Original Article　　　　　　　　　　　　　　　　**Open Access**

Clinical symptoms and outcomes among hospitalized COVID-19 patients in Ondo State, Southwestern Nigeria

*[*1]Usman, S. O., [2]Busari, I. I., [3]Fagbemi, S., [2]Adeniyi, M. M., [2]Irabor, P., [4]Usman, I. N., and [5]Akintayo-Usman, N. O.

[1]APIN Public Health Initiatives, Akure, Ondo State, Nigeria
[2]Infectious Disease Hospital, Akure, Ondo State, Nigeria
[3]Ondo State Ministry of Health, Akure, Ondo State, Nigeria
[4]Department of Public Health, Ladoke Akintola University of Technology, Ogbomoso, Oyo State, Nigeria
[5]Nurse Tutors Programme, University College Hospital, Ibadan, Oyo State, Nigeria
*Correspondence to: senatorhopsy@yahoo.com

Abstract:

Background: The severe acute respiratory syndrome coronavirus-2 (SARS-CoV-2) is a novel strain of coronavirus, which is the cause of the current coronavirus disease 2019 (COVID-19) pandemic, ravaging many countries of the world. The objective of this study is to assess the symptomatology and case management outcome of hospitalized COVID-19 patients in Ondo State, Southwestern Nigeria.
Methodology: This was a longitudinal study carried out on randomly selected patients with COVID-19, confirmed by real-time reverse transcriptase-polymerase chain reaction (rRT-PCR), admitted to the Infectious Disease Hospital, Akure, from March to July 2020. Clinical and outcome data obtained from the patients were analysed using the Statistical Package for the Social Sciences (SPSS) version 24.0 software, and variables were compared using the Chi square (χ^2) test and Odds ratio (OR).
Results: A total of 215 hospitalized COVID-19 patients were randomly recruited, with 103 males and 112 females (M:F ratio of 1:1.1), and mean age of 37.24 ± 16.83 years. The most common symptoms were shortness of breath (22.8%), cough (18.6%), fatigue (17.2%), runny nose (16.7%), fever (16.3%), and sneezing (14.0%). Mortality rate among the patients was 4.7% (10/215). Statistical analysis showed that fever [χ^2 = 8.75, OR 2.17 (95% CI: 0.29-16.63), *p*=0.003] and sneezing [χ^2=11.35, OR 2.75 (95% CI: 0.34-18.27), *p*=0.001] were clinical presentations with significant impact on the final outcome of the patients.
Conclusion: This study showed that the most common symptoms in hospitalized COVID-19 patients were shortness of breath, cough, running nose, fever and sneezing, which underscores the importance of monitoring of patients for these symptoms.

Keywords: COVID-19; symptoms; management; hospitalized; outcome; Nigeria

Symptômes cliniques et résultats chez les patients hospitalisés COVID-19 dans l'État d'Ondo, dans le sud-ouest du Nigéria

*[*1]Usman, S. O., [2]Busari, I. I., [3]Fagbemi, S., [2]Adeniyi, M. M., [2]Irabor, P., [4]Usman, I. N., et [5]Akintayo-Usman, N. O.

[1]Initiatives de santé publique 1APIN, Akure, État d'Ondo, Nigéria
[2]Hôpital des maladies infectieuses, Akure, État d'Ondo, Nigéria
[3]Ministère de la Santé de l'État de Ando, Akure, État d'Ondo, Nigéria
[4]Département de la santé publique, Université de technologie Ladoke Akintola, Ogbomoso, État d'Oyo, Nigéria
[5]Programme d'infirmières tuteurs, Hôpital universitaire, Ibadan, État d'Oyo, Nigéria
*Correspondance à: senatorhopsy@yahoo.com

Abstrait:

Contexte: Le coronavirus-2 du syndrome respiratoire aigu sévère (SRAS-CoV-2) est une nouvelle souche de coronavirus, qui est à l'origine de la pandémie actuelle de coronavirus 2019 (COVID-19), ravageant de nombreux pays du monde. L'objectif de cette étude est d'évaluer les résultats de la symptomatologie et de la prise en charge des cas de patients hospitalisés COVID-19 dans l'État d'Ondo, dans le sud-ouest du Nigéria.

Méthodologie: Il s'agissait d'une étude longitudinale réalisée sur des patients sélectionnés au hasard atteints de COVID-19, confirmée par réaction en chaîne par transcriptase-polymérase inverse en temps réel (rRT-PCR), admis à l'hôpital des maladies infectieuses d'Akure de mars à juillet 2020. Les données cliniques et les résultats obtenus des patients ont été analysés à l'aide du logiciel Statistical Package for the Social Sciences (SPSS) version 24.0, et les variables ont été comparées à l'aide du test du Chi carré (χ²) et du rapport de cotes (OR).

Résultats: Un total de 215 patients hospitalisés COVID-19 ont été recrutés au hasard, avec 103 hommes et 112 femmes (rapport H: F de 1: 1,1), et un âge moyen de 37,24±16,83 ans. Les symptômes les plus courants étaient l'essoufflement (22,8%), la toux (18,6%), la fatigue (17,2%), l'écoulement nasal (16,7%), la fièvre (16,3%) et les éternuements (14,0%). Le taux de mortalité parmi les patients était de 4,7% (10/215). L'analyse statistique a montré que la fièvre [χ²=8,75, OR 2,17 (IC à 95%: 0,29 à 16,63), *p*=0,003] et les éternuements [χ²=11,35, OR 2,75 (IC à 95%: 0,34 à 18,27), *p*=0,001] étaient présentations cliniques avec un impact significatif sur le résultat final des patients.

Conclusion: Cette étude a montré que les symptômes les plus courants chez les patients hospitalisés sous COVID-19 étaient l'essoufflement, la toux, le nez qui coule, la fièvre et les éternuements, ce qui souligne l'importance de la surveillance des patients pour ces symptômes.

Mots clés: COVID-19; symptômes; la gestion; hospitalisé; résultat; Nigeria

Introduction:

Coronavirus disease 2019 (COVID-19) is an infectious disease caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2). It was first identified in Wuhan, the capital of Hubei province of China in December 2019 and has gone on to spread across different parts of the world becoming a pandemic in the process (1). Specifically, on the 29th December, 2019, the first four cases of an acute respiratory syndrome of unknown aetiology were reported in Wuhan City, Hubei Province, China among people linked to a local seafood market (2). Studies thus far indicate that the virus origin is connected to a seafood market in Wuhan, but specific animal associations have not been confirmed. Reported symptoms include fever, cough, fatigue, headache, diarrhoea, haemoptysis, and dyspnea. Preventive measures such as masks, hand hygiene practices, avoidance of public contact, and quarantines have been discussed as ways to reduce transmission. To date, no specific antiviral treatment has proven effective, hence, management of infected persons primarily rely on symptomatic treatment and supportive care (3).

On 11th March, 2020, the World Health Organization (WHO) declared COVID-19 a pandemic, having met epidemiological criteria of more than a hundred thousand infected persons in at least 100 countries (4). The virus is primarily spread between people during close contact, most often through small droplets produced by coughing, sneezing, and talking. The droplets usually fall to the ground or onto surfaces rather than travelling through air over long distances (5). While the majority of COVID-19 cases have mild symptoms, severe complications include acute respiratory distress syndrome (ARDs), pneumonia and bronchitis (6). These complications are more pronounced in patients with underlying health conditions such as immuno-compromised individuals, the elderly and those with cardio-pulmonary diseases (7,8). The time from exposure to onset of symptoms is typically around 5 days, but may range from 2-14 days (9,10).

The WHO has published several testing protocols for the diagnosis of COVID-19 (11). The standard method of testing is the real-time reverse transcription polymerase chain reaction (rRT-PCR) (9), which is typically done on respiratory samples obtained by a nasopharyngeal swab, however, oropharyngeal swab or sputum sample may also be used. The samples should be collected after 48-72 hours of fever subsiding without treatment (12-15). The treatment of COVID-19 patients remains largely supportive, with a number of cases requiring oxygen supplementation and intensive care (16,17).

The first index case in Nigeria was reported on 27th February 2020, when an Italian citizen in Lagos tested positive for the virus in the wake of increasing cases in Africa (18, 19). A second case of the virus was reported in Ewekoro, Ogun State on 9th March 2020 (20), a Nigerian citizen who had been a contact of the Italian index case. African countries are known to have fragile health systems and this remains a source of concern, especially in the event of increased outbreaks (20). On 23rd March, 2020, Nigeria confirmed the first COVID death, a 67-year-old Engineer and former managing director of Pipelines and Products Marketing Company, who returned from United Kingdom with underlying health conditions (21). A study on the clinical presentation of COVID-19 patients in Nigeria by Bowale et al., (8), revealed that 75% of the patients presented in moderately severe condition while 16% were asymptomatic. The most common presenting symptoms were fever (59%) and dry cough (44%). The study also showed that 97% of the patients were treated with lopinavir-ritonavir with no recorded death while the average duration of hospitalization was 12 days (8).

In a review of 1556 hospitalized patients with COVID-19 (22), 57.5% were male and mean age of the patients was 49.1 years. Pooled data revealed that nasal congestion

was observed in 3.7% of the patients and the most common symptoms were fever (85.6%), cough (68.7%), and fatigue (39.4%). In a South African report on the primary care management of COVID-19 patients by Mash (23), the common clinical symptoms were cough (95%), fever (86%), fatigue (71%), shortness of breath (43%) and diarrhoea (10%). The severities of the COVID-19 among admitted patients in a Chinese study (24) were 62% mild, 19% severe, and 19% critical, according to the Chinese Center for Disease Control (CDC) classification guidelines. The patients in the study reportedly received standard treatments based on the guidelines of Chinese CDC including antiviral remedies (arbidol, lopinavir and ritonavir, interferon-α inhalation) and anti-inflammatory treatments (corticosteroid) among others. Seventeen (81%) patients recovered and were discharged while 4 (19%) died. In a study of 1591 Italian patients with SARS-CoV-2 infection, patients had clinical manifestations of fever (70.1%), cough (45.3%), and expectoration (26.7%) at admission (25).

There has been several and worryingly increasing cases of COVID-19 incidence in the study area of the authors and in Nigeria as a whole. However, dearth of literature exists on the effective management and final outcomes of COVID-19. Hence, the objective of this study is to assess the clinical presentations and outcomes among hospitalized COVID-19 patients in Ondo State, Southwestern Nigeria.

Materials and method

Study setting

The study was conducted in Ondo State, Nigeria, created on February 3, 1976 from the former Western State with GPS coordinates of 7° 6' 0.0180'' N and 4° 50' 30.0984'' E (Fig 1). It originally included the present Ekiti State, which was split off in 1996. Akure is the State capital and according to the 2006 census, the State had a population of 3,460,877 (26).

Study design, population and criteria

This study was longitudinal in design and was conducted on COVID-19 patients admitted to the Infectious Disease Hospital, Akure, Ondo State from March 2020 to July 2020. COVID-19 diagnosis was made on the basis of positive SARS-COV-2 rRT-PCR test (11). Patients whose disease did not require hospitalization or for certain reasons were not admitted into the hospital, were excluded from the study.

A simple random sampling method was used to select the hospitalized COVID-19 patients for the study. Data was collected from each patient medical record using a chart abstraction tool containing biodata, socio-demographic, clinical presentations, underlying health conditions, management and outcome of COVID-19. Ethical approval was obtained from the Ondo State Ministry of Health, Akure, with NHREC/18/08/2016 and OSHREC/17/07/2020/278.

Fig 1: Map of Nigeria showing the location of Ondo State

Specimen collection and laboratory analysis
Both oropharyngeal and nasopharyn-geal swabs were obtained from each patient for the diagnosis of COVID-19 by the real-time RT-PCR (rRT-PCR) assay

Statistical analysis
Clinical data were analysed using the Statistical Package for the Social Sciences (SPSS) for windows version 24.0 software (SPSS Inc; Chicago, IL, USA). Frequency distribution was generated for all variables and statistical test of significance was performed with Chi-square test and Odd's ratio (OR). Other data were expressed as mean±standard deviation. Significant association was fixed at $p<0.05$ and highly significant association at $p<0.01$.

Results:

A total of 215 COVID-19 patients were studied; 103 males and 112 females (M:F ratio of 1:1.1). The mean age of the patients was 37.24±16.83 years, and over half (53.0%) were between the ages 25-44 years (Table 1). Tables 2 shows the symptoms exhibited by patients. The most common symptoms were shortness of breath (22.8%), cough (18.6%), fatigue (17.2%), runny nose (16.7%), fever (16.3%) and sneezing (14.0%). Less than 2% of the patients experienced ageusia and anosmia (Tables 2).

The patients were routinely treated with lopinavir-ritonavir, and also received supplements such as vitamin C, zinc and calcium. The mean duration of admission was 9.00±5.20 days, with certain patients admitted for as long as 39 days. Ten (4.7%) of the 215 hospitalized patients died and most death occurred within 1-3 days of admission.

Table 1: Age and gender distribution of COVID-19 patients in Ondo State, Nigeria (March – July 2020)

Age group (years)	Gender		Total (%)
	Male (%)	Female (%)	
<10	7 (3.3)	7 (3.3)	14 (6.5)
10 – 14	0	2 (0.9)	2 (0.9)
15 – 19	4 (1.9)	4 (1.9)	8 (3.7)
20 - 24	2 (0.9)	11 (5.1)	13 (6.0)
25 – 29	14 (6.5)	19 (8.8)	33 (15.3)
30 – 34	15 (7.0)	14 (6.5)	29 (13.5)
35 – 39	17 (7.9)	14 (6.5)	31 (14.4)
40 – 44	9 (4.2)	12 (5.6)	21 (9.8)
45 – 49	9 (4.2)	8 (3.7)	17 (7.9)
50 – 54	4 (1.9)	6 (2.8)	10 (4.7)
55 – 60	11 (5.1)	6 (2.8)	17 (7.9)
≥ 60	11 (5.1)	9 (4.2)	20 (9.3)
Total	**103 (47.9)**	**112 (52.1)**	**215 (100)**

Table 2: Clinical symptoms in hospitalized COVID-19 patients in Ondo State, Nigeria (March – July 2020)

Clinical symptom	Frequency (%)
Fever	35 (16.3)
Cough	40 (18.6)
Shortness of breath	49 (22.8)
Sore throat	14 (6.5)
Runny nose	36 (16.7)
Sneezing	30 (14.0)
Body Ache	13 (6.0)
Fatigue	37 (17.2)
Loss of appetite	14 (6.5)
Muscle/Joint Pain	29 (13.5)
Vomiting	14 (6.5)
Headache	8 (3.7)
Diarrhoea	19 (8.8)
Ageusia	2 (0.9)
Anosmia	3 (1.4)

Table 3: Statistical analysis of impacts of clinical symptoms on outcome of hospitalized COVID-19 patients in Ondo State, Nigeria (March to July 2020)

Clinical symptoms	*χ^2	OR	95% CI	p value**
Shortness of breath	0.98	0.14	0.04 – 0.51	0.323
Fever	8.75	2.17	0.29 – 16.63	0.003
Sneezing	11.35	2.75	0.34 – 18.27	0.001
Cough	0.90	0.51	0.13 – 2.08	0.343

*The null hypothesis is rejected when the Chi square test statistic (χ^2) is greater than the critical value of 3.84; **$p<0.05$ is statistically significant; OR = Odds ratio; CI = Confidence interval

Discussion:

This study revealed that the most common symptoms were shortness of breath (22.8%), cough (18.6%), fatigue (17.2%), runny nose (16.7%), fever (16.3%) and sneezing (14.0%). These symptoms are typical of the epidemiology of the disease and similar to findings of other previous studies in Africa, Europe and Asia (8,27,28) although COVID-19 has been reported to affect different people in different ways, with some asymptomatic for the disease. The most common symptoms across the world have been reported to include cough and fever (29), thus, this study shows that identification of suspected COVID-19 patients may be more difficult than envisaged as over two-thirds of the patients shows neither symptom of cough nor fever. An elevated temperature is one way to identify a person who may have COVID-19 infection, although an infected person may be contagious without an elevated temperature or not detected by the temperature assessment device. Therefore, the efficiency of the use of non-contact temperature assessment devices as part of initial check to identify possible COVID-19 patients may have to be reviewed. This suggests that temperature measurements alone may not be adequate to identify potential positive coronavirus patients.

This study showed that less than 2% of the patients experienced ageusia and anosmia. This is in contrast to a Qatar study which reported prevalence rates of ageusia, anosmia, and ageusia and anosmia to be 8.51%, 11.35%, and 4.96% respectively, with overall prevalence rate 24.8% (30). Loss of smell and taste are common complaints in patients with the COVID-19, which may present alone or with other symptoms. Anosmia has already been reported in the course of COVID-19 worldwide, however, it represents a rare occurrence as shown in this study. It is not uncommon for upper respiratory infections to affect the senses of smell and taste (31), as the sense of taste and sense of smell are closely linked. Infact, experiencing a loss of smell can greatly impact the sense of taste. It is estimated that 95% of the time when there is a loss of taste, it is associated with a reduced sense of smell (31). Therefore, it is not uncommon for both to occur together in patients as indicated in this study.

The Chi square and Odd's ratio (OR) showed that fever and sneezing were the two clinical symptoms that had impact on the outcome of patients. This was evidenced by the fact that of the 35 patients who had fever on presentation at the point of hospital admission, 30 (86%) of them recovered (χ^2=8.75, OR 2.17, p=0.003), while of 30 patients who were sneezing on admission day, 25 (83%) recovered from the virus infection (χ^2=11.35, OR 2.75, p=0.001). Conversely, cough and shortness of breath did not have significant impact on outcome as 37 (93%) of the 40 patients who presented with cough at the point of hospital admission recovered (χ^2= 0.90, OR 0.51, p=0.343) while 48 of 49 (98%) of the patients who presented with shortness of breath on the day of admission recovered from the disease (χ^2=0.98, OR 0.98, p= 0.323). This observation may be due to the fact that most of the COVID-19 patients who presented with fever and sneezing had some other health conditions (data not shown), which may have contributed to these clinical symptoms that were further exacerbated by the virus infection, thereby impacting the final outcome, with more fatalities in this category of patients compared to others.

Conclusion:

In conclusion, this study showed that the most common clinical presentations in COVID-19 include shortness of breath, cough and fever, however, identification of suspected COVID-19 patients may be more difficult than envisaged as over two-thirds of the patients showed neither symptom of cough nor fever. Temperature measurements alone may not be adequate to identify potential positive COVID-19 patients.

References:

1.   Hui, D. S., Azhar, E., Madani, T. A., et al. The continuing 2019-nCoV epidemic threat of novel coronaviruses to global health — The latest 2019

novel coronavirus outbreak in Wuhan, China. Int J Infect Dis. 2020; 91: 264–266.

2. 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): 1199–1207.

3. Adhikari, S. P., Meng, S., Wu, Y., et al. Epidemiology, causes, clinical manifestation and diagnosis, prevention and control of new coronavirus disease (COVID-19) during the early outbreak period: a scoping rebiew. Infect Dis Poverty. 2020; 9: 29. https://doi.org/10.1186/s40249-020-00646-x

4. Callaway, E. Time to use the p-word? Coronavirus enters dangerous new phase. Nature. 2020: doi:10.1038/d41586-020-00551-1

5. Centers for Disease Control and Prevention Newsroom CDC Updates " How COVID is Spread " Webpage. 2021; 2021.

6. World Health Organization (WH)) Estimates for 2000–2015. WHO, 2017 http://www.who.int/healthinfo/global_burden_disease/estimates/en/index1.html.

7. Centers for Disease Control and Prevention. Common Human Coronaviruses. CDC. 2019; 2: 229. https://www.cdc.gov/handwashing

8. Bowale, A., Abayomi, A., Idris, J., et al. Clinical presentation, case management and outcomes for the first 32 COVID-19 patients in Nigeria. Pan Afr Med J. 2020; 35 (2): 24. doi:10.11604/pamj.2020.35.2.23262

9. Centers for Disease Control and Prevention. Symptoms of Coronavirus. CDC 2020; 2019: 316475.

10. Velavan, T. P., and Meyer, C. G. The COVID-19 epidemic. Trop Med Int Health. 2020; 25 (3): 278–80.

11. World Health Organization. Laboratory testing for coronavirus disease 2019 (COVID-19) in suspected human cases. 2020; (March): 1–7.

12. Centers for Disease Control and Prevention. 2019 Novel Coronavirus 2019 Novel Coronavirus (2019-nCoV) Situation Summary. 2019;

13. Center for Disesase Control Division of Viral Diseases. CDC 2019-Novel Coronavirus (2019-nCoV) Real-Time RT-PCR Diagnostic Panel 2019-nCoVEUA-01 CDC-006-00019, Revision: 06.2020; 80. https://www.fda.gov/media/134922/download

14. Division of Laboratory Systems (DLS) 03/15/2020. Lab Advisory : Updated Interim Guidelines for Collecting, Handling, and Testing Clinical Specimens from Persons Under Investigation (PUIs) for Coronavirus Disease 2019 (COVID-19). 2021; 2019: 2020–1.

15. Center for Disease Control. Interim gudielines for collecting, handling and testing clinical specimens from persons for coronavirus disease 2019 (COVID-19).

16. World Health Organization. Clinical management of severe acute respiratory infection when novel coronavirus (2019-nCoV) infection is suspected: interim guidance. 28 January 2020. WHO/2019-nCoV/clinical/2020.5%0ACCBY-NC-SA3.0IGO%0AWHO/2019-nCoV/clinical/2020.5%0ACCBY-NC-SA3.0IGO%0Ahttps://apps.who.int/iris/handle/10665/330893e

17. Stebbing, J., Phelan, A., Griffin, I., Tucker, C., Oechsle, O., Smith, D., and Richardson, P. COVID-19: combining antiviral and anti-inflammatory treatments. Lancet Infect Dis. 2020; 20 (4): 400–402. http://doi.org/10.1016/s1473-3099(20)30132-8

18. Nigeria Centre for Disease Control. First case of corona virus disease confirmed in Nigeria. NCDC 2020; (February 2020): 1–6. https://ncdc.gov.ng/news/227/first-case-of-corona-virus-disease-confirmed-in-nigeria

19. Maclean, R., and Dahir, A. L. Nigeria Responds to First Coronavirus Case in Sub-Saharan Africa. New York Times 2020; 1–6. https://www.nytimes.com/2020/02/28/world/africa/nigeria-coronavirus.html

20. Remuzzi, A., and Remuzzi, G. COVID-19 and Italy: what next? Lancet 2020; 395 (10231): 1225–1228. http://dx.doi.org/10.1016/S0140-6736(20)30627-9

21. Emorinken, M. COVID-19: Updated: First death recorded as confirmed cases rise to 36. Nation Newspaper. 2020.

22. Lovato, A., and de Filippis, C. Clinical Presentation of COVID-19: A Systematic Review Focusing on Upper Airway Symptoms. Ear, Nose Throat J. 2020; 99 (9): 569–576.

23. Mash, B. Primary care management of the coronavirus (Covid-19). South Afr Fam Pract. 2020; 62 (1): 1–4.

24. Fan, J., Wang, H., Ye, G., et al. Low-density lipoprotein is a potential predictor of poor prognosis in patients with coronavirus disease 2019. Metabolism. 2020; 107 (154243).

25. Grasselli, G., Zangrillo, A., Zanella, A., et al. Baseline Characteristics and Outcomes of 1591 Patients Infected with SARS-CoV-2 Admitted to ICUs of the Lombardy Region, Italy. JAMA 2020; 323 (16): 1574–1581.

26. National Population Commission (NPC). 2006 PHC Priority Tables. NPC 2006; 1: 10–12. http://population.gov.ng/core-activities/surveys/ dataset/2006-phc-priority-tables/%0Ahttps://www.citypopulation.de/php/nigeria-admin.php?adm1id=NGA016%0A

27. Hu, Y., Sun, J., Dai, Z., Deng, H., Li, X., and Huang, Q. Prevalence and severity of corona virus disease 2019 (COVID-19): a systematic review and meta-analysis. J Clin Virol. 2020; 127: 104371. doi: 10.1016/j.jcv.2020.104371

28. Sun, P., Qie, S., Liu, Z., Ren, J., Li, K., and Xi, J. Clinical characteristics of hospitalized patients with SARS-CoV-2 infection: A single arm meta-analysis. J Med Virol. 2020; 92 (6): 612–617.

29. Tu, H., Tu, S., Gao, S., Shao, A., and Sheng, J. Current epidemiological and clinical features of COVID-19; a global perspective from China. J Infect. 2020; 81 (1): 1–9.

30. Al-Ani, R. M., and Acharya, D. Prevalence of Anosmia and Ageusia in Patients with COVID-19 at a Primary Health Center, Doha, Qatar. Indian J Otolaryngol Head Neck Surg. 2020; 1-7 https://doi.org/10.1007/s12070-020-02064-9

31. Agyeman, A. A., Chin, K. L., Landersdorfer, C. B., Liew, D., and Ofori-Asenso, R. Smell and Taste Dysfunction in Patients With COVID-19: A Systematic Review and Meta-analysis. Mayo Clin Proc. 2020; 95 (8): 1621–1631.