The Journal of School Nursing
27(5) 380-389

DOI: 10.1177/1059840511411716
http://jsn.sagepub.com
SAGE

School Nurses' Role in Identifying and Referring Children at Risk of Noise-Induced Hearing Loss

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Abstract

Young people are likely to experience noise-induced hearing loss (NIHL), as the use of personal listening devices and other damaging factors (e.g., video games) increases. Little research has examined the role of school health personnel in the prevention and early identification of hearing impairment. A 32-item, valid and reliable survey was developed regarding elementary and middle school nurses' practices concerning hearing loss screening and prevention. The survey instrument was based on the Stages of Change theory and the Health Belief Model. A random sample of 800 nurses was obtained from The National Association of School Nurses. A two-wave mailing was used to achieve a 58% response rate. Forty eight percent indicated there were not many educational programs that addressed NIHL in students. Performing hearing screenings routinely can help identify those students at risk. School nurses need to become advocates for policies and programs that mandate hearing screenings and educational programs to help reduce hearing loss.

Keywords

hearing loss, school nurses, health belief model, stages of change

It is estimated that 1.5 million young people ages 0 to 21 have some type of hearing problem. Moreover, for 19.5% of children and adolescents aged 6–19 years that have permanent and irreversible damage to their hearing, it is related to excessive exposure to noise (National Institute on Deafness and Other Communication Disorders (NIDCD), 2008; Niskar et al., 2001; Shargorodsky, Curhan, Curhang, & Eavey, 2010). An increasing number of young people are likely to experience noise-induced hearing loss (NIHL) as the use of personal listening devices and other potentially damaging activities (e.g., video games) continue in popularity. NIHL, particularly when unidentified and untreated in youths, contributes to serious academic, language learning, social and emotional problems (American Speech Language Hearing Association, 2010a; Evans & Lepore, 1993; Evans & Maxwell, 1997; Tharpe & Sladen, 2008).

There is a plethora of recent studies related to NIHL for youths. The majority of these studies focus on surveys of students' knowledge and perceptions of NIHL (e.g., Chen, Huang, & Wei, 2009; Zogby, 2006) and hearing conservation programs (e.g., for a review, see Folmer, Griest, & Hal Martin, 2002). Yet, little research has been conducted to address the role of school health personnel in prevention and early identification of student hearing problems.

Etiology of NIHL

NIHL in youth is a relatively recent phenomenon that is cause for growing concern. Over the past decade, the concern has widened to include young children since the culprit of excessive sound exposure has shifted to the use of personal listening devices, toys, and recreational settings. In a decade, hearing loss has increased in prevalence in children and adolescents (aged 6 to 19) from 14.9% to 19.5% (Shargorodsky et al., 2010).

On a daily basis, children experience potentially hazardous sounds in their homes, schools, and recreational settings. The sources for these sounds include personal listening devices (e.g., iPod and MP3 players),video games (e.g., Rock Band®), auto races and tractor pulls, concerts, firearms (hunting and target shooting), household items (e.g., blow dryer, vacuum), children's toys, lawn tools

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(e.g., lawn mower, leaf blower), shop tools (e.g., electric saw or drill), fireworks, and band or orchestra instruments (American Speech-Language-Hearing Association [ASHA], 2010b).

While some potentially damaging sound sources are obvious (e.g., loud music), others are much more difficult to identify, such as the hazardous noise levels of some children's toys. According to the American Speech-Language-Hearing Association (2010), "when held directly to the ear, as children often do, a noisy toy actually exposes the ear to as much as 120 dB of sound, a damaging dose—the equivalent of a jet plane taking off. Noise at this level is painful and can result in permanent hearing loss." These toys typically include vehicles with horns or sirens, musical and educational electronic toys, squeaky toys, toy phones, and cap guns.

The etiology of NIHL is relatively straightforward: excessive noise exposure causes permanent damage to the sensory hair cells in the cochlea. Changes in sound pressure create a force on hair cells lining the basilar membrane of the cochlea, which leads to the perception of sound. Excessive force caused by high-intensity sound levels can lead to cellular metabolic overload, cell damage, and cell death resulting in permanent irreversible hearing loss (Tharpe & Sladen, 2008). Researchers have reported that damage to the structures of the inner ear as a result of noise exposure is caused by an interaction of mediators or confounders including noise intensity, duration, number of exposures, and individual susceptibility (Cooley Hidecker, 2008; Fligor, 2009). NIHL may be the result of chronic (exposure to lower, but still damaging, intensity levels across a 4- or 8-hr period), or acute damage, which occurs as a result of a single event such as exposure to an explosion (i.e., fireworks) or gunshot.

Identification of NIHL

Chronic damage to the cochlea leads to gradual changes in high-frequency hearing, which may be noticed early in life or may not be detected until many years after the exposure. In other words, the cochlear damage may occur in elementary or middle school, but the resultant change in hearing threshold may not be noticed until early or late adulthood. Despite the deleterious effects of NIHL, it can be difficult to identify since it is generally associated with a subtle and gradual shift in high-frequency hearing (generally between 3000 and 6000 Hz). When NIHL occurs, an individual typically maintains normal hearing thresholds for low- and mid-frequency sounds, and consequently, still perceives their hearing as fine. Yet, the individual will exhibit difficulty understanding what was said particularly in a noisy situation and may not be able to adequately hear at a distance. Ringing in the ears, called tinnitus, is a common early warning sign of NIHL, but is often ignored.

Hearing screenings are performed routinely in schools in an effort to identify hearing loss among children. However, pure tone audiometric screenings are not always sensitive to the subtle shifts in high-frequency hearing related to NIHL. Other methods such as otoacoustic emissions are more sensitive to sensory cell damage created by noise (Hall & Lutman, 1999; Hellerman, Jansen, & Dreschler, 2010). First, children, and even adults, are unlikely to notice slight shifts in high-frequency hearing and thus will not report any problem. The damage to the ear itself cannot be seen. Subsequent, changes in threshold or sensory cell damage must be detected in the assessment component of the screening program. However, in many cases, the early threshold shift is likely to be only 5–10 dB at the highest test frequency, 4000 Hz. Since normal hearing ranges from 10 to 15 dB hearing level (dB HL) for children, screening is conducted at 20 dB HL. Consequently, a child could have a 10 or even 15 dB shift and still pass the traditional pure tone audiometric hearing screening. While this shift falls within normal limits, it still creates significant concerns since it is permanent and will likely become worse over time (Daud, Noor, Rahman, Sidek, & Mohamad, 2010; Tharpe, Sladen, Dodd-Murphy, & Boney, 2009). Considering that most children are not screened beyond 9th grade, it is unlikely that screenings will be conducted to detect changes that occur later in life. While the screening protocol does allow for additional screenings for students at risk for noise exposure (e.g., band, vocational education, industrial education, and automotive mechanics), data are not available to indicate who refers these children, at what ages they are seen, and pass rates for hearing screening among this high-risk population.

Although changes in hearing threshold may be considered subtle, the NIHL is permanent and worsens with continued exposures. It creates problems in listening, language, and learning, leading to serious academic and social concerns and it jeopardizes quality of life (ASHA, 2010a; Kochkin, Luxford, Northern, Mason, & Tharpe, 2007; McFadden & Pittman, 2008), even when the threshold change is minimal (Bess, 1985; Kaderavek & Pakulski, 2002; Tharpe et al., 2009).

Impact of NIHL on Students' Academic Success

Hearing is paramount to child development for spoken language. It is through auditory-based learning that children most effectively approach spoken language development, reading and academic learning, and become acculturated into our society (Pakulski, 2011). Much of what children learn occurs incidentally. Children hear their parents and siblings, teachers, and classmates in day-to-day conversations and in direct instruction. They must be able to do so with varying levels of background noise, at a distance, face-to-face or away from direct line of vision, and when they are distracted. Yet, minor reductions in sound intensity (such as that caused by subtle changes in hearing due to NIHL) will significantly reduce a child's ability to comprehend and increase the effort required to listen effectively (Bess,

1985; Kaderavek & Pakulski, 2002; Tharpe et al., 2009). Hearing loss may also be associated with overall reduced quality of life and behavioral problems when students cannot hear educational content or teacher directions/instructions.

There are four major ways in which hearing loss (even a mild degree) affects children: (a) it causes delay in the development of receptive and expressive communication skills (speech and language); (b) the resultant language deficit causes learning problems that lead to reduced academic achievement; (c) communication difficulties often lead to social isolation and poor self-concept; and (d) it may have an impact on vocational choices (ASHA 2010a; Daud, Noor, Rahman, Sidek, & Mohamad, 2010; Kochkin et al., 2007).

When parents and other professionals do not recognize that hearing loss is present in students, the school nurse may document hearing loss and bring it to their attention during routine screenings. In conjunction with screenings, the school nurse may also provide education to the student and parents to help them better understand the causes, prevention, and intervention when NIHL is present.

The purpose of the current study was to assess the role of school nurses in screening for NIHL and providing follow-up when hearing loss has been tentatively identified. Current practices and perceived benefits and barriers regarding hearing screening and education were also assessed.

Method

Participants

The National Association of School Nurses was contacted regarding the generation of a list of members. The membership list consisted of approximately 13,000 school nurses. Based on an a priori power analysis using a 50/50 split in responses with a 95% confidence level and plus or minus 5% error, it was determined that data from 374 nurses would be needed for generalizing the overall results to the population of elementary and middle school nurses (Price, Dake Murnan, Dimming, et al., 2005). A simple random sample was used to generate 800 names of school nurses. The list only included nurses who currently worked in the 48 contiguous states.

Instrument

A 30-item, closed format survey was developed (utilizing a four-page, fold-over booklet style format) concerning elementary and middle school nurses' practices regarding hearing loss screening and prevention. The survey instrument was constructed using the Stages of Change theory (Prochaska, DiClemente, & Norcross, 1992) and key components of the Health Belief Model (Janz & Becker, 1984). The Stages of Change theory is commonly used in survey research to assess the current status of programming or behavioral change. In this case, the theory was used to determine whether school nurses followed up students who were screened and found to possibly have hearing loss. The Health Belief Model utilizes the constructs of perceived benefits and barriers to assess factors that affect programming or behavior change. For this survey, perceived benefits and barriers were used to determine possible issues that may have facilitated or interfered with school nurses screening or providing prevention programs. The instrument also consisted of background characteristics including school location, age, education, race, years worked as a school nurse, and certification status. Survey items dealt with questions on perceptions and practices regarding screenings, perceptions of interventions and education, and steps nurses take to educate students, parents, and administrators regarding hearing damage prevention.

Additional items were included based on a comprehensive review of the literature. To establish content validity, the survey instrument was sent to a panel of nurses, audiologists, and survey research experts for review ($n = 9$). The content experts were identified based on their publication record and expertise related to school nursing and/or speech and language expertise. After the expert review, minor changes were made to the instrument to ensure that adequate measures of nurses' perceptions and interventions regarding hearing loss and prevention were included and that the survey was clear and easy to read. In addition, the questionnaire was pilot tested for stability reliability through testing and retesting with a convenience pilot sample of elementary and middle school nurses ($n = 10$). The convenience sample of school nurses was obtained through the Ohio Association of School Nurses and the American School Health Association. The survey was mailed to a sample of school nurses along with a cover letter asking that they complete the survey and return it in the self-addressed envelope. The same nurses were mailed the survey and return envelope a second time, 1 week later. Using Statistical Package for the Social Sciences (SPSS) 16.0 to analyze data, an item mean percent agreement (82.4%) and item mean Pearson product moment correlation coefficient ($r^2 = .86$) were calculated to determine the stability reliability of the instrument and the items measuring various constructs of this instrument. Percent agreement on items was calculated on multiple response items where it was not appropriate to use inter-item correlations. Inter-item reliability was established using KR-20 or Cronbach's alpha depending on the response format of the items (dichotomous vs. Likert-type responses, respectively). Six subscales were analyzed yielding the following results which had moderate to high reliability scores; benefits of screening, (KR-20 = .57), benefits of prevention (KR-20 = .53), barriers to screening, (KR-20 = .64), barriers to providing follow-up, (KR-20 = .41), efficacy expectations (α = .83), screening protocols (α = .43), and barriers to providing follow-up, (KR-20 = .41). There was considerable variation in types of topics listed in the benefit and barriers subscales. Thus, there was limited likelihood that all items would have equal probability of being selected, reducing the internal reliabilities of those subscales.

The final questionnaire consisted of 30 items: Stages of Change theory (precontemplation, contemplation, preparation, action, and maintenance; Prochaska et al., 1992) to assess participants' readiness to provide students with follow-up of potential hearing loss. In addition, two key constructs of the Health Belief Model were operationalized; perceived barriers ($n = 5$ items) for providing hearing loss prevention training to students and perceived benefits ($n = 5$ items) of providing hearing loss prevention training (Janz & Becker, 1984). Perceived benefits and barriers were utilized in the survey because these constructs have been found to be the most significant predictors of behaviors within the Health Belief Model (Harrison, Mullen, & Green, 1992). Also included were perceptions ($n = 7$ items) of hearing loss prevention activities such as accuracy in screening and tracking hearing loss over time, and providing appropriate referrals and background/demographic questions ($n = 13$ items; including school location, age, education, race, years worked as a school nurse, and certification status). Most questions on the survey were closed format questions with multiple response categories. Likert-type scales (e.g., *not confident* to *very confident*) were used to assess school nurses' perceptions and beliefs.

Procedures

This study was approved by the university human subjects committee. A brief cover letter explaining the confidentiality of responses and a copy of the questionnaire printed on pastel paper was mailed to the school nurses across the United States. Postage-paid, self-addressed, return envelopes, along with a $1 incentive were included in the initial mailing (Oden & Price, 1999). Approximately 2 weeks after the initial mailing, a second cover letter, another copy of the survey, and another postage-paid return envelope were sent to the school nurses. Several published techniques were used to maximize the survey response rate. These included limiting the length of the questionnaire, placing demographic items at the end of the survey, including a $1 incentive, personalizing the introductory letter, affixing first class stamps, and using a two-wave mailing (Edwards et al., 2002; King, Pealer, & Bernard, 2001).

Data Analysis

Data were analyzed using SPSS 16.0. Data analysis included descriptive statistics with a report of the frequencies, means, and standard deviations to describe the responses to the questionnaire items as well as the demographic and background characteristics of the respondents. *T* tests were calculated to determine relationships between dichotomous independent and parametric dependent variables. Multivariate analysis of variance (MANOVA) tests were calculated to determine the relationship between categorical independent and multiple parametric dependent variables. Analysis of variance (ANOVA) tests were conducted to determine the relationships between categorical independent and parametric dependent variables. Chi-square tests were conducted to compare the types of interventions being planned or carried out by the Stage of Change theory in which the school nurses placed themselves.

Table 1. Demographics of Responding School Nurses

Item	Total *n* (%)
School nursing	
Currently a school nurse	412 (94.9)
Certified as a school nurse	222 (51.2)
State certified as a school nurse	166 (38.2)
Nationally certified as a school nurse	20 (4.6)
Both certifications	36 (8.3)
Sex	
Male	5 (1.2)
Female	416 (95.9)
Highest level of nursing education	
Associate degree	47 (10.8)
Diploma program	13 (3.0)
Bachelor's degree	244 (56.2)
Master's degree	111 (25.6)
Doctoral degree	3 (0.7)
Race/ethnicity	
African/American	7 (1.6)
Asian/Pacific Islander	6 (1.4)
Hispanic	5 (1.2)
White	395 (91.0)
Other	2 (0.5)
School location	
Urban	95 (21.9)
Suburban	209 (48.2)
Rural	111 (25.6)
Type of school	
Public	374 (86.2)
Private	40 (9.2)
Charter	3 (0.7)
Geographic location*	
Northeast	99 (23.2)
Midwest	141 (33.0)
West	64 (14.9)
South	97 (22.7)
Southwest	26 (6.1)

Note. $n = 427$ (percentages add up to 99.9% due to rounding).
*some people selected more than one state (percentages add up to 99.9% due to rounding).

Results

Demographics and Background Characteristics

Of the 800 surveys mailed, 50 were nondeliverable. In all, 434 surveys were returned, for a response rate of 58% (434/750). A majority of the responding school nurses were White (91%), female (96%), held a bachelor's degree in nursing (56%), and worked in a public school (86%). About half (51%) were certified as a school nurse. Half (48%) of the responding nurses worked in a suburban setting. Of the responding nurses, 81% reported they had mandates for screening of students' hearing (Table 1).

Table 2. Stages of Change Regarding Follow-Up After Hearing Screening

Follow-Up for Students Who are Suspected of Having Noise-Induced Hearing Loss (Stage)	Total *n* (%)
I have not seriously thought about follow-up (Precontemplation)	63 (17.1)
I have thought about follow-up but not made a plan (Contemplation)	28 (7.6)
I plan to create a plan for follow-up within the next year (Preparation)	13 (3.5)
I have been following-up with students at my schools for less than one year (Action)	48 (13.0)
I have been following-up with students at my schools for one year or more (Maintenance)	200 (54.3)
I used to follow-up but no longer do so (Relapse)	16 (4.3)

Note. $n = 368$.

Stages of Change

Five items identified respondents Stage of Change among students who were suspected of having NIHL (Table 2). About half (54.3%) of responding nurses reported being in the maintenance phase. A statistically significant difference ($\chi^2 = 22.3$, $df = 2371$; $p < .01$) was found regarding stages of follow-up for students who were suspected of having hearing loss in schools with a mandate compared to nurses in schools without a mandate for screening students hearing. Nurses in schools with a mandate for screening were significantly less likely to be following up with students compared with nurses in schools without mandates (28.3% vs. 71.7%, respectively).

Hearing Screening Efficacy Expectations

Nurses were asked about their efficacy expectations regarding the screening of students' hearing (Table 3). Two thirds of responding school nurses (65.5%) indicated they were confident or very confident in accurately screening the status of a student's hearing. Having a mandate versus not having a mandate resulted in a statistically significant difference, $t(391) = 2.956$, $p = .003$, in efficacy expectations of elementary school nurses in screening for hearing loss in children. Nurses in schools with a mandate had greater ($M = 21.65$, $SD = 5.65$) efficacy expectation scores regarding screening for hearing loss than did nurses in schools without a mandate ($M = 18.89$, $SD = 5.69$). Education level of the nurses approached a statistically significant difference on their efficacy expectation scores in screening for hearing loss, $F(4) = 2.292$, $df = 4413$; $p = .06$, where nurses with more education were more likely to be screening for hearing loss.

Perceived Benefits of Screening for Hearing Loss

Nurses were also queried concerning their perceived benefits of screening students for hearing loss (Table 4). The top three perceived benefits of screening the hearing of students were: screening increases the quality of life for students (83.6%), provides information to parents about hearing loss (78.2%), and creates awareness of hearing loss problems (68.6%). Having a mandate to screen for hearing loss did not result in a statistically significant difference in nurses' number of perceived benefits of screening students for hearing loss. There was not a statistically significant difference between school nurses' education levels and their perceived benefits for measuring hearing loss.

Perceived Benefits of Including Prevention Education Programs for Students

Nurses' perceived benefits of including hearing loss prevention education programs in schools was assessed (Table 4). The top three benefits school nurses identified for offering prevention programs were: decreased incidence of hearing loss across students' lifetime (76.3%), improved academics (76.6%), and increased student motivation to take action to prevent hearing loss (72.0%). Having a mandate to measure hearing loss versus not having such a mandate did not result in a statistically significant difference in perceived benefits to screening, $t(387) = 1.382$, $p = .17$. There was not a statistically significant difference between education levels and perceived benefits of prevention of hearing loss.

Perceived Barriers to Screening Students' Hearing

School nurses were asked to identify potential barriers related to screening students' hearing (Table 4). Responding nurses identified a lack of parental response (36.5%), not knowing how to properly screen for noise-related hearing loss (30.7%), and not having enough time (34.1%) as the top three barriers of screening students' hearing. Nurses in schools with a mandate perceived statistically significantly fewer ($M = 1.84$, $SD = 1.38$) barriers than those in schools without such a mandate ($M = 2.56$, $SD = 1.91$; $t(385) = -2.331$, $p = .02$).

There was not a statistically significant difference by educational levels of school nurses and total number of perceived barriers to screening students for hearing loss.

Perceived Barriers to Providing Appropriate Follow-Up for NIHL

School nurses were asked to identify potential barriers related to providing appropriate follow-up for NIHL (Table 4). Responding nurses identified a lack of time to focus on students who may be at risk because of other job responsibilities (63.9%), lack of expertise on noise-related hearing loss prevention (59.1%), and lack of standardized educational materials for parents and students (55.6%) as the top three barriers to providing appropriate follow-up for NIHL. There

Table 3. School Nurses Self-Efficacy for Screening for Hearing Loss

How Confident are You in You Ability to:	Not Confident	Slightly Confident	Moderately Confident	Confident	Very Confident
Item					
Provide appropriate referrals to parents whose children do not pass their hearing screening	25 (6.1)	27 (6.6)	47 (11.4)	140 (34.1)	172 (41.8)
Accurately screen a student's hearing	67 (16.3)	19 (4.6)	56 (13.6)	138 (33.6)	131 (31.9)
Track students' hearing screening results over time	60 (14.6)	70 (17.0)	89 (21.7)	113 (27.5)	79 (19.2)
Provide appropriate referrals to parents whose children are at risk for noise-induced hearing loss specifically	96 (23.6)	78 (19.2)	97 (23.9)	90 (22.2)	45 (11.1)
Recommend appropriate changes in the home environment and personal device use to help child maintain hearing status	72 (17.6)	112 (27.4	121 (29.6)	72 (17.6)	32 (7.8)
Use data regarding children's hearing status to convince administrators to implement programs to prevent noise-induced hearing loss	109 (26.9)	109 (26.9)	98 (24.2)	70 (17.3)	19 (4.7)
Accurately identify students at risk specifically for noise-induced hearing loss	76 (35.2)	43 (19.9)	49 (22.7)	33 (15.3)	14 (6.5)

Note. $n = 304$.

was not a significant difference in number of perceived barriers to follow-up of students initially identified as having hearing loss and whether schools mandated hearing screening for students.

Current Screening Practices of School Nurses in Hearing Loss

School nurses who indicated they were currently measuring hearing loss were asked to identify which practices they were currently using in their schools to address the issue of NIHL (Table 5). Several of the screening questions referred to best practices in accurately screening/detecting hearing loss. Regarding these screening practices, the most common practice was using a calibrated audiometer (92.5%) and the least common was having students refrain from listening to loud sounds 24 hr before screening (0.3%).

Discussion

Many schools currently screen for hearing loss as part of the recommended or required student health screenings. Schools determine their status usually by a state or district mandate. Although 83.6% of school nurses stated that screening students for hearing loss improves the quality of life of students, there was no policy that was universal for every state and some states did not undertake the process of hearing screenings at all. Only 23.5% of the school nurses surveyed stated there were no barriers to screening students for hearing loss. Lack of time, lack of parental support, and not knowing how to properly screen for NIHL were major barriers for school nurses in performing hearing screenings in their schools. Educational level did not have a significant impact on perceived benefits or total number of barriers to performing hearing screenings. This may have been due to the fact that only 14% of the respondents had less than a bachelor's degree in nursing and thus the study may have been underpowered to detect a difference. Nurses in schools with a mandate for screenings perceived fewer barriers than those in schools without a mandate. It can be hypothesized that the administration in schools with screening mandates were willing to provide more resources for screening than did schools without a mandate. If so, then nurses in those schools would likely perceive there to be fewer barriers to screening and follow-up.

While 65.5% of nurses were confident to very confident in their ability to accurately screen a student's hearing, only 21.8% were confident or very confident in their ability to accurately identify students at risk specifically for NIHL. Fifty-three percent of nurses said they were not confident or only slightly confident they could use data from a hearing screening to convince administrators to implement programs to prevent NIHL, even though 86.5% of nurses strongly agreed or agreed that NIHL has a significant impact on the health and well-being of students. With such a high percentage of nurses agreeing that hearing loss impacts one's well-being, it was significant that 25% of the school nurses were in the precontemplation or contemplation stages of the Stages of Change theory regarding follow-up on screened students with possible hearing problems.

Many schools screen most often for hearing loss in the elementary and middle school grades rather than at the high school level (Roeser & Clark, 2004). In fact, many schools do not conduct hearing screenings after 9th grade. This is unfortunate, given that NIHL is more likely to manifest itself in later years after repeated exposure to noise. Further, teens and adults are unlikely to receive hearing screenings or referrals through their primary care providers (Cohen, Labadie, & Haynes, 2005). When children do suffer NIHL at a young age and are not identified for hearing loss and do not receive early interventions, special education for a child with hearing loss costs schools an additional $420,000, and has a lifetime cost of approximately $1 million per individual (Johnson, Mauk, Takekawa, Simon, Sia, & Blackwell, 1993).

Table 4. Benefits and Barriers to Screening Students for Hearing Loss and Providing Hearing Loss Prevention Programs

	n (%)
Benefits of screening students for hearing loss	
There are no benefits to screening students for hearing loss	8 (1.9)
Increases quality of life for students	353 (83.6)
Provides information to parents	330 (78.2)
Decrease incidence of hearing loss across students' lifetime	319 (76.3)
Creates awareness of hearing loss problems	310 (73.5)
Provides support for programs to address preventable hearing loss	250 (59.2)
There are no benefits to screening students for hearing loss	8 (1.9)
Benefits of including prevention programs for students' hearing loss	
There are no benefits to including prevention programs for students' hearing loss	11 (2.6)
Improved academics	320 (76.6)
Decrease incidence of hearing loss across students' lifetime	319 (76.3)
Increased student motivation to take action to prevent hearing loss	301 (72.0)
Improved social outcomes	265 (63.4)
Barriers to screening students' hearing	
There are no barriers to screening students for hearing loss	98 (23.5)
There is a lack of parental response	152 (36.5)
Do not have enough time	142 (34.1)
Do not know how to properly screen for noise-related hearing loss	128 (30.7)
Do not have adequate resources and/or referral sources for students with hearing problems	99 (23.7)
Do not have proper equipment to screen hearing	88 (21.1)
Do not know how to properly screen	55 (13.2)
There is a lack of administrative support	54 (12.9)
Barriers to providing appropriate follow-up for noise-induced hearing loss	
Lack of time to focus in students who may be at-risk because of other job responsibilities	252 (63.9)
Lack of expertise on noise-related hearing loss prevention in our school	233 (59.1)
Lack of standardized material for parents and students	211 (55.6)
Lack of resources available to students who may be at-risk	184 (46.7)
The issues of noise-induced hearing loss and prevention are minor, compared to other health issues addressed by the school nurses	99 (25.1)
Lack of professional guidelines provided by NASN	93 (23.6)

Even though most states do have some sort of hearing screening mandate in place, there does not seem to be a set protocol or guideline in place to support those children who fail their hearing screenings. When an NIHL is identified, nurses are faced with several barriers to follow-up with parents, including lack of standardized educational material to share with them (55.6%) and a general lack of expertise for NIHL prevention in school (59.1%). Half of the nurses (50.0%) believed they had an inability to affect students' behavior related to personal listening devices and other causes of NIHL.

Limitations

The findings of this research should be interpreted in light of the potential limitations of the study. First, the data were self-reported, and some of the nurses could have over- or underreported some of their responses. If this occurred, this could be a threat to the internal validity of the findings. The response rate could also be a threat to the generalizability (external validity) of the findings if those who did not respond to the survey would have responded differently from the respondents. Fifty-one percent of the respondents were certified school nurses and this high percentage could also limit the external validity of the findings. School nurses who perceived the area of working with children who have a potential hearing loss to be a sensitive issue may have given socially desirable responses to some questions. School nurses who do not routinely screen for hearing loss in their students may have also given more socially desirable responses, if so this would be a threat to the internal validity of the findings. The survey questions were developed on the basis of a review of the literature and expert opinion. Actual focus groups with school nurses were not used to elicit items for the questionnaire. It is possible that such focus groups could have uncovered other equally important issues not included in the questionnaire. If so, this too could be a threat to the quality of the results. Some of the hearing screening mandates (state, district, or school) may not have been in place for an extended period of time and may not have had time to influence some of the nurses' perceptions and behaviors. If so, this could have caused an inability to detect differences between schools with mandates and those without mandates. However, since we did find significant

Table 5. Current Practices of School Nurses Regarding Hearing Screening

How often do you take the following steps when you screen a student's hearing?	Never	Almost Never	Most of the Time	Always	Not Sure
I use a calibrated audiometer	8 (2.6)	1 (0.3)	2 (0.7)	285 (92.5)	12 (3.9)
I perform a listening check/visual inspection of the audiometer before initiating a screening	11 (3.5)	20 (6.4)	56 (17.9)	216 (69.0)	10 (3.2)
I measure sound levels in the environment before beginning a screening	148 (48.5)	28 (9.2)	35 (11.5)	87 (28.5)	7 (2.3)
I examine the ear drum and ear canal for infections using an otoscope	102 (33.3)	101 (33.0)	53 (17.3)	49 (16.0)	1 (0.3)
I obtain written consent from parents	239 (77.6)	25 (8.1)	5 (1.6)	35 (11.4)	4 (1.3)
When noise-induced hearing loss is suspected, the student is screened using otoacoustic emissions	231 (75.9)	14 (4.6)	12 (3.9)	12 (3.9)	35 (11.5)
I obtain a brief history for each student to determine risk factors for hearing loss, including noise exposure	194 (62.6)	75 (24.2)	29 (9.4)	10 (3.2)	2 (0.7)
I have students refrain from listening to loud sounds 24 hr before the screening	272 (87.7)	30 (9.7)	5 (1.6)	1 (0.3)	2 (0.6)

differences between nurses at these two types of schools it implies this may not have been a significant limitation.

Implications for School Nursing Practice

School nurses are in a key position to identify children at risk of NIHL as a result of exposure to loud sounds through personal listening devices such as iPods and MP3 players, and other risky practices related to environmental noises. The importance of the school nurse in identifying children at risk of hearing loss is underscored by the fact that 40% of children newly identified with hearing loss in 4–6 years of age and the percentage of children decreases significantly as children get older to only a fraction of children being identified with hearing loss at age 9 or older (Kochkin et al., 2007). For those children identified with hearing loss in their school years, 21% of them were diagnosed because they failed a school hearing screening (Kochkin et al., 2007). Schools should be able to do a much better job of screening for hearing loss in their students, especially given the implications for academic success.

Performing hearing screenings in school on a regular basis can help identify those students at risk of hearing loss. School nurses need to become advocates for policies and programs that mandate hearing screenings and educational programs aimed at reducing hearing loss in students as early as elementary school. The potential for improving a student's academic success or social outcomes could, in part, depend on identifying hearing loss problems in school aged children and following up with appropriate materials and interventions including hearing conservation programs, hearing aids or other assistive listening devices, and related educational programming aimed at reducing risk and long-term impact. School nurses can also take the lead in making sure the school environment is a healthy one that does not add to the potential for hearing loss by educating teachers who coordinate band or orchestra and vocational classes that utilize loud machinery. Once areas are identified, the school nurse can educate teachers, staff, parents, and students concerning hearing loss prevention.

In addition to screening hearing, conservation education and social attitudes regarding noise levels should be a regular part of the school curricula. For example, teaching children how to use personal listening devices to avoid damage, the value of hearing protection, and other healthy hearing practices can diminish hearing loss over a lifetime. In a study of elementary children's knowledge and intended behavior toward hearing conservation, Chen et al. (2009) found that only 55% of children knew that hearing protective devices could protect them against noise; 28% of children did not intend to adopt any protection behavior against noise, which the authors indicated was likely due to lack of knowledge. Holmes, Widen, Erlandsson, Carver, and White (2007) reported that very few young adults report consistent use of hearing protection, despite the fact that more than 20% complain of ear pain, tinnitus, and/or a temporary threshold shift after noise exposure. Researchers agree that the question remains as to "whether this risk-taking behavior" is due to lack of knowledge, attitudes, social acceptance, or a combination of these variables (Chung, DesRoches, Meunier, & Eavey, 2005; Folmer, 2006; Holmes et al., 2007).

Often health-related topics, such as hearing loss, are not regularly included in the classroom due, in part, to the fact that students are not tested on this information for proficiency tests. Moreover, hearing conservation education often is not part of the school curriculum and often is not taught because of the perceived need to teach other health-related topics like nutrition, obesity prevention, substance abuse, sexuality education, and the limited time to cover all of these topics. Therefore, despite growing concerns related to childhood hearing loss due to noise exposure, basic hearing loss information remains absent from most school curricula and few pediatricians or other medical personnel routinely screen children for noise damage (Kochkin et al., 2007).

Another major concern is that much of noise exposure occurs outside of school. Everyday activities put unsuspecting

children and their families at risk. In a Swedish national project to evaluate and reduce high sound pressure levels from music at establishments including: restaurants, festivals and concerts, gyms, cinemas, and sporting events, it was found that 24% of establishments investigated exceeded sound level measurements considered safe for leisure sounds Ryberg (2009). Festival or concert events were found to be the activities most likely to exceed the recommended noise levels (42%). Thus, Ryberg concluded that continued monitoring of dangerous noise levels is necessary. The school nurse needs to be a vital link among community, parents, and schools to help conserve the hearing of youths through education and detection of hearing problems.

Conclusion

The incidence of preventable hearing loss in children is increasing due to I-Pod and Mp4 player use and other unhealthy practices. There are many ways that NIHL can impact student success in the classroom. School nurses must recognize the importance of detecting NIHL and taking appropriate steps to get students help when failed screenings are recognized. The nurse must also become a leader in advocating for programs to address NIHL and help parents, students, and staff understand the importance of taking care of one's hearing beginning at an early age .More emphasis on educating students regarding hearing loss needs to be incorporated into school curricula. In addition, the medical community needs to screen students on a regular basis for hearing loss.

Acknowledgment

The authors would like to thank Erica DeVantier, an undergraduate speech-language pathology student at UT, who was responsible for coding and entering the data and for the countless hours she contributed.

Declaration of Conflicting Interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Funding

The author(s) disclosed receipt of the following financial support for the research and/or authorship of this article: Funded by a grant from National Association of School Nurses and Ohio Association of School Nurses.

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