

COVID-19 Vaccination Effects on Tinnitus and Hyperacusis: Longitudinal Case study

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ABSTRACT

The case study explores COVID-19 vaccination connection to tinnitus and hyperacusis, considering its onset and exacerbation post vaccination. The subject is a 47-year-old woman with a history of bilateral tinnitus, and her hearing history was tracked from 2014 to 2023. An intense episode of tinnitus occurred in 2021, distinct from previous experiences post COVID-19 vaccination, second dose. Symptoms manifested as sudden onset of hyperacusis, pronounced “roar” type tinnitus, and a sudden decline in hearing. Audiometric results showed reduce thresholds in low frequencies and lower speech scores in the left ear. This escalation significantly affects speech understanding in group conditions and noisy environments. There was a gradual improvement in tinnitus and hyperacusis severity, but the subject has a greater problem with speech understanding. The subject’s journey involved visits to specialists, multiple testing including neuroimaging, naturopath consultations, and anxiety medication. It emphasizes the importance of healthcare practitioners recognizing and documenting these issues and need for timely multidisciplinary intervention and support. Further research is necessary to better understand the relationship between COVID-19, vaccination, and auditory symptoms.

Keywords: Tinnitus, Hyperacusis, Speech understanding, Covid-19 vaccination, Hearing loss.

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INTRODUCTION

The impact of COVID-19 on neurosensory systems remains insufficiently understood. There have been reports of tinnitus, vertigo, and sensorineural hearing loss occurring after COVID-19 infections. However, a clear correlation and causation between these conditions and the virus have not been established¹. Understanding COVID-19-Related Tinnitus: Emerging Evidence and Implications,” Science & Research News. Tinnitus Today, 2023. Early studies noted cases of new-onset tinnitus in conjunction with hearing loss following COVID-19 infection²⁻⁵. Subsequent case reports⁶⁻⁸ and comprehensive studies further indicated its frequent occurrence among affected patients^{9, 10}. Some cases have been reported where patients experienced changes in hearing loss and perceived loudness^{11, 12}.

The relation between tinnitus and hyperacusis is notably strong, with approximately 86% of hyperacusis patients also experiencing tinnitus¹³, and around 27% to 40% of tinnitus patients displaying hyperacusis symptoms^{14, 15}. Hyperacusis in tinnitus has been associated with younger age, greater tinnitus-related mental and general distress, and increased pain disorders and vertigo¹⁶. In addition, individuals with persistent tinnitus commonly experience an exacerbation of their symptoms in response to psychological stress or emotional strain^{17, 18}, and the circumstances brought about by the pandemic can be regarded as a stress-inducing factor¹⁹⁻²¹. During the recent phase of the pandemic, many people noted heightened sensitivity to sounds on the day of vaccination or during the first week after vaccination²². Studies like Erinc, et al.²³ reported the relationship of tinnitus and hyperacusis in patients affected by COVID-19 infection. In this study, the notable increase in hyperacusis is related to stress, but the factor of vaccination changes in the auditory system was not considered.

Driven by two research questions, this case study outlined herein examined (i) if COVID-19 vaccination impacts pre-existing hearing loss, tinnitus, and hyperacusis and (ii) whether the pandemic-induced circumstances affect existing tinnitus or hyperacusis. To address these questions, investigated the influence of COVID-19 and vaccination on a subject with chronic tinnitus. Gathered and compared data related to hearing tinnitus and hyperacusis from a subject before and two years after the start of the pandemic.

This study presents a unique case of severe change in the sensitivity of hearing, tinnitus and hyperacusis post first dose of COVID-19 vaccine.

CASE PRESENTATION

A female subject aged 47 years has reportedly been experiencing bilateral tinnitus for the preceding three decades. Subject history indicated recurrent middle ear infections and developed scarring on their tympanic membranes due to frequent air travel during childhood. By their adolescent years, these ear infections ceased.

Their initial recollection of a hearing assessment indicated minor hearing loss. While lacking official records, it is noteworthy that mild, intermittent tinnitus persisted since their teenage years—an aspect consistently communicated to audiologists. This tinnitus, typically bilateral, held limited significance to the subject.

A report from 2014 stated that the subject reported occasional tinnitus in her right ear only. In 2008, subject had her middle ear infection and was diagnosed with labyrinthitis in 2010. The subject experienced dizziness during this period. Her pure-tone audiometry revealed a symmetrical bilateral mild to moderate Sensorineural Hearing Loss (SNHL) (Table 1) with absent reflexes and good speech scores. In 2016, despite discussions about hearing aids, the subject chose not to proceed at that juncture.

Audiological reports from 2017 (Table 1) indicate mild to moderate SNHL and reported intermittent use of hearing aids, evolving into more regular usage. In mid-late 2019, the subject reported vertigo issues and received a diagnosis of Benign Paroxysmal Positional Vertigo (BPPV) and engaged in physiotherapy, resulting in its amelioration (Table 1).

In the context leading up to October 1, 2021 (the day of their second Pfizer vaccination) and from 2021, the subject's contemporaneous diary facilitated the documentation of their ear health trajectory:

May-June: There was a reported Eustachian tube dysfunction which prompted a sense of aural obstruction. Allergy tests revealed environmental sensitivities (like dust, cats). A referral to an otolaryngologist ensued.

July 12, 2021: The Subject experienced hyperacusis for the first time in the left ear (which might be associated with the existing middle ear issues).

July 13, 2021: Consulted an otolaryngologist with no documented report. The otolaryngologist noted no definitive treatment for the eustachian tube dysfunction or hyperacusis, anticipating their spontaneous resolution over time. By July 19, hyperacusis abated, and minimal discomfort prevailed for several weeks.

August 12, 2021: An annual hearing evaluation indicated no deterioration from the prior year (Table 1).

September 4, 2021: Received the first dose of the Pfizer vaccine with minimal apprehension.

September 9, 2021: Hyperacusis re-emerged in the left ear alongside pronounced “roar” type tinnitus, persisting through most of September and continuing to the present.

October 1, 2021: received her second Pfizer vaccination in the left arm. On October 2, there is unequivocal evidence of an exceptionally intense episode of tinnitus in the left ear in 2021 distinct from any previous experiences. The onset of tinnitus commenced at around 4:30 PM, a moment firmly etched in their memory due to its profound impact. The subject noticed a significant increase in

Table 1. Pure tone audiometry and speech scores of the patient from the year 2014 to 2023.

Date of test	Right ear (AC thresholds in dB HL)										Left ear (AC thresholds in dB HL)											
	Speech scores (dB)	250	500	750	1k	1.5k	2k	3k	4k	6k	8k	Speech scores (dB)	250	500	750	1k	1.5k	2k	3k	4k	6k	8k
26/11/2014	100% at 55	35	25		30		45	45	35	40	25	97% at 55	25	30		30		40	35	45	45	45
09/05/2017	100% at 55	25	20		30	45	45	40	35	40	45	100% at 55	30	25		40	40	45	45	50	45	50
12/08/2021	100% at 65	20	15	30	35	45	50	45	40	35	50	100% at 70	25	20	40	45	45	50	40	50	40	55
24/06/2022	100% at 60	25	30	35	35	45	40	40	40	50	50	87% at 70	50	50	50	50	45	55	40	55	55	55
29/03/2023	97% at 60	20	30	35	40	50	50	45	35	60	55	87% at 70	40	40	45	50	50	50	45	50	55	55

tinnitus in her left ear, reaching an almost unbearable level, accompanied by a sudden deterioration in her hearing. She consulted an ENT on October 8 2021, subject was told her tinnitus and hyperacusis might be due to anxiety. An MRI was recommended, with no hearing tests deemed necessary given the recent August evaluation. However, the MRI was deferred due to concerns related to noise. The subject then leaned towards naturopath consultation which recommended a regimen of herbal and mineral supplements, including high-dose magnesium. During this week, subject perceived the sound as being so loud that subject worried it might be causing damage to her hearing, much like any other intense noise would. The episodes lasted for 3-8 hours each day and occur regularly. The subject reported the hyperacusis experienced after receiving the vaccine has profoundly impacted her daily life. The subjects now find tolerating everyday sounds, such as stacking plates, the TV, or the hair dryer, extremely challenging. The condition has caused weeks of insomnia, even with the aid of sleep medication, leading to feelings of depression. As a result of heightened sensitivity to sound, the subject has been unable to socialize or leave the house except for essential activities like attending her children’s school events. From January 2022, the subject was on medication for anxiety management (10mg Entrip).

June 2022: The Subject visited an audiologist with ongoing concerns, leading to the suggestion of seeking a second opinion from another ENT specialist. Her left ear showed a significant deterioration at low frequencies with reduced speech scores (Table 1). The second ENT acknowledged hearing loss and tinnitus. Requested an MRI for further evaluation, and no anomalies emerged from the imaging. The subject was then on Cognitive Based Therapy to improve tinnitus and hyperacusis. Over time, the extreme tinnitus in her left ear gradually diminished to a more tolerable level. However, it still fluctuates, and the subject now experiences three different constant ‘tones’ of bilateral tinnitus. Her hearing has not changed per March 2023 audiogram values (Table 1). In May 2023, the subject contracted

COVID-19 and noticed a slight increase in tinnitus (though not as severe as in October 2021), but there have been no significant changes since then.

August 2023: Current hyperacusis in the subjects left ear remains constant, and the tinnitus levels are a little closer to pre-vaccination levels but do still spike at times and can become overwhelming. The subject has been consulting a psychologist since 2021 for the management of the ongoing hyperacusis and hearing loss. Since July 2023, the subject has been able to tolerate using hearing aids occasionally at a reduced volume.

COVID-19 vaccination effects on Tinnitus, Hyperacusis and Speech Understanding

The subject was asked to rate the questions Figure 1 on tinnitus, hyperacusis, and speech understanding before COVID-19 vaccination, after COVID-19 vaccination, and their status as of August 25, 2023. The rating scale was from 0 to 10, where 0 is no effect and 10 is extreme. Questions were adapted for different standardized questionnaires for tinnitus and hyperacusis. Figure 1 illustrates the results of the rating. The comparison of the effect of COVID-19 vaccination (i) before to immediately after vaccination results showed an increase in all the aspects of tinnitus- loudness, severity and anxiety from 2 to 10, and pitch changed from 3 (low) to 8 (high). As time passed, as of August 25 2023, the ratings lowered i.e., loudness, severity, and anxiety from 10 to 7, and pitch changed from 8 to 7. (ii) For hyperacusis, the change from before to immediately after COVID-19 vaccination was from median 1 to 7 and reduced to 5 as of Aug 2023. (iii) Speech Understanding ability followed a similar trend before and after vaccination, rating showed a change median 3 to 8. The effect remained the same for the speech’s clarity, rated as 8. Understanding group/ conversations has slightly improved.

Regarding hearing impairment, during the intense bout of tinnitus in 2021, the subject’s hearing was diminished and compounded by the struggle to hear beyond the tinnitus noise. Gradually, the tinnitus was reported to subside to a

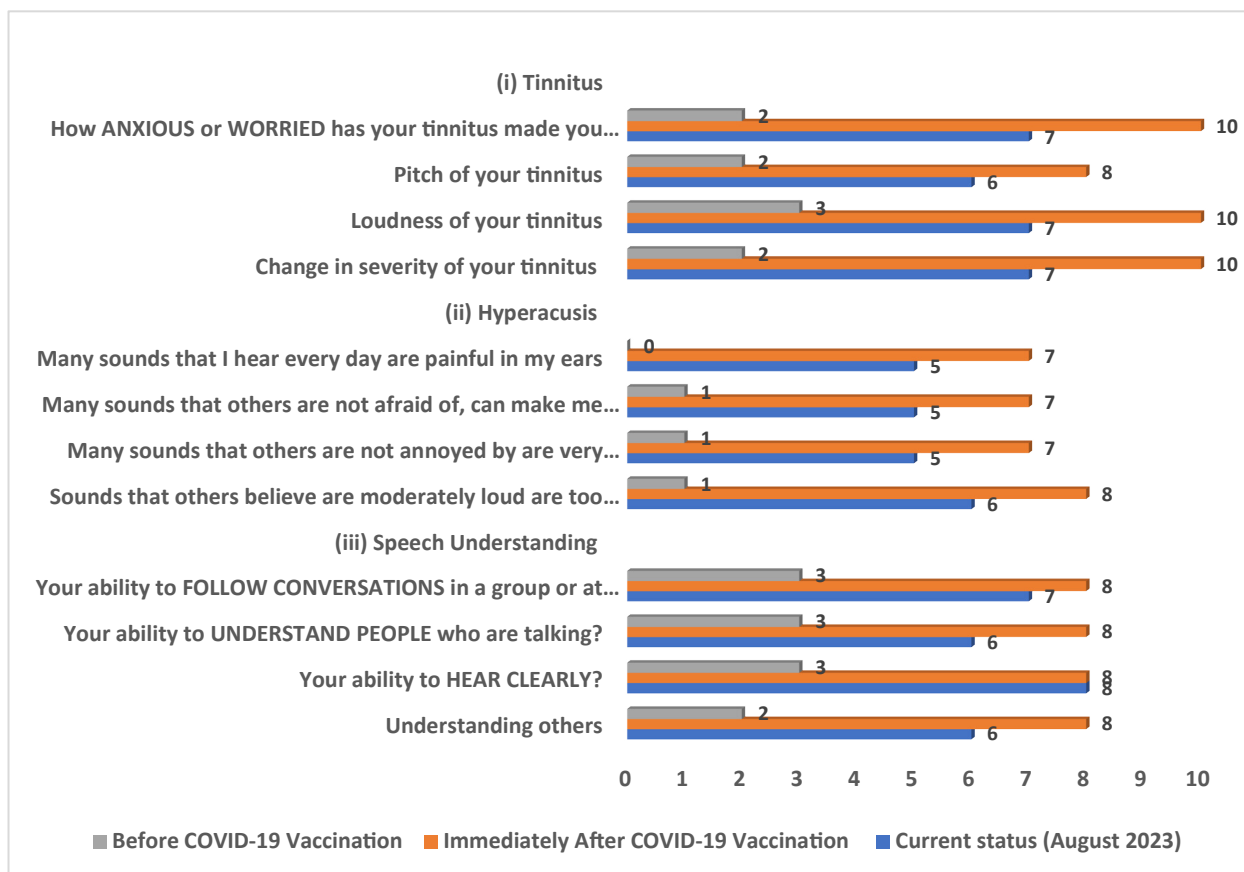


Figure 1: Subjective rating of (i) Tinnitus, (ii) Hyperacusis and (iii) Speech Understanding ability of the patient before COVID-19 vaccination, immediately after COVID-19 vaccination and as of 25 Aug 2023 (current status). Rating scale: 0-10 scale (0 = No effect, 10 = extremely).

Table 2. Showing responses of Modified Khalfa Hyperacusis Questionnaire²³ for before COVID-19 vaccination and after COVID-19 vaccination. The questionnaire contains 7 Functional, 6 Social, and 7 Emotional questions. Rating scored as Yes as 5, Sometimes as 2, No as 0. Loudness Sensitivity Handicap Scale (LSHS) for before COVID-19 vaccination indicated normal sensitivity and after COVID-19 vaccination indicated severe loudness sensitivity.

Modified Khalfa Hyperacusis Questionnaire (Khalifa et al, 2002)	Before COVID_19 Vaccination	After COVID_19 vaccination
1. Do you have trouble concentrating in a noisy or loud environment?	Sometimes	Yes
2. Do you have trouble reading in a noisy or loud environment?	No	Sometimes
3. Do you ever use earplugs or earmuffs to reduce your noise perception? (Do not consider the use of hearing protection during abnormally high exposure situations.)	No	Sometimes
4. Do you find it harder to ignore sounds around you in everyday situations?	No	Yes
5. Do you find it difficult to listen to speaker announcements (such as airport, airplanes, trains, etc.)?	No	Sometimes
6. Are you particularly sensitive to or bothered by street noise?	No	Sometimes
7. Do you “automatically” cover your ears in the presence of somewhat louder sounds?	No	Yes
Functional Subscale Total	0	23
8. When someone suggests doing something (going out, to the cinema, to a concert, etc.), do you immediately think about the noise you are going to have to put up with?	No	Yes
9. Do you ever turn down an invitation or not go out because of the noise you would have to face?	No	Yes
10. Do you find the noise unpleasant in certain social situations (e.g., nightclubs, pubs or bars, concerts, firework displays, cocktail receptions)?	Sometimes	Yes
11. Has anyone you know ever told you that you tolerate noise or certain kinds of sounds badly?	No	No
12. Are you particularly bothered by sounds others are not?	No	Yes
13. Are you afraid of sounds that others are not?	No	Sometimes

Social Subscale Total	2	22
14. Do noise and certain sounds cause you stress and irritation?	No	Sometimes
15. Are you less able to concentrate in noise toward the end of the day?	Sometimes	Yes
16. Do stress and tiredness reduce your ability to concentrate in noise?	Sometimes	Yes
17. Do you find sounds annoy you and not others?	No	Yes
18. Are you emotionally drained by having to put up with all daily sounds?	No	Yes
19. Do you find daily sounds having an emotional impact on you?	No	Yes
20. Are you irritated by sounds others are not?	No	Yes
Emotional Subscale Total	4	32
Subscale Total	8 (Normal)	77 (Severe)

more bearable level, making it less challenging to disregard. The hearing loss's substantial effects persist on speech perception and on her lifestyle. For instance, subjects reported watching TV without subtitles is a challenge for her despite using hearing aids or returning to the cinema seems implausible, too loud, and wouldn't understand.

To understand the effect of hyperacusis on the subject's functional, social, and emotional wellbeing, 'Tinnitus Practitioners Association MODIFIED Khalfa Hyperacusis Questionnaire²⁴ was administered. A questionnaire was administered before and after COVID-19 vaccination. The results showed a severe effect on all three categories after COVID-19 vaccination condition compared to normal before vaccination results (Table 2).

DISCUSSION

Numerous reports have been published, sparking controversy and debate surrounding the potential effects of COVID-19 vaccination on tinnitus and hyperacusis²⁵. Notably, there exists a body of extensive studies²⁶⁻²⁹ that supports and delves into this phenomenon. In addition to the discussions on auditory issues, various research studies have highlighted a notable increase in psychological challenges, including anxiety, depression, and other mental health issues, throughout the course of the COVID-19 pandemic³⁰. In this case presentation, the subject reported experiencing stress and anxiety post onset of tinnitus and experienced hyperacusis. The association between stress and anxiety during the pandemic has been suggested to contribute to tinnitus in some individuals³¹. The key observation in this particular case study is that COVID-19 could potentially exacerbate pre-existing conditions, leading to the advertising of the existing tinnitus and sudden relapse of hyperacusis. The subject reported experiencing tinnitus on July 21, 2021 and relapsed after the second vaccination on October 1, 2021. The tinnitus experienced a notable surge in severity, pitch, and loudness³². Over time, there seems to be improvement in medical and psychological management for hyperacusis and hearing loss. The hyperacusis became more severe, leading to negative impacts. Tinnitus and hyperacusis have significantly compromised subjects' lifestyle and speech comprehension abilities. Their description indicates profound disturbances in daily life.

These poignant encounters emphasize the urgency of timely assistance and support for individuals affected

by tinnitus. Ongoing research aims to elucidate the precise mechanisms that establish a connection between COVID-19 vaccination and the development of tinnitus or hyperacusis. Healthcare practitioners must remain vigilant in recognizing and documenting instances of tinnitus and hyperacusis in patients with a history of COVID-19. Swift intervention, in collaboration with specialists in audiology, as well as the provision of empathetic care, play a pivotal role in mitigating the adverse effects of tinnitus on patients' overall well-being. During this ongoing inquiry, healthcare providers should stay attuned to the evolving evidence surrounding tinnitus concerning COVID-19.

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