

ABSTRACT

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Farmers are exposed to noise levels that may result in hearing loss as early as adolescence. A school-based noise-induced hearing loss study targeting adolescent farm students was implemented. Youth were clustered by schools (either control or intervention) with intervention schools receiving a hearing conservation program. The effects of the study on parents hearing conservation knowledge, attitude, and behavior is the focus of this research. Subjects were parents of students (N = 523). Parents were mailed a survey and a response rate of 66% was achieved. Fifty-six percent of the intervention parents reported use of hearing protection devices (HPDs) when exposed to loud machinery as compared to 44% of the control parents. Results indicated that intervention parents significantly ($p < .05$) changed hearing protection with 31% beginning HPD use after the hearing study started as compared to only 7% of control group parents. Data revealed that 80.4% of intervention parents intend to use HPDs in the future compared to 67.9% of control parents. There was no significant difference in hearing protection knowledge or attitude between the intervention and control groups of parents.

THE EFFECTS OF A FARM YOUTH HEARING STUDY
ON PARENTAL HEARING PROTECTION
KNOWLEDGE, ATTITUDES, AND BEHAVIOR

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CHAPTER I
INTRODUCTION

Background

Adolescents who live and work on farms may be exposed to loud noise from numerous sources such as tractors, combines, silo blowers and unloaders, grain and bale elevators, milking equipment, barn cleaners, and compressors. Some equipment may be used on a daily basis for extended periods of times. Decibel levels for the tractor, which is the most frequently used piece of farm equipment, range anywhere from 73 to 103dB at driver's ear level (Holt, Broste, & Hansen, 1993). Many farm teens are also accustomed to using firearms, chain saws, woodworking equipment, motorcycles, lawn mowers, and all-terrain vehicles. Decibel levels of the equipment used for these activities can range from 90 to 140dB (Council for Accreditation in Occupational Hearing Conservation, 1991). This range of noise exposure may cause irreparable damage to the hair cells of the inner ear (Ward, 1988). Exposure to portable stereo equipment, car stereos, band, orchestra, and sports events held in gymnasiums may also factor into the total noise exposure of an adolescent (Axelsson, Jerson, & Lindgren, 1981).

A study comparing audiometric threshold test results of Wisconsin high school farm students with nonfarm students found that teens actively involved in farm work have a higher prevalence of mild hearing loss and early noise-induced hearing loss

(NIHL) than teens not involved with farm work (Broste, Hansen, Strand, & Stueland, 1989). In fact, the four major findings from this study were: (a) the odds of mild or early NIHL more than doubled in students working on farms, (b) more than 50% of farm students had evidence of early NIHL, (c) use of hearing protection devices (HPDs) was infrequent, and (d) not using HPDs increased the estimated odds of NIHL by 64% in farm students.

Noise-induced hearing loss is one of the most common occupational conditions yet it is often neglected or underrated because there are no visible effects. Insidious is the term most often used when referring to NIHL. By the time a person notices a hearing loss, permanent irreparable damage has been done (Berger, Ward, Morrill, & Royster, 1988). Some characteristics of occupational NIHL include: (a) it almost always affects both ears, (b) it almost never produces a profound hearing loss, (c) there is no significant further progression of hearing loss as a result of noise exposure once the exposure is discontinued, (d) continuous noise exposure over the years is more damaging than interrupted noise exposure, and (e) NIHL is almost entirely preventable (Dobie, 1995).

According to Brookhouser (1994), there are approximately 28 million North Americans with some degree of hearing impairment with about 10 million of these impairments attributed to noise. Noise-induced hearing loss in industry has been addressed by safety engineers and managers for years by implementing mandatory hearing conservation programs (HCPs). However, no studies have been done that offer evidence of the efficacy of hearing conservation programs (Dobie, 1995).

Components of an ideal HCP for industry have been outlined by Royster and Royster (1990), and consist of: (a) an educational and motivational component with ongoing reinforcement, (b) a variety of HPDs provided for employees, (c) a sound survey to determine the degree of hazardous noise exposure, (d) a key individual in charge of the program, and (e) an audiometric evaluation done on a yearly basis.

Much like industrial settings, few documented studies were found of the implementation and evaluation of HCPs in school settings. The studies found included classroom style educational units, but had limited evaluation components for assessing change in knowledge, attitude, and behavior (Lass, Woodford, Lundeen, Lundeen, & Everly-Myers, 1987; Roeser, Coleman, & Adams, 1983; Wuest & Getty, 1992). Baseline hearing testing coupled with yearly audiometric follow-up were not included in these studies. Long term compliance evaluations with regard to HPD use, and the secondary impact of the programs were not addressed in any reported evaluation of these studies.

Broste et al. (1989) found that only 9% of farm teens reported ever using HPDs when exposed to loud noise. "The evidence that students using hearing protection have a lower prevalence of hearing loss suggests there may be great potential for preventive efforts in this age group" (p. 622). Based on this finding, Broste et al. and the National Farm Medicine Center (NFMC) of Marshfield, Wisconsin received funding in 1990 from the National Institute for Occupational Safety and Health (NIOSH) to conduct a school-based research study targeting farm youth.

This four-year NIHL study was planned and implemented to test whether a HCP directed at junior and senior high school students actively involved in farm work (intervention group) would result in the reduced prevalence of mild hearing loss at later follow-up, as compared to a similar group of active farm students not receiving a HCP (control group).

A secondary purpose for the research study was to confirm results of the earlier NFMC study done by Broste et al. showing the increased prevalence of hearing loss in agricultural youth. The study also attempted to measure hearing protection compliance rates in an adolescent population.

The study involved 753 students from 34 Wisconsin schools. Schools were recruited based on the number of farm students available at the 7th, 8th, and 9th grade levels, and the activity level of the FFA advisor and organization. Once recruited, schools were randomized into control and intervention groups. Students in the intervention group ($n = 375$) received a HCP much like industrial programs and aligned with an ideal HCP described by Royster and Royster (1990). The five key components of the intervention were (a) classroom style education, (b) reminders through school visits and direct mailings to students at their home address, (c) a variety of HPDs given to students and replaced on a regular basis, (d) sound level surveys done by students on their own farms, and (e) yearly audiometric exams and consultation.

Students in the control group ($n = 378$) did not receive an educational intervention or any educational information. These students were given a baseline audiometric exam

and follow-up audiometric exams in the second and third year. The additional audiometric exam conducted in the second year was intended to offset any learning effect that may have occurred in the intervention group due to the four times the intervention students were exposed to the audiometric test procedures.

Throughout the course of the study, a variety of earplugs and earmuffs were given to intervention students on a regular basis with the expressed purpose of replacing old and worn HPDs, and to give the students a chance to try out various brands. In total, intervention students received at least three earmuffs and 15 earplugs. Many students asked for more earplugs and earmuffs because of family members using them. Also, some students reported wanting to place HPDs near certain pieces of equipment around their farm. These reports and requests led NFMC researchers to believe that parents may be practicing hearing conservation as a result of their son or daughter being involved in the research study.

Since the focus of the school-based study was to test the effect of a hearing conservation program on the hearing protection practices of agricultural youth, evaluation procedures were focused on reported youth compliance with using HPDs and the comparison of hearing threshold levels (audiometric exam) at baseline and the third year of the program. The school-based study did not include any intended focus on parents' knowledge, attitude, or behavior changes in regard to hearing protection. Therefore, no secondary impacts of the student intervention were studied.

Statement of the Problem

A need exists for research which investigates the secondary impact of a school-based health education intervention targeting students. A literature review done by Crockett, Mullis, and Perry (1988) revealed that few studies assess the secondary effects of school-based, youth-directed interventions on parent knowledge, attitudes, and behavior.

Purpose of the Study

The purpose of this study was to investigate the secondary impact of a school-based, youth-directed NIHL research study on the hearing protection knowledge, attitudes, and behavior of the parents. This investigation was accomplished by a mailed survey to the parents of students who reported living and working on farms.

Hypotheses

The following null hypotheses were formulated for the study:

1. There is no significant difference in intervention parents' hearing protection behavior pre- and post-NIHL research study.
2. There is no significant difference in control parents' hearing protection behavior pre- and post-NIHL research study.
3. There is no significant difference between intervention and control parents' intent to use HPDs in the future.

4. There is no significant difference in hearing protection knowledge of parents with youth involved in the intervention group compared to parents with youth involved in the control group of the NIHL research study.
5. There is no significant difference in the hearing protection attitudes of parents with youth involved in the intervention group compared to parents with youth involved in the control group of the NIHL research study.
6. There is no significant difference in the hearing protection behavior of parents with youth involved in the intervention group compared to parents with youth involved in the control group of the NIHL research study.

Assumptions

The following were assumptions of the study:

1. Each subject was able to understand the survey questions.
2. Each subject answered the survey questions honestly.
3. Each subject answered the survey questions without help from their son or daughter involved in the school-based NIHL study.
4. The survey instrument was completed by the adult in the farm family household who is most responsible for working with farm equipment.
5. The parents of all students in the study were familiar with the school-based NIHL study which lasted for four years.
6. Respondents from both groups were similar in the honesty and accuracy of their reporting.

Delimitations

The following were delimitations of the study:

1. Only those parents of students who reported living on a farm in the school-based study were used in the sample.
2. Only Wisconsin farm households were included in the school-based study and therefore, only Wisconsin farm households were included in this study.

Limitations

The following were limitations to the study:

1. All farm parents were exposed to noise of varying levels depending on individual and family responsibilities. Individual noise exposure levels may have determined level of hearing protection use.
2. The mailing of the survey was early summer. This was an extremely busy time of year for most farm families as planting was being completed and harvesting of hay was beginning. Due to a long inclement winter season, spring planting and harvesting of hay overlapped in Wisconsin during the 1996 growing season.
3. The questionnaire was meant to be completed by the person in the household who works most with farm machinery. Even though respondents provided names, it could not be determined who actually completed the survey.

Definitions of Terms

Decibel - a unit for measuring intensity or amplitude of sound, usually reported as dB.

Hearing Conservation Program - a specified educational program usually implemented in industry with the purpose of preventing employees from developing NIHL on the job (Royster & Royster, 1990).

Hearing Protection Devices - earplugs or earmuffs designed to keep noxious noise from reaching the cochlea, thereby helping to preserve hearing sensitivity.

Hearing Threshold Level - "the deviation in decibels of an individual's threshold from a zero reference of the audiometer" (Council for Accreditation in Occupational Hearing Conservation, 1985, p. 215).

Noise-Induced Hearing Loss (NIHL) - "the slowly progressing inner ear hearing loss which results from exposure to high intensity noise over a long period of time" (Council for Accreditation in Occupational Hearing Conservation, 1985, p. 216).

Sound Level Meter - "an instrument including a microphone, an amplifier, an output meter, and frequency weighting networks for measuring of noise and sound levels" (Council for Accreditation in Occupational Hearing Conservation, 1985, p. 217).

Temporary Threshold Shift - a temporary loss of hearing that may occur when exposed to loud noise. With rest, much or all of the hearing may return. However, in time, with more exposure to noise, the loss may become permanent. (Council for Accreditation in Occupational Hearing Conservation, 1985, p. 37).

CHAPTER II

REVIEW OF RELATED LITERATURE

Introduction

This study examined the effects of a school-based, youth-directed NIHL study on the hearing conservation knowledge, attitudes, and behavior of parents indirectly involved in the program. In this chapter, literature was reviewed and categorized into sections as follows: (a) NIHL as a public health problem (b) noise-induced hearing loss in farmers, (c) hearing conservation programs in industry and schools, (d) details of the school-based NIHL study, and (e) secondary effects of youth-directed school-based health education.

Noise-Induced Hearing Loss as a Public Health Problem

Noise-induced hearing loss has been recognized as a public health problem since the 18th century. Ramazzini reported NIHL information in a document titled "Diseases of Workers" in the year 1713 (as cited in Centers for Disease Control, 1988). The National Institute for Occupational Safety and Health identified NIHL as one of ten leading work-related diseases and injuries (Centers for Disease Control, 1983). Noise-induced hearing loss develops slowly over years of exposure to sounds of high intensity or loudness. It is an irreversible but preventable public health problem. Noise-induced hearing loss is characterized as follows:

Sounds of sufficient intensity and duration will damage the ear and result in temporary or permanent hearing loss. The hearing loss may range from mild to profound and may also result in tinnitus. The effect of repeated sound overstimulation is cumulative over a lifetime and is not currently treatable. Hearing impairment has a major impact on one's communication ability, and even mild impairment may adversely affect the quality of life. Unfortunately, although NIHL is preventable, our increasingly noisy environment places more and more people at risk (NIH Consensus Development Conference, as cited in JAMA, 1990, p. 3185).

Since NIHL is preventable, efforts to educate young people regarding hearing conservation are imperative. Noise exposure for children and adolescents has been studied with particular attention focused on leisure activities. Five hundred thirty-eight teen males from technical schools were studied to ascertain information on leisure time activities and noise-levels. Ninety-five percent reported listening to loud music several times weekly or daily (Axelsson et al., 1981). A further analysis by Axelsson et al. found that 40% listened regularly to loud music using headphones. A more recent study by Wuest and Getty (1992) revealed that 5% of the 111 girls studied, and 14% of the 69 boys studied classified themselves as listening to music at a very loud level. Many students reported temporary threshold shifts after exposure to music at school dances, rock concerts, and even in the school cafeteria. Only a few students reported using any hearing protection.

Environmental noise is also a threat to public health. A study done by Chen and Chen (1993), which looked at the effects of aircraft noise on the hearing of school-age children, revealed that high frequency noise is more damaging than that caused by low frequency noise at identical sound intensities. Children and adolescents are exposed to

high frequency noise through many recreational activities such as snowmobiling, boating, and woodworking (Clark, 1990).

One of the major concerns raised by the NIH Consensus Conference was the lack of comprehensive data on what children know about preventing noise-induced hearing loss (Florentine, 1990). In a study done by Brookhouser, Worthington, and Kelly (1992) which focused on children with noise-induced hearing loss, comprehensive and age-appropriate education programs were suggested for both elementary and high school level students. Brookhouser et al. also suggested that NIHL receive additional legislative and regulatory attention at the local, state, and federal levels with special attention given to youth in rural environments.

Noise-Induced Hearing Loss in Farmers

Linking hearing loss with the occupation of farming has been documented for decades. A 1954 Wisconsin State Fair hearing survey demonstrated differences between the auditory thresholds of office workers, farmers, and factory workers. Farmers in the older age groups showed significantly more loss than office employees (Glorig, 1957). Plakke and Dare (1992) agreed with the findings of the Wisconsin State Fair study and suggested that during the planting and harvesting seasons, the farmer may be getting a high dose of noise just from farming alone, not including any recreational or off-farm job exposures to noise. A study done in 1983 by Thelin, Joseph, Davis, Baker, and Hosokawa found that farmers aged 25-64 had a high rate of hearing loss as compared to office workers of the same ages. In addition, a random sample of a large cohort of dairy farmers

demonstrated an increased prevalence of significant high frequency hearing loss in upstate New York dairy farmers (May, Marvel, Regan, Marvel, & Pratt, 1990). This finding of predominantly high-frequency involvement suggests losses related to noise-induced injury.

Similarly, a recent report titled the Minnesota Farm Health Survey Report (Minnesota Department of Health, 1994) stated that moderate to severe hearing losses were found in 36% of the 201 men, and 10% of 270 women studied. All study subjects were between the ages of 20 and 59.

Additional results from a study of 278 females and 534 males residing in rural Wisconsin (Karlovich, Wiley, Tweed, & Jensen, 1988) suggested that men who live in rural areas demonstrate a high prevalence of hearing loss by age 30.

A study done by Broste et al. (1989) concluded that teenage children on farms may be at an increased risk for developing hearing loss from noise because of their early involvement in farm work which utilizes high powered equipment. In fact, this same study revealed that 94% of the high school students reported use of a tractor.

Most farmers own at least one tractor, therefore, the farm tractor is one of many pieces of farm equipment that has been studied extensively for noise levels. Starting with a study in 1958 by Lierle and Reger, tractors have been reported to produce noise sufficiently high in intensity to induce high frequency hearing losses in tractor operators if exposed for long periods of time. A 1969 study by researchers at the University of Nebraska showed that virtually all tractors used at that time produced noise in excess of

85dB. Similar results were found in tests of other farm equipment such as combines, elevators, mixers, and power saws (Simpson & Deshayes, 1969).

Traditional methods to reduce occupational injuries include legislation, engineering controls, personal protective equipment, and education. Occupational health and safety specialists enlist a variety of these methods when designing interventions. A recent study indicated that using engineering controls for tractor noise may reduce noise levels. This study tested noise levels of 155 tractors on 36 Wisconsin farms and revealed that 75% of tractors without cabs had noise levels exceeding 90dB, compared to 18% of tractors with cabs (Holt et al., 1993). However, this study also revealed that only 45 of the 155 tractors had cabs and most tractors were more than 10 years old.

Industry is regulated by the Occupational Safety and Health Administration (OSHA) which mandates that workers protect themselves from NIHL by wearing earmuffs or earplugs. However, farmers have been excluded from the OSHA hearing conservation mandate and therefore must obtain hearing conservation education and information from other sources (Thelin et al., 1983). Results of a study done by Karlovich et al. (1988) indicated the need for intensification of education and hearing conservation programs for rural populations. "Less than 20% of farmers reported consistent use of personal protection in their farm-related activities" (p. 61).

In addition to increased exposures to noise, farming can be an occupation in which the worker is geographically isolated. Having a hearing loss can exacerbate isolation because the farmer may feel lonely, frustrated, depressed, and angry because of

having difficulty understanding others. A hearing loss will impair communication, and involvement in social functions will most likely be affected by the hearing loss (Hetu, LaLonde, & Getty, 1987). In fact, according to Guidotti and Novak (1983), the level of social withdrawal almost directly related to the degree of hearing loss.

Hearing Conservation Programs in Industry and Schools

A study done by Roeser et al. (1983) implemented a hearing conservation program for students and teachers involved in industrial arts programs in three schools. The classroom education program was similar to the NFMC school-based intervention component, which included providing various types of HPDs to students and teachers. Results were encouraging, as instructors unanimously favored permanent implementation. Several faculty reported adopting hearing conservation practices in their own home workshops. Other results from this study indicated that more than two-thirds of the equipment used in a school shop environment had noise levels exceeding the 90dB minimum noise level recognized by OSHA as being excessive. Three pieces of equipment exceeded 105dB. The findings suggested the need for some form of hearing conservation program at the high school level.

Another study which explored adolescent hearing status queried students about their experience with temporary threshold shifts. Fifty-one percent of 180 students reported experiencing a temporary hearing loss after being exposed to loud noise. Many of these students reported regular use of power tools, guns, motorcycles, and

snowmobiles. However, very few students reported ever using hearing protection (Wuest & Getty, 1992).

A study done by Lass et al. (1987) indicated that even a modified form of a hearing conservation program, excluding hearing tests or sound surveys, can change knowledge, attitudes, and behavior regarding hearing protection. Consistent with these studies, Wuest and Getty (1992) state "In keeping with the philosophy of primary health care, some sociopolitical responsibility exists to establish safe levels of noise-exposure beyond the industrial work place"(p. 438). After studying audiometric results from three Farm Progress Shows in Illinois, Lankford from Northern Illinois University (1991) suggested that young farmers need an aggressive HCP which provides ear protection and annual hearing tests over time to document changes in hearing.

The intervention portion of the NFMC school-based study outlined earlier consisted of multilevel educational strategies which included classroom teaching, video presentations, use of a sound level meter, yearly audiometric exams, educational information sent directly to student homes, a variety of HPDs given to the students, and personal consultation with each student. In addition to the educational strategies used, the intervention group of students also received four audiometric exams and questionnaires. In contrast, the control group of students received only two audiometric exams (baseline and final) along with questionnaires to complete before each exam.

Both intervention and control students received disposable foam earplugs attached to the questionnaire they completed before each audiometric exam. Students were to use

these earplugs if they anticipated exposure to loud noise 24 hours prior to the audiometric exam. Protecting themselves from noise before the exam prevented temporary threshold shifts at the time of the exam.

Compliance results from the school-based study were positive. Intervention students were asked how often they wear earplugs or earmuffs when working in noisy areas. At the beginning of the study, 23% of the students reported wearing HPDs at least sometimes. The final compliance survey (after four years) revealed that 87.5% of the intervention students reported protecting themselves at least sometimes. The final survey also revealed that 62% of all the students (intervention and control) plan to use HPDs in the future. The intervention group alone revealed an intent rate of 81% (Knobloch & Broste, 1996).

Secondary Effects of Youth-Directed School-Based Health Education

Parents can be important secondary targets for an adolescent school-based NIHL study since most are approaching an age when hearing loss symptoms may begin to appear. Therefore, the information is relevant to the adult population. Also, evidence exists suggesting that interventions involving and influencing family habits are likely to provide lasting health behavior changes (Nader et al., 1983). In a study of nutrition education at the elementary level, Perry, Crockett, and Pirie (1987) found that children were able to influence the attitudes and behaviors of their parents. Many successful school-based health education programs included a family component and some used the family as a central focus of the intervention (Nader et al., 1982; Nader et al., 1983; Nader

et al., 1986; Perry, Mullis, & Maile, 1985; Perry et al., 1988). Empirical evidence is lacking, but it appears that adolescents may be able to influence changes in attitudes and behavior of parents (Baranowski, 1978).

A recent study done by Hopper, Gruber, Munoz, and MacConnie (1996) concluded that adding a parent component to a school-based cardiovascular exercise and nutrition program increased levels of awareness and knowledge for the students. However, only a few studies have assessed the secondary impact of school-based, youth-directed interventions on parents' health behaviors and attitudes. Carefully designed evaluation studies are needed to better understand the effect school-based interventions have on parents' behavior (Crockett, Mullis, & Perry, 1988).

Parents were not a target audience for the NIHL school-based study. However, the impact of the school-based study on the hearing protection behavior of parents was the focus for this study.

Summary

The review of related literature indicated that research available on the effects and impact of hearing conservation programs is limited to school and industrial hearing conservation programs with a primary focus on the design of the programs instead of compliance or hearing threshold levels. Few studies have evaluated the noise-exposed worker populations enrolled in a comprehensive hearing conservation program (Adera, Donahue, Mallit, & Gaydos, 1993). Even fewer studies have examined these populations with regard to HPD compliance and hearing threshold levels over time. In addition to a

comprehensive evaluation of HCPs, the NIH Consensus Development Conference recommended a comprehensive program of education regarding the causes and prevention of NIHL be developed and disseminated, with a special focus on educating school-age children (1990). Brookhouser (1994) suggested that studies should be designed to assess the effect of various NIHL prevention strategies aimed at students. Brookhouser also recommended that adolescent behavioral studies concerned with NIHL should be longitudinal and should incorporate the knowledge already acquired regarding strategies that work for teens when working with risk taking behavior.

Many studies have examined inclusion of the parents and other family members in behavioral change educational interventions. However, very little has been done to explore the unintentional secondary effects of a school-based health education program.

CHAPTER III

METHODS AND PROCEDURES

Introduction

The aim of this study was to assess the impact of a school-based, youth-directed hearing conservation program on the hearing protection knowledge, attitudes, and behavior of parents. The methods will be discussed in the following categories: subject selection, instrumentation, procedures, and statistical analysis.

Subject Selection

Study subjects were male or female parents/guardians of students involved in the school-based NIHL study. This included parents of students in both the intervention and control groups. Only parents/guardians of students living on a farm (reported on the fourth year student survey from the NIHL school-based study) were sent the questionnaire (N = 523). The cover letter (see Appendix A) and questionnaire (see Appendix B) specifically requested that the respondent be the adult parent/guardian who is most responsible for working with farm machinery.

Instrumentation

There were no instruments available to assess the impact of a hearing conservation program on the knowledge, attitudes, and behavior of parents whose children were involved in an educational intervention. Since no baseline questionnaire

existed, knowledge and attitude questions were developed to assess differences between intervention and control parents. Reported behavior was assessed to determine differences within groups (intervention and control) before and after implementation of the NIHL school-based study, and differences between intervention and control parents.

Test-retest reliability was not calculated due to the time of year and the adverse weather conditions experienced in Spring, 1996. Farmers in Wisconsin were perceived to be very stressed and since the survey was being mailed out under the National Farm Medicine Center name, researchers did not want to tarnish the reputation of the NFMC by sending out duplicate surveys at the busiest and most stressful time of year. Also, the survey contained primarily nontechnical information and it may have been easy for respondents to change their answers due to the influence of the survey itself, or due to someone in the household (student from original study) providing answers. Webb, Campbell, Schwartz, Sechrest, and Grove's study (as cited in Green & Lewis, 1986) stated this as a problem of reactivity which directly relates to test-retest reliability. Interrater reliability testing was not necessary due to the instrument being mailed and self-administered.

Content validity was tested utilizing a panel of 10 experts from the fields of adult education, farm health and safety, epidemiology, audiology, health education, public health, and agricultural education (Gilmore, 1974). Each panel member was sent the list of null hypotheses for the study. Along with the list of null hypotheses, questions from the instrument were sent. Each panel member was asked to rate the question on a five-

point Likert-type scale with respect to the question's appropriateness for obtaining information to answer the related knowledge, attitude and behavior hypotheses.

Readability testing of the instrument was done using SMOG Readability Formula (McLaughlin, 1969). Readability was determined to be at an eighth grade level.

Procedures

In an effort to increase response rates, an initial letter was sent to each of the 523 students involved in the school-based study (intervention and control) who reported living on a farm. This demographic information was taken from the fourth year of the study data. The letter to the student was sent four days prior to the mailing of the parent questionnaire. The letter requested the student to encourage his or her parent/guardian to complete and return the questionnaire when it arrived at their household. It also stated that the survey was to be completed by the adult in the family most involved with operating farm machinery and that they (the student) should not help their parent/guardian with answering the questions (see Appendix C).

The first mailing of the parent questionnaire was done in late June, 1996. A cover letter on NFMC letterhead was attached to the questionnaire stating that this was research regarding hearing protection knowledge, attitudes, and behavior. It stated that the information would be kept confidential and only group data would be reported. The cover letter reminded the subject that the questionnaire should be filled out by the adult in the family that is most involved with operating farm machinery. An addressed, stamped return envelope was enclosed for ease in responding. Three weeks after the first mailing,

a reminder postcard was sent to nonrespondents. A second mailing was done to increase response rates. Institutional Review Boards at the University of Wisconsin-La Crosse and the Marshfield Medical Research Foundation determined that the research protocol posed little or no risk to the subjects. Also, the study subjects (parents) were indirectly involved in the school-based study for the past four years. They were presumed to be somewhat familiar with the forms, the NFMC letterhead, and the name of the study manager.

Statistical Analysis

Descriptive statistics are provided in tables in the Results section. Subject demographic information included age, gender, number of years farming, and number of the intervention and control group respondents.

The first null hypothesis addressed hearing protection behavior of intervention parents before and after the school-based NIHL research study. Since no prestudy questionnaire was implemented, prestudy hearing protection behavior was assessed by question two, which asked for recall of hearing protection practices before the school-based study. Question one asked subjects' current use of hearing protection. The nonparametric Wilcoxon matched-pairs-signed-ranks test was used to compare paired responses to questions one and two within the intervention group of parents.

The second null hypothesis examined hearing protection behavior of control parents before and after the school-based NIHL research study. The Wilcoxon matched-pairs-signed-ranks test was used to compare paired responses to questions one and two within the control group of parents.

The third null hypothesis examined differences between intervention and control group parents' intent to use hearing protection in the future. These were ordinal data and therefore the Wilcoxon rank sum test was used for question three.

The fourth null hypothesis examined the difference in knowledge of intervention group parents compared to control group parents. Question seven and eight were nominal data and therefore the chi-square test was used. Question nine was knowledge-based and ordinal. The Wilcoxon rank sum test was used to analyze these data.

Questions four, five, and six related to null hypothesis five which examined the difference in attitudes regarding hearing protection between the intervention group of parents compared to parents of the control group. These were ordinal data and therefore, the Wilcoxon rank sum test was utilized to examine the possibility of statistical differences between the two groups.

Null hypothesis six was addressed by question one. This hypothesis intended to examine the statistical difference of current hearing protection behavior between parents of the intervention group and parents of the control group. The Wilcoxon rank sum test was used for these ordinal data.

CHAPTER IV

RESULTS AND DISCUSSION

Introduction

Given the timing of the survey, a rather high response rate of 66% was achieved. This high response rate may have been due to the importance of the topic to family health or to the familiarity of the National Farm Medicine Center name and the name of the investigator (due to their son or daughter being involved with the school-based study). Also, the questionnaire consisted of nine questions and could have been completed in less than 5 minutes. Another factor may have been that students in the household were sent a letter regarding this study and were told to encourage parents to complete the survey. A total of 276 surveys were returned after the first mailing, with a majority of the remaining 72 returned after a postcard reminder. The intervention group returned 65% of their surveys compared to the control group at 68%. This chapter presents the data responding to demographics and the null hypotheses listed in Chapter 1.

Demographic Information

A total of 348 surveys were returned out of 523 mailed with 47.4% of the total returned from the intervention group, and 52.6% of the total returned from the control group of parents. There were 252 intervention surveys mailed and 271 control surveys mailed. The average age of the respondent was 46, with 91% male and 9% female

respondents. Twenty-four years was the average time spent in the farming occupation. Respondents also provided their name.

Results of Null Hypotheses Analysis

Hypothesis 1 stated: There is no significant difference in intervention parents' hearing protection behavior pre- and post-NIHL research study. The Wilcoxon matched-pairs-signed-ranks test used to compare paired responses to questions one and two within the intervention group of parents generated a Z-score of -5.3878. Because the p-value (0.0000) was less than the .05 significance level, the null hypotheses was rejected. These data indicated that 51 (31%) of intervention parents began using HPDs after the hearing study started, 109 (66%) stayed the same in their HPD use, and 5 (3%) used HPDs less after the study began. The negative Z-score value for these data and the data to follow were calculated using the smallest rank sum score, whether it was positive or negative.

Hypothesis 2 stated: There is no significant difference in control parents' hearing protection behavior pre- and post-NIHL research study. The Wilcoxon matched-pairs-signed-ranks test used to compare paired responses to questions one and two within the control group of parents generated a Z-score of -1.3718. Because the p-value (.1701) was greater than the .05 level of significance, the null hypothesis was accepted. Data collected revealed that 12 (7%) of control parents started to use HPDs after their child became involved in the school-based hearing study, 165 (90%) stayed the same regarding HPD use, and 6 (3%) reported using HPDs less often.

Hypothesis 3 stated: There is no significant difference between intervention and control parents' intent to use HPDs in the future. The Wilcoxon rank sum test was used to compare intervention and control group responses to question three which generated a Z-score of -2.4019 with a p-value (.0163). This was statistically significant, therefore, the null hypothesis was rejected. Data revealed that 80.4% of intervention parents intend to use HPDs in the future (when exposed to loud noise) compared to 67.9% of the control parents.

Hypothesis 4 stated: There is no significant difference in hearing protection knowledge of parents with youth involved in the intervention group compared to parents with youth involved in the control group of the NIHL research study. Questions seven, eight, and nine were analyzed separately. The Wilcoxon rank sum test used to analyze question nine generated Z-score of -1.1663. Because the p-value (.2435) was greater than the .05 level of significance, the null hypothesis was accepted. The chi-square test used to analyze the data for knowledge question seven generated a significance level of .04274, and the data for knowledge question eight generated a significance level of .26350.

Hypothesis 5 stated: There is no significant difference in the hearing protection attitudes of parents with youth involved in the intervention group compared to parents with youth involved in the control group of the NIHL research study. The Wilcoxon rank sum test used to analyze the data for questions four, five, and six generated Z-scores of -1.0026, -1.8020, and -.2704, respectively. All p-values (.3161, .0716, and .7869) were greater than the .05 level of significance. Therefore, the null hypothesis was accepted.

However, as shown in Table 1, 98% of intervention parents and 99% of control parents either strongly agreed or agreed that loud noise can damage hearing. However, nearly half (49%) reported never using any hearing protection. Contributing to their nonuse of HPDs may be the fact that approximately 33% of intervention parents and approximately 36% of control parents agreed or strongly agreed that it could be dangerous to wear HPDs while operating a tractor or other moving equipment (see Table 2). Also, 21% of control parents compared to only 7% of intervention parents believe that wearing HPDs makes little difference in hearing, believing that hearing loss is just part of growing old.

Table 1. Comparison of intervention and control hearing protection beliefs:
Noise can be damaging to hearing

Group	n	Strongly agree	Agree	Disagree	Strongly disagree
Intervention	165	79 47.9%	84 50.9%	1 0.6%	1 0.6%
Control	183	77 42.1%	105 57.4%		1 0.5%

Table 2. Comparison of intervention and control hearing protection beliefs:
It can be dangerous to wear HPDs when operating a tractor

Group	n	Strongly agree	Agree	Disagree	Strongly disagree
Intervention	165	2 1.2%	52 31.5%	92 55.8%	19 11.5%
Control	181	10 5.5%	55 30.4%	88 48.6%	28 15.5%

Hypothesis 6 stated: There is no significant difference in the hearing protection behavior of parents with youth involved in the intervention group compared to parents with youth involved in the control group of the NIHL research study. The Wilcoxon rank sum test used to analyze the data for question one generated a Z-score of -1.6466. Because the p-value (.0996) was greater than the .05 level of significance, the null hypothesis was accepted. However, approximately 56% of intervention parents reported wearing HPDs some or almost all the time, and approximately 44% of control parents reported wearing HPDs some or almost all the time (see Table 3).

Table 3. Hearing protection behavior differences between intervention and control groups

Group	n	Never use	Use sometimes	Use all or almost all the time
Intervention	165	72 43.6%	79 47.9%	14 8.5%
Control	183	101 55.2%	62 33.9%	20 10.9%

Discussion

The purpose of this study was to investigate the secondary impact of a school-based study on the hearing protection knowledge, attitude, and behavior of the parents of students involved in the study. Two of the six null hypotheses were rejected which indicated a significant change in intervention parents' current hearing protection behavior compared to their hearing protection behavior prior to their child becoming involved in the school-based study. Also, intent to use hearing protection in the future when exposed to loud noise was significantly higher for the parents of students involved in the intervention group compared to those with children in the control group. These combined findings were not unexpected as many intervention students expressed the need for additional earmuffs and earplugs due to parent use. Also, a separate compliance study of

students revealed that having a variety of HPDs available on the farm had a great deal of influence in the student's decision to use the HPDs (Knobloch & Broste, 1996). This may have been why intervention parents' hearing protection behavior increased after their child became involved in the program. Just having HPDs on the farm, placed by certain pieces of equipment, may have influenced parents' behavior.

While the data indicated significant changes in intervention parents' hearing protection behavior, there were no significant differences in hearing protection attitudes and knowledge between intervention and control parent groups. This finding was unexpected due to the amount of written educational material sent directly to intervention homes and the possibility of interaction between students and parents on the topic of hearing protection. Since baseline knowledge and attitude data were missing, the survey only detected differences in current levels of knowledge and attitude between intervention and control groups of parents.

There was no significant difference in the control group parents' use of hearing protection pre- and post-NIHL research study. This was an expected result since their children were not exposed to the educational intervention. However, the lack of a significant hearing protection behavior difference between intervention and control parents was surprising to the investigator. This result indicated that the control group may have already been using HPDs at a greater level than the intervention group due to chance exposure to other sources of information such as television, radio, or printed materials.

CHAPTER V

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

Summary

The purpose of this study was to investigate the secondary impact of a four year school-based, youth-directed NIHL research study on the hearing protection knowledge, attitudes, and behavior of the parents of students involved in the study. This study revealed an important finding for health educators: a comprehensive school-based program focused on adolescent behavior change had a statistically significant effect on parent behaviors as well. Many studies have examined the inclusion of parents and family in behavior change educational models (Nader et al., 1982; Nader et al., 1983; Nader et al., 1986; Perry et al., 1985; Perry et al., 1988), but few have explored the secondary effects of a school-based program on parent behavior change.

Conclusions

The following conclusions were formulated based on the results of this study:

1. It is feasible to change parental behavior as a result of a youth-directed intervention. Intervention parents showed a statistically significant difference in HPD use pre- and post-NIHL school-based study compared to control parents HPD use pre- and post-NIHL study. Although 66% of intervention parents stayed the same in their use of hearing protection, 31% reported starting the use of HPDs after their child became involved in the NIHL research study. This information

indicates the intervention may have had an impact on hearing protection behavior in intervention group parents.

The most credible impact variables in health education, short of changes in health measures themselves, are behavioral variables. Demonstrated change or not change in behavior carries more weight for most potential readers of an evaluation report than demonstrated changes in predisposing, enabling, or reinforcing factors (Green & Lewis, 1986, p. 277).

2. There was a statistically significant difference between intervention and control parents' intent to use HPDs when exposed to loud noise. Eighty percent of intervention parents reported intent to use HPDs in the future as compared to 68% of control parents. Although statistically significant differences occurred, both percentages were rather high which could indicate one or both of the following: (a) since NIHL may have been a relevant topic for parents, the survey itself may have heightened awareness of the need for hearing protection, and (b) the respondent may have reported what he or she thought was a socially desirable response.
3. The data from this study suggest that it is feasible to change parental hearing protection behavior by intervening with students through the school environment. Both rejected null hypotheses support this statement. However, since differences in knowledge and attitude were only measured as differences between intervention and control groups, it is not known whether there was a change in knowledge and attitude within each group. Change could not be determined because pretests were not administered to either group of parents. Differences in

knowledge and attitude between intervention and control parents were tested, with no significant differences found. These findings were unexpected due to the amount of educational materials sent to intervention homes throughout the four project years. It is possible that due to the limited number of questions asked, attitude and knowledge were not adequately assessed. Also, teachers were not trained as to their level of involvement and classrooms were not identical.

Therefore, variations in how the teacher administered the school-based program could have accounted for varying interest levels of students and parents. There also may have been unintentional contamination in the control groups due to general farm health and safety information published in newspapers, magazines, or heard on the farm radio networks.

Study Recommendations

Based on the review of literature and the findings of this secondary study dealing with the effects of a school-based program on parents, the following recommendations are presented for further research and education opportunities:

1. More educational research studies are needed to evaluate longitudinal approaches when addressing health and safety issues. According to Mustard (1945), there are two difficulties in a scientific approach to health education: "Health education is an undertaking that produces its results slowly and these results are difficult to measure" (as cited in Green & Lewis, 1986). Evaluation methods and techniques are now accessible to the health educator, however, funding sources for

longitudinal studies tend to be scarce. There needs to be an increase in the level of governmental funding and commitment to the study of evaluating the impact of health education programs and the impact of various strategies within a program. This may be important in continuing to justify health education in schools and in communities when budgets are not flexible.

2. In advance of studying the secondary impacts of school-based programs, the health educator must clearly define all target audiences to be evaluated. Because parents were not an original target audience for the school-based study, no baseline pretests were given to measure changes over time. This made it impossible to assess knowledge and attitude change and somewhat difficult to assess behavior change within groups. Differences in knowledge and attitude between groups were the only items able to be assessed.
3. Further studies are needed to evaluate the process and impact of multilevel educational strategies within longitudinal interventions. Health educators need to explore the various components of a youth-directed study to determine which components were most successful in changing behavior. This includes exploring the use of unique vehicles for dispersing and disseminating health information in rural areas. For example, an American Cancer Society demonstration project funded by NIOSH and implemented by Reding, Fischer, Lappe, and Gunderson (1994), utilized veterinarians to deliver skin cancer educational materials to farmers. The success of this project and acceptance by farmers suggest further

studies using a variety of creative educational strategies for rural populations.

Public health agencies, extension agents, and community organizations may need to reach out to the rural population utilizing new and unique creative approaches.

4. More health educators are needed in organizations such as agricultural research facilities, 4-H, FFA, university extension, and migrant health services. Providing longitudinal outreach and education to specialized populations will lend itself to extensive evaluation in the field of health education. There are three gaps in health education evaluation and measurement according to Green and Lewis (1986).

First, practitioners need to be better trained in applying and interpreting measures and evaluations. Second, there is a need for more research specialists who balance research with health education practice. And third, future health education and training must result from the effective translation of research and evaluation into theory and policy for health educators.

5. More studies are needed which intentionally utilize children to influence parental health behaviors. The family approach to health education is not a new idea, but according to Crockett et al. (1988), few studies have adequately assessed the secondary impact of a youth-directed intervention on parents' health behavior changes. The intended focus of the school-based study was to influence students to wear HPDs. However, the results of this secondary impact study indicate that, without any intended effort, some behavior change occurred with parents. This study can be used to justify further studies in the area of family behavior change

with various topics such as alcohol and tobacco use, nutrition, physical exercise, bicycle helmet use, and back injury prevention.

6. Health educators located outside the school system can provide a service to the schools and have a positive impact on the health and safety of rural youth. Public health agencies, university-based extension specialists, hospital personnel, and organizations such as the 4-H and farm health and safety groups should consider using school settings, in cooperation with school health teachers, to educate youth, parents, and entire families. However, prior to utilizing schools for interventions, and in fulfillment of objective 10 of the occupational injury's section of the Wisconsin Department of Health and Social Services (WDHSS) document Healthier People in Wisconsin (1990), health educators and other health care professionals need specific training and education regarding the unique health and safety problems facing the agricultural population.
7. Expanding and enhancing the questionnaire would have allowed for maximum examination of knowledge and attitude changes within groups of parents. Due to the inconvenient timing of the survey for a Wisconsin farming population, only a limited number of survey questions were asked. The small number of questions may not have adequately assessed knowledge, attitude, and behavior. It would have been advantageous to mail the survey in January or February when farmers were not involved with field work. Better timing would have given the researcher the option of including more questions and therefore, better able to evaluate

knowledge, attitude, and behavior differences. Also, test-retest reliability calculation would have been feasible if the survey had been mailed to farmers during the winter months.

8. In agreement with Brookhouser et al. (1992), noise-induced hearing loss deserves more attention from local, state, and federal levels. Adult and adolescent farmers are at an increased risk for developing NIHL due to daily exposures to loud equipment. Farm residents throughout the country should have access to longitudinal educational programs which provide baseline and yearly hearing tests, HPDs, and consultative services via rural health specialists. As availability of earplugs and earmuffs may have been a cause for behavior change in this study, increasing the availability of HPDs for farmers may be a next step. Health Maintenance Organizations (HMOs) and other insurance plans could provide enrollees with free or low-cost hearing protection devices as an incentive to protect themselves from the consequences of hearing loss. Insurance companies could encourage farm families to have regular hearing tests to detect changes in hearing threshold levels at an early stage. Educational materials and reminders could be sent to farm families via monthly HMO newsletters or the HMO could cooperate with local milk haulers or veterinarians to deliver HPDs directly to the farm family.
9. Health educators must design practical interventions relevant to the target population. Farm families are unique due to economic reasons related to the farm

business. Most family members are directly involved in some form of labor on the farm which puts young children at risk for many occupational exposures. As health educators, it is imperative to design practical interventions that meet the perceived needs of the target audience while keeping economic reality in perspective. Utilizing social diagnosis techniques, such as focus groups and personal interviews, described by Green and Kreuter (1991), can assist the health educator in determining health education and health promotion strategies for this specific population. Also it would be beneficial to involve both adult and adolescent farm family members in the planning phase of any intervention.

10. A final recommendation would be in fulfillment of objective eight of the occupational injury section of the WDHSS Healthier People in Wisconsin (1990). This objective calls for an increase in public awareness regarding the extent and causes of agricultural injuries and preventive measures. Results of the school-based study and the secondary impact it had on parental hearing protection behavior is an indicator that the farm population can be reached. "Future reductions in farm injuries depend on the preventative behavior of young farmers" (WDHSS, 1990 p. 92). All farmers need to know that hearing loss is not just the price to pay for choosing the occupation of farming.

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APPENDIX A

COVER LETTER SENT TO PARENTS

Dear Parent:

Your son/daughter has been involved in the Hearing Conservation Program for Agricultural Youth (through school) for the last four years and his/her involvement is very much appreciated...but now I need your help!

This is a survey asking about your hearing protection knowledge, attitudes, and practices. *It is intended for the adult in the household who is most responsible for working with farm machinery.* The survey will take only five minutes of your time.

Please fill out the survey and mail it back to me by July 1, 1996 in the enclosed stamped envelope. Information you provide will be kept confidential and will only be reported as large group data. No individual data will be reported. Completion and return of this survey implies your consent of the inclusion of the data in this study.

Thank you for taking the time out of your very busy schedule to answer this questionnaire. If you have any questions at all, please feel free to call me toll-free at 800-662-6900 or 715-389-3754.

Sincerely,

Mary Jo Knobloch
Project Manager/Health Educator

APPENDIX B

PARENT QUESTIONNAIRE

NFMFC Use Only

School Code	_____
ID Code	_____

Hearing Conservation Study Parent/Guardian Questionnaire

This survey is intended for the adult in the household who is most responsible for working with farm machinery.

Name: _____

Age: _____

Number of years farming: _____ years

Circle one: Male Female

PLEASE RESPOND TO THE FOLLOWING BY CHECKING ONLY ONE RESPONSE

1. When exposed to loud noise such as noise from tractors, silo blowers, lawnmowers, etc., how often do you use earplugs or earmuffs?
 - never use
 - use sometimes
 - use all or almost all the time

2. Did you use earplugs or earmuffs before your son/daughter became involved in the hearing study at school?
 - never used
 - used earplugs or earmuffs sometimes
 - used earplugs or earmuffs all or almost all the time

3. Do you plan to use earplugs or earmuffs in the future when you are exposed to farm machinery noise such as tractors, silo blowers, choppers, etc.?
 - don't plan to ever use
 - plan to use sometimes
 - plan to use all or almost all the time

4. I believe loud noise can damage hearing.

- 1 strongly agree
- 2 agree
- 3 disagree
- 4 strongly disagree

Remember....the adult in the household who is most responsible for working with farm machinery should be answering these questions.

PLEASE RESPOND TO THE FOLLOWING BY CHECKING ONLY ONE RESPONSE

5. I believe wearing earplugs or earmuffs makes little difference; hearing loss is just part of growing old.

- 1 strongly agree
- 2 agree
- 3 disagree
- 4 strongly disagree

6. I believe it can be dangerous to wear earplugs or earmuffs while operating a tractor or other moving equipment.

- 1 strongly agree
- 2 agree
- 3 disagree
- 4 strongly disagree

7. The most common cause of permanent hearing loss is:

- 1 blockage in the ear canal
- 2 repeated exposure to loud noise
- 3 hole in the eardrum

8. Noise may begin to affect your hearing with an 8 hour exposure (per day) at which decibel level?

- 1 50 decibels
- 2 65 decibels
- 3 85 decibels

9. Once you have lost hearing due to repeated noise exposure, normal hearing...

- ¹ always returns
- ² sometimes returns
- ³ never returns

Thank you for completing this survey. Please mail it to the National Farm Medicine Center, 1000 North Oak Avenue, Marshfield, WI 54449 (c/o Mary Jo Knobloch) in the enclosed stamped envelope.

APPENDIX C

LETTER TO THE STUDENTS

Dear Hearing Study Participant:

You've been involved with the "Hearing Study" for the last four years. You've filled out forms, surveys, and questionnaires. Now, it's your parent's turn! *In a few days, your parents will receive a short survey from the National Farm Medicine Center.* Please encourage them to fill it out and return it quickly. Do not help them with any answers!

The survey is to be completed by the adult in the household who works the most with farm machinery. Please help in getting this survey back to me soon. Thanks!

Sincerely,

Mary Jo Knobloch
Project Manager