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Systematic Review

Hearing risk in the digital age: a systematic review on recreational audio device use among youth

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ABSTRACT

Prolonged use of personal listening devices (PLDs) like earphones and headphones among young people has become a global concern due to the risk of hearing damage. This systematic review, which included 15 studies, found that such use is associated with early signs of auditory damage, particularly at high frequencies. While the quality of evidence varied, with some studies having a low risk of bias and others showing moderate concerns due to issues like selection and detection bias, key risk factors were consistently identified. These included the duration of listening, the volume level, and the use of earphones in noisy environments. The findings highlight the pressing need for standardised research and public health initiatives to promote safer listening practices among individuals aged 12-30.

Keywords: Hearing loss, Earphones, Personal listening devices, Adolescents, Pure tone audiometry, Noise-induced hearing loss, Systematic review

INTRODUCTION

Hearing loss among adolescents and young adults is increasingly recognized as a global health issue. According to the world health organization, over 1 billion young people aged 12-35 years are at risk of permanent, avoidable hearing loss due to unsafe listening habits from PLDs and attendance at loud venues.[1] A 2024 meta-analysis of 33 international studies involving approximately 19,000 individuals aged 12-34 years found that around 24% of PLD users and 48% of young people attending loud events are exposed to unsafe sound levels, putting between 670 million and 1.35 billion individuals worldwide at potential risk.[2]

The WHO further estimates that globally over 430 million people already live with disabling hearing loss, and projections indicate that by 2050, nearly 2.5 billion people may have some degree of hearing impairment, with more than 700 million requiring rehabilitation.[3]

Such figures highlight the scale of the problem: young people regularly exposed to volumes exceeding recommended limits (85 dB) can accumulate cochlear damage over time. In adolescents, prevalence estimates of noise-induced hearing loss (NIHL) range from 17% to 19% in surveys of teens and young adults.[4] Despite these statistics, adolescents may not fully recognize the risks of prolonged and high-volume earphone use, nor appreciate that damage often occurs gradually and silently.

Given the ubiquity of smartphones, streaming platforms, and PLDs, understanding the impact of listening behaviors in real-world settings is essential. This review aims to synthesize evidence from studies published up to July 2025 on prolonged earphone or headphone use among individuals aged 12-30 years. We examine exposure definitions (e.g., listening duration, volume, use in noisy environments), auditory assessment methods (e.g., pure tone audiometry (PTA), otoacoustic emissions, mobile screening tools), key hearing outcomes, and methodological quality using the ROBINS-I tool. Through

this, we assess whether prolonged PLD use contributes to early auditory changes, with implications for prevention and public health policy.

METHODS

This systematic review was conducted at Healthway hospitals, old Goa and included studies published between January 2016 and July 2025 that assessed hearing outcomes associated with prolonged PLD use among individuals aged 12-30 years. Searches were performed in PubMed, Scopus, and Web of Science using terms such as 'earphones', 'headphones', 'hearing loss', and 'young adults'.

Inclusion criteria were observational or interventional studies reporting quantitative auditory outcomes. Studies were excluded if they were reviews, case reports, conference abstracts, or included participants outside the target age group, and those with pre-existing ear disease, congenital hearing loss, or history of ototoxic drug use.

This review followed PRISMA guidelines. Two reviewers independently screened and extracted data on study design, exposure characteristics, and hearing outcomes. Discrepancies were resolved by consensus. Risk of bias was assessed with a modified ROBINS-I tool. A total of 875 records were identified, and after screening, 15 studies were included.

RESULTS

The PRISMA flow diagram illustrates the selection process for studies included in the review. A total of 875 records were identified through database searches. After removing 92 duplicates and 328 records for other reasons, 455 records were screened. Of these, 430 were excluded, and 25 reports were sought for retrieval, with 5 not retrieved. Among the 20 reports assessed for eligibility, 5 were excluded, resulting in 15 studies included in the final review.

Key findings are summarised below.

Grinn et al reported no significant auditory changes among college students despite frequent use, likely due to a well-controlled lap setup and robust objective measurements.[5] Kashyap and Bhatia found a moderate risk of bias and suggested early hearing threshold shifts among users, but the small sample size and self-report limitations were noted.[6] Le Prell et al confirmed no measurable hearing damage among young listeners with routine exposure, though exposure was self-reported.[7]

Haruna et al used PTA and found consistent results indicating minimal threshold shifts, with low risk of bias.[8] Asghar et al employed convenience sampling and found minor auditory differences between users and non-users.[9] Twardella et al also found minor differences but noted that exposure was self-reported, introducing moderate detection bias.[10]

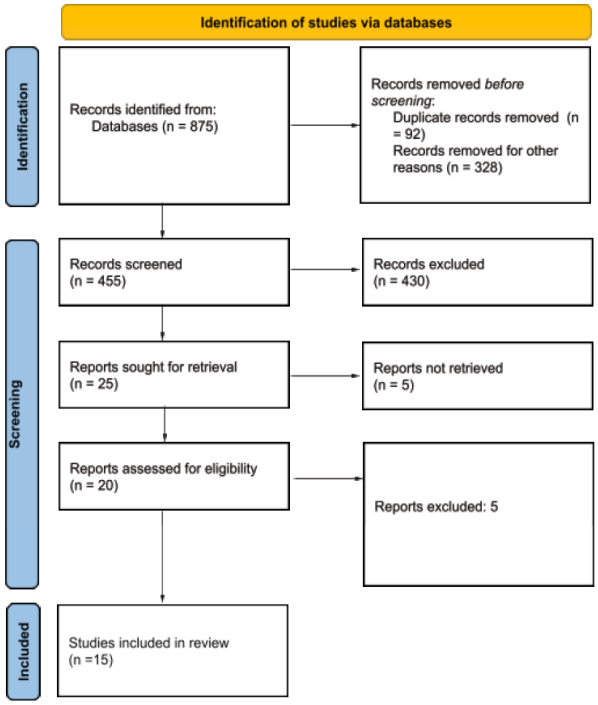

Figure 1: PRISMA flow diagram.

You et al used large survey data to reveal subjective hearing complaints in frequent PLD users.[11] Mogan employed an app-based tool and found both subjective and objective hearing concerns among users.[12] Hussain et al noted early signs of damage in habitual users despite a small sample size.[13] Hong et al reported moderate bias due to reliance on self-reported exposure data.[14]

Widen et al measured sound pressure levels (SPL) and found threshold shifts in a subset, highlighting the importance of direct SPL measurement.[15] Rhee et al provided strong evidence of damage in habitual users, with low overall bias.[16] Alshamrani et al found minor auditory changes using objective measures despite moderate sampling bias.[17]

Colon et al demonstrated a strong study design with stringent data criteria and found no damage among low-risk users.[18] Byeon used national-level data and found a moderate risk associated with self-reported listening habits, despite using audiologist-conducted PTA.[19]

Overall, 6 studies had low risk of bias, while 9 showed moderate risk, primarily due to issues in selection (e.g., convenience sampling), detection (e. g., self-reporting), and performance domains. Studies with robust designs like Rhee et al, Colon et al and Grinn et al showed clearer associations due to objective methods and controlled settings.[5,16,18]

DISCUSSION

The systematic review, which commenced with the identification of 875 records and culminated in 15 studies after rigorous screening and eligibility assessment, demonstrates a selection pattern consistent with other high-quality systematic reviews and meta-analyses.

Li et al conducted a review on the association between sleep duration and hypertension and ultimately included 15 systematic reviews after screening over 2,200 records, indicating that our inclusion number aligns well with established studies.[20] Similarly, in a meta-research review, by Draborg, e. et al. included 15 meta-research studies, again reinforcing the common outcome of narrowing a large initial pool to a focused set of eligible studies.[21]

Naing et al analysed 14 studies which included a similarly rigorous screening process, suggesting that our final inclusion count is not atypical and may represent the necessary trade-off between relevance and methodological quality.[22]

In our case, 455 studies were screened after duplicate and irrelevant record removal, of which 430 were excluded. This high exclusion rate is comparable to the work of Bigna et al who noted that strict inclusion criteria often lead to steep reductions in eligible studies, which strengthens the internal validity of the final synthesis.[23] Notably, we were unable to retrieve 5 full-text articles, a limitation also observed by Willis et al who acknowledged that retrieval barriers, including language restrictions and access limitations, are common in systematic reviews and may influence the comprehensiveness of the analysis.[24]

This review reveals mixed findings on the impact of prolonged PLD use. While some studies demonstrated early auditory changes, others did not observe measurable damage, particularly when listening practices adhered to safe exposure limits. Importantly, studies using objective measures like SPL meters, PTA, and otoacoustic emissions reported clearer associations than those relying solely on self-reported data.

High-volume and long-duration exposure remain key risk factors.[25] Studies suggest that exceeding 80 dB for over 60 minutes daily can result in subtle cochlear stress, which may not be immediately evident but can accumulate over time.[26] Furthermore, listening in noisy environments, common among commuters, promotes higher volume use, compounding the risk. [27]

Despite the observed trends, heterogeneity in study design, exposure definitions, and outcome measures complicated direct comparison. There is an urgent need for standardised methodologies to assess PLD use and its consequences. Widespread adoption of mobile audiometry and SPL-integrated earphones may enhance early detection and prevention efforts.

CONCLUSION

Prolonged earphone use at high volumes may be associated with early auditory changes in young individuals, though evidence is mixed and heavily influenced by methodological quality. With increasing reliance on PLDs, it is essential to promote safe listening practices and implement routine hearing screening for adolescents. Further research should prioritize longitudinal designs, objective exposure monitoring, and real-time auditory assessments.

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