FEATURE ARTICLE
Research

Communicating Hearing Loss Information to Young Children

Effectiveness of Lecture and Printed Materials

by Robert F. Randolph, MS, Roberta L. Hudak, RN, BSN, and Charles Vaught, PhD

Abstract

Developing positive attitudes and behaviors toward hearing loss prevention is more effective the earlier it begins. This study evaluated two training techniques for educating young children about noise and hearing loss. Third grade students from seven Pennsylvania elementary schools received either no intervention between the pre-tests and post-tests, a lecture about hearing loss, or an informational bookmark along with the same lecture. A 10 item quiz was administered as a pre-test and post-test to assess changes in knowledge. Scores on the quiz improved the most for the lecture intervention groups regardless of whether they received the bookmark. Adding the bookmark did not have a significant effect on knowledge gain. The findings reinforce the value of providing an educational foundation along with communication products.

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Effective prevention of hearing loss, as with other health risks, should begin prior to exposure to the hazard. The National Institute for Occupational Safety and Health (NIOSH) is performing extensive research and outreach for hearing loss prevention for all ages and demographic groups consistent with the goals of the Healthy People 2010 initiative (U.S. Department of Health and Human Services, 2000). Although children are unlikely to be exposed directly to occupational health hazards, they can use prevention techniques when they are exposed to similar hazards in nonoccupational settings. They can also share their prevention attitudes and skills with their working parents. Finally, they will need effective prevention strategies when they eventually enter the work force.

Research in other public health domains has shown the value of educating children about issues, especially cardiovascular health, that affect all family members (Arbeit, 1992; Vega, 1988). Occupational health nurses and other occupational health professionals can make use of a variety of opportunities for hearing loss outreach to children, including plant tours, school visits, and informational materials sent home with workers but targeted toward all family members.

Even before they enter the workplace, children often have measurable noise induced hearing loss. For instance, Niskar (2001) reported 12.5% of 6 to 19 year old children in the United States have a noise induced threshold shift based on data from the Third National Health and Nutrition Examination Survey (NHANES). Montgomery (1992) showed the rates of hearing loss among children have increased during time. Specifically, they found that from 1979 to 1989, 2.8 times as many

What Does This Mean for Workplace Application?

The debilitating and costly effects of noise induced hearing loss continue to occur at alarmingly high rates despite efforts at prevention. Any tool that can add to the effective prevention should be considered, including thinking beyond workers to their families. In many cases, occupational health professionals have routine contact with employee families at open houses, wellness fairs, school visits, and other settings, which provide excellent teaching opportunities. This study shows how even a brief lesson about hearing loss can have an effect with school children. The lessons they learn can be brought to bear on their working parents, and will help the children establish effective preventive habits now and into their working years.

second graders and 4 times as many eighth graders showed a hearing level of 25 decibels (dB) or worse at 2 kilohertz (kHz), 4 kHz, or 8 kHz.

Some possible reasons for the higher rates include more prevalent use of portable audio systems, motorized recreational equipment, and other environmental exposures. Even when these losses are relatively mild, they may eventually accumulate with losses later in life to become disabling. Consequently, hearing conservation should begin before any losses occur to be most effective during an individual's life span.

Hearing conservation programs for school children have been shown to be an effective prevention strategy. Lass (1986) showed increases in hearing loss prevention knowledge resulting from an educational hearing conservation program that included a film, lecture, and handouts. Chermak (1996) found an increase in hearing conservation knowledge and behavioral intentions for fourth grade students given two 1 hour sessions of instruction. They noted scores were higher in a class that performed more extensive participatory activities.

Bennett (1999) also found differences in effectiveness based on the instructional approach. They observed higher post-test scores on a hearing conservation knowledge test when students were given more interactive "hands on" lessons rather than traditional lectures. However, the current intervention differed from these educational programs because the duration was much shorter and it was conducted outside the classroom as part of a field trip.

The National Institute for Occupational Safety and Health (NIOSH) Pittsburgh Research Laboratory is a popular field trip destination for local school children who tour its coal mine and extensive engineering and behavioral research facilities. During a tour of the hearing loss prevention facilities, children are given information about protecting their own hearing. This study was conducted to evaluate the effectiveness of these information presentations.

During the presentations, two main concepts were communicated—noise is a well known, measurable hazard and noise induced hearing loss can be avoided by taking specific preventive actions. Referring to the decibel scale and identifying the increasing level of hazard greater than 85 decibels, A-weighted (dBA) emphasized the objective nature of the noise hazard. While there is some risk of hearing loss at lower levels, NIOSH recommends 85 dBA as the level at which sound becomes hazardous (NIOSH, 1998). This level is reflected in Occupational Safety and Health Administration (OSHA) and Mine Safety and Health Administration regulations in which exposure to 85 dBA more than 8 hours triggers hearing conservation efforts.

The simplicity and brevity of the studied intervention is potentially very important to health educators. Hearing conservation education is rare in U.S. elementary schools (Chermak, 1996; Lass, 1986). A significant barrier to adoption of hearing conservation curricula is the resource intensive nature of the more effective training approaches. The individualized, interactive approach that has shown some success (Bennett, 1999, Chermak, 1996) may be impractical for resource strapped schools making an attempt to address many other high priority public health concerns. In these settings, the simpler and less costly the intervention, the more likely it is to reach a large population of students. Consequently, a major purpose of this study was to determine whether a brief lecture and demonstration along with a simple informational handout generates meaningful increases in hearing loss prevention knowledge. Such a finding would alert educators that, while an elaborate interactive hearing conservation curriculum might be ideal, even a very modest program was worth implementing.

METHOD

Participants

Participants were elementary school children at seven schools in the Pittsburgh region: 565 students participated in the pre-test phase and 546 participated in the post-test. The slight discrepancy in numbers between the pre-tests and post-tests is most likely because of student absences. To preserve anonymity, names or other tracking identifiers were not used to strictly relate the pre-test and post-test participants. The NIOSH presenters were invited by the schools to deliver a workshop on hearing loss prevention.

Design

This study followed a variation on the pre-test–post-test control group design (Campbell, 1966). Each visiting tour group, consisting of one or more classrooms from an individual school, was treated as a group for random assignment to the experimental conditions. Individual students were not tracked to avoid confidentiality issues and to allow for slight changes in class composition caused by of student absences. A total of 565 students participated in the pre-test, and 546 completed the post-test. The number of students participating from each school ranged from 61 to 97 (two or three classrooms). The seven participating schools were randomly assigned to one of three groups:

- No intervention group.
- Lecture only group.
- Lecture and bookmark group.

Noise Lecture Components

Definition of noise. Noise was defined simply as unwanted sound. This was to introduce the fact that some noise, although unpleasant, may not be dangerous. However, any dangerous sound can be considered noise because of the potentially negative effects.

Assessment item: *Noise is unwanted sound.*

Range of noisy environments. Occupational noise was described, but students were also informed that modern society contains many more noisy environments. They are at risk from loud music, lawn mowers, vacuum cleaners, and other sources they may not have considered. While the workplace is regulated and often professionally noise controlled, other settings are not. They should be equally concerned about noise at work as well as away from work.

Assessment item: *Noise only happens where people work.*

Noise and hearing damage. The direct relationship between noise and hearing loss was presented. Specifically, different causes and types of hearing loss were reviewed, but noise was singled out as the most common cause.

Assessment item: *Noise will not hurt my hearing.*

Objective measurement of noise. The basic instruments used to measure noise were described, including dosimeters and sound pressure level meters. It was explained that these are in widespread standardized use, and the readings provide an accurate, reliable index of actual risk of hearing damage.

Assessment item: *There is no way to measure noise.*

Noise level measurement units. The widespread use of decibels as the most common single measure of sound pressure level was explained. The scaling of decibels was compared to other familiar scales, including rulers to measure distance in inches and thermometers to measure temperature in degrees. The exponential nature of decibels was touched upon, but was not a major focus. Different weighting schemes ("A", "C," etc.) were not discussed.

Assessment item: *A "decibel" measures loudness.*

Negative effects of loud noise. Specific and general effects of noise were explained. The discussion started with an explanation of how noise affects the hair cells in the inner ear, and it has long term effects including hearing loss in the speech frequencies and tinnitus. Several quality of life effects were reviewed, including difficulty communicating with family, friends, and coworkers, and difficulty sleeping and concentrating as a result of oppressive tinnitus.

Assessment item: *Very loud noises may hurt my ears.*

Risk threshold. Students were told the risk for hearing damage begins at sound levels around 85 A-weighted decibels (dBA). The "85 dBA more than 8 hours" standard was discussed, along with the use of hearing protection to bring sound levels down to a safer range. Examples of hearing protection devices were shown, along with a demonstration of how and when to wear each one.

Assessment item: *Noises above 85 decibels cause harm.*

Permanence of hearing loss. This was a critical portion of the lecture. The permanent, irreversible, usually painless nature of sensori-neural hearing damage was described. To reinforce this concept, hearing damage was contrasted with a typical bodily injury resulting from a fall. In the case of bodily injury, the victim may have pain, bleeding, swelling, bruising, and other obvious symptoms. The symptoms of hearing damage are much harder to detect.

Assessment item: *If noise makes me lose my hearing, I will get it back soon.*

Efficacy of hearing protection strategies. A variety of time, distance, and barrier self protection strategies were described or demonstrated, specifically, these involved using some combination of reducing time of exposure, increasing distance from noise, and using hearing protection or some other protective barrier. Examples of these strategies included leaving noisy areas, covering the ears with hands or hearing protection devices, and lowering the volume on electronic devices.

Assessment item: *I should always protect my ears from loud noises.*

Self exposure assessment. Temporary tinnitus is one of the few warning signs of overexposure to noise. The typical nature of this high pitched "ringing" was described and students were asked if they had ever experienced it. They were told this ringing indicates the sound was too loud. If they were to continue their exposure, instead of temporary ringing or hearing loss, they would be in danger of permanent damage. They were also told how to "listen" for a temporary threshold shift that is another good indicator of potentially damaging noise exposure.

Assessment item: *It is good if my ears ring after I leave a noisy place.*

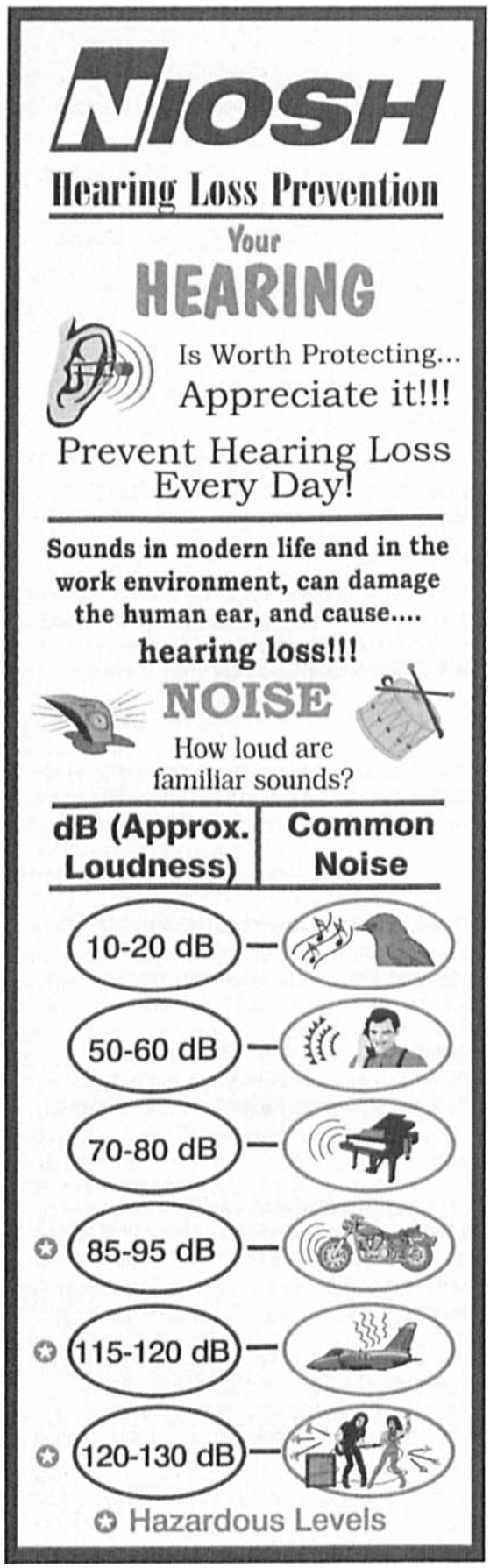

Figure 1. NIOSH hearing loss informational bookmark intended for elementary school children.

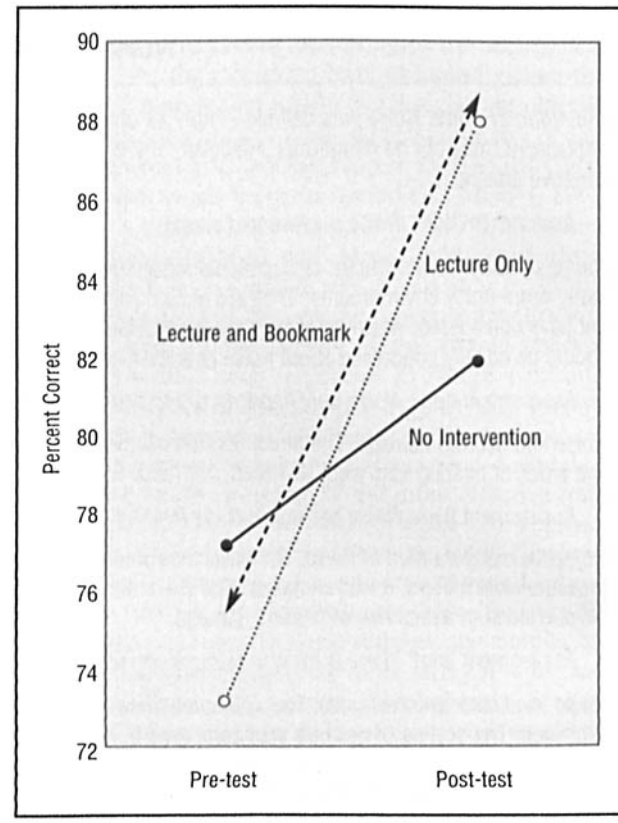

Figure 2. Changes in hearing loss knowledge test scores from pretest to posttest for no intervention, lecture only, and lecture and bookmark groups.

No intervention group. The students in the no intervention group were given a knowledge pre-test 3 months prior to the post-test, with no intervention between the two tests. These students participated in an educational tour and received information materials, but only after completion of the post-test. Because the tour and other information dissemination occurred after both the pre- and post-tests, it served just an outreach function and would not have affected the test results.

Lecture only group. Lecture only students received a pre-test 6 weeks prior to attending a tour and educational lecture at the NIOSH facility. They received a post-test 6 weeks after the tour and lecture. After the post-test, a member of the research team gave the students an informational bookmark during a classroom visit.

Lecture and bookmark group. Students in the lecture and bookmark group also received a pre-test 6 weeks prior to a combined intervention consisting of an informational lecture and presentation of the bookmark. This was followed by a post-test 6 weeks after the intervention.

A short (30 minute) informative lecture was delivered by one of the authors, an occupational health nurse. The lecture contained information about the nature of hazardous noise, causes of hearing loss, hearing damage resulting from noise, and prevention strategies. Points covered in the lecture were directly reflected in the knowledge assessment instrument, "Things About Noise." The main components of the lecture are detailed

Table

Initial Average Pre-test Scores for all Groups and Changes in Percentage Correct by Intervention Group

Question	All Pre-tests	Changes by Intervention Group: None	Lecture only	Lecture and Bookmark
Noise is unwanted sound	51.2%	-12.4%	8.5%	3.2%
Noise happens only where people work	94.9%	1.9%	1.2%	1.6%
Noise will not hurt my hearing	71.0%	17.2%	22.0%	19.4%
There is no way to measure noise	43.0%	15.2%	39.2%	32.0%
A "decibel" measures loudness	60.0%	12.4%	31.6%	31.3%
Very loud noises may hurt my ears	96.5%	.8%	3.5%	1.7%
Noises above 85 decibels cause harm	83.9%	11.4%	10.0%	12.0%
If noise makes me lose my hearing, I will get it back soon	86.5%	3.1%	6.1%	17.2%
I should always protect my ears from loud noises	91.7%	1.9%	9.2%	5.7%
It is good if my ears ring after I leave a noisy place	77.3%	-1.5%	19.6%	11.8%
Overall	75.6%	5.0%	15.1%	13.6%

in the Sidebar on page 435, along with the corresponding assessment item.

An informational bookmark was developed based on the suggestions of educators who had participated in earlier communications efforts. The bookmark used in this study contained a general message that "your hearing is worth protecting" and a listing of common noise or sound levels. Sounds louder than 85 dBA were flagged as being hazardous (see Figure 1).

RESULTS

Total scores for hearing loss knowledge increased between the pre-tests and post-tests regardless of intervention treatment. Figure 2 shows that both intervention groups (i.e., lecture only, lecture and bookmark) experienced greater improvements in knowledge test scores than the no intervention group. The no intervention group increased its scores by 4.99% while the lecture only group increased by 15.1% and the lecture and bookmark groups increased by 13.6%. Also, the percentage of students in all groups who answered every question correctly increased from 8.1 in the pre-test to 22.2 in the post-test. An analysis of variance showed there was a significant difference between pre-test and post-test scores (F = 40.020, p = .000), between the intervention groups (F = 3.64, p = .027), and for the interaction between test and intervention (F = 16.902, p = .000). Although the improvement in test scores for the lecture only group was greater than that of the lecture and bookmark group, this difference was too small to reach statistical significance at the p = .05 level.

Individual Test Items

Separate results were combined for each of the 10 test items. Because the items assess different concepts, these results provide some clues about the relative strengths of the interventions.

The Table shows changes in percent correct for each test question, along with the overall percent correct for all pretests. For some of the items, pretest scores were very high, which limited how much improvement was possible. For instance, 96.5% of the students correctly answered the question, "Very loud noises may hurt my ears," and subsequent improvements in this score were small.

While the no intervention group increased its rate of correct answers for 8 of the 10 questions, the scores for "Noise is unwanted sound" declined substantially. This group also performed slightly worse on the item, "It is good if my ears ring after I leave a noisy place."

The two intervention groups showed their greatest gains for two measurement questions, "There is no way to measure noise" and "A 'decibel' measures loudness." These points were covered in detail in the lecture, along with demonstrations of the measurement instruments. The lecture and bookmark scores generally improved within a few percentage points of the lecture only group with the exception of the item, "If noise makes me lose my hearing, I will get it back soon."

DISCUSSION

The results show a clear improvement in knowledge resulting from the informational interventions. While the study did not address changes in behavior or other public health outcomes, it does indicate that carefully selected and presented messages can influence understanding of health risks and appropriate preventive measures. These results should encourage occupational health nurses and other public health professionals to use even brief encounters with children to deliver a

focused hearing loss message. While the intervention in the current study took place in a government facility, it bears strong resemblance to factory tours that are a popular field trip destination and the results should generalize to those broader industrial settings. The results would also likely generalize to brief presentations in a school setting for occupational health nurses who perform community outreach activities.

The lack of additional effect from the bookmark intervention may be attributable to its design. The bookmark contained several messages, but none were clearly emphasized. Also, the hazardous sound levels were indicated with a small star rather than a more "eye catching" layout device. Because of these limitations, new educational materials are under development. The new materials are based on a more focused communication theory and will be subjected to evaluations with both children and adults.

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