

# Research Paper: The Relationship Between Sudden Sensorineural Hearing Loss, Vestibular Neuritis, and Infection With COVID-19

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## ABSTRACT

**Introduction:** This study aimed to investigate the relationship between sudden sensorineural hearing loss, vestibular neuritis, and infection with COVID-19.

**Materials and Methods:** In this study, a total of 56 Iranians (32 females and 24 males) with a Mean±SD age of 45.12±14 years were studied in Tehran City, Iran. Individuals diagnosed with Sudden Sensorineural Hearing Loss (SSNHL) or vestibular neuritis based on definitive diagnostic criteria were included in the study. The methodology comprised four sections of underlying Sudden Hearing Loss, auditory and vestibular inspection, SARS-CoV-2 Reverse Transcription-Polymerase Chain Reaction (RT-PCR) test, and statistical analysis. Also, the videonystagmography test was used in participants with vertigo to diagnose vestibular neuritis. Pure tone audiometry confirmed SSNHL in some patients with a complaint of hearing loss. Furthermore, tuning fork, Rinne and Weber tests were also performed.

**Results:** The results of SARS-CoV-2 RT-PCR in 56 subjects showed that eight subjects (22.2%) with vestibular neuritis and two with SSNHL (10%) had a positive RT-PCR test. The Chi-square and Fisher exact-tests with a 95% confidence interval revealed no statistically significant ( $P>0.05$ ) relationship between COVID-19 infection and vestibular neuritis or SSNHL.

**Conclusion:** The present study showed no statistically significant relationship between audiovestibular disorders and positive SARS-CoV-2 RT-PCR test. However, the possibility of this relationship cannot be ruled out, and there is a need for studies with larger sample sizes.

**Keywords:** COVID-19, Sudden hearing loss, Vestibular Neuritis (VN), Vertigo, Hearing loss, Otolaryngology

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## 1. Introduction

**A**s of November 15, 2020, The World Health Organization has reported 53507282 confirmed cases of COVID-19 [1]. According to current evidence, the COVID-19 virus is transmitted through respiratory droplets and direct contact [2-6]. Those infected with COVID-19 show a wide range of symptoms that may appear 2-14 days after exposure to the virus [3, 4]. The Centers for Disease Control and Prevention (CDC) reported that people with fever or chills, cough, fatigue, sore throat, headache, muscle or body aches, diarrhea, shortness of breath or breathing difficulty, the new loss of taste or smell, congestion, or a runny nose might have COVID-19 (“Centers for Disease Control and Prevention, Coronavirus Disease, Watch for symptoms”) [7].

To date, several neurological complications have been reported in patients with COVID-19. Neurological symptoms in these patients are classified into three categories: symptoms related to Central Nervous System (CNS) involvement (including headache and dizziness, cerebrovascular events, demyelinating diseases, impaired consciousness, seizure, movement disorders, CNS vasculitis, and cranial nerve disorders), symptoms related to the Peripheral Nervous System (PNS) involvement (including cranial nerve disorders and Guillain-Barré Syndrome [GBS]), and symptoms related to musculoskeletal injury or Neuromuscular Junction (NMJ) disorder [7]. Besides the mentioned symptoms, some studies have recently reported and evaluated Sudden Sensorineural Hearing Loss (SSNHL) [7-12] and Vestibular Neuritis (VN) [13, 14] in COVID-19 patients. It is unclear whether these neurologic problems are the direct effect of the nervous system infection by the virus or through an indirect or inflammatory response to the cytokine storm [14]. VN is one of the most common peripheral causes of the acute vestibular syndrome. The main signs of VN are spontaneous horizontal torsional nystagmus beating away from the side of the lesion, abnormal head impulse test results on the involved semicircular canals, unsteadiness, with a falling tendency toward the lesion side and ipsilesional Canal Paresis (CP) [15].

The review of literature on coronavirus associated with SSNHL and VN, the unknown pathophysiology of this problem, and the contradictory results of recent studies highlights the importance of the topic. Also, more investigation into the auditory complication of COVID-19 patients during the pandemic may play an essential role in controlling auditory complications. This study aimed to investigate the relationship between SSNHL, VN, and infection with COVID-19.

## 2. Materials and Methods

The present study was conducted on 1280 individuals who complained of otolaryngology visiting an Ear, Nose, and Throat (ENT) clinic in Tehran City, Iran, from August to October 2020. The methodology comprised four sections of underlying diseases, auditory and vestibular inspection, SARS-CoV-2 Reverse Transcription-Polymerase Chain Reaction (RT-PCR) test, and statistical analysis.

In this study, a total of 56 Iranians (32 females and 24 males) with a Mean±SD age of 45.12±14 years were studied in Tehran. Individuals diagnosed with SSNHL or VN based on definitive diagnosis criteria were included in the study.

### Underlying diseases

First, the profile of participants was collected (such as age, gender, underlying disease, auditory symptoms, etc.). Patients under a specific medication or with blood circulation problems, neurological disorders, inner ear disorders, and head trauma were excluded from the study [16].

### Auditory and vestibular inspection

After collecting data about the history of diseases, the patients with a complaint of acute vertigo or sudden hearing loss entered the study for Videonystagmography (VNG) and audiometry tests, respectively. Otosopic examination and tympanometry were performed to check for bilateral normal tympanic membranes and external auditory canals. The VNG test was used in participants with vertigo to diagnose vestibular neuritis. Pure tone audiometry confirmed SSNHL in some patients with a complaint of hearing loss. Furthermore, tuning fork, Rinne and Weber tests were also performed.

In this study, VN is an essential variety in its features with various complications for the common VNG examination method. According to the VNG test protocol, weakness of over 25% in caloric testing of individuals is the confirmation of vestibular neuritis [17]. In addition, SSNHL is defined as a sensorineural hearing loss of 30 dB or greater over at least three consecutive audiometric frequencies occurring within 72 hours [18]. Some viruses can cause unilateral or bilateral SSNHL. This injury happens through damaging the inner ear structures or precipitating inflammatory responses [18, 19]

### Treatment

In this study, high doses of steroids (prednisone) were administered orally for SSNHL cases, and if there was no adequate response, three to six sessions of intratympanic corticosteroid injection were performed. Vestibular rehabilitation exercises and vertigo suppressant medications were used to treat those with vertigo.

### SARS-CoV-2 RT-PCR test

The patients with SSNHL or VN were referred to the Infectious Diseases Clinic for SARS-CoV-2 RT-PCR testing. Strict precautions were taken in a safety cabinet with disposable isolation gowns, masks, gloves, and shields. Oropharyngeal secretion samples were collected from the oropharynx and then the nasopharynx through direct contact of the synthetic fiber-tipped swabs with plastic shafts.

### Statistical analysis

The collected data were analyzed in SPSS v. 24. They were analyzed using descriptive statistics and tests such as the Chi-square and Fisher exact-test with a 95% confidence interval to assess the relationship between SSNHL and VN and COVID-19.

### 3. Results

Hearing loss varied from moderate to severe in SSNHL (n=20) patients where the affected side was 70% right and 30% left. Three SSNHL cases had a history of hearing loss on the other side (15%), one had SSNHL in the last year (5%), and one case of the SSNHL was diabetic (5%). Among the SSNHL cases, one patient (5%) has been infected with COVID-19 in the study and recovered in the past four months, and incidentally, he had anosmia.

Results of pure tone audiometry in suspected VN showed normal audiometry, and the patient experienced true vertigo a week ago. The results of the Dix-Hallpike

test were negative for them. The caloric test showed that vestibular weakness in these patients (n=36) was over 25% in both affected sides. This finding with spontaneous nystagmus in darkness or head-shaking nystagmus indicated vestibular neuritis. The descriptive characteristics of individuals with both SSNHL and VN are presented in Table 1.

The results of SARS-CoV-2 RT-PCR in 56 subjects showed that eight subjects (22.2%) with VN and two (10%) with SSNHL had a positive RT-PCR test.

The results of the Chi-square and Fisher exact-test with a 95% confidence interval revealed no statistically significant ( $P>0.05$ ) relationship between COVID-19 infection and VN and SSNHL (Table 2). Odds Ratio (ORs) calculation was not carried out in this study due to the absence of a significant relationship.

### 4. Discussion

Sudden sensorineural hearing loss in the context of COVID-19 has not been extensively identified to date. The first case report on the interrelationship between SARS-CoV-2-induced hearing loss was recorded in Thailand by Sriwijitalai and Wiwanitkit. It was an older woman infected with COVID-19 with neurosensory hearing loss. However, no changes in the hearing loss problem were observed after recovery [8]. Koumpa et al. reported SSNHL in a 45-year-old patient with asthma followed by hearing loss for a week while hospitalized for COVID-19 treatment. After following up, they reported no clear etiology for SSNHL [10]. In the case report by Rhman and Wahid, a 52-year-old man with confirmed COVID-19 and no neurological deficit was studied. His audiometry revealed left severe sensorineural hearing loss. Thus, they stated that in patients with sudden hearing loss, COVID-19 should be considered [9]. Degan et al. reported acute profound SSNHL in a 60-year-old man after COVID-19 pneumonia [20]. According to some studies, SARS-COV-2 was investigated

**Table 1.** Descriptive characteristics of Sudden Sensorineural Hearing Loss (SSNHL) and Vestibular Neuritis (VN) individuals

Disease	Age Range (y)	Affected Side	No. (%)
SSNHL (n=20)	9-78	Right	14(70)
		Left	6(30)
VN (n=36)	18-56	Right	23(64)
		Left	13(36)

**Table 2.** The results of relationship between COVID-19 infectious and occurrence of Sudden Sensorineural Hearing Loss (SSNHL) and Vestibular Neuritis (VN)

Dependent Variable	RT-PCR		Odds Ratio	
	Negative Case	Positive Case		
VN	Case	18	2	2.5
	% within VN	90.0	10.0	
	Case	28	8	
	Yes	77.8	22.2	
	% within VN			
	Approximate significance		0.264	
SSNHL	Case	28	8	0.389
	% within SSNHL	77.8	22.2	
	Case	18	2	
	Yes	90.0	10.0	
	% within SSNHL			
	Approximate significance		0.253	

RT-PCR: Reverse Transcription-Polymerase Chain Reaction.



in the etiology of SSNHL, and they stated that SSNHL with non-specific symptoms could be the only symptom of COVID-19 in patients [11, 21].

Studies failed to be specific enough in the context of COVID-19 for the symptoms to be considered vestibular in basis. Vertigo was reported in 7 patients in the studies by Han et al. [22] and Lechien et al. [23]. Fadakar reported a case with progressive vertigo [24]. Although vertigo has not yet been investigated in the academic literature, it does not mean that neurologists underestimate any neurological symptoms.

Considering the previous studies and notable literature on the novel coronavirus infection, the results of the studies were contradictory, and COVID-19-induced audiovestibular symptoms have not yet been widely identified. In a systematic review, Almufarrij et al. confirmed this and concluded that reports on audiovestibular symptoms in COVID-19 patients are few with poor quality [13].

The present study sought to investigate the confirmed VN and SSNHL in patients visiting an ENT clinic during the COVID-19 pandemic to determine the relationship between these symptoms and infection with COVID-19. Based on the findings of this study, there was no statistically significant relationship between sudden sensorineural hearing loss, vestibular neuritis, and infection with COVID-19. However, This result can be different with other samples or clinical settings.

## 5. Conclusion

The present study showed no statistically significant relationship among confirmed audiovestibular disorders and positive SARS-CoV-2 RT-PCR test. To conclude, it is necessary to conduct further studies and research on different Groups involved. Also, due to published reports of audiovestibular disorders during the COVID-19 epidemic, future studies with larger sample sizes are recommended.

## Ethical Considerations

### Compliance with ethical guidelines

This study was approved by the Ethics Committee of Tehran University of Medical Sciences (Code. IR.TUMS.FNM.REC.1399.214). All ethical principles are considered in this article. The participants were informed about the purpose of the research and its implementation stages. They were also assured about the confidentiality of their information and were free to leave the study whenever they wished, and if desired, the research results would be available to them.

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### Authors contributions

All authors equally contributed to preparing this article.

### Conflict of interest

The authors declared no conflict of interest.

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