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## COVID-19 AND AUDIO-VESTIBULAR SYSTEM: A SYSTEMATIC REVIEW

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### Abstract

Audio-vestibular symptoms were noted in some covid-19 patients. In this review study, audio-vestibular symptoms associated with Covid-19 were investigated. Studies on Covid-19 and audio-vestibular system from Pubmed and Google Scholar electronic databases were reviewed. These studies were discussed under 2 titles as “hearing” and “dizziness”. It has been confirmed by studies in the literature that patients with Covid-19 may have symptoms such as hearing loss, tinnitus and dizziness, with mostly minor symptoms. These symptoms are generally in the form of sensorinoral hearing loss. Symptoms of tinnitus and dizziness have been reported less frequently. Further studies with objective tests are needed to understand the effect of Covid-19 on the audio-vestibular system.

**Key Words:** Covid-19, Hearing loss, Dizziness, Vestibular

## **COVID-19 VE ODYO-VESTİBÜLER SİSTEM: SİSTEMATİK DERLEME**

### **Öz**

Bazı covid-19 hastalarında odyo-vestibuler semptomlar belirtilmiştir. Bu derleme çalışmasında, Covid-19 ile ilişkili odyo-vestibüler semptomlar araştırılmıştır. Pubmed ve Google Akademik elektronik veri tabanlarından Covid-19 ve odyo-vestibular sistem ile ilgili çalışmalar incelenmiştir. Bu çalışmalar 'işitme' ve 'baş dönmesi' olmak üzere 2 başlık altında tartışılmıştır. Covid-19'lu hastalarda, çoğunlukla hafif düzeyde olmakla birlikte işitme kaybı, tinnitus ve dizziness gibi semptomların olabileceği literatürdeki çalışmalar ile doğrulanmıştır. Bu semptomlar genel olarak sensörinoral işitme kaybı şeklindedir. Tinnitus ve dizziness semptomları ise daha az bildirilmiştir. Covid-19'un odyo-vestibüler sisteme olan etkisini anlamak için objektif testlerle yapılan daha fazla çalışmaya ihtiyaç vardır.

**Anahtar kelimeler:** COVID-19, Dizziness, İşitme kaybı, Vestibüler

## **1. INTRODUCTION**

The novel coronavirus (SARS CoV-2), which the first appeared in China in late 2019, causing acute respiratory disease, affected the world. The disease that caused a global pandemic was named Covid-19 by the World Health Organization (WHO, 2020a). The clinical symptoms of the disease differ according to the individuals and cause symptoms such as fever, dry cough, weakness, anosmia, loss of taste and shortness of breath (Iacobucci, 2020; Menni et al, 2020; Xu et al, 2020; Uysal et al, 2020). Besides, it may be asymptomatic in some individuals. As the research on the disease increased, the previously unknown symptoms of the disease were understood day by day. Many medicines are administered to infected individuals to reduce the symptoms of this new disease and prevent deaths. However, some of these medicines may have several side effects. Finally, WHO made a statement (26 May 2020) (WHO, 2020a). In this statement, it stated that medicines with hydroxychloroquine, which have been used for Covid-19 treatment in many countries since the beginning of the pandemic, did not have a positive effect for the disease and that such medicines may have some side effects (WHO, 2020).

Viral infections have an important place in the pathogenesis of some audio-vestibular diseases (Goddard et al, 2011; Cohen et al, 2014). Vestibular neuritis that develops after upper respiratory tract infection may cause severe vertigo in individuals (Goddard et al, 2011). Viral labyrinthitis may affect hearing and balance. It may also seriously damage brain functions. Viral infections such as cytomegalovirus, rubella and measles may cause both acquired and congenital hearing loss (Cohen et al, 2014).

It has been reported that coronaviruses have neuro-trophic and neuro-invasive characters (Sahin et al, 2020). Therefore, coronaviruses may cause peripheral neuropathies. Besides, if the auditory nerve is affected, auditory neuropathy spectrum disorder may occur in these individuals.

The effect of Covid-19 on the audio-vestibular system is not fully known. In recent studies, it has been stated that covid-19 also affects the audio-vestibular system. The effect of covid-19 on the audio-vestibular system was investigated in this review.

## 2. MATERIAL AND METHODS

This review study included studies published between January 2020 and June 2020, investigating the effect of covid-19 on the audio-vestibular system. PubMed and Google Scholar were used as electronic database. 'Covid-19 and hearing', 'Covid-19 and vestibular', 'Covid-19 and vertigo' and 'Covid-19 and ear' were selected as the keywords. Case reports, original articles and letters to the editor were included in this review (Table 1). These articles were discussed under two topic; effect of covid-19 on hearing and effect of covid-19 on vestibular.

## 3. RESULTS AND DISCUSSION

Hearing receptors and vestibular receptors share the same bone and membranous labyrinth and show anatomical similarities with each other. Therefore, covid-19 may affect both the hearing system and the vestibular system. In addition, covid-19 may indirectly affect audio-vestibular patients. In the literature, the effect of covid-19 on the audio-vestibular system has been shown in some studies (Table 1).

**Table 1:** The characteristics and main symptoms of the included studies.

Authors	Publication Year	Study Type	Participants (n)	Audio-vestibular Symptoms	Audio-vestibular tests
Mustafa	2020	Original article	20	SNHL	Pure tone audiometr and TEOAE
Fidan	2020	Case report	1	Tinnitus and conductive hearing loss (Also otalgia)	Pure tone audiometry and tympanometry tests
Sriwijitalai et al.	2020	Letter to the editor	82	SNHL (n:1)	Unspecified
Kiliç et al.	2020	Original article	5	SNHL (1 patient with covid-19)	Pure tone audiometry
Lechien et al.	2020	Original article	1420	Earache (n: 358) Dizziness (n:6) Tinnitus (n:5)	unspecified
Karimi-Galougahi et al.	2020	Letter to the editor	6	Vertigo (n:2) SNHL (N:6)	Pure tone audiometry
Han et al.	2020	Letter to the editor	1	Conductive hearing loss (Acute otitis media) and vertigo	Unspecified
Cui et al.	2020	Original article	20	Dizzines and tinnitus (n:1), Otitis externa (n:1)	Unspecified

SNHL: Sensorineural hearing loss

The effect of Covid-19 on the hearing system was demonstrated by the pure sound audiometry test (PTO) and the Transient otoacoustic emission test (TEAOE) by Mustafa (Mustafa, 2020). Asymptomatic Covid-19 patients were reported to have worse high frequency PTO and TEOAE than the control group. The most sensitive area of the cochlea is the 1/3 basal part, including the high frequency region. In addition, outer hair cells are first affected by agents such as noise and ototoxicity. Therefore, the fact that asymptomatic covid-19 patients have worse high frequency PTO and TEOAE results may indicate that covid-19 affects the sensitive parts of the cochlea. Fidan (Fidan, 2020) reported that otalgia, tinnitus and unilateral conductive hearing loss in a patient with covid-19. In another study, it was reported that the disease caused sensorineural hearing loss (SNHL) in an elderly individual (Sriwijitalai et al, 2020). Covid-19 penetrates into the cell by affecting angiotensin-converting enzyme 2 (ACE2) (Cure et al, 2020a). As the cytosolic pH decreases, the virus becomes easier to bind to ACE2 (Cure et al, 2020b). There is also ACE2 in the brain. As a result, cytosolic pH levels may be transmitted more easily to elderly individuals, and may affect hearing loss in elderly individuals by affecting the temporal lobe, which is the center of hearing in the cortex (Cure et al, 2020a). Kılıç et al (2020) stated that 20% of patients who came to the clinic with a diagnosis of sudden hearing loss in the Covid process had positive the PRC test. They suggested that individuals who come to the clinic with the diagnosis of sudden hearing loss in this process, should be evaluated in terms of Covid-19 even if they do not have a specific symptom. Lechien et al (2020) studied the symptoms of 1420 covid-19 patients and reported tinnitus in 5 (3.5%) of these patients. In another study, it was reported that some patients with covid-19 had acute unilateral SNHL hearing loss (Karimi-Galougahi et al, 2020). Finally, Cui et al (2020) reported otitis externa in a patient with covid-19. As can be seen from these studies, the effect of covid-19 on the hearing system is quite diverse. In addition, there is no specific audiological symptom in individuals with covid-19.

The effect of Covid-19 on the vestibular system is less known (Lechien et al, 2020; Karimi-Galougahi et al, 2020; Cui et al, 2020; Han et al, 2020). In the study of Lechien et al (2020) 6 (4.2%) of 1420 Covid-19 patients reported vertigo symptoms. Limited information has been provided in other studies on dizziness (Cui et al, 2020; Han et al, 2020).

On the other hand, Covid-19 may also affect the audio-vestibular patients. In a study, masks used to reduce the spread of coronavirus have been reported to prevent lip reading (Trecca et al, 2020). It is stated that this situation causes communication problems in individuals with hearing loss. Undoubtedly, such studies will lead to the production of ergonomic masks for individuals with hearing loss.

In conclusion, hearing loss has been reported in asymptomatic Covid-19 patients. Although this hearing loss is generally seen as SNHL, it may also be in the form of conduction hearing loss. Tinnitus and dizziness was less reported in patients with Covid-19. Vestibular compensation mechanism may hide vestibular symptoms. For this reason, vestibular evaluation should be done with objective tests in these patients. Further studies with objective tests are needed to understand the effect of Covid-19 on the audio-vestibular system.

## **REFERENCES**

Cohen BE, Durstenfeld A, Roehm PC. (2014) Viral causes of hearing loss: a review for hearing health professionals. Trends in Hearing. 18:2331216514541361. doi:10.1177/2331216514541361

Cui C, Yao Q, Zhang D, et al. (2020). Approaching Otolaryngology Patients During the COVID-19. Pandemic. Otolaryngology Head Neck Surgery. 163(1):121-131. doi:10.1177/0194599820926144

Cure E, Cumhuriyet Cure M. (2020a). Comment on "Hearing loss and COVID-19: A note". American Journal of Otolaryngology. 41(4):102513. doi:10.1016/j.amjoto.2020.102513

Cure E, Cumhuriyet Cure M. (2020b). Comment on "organ-protective effect of angiotensin-converting enzyme 2 and its effect on the prognosis of COVID-19". Journal of Medical Virology. 8;10.1002/jmv.25848 <https://doi.org/10.1002/jmv.25848>.

Fidan V. (2020). New type of corona virus induced acute otitis media in adult. American Journal of Otolaryngology. 41(3):102487. doi:10.1016/j.amjoto.2020.102487

Goddard JC, Fayad JN. (2011). Vestibular neuritis. *Otolaryngologic Clinics of Nort America*. 44:361-5. <https://doi.org/10.1016/j.otc.2011.01.00>.

Han W, Quan B, Guo Y, et al. (2020). The course of clinical diagnosis and treatment of a case infected with coronavirus disease 2019. *Journal of Medical Virology*. 92(5):461-463. doi:10.1002/jmv.25711

Iacobucci G. (2020). Sixty Seconds on ... Anosmia. *BMJ*. 368: m1202. doi: [10.1136/bmj.m1202](https://doi.org/10.1136/bmj.m1202).

Karimi-Galougahi M, Naeini AS, Raad N, Mikaniki N, Ghorbani J. (2020). Vertigo and hearing loss during the COVID-19 pandemic - is there an association?. *Acta Otorhinolaryngologica Italica*. 2020;10.14639/0392-100X-N0820. doi:10.14639/0392-100X-N0820

Kilic O, Kalcioğlu MT, Çağ Y, et al. (2020). Could sudden sensorineural hearing loss be the sole manifestation of COVID-19? An investigation into SARS-COV-2 in the etiology of sudden sensorineural hearing loss. *Journal of Infection Disease*. 97:208-211. doi:10.1016/j.ijid.2020.06.023

Lechien JR, Chiesa-Estomba CM, Place S, et al. (2020). Clinical and epidemiological characteristics of 1420 European patients with mild-to-moderate coronavirus disease 2019 *Journal of International Medicine*. 10.1111/joim.13089. doi:10.1111/joim.13089

Menni C, Valdes A, Freydin MB et al. (2020). Loss of Smell and Taste in Combination with Other Symptoms is a Strong Predictor of COVID-19 Infection. *MedRxiv*. doi:10.1101/2020.04.05.20048421.

Mustafa MWM. (2020). Audiological profile of asymptomatic Covid-19 PCR-positive cases. *American Journal of Otolaryngolgy*. 41(3):102483. doi:10.1016/j.amjoto.2020.102483

Sahin AR, Erdogan A, Agaoglu PM et al. (2020). 2020 Novel Coronavirus (COVID-19) Outbreak: A Review of the Current Literature. Eurasian Journal of Medicine and Oncology 4 (1): 1–7. doi:10.14744/ejmo.2020.12220.

Sriwijitalai W, Wiwanitkit V. (2020). Hearing loss and COVID-19: A note. American Journal of Otolaryngology. 41(3):102473. doi:10.1016/j.amjoto.2020.102473

Trecca EMC, Gelardi M, Cassano M. (2020). COVID-19 and hearing difficulties. American Journal of Otolaryngology. 41(4):102496. doi:10.1016/j.amjoto.2020.102496

Uysal B, Demirkıran M, Yorulmaz, M. (2020). Assessing of factors effecting COVID-19 mortality rate on a global basis. Turkish Studies, 15(4), 1185-1192. <https://dx.doi.org/10.7827/TurkishStudies.44390>

World Health Organization, WHO. (2020a) Rolling updates on coronavirus disease (COVID-19). <https://www.who.int/emergencies/diseases/novel-coronavirus-2019/events-as-theyhappen>.

World Health Organization, WHO. (2020b) Hydroxychloroquine and COVID-19. <https://www.who.int/news-room/q-a-detail/q-a-hydroxychloroquineandcovid19#:~:text=Although%20hydroxychloroquine%20and%20chloroquine%20are,of%20COVID%2D19>.

Xu XW, Wu XX, Jiang XG, et al. (2020). Clinical findings in a group of patients infected with the 2019 novel coronavirus (SARS-Cov-2) outside of Wuhan, China: retrospective case series BMJ. 368:m606. Published 2020 Feb 19. doi:10.1136/bmj.m606