

Main Article

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Author for correspondence:
Dr Suna Tokgoz Yilmaz, Audiology, Balance,
Speech Disorders Diagnosis and Rehabilitation
Center, Ankara University, Ibni Sina Hospital,
No: 82, Talatpaşa Street,
06230 Altındağ/Ankara, Turkey
E-mail: sunayilmaz11@gmail.com

Effects of the coronavirus disease 2019 pandemic on subjective tinnitus perception

Z Aydoğan¹ , M Çınar Satekin², E Ocak³ and S Tokgoz Yilmaz²

¹Audiology Department, Faculty of Health Sciences, Ankara University, ²Audiology, Balance, Speech Disorders Diagnosis and Rehabilitation Center, Ankara University, Ibni Sina Hospital, Ankara and ³ENT Department, Faculty of Medicine, Ankara University, Ibni Sina Hospital, Ankara, Turkey

Abstract

Objective. This study investigated the effects of the coronavirus disease 2019 pandemic on tinnitus severity and quality of life in individuals with subjective tinnitus.

Methods. The study was carried out during the coronavirus disease 2019 pandemic. Sixty patients were evaluated with the Tinnitus Handicap Inventory and a visual analogue scale on resonance intensity and disturbance, together with questions assessing their emotional states.

Results. There was a significant difference between the visual analogue scale and the Tinnitus Handicap Inventory scores before the pandemic and during the pandemic. It was determined that tinnitus loudness and annoyance were significantly worse in the pandemic and, consequently, that the coronavirus disease 2019 pandemic negatively affected perceptions of tinnitus and quality of life.

Conclusion. Psychological support can affect positively the perception of tinnitus and the change in moods experienced during the pandemic. Because personal contact and quotidian activities are severely limited during the pandemic, internet-based interventions should be prioritised in tinnitus therapy.

Introduction

Coronavirus disease 2019 (Covid-19) is an infectious disease caused by a newly discovered coronavirus. Covid-19 spread quickly, becoming a world-wide pandemic.¹ The numbers of positive cases and deaths have reached remarkable numbers globally.² The rapid increase in cases and deaths has brought new challenges and concerns. Previously published studies reported that this process is likely to have negative psychosocial effects on individuals.^{3,4} Accordingly, the Covid-19 pandemic is a potential environmental stressor that might influence individually perceived tinnitus distress.

Tinnitus is defined as the sound perceived in the ear or head in the absence of an acoustic stimulus, and is evaluated as either objective or subjective.⁵ Given its complex physiology, the precise aetiopathogenesis of subjective tinnitus remains unclear. Many risk factors have been defined for tinnitus, such as sensorineural hearing loss, ototoxic drugs, tumours and emotional stress.⁶ Tinnitus has also been associated with psychosocial disorders, such as stress, depression and anxiety.^{7,8} Changes in the emotional state and quality of life of individuals who have subjective tinnitus complaints appear to be important factors for changes in tinnitus perception.⁹

It was observed that the patients who were diagnosed and were being followed up for subjective tinnitus in our clinic before the Covid-19 pandemic experienced more emotional complaints and increased tinnitus severity when re-admitted to our clinic during the pandemic. We believe that the increased stress levels due to quarantine conditions during the pandemic may have changed the patients' perception of tinnitus and increased its severity. We aimed to evaluate the effects of the pandemic in terms of changes in emotional state and quality of life associated with tinnitus severity in these patients.

Materials and methods

This study involved data collected between January 2018 and February 2020 at the ENT Department, Faculty of Medicine, Ankara University, Ibni Sina Hospital, and Audiology Center. Ethics committee permission (decision number: 19-596-20, 12 November 2020, Human Research Ethics Committee, Faculty of Medicine, Ankara University), and Ministry of Health permission (approval code: 2020-10-19T14_47_08) were obtained before the study commenced. Informed consent was given by all participants via e-mail before the study, and the Declaration of Helsinki principles were followed.

A total of 60 patients (26 females and 34 males) were included in the study. All patients were diagnosed with subjective tinnitus before the official announcement of the Covid-19 pandemic in Turkey in March 2020. In this study, the availability of the data for

2018–2019 enabled a prospective longitudinal study design with a direct within-subject comparison.

The inclusion criteria were: tinnitus complaints for at least six months; normal magnetic resonance imaging results; normal otoscopic examination results; normal hearing (pure tone hearing thresholds of less than 20 dB at 0.5, 1, 2 and 4 kHz and an air–bone gap of less than 10 dB HL); normal immittance metric measurements (middle-ear pressure within the limits of -100 , $+50$ daPa, and with a type A tympanogram); normal limits of ipsilateral and contralateral acoustic reflex thresholds (at 0.5, 1, 2 and 4 kHz); and no systemic diseases.

The exclusion criteria were: abnormal hearing and normal immittance metric measurements; hypertension, hyperlipidaemia or diabetes; any middle-ear pathology such as otosclerosis or otitis media; being diagnosed with acoustic neuroma (monitored or treated); previous ear surgery and/or cranial surgery; Ménière's disease or active ear discharge; and any neuropsychiatric disease.

The participants' pre-pandemic data were obtained from the patient files. During the Covid-19 pandemic, participants were questioned via telephone or e-mail to ensure social distancing, and visual analogue scale (VAS) and Tinnitus Handicap Inventory data were collected. In addition, the emotional state of individuals during the pandemic was assessed in terms of five categories (happy and joyful; neutral; sad; stressful, anxious and pessimistic; or angry) and compared with the VAS and Tinnitus Handicap Inventory scores.

Tinnitus Handicap Inventory

The questionnaire consisted of 25 questions, each of which could be answered with 'yes' (4 points), 'sometimes' (2 points) or 'no' (0 points). The total score could range from 0 to 100. A higher score indicates a greater tinnitus-related handicap. A validated Turkish form of the Tinnitus Handicap Inventory was used in this study.¹⁰

Visual analogue scale

The patients were asked to mark the severity of the resonance and the level of disturbance from the resonance on two separate lines measuring 10 cm in length each. The marked point was measured using a ruler. Greater deviance from zero indicates higher resonance intensity (loudness) and increased disturbance (annoyance).

Emotional states

Five different emotional states were used to evaluate the patients' subjective perception of tinnitus during the pandemic.¹¹ A 'happy and joyful' mood reflects feeling satisfied or lucky. A 'neutral' mood represents feeling the same or indifferent. A 'sad' mood is defined as being unhappy, upset or joyless. A 'stressful, anxious and pessimistic' mood reflects feeling uptight or overstrung. An 'angry' mood represents feeling annoyed.

Statistical analysis

Statistical analysis was performed using the SPSS version 21.0 software (IBM, Armonk, New York, USA). G*Power version 3.1 software¹² was used to decide the sample size (with the parameters: correlation of interest $\rho = 0.5$, type I error rate $\alpha = 0.05$, and power = 0.95). Using a one-way hypothesis, the

Table 1. Participants' demographic data

Parameter	Participants (n (%))	Age (mean \pm SD; years)
Female	26 (43.3)	41.50 \pm 12.8
Male	34 (56.7)	47.23 \pm 13.5
Total	60 (100)	44.22 \pm 14.7

SD = standard deviation

total sample size needed was determined to be 59. Percentage values for categorical variables and mean \pm standard deviation values for age variables were used for the descriptive statistics. Pre- and peri-pandemic VAS (tinnitus loudness and annoyance) and total Tinnitus Handicap Inventory scores were compared. Histogram curves were used to evaluate whether the data were normally distributed. A paired samples *t*-test was used to compare normally distributed Tinnitus Handicap Inventory and VAS data. A *p*-value of 0.05 was considered statistically significant.

Results

This retrospective study compared the perception of tinnitus among individuals with tinnitus, both before and during the Covid-19 pandemic. The mean age (and standard deviation values) of the 60 individuals who participated in the study are shown in Table 1.

A significant difference was found between participants' pre- and peri-pandemic Tinnitus Handicap Inventory and VAS (tinnitus loudness and annoyance) scores ($p < 0.05$) (Table 2). Furthermore, the effect sizes were large (Cohen's *d* and Hedges' *g*), and the effects were found to be statistically significant when multiple comparisons were performed.

The emotional states of the participants during the pandemic are shown in Figure 1. There was a positive correlation between a 'stressful, anxious and pessimistic' mood and the participants' Tinnitus Handicap Inventory scores. A significant increase in stressful, anxious and pessimistic mood was observed in individuals with subjective tinnitus complaints, related to the Covid-19 pandemic.^{3,4} Our findings revealed that the stressful, anxious and pessimistic mood was associated with an increase in tinnitus loudness and annoyance. Furthermore, increased Tinnitus Handicap Inventory scores were associated with the stress, anxiety and pessimism experienced during the pandemic. Therefore, a stressful, anxious and pessimistic mood might be the trigger for tinnitus during the pandemic.

Discussion

This study investigated the effects of the Covid-19 pandemic on patients with tinnitus. The study revealed new insights regarding environmental influences on tinnitus distress and specific situations that affect tinnitus severity.

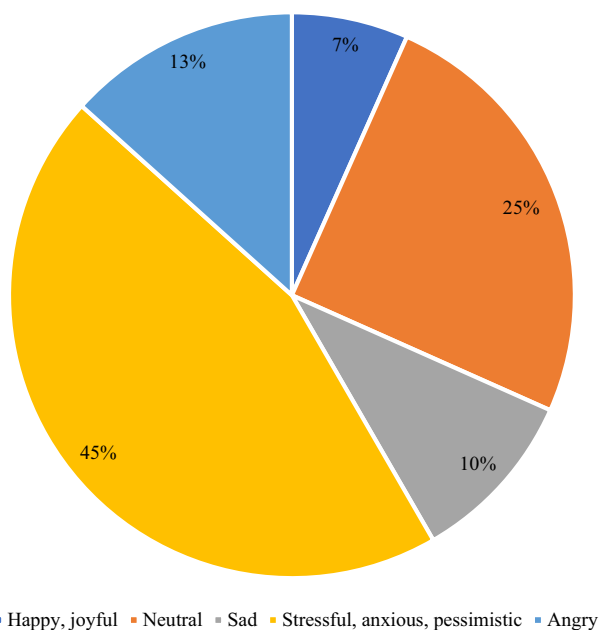
The survey, completed by 60 individuals, provided insights regarding tinnitus experiences during the Covid-19 pandemic. Lifestyle changes imposed by the pandemic appeared to be one of the factors that made tinnitus worse, as reported by almost two-thirds of the participants. Several studies have reported that factors such as anxiety, stress and pessimism have a negative effect on tinnitus.^{8,13}

Almost half of the respondents reported occupational changes due to the pandemic; this was reflected in the survey

Table 2. Comparison of scores before and during Covid-19 pandemic

Parameter	Participants (n)	Pre-pandemic scores (mean ± SD)	Peri-pandemic scores (mean ± SD)	p-value (paired t-test)	Cohen's d	Hedges' g
THI	60	31.53 ± 19.14	37.56 ± 21.80	0.026*	0.2939	0.2939
VAS						
- Loudness	60	4.35 ± 2.10	5.33 ± 2.60	0.002*	3.25	3.25
- Annoyance	60	4.53 ± 1.99	5.05 ± 2.66	0.002*	1.74	1.74

* $p < 0.05$. Covid-19 = coronavirus disease 2019; SD = standard deviation; THI = Tinnitus Handicap Inventory; VAS = visual analogue scale

**Fig. 1.** Tinnitus participants' emotional states during the pandemic.

results, and indicated that this situation negatively impacts tinnitus. The Tinnitus Handicap Inventory and VAS scores were worse during the pandemic than those before the pandemic.

The mechanism of tinnitus occurrence and treatment methods are still being discussed. Tinnitus is often claimed to be more noticeable in quiet environments, and this has led to the use of some form of background noise during tinnitus treatments to help prevent the starkness of tinnitus perception.¹⁴ Avoiding a silent environment has been suggested as an effective method to overcome auditory deprivation and increase symptom masking.¹⁵ During the pandemic, it is believed that the absence of environmental masking sounds in daily life may have increased the perception of tinnitus.^{16,17} Moreover, increased stress and anxiety levels during the pandemic are other potential risk factors that could have worsened tinnitus perception.^{16,17} In our study, parallel to these results, it was observed that the pandemic increased stressful, anxious and pessimistic moods, and consequently increased the perception of tinnitus.

Although tinnitus is not a personality disorder, it is a serious psychologically disabling factor. Severe tinnitus is generally associated with symptoms of depression, anxiety and sleep disorders.^{15,17} Insecurity, anxiety, nervousness and sleep problems can be seen in individuals with tinnitus.¹⁸ Studies have reported that tinnitus has a wide-ranging effect on affected individuals' quality of life, including their emotional state, concentration and sleep quality.¹⁹ Conversely,

psychological factors also increase the perception of tinnitus. Accordingly, anxiety, depression and sleep problems are often seen in individuals with tinnitus.¹⁶ Increased environmental stress and heightened awareness of tinnitus may also worsen tinnitus.¹⁶ Indeed, our findings revealed that increased stress and anxiety during the pandemic had a negative effect on tinnitus perception.

We observed a statistically significant increase in the subjective perception of tinnitus according to the Tinnitus Handicap Inventory and VAS scores, which is consistent with the main hypothesis of our study. The average increase in Tinnitus Handicap Inventory score was 6.03 points, while the average increase in VAS annoyance and loudness scores was 0.97 and 0.98 points, respectively.

Five different emotional states were used to evaluate participants' subjective perception of tinnitus during the pandemic. The participants were asked to choose the emotional state that best described their mood when experiencing tinnitus. Individuals with tinnitus who perceived their mood as stressful, anxious and pessimistic, or angry, during the pandemic reported an increase in their tinnitus perception.

It is known from clinical experience that life events which cause a stressful, anxious and pessimistic mood in individuals with tinnitus may worsen the perception of tinnitus. Our findings revealed that the worsening of tinnitus perception is mainly associated with a general emotional response during the pandemic. Particularly, we observed a positive correlation between Tinnitus Handicap Inventory scores and a sad, stressful, anxious and pessimistic, or angry, mood. Forty-five per cent of the participants indicated that they had a stressful, anxious and pessimistic mood during the Covid-19 pandemic, and it was observed that these individuals also had increased Tinnitus Handicap Inventory scores.

A study by Collet *et al.* (1990), which utilised the Minnesota Multiphasic Personality Inventory questionnaire in tinnitus cases, revealed a high score on the depression scale in men, and indicated a connection between long-term tinnitus and hypochondria, defined as health phobia.²⁰ In the literature, it is stated that a high score on the Minnesota Multiphasic Personality Inventory depression scale is specific to patients with severe tinnitus, and that stress and anxiety exacerbated their tinnitus symptoms.²¹ When compared with the general population, the rate of anxiety and somatoform disorders are higher in individuals with tinnitus, and anxiety and somatoform disorders are also associated with tinnitus perception.¹⁶

In our study, a difference was found between the pre- and peri-pandemic Tinnitus Handicap Inventory scores ($p = 0.026$), which is in line with studies that found a relationship between tinnitus and mood.^{11,22} Individuals with tinnitus complaints are unhappy, pessimistic, anxious, aggressive, stressed and

depressive, and can find it difficult to fall asleep. Tinnitus can prevent these individuals from enjoying life, focusing and relaxing.¹⁶ In addition, the perception of tinnitus loudness and annoyance increases in emotional situations, such as when experiencing stress, anxiety, pessimism, unhappiness or sadness.¹⁶

Besides the worsened perception of tinnitus in 2020 associated with the effects of the Covid-19 pandemic, a significant increase in tinnitus incidence was observed. An increase in tinnitus cases due to elevated psychological stress related to the Covid-19 pandemic was supported by relevant studies, according to which the psychological stress that emerged when coping with various pressures related to the Covid-19 pandemic increased the prevalence of anxiety in tinnitus patients.^{11,22} We attributed the increase in the scores to elevated stress associated with the Covid-19 pandemic because we found a positive correlation between the participants' moods and their Tinnitus Handicap Inventory and VAS scores. More studies need to be conducted to investigate the long-term effects of coronavirus infection on the hearing system and tinnitus. Our study included only a small sample size, with a limited number of research articles reviewed.

- The link between anxiety and tinnitus is often evaluated by how tinnitus as a stressor interacts with (pre-existing) psychological disorders and alters individuals' reactions
- Psychological support can positively affect tinnitus perception and moods experienced during the pandemic
- Personal contacts and social or daily life activities are severely limited during the pandemic
- Internet-based interventions could be considered primary in tinnitus therapy
- Mindfulness-based stress reduction interventions and psychological support are effective in coping with negative emotional situations during the pandemic

There are some limitations to this study. Although patients' Tinnitus Handicap Inventory and VAS scores were measured before the pandemic, we did not conduct face-to-face audiological and psychometric evaluations to determine their current hearing status, and the frequency and loudness of their tinnitus symptoms experienced in social isolation situations during the pandemic. Our study included only subjective, patient-centred data. In addition, no scale was used to evaluate the relationship between the participants' tinnitus and depression or their quality of life. Finally, the overall sample size in our study was small as the data were collected from only one hospital; thus, diversity of data was low. Our study findings need to be confirmed in further studies involving larger samples.

Conclusion

Currently, the link between anxiety and tinnitus is evaluated more in terms of how tinnitus as a stressor can interact with (pre-existing) psychological disorders and alter individuals' reactions, but no emphasis is placed on whether other stressors may worsen tinnitus.^{23,24} It is suggested that psychological support could positively influence tinnitus patients' perception of their symptoms and change their moods experienced during the pandemic. As personal contacts and social or daily life activities are severely limited during the pandemic, internet-based interventions could be considered primary in tinnitus therapy. In addition, we think that mindfulness-based stress reduction interventions and psychological support are

effective tools for coping with negative emotional situations during the pandemic.

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Competing interests. None declared

References

- 1 Remuzzi A, Remuzzi G. COVID-19 and Italy: what next? *Lancet* 2020;**395**:1225–8
- 2 World Health Organization. Coronavirus disease 2019 (COVID-19): situation report, 169 In: <https://apps.who.int/iris/bitstream/handle/10665/333149/nCoVsitrep07Jul2020-eng.pdf> [4 March 2020]
- 3 Brooks SK, Webster RK, Smith LE, Woodland L, Wessely S, Greenberg N *et al*. The psychological impact of quarantine and how to reduce it: rapid review of the evidence. *Lancet* 2020;**395**:912–20
- 4 Lu W, Wang H, Lin Y, Li L. Psychological status of medical workforce during the COVID-19 pandemic: a cross-sectional study. *Psychiatry Res* 2020;**288**:1129–36
- 5 Eggermont JJ, Roberts LE. The neuroscience of tinnitus. *Trends Neurosci* 2004;**27**:676–82
- 6 Bartels H, Pedersen SS, van der Laan BF, Staal MJ, Albers FW, Middel B. The impact of type D personality on health-related quality of life in tinnitus patients is mainly mediated by anxiety and depression. *Otol Neurotol* 2010;**31**:11–18
- 7 Durai M, Searchfield G. Anxiety and depression, personality traits relevant to tinnitus: a scoping review. *Int J Audiol* 2016;**55**:605–15
- 8 Mazurek B, Boecking B, Brueggemann P. Association between stress and tinnitus—new aspects. *Otol Neurotol* 2019;**40**:e467–73
- 9 Schlee W, Pryss RC, Probst T, Schobel J, Bachmeier A, Reichert M *et al*. Measuring the moment-to-moment variability of tinnitus: the TrackYourTinnitus smart phone app. *Front Aging Neurosci* 2016;**8**:294
- 10 Aksoy S, Firat Y, Alpar R. The Tinnitus Handicap Inventory: a study of validity and reliability. *Int Tinnitus J* 2007;**13**:94–8
- 11 Schlee W, Hølleland S, Bulla J, Simoes J, Neff P, Schoisswohl S *et al*. The effect of environmental stressors on tinnitus: a prospective longitudinal study on the impact of the COVID-19 pandemic. *J Clin Med* 2020;**9**:2756
- 12 G*Power: Statistical Power Analyses for Mac and Windows. In: <https://www.psychologie.hhu.de/arbeitsgruppen/allgemeine-psychologie-und-arbeitspsychologie/gpower.html> [16 March 2022]
- 13 Mazurek B, Szczepek A, Hebert S. Stress and tinnitus. *HNO* 2015;**63**:258–65
- 14 Harter M, Maurischat C, Weske G, Laszig R, Berger M. Psychological stress and impaired quality of life in patients with tinnitus [in German]. *HNO* 2004;**52**:125–31
- 15 Gritsenko K, Caldwell W, Shaparin N, Vydyanathan A, Kosharsky B. Resolution of long standing tinnitus following radiofrequency ablation of C2–C3 medial branches—a case report. *Pain Physician* 2014;**17**:E95–8
- 16 Wilson PH. Tinnitus reaction questionnaire properties of a measure of distress associated with tinnitus. *J Speech Hear Res* 1991;**34**:197–201
- 17 Zenner HP, Delb W, Kröner-Herwig B, Jäger B, Peroz I, Hesse G *et al*. A multidisciplinary systematic review of the treatment for chronic idiopathic tinnitus. *Eur Arch Otorhinolaryngol* 2017;**274**:2079–91
- 18 Budd RJ, Pugh R. The relationship between locus of control, tinnitus severity, and emotional distress in a group of tinnitus sufferers. *J Psychosom Res* 1995;**39**:1015–18
- 19 Anzivino R, Sciancalepore PI, Petrone P, D'Elia A, Petrone D, Quaranta N. Tinnitus revival during COVID-19 lockdown: how to deal with it? *Eur Arch Otorhinolaryngol* 2021;**278**:295–6
- 20 Collet L, Moussu MF, Disant F, Ahami T, Morgon A. Minnesota multiphasic personality inventory in tinnitus disorders. *Audiology* 1990;**29**:101–6
- 21 Marion MS, Cevette MJ. Tinnitus. *Mayo Clin Proc* 1991;**66**:614–20
- 22 Xia L, He G, Feng Y, Yu X, Zhao X, Chen Z *et al*. COVID 19 associated anxiety enhances tinnitus. *PLoS One* 2021;**16**:e0246328
- 23 Kröner-Herwig B, Zachriat C, Weigand D. Do patient characteristics predict outcome in the outpatient treatment of chronic tinnitus? *Psychosom Med* 2006;**3**:Doc07
- 24 Beukes EW, Baguley DM, Allen PM, Manchaiah V, Andersson G, Kaldo V *et al*. How does the COVID-19 pandemic affect tinnitus? In: British Tinnitus Association Virtual Conference 2020. In: <https://arro.anglia.ac.uk/id/eprint/705950/> [8 March 2021]