Phonak Field Study News.

Reported reduction in tinnitus-related annoyance when wearing hearing aids

This retrospective survey conducted with 329 adults with hearing loss and tinnitus found that the use of hearing aids reduced tinnitus-related annoyance in 72% of the participants.

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Key highlights

- The current report adds to the growing body of evidence which shows that hearing aid use has a positive influence on tinnitus.
- Hearing aid use led to a reduction in tinnitus-related annoyance in more than 70% of the participants. The effect did not vary based on daily use time.

Considerations for practice

- Hearing loss is a key risk factor for tinnitus (Biswas et al., 2023).
- Hearing aids offer a promising management option for tinnitus when accompanied by hearing loss. In severe cases of tinnitus, additional therapeutic approaches (e.g., psychotherapy) are necessary (Cima et al., 2019).
- Educating clients about tinnitus forms the basis for successful tinnitus management (Cima et al., 2019).

Introduction

Tinnitus is a highly prevalent symptom affecting approximately 15% of the global adult population (Jarach et al., 2022). Due to its heterogeneity, both in aetiology, perceptual characteristics, comorbidities, and patients' responses to therapeutic interventions, tinnitus remains largely an enigma (Cederroth et al., 2019). This poses a considerable challenge for tinnitus management, as a universal solution accounting for its heterogeneity is lacking. While several, partially overlapping, pathophysiological models exist, a unified model that adequately explains this heterogeneity remains elusive (Langguth et al., 2024). A recurring element of these different models is that tinnitus is preceded by some form of hearing loss. It is assumed that the reduction in auditory input leads to maladaptive changes in neural activity along the auditory pathway and altered activity, or connectivity, in various networks of the cerebral cortex. In some cases, this altered activity is interpreted as sound—tinnitus occurs. In a recent systematic review and meta-analysis, the connection between hearing integrity and tinnitus occurrence was further substantiated. Biswas et al. (2023) identified hearing loss as one of the key risk factors for tinnitus. Consequently, addressing the reduced auditory input by means of using hearing aids is one approach in tinnitus management. Although evidence is mixed, most studies show a positive effect of hearing aid use on tinnitus-related distress, loudness, and/or annoyance (Jacquemin et al., 2022) which is further corroborated by a recent multi-centre randomized clinical trial (Schoisswohl et al., 2024). The benefits of hearing aid provision are widely recognized in clinical practice and accordingly recommended by clinical guidelines (e.g., the European guidelines; Cima et al., 2019). The present report contributes to the existing evidence by exploring the impact of hearing aid use on tinnitus, based on survey data that assessed its influence on tinnitus-related annoyance.

Methodology

Customers from Lapperre clinics in Belgium experiencing tinnitus who purchased their first hearing aids between 2022 and 2024 were invited to participate in a survey. The survey comprised 12 questions focusing on their tinnitus and the perceived impact of hearing aids. The complete list of questions is provided in Supplementary Table 1. Two questions assessed tinnitus-related annoyance using a numeric rating scale ranging from 0 to 10, which served as primary outcome measure. Higher scores indicate greater levels of tinnitus-related annoyance. The questions were as follows:

"Can you estimate the annoyance you experienced from your tinnitus before wearing hearing aids?"
"Can you estimate the annoyance you experience from your tinnitus while you wear hearing aids?"

Additionally, when available, information on device usage, age, and various hearing-related data were collected, serving as covariates in subsequent analyses.

Device use

Participants indicated how long they wear their devices daily, with the following options: < 5 hours per day, 5–10 hours per day, > 10 hours per day, I do not wear my hearing aids.

Age

Participants' ages were classified in one of three categories: < 45 years, 45–65 years, > 65 years. Furthermore, a range of hearing-related data were collected by the HCPs before fitting the devices.

Audiometry

Hearing sensitivity was measured using standard pure tone audiometry for the frequencies of 1, 2, and 4 kHz. Participants' hearing was categorized in A, B, and C based on the pure tone average (PTA) of their worse ear: A = PTA < 30 dB HL, B = PTA 30–40 dB HL, C = PTA > 40 dB HL.

Speech-in-noise

Furthermore, speech perception in noise was assessed using speech-in-noise (SiN) tests. Participants' performance (i.e., signal to noise ratio; SNR) was categorized in A, B, and C according to the deviation from the normative values appropriate for their age group: A = Deviation of 0–2 dB SNR, B = Deviation of 3–6 dB SNR, C = Deviation of > 6 dB SNR. Higher deviations indicate greater SiN difficulties.

Subjective hearing

In addition to these perceptual tests, subjective hearing abilities were assessed using the *Do you hear well?* questionnaire (Caron & Picard, 1998). The questionnaire comprises 15 questions evaluating hearing abilities in various daily listening situations. Participants were again categorized into three different categories A, B, and C based on their scores: A = ≤ 14 points, B = 15–29 points, C = ≥ 30 points. Higher scores suggest greater issues with subjectively perceived hearing abilities.

Statistical analyses

A two-sided paired samples *t*-test was used to evaluate the difference in tinnitus-related annoyance before and while wearing hearing aids. Cohen's *d* is reported as standardized

effect size. In a further step, potential influences of additional covariates (i.e., device use, age, PTA, SiN, and subjective hearing) on the effects of hearing aid use on tinnitus-related annoyance were examined. Linear mixed effects models were fit using the *lme4* package (Bates et al., 2015) with tinnitus-related annoyance as dependent variable. For each model, fixed effects included the respective covariate, hearing aid use as categorical predictor (i.e., *before* and *while using hearing aids*), as well as the interaction between the two. Random effects included random intercepts for participants. All statistical tests were conducted in R (version 4.3.1; R Core Team, 2023).

Results

A total of 379 surveys were submitted. Among these, 10 surveys were returned blank, with 7 of those indicating that they did not wear their devices at all, and 40 participants reported not experiencing tinnitus, leading to their exclusion from the dataset. Consequently, 329 completed surveys served as basis for all subsequent analyses. Participants wore hearing aids from the brands Phonak or Unitron. A comprehensive list of the 37 device types used can be found in Supplementary Table 2. Sample characteristics, including distributions for age, device use per day, and hearing-related data, are depicted in Figure 1.

Tinnitus-related annoyance was retrospectively rated by participants before and during the use of hearing aids. Descriptively, among the 329 participants, ~72% (n = 237) reported a reduction, ~23% (n = 76) reported no change, and ~5% (n = 16) reported an increase in tinnitus-related annoyance while wearing their hearing aids compared to before wearing them. Utilizing a two-tailed paired samples t-test the effect of hearing aid use was statistically tested. This comparison indicates that wearing the devices had a significant impact on the perception of tinnitus ($t(328)$ = 16.93, $p < .001$). While wearing the hearing aids, participants found their tinnitus to be significantly less annoying (M = 4.59, SD = 2.37) than before wearing the hearing aids (M = 6.83, SD = 1.98) (Figure 2a). Furthermore, the effect size of d = 0.93 suggests a large effect. Figure 2b provides further insights into the data. Participants who report a higher initial level of annoyance (i.e., before hearing aid use) benefit most from using their devices.

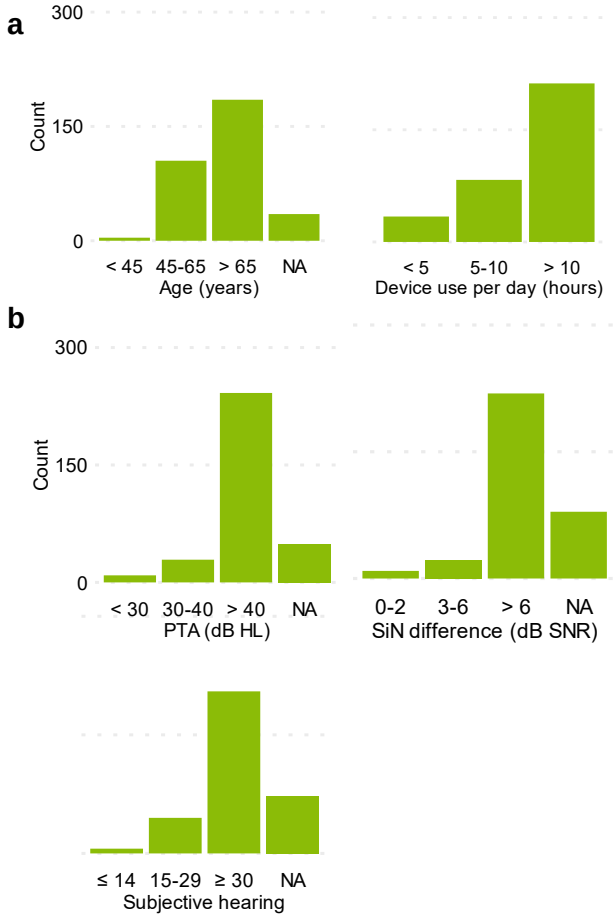

Figure 1. a Bar plots depicting participants' ages and daily hearing aid use times. Most participants were older than 65 years and most participants indicated that they use their devices for more than 10 hours a day. b Bar plots depicting participants' worse ear pure tone averages, performances in speech-in-noise tests relative to age-appropriate normative data, and scores in a subjective hearing abilities questionnaire. Most participants exhibit diminished hearing abilities, which is evident from the bar plots.
PTA = Pure Tone Average, SiN = Speech-in-Noise, NA = Not Available

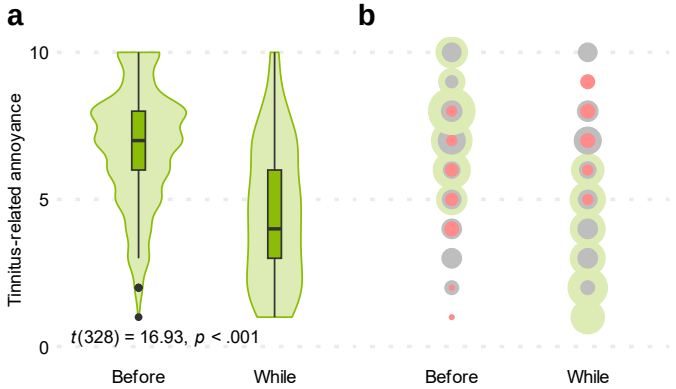

Figure 2. Effect of hearing aid use on tinnitus perception. a Box and violin plots depicting values in tinnitus-related annoyance before and while wearing hearing aids. Higher scores indicate greater levels of tinnitus-related annoyance. Statistical comparison revealed a significant reduction in annoyance while wearing hearing aids compared to before wearing them. b Plot illustrating reduction, no change, and increase in tinnitus-related annoyance. Participants who reported a reduction in annoyance are represented in green, while those who reported no change are shown in grey, and participants indicating an increase are depicted in red. The size of the circles corresponds to the number of participants who provided a specific score, with larger circles indicating a greater number of participants giving that score.

In a further step, it was explored whether various covariates had an effect on the observed reduction in tinnitus-related annoyance. Using linear mixed effects models, none of the covariates had a significant impact on the observed effect as indicated by the nonsignificant interaction between hearing aid use and the respective covariate (device use: $F(2, 326) = 1.74$, $p = .177$; age: $F(3, 325) = 0.85$, $p = .468$; PTA: $F(3, 325) = 1.09$, $p = .354$; SiN: $F(3, 325) = 0.88$, $p = .451$; subjective hearing: $F(3, 325) = 0.39$, $p = .759$).

Conclusion

Hearing loss has been identified as a primary risk factor for tinnitus (Biswas et al., 2023), and research suggests that hearing aids can have a positive effect on tinnitus and its associated consequences (Jacquemin et al., 2022). The current report adds to the growing body of evidence. In this survey, more than 70% of customers with tinnitus reported a reduction in tinnitus-related annoyance while wearing hearing aids. Given that tinnitus is a widespread issue that poses a considerable burden for many individuals, these findings are particularly important. However, it is essential to acknowledge that this report is based on survey data, which does not provide the same level of evidence as a well-designed randomized controlled trial. Furthermore, participants were required to retrospectively recall their levels of annoyance prior to purchasing hearing aids, potentially introducing a source of error. Moreover, while annoyance is an important dimension that characterizes tinnitus and its consequences, it is crucial to recognize that other factors, such as loudness, distress, and handicap, also play a vital role in the overall impact of tinnitus (Langguth & Gilles, 2024). Nevertheless, the findings presented here remain significant, offering distinct insights derived from real-world evidence.

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Supplementary information

Supplementary Table 1. List of survey questions. The questions serving as primary outcome are marked in bold

Q1 How many hours a day do you wear your Lapperre hearing aids?
Less than 5 hours per day
Between 5 and 10 hours per day
More than 10 hours per day
I do not wear my hearing aids

Q2 Did you experience tinnitus (ringing in the ears) before you started wearing hearing aids?
Yes
Sometimes
No

Q3 Can you estimate the annoyance you experienced from your tinnitus before wearing hearing aids?
0 1 2 3 4 5 6 7 8 9 10

Q4 Click on the answer to complete the sentence: "While wearing my hearing aids, my tinnitus is":
Completely gone
Much less present
Less present
The same
More present
Much more present

Q5 Can you estimate the annoyance you experience from your tinnitus while you wear hearing aids?
0 1 2 3 4 5 6 7 8 9 10

Q6 What is the tinnitus like when you take the hearing aids off?
Tinnitus does not come back
Tinnitus comes back after a while
Tinnitus comes back after a few minutes
Tinnitus comes back immediately

Q7 Indicate to what extent you agree with the following statement: "I can no longer do without my hearing aids in function of my tinnitus."
Totally agree
Agree
Neural
Disagree
Totally disagree

Q8 Indicate to what extent you agree with the following statement: "I advise people with tinnitus to try hearing aids."
Totally agree
Agree
Neural
Disagree
Totally disagree

Q9 What has had the most positive impact on your tinnitus for you?
Hearing aids
Additional information from the audiologist
Lapperre tinnitus app: SilentCloud
Other

Q10 How likely would you be to recommend Lapperre for the treatment of tinnitus?
1 2 3 4 5 6 7 8 9 10

Q11 Do you have any suggestions or questions to improve/optimize our approach for tinnitus patients in the future?
Open format

Q12 Why don't you wear your hearing aids (anymore)?
Open format

Supplementary Table 2. Hearing aid types used by survey participants. The table is sorted by number of occurrences of each hearing aid type in descending order. NA = Not Available

Article	*n*
Phonak Audéo L90-R	43
Phonak Audéo L70-R	35
Phonak Audéo P90-R	35
NA	34
Phonak Audéo P70-R	34
Phonak Audéo L50-R	27
Phonak Audéo P50-R	17
Phonak Audéo L90-RL	12
AudioNova B3-R	10
Phonak Audéo L30-R	8
Phonak Audéo P30-R	8
AudioNova B1-R	6
Phonak Audéo L70-RL	6
Phonak Slim L90-R Left	6
AudioNova B5-R	5
Phonak Audéo P90-RL	5
Phonak Slim L70-R Left	5
Phonak Audéo P90-13T	4
Phonak Audéo P90-312	4

Phonak Virto P90-titanium	4
Phonak Audéo P70-RL	2
Phonak Virto M90-titanium	2
Phonak Virto P70-titanium	2
AudioNova B3-312	1
AudioNova B7-R	1
AudioNova DX 50 R Li	1
AudioNova T 30 R 312	1
Phonak Audéo P50-312	1
Phonak Audéo P50-RL	1
Phonak Audéo P50-RT	1
Phonak Audéo P70-312	1
Phonak Naida P30-PR	1
Phonak Naida P50-PR	1
Phonak Naida P50-UP	1
Phonak Naida P70-PR	1
Phonak Slim L90-R Right	1
Phonak Virto M50 312	1
Phonak Virto P50-10 NW 0	1