s study was 26 patients which is very low compared to other studies. In the present study, 134 subjects (57%) were female and the gender variable was matched between two groups. Also, difference in job showed that the chance of employee patients was OR=2.29 to non-salary patients and freelance work was OR=0.64 compared to non-salary patients. Andrews et al. study indicated that occupational role such as nurse or health care agent negatively influenced OD (P = 0.002)(24). It can be related to services provided by government staffs in covid-19 pandemic. Furthermore, some jobs were not closed in this period.

The main limitation of the present study was the small number of patients who cannot follow-up for during the current COVID 19 pandemic situation. On other hand, to our knowledge, the present study is the first standard smell test for COVID-19 patients in the north of Iran which is more sensitive instead of relying on self-reports or subjective questionnaires.

**Conclusion:** The result of the study revealed that half of the patients were affected by olfactory dysfunction. Furthermore, Covid-19 patients, urban residency, lower age, being female and an employee were the prognostic factors for olfactory dysfunction. The standard olfactory test such as IR-SIT is suggested especially in younger age to screen and detect the clients probably affected by covid-19.

**Acknowledgments**

We appreciate the patients and their families’ cooperation for participating in the present study.

**Authors’ contributions:** Dr Payam Saadat and Dr Shokri designed the study and participated in the diagnosis of covid-19, approved the final version, prepared the manuscript and were in charge of writing the manuscript. Sepanta Saadat and Azam Khodami participated in olfactory examination and sample gathering. Shayan Alijanpour participated in data analysis, writing of manuscript and approved the final version.

**Funding:** This survey was funded by Babol University of Medical Science (proposal, number: 9910019).

**Conflict of interests:** No conflict of interest.

**References**

1. Wu Z, McGoogan MJ. Characteristics of and important lessons from the coronavirus disease 2019 (COVID-19) outbreak in China: summary of a report of 72 314 cases from the Chinese center for disease control and prevention. JAMA 2020; 323: 1239-42.
2. WHO Coronavirus (COVID-19): World Health Organization; 2021. Available at: https://covid19.who.int/
3. JICA. Iran Ministry of Health and Medical Education and JICA hold Joint Webinars on Hospital Management and NCD Treatment under COVID-19 Pandemic. JICA 2020. Available at: https://www.jica.go.jp/iran/english/office/topics/201203.html
4. Mao L, Wang M, Chen S, et al. Neurological manifestations of hospitalized patients with COVID-19 in Wuhan, China: a retrospective case series study. MedRxiv 2020. Available at: https://www.medrxiv.org/content/10.1101/2020.02.22.20026500v1L
5. Baig AM, Khaleeq A, Ali U, Syeda H. Evidence of the COVID-19 virus targeting the CNS: tissue distribution, host–virus interaction, and proposed neurotropic mechanisms. J ACS Chem Neurosci 2020; 11: 995-8.
6. Lechien JR, Chiesa-Estomba CM, De Siati DR, et al. Olfactory and gustatory dysfunctions as a clinical presentation of mild-to-moderate forms of the coronavirus disease (COVID-19): a multicenter European study. J Eur Arch Otorhinolaryngol 2020; 277: 2251-61.
7. Brann DH, Tsukahara T, Weinreb C, et al. Non-neuronal expression of SARS-CoV-2 entry genes in the olfactory system suggests mechanisms underlying COVID-19-associated anosmia. J Sci Adv 2020;6:eabc5801.
8. Klopfenstein T, Kadiane-Oussou N, Toko L, et al. Features of anosmia in COVID-19. Med Mal Infect 2020; 50: 436-9.
9. Yuan T-F, Slotnick BM. Roles of olfactory system dysfunction in depression. Prog Neuropsychopharmacol Biol Psychiatry 2014; 54: 26-30.
10. Meng X, Deng Y, Dai Z, Meng Z. COVID-19 and anosmia: A review based on up-to-date knowledge. Am J Otolaryngol 2020; 41: 102581. Available at: https://pubmed.ncbi.nlm.nih.gov/32563019/
11. Kamrava SK, Jalessi M, Ghalehbaghi S, et al. Validity and reliability of Persian smell identification test. J Iran J Otorhinolaryngol 2020; 32: 65-71.
12. Tabari A, Golpayegani G, Tabari A, et al. Olfactory dysfunction is associated with more severe clinical course in COVID-19. Indian J Otolaryngol Head Neck Surg 2021 Mar 12:1-6. [Online ahead of print]
13. Saniasiaya J, Islam MA, Abdullah B. Prevalence of olfactory dysfunction in coronavirus disease 2019 (COVID-19): a meta-analysis of 27,492 patients. Laryngoscope 2021; 131: 865-78.
14. Kaye R, Chang CWD, Kazahaya K, Brereton J, Denneny JC 3rd. COVID-19 anosmia reporting tool: initial findings. J Otolaryngology–Head Neck Surg 2020; 163: 132-4.
15. Taherkhani S, Moztarzadeh F, Mehdizadeh Seraj J, Hashemi Nazari SS, Taherkhani F, Gharehdaghi J, Okazi A, Pouraghaei S. Iran smell identification test (Iran-SIT): A modified version of the university of pennsylvania smell identification test (UPSIT) for Iranian population. Chemosensory perception. 2015; 8(4):183-91.
16. Mazzoli M, Molinari MA, Tondelli M, et al. Olfactory function and viral recovery in COVID-19. J Brain Behavior 2021; 11:e02006.
17. Hannum ME, Ramirez VA, Lipson SJ, et al. Objective sensory testing methods reveal a higher prevalence of olfactory loss in COVID-19–positive patients compared to subjective methods: A systematic review and meta-analysis. J Chem Senses 2020; 45: 865-74.
18. Borah H, Das S, Goswami A. Otorhinolaryngological Manifestations and its management in COVID 19 patients. Indian J Otolaryngol Head Neck Surg. 2021 Feb 17:1-4. doi: 10.1007/s12070-021-02436-9.
19. Ermis U, Rust MI, Bungenberg J, et al. Neurological symptoms in COVID-19: a cross-sectional monocentric study of hospitalized patients. J Neurol Res Prac 2021; 3: 17.
20. D’Ascanio L, Pandolfini M, Cingolani C, et al. Olfactory dysfunction in COVID-19 patients: Prevalence and prognosis for recovering sense of smell. Otolaryngol Head Neck Surg 2021; 164: 82-6.
21. Talavera B, García-Azorín D, Martínez-Pías E, et al. Anosmia is associated with lower in-hospital mortality in COVID-19. J Neurol Sci 2020; 419:117163.
22. Sisó-Almirall A, Kostov B, Mas-Heredia M, et al. Prognostic factors in Spanish COVID-19 patients: A case series from Barcelona. PLoS One 2020; 15:e0237960.
23. Carignan A, Valiquette L, Grenier C, et al. Anosmia and dysgeusia associated with SARS-CoV-2 infection: an age-matched case–control study. CMAJ 2020; 192: E702-E7.
24. Andrews PJ, Pendolino AL, Ottaviano G, et al. Olfactory and taste dysfunction among mild-to-moderate symptomatic COVID-19 positive health care workers: An international survey. Laryngoscope Investig Otolaryngol 2020; 5: 1019-28.