

MUSIC-INDUCED HEARING LOSS IN SCHOOL-AGE CHILDREN: DATA FROM A QUESTIONNAIRE, OTOLOGICAL EXAMINATION, AND AUDIOMETRY

Contributions:

A Study design/planning
B Data collection/entry
C Data analysis/statistics
D Data interpretation
E Preparation of manuscript
F Literature analysis/search
G Funds collection

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Abstract

Objective. The study sought to evaluate the prevalence of hearing disorders in school-age children due to exposure to loud music.

Material and methods. A sample of 700 pupils from grammar and secondary schools in Poland, aged 13–18 years, were given otological and audiometric examinations. A questionnaire was used to gauge the frequency and duration of visits to discotheques or pop/rock music concerts and the use of personal audio players (PAPs).

Results. The final sample consisted of 643 subjects, after excluding 57 pupils because of middle ear disease or other auditory pathology. They were divided into three groups according to the findings of the questionnaire: 131 not exposed (never attended discos/concerts or used PAPs); 169 mildly exposed (visits to discos/concerts once per month, PAPs 1–3 hours per day for 1–3 times per week); and 343 heavily exposed (discos/concerts 1–2 times per week, PAPs 4–7 hours per day for 4–7 times per week). In exposed groups a notched hearing loss of 25–60 dB at 4 or 6 kHz was identified in 18 pupils with mild exposure (10.7%) and in 56 with heavy exposure (16.3%). Of those showing the notch, 24 subjects (32.4%) complained of tinnitus.

Conclusions. Our study confirms that the apparently “beautiful noise” of loud music carries with it the risk of hearing loss and tinnitus, and so hearing screening and the promotion of healthy listening habits in school-age children are recommended.

Key words: noise exposure • loud music • children • high-frequency notch

LA PÉRDIDA DE AUDICIÓN INDUCIDA POR LA MÚSICA EN NIÑOS DE EDAD ESCOLAR: CUESTIONARIO, EXAMEN OTOLÓGICO Y AUDIOMÉTRICO

Resumen

Objetivo: El objetivo del estudio lo fue la evaluación de la frecuencia de existencia de los trastornos auditivos en niños de edad escolar debidos a la exposición a música alta.

Material y métodos: La prueba contó con 700 alumnos de escuelas secundarias en la edad entre 13 y 18 años sometidos a pruebas otológicas y audiométricas. El cuestionario fue llevado a cabo anteriormente con el fin de definir la frecuencia y la duración de las visitas a clubes o a conciertos de música pop/rock, así como del uso de los dispositivos de audio.

Resultados: Quedaron excluidos 57 alumnos de las pruebas posteriores debido a las enfermedades del oído medio o a otros trastornos auditivos, por eso la prueba definitiva abarcó a 643 personas y fue dividida según los resultados del cuestionario en tres grupos: 131 personas no expuestas al ruido (jamás han ido a clubes ni conciertos y tampoco han usado los dispositivos de audio), 169 personas de exposición media al ruido (una visita al mes a un club o al concierto, 1-3 horas diarias del uso de dispositivos de audio) y 343 personas de exposición alta al ruido (1-2 veces a la semana la visita a un club o al concierto, uso de los dispositivos de audio durante 4-7 horas diarias 4 a 7 veces a la semana).

En ambos grupos expuestos al ruido se ha registrado la pérdida de audición al nivel de 4000 o 6000 Hz en el rango entre 25 y 60 dB en 18 alumnos (10,7%) del grupo de media exposición al ruido y en 56 (16,3%) del grupo de alta exposición al ruido. 24 personas (32,4%) se han quejado de la existencia de tinnitus.

Conclusiones: Nuestras pruebas comprueban que “el ruido bello” de la música alta puede provocar el riesgo de la pérdida de audición y de la existencia de tinnitus; por lo tanto, se recomienda llevar a cabo el cribado auditivo y fomentar los hábitos sanos entre los niños de edad escolar en materia relativa a la forma de escuchar la música.

Palabras claves: exposición al „ruido bello” de música alta • niños • pérdida de audición inducida por la música

ПОТЕРЯ СЛУХА, ВЫЗВАННАЯ МУЗЫКОЙ, У ДЕТЕЙ ШКОЛЬНОГО ВОЗРАСТА: АНКЕТА, ОТОЛОГИЧЕСКОЕ И АУДИОМЕТРИЧЕСКОЕ ИССЛЕДОВАНИЕ

Абстракт

Цель: Целью исследования являлась оценка частоты появления нарушений слуха по причине воздействия громкой музыки у детей школьного возраста.

Материал и методы: Исследование проводилось на 700 учениках средних школ (гимназий) в возрасте 13-18 лет – были проведены отологическое и аудиометрическое исследование. Анкета была проведена заранее с целью определить частоту и длительность посещений клубов или концертов поп-/рок-музыки и использования аудиоустройств.

Результаты: Из дальнейших исследований было исключено 57 учеников по причине болезни среднего уха или других нарушений слуха, поэтому окончательное испытание охватило 643 человек, которые по результатам анкеты были разделены на три группы: 131 человек, не подвергающийся воздействию шума (никогда не ходили в клубы, на концерты и не пользуются аудиоустройствами), 169 человек, в средней степени подверженных воздействию шума (1 посещение клуба или концерта в месяц, 1-3 раза в неделю пользуются аудиоустройствами по 1-3 часа в день) и 343 человека, в высокой степени подверженных воздействию шума (1-2 раза в неделю посещают клуб или концерт, пользуются аудиоустройствами в течение 4-7 часов в день 4-7 раз в неделю).

В обеих группах, подверженных воздействию шума, была отмечена потеря слуха на уровне 4000 или 6000 Гц в диапазоне 25-60 дБ: у 18 учеников (10,7%) из группы, в средней степени подверженной воздействию шума, и 56 (16,3%) из группы, в высокой степени подверженной воздействию шума. Из исследуемых 24 человека (32,4%) жаловались на наличие шума в ушах.

Выводы: Наши исследования подтверждают, что «прекрасный шум» громкой музыки может создавать риск потери слуха и появления шума в ушах. Поэтому рекомендуется проводить скрининговые исследования слуха и развивать здоровые навыки слушания у детей школьного возраста.

Ключевые слова: подверженность воздействию «прекрасного шума» громкой • музыки, дети, потеря слуха • вызванная музыкой

UTRATA SŁUCHU WYWOŁANA MUZYKĄ U DZIECI W WIEKU SZKOLNYM: KWESTIONARIUSZ, BADANIE OTOLOGICZNE I AUDIOMETRYCZNE

Streszczenie

Cel: Celem badania była ocena częstości występowania zaburzeń słuchu spowodowanych narażeniem na głośną muzykę u dzieci w wieku szkolnym.

Materiał i metody: Próba liczyła 700 uczniów szkół gimnazjalnych i średnich w wieku 13-18 lat poddanych badaniom otologicznym i audiometrycznym. Kwestionariusz został przeprowadzony wcześniej w celu określenia częstotliwości i czasu trwania wizyt w klubach lub na koncertach muzyki pop/rock oraz korzystania z urządzeń audio.

Wyniki: Z dalszego badania wykluczono 57 uczniów z powodu chorób ucha środkowego lub innych zaburzeń słuchu, dlatego ostateczna próba składała się z 643 osób i została podzielona zgodnie z wynikami kwestionariusza na trzy grupy: 131 osób nienarażonych na hałas (nigdy nie chodzili do klubów, na koncerty oraz nie korzystają z urządzeń audio), 169 osób średnio narażonych na hałas (1 w miesiącu wizyta w klubie lub na koncercie, 1-3 razy w tygodniu korzystanie z urządzeń audio przez 1-3 godziny dziennie) oraz 343 osoby wysoce narażone na hałas (1-2 razy w tygodniu wizyty w klubie lub na koncercie, korzystanie z urządzeń audio przez 4-7 godzin dziennie 4-7 razy w tygodniu).

W obydwu grupach narażonych na hałas odnotowano utratę słuchu na poziomie 4000 lub 6000 Hz w zakresie 25-60 dB u 18 uczniów (10,7%) z grupy średnio narażonej na hałas oraz u 56 (16,3%) z grupy wysoce narażonej na hałas. 24 osoby (32,4%) narzekały na występowanie szumów usznych.

Wnioski: Nasze badania potwierdzają, że „piękny hałas” głośnej muzyki może stwarzać ryzyko utraty słuchu i występowanie szumów usznych; dlatego zaleca się przeprowadzanie przesiewowych badań słuchu i promowanie zdrowych nawyków słuchania u dzieci w wieku szkolnym.

Słowa kluczowe: narażenie na „piękny hałas” głośnej muzyki • dzieci • utrata słuchu wywołana muzyką

Introduction

Numerous screening studies have shown that hearing loss in children is becoming increasingly common and it has now become a major public health concern. The etiology is varied and includes auditory processing disorders (resulting from maturational delay of the central auditory nervous system or neurologic defects), congenital or acquired middle ear pathologies (giving conductive hearing loss), and sensorineural loss due to inner ear or auditory nerve damage. Among the well-known causes of sensorineural hearing loss are viral/bacterial infections, ototoxicity, congenital abnormality, head trauma, and, more recently, leisure-time noise and loud music [1-3]. With the omnipresence of portable listening devices and loud

sound systems for live sound reproduction, as well as the popularity of pop/rock concerts, the impact of music-induced hearing loss is of great interest especially in terms of prevention [1-4].

Besides adult musicians, sound engineers, and listeners of amplified music (so-called “beautiful noise”), many children and adolescents are also put at risk. A number of them deliberately expose themselves to loud music for entertainment not being aware that such exposure can result in hearing loss [5-10]. Modern pop concerts often produce sound levels of over 135 dB(A), with peaks exceeding 150 dB(C), and personal audio players are capable of producing potentially damaging noise levels of up to 136 dB(A) in artificial ears [1].

Despite many reports on the hazardous effects of loud music on hearing, the scientific evidence of a relationship between them in young people is still inconclusive mainly because of the limitations in knowing the exposure characteristics. The prevalence figures therefore vary between studies and the epidemiology of hearing loss due to noisy music, as well as its clinical symptoms in children, are not yet completely defined [1,4,6,7,9]. We do know that such hearing loss occurs within the 3–6 kHz range with audiometric notches usually centred at 6 kHz, possibly because music has a greater high-frequency content than does industrial noise [1,5,8-10].

This study was conceived as another contribution to complete the data on likely consequences of exposure of school children to loud recreational musical noise. Consequently, it aimed to assess the prevalence of hearing loss in children in Poland, keeping in mind that even a minimal loss may cause poorer school performance and perhaps limit the individual's ability to work as an adult employee.

Material and methods

A representative sample of 700 pupils, age 13–18 years (mean 16.0 ± 1.6), from 9 grammar and secondary schools in Lodz, were selected by two-stage random sampling and given otological and audiometric examinations by ENT physicians and trained technicians. Hearing thresholds were measured for each ear at 0.25, 0.5, 1, 1.5, 2, 3, 4, 6, and 8 kHz in 5 dB increments using an Interacoustics Audio-Traveler AA 222 audiometer equipped with TDH 39P earphones. Ambient noise in the audiometric sound-treated room met IEC 645 standards. A detailed questionnaire was given before the examinations to determine the frequency and duration of visits to discotheques or pop/rock music concerts and the use of personal audio players (PAPs); the questionnaire also asked about factors that might affect the study results (otitis media, ear surgery, head trauma, past epidemic parotitis, cerebrospinal meningitis).

The data were statistically verified using a chi-square test of independence to compare the distribution of hearing loss across categories of loud music exposure; an analysis of covariance (ANCOVA) was used to compare mean hearing thresholds between groups having different degrees of exposure and according to sex. A significance level of 0.05 was selected.

Results

Fifty-seven pupils (8.1%) were excluded from further evaluation because of middle ear pathologies producing conductive hearing loss ($n = 50$), profound sensorineural hearing impairment due to meningitis in childhood ($n = 1$), or an incomplete questionnaire ($n = 6$). The resulting sample consisted of 643 children and their distribution according to type of school, sex, and age is shown in Figure 1.

Based on the questionnaire, we separated the pupils into three groups as shown in Table 1: 131 pupils (20.4%) not exposed (never attended discos/concerts or used PAPs), 169 (26.3%) with mild exposure (they reported visiting

discos or concerts once per month and used PAPs 1–3 hours daily for 1–3 times per week), and 343 (53.3%) with heavy exposure (discos or concerts 1–2 times per week or more, and PAPs 4–7 hours or more daily, 4–7 times per week).

In both the exposed groups, a notched hearing loss at 4 or 6 kHz was detected respectively in 18 pupils (10.7%) with mild exposure and in 56 (16.3%) with heavy exposure (see Table 1) as illustrated by examples in Figures 2 and 3.

Tinnitus is a frequent concomitant of noise-induced hearing loss, and was reported by 24 subjects (32.4%) with hearing loss, by 11 (14.8%) in those with mild exposure, and by 13 (17.6%) in those with heavy exposure. In

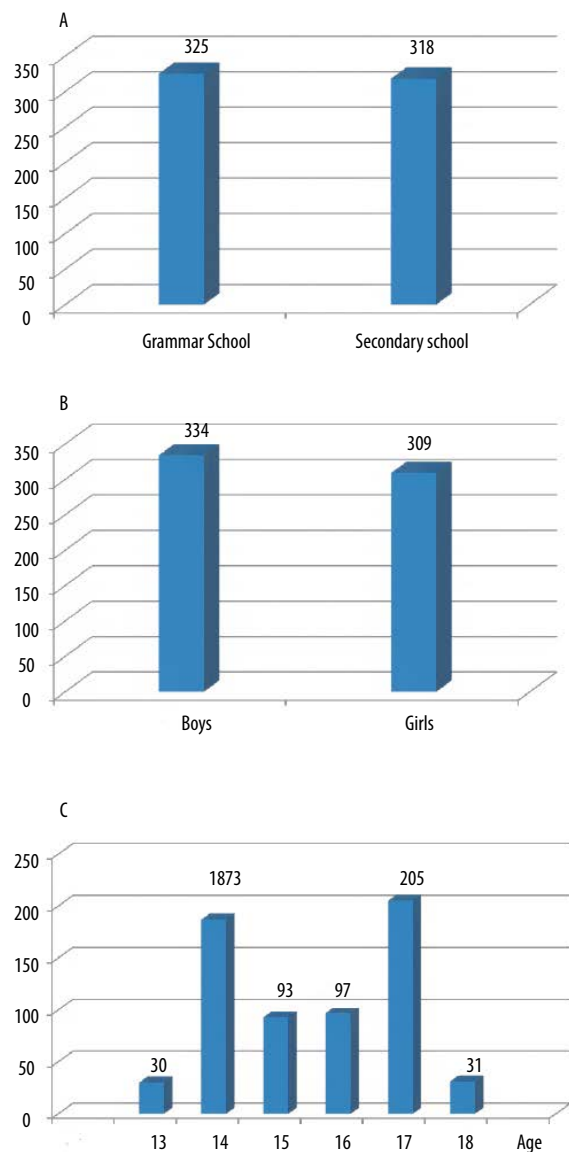


Figure 1. Pupils by type of school (A), sex (B), and age (C)

Table 1. Prevalence of hearing loss in the examined pupils

Subjects	Exposure						All together	
	no exposure		mild		heavy			
	n	%	n	%	n	%	n	%
Pupils without hearing loss	131	20.4	151	23.5	287	44.6	569	88.5
Pupils with hearing loss	0	0	18	10.7	56	16.3	74	11.5
All together	131	20.4	169	26.3	343	53.3	643	100.0

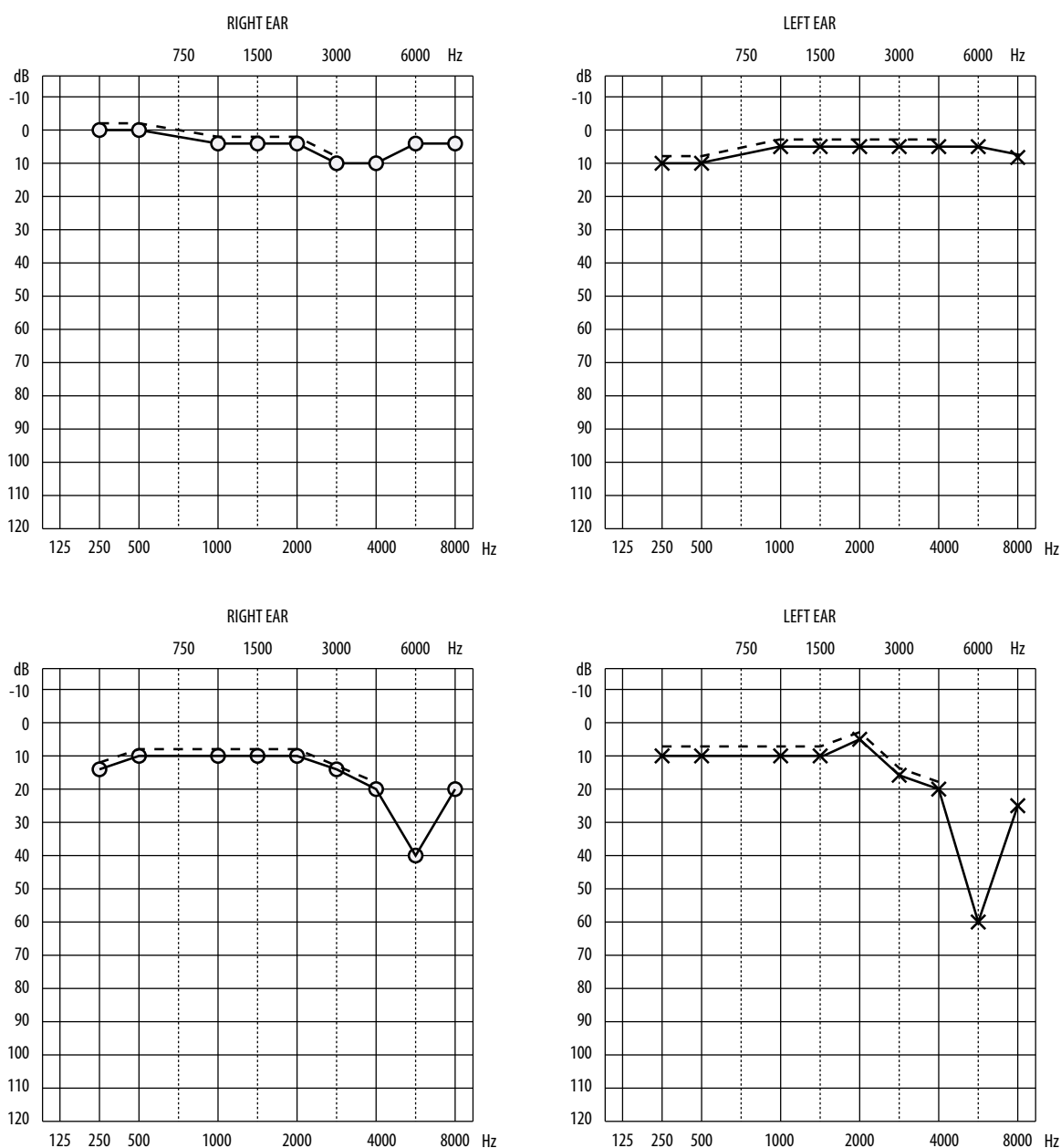


Figure 2. Two examples of audiograms showing the most frequently found type of hearing loss – a 6 kHz notch in a heavily exposed pupil – (bottom) compared to that of a normal audiogram in an unexposed pupil (top). Top example is from J.K., 14 years old, grammar school, no exposure; bottom is from W.P., 17 years old, secondary school, heavy exposure

comparison, tinnitus was perceived by 11 pupils (1.9%) without hearing loss. The computed mean hearing loss is shown in Figure 4 for each group of exposed pupils, and they do not vary between right and left ear or by sex.

However, the mean hearing thresholds of the unexposed group vs. the exposed groups differed significantly ($p < 0.005$), amounting respectively to 4.39–9.31 dB vs 5.53–12.97 dB (see Figure 5).

Discussion

The results from numerous cross-sectional and hearing screening investigations in children and youths indicate the

significance of their listening activities. Screening allows for early detection of hearing disorders and promotes hearing health [5,6,8,11–19]. In recent years there has been growing epidemiological evidence that the apparently “beautiful noise” generated by loud music and favoured by young people contributes to hearing loss and/or tinnitus [9,10,20–27].

Our study concurs with the above epidemiological data, proving that school-age children are endangered by music-induced hearing loss. Appreciable losses were found in 14.5% pupils who attended discotheques or pop/rock concerts or used personal audio players (74 individuals among 512 exposed). Of those with hearing loss, 32.4% also perceived tinnitus.

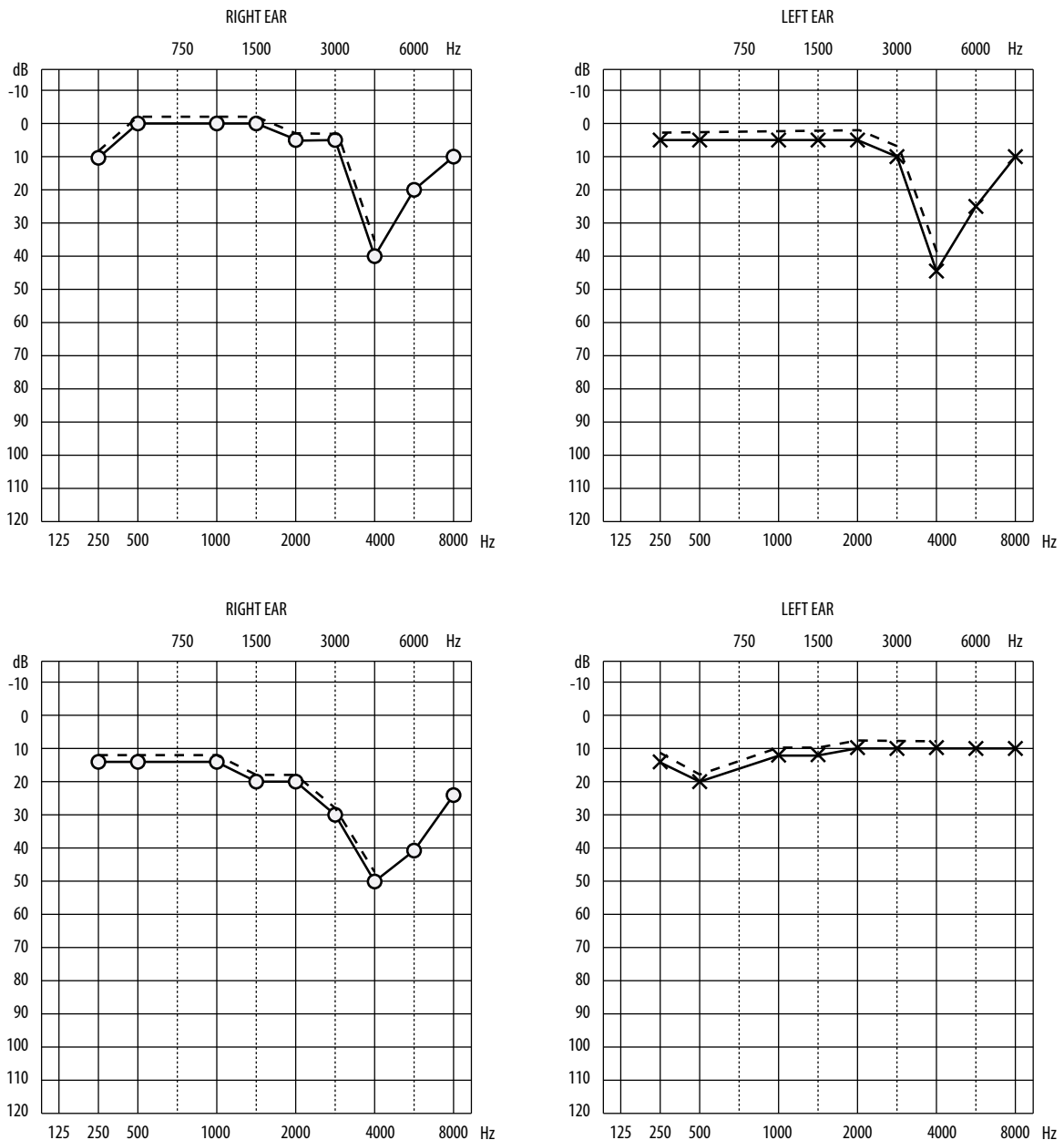


Figure 3. Example audiograms illustrating the less frequently observed hearing loss of a notch at 4 kHz. Top shows notch in mildly exposed pupil; bottom shows notch in heavily exposed pupil. (Upper is from M.L., 15 years old, grammar school; bottom is from B.C., 16 years old, secondary school)

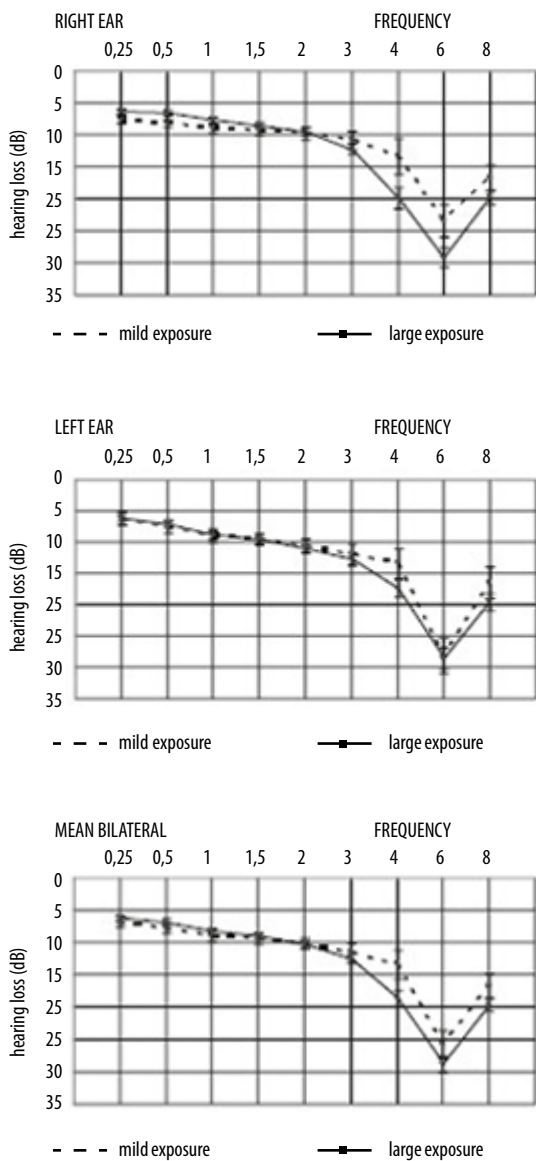


Figure 4. Mean hearing thresholds (with standard errors) in 74 pupils with identified hearing loss according to degree of exposure and sex

The available statistics suggest that the prevalence of noise-induced hearing loss in children is 15–17%, and that the prevalence of noise-induced tinnitus is 6–36%, a figure which is higher in hearing-impaired individuals than in those with normal hearing [4,9,21,25]. It is usually thought that noise from music is less hazardous than occupational noise, an assumption based on the study of hearing in professional musicians; however, it should be noted that children appear to be more susceptible to noise than are adults [1,9]. The hearing loss identified in our pure-tone audiometric examinations was a slight high-frequency loss centered at 4–6 kHz, a loss not so severe as to interfere with speech perception; nevertheless it could lead to diminished

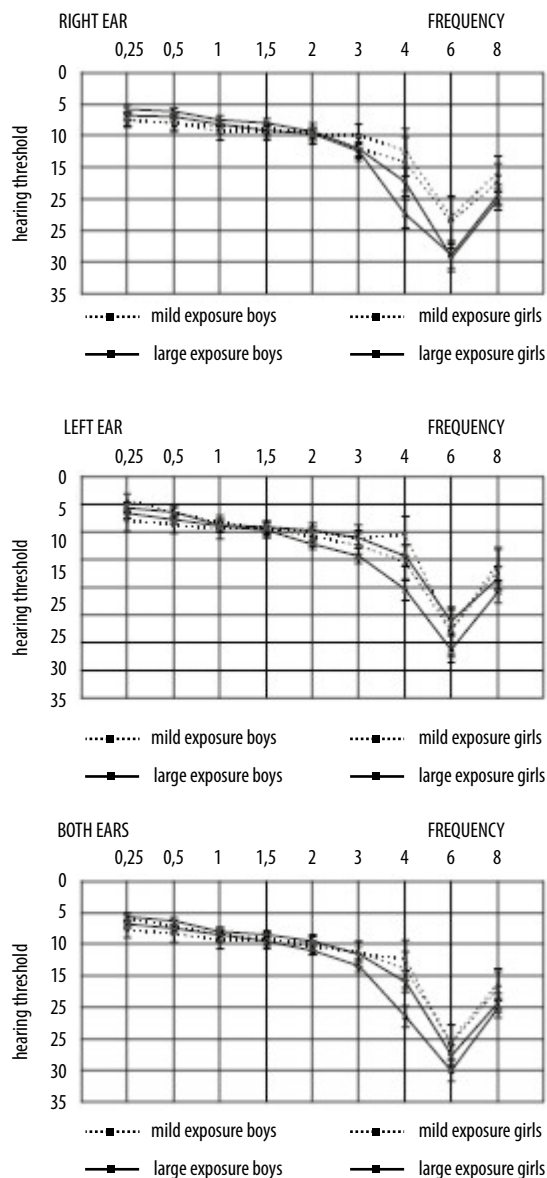


Figure 5. Mean hearing thresholds (with standard errors) in all 512 exposed pupils according to degree of exposure

social-educational achievement and impaired social-emotional development.

The mean hearing thresholds for both groups of music-exposed children ranged from 5.53 to 12.97 dB (with small standard errors), with the poorest thresholds at 4, 6, and 8 kHz. The above thresholds correspond with those reported in surveys conducted by Niskar et al. [11], Holmes et al. [12], Martinez-Wbaldo et al. [23], and Shargodsky et al. [13].

In summary, the results of our study provide clear evidence that loud music – at a “dangerous decibels” level – creates a risk of hearing damage in school-age children. To

prevent hearing loss, we suggest that the promotion and education of healthy music-listening behavior, as well as of hearing screening in schools, should be urgently introduced [2,7,9,22,28].

Conclusions

This study confirms that a significant number of school-age children have high-frequency hearing loss and tinnitus

related to their exposure to loud music. To conserve hearing, steps need to be taken in educating children on healthy music-listening habits.

Acknowledgments

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