Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

Elsevier hereby grants permission to make all its COVID-19-related research that is available on the COVID-19 resource centre - including this research content - immediately available in PubMed Central and other publicly funded repositories, such as the WHO COVID database with rights for unrestricted research re-use and analyses in any form or by any means with acknowledgement of the original source. These permissions are granted for free by Elsevier for as long as the COVID-19 resource centre remains active.
Temporal patterns of nasal symptoms in patients with mild severity SARS-CoV-2 infection

Richard A. Raad\textsuperscript{a}, Ashwin Ganti\textsuperscript{b}, Khodayar Goshtasbi\textsuperscript{c}, Brandon M. Lehrich\textsuperscript{c}, Peter Papagiannopoulos\textsuperscript{a}, Phillip LoSavio\textsuperscript{a}, Mahboobeh Mahdavinia\textsuperscript{d}, Edward C. Kuan\textsuperscript{c}, Pete S. Batra\textsuperscript{a}, Bobby A. Tajudeen\textsuperscript{a,*}

\textsuperscript{a} Department of Otorhinolaryngology – Head & Neck Surgery, Rush University Medical Center, Chicago, IL, United States of America
\textsuperscript{b} Department of Otolaryngology – Head and Neck Surgery, University of Minnesota, Minneapolis, MN, United States of America
\textsuperscript{c} Department of Otolaryngology – Head and Neck Surgery, University of California, Irvine, Orange, CA, United States of America
\textsuperscript{d} Division of Allergy/Immunology, Department of Internal Medicine, Rush University Medical Center, Chicago, IL, United States of America

ARTICLE INFO

Keywords:
COVID-19
SNOT-22
Anosmia

ABSTRACT

Background: No study to date has analyzed the progression of sinonasal symptoms over time in COVID-19 patients. The purpose of this study is to analyze the progression of sinonasal symptoms and risk factors for olfactory dysfunction in the mild severity COVID-19 patient.

Methods: An internet survey was used to assess sinonasal symptoms in patients with COVID-19. Changes in rhinologic domain and symptom-specific Sinonasal Outcome Test (SNOT-22) scores were compared at five time points: two weeks before diagnosis, at diagnosis, two weeks after diagnosis, four weeks after diagnosis, and six months after diagnosis.

Results: 521 responses were collected. Rhinologic domain SNOT-22 scores increased significantly ($p < 0.001$) to 8.94 at the time of diagnosis, remained elevated two weeks post-diagnosis (5.14, $p = 0.004$), and decreased significantly four weeks post-diagnosis (3.14, $p = 0.004$). Smell-specific SNOT-22 scores peaked at the time of diagnosis (2.05, $p < 0.001$), remained elevated two weeks after diagnosis (1.19, $p < 0.001$), and returned to baseline four weeks after diagnosis (0.64, $p > 0.999$). Taste-specific SNOT-22 scores also peaked at diagnosis (2.06, $p < 0.001$), remained elevated two weeks after diagnosis (1.19, $p < 0.001$), and returned to baseline four weeks after diagnosis (0.71, $p > 0.999$). There were no significant differences in sense of smell or taste between 1-month and 6-month timepoints.

Conclusion: Sinonasal symptoms, particularly loss of smell and taste, may be important presenting symptoms in the mild severity COVID-19 patient. Our findings support incorporating these symptoms into screening protocols.

Level of evidence: 4

1. Introduction

Coronavirus disease-19 (COVID-19), caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), was declared a pandemic by the World Health Organization (WHO) on March 11, 2020 and continues to strain the healthcare system throughout the world [1,2]. Although SARS-CoV-2 shares significant genetic similarities with SARS-CoV-1 and the Middle East Respiratory Syndrome coronavirus (MERS), it has proven to spread more rapidly with a higher basic reproduction number despite a lower fatality rate [3]. Early studies in China, where it was first reported, described largely non-specific symptoms such as fever, cough, dyspnea, and fatigue, and more recent data have suggested that over 80% of patients have only mild symptoms [4–7].

Additionally, there is growing evidence in favor of an association between SARS-CoV-2 infection and loss of smell or taste, particularly among those with mild-to-moderate disease [8–11]. This phenomenon of post-viral olfactory dysfunction is not new to otolaryngology, and numerous viruses, including non-SARS-CoV-2 strains of coronavirus, have been implicated [12]. In March 2020, The American Academy of Otolaryngology – Head and Neck Surgery (AAO-HNS) recommended

* Corresponding author at: Department of Otorhinolaryngology – Head and Neck Surgery, Rush University Medical Center, 1611 W. Harrison St., Suite 550, Chicago, IL 60612, United States of America.
E-mail address: Bobby_Tajudeen@rush.edu (B.A. Tajudeen).

https://doi.org/10.1016/j.amjoto.2021.103076
Received 7 January 2021;
Available online 24 April 2021
0196-0709/© 2021 Elsevier Inc. All rights reserved.
that the presence of smell or taste dysfunction, in those without underly-
ing sinonasal or respiratory disease, should alert physicians to the pos-
sibility of COVID-19 [13]. Furthermore, the academy’s “COVID-19
Anosmia Reporting Tool” was designed for clinicians and patients to
gather data about such experiences, in an effort to learn more about this
reported association [14]. Since that time, evidence in favor of this as-
sociation has grown significantly, with a recent meta-analysis reporting a
47% prevalence of smell or taste loss among those with COVID-19
[15]. As a result, the Centers for Disease Control and Prevention (CDC)
and World Health Organization (WHO) have endorsed new-onset smell or taste loss as symptoms of SARS-CoV-2 infection [16,17].

Although a strong association has been demonstrated between
COVID-19 and chemosensory dysfunction, few studies have described the
temporal progression of these symptoms [18,19]. To our knowledge,
only early reports over short follow-up periods have been published
[15,20–22]. Currently-available data suggests smell or taste loss is
present early in the disease course and that majority of those who
experience these symptoms recover function within one to two weeks
[15]. However, these studies report that at least 10% of those with smell or taste loss will have persistent symptoms beyond one month.
Furthermore, little is known about the progression of these and other
sinonasal symptoms beyond one month. Therefore, the purpose of this
study is to characterize the long-term temporal progression of sinonasal
symptoms, including smell and taste loss, among a diverse, urban SARS-
CoV-2 population over six months. This information may aid in coun-
seling infected persons on the expected recovery from sinonasal symp-
toms in COVID-19 and provide information in order to assess the feas-
ibility of potential therapeutic approaches.

2. Materials and methods

2.1. Study design and subjects

This study is a prospective, internet-based survey analysis of patients
with SARS-CoV-2 infection conducted at an urban, tertiary-care acade-
mic medical center within the Chicago region. The clinical research
analytics team identified subjects based on the following inclusion
criteria: adult patients (18 years and older) with an encounter between
January 1, 2020 and April 15, 2020 with laboratory-confirmed SARS-
CoV-2 infection. Contact information for these patients including email
address and phone number, was provided to the study team. Only living
adult patients diagnosed with COVID-19 and discharged to quarantine at
home at the time of their evaluation were included, thus defining a “mild
severity” cohort of COVID-19 patients. The study received approval
from the Rush University Medical Center Institutional Review Board.

2.2. Survey distribution, data collection, and reporting of results

A two-part, internet-based survey was designed using SurveyMonkey
and distributed electronically via email to all subjects with a valid email
address on file. Survey responses were collected at two separate time
points. The initial survey was sent in April and the follow-up survey was
sent in September. These were “closed” surveys with each subject
receiving a unique email survey invite. Subjects were not allowed to
access the survey more than once, preventing multiple responses from a
single subject. Survey responses were automatically collected anony-
mously and stored securely in SurveyMonkey’s online database. Partial
responses were accepted and included in the results. Survey results were
reported according to the Journal of Medical Internet Research’s
Checklist for Reporting Results of Internet E-Surveys (CHERRIES) [23].
Survey completion rate was calculated as the number of surveys completed out of the total number started.

2.3. The sinonasal survey of COVID-19 patients

The initial survey consisted of eight questions to identify: patient
demographics; relevant past medical problems, including history of
smell or taste dysfunction, seasonal allergies, sinus disease, sinus sur-
gery, asthma, and smoking; and the progression of sinonasal symptoms in
relation to a patient’s diagnosis of COVID-19. Importantly, the tem-
poral progression of sinonasal symptoms was assessed using the rhino-
logic domain from a validated symptom-reporting tool widely used
among otolaryngologists, the 22-item Sinonasal Outcome Test (SNOT-
22) [24]. The rhinologic domain includes symptoms of decreased smell,
decreased sense of taste, need to blow nose, sneezing, runny nose, and
blockage or congestion of the nose. Initial survey participants were
asked to rate the severity of each symptom on a Likert scale of 0–5 (0 –
No problem, 5 – problem as bad as it can be) at four time points: two
weeks prior to diagnosis of COVID-19, at the time of diagnosis by
confirmation testing, two weeks after diagnosis, and four weeks after
diagnosis. Rhinologic-domain SNOT-22 scores were calculated by add-
ing subjects’ ratings of the six symptoms, with a minimum score of zero
and a maximum of 30. A higher score indicates greater severity of
sinonasal symptoms. A copy of this survey is attached as a supplemental
material titled “Sinonasal Survey of COVID-19 Patients”. Temporal
progression of sinonasal symptoms was assessed based on responses to
two additional follow-up surveys approximately six months later. In con-
trast to the initial survey, follow-up respondents were asked to rate the cur-
rent severity of their rhinologic symptoms.

2.4. Data analysis

To characterize the temporal progression of symptoms, a one-way
ANOVA with repeated measures was utilized to compare the rhino-
logic domain of the SNOT-22 score as well as responses to individual
questions in the rhinologic domain across time points [25]. Post-hoc
analysis with the Bonferroni correction was subsequently performed to
assess pairwise comparisons between time points. Associations between
rhinologic domain variables were assessed with bivariate Pearson’s
correlation. To compare mean sinonasal symptom scores between pa-
tients stratified by past medical history, an independent samples two-
tailed Student’s t-test was utilized. Statistical significance was estab-
lished as p < 0.05. All statistical analysis was performed using Statistical
Package for the Social Sciences (SPSS Statistics Version 26, IBM Cor-
poration, Armonk, NY).

3. Results

A total of 2042 subjects met inclusion criteria, and 1346 subjects had
sufficient contact information to participate in the initial survey. Over
seven days, 521 (38.7% response rate) internet-based responses or were
collected from the initial survey. The average age of participants was
43.5 ± 13.9 years and 65.1% of participants were female (Table 1).
A history of seasonal allergies or allergic rhinitis was endorsed by 207
participants (39.7%), and 171 participants (32.8%) endorsed a history
of prior smell taste loss. In addition, 81 subjects (15.9%) reported some
abnormality in smell, taste, or both prior to their diagnosis of COVID-19.
Analysis of the temporal progression of sinonasal symptom scores
is depicted in Table 2. The mean rhinologic domain SNOT-22 score
reached a maximum of 8.94 at the time of COVID-19 diagnosis, repre-
senting a statistically significant increase from the baseline value two
weeks before diagnosis (p < 0.001) (Fig. 1). The mean rhinologic
domain SNOT-22 score remained above baseline beyond two weeks
post-diagnosis (5.14, p = 0.004) but subsequently decreased below
baseline values four weeks after diagnosis (3.14, p = 0.004).

Analysis of patient reported loss of smell scores demonstrated a
significant increase at the time of diagnosis (2.05, p < 0.001); this
elevation persisted two weeks after diagnosis (1.19, p < 0.001), but

American Journal of Otolaryngology–Head and Neck Medicine and Surgery 42 (2021) 103076
Patient-reported taste dysfunction follows a similar course, peaking at diagnosis (2.06, < 0.001), remains elevated two weeks after diagnosis (1.96 vs. 2.85, p < 0.001), and loss of taste (1.96 vs. 2.85, p < 0.001) compared to patients without prior smell dysfunction. Patients with asthma also had significantly higher rhinologic SNOT scores (8.99 vs. 11.06, p = 0.010), loss of smell (2.13 vs. 2.66, p = 0.021), and loss of taste (2.12 vs. 2.92, p < 0.001).

4. Discussion

Coronaviruses are traditionally implicated in the common cold but have also given rise to severe epidemics, including the SARS and MERS outbreaks in 2003 and 2012, respectively [26,27]. In the current COVID-19 pandemic, the literature has focused on lower respiratory system consequences, including pneumonia, need for ventilation, and acute respiratory distress syndrome. However, greater than 80% of patients present with mild rhinologic symptoms alone, underscoring the importance of characterizing the severity and progression of such symptoms [7]. To our knowledge, this investigation is the largest to date to evaluate the temporal progression of rhinologic symptoms in COVID-19 through a 6-month follow-up timepoint.

Current literature suggests that changes in sense of smell or taste may precede other COVID-19 symptoms [11,14,28–30]. Based on early results of the AAO-HNS “COVID-19 Anosmia Reporting Tool”, Kaye et al. reported that nearly 75% of those with anosmia noted that it began before their COVID-19 diagnosis; in addition, smell loss was the initial symptom in over 25% of these patients [14]. In our analysis, patients reported some degree of smell or taste dysfunction and nasal congestion beginning as early as two weeks before having a positive test. Thus, one strategy for patients who develop new onset chemosensory dysfunction is to self-quarantine and seek medical advice. Recognizing smell or taste loss as a possible sign of infection offers an additional opportunity to prevent unintended viral transmission.

The persistence of smell loss in COVID-19 patients has been an active area of investigation that is particularly important for patient counseling. Our analysis demonstrates that sense of smell significantly worsens from baseline to 2-weeks after diagnosis but normalizes by 1-month after diagnosis. In addition, there was no significant difference in mean sense of smell scores from 1-month to 6-months after diagnosis. These findings are consistent with prior studies of smell loss in COVID-19: an analysis conducted by Hopkins et al. reports that the majority of patients with loss of smell had resolution of these symptoms within two weeks [15]. Additionally, an analysis of anosmic COVID-19 patients reports an eight-day median duration of smell loss [31].

Less characteristic rhinologic symptoms, including nasal congestion and runny nose, have not been well-studied in the context of COVID-19. Our investigation suggested that patients experienced a significant increase in the severity of nasal congestion, rhinorrhea, and the need to blow nose from baseline to the time of diagnosis; however, these symptoms resolved two weeks after diagnosis and remained normal through the 6-month time point. Our findings of symptom resolution within two weeks after diagnosis are consistent with prior studies of SARS and MERS outbreaks [26,27].

Finally, our analysis also explored the relationship between severity of sinonasal symptoms and prior history of rhinologic comorbidities.
Patients with a history of hyposmia, asthma, or chronic sinusitis experienced an exaggerated worsening of sinonasal symptoms, as measured by the rhinologic SNOT score at the time of diagnosis. Additionally, patients with a history of hyposmia and asthma experienced a more significant degree of smell loss at the time of diagnosis. The nasal cavity and nasopharynx are reservoirs for SARS-CoV-2, and it is believed that the virus causes sinonasal mucosal inflammation, resulting in subsequent nasal congestion [32]. Any underlying inflammation associated with pre-morbid asthma or chronic sinusitis, would likely be compounded by SARS-CoV-2, resulting in more severe symptoms.

The current study has several limitations. First, the study design

Table 3
Comparison of 6-month mean sinonasal symptom scores to 1-month scores.

| Domain                  | 6-month mean score (standard deviation) | p Value |
|-------------------------|----------------------------------------|---------|
| Rhinologic SNOT         | 3.28 (4.28)                            | 0.708   |
| Sense of smell          | 0.66 (1.19)                            | 0.664   |
| Sense of taste          | 0.47 (1.05)                            | 0.058   |
| Need to blow nose       | 0.55 (0.96)                            | 0.218   |
| Sneezing                | 0.50 (0.84)                            | 0.064   |
| Runny Nose              | 0.44 (0.84)                            | 0.867   |
| Blockage/congestion     | 0.64 (1.05)                            | 0.202   |

SNOT Sinonasal outcome test.
introduces potential for recall bias: initial survey respondents were asked to retrospectively report symptoms at several previous time points. Respondents reported symptoms they experienced from weeks, up to three months in the past. In contrast, respondents to the follow-up survey were only asked to report their current severity of symptoms. Surveys were also sent on discrete dates, so there was variability as to where each patient was in their individual course of disease. These aspects of the study design may have adversely affected patient’s ability to accurately recall and report true symptom severity. Second, there is no information on whether medical therapies were used by patients, which may affect severity of symptoms. Third, despite a 2% false negative rate for the screening test used in this study, the possibility of false positives is recognized; this is somewhat mitigated by the large sample size. Fourth, the current study is focused in one metropolitan area, although the results may be generalizable given its large population. Finally, the time points selected for assessment of symptoms were chosen based on intervals of incubation time and resolution of disease in mild cases; these may not apply consistently across all cases but serve as reasonable estimates for most cases.

5. Conclusion

This investigation is the largest to date to describe the temporal progression of sinonasal symptoms up to six months in the mild severity COVID-19 population. Overall, sinonasal symptoms, particularly loss of smell and taste, peak at the time of diagnosis, normalize by 1-month after diagnosis, and remain normal through 6-months after diagnosis.

Supplementary data to this article can be found online at https://doi.org/10.1016/j.amjoto.2021.103076.

CRediT authorship contribution statement

Conceptualization: RR, PSB, BAT.
Data curation: RR, PSB, BAT.
Formal analysis: AG, MM.
Project administration: PP, PL, PSB, BAT.
Resources: PP, PL, PSB, BAT.
Software: AG.
Supervision: PP, PL, PSB, BAT.
Validation: PP, PL, MM, ECK, PSB, BAT.
Visualization: RR, AG.
Writing (Original Draft): RR, AG.
Writing (Reviewing and editing): RR, AG, KG, BML, PP, PL, MM, ECK, PSB, BAT

Declaration of competing interest

All authors declare that they have no relevant conflicts of interest.

Acknowledgements

The authors would like to thank Rush University Medical Center clinical research analytics team for their assistance with identification of study subjects.

Funding

The authors report that no funding was received for this study.

References

[1] Organization WH. WHO announces COVID-19 outbreak a pandemic. World Health Organization; 2020.
[2] Zhu N, Zhang D, Wang W, et al. A novel coronavirus from patients with pneumonia in China, 2019. N Engl J Med 2020;382(8):727–33.
[3] Li Q, Guan X, Wu P, et al. Early transmission dynamics in Wuhan, China, of novel coronavirus-infected pneumonia. N Engl J Med 2020;382(13):1199–207.
[4] Guan W-j, Ni Z-y, Hu Y, et al. Clinical characteristics of coronavirus disease 2019 in China. N Engl J Med 2020;382(11):1708–20.
[5] Li Q, Guan X, Wu P, et al. Early transmission dynamics in Wuhan, China, of novel coronavirus-infected pneumonia. N Engl J Med 2020;382(13):1199–207.
[6] Wan S, Xiang Y, Fang W, et al. Clinical features and treatment of COVID-19 patients in Northeast Chongqing. J Med Virol 2020;92(7):797–806.
[7] Wu Z, McGoogan JM. Characteristics of and important lessons from the coronavirus disease 2019 (COVID-19) outbreak in China. JAMA 2020;323(13):1239–42.
[8] Brodwin E. Doctors warn an inability to smell could be a symptom of Covid-19 — but caution the evidence is preliminary. STAT; 2020.

| History | Average rhinologic SNOT at time of diagnosis (n = 517) | Average loss of smell score at diagnosis (n = 514) | Average loss of taste score at diagnosis (n = 511) |
|---------|--------------------------------------------------|------------------------------------------|------------------------------------------|
| Prior smell or taste loss | | | |
| Yes | 11.45 | 2.83 | 2.85 |
| No | 8.30 | 1.92 | 1.96 |
| p-Value | <0.001 | <0.001 | <0.001 |
| Allergic rhinitis | | | |
| Yes | 10.05 | 2.32 | 2.20 |
| No | 8.87 | 2.42 | 2.28 |
| p-Value | 0.053 | 0.647 |
| Asthma | | | |
| Yes | 11.06 | 2.66 | 2.92 |
| No | 8.99 | 2.13 | 2.12 |
| p-Value | 0.010 | <0.001 |
| Chronic sinusitis | | | |
| Yes | 14.5 | 2.46 | 2.71 |
| No | 9.09 | 2.21 | 2.23 |
| p-Value | <0.001 | 0.234 |
| Sinus surgery | | | |
| Yes | 10.95 | 1.85 | 1.65 |
| No | 9.27 | 2.23 | 2.28 |
| p-Value | 0.280 | 0.153 |
| Tobacco use | | | |
| Yes | 9.24 | 2.24 | 2.29 |
| No | 9.34 | 2.22 | 2.25 |
| p-Value | 0.946 | 0.935 |

SNOT Sinonasal outcome test.
[9] Hopkins C, Kumar N. Loss of sense of smell as marker of COVID-19 infection. Ent Uk 2020.
[10] Kim Y. (Exclusive) Daegu 15% of 3191 confirmed patients lost their sense of smell or taste. Jangang Daily 2020.
[11] Lechien JR, Chiesa-Estomba CM, De Siti 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. Eur Arch Otorhinolaryngol 2020;277(8):2251–61.
[12] Suzuki M, Saito K, Min WP, et al. Identification of viruses in patients with postviral olfactory dysfunction. Laryngoscope 2007;117(2):272–7.
[13] Anosmia, hyposmia, and dysgeusia symptoms of coronavirus disease. American Academy of Otolaryngology - Head and Neck Surgery; 2020.
[14] Kaye RM, Chang CID, Kazehaya KMM, Berreton JM, Denneau JM. COVID-19 Anosmia reporting tool: initial findings. Otolaryngol Head Neck Surg 2020;163(1):132–4.
[15] Hopkins C, Alanin M, Philpott C, et al. Management of new onset loss of sense of smell during the COVID-19 pandemic - BRS Consensus Guidelines. Clin Otolaryngology Off J ENT-UK; Off J Netherlands Soc Oto-Rhino-Laryngology Cerv-fac Surg 2020;46(1):16–22.
[16] Symptoms of coronavirus. Centers for Disease Control and Prevention.
[17] Coronavirus disease pandemic. The World Health Organization.
[18] Tong JY, Wong A, Zhu D, Fastenberg JH, Tham T. The prevalence of olfactory and gustatory dysfunction in COVID-19 patients: a systematic review and meta-analysis. Otolaryngol Head Neck Surg 2020;163(1):3–11.
[19] Mullol J, Alobid I, Maritio-Sánchez F, et al. The loss of smell and taste in the COVID-19 outbreak: a tale of many countries. Curr Allergy Asthma Rep 2020;20 (10):61.
[20] Spinato G, Fabbris C, Polese J, et al. Alterations in smell or taste in mildly symptomatic outpatients with SARS-CoV-2 infection. JAMA. 2020;323(20):2989–90.
[21] Boscolo-Rizzo P, Borsetto D, Fabbris C, et al. Evolution of altered sense of smell or taste in patients with mildly symptomatic COVID-19. JAMA Otolaryngol Head Neck Surg 2020;146(8):729–32.
[22] Lee Y, Min P, Lee S, Kim SW. Prevalence and duration of acute loss of smell or taste in COVID-19 patients. J Korean Med Sci 2020;35(18):174.
[23] Improving the quality of web surveys: the Checklist for Reporting Results of Internet E-Surveys (CHERRIES). J Med Internet Res 2004;6(3):54.
[24] Hopkins C, Gillett S, Slack R, Lund VJ, Browne JP. Psychometric validity of the 22-item Sinonasal Outcome Test. Clin Otolaryngol 2009;34(5):447–54.
[25] Ksiazek TG, Erdman B, Goldsmith CS, et al. A novel coronavirus associated with severe acute respiratory syndrome. N Engl J Med 2003;348(20):1953–66.
[26] Norman G. Likert scales, levels of measurement and the “laws” of statistics. Adv Health Sci Educ Theory Pract 2010;15(3):625–32.
[27] Zaki AM, Van Boheemen S, Bestebroer TM, Osterhaus ADME, Fouchier RAM. Isolation of a novel coronavirus from a man with pneumonia in Saudi Arabia. N Engl J Med 2012;367(19):1814–20.
[28] Soler ZM, Patel ZM, Turner JH, Holbrook EH. A primer on viral-associated olfactory loss in the era of COVID-19. Int Forum Allergy Rhinol 2020;10(7):814–20.
[29] Yan MDCH, Faraji MD/PhD F, Prajapati BSDP, et al. Association of chemosensory dysfunction and COVID-19 in patients presenting with influenza-like symptoms. Int Forum Allergy Rhinol 2020;10(7):806–13.
[30] Lee DJ, Lockwood J, Das P, Wang R, Grinspun E, Lee JM. Self-reported anosmia and dysgeusia as key symptoms of COVID-19. Cjem. 2020;1–19.
[31] Patel A, Charani E, Aryanayagam D, et al. New-onset anosmia and ageusia in adult patients diagnosed with SARS-CoV-2 infection. Clin Microbiol Infect 2020;26(9):1236–41.
[32] Zou L, Ruan F, Huang M, et al. SARS-CoV-2 viral load in upper respiratory specimens of infected patients. N Engl J Med 2020;382:1177–9.