



Tinnitus reported by children aged 7 and 12 years



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ABSTRACT

Objectives: To assess prevalence and risk factors of tinnitus reported by 7- and 12-year-old children from primary schools in Warsaw. A secondary objective was to test the relationship between hearing loss and tinnitus prevalence.

Methods: Observational cross-sectional study of 15,199 students aged 7 and 12 years (66.9% of the students of those ages) from all 173 public primary schools in Warsaw in the school year 2012/13. Audiometric hearing threshold levels were determined for the right and left ear of each student at frequencies of 0.5, 1, 2, 4, and 8 kHz. Normal hearing was defined as air threshold values of 20 dB HL or less for all tested frequencies. Unilateral and bilateral hearing loss cases were included into the analysis. Tinnitus experience was assessed with an audiological questionnaire administered verbally to the children.

Results: Overall 6.0% of the 7- and 12-year-old students reported tinnitus lasting for 5 min or more. The prevalence of tinnitus was significantly related to the hearing loss and age. Children with the unilateral high-frequency hearing loss reported tinnitus significantly less often compared to other children from the unilateral loss group. Children with bilateral moderate hearing loss reported tinnitus significantly more often than other children from the bilateral hearing loss group. Frequency of tinnitus reported by children was equal between the sexes and also between the children with unilateral and bilateral hearing loss.

Conclusion: Results obtained in this study with a large sample suggest that hearing loss and young age can be considered potential risk factors for tinnitus in school-age children. A consensus on how to define tinnitus is needed in order to enable direct comparison between data from different studies.

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1. Introduction

Tinnitus is defined as a perception of sound (ringing, buzzing, roaring, and hissing) in the absence of any external acoustic stimuli. Children rarely complain about tinnitus spontaneously [1], so it often goes unnoticed. However, when questioned, they are able to describe such sensations [1,2].

Prevalence of tinnitus in the adult population has been reported in many studies. It ranges mostly from 10% to 15% [3]. In the past three decades, there has been an increase in the number of investigations of tinnitus in children. However, only a few studies, all limited to small sample sizes, have addressed tinnitus in the pediatric population. They have reported prevalence of tinnitus in

children with normal hearing ranging from 13% to 47% [2,4–10]. However, in children with moderate to profound hearing loss, tinnitus prevalence increases significantly, and it ranges from 23% up to 56% [11–15]. Reported differences in prevalence, for both adults and children, result from the study methods used and depend on population, diagnostic criteria of hearing loss, age group, and wide variability of tinnitus definition adopted by researchers.

Properties of interest include duration, frequency and severity, and vary across studies.

Tinnitus lasting for more than 5 min at a time is the most commonly used question in epidemiological studies [16]. The age of children studied ranges from 5 to 18 years. Various age categories have been used, with the majority of data averaged across children of different ages [2,17–20]. Hearing loss is known to be risk factor for tinnitus among young people [8,9]. However, there have been very few studies that differentiated between unilateral vs. bilateral hearing and low vs. high frequency loss as potential risk factors [7,17].

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2. Material and methods

Data of 15,199 first-grade (7 years old) and sixth-grade (12 years old) students from all 173 public primary schools in Warsaw in the school year 2012/2013 was included in the study. The group constitutes 66.9% of the population of students in this category ($N = 22,715$). The characteristic of the study group is presented in Table 1. The students not included in the study (33.1%) were those who were absent on the days of testing or had no parental consent (27.4%) or they were excluded due to incomplete data entered into a computer, i.e., incomplete personal data, such as age or sex – 272 (1.2%), incomplete hearing test – 67 (0.3%), incomplete questionnaire in terms of tinnitus-related question – 948 (4.2%).

Children selected for the study group provided a consent form signed by their parents or caregivers, performed a hearing test, and completed a questionnaire. Testing was performed at school by experienced audiometricians. The time to test all children in each school was limited and calculated according to the number of students that were to be tested. Each school was visited only once, so children absent during the testing period were omitted. Hearing threshold levels were determined for the right and left ear of each student at the frequencies of 0.5, 1, 2, 4, and 8 kHz with the use of a class 4 audiometer (the “Sense Examination Platform”). Normal hearing was defined as air threshold values of 20 dB HL or less for all tested frequencies. Unilateral high frequency hearing loss (UHFHL) was recognized when there was normal hearing in one ear and high-frequency hearing loss in the other with threshold values of 20 dB HL or less for 0.5 to 2 kHz with thresholds greater than 20 dB at one or more frequencies above 2 kHz. Remaining audiograms of children with unilateral hearing loss which did not fit precisely into UHFHL were referred to as other unilateral hearing loss (UHL–others).

Bilateral moderate hearing loss (BMHL) was defined according to the WHO classification as having a 0.5, 1, 2 and 4 kHz pure tone average within the range from 41 to 60 dB in both ears. Remaining audiograms of children with bilateral hearing loss which did not fit precisely into BMHL were referred to as other bilateral hearing loss (BHL–others).

Tinnitus was assessed with an audiological questionnaire. The questionnaire consisted of 9 closed-set questions concerning different aspects of hearing. The audiometrician administered the questionnaire before performing the hearing test, and the answers given by the child were entered into a computer.

The question addressing the tinnitus experience was carefully formulated, since the previous work has indicated that figures for tinnitus prevalence can be affected by difficulties communicating with children [6,15,21]. It has been found that children mostly define tinnitus using the terms ringing (54%), buzzing (29%), and hissing (17%) [22], so these descriptions were used in our question, which, translated into English, asked the following: ‘Within the past 6 months, have you experienced any noise such as ringing, buzzing, hissing, or any other sort of sound in your ear or your head that had no apparent cause?’. The question was administered verbally to the child by the audiometrician. It was done sensitively in a non-leading manner to enable child to follow it. Furthermore,

audiometricians were trained how to listen respectfully to the child and communicate at the child’s level both developmentally and linguistically. They were also sensitized to the factors that may influence the way the child communicates with them [23]. There were 4 possible answers to the question: (A) ‘No, not at all.’ (B) ‘Yes, but it happens rarely and does not last long, less than 5 min.’ (C) ‘Yes, it happens often and lasts more than 5 min.’ (D) ‘Yes, I experience it permanently’.

All responses (A, B, C, and D) to this question were next grouped into two categories: category I, tinnitus negative (T–), responses A and B; category II, tinnitus positive (T+), responses C and D. Thus, children who gave A or B answers were considered to have no tinnitus (T–), and children with C or D answers were considered as those experiencing tinnitus (T+).

The prevalence of tinnitus and odds ratio (OR) of experiencing tinnitus in the population of normal hearing and hearing impaired children were calculated. Differences between the groups for categorical variables such as age, sex, and hearing status were assessed using the Pearson chi-squared test of independence (χ^2) with alpha level of 0.05 to determine significance.

The study has been approved by the Ethical Committee of the Institute of Physiology and Pathology of Hearing and conforms to the stipulations of the Declaration of Helsinki.

3. Results

Of the 15,199 students in the study group, the majority had normal hearing, while 10.9% of the children were diagnosed with hearing loss (Table 2).

Overall, 6.0% of the 7- and 12-year-old students reported tinnitus that lasted for 5 min or more during the preceding 6 months. Of those 19.8% (4.8% of the study group) reported permanent experience of tinnitus (Table 3). Prevalence of tinnitus in girls and boys was 5.8% and 6.1% respectively and the difference was not significant ($p > 0.05$). The outcome of the χ^2 test indicated that the prevalence of tinnitus was significantly related to hearing loss. Table 2 shows that 5.6% of children with normal hearing and 9.0% of children with hearing loss reported tinnitus [χ^2 (1, $n = 15,199$) = 31.43, $p < 0.001$].

The odds ratio for tinnitus in children with hearing loss compared to normal hearing children is 1.68 (95% CI, 1.4–2.1), indicating increased odds for tinnitus in children with hearing loss. The 95% CI indicates that in the population studied the odds of experiencing tinnitus are significantly higher for the hearing loss group compared to the normal hearing group.

In the hearing loss group (1662 students), children with unilateral hearing loss (UHFHL and UHL–others) constituted 69.3% (Table 3), and 8.9% of them reported tinnitus vs. 8.6% reported by children with any type of bilateral hearing loss (BMHL and BHL–others; Table 3) ($p > 0.05$). In the group of unilaterally impaired children (UHL–others), those with more than 3 frequencies affected constituted 53.3%; left and right loss was 54.8% and 45.2%, respectively (631 children vs. 520 children). The difference in prevalence of tinnitus between ears was not statistically significant ($p > 0.05$).

Table 1
Characteristics of the study group.

Age group	Girls			Boys			Total	
	N	% within age group	% of girls	N	% within age group	% of boys	N	% of all children
7-year olds	3544	48.67	46.74	3737	51.33	49.06	7281	47.9
12-year olds	4038	51.00	53.26	3880	49.00	50.94	7918	52.1
Total	7582		100	7617		100	15,199	100

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