*Available online at* **www.ijmrhs.com**

**ISSN No: 2319-5886**

**International Journal of Medical Research & Health Sciences, 2021, 10(6): 55-62**

# Smell and Taste Dysfunctions in Patients with Coronavirus Disease (COVID-19) Infection in Jeddah, Kingdom of Saudi Arabia: An Analytical Cross-Sectional Study

**Sara Alqurashi* and Najlaa Mandoura**

*Directorate of Health Affairs for Public Health Division, Ministry of Health, Jeddah, Kingdom of Saudi Arabia*

*Corresponding e-mail: s.a.alqurashi@hotmail.com*

## ABSTRACT

***Introduction:*** *Coronavirus Disease (COVID-19) is the main primary health issue of our time. Smell and taste loss are hallmarks of COVID-19 infection. A complete understanding of the disease and its features has yet to be investigated. Here, we aimed to estimate the prevalence and patterns of smell and taste loss among COVID-19 patients.* ***Methods:*** *This was a multi-center, analytical, cross-sectional study conducted in Jeddah, Kingdom of Saudi Arabia that utilized the COVID-19 anosmia (loss of sense of smell) reporting tool developed by the American Academy of Otolaryngology-Head and Neck Surgery (AAO-HNS).* ***Results:*** *The loss of smell, taste, or both among COVID-19 patients was 56.6% with the majority (74.9%) experiencing both smell and taste loss. The median duration from dysfunction to recovery is ten days (IQR: 7 days). Gender and nationality showed significant association with smell/taste loss during the COVID-19 course (p=0.011 and 0.004, respectively). In addition, diabetes mellitus and hypertension showed significant association with smell/taste loss (p=0.038 and 0.012, respectively). Advanced age was a significant predictor of smell/taste loss (Exp(B)=1.042, CI: 1.023-1.061).* ***Conclusions:*** *Loss of smell/taste among COVID-19 patients was present in more than half of the samples. This symptom of concern was significantly associated with demographic characteristics and chronic diseases. Further studies are needed to understand the well-characterized symptoms of COVID-19 infection and assess early markers of disease prevalence and progression as well as establish the best preventive measures.*

**Keywords:** Smell loss, Taste loss, Olfactory dysfunction, Gustatory dysfunction, pandemic, SARS-CoV-2

**Abbreviations:** COVID-19: Coronavirus Disease 2019, SARS-CoV-2: Severe Acute Respiratory Syndrome Coronavirus-2, OD: Olfactory Dysfunction, GD: Gustatory Dysfunction, RT-PCR SARS-CoV-2: Reverse Transcription-Polymerase Chain Reaction for Severe Acute Respiratory Syndrome Coronavirus-2, IQR: Interquartile Range, ACE2: Angiotensin-Converting Enzyme 2

## INTRODUCTION

In December 2019, Coronavirus Disease (COVID-19) infection was first identified as the cause of a disease outbreak originating in Wuhan, China, and then spread rapidly [1]. The World Health Organization (WHO) declared the COVID-19 outbreak to be a pandemic infectious disease and global health emergency on March 11, 2020 [2]. Various clinical symptoms characterize COVID-19 infection: The most frequent clinical manifestations include fever, dry cough, fatigue, and shortness of breath [3]. The spread of the COVID-19 infection and the increase in the number of new cases worldwide shows characteristic olfactory and gustatory dysfunction [4].

Olfactory Dysfunction (OD) and Gustatory Dysfunction (GD) in COVID-19 patients are incompletely characterized: More information is needed to better understand their role in COVID-19 infection. A systematic review and meta-analysis to determine the pooled global prevalence of OD and GD in patients with COVID-19 infection were done in April 2020. That work involved ten studies that analyzed for OD and nine studies that analyzed for GD; the evidence suggests that OD and GD are common symptoms in patients with COVID-19 and may represent early symptoms in the clinical course of infection [5].

Another systematic review and meta-analysis identified 24 studies from 13 countries to estimate the prevalence of OD and GD in COVID-19 patients; the pooled proportion of patients presenting with OD and GD was 41.0% (95% Confidence Interval (CI) 28.5% to 53.9%) and 38.2% (95% CI 24% to 53.6%), respectively. There was no significant moderation of the prevalence of OD and GD by gender-increasing mean age correlated with a lower prevalence of OD and GD [6].

A questionnaire was also administered to patients with COVID-19 at home in Italy (50.5%) who had extensive taste disorders (>8 on a 10-grade Likert scale) and smell disorders versus their experience before onset of fever and COVID-19 symptoms (grade >6, Likert scale); OD and GD occurred in early disease (within five days from the onset of fever) [7]. Telephone interviews from March 8, 2020, in Korea, investigated the prevalence of acute loss of smell and taste among COVID-19 patients to evaluate their diagnostic significance. The interviews found that the loss of smell or taste was 15.3% in the early stage of COVID-19 and 15.7% with asymptomatic to mild disease. It was more common among females and younger patients. However, most patients with a loss of smell or taste recovered within three weeks; the median time to recovery was seven days for both symptoms [3].

A case-control study in Iran concluded that quantitative smell testing demonstrates that decreased smell function is a significant marker for Covid-19 infection [8]. Surprisingly, there are few studies and limited knowledge about the olfactory and gustatory dysfunctions in COVID-19 infection in the Kingdom of Saudi Arabia. Therefore, this study estimated the prevalence of olfactory and gustatory dysfunction and investigated the factors associated with these dysfunctions.

## MATERIALS AND METHODS

### Study Design

This was a multi-center, analytical, cross-sectional study of patients diagnosed with COVID-19 infection in Jeddah's healthcare facilities. The work used nasopharyngeal swabs with a Reverse Transcription-Polymerase Chain Reaction for Severe Acute Respiratory Syndrome Coronavirus-2 (RT-PCR SARS-CoV-2) test. We used standardized telephone calls with selected patients who fulfilled the eligibility criteria from November 2020 to February 2021. All participants were informed of the aim of the study, and verbal informed consent was required for enrolment.

### Eligibility Criteria

The inclusion criteria were as follows:

- Laboratory-confirmed COVID-19 cases using an RT-PCR SARS-CoV-2 test
- Patients clinically able to fulfill the questionnaire (ward, home isolation)
- Adult (>18 years old).
- Arabic and English fluency

The exclusion criterion was patients with olfactory or gustatory dysfunctions before the COVID-19 epidemic.

### Sample Size

The sample size calculated using the Raosoft website. The margin of error was 5%, and the confidence level was 95%. The estimated population size of positive COVID-19 cases in Jeddah was 33,700 based on the Ministry of Health (MOH) statistics by the end of October 2020; the hypothesized percentage frequency of the outcome is 50% because it was unknown at the time. Thus, the estimated sample size was 380 [9].

### Sampling Technique

This study employed a simple random sampling technique with a random number generator (http://www.random.org). A list of patients registered in the Health Electronic Surveillance Network (HESN) was obtained from the Public Health Department at the Ministry of Health (MOH).

### Questionnaire

The COVID-19 anosmia (loss of sense of smell) reporting tool was developed by the American Academy of

Otolaryngology-Head and Neck Surgery (AAO-HNS). It was used with some modifications to suit the objectives of this study [10]. Permission to use the questionnaire was obtained from the owner. It was translated into Arabic and then translated back to English to confirm little or no loss of content (similarity of 80%-90%).

The questionnaire assessed:

- The different smell/taste loss components including onset, duration, resolution (partial or complete), and patient condition
- Other symptoms, risk factors, and comorbidities
- Demographic characteristics of the participants: age, gender, and nationality

**Statistical Methods**

The statistical analysis using statistical package for the social sciences (SPSS, version 27.0). All continuous variables were skewed, and thus the median and Interquartile Range (IQR) were used for summarization. The proportion and frequency distributions were used to summarize categorical variables. Bivariate analyses used Pearson correlation logistic regression. Pearson's chi-square test and Fisher's exact test were used to finding an association between categorical variables. The predetermined level of significance was $p<0.05$, and the level of confidence was 95% CI.

## RESULT

There were 380 responses entered and analyzed. The median age in this sample was 38 years with an Interquartile Range (IQR) of 19 years old (range 18-71). The majority of the respondents were males and represented 60% of the sample. Saudi participants made up the majority. Other characteristics of COVID-19 patients are shown in Table 1.

**Table 1 General characteristic of COVID-19 patients**

| N=380 | Frequency (n) | Percentage (%) |
|---|---|---|
| **Gender** | | |
| Male | 228 | 60.0 |
| Female | 152 | 40.0 |
| **Nationality** | | |
| Saudi | 260 | 68.4 |
| Non-Saudi | 120 | 31.6 |
| **Risks factors for Covid-19 infection** | | |
| None | 189 | 49.7 |
| Healthcare worker | 30 | 7.9 |
| Close contact with a confirmed case | 144 | 37.9 |
| Congregate living | 3 | 0.8 |
| Travel to areas with widespread transmission | 15 | 3.9 |
| N: total sample number | | |

Table 2 shows risk factors and comorbidities reported by the current study candidates; 50% of the participants had at least one risk factor. Sinusitis/allergy was the most common risk factor in this sample followed by smoking. Neurologic disease and head trauma were less commonly reported risk factors and comorbidities.

**Table 2 Risk factors/comorbidities**

| N=380 | Frequency (n) | Percentage (%) |
|---|---|---|
| None | 190 | 50 |

| | | |
|---|---|---|
| Smoking | 61 | 16.1 |
| Head trauma | 7 | 1.8 |
| Sinusitis/allergy | 82 | 21.6 |
| Chronic respiratory disease/asthma | 28 | 7.4 |
| Cardiac disease | 11 | 2.9 |
| Neurologic disease | 7 | 1.8 |
| Diabetes mellitus | 35 | 9.2 |
| Hypertension | 18 | 4.7 |
| N: total sample number | | |

The results of investigating the prevalence of smell/taste loss among the study cohort showed that 215 (56.6%) encountered a loss of either smell, taste, or both during their COVID-19 infection. Indeed, most (74.9%) experienced both smell and taste loss. Thankfully, most participants recovered; the majority reported complete resolution of smell/taste loss as shown in Table 3. The median duration of dysfunction was ten days (IQR: 7 days).

**Table 3 Smell/taste loss during COVID-19 infection**

| N=380 | Frequency (n) | Percentage (%) |
|---|---|---|
| No smell/taste loss | 165 | 43.4 |
| Smell and taste loss | 161 | 42.4 |
| Smell loss only | 47 | 12.4 |
| Taste loss only | 7 | 1.8 |
| Resolution of smell/taste loss | 208 | 96.7 |
| Complete resolution | 129 | 62 |
| Partial resolution | 79 | 38 |
| N: total sample number | | |

Here, 165 (43.4%) participants denied smell/taste loss. Fever and malaise were the most common symptoms of COVID-19 in this group. Other symptoms are shown in Table 4. Respondents who experienced smell/taste loss during their COVID-19 course were asked about the symptoms that they had before and at the time of the onset of smell/taste loss. Fever was the most common symptom before the onset of dysfunction, and malaise was the most common symptom reported at the time of dysfunction. Table 5 shows symptoms reported by participants who encountered smell/taste loss.

**Table 4 Symptoms reported by patients with no smell/taste loss**

| Symptoms N=165 | Frequency (n) | Percentage (%) |
|---|---|---|
| None | 20 | 12.1 |
| Fever | 103 | 62.4 |
| Chills | 26 | 15.8 |
| Malaise | 81 | 49.1 |
| Cough | 74 | 44.8 |
| Headache | 58 | 35.2 |
| Nasal congestion | 17 | 10.3 |
| Rhinorrhea | 27 | 16.4 |
| Gastrointestinal distress | 52 | 31.5 |
| Sore throat | 25 | 15.2 |
| Shortness of breath | 22 | 13.3 |
| N: total sample number | | |

**Table 5 Symptoms reported by patients who developed smell/taste loss**

| Symptoms N=125 | Before the smell/taste loss | | At the time of smell/taste loss | |
|---|---|---|---|---|
| | Frequency | Percentage | Frequency | Percentage |
| None | 20 | 9.3 | 74 | 34.4 |
| Fever | 119 | 55.3 | 57 | 26.5 |
| Chills | 8 | 3.7 | 7 | 3.3 |
| Malaise | 107 | 49.8 | 74 | 34.4 |
| Cough | 39 | 18.1 | 33 | 15.3 |
| Headache | 70 | 32.6 | 53 | 24.7 |
| Nasal congestion | 26 | 12.1 | 16 | 7.4 |
| Rhinorrhea | 35 | 16.3 | 13 | 6 |
| Gastrointestinal distress | 23 | 10.7 | 25 | 11.6 |
| Sore throat | 19 | 8.8 | 12 | 5.6 |
| Shortness of breath | 16 | 7.4 | 18 | 8.4 |
| N: total sample number | | | | |

Among all independent factors investigated here, gender and nationality showed significant association with smell/taste loss during the COVID-19 course (p=0.011, 0.004, respectively). Diabetes Mellitus (DM) and Hypertension (HTN) also showed significant association with smell/taste loss; p=0.038 and 0.012, respectively. Association between numerous factors and smell/taste loss is shown in Table 6. The age of the participants seems to predict smell/taste loss-there was a significant correlation and regression with age and the presence of dysfunction (Exp(B)=1.042, CI: 1.023-1.061, p<0.001). Other determinants of smell/taste loss are shown in Table 7.

**Table 6 Association between smell/taste loss and patient demographic characteristics and comorbidities**

| Factor N=380 | Yes; n (%) | No; n (%) | p-value |
|---|---|---|---|
| **Gender** | | | |
| Male | 117 (51.3) | 111 (48.7) | 0.011* |
| Female | 98 (64.5) | 54 (35.5) | |
| **Nationality** | | | |
| Saudi | 160 (61.5) | 100 (38.5) | 0.004* |
| Non-Saudi | 55 (45.8) | 65 (54.2) | |
| **Risk factors/comorbidities** | | | |
| Diabetes mellitus | 14 (40) | 21 (60) | 0.038* |
| No diabetes mellitus | 201 (58.3) | 144 (41.7) | |
| Hypertension | 5 (27.8) | 13 (72.2) | 0.012* |
| No hypertension | 210 (58) | 152 (42) | |
| Smoker | 34 (55.7) | 27 (44.3) | 0.885* |
| Non-smoker | 181 (56.7) | 138 (43.3) | |
| Head trauma | 3 (42.9) | 4 (57.1) | 0.473** |
| No head trauma | 212 (56.8) | 161 (43.2) | |
| Sinusitis/allergy | 48 (58.5) | 34 (41.5) | 0.686* |
| No sinusitis/allergy | 167 (56.0) | 131 (44.0) | |
| Chronic respiratory disease/asthma | 14 (50) | 14 (50) | 0.466* |
| No chronic respiratory disease/asthma | 201 (57.1) | 151 (42.9) | |
| Cardiac disease | 6 (54.5) | 5 (45.5) | 1.000** |
| No cardiac disease | 209 (56.6) | 160 (43.4) | |

| | | | |
|---|---|---|---|
| Neurologic disease | 2 (28.6) | 5 (71.4) | 0.247** |
| No neurologic disease | 213 (57.1) | 160 (42.9) | |
| *Pearson chi-square test **Fisher's exact test | | | |

**Table 7 Determinants of smell/taste loss**

| Variable | Exp (B) | CI | p-value |
|---|---|---|---|
| Gender | 1.627 | 1.046-2.529 | 0.031 |
| Age | 1.042 | 1.023-1.061 | 0.000 |
| Nationality | 0.582 | 0.369-0.920 | 0.021 |
| CI: Confidence Interval | | | |

Of the 215 participants who experienced smell/taste loss, 85 (39.5%) reported that the source of infection was identifiable. The median duration of smell/taste loss was five days (IQR: 3). Moreover, 85 (39.5%) of those who developed smell/taste loss reported that they noticed the loss before the diagnosis, and 48 (56.5%) stated that it was one of the reasons that they had the COVID-19 test. Other respondents (n=130; 60.5%) noticed the dysfunction after the diagnosis and reported a median duration of five days (IQR two days). The majority (n=209; 97.2%) of those who experienced smell/taste loss were in the outpatient setting when they first noticed the dysfunction. Moreover, 168 (78%) of those who had a smell/taste loss reported that their condition improved after observing the dysfunction.

## DISCUSSION

This study explored the prevalence, patterns, and associated factors of smell/taste loss among COVID-19 patients in Jeddah, Kingdom of Saudi Arabia. The results showed that more than 50% of the respondents suffered from smell/taste loss during their disease. Most individuals reported smell/taste recovery within five days. These findings are similar to those found in an Italian study where the prevalence of olfactory and gustatory dysfunction was 50.5% [7]. The median duration of recovery reported by the participants was five days within fever onset [7]. Similar median duration was found by Jan, et al. where most participants noted OD and GD in the fourth day after the onset of other COVID-19 symptoms [11]. Interestingly, Jan, et al. reported a much higher prevalence among their sample [11]. They reported reduced olfaction in 74% and a reduced sense of taste in 69% [11]. A systematic review included 17 articles and made similar conclusions as ours: the onset of OD/GD is usually 7 days after the manifestation of other symptoms and the dysfunctions started to disappear after 1-2 weeks [12].

Another multi-center European study included 417 mild to moderate COVID-19 patients and found that 85.6% and 88.0% of patients reported OD and GD, respectively [4]. On the other hand, a telephone-interview-based survey in Korea revealed that 15.3% of COVID-19 patients experienced smell/taste loss [3]. Similarly, an Omani study of patients diagnosed with COVID-19 infection noted the loss of smell in only 8.4%. Only 9.6% of the respondents suffered from loss of taste among those who did not require critical care [13]. This variation in the prevalence of OD and GD creates a range of (8.4%-88%) with a median of 56.6%, which is the prevalence of this study.

In this study, most participants (97.2%) who encountered OD/GD were isolated at home. These findings agree with other results found by Paderno, et al. [14]. Individuals who experienced OD/GD in Korea reported resolving these dysfunctions with a median duration of 7 days, which is similar to our results (5 days) [3]. Females were significantly more affected by smell/taste dysfunction than male participants, which seems consistent with the literature [3,4,14]. Fever and malaise were the most common symptoms in our cohort regardless of smell/taste loss.

As mentioned earlier, OD and GD were significantly more prevalent in female participants than males. Moreover, Saudi respondents were significantly more affected by OD/GD than non-Saudi participants. This might be because smell/taste loss is a significant concern for females and may impact their daily life dramatically; thus, they may notice these dysfunctions more. We noticed that the loss of smell and taste are common questions among the Saudi population. Moreover, our results showed that more than 50% of those who noticed smell/taste loss before the diagnosis was triggered to seek screening for these symptoms.

Diabetes mellitus and hypertension showed a statistically significant association with smell/taste loss in this study. Although the exact pathophysiology to explain this association is incomplete, multiple hypotheses exist. Angiotensin-Converting Enzyme 2 (ACE2) is a membrane-bound enzyme found in the epithelium and known to play a significant role in COVID-19 [15]. Two medications commonly used by hypertensive patients are Angiotensin-Converting Enzyme Inhibitors (ACEI) and Angiotensin Receptor Blockers (ARBs), which theoretically increase the number of ACE2 and thus lead to more serious clinical manifestations including OD and GD in hypertensive patients [16]. Similarly, in DM, multiple medications increase the number of ACE2 including dipeptidyl peptidase-4 (DPP-4) inhibitors [17].

Only a few studies have described the pathophysiological mechanisms of the smell and taste dysfunctions in COVID-19 infection. Gustatory cells had a higher proportion of ACE2-positive cells suggesting that SARS-CoV-2 could attack these cells and cause loss of taste. The virus may bind to the sialic acid receptors speeding up the breakdown of the gustatory particles resulting in the lowering of gustatory sensation [18].

Some coronaviruses can attack the Central Nervous System (CNS) by invading the ethmoid bone compromising the ability of the olfactory bulb to control the viral attack and allowing a retrograde trans-synaptic transmission. SARS-CoV-2 can directly attack the CNS at the early part of the disease or in the late stage. Another retrograde route of spread could be mediated by the attack of sensory receptors in the airways by SARS-CoV-2 [19]. Further studies with sufficient follow-up duration would reveal better clarifications and explain the pathophysiological mechanisms of these dysfunctions in COVID-19 infection.

### Study Limitations

There are certain limitations in these findings that should be considered. The current study was multi-center, analytical, and cross-sectional. It was also limited to the Jeddah region; therefore, the results cannot be generalized. Furthermore, some independent variables were not assessed in this study such as the treatment received for the olfactory and gustatory dysfunction of COVID-19 patients.

## CONCLUSION

The prevalence of the loss of smell, taste, or both was 56.6% among the COVID-19 patients included in this study. The majority (74.9%) experienced both smell and taste loss. More than half of the patients had at least one risk factor such as sinusitis. The median duration of dysfunction was ten days (IQR: 7 days). Advanced age was a significant predictor of smell/taste loss. The current study provides the baseline and the essential information about the prevalence, patterns, and the factors influencing the olfactory and gustatory dysfunction in COVID-19 patients such as demographic characteristics and comorbidities for any future studies in the Jeddah region; therefore, considering these symptoms as part of the screening and diagnostic approaches for COVID-19 infection could help improve case detection and further control the spread of the disease. We recommend further and more detailed studies to understand the well-characterized symptoms of COVID-19 infection, assess early markers of disease prevalence and progression, and establish preventive measures.

## DECLARATIONS

### Conflicts of Interest

The authors declared no potential conflicts of interest concerning the research, authorship, and/or publication of this article.

### Ethical Approval

The initial approval for conducting the study was obtained from the Institutional Review Board (IRB)-Research and Studies Department at the Directorate of Health Affairs in Jeddah on November 17, 2020. The final approval was obtained on April 13, 2021 (approval number: A01024).

## REFERENCES

[1] World Health Organization. “WHO Director-General’s remarks at the media briefing on 2019-nCoV on 11

February 2020." 2020.

[2] World Health Organization. "Archived: WHO timeline-covid-19." *Retrieved* 23 (2020): 2020.

[3] Lee, Yonghyun, et al. "Prevalence and duration of acute loss of smell or taste in COVID-19 patients." *Journal of Korean Medical Science,* Vol. 35, No. 18, 2020, p. e174.

[4] Lechien, Jerome R., 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." *European Archives of Oto-Rhino-Laryngology,* Vol. 277, No. 8, 2020, pp. 2251-61.

[5] Tong, Jane Y., et al. "The prevalence of olfactory and gustatory dysfunction in COVID-19 patients: A systematic review and meta-analysis." *Otolaryngology-Head and Neck Surgery,* Vol. 163, No. 1, 2020, pp. 3-11.

[6] Agyeman, Akosua Adom, et al. "Smell and taste dysfunction in patients with COVID-19: A systematic review and meta-analysis." *Mayo Clinic Proceedings*, Vol. 95, No. 8, 2020, pp. 1621-31.

[7] De Maria, Andrea, et al. "High prevalence of olfactory and taste disorder during SARS-CoV-2 infection in outpatients." *Journal of Medical Virology,* Vol. 92, No. 11, 2020, pp. 2310-11.

[8] Moein, Shima T., et al. "Smell dysfunction: A biomarker for COVID-19." *International Forum of Allergy & Rhinology*, Vol. 10, No. 8, 2020, pp. 944-50.

[9] COVID 19 Dashboard: Saudi Arabia. https://covid19.moh.gov.sa/

[10] Kaye, Rachel, et al. "COVID-19 anosmia reporting tool: Initial findings." *Otolaryngology-Head and Neck Surgery,* Vol. 163, No. 1, 2020, pp. 132-34.

[11] Luers, Jan C., et al. "Olfactory and gustatory dysfunction in Coronavirus Disease 2019 (COVID-19)." *Clinical Infectious Diseases,* Vol. 71, No. 16, 2020, pp. 2262-64.

[12] Santos, Renata Emmanuele Assuncao, et al. "Onset and duration of symptoms of loss of smell/taste in patients with COVID-19: A systematic review." *American Journal of Otolaryngology,* Vol. 42, No. 2, 2021, p. 102889.

[13] Al Harthi, Saud, et al. "Clinical characteristics of confirmed cases of COVID-19 admitted at Al-Nahdha hospital, Oman: A cross-sectional descriptive study." 2020, pp. 1-25.

[14] Paderno, Alberto, et al. "Smell and taste alterations in Covid-19: A cross-sectional analysis of different cohorts." *International Forum of Allergy & Rhinology,* Vol. 10, No. 8, 2020, pp. 955-62.

[15] Zheng, Ying-Ying, et al. "COVID-19 and the cardiovascular system." *Nature Reviews Cardiology,* Vol. 17, No. 5, 2020, pp. 259-60.

[16] Schiffrin, Ernesto L., et al. "Hypertension and COVID-19." *American Journal of Hypertension*, Vol. 33, No. 5, 2020, pp. 373-74.

[17] Guo, Li, et al. "Comorbid diabetes and the risk of disease severity or death among 8807 COVID-19 patients in China: A meta-analysis." *Diabetes Research and Clinical Practice,* Vol. 166, 2020, p. 108346.

[18] Tanasa, Ingrid Andrada, et al. "Anosmia and ageusia associated with coronavirus infection (COVID-19)-what is known?" *Experimental and Therapeutic Medicine,* Vol. 20, No. 3, 2020, pp. 2344-47.

[19] Tsatsakis, Aristides, et al. "SARS-CoV-2 pathophysiology and its clinical implications: An integrative overview of the pharmacotherapeutic management of COVID-19." *Food and Chemical Toxicology,* Vol. 146, 2020, p. 111769.