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# THE UNHEARD HAZARD: A CROSS-SECTIONAL ANALYSIS OF NOISE-INDUCED HEARING LOSS, TINNITUS, AND PROTECTIVE BEHAVIORS AMONG ROMANIAN DENTISTS

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**Objective:** To evaluate the prevalence of diagnosed hearing loss, audiometrically-indicated hearing threshold shifts, tinnitus, and the adoption of hearing protection practices in a cohort of Romanian dental practitioners. **Methods:** A cross-sectional study was conducted on a cohort of 31 dentists from private clinics in Bucharest, Romania. Data were collected via a structured online questionnaire assessing demographics, work experience, noise exposure, and auditory symptoms. Audiometric evaluation was performed using portable pure-tone air conduction audiometry. **Results:** The cohort was predominantly young (83.9% under 40) with limited professional experience (90.3% < 10 years). While only one participant (3.2%) reported a formal diagnosis of hypoacusis, audiograms of more experienced dentists revealed characteristic high-frequency hearing threshold shifts consistent with incipient Noise-Induced Hearing Loss (NIHL). Tinnitus was reported by 6.5% of participants. Critically, 100% of participants reported using no form of hearing protection. **Conclusion:** The findings, particularly the universal lack of hearing protection, highlight a profound policy-practice gap in occupational health within this professional group. The audiometric data suggest that the low prevalence of diagnosed hearing loss masks a significant underlying risk of developing cumulative, irreversible NIHL. Urgent implementation of comprehensive Hearing Conservation Programs (HCPs), incorporating education, advanced screening, and modern protective technologies, is imperative for the dental profession.

*Keywords*: noise-induced hearing loss, dental office, tinnitus.

## INTRODUCTION

Noise-induced hearing loss (NIHL) represents one of the most pervasive and insidious occupational hazards within the dental profession, yet it remains profoundly underestimated by practitioners and inadequately addressed by institutional policy[1]. Defined as a permanent, irreversible sensorineural hearing impairment resulting from chronic, cumulative exposure to hazardous noise levels, NIHL is an entirely preventable condition[2]. The pathophysiology involves progressive damage to the delicate stereocilia of the outer and inner hair cells within the cochlea, the sensory organ of hearing. This damage typically manifests as a characteristic audiometric "notch", a significant decrease in hearing sensitivity in the high-frequency range of 3000 to 6000 Hz, which often precedes noticeable deficits in the frequencies critical for speech comprehension[3].

The scale of this occupational disease is significant. The U.S. Centers for Disease Control and Prevention (CDC) estimates that 22 million workers are exposed to potentially damaging noise annually, with occupational hearing loss being the most common work-related illness[2]. Within dentistry specifically, a substantial body of evidence confirms an elevated risk. A 2023 systematic review found that a clear majority of studies (82%) reported a positive association between the practice of dentistry and the development of hearing loss[4]. A more recent 2024 scoping review confirmed these findings, concluding that NIHL appears to be more prevalent among dental personnel than in most

control groups, with 67% of comparative studies showing significantly more hearing loss among dental professionals[5]. Despite this evidence, a persistent gap exists between the objective risk and the subjective awareness and protective behaviors within the profession, creating a silent epidemic that threatens the long-term health and professional longevity of clinicians.

The modern dental office is a complex and dynamic acoustic environment, far from the quiet setting it may appear to be between procedures. International regulatory bodies, such as the U.S. Occupational Safety and Health Administration (OSHA) and the National Institute for Occupational Safety and Health (NIOSH), have established clear action levels for noise exposure. NIOSH recommends a limit of 85 decibels on an A-weighted scale (dBA) as an 8-hour time-weighted average (TWA), above which the risk of hearing damage increases significantly. OSHA mandates the implementation of a Hearing Conservation Program (HCP) when exposures meet or exceed this 85 dBA TWA[2].

Analysis of noise levels from contemporary dental equipment reveals that many instruments operate perilously close to, and often exceed, this critical 85 dBA threshold.

- High-Speed Air-Turbine Handpieces: These are a ubiquitous source of high-frequency noise, with measurements consistently falling in the range of 70–99 dBA[3].
- Ultrasonic Scalers: Often identified as the single loudest piece of equipment in the dental office, ultrasonic scalers can generate sound pressure levels from 83 dBA to as high as 107 dBA. One study found they were the only equipment to consistently exceed 85 dBA in the practices surveyed[6].
- High-Volume Suction/Evacuation (HVE): HVE systems, particularly when the nozzle is partially or fully obstructed, can produce noise levels ranging from 81 dBA to a hazardous 96.5 dBA[7].
- Laboratory and Other Equipment: Additional sources, such as micromotor handpieces used on acrylics (up to 92.2 dB), model trimmers, and sandblasters (up to 96 dB), contribute to the overall noise dose for staff who work in or near dental laboratories[8].

The consequences of chronic occupational noise exposure in dentistry extend far beyond a simple decrease in hearing acuity. NIHL is frequently accompanied by debilitating comorbidities that can severely impact a practitioner's professional efficacy and overall quality of life[9].

Tinnitus, the perception of sound (such as ringing, buzzing, or hissing) in the absence of an external acoustic source, is a particularly prevalent and distressing symptom[1]. Research indicates that dentists are disproportionately affected, with some studies suggesting they are up to 50% more likely to experience tinnitus than the general population[9]. Reported prevalence rates among dental professionals vary widely across studies but consistently fall within a range of 19% to 40%, figures that are substantially higher than in control populations[1]. Persistent tinnitus can disrupt sleep, impair concentration, and contribute to anxiety and depression, directly affecting a dentist's ability to perform tasks requiring high levels of focus.

**Materials and Methods**

A cross-sectional study design was made to investigate the prevalence of hearing loss and associated factors among dental practitioners. The study population was composed of a convenience sample of 31 practicing dentists who were recruited from various private dental clinics located in Bucharest, Romania. All participants volunteered for the study.

Data for the study were acquired through a dual-method approach, combining a self-administered online questionnaire with an in-person audiometric screening to capture both subjective and objective data points.

Online Questionnaire: A structured questionnaire was developed and administered using the Google Forms platform. This instrument was designed to be an efficient method for collecting standardized information from all participants. The questionnaire gathered data across several domains:

- Socio-demographic and Professional Data: Information collected included participant sex, age, and the total number of years in clinical practice.
- Auditory Health Status: Participants were asked to report if they had a prior medical diagnosis of hypoacusis (hearing loss). They were also surveyed on the presence of tinnitus, and for those who reported it, its nature (*e.g.*, intermittent "ringing in the ear").
- Subjective exposure and risk perception: the questionnaire assessed the practitioners' subjective perception of their work environment's noise level using a categorical scale ("very noisy", "somewhat noisy", "somewhat quiet", "very quiet"). It also

quantified weekly exposure by asking for the number of hours spent in proximity to noise-generating handpieces. Finally, it gauged their personal risk perception by asking if they believed their profession had negatively affected their hearing ("yes", "no", "not sure").

● Preventive Behaviors: A direct question was included to determine the use of any hearing protection methods during clinical work.

Audiometric Evaluation: Objective hearing assessment was conducted using a PICCOLO basic screening portable audiometer.

The research was conducted in accordance with established ethical principles for studies involving human subjects. The confidentiality of all personal information and clinical data was strictly maintained throughout the collection, analysis, and reporting phases of the study. Participation was entirely voluntary, and informed consent was implicitly or explicitly obtained from all 31 dentists who chose to be part of the investigation.

## RESULTS

The study cohort consisted of 31 dental practitioners from private clinics in Bucharest. The demographic and professional profile of the participants was characterized by a predominance of female practitioners and a strong skew towards younger age groups with relatively limited years of clinical experience. This profile is critical for the interpretation of the study's prevalence findings.

The sample was predominantly female, with 23 participants (74.2%) compared to 8 male participants (25.8%). The age distribution was heavily weighted towards early – to mid-career professionals; 83.9% of the cohort (n =26) was under the age of 40, with the largest single group (45.2%, n=14) being in the 30–39 years age bracket. Only five participants (16.1%) were aged 40-49. This age distribution was directly reflected in the participants' years of professional experience. A vast majority of the cohort (90.3%, n = 28) had been in practice for 10 years or less. More than half (58.1%, n =18) had between 1 and 5 years of experience. Only two participants (6.45%) had practiced for 20–25 years, providing a small but crucial window into the potential long-term effects of occupational exposure within this sample.

The study's findings on auditory health revealed a significant disparity between self-reported diagnoses and objective audiometric evidence, particularly when correlated with age and experience.

Diagnosed hypoacusis: based on self-report data, the prevalence of formally diagnosed hearing loss was exceedingly low. Only a single participant out of 31 (3.2%) reported having been diagnosed with hypoacusis. The remaining 30 participants (96.8%) stated they had not been diagnosed with any hearing impairment. The individual with the diagnosis was a 33-year-old practitioner with 8 years of experience. The corresponding audiogram 8 indicated a slight bilateral hearing loss affecting both low and high frequencies.

Audiometric findings: in stark contrast to the low rate of formal diagnosis, the audiometric screenings performed as part of the study revealed clear evidence of hearing threshold shifts consistent with the early stages of NIHL, especially among the few participants with extensive professional experience.

● The audiogram of a 46-year-old dentist with 21 years of practice demonstrated a pronounced dip in hearing sensitivity at high frequencies, a classic indicator of noise-induced cochlear damage.

● Similarly, a 49-year-old practitioner showed evidence of high-frequency hearing loss, though to a lesser degree than the previous case.

● These findings were juxtaposed with the audiogram of a 33-year-old dentist with only 6 years of experience, which showed hearing thresholds well within the normal range, serving as a healthy baseline for comparison.

Tinnitus: The self-reported prevalence of tinnitus was also low within this cohort. Only two participants (6.5%) reported experiencing the condition, which they described as an intermittent "ringing in the ear". The vast majority (93.5%) reported no tinnitus symptoms.

The study uncovered a critical disconnect between the participants' regular exposure to hazardous noise, their subjective perception of this risk, and their adoption of protective behaviors.

Weekly noise exposure: A significant portion of the cohort reported substantial weekly exposure to noise from dental handpieces. While the majority (51.6%, n =16) reported 10–20 hours of exposure per week, a combined 45.15% (n =14) reported working with these instruments for 20–40 hours per week. This indicates that nearly half the sample was exposed to the primary noise source for a duration equivalent to half or more of a standard work week.

Perception of clinic noise and hearing damage: despite this high level of exposure, participants' perception of the risk was muted. Over half of the

dentists (54.8%) described their work environment as only "somewhat noisy". More critically, when asked directly if they believed their profession had damaged their hearing, only 4 participants (12.9%) responded affirmatively. A plurality of 14 participants (45.2%) stated it had not, while 13 participants (41.9%) were "not sure". This demonstrates a profound level of uncertainty and a low perception of personal risk among the cohort.

Use of hearing protection: The most striking finding of the entire study relates to protective behaviors. When asked about the use of hearing protection methods, such as earplugs or earmuffs, 100% of the 31 participants reported that they use no form of auditory protection whatsoever. This universal lack of preventive action, in a profession demonstrably exposed to hazardous noise, represents the central and most alarming result of the investigation.

## DISCUSSION

The results of this cross-sectional study of Romanian dentists, while based on a limited sample, provide a compelling and cautionary snapshot of the state of occupational hearing health in the profession. The findings illuminate a significant disconnect between objective risk, subjective perception, and preventive action. When contextualized within the broader international literature, the data suggest that the low prevalence of diagnosed hearing loss in this young cohort masks a substantial underlying risk of cumulative, irreversible NIHL, driven by a systemic failure in occupational health culture.

At first glance, a 3.2% prevalence of diagnosed hypoacusis might suggest that hearing loss is not a significant issue in this population. However, this conclusion would be a profound misinterpretation of the data, attributable to a well-known epidemiological phenomenon: the "healthy worker effect". The study's cohort is overwhelmingly young and has limited professional experience, with 84% of participants under 40 and 90% having practiced for less than a decade. Since NIHL is a disease of cumulative exposure, its clinical manifestations – and subsequent diagnosis – are strongly correlated with age and years in the profession[10]. The low prevalence of diagnosed disease in this sample is not evidence of a safe working environment, but rather an artifact of insufficient time for the pathology to become clinically significant for most participants.

The true significance of the data lies not in the low overall prevalence, but in the audiograms of the few older, more experienced practitioners. The audiogram of the 46-year-old dentist with 21 years of experience, showing a clear high-frequency threshold shift, is the critical piece of evidence. This pattern is the classic signature of NIHL. This individual serves as a "canary in the coal mine" illustrating the probable auditory future for the younger members of the cohort if their exposure continues unabated and without intervention. The findings are therefore highly suggestive of widespread, subclinical, or incipient NIHL that is currently undiagnosed. This aligns with systematic reviews that consistently identify years of clinical experience as a prominent risk factor for hearing loss in dentists[4]. Furthermore, the broader literature often points to a greater hearing loss in the left ear for right-handed clinicians, a result of the typical working posture that places the left ear closer to the noise source of the handpiece[4]. While not specifically tested in the Romanian study, this asymmetric pattern is another key indicator of occupational, rather than purely age-related, hearing loss.

Similarly, the reported tinnitus prevalence of 6.5% is anomalously low compared to international studies that place the figure between 19% and 40% for dental professionals[1]. This discrepancy is almost certainly a function of the cohort's youth and the study's small sample size, as the prevalence of tinnitus also increases with the duration and cumulative dose of noise exposure.

The most unequivocal and alarming finding of this study is the 100% rate of non-use of personal hearing protection. This behavior is a direct consequence of the quantifiable mismatch between exposure, risk perception, and action. Despite nearly half the cohort reporting exposure to noisy instruments for over 20 hours per week, only 12.9% believe their hearing has been affected, and a significant 41.9% remain "not sure". This profound uncertainty and low perception of personal vulnerability directly explains the universal failure to adopt the simplest of preventive measures.

This awareness-action gap is not unique to this Romanian cohort but is a well-documented global issue. Studies from various countries show that even when dentists acknowledge the presence of noise, they fail to translate this awareness into protective practice[11]. Commonly cited reasons include the

inconvenience of using earplugs, a perceived difficulty in communicating with patients and staff, and simple lack of habit[12]. These barriers suggest that the problem is not merely a lack of available equipment but a deeply ingrained set of professional behaviors and attitudes that discount the long-term risk of NIHL.

The presence of tinnitus, even at the low rate reported in this study, is a significant concern due to its well-documented effects on cognitive function – an area of paramount importance for a profession that demands precision, focus, and complex decision-making. A comprehensive meta-analysis has shown that tinnitus is associated with quantifiable deficits in executive function, processing speed, and short-term memory[13]. The brain of a person with chronic tinnitus is in a constant state of heightened attention, as the default mode network, which governs rest and relaxation, is persistently interrupted by the internal sound. This leads to increased mental fatigue, slower reaction times during cognitive tasks, and a depletion of the attentional resources necessary for clinical work. The constant effort to "tune out" the tinnitus and focus on the patient and procedure degrades professional performance and increases the risk of error, posing a threat to both the clinician's well-being and patient safety[14].

## CONCLUSION

Noise-Induced Hearing Loss and its associated comorbidities – tinnitus, hyperacusis, cognitive strain, and burnout – represent a significant and largely unaddressed occupational health crisis in modern dentistry. The evidence is unequivocal: the tools of the trade generate hazardous levels of noise, and chronic exposure leads to irreversible harm.

The findings from the Romanian cohort, though limited in scope, serve as a stark and powerful microcosm of a global problem. The audiometric evidence of incipient NIHL in experienced practitioners, contrasted with the cohort's youthful profile and low rate of formal diagnosis, perfectly illustrates the deceptive, cumulative nature of the disease. Most critically, the finding of a 100% non-use rate of hearing protection lays bares a profound policy-practice gap, rooted in a professional culture that has normalized the hazard and failed to instill the principles of self-protection.

The dental profession is at an inflection point. A fundamental cultural shift is required, moving from a reactive stance on a silent disease to a proactive paradigm of comprehensive hearing conservation. This shift must be driven by a multi-tiered, evidence-based approach that prioritizes engineering controls like quieter electric handpieces, mandates advanced audiometric surveillance, promotes the use of earplugs, and embeds hearing conservation into the core of dental education. This is not merely a recommendation but an ethical and professional imperative. Safeguarding the auditory health of dental professionals is essential for ensuring their long-term well-being, preserving their clinical efficacy, and maintaining the highest standard of care for their patients worldwide.

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