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Effectiveness of the Dangerous Decibels Program in Children from Military Families

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EFFECTIVENESS OF THE DANGEROUS DECIBELS PROGRAM®
IN CHILDREN FROM MILITARY FAMILIES

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ABSTRACT

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There is a high prevalence of permanent hearing damage due to exposure to hazardous sound levels in many populations, including children (5.2 million between the ages of 6-19) and military members (88,285 reports of noise-induced hearing-related visits in active duty military members and disabilities of the auditory system being the third most common injury among veterans). Research has indicated that children are more likely to join the military if they have a parent who is/was in the military. Therefore, if children, specifically children from military families, can be informed about the risk of noise-induced hearing loss (NIHL) and learn prevention strategies early, hearing loss due to hazardous noise may be prevented. The Dangerous Decibels® classroom program has been effective in changing the knowledge, attitudes, and intended behaviors related to hearing health and hearing loss prevention when delivered to children. The purpose of this study was to assess the relative effectiveness of an adapted Dangerous Decibels program in children from military families and non-military families. Adaptations, specifically the addition of military-related content, were supplemental to the traditional Dangerous Decibels classroom program.

Fifty-three students from four, 4th grade classrooms were included in the study. Children from military families and children from non-military families were categorized into two experimental groups. All participants were trained in the Dangerous Decibels program in their regular classroom setting. Changes in knowledge, attitudes, and intended behaviors related to NIHL and hearing loss prevention were evaluated using pre, post, and 3-month follow-up surveys.

There were no significant differences in knowledge, attitudes, and intended behaviors at any of the time points between children from military families and those not from military families. There were significant increases in knowledge, attitudes, and intended behaviors between baseline and the two subsequent time points when the population was measured as a whole. Positive changes in the three constructs from baseline to post, and post to follow-up demonstrate the effectiveness of the Dangerous Decibels classroom program in 4th grade children from military and non-military families.

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ABBREVIATIONS

AHP: Army Hearing Program

dBHL: Hearing Level Decibel

DODI: Department of Defense Instruction

DOEHRS: Defense Occupational and Environmental Health Readiness System

HCP: Hearing Conservation Program

HLPP: Hearing Loss Prevention Program

HPD: Hearing Protection Device

kHz: Kilohertz

NCRAR: National Center for Rehabilitative Auditory Research

NHANES III: Third National Health and Nutrition Examination Survey

NIDCD: National Institute on Deafness and Other Communication Disorders

NIHI: Noise-Induced Hearing Injury

NIHL: Noise-Induced Hearing Loss

NITS: Noise-Induced Threshold Shift

OHSU: Oregon Health & Science University

OMSI: Oregon Museum of Science & Industry

SCM: Stages of Change Model

SCT: Social Cognitive Theory

TRA: Theory or Reasoned Action

TPB: Theory of Planned Behavior

CHAPTER I

INTRODUCTION

Dangerous Decibels® is a school-based hearing loss prevention program designed to increase knowledge related to hearing and hearing loss prevention in children and to positively change children's attitudes and intended behaviors related to noise-induced hearing loss and hearing loss prevention (Griest, Folmer, & Martin, 2007). The program has been shown to be effective in changing children's knowledge regarding hearing and hearing loss as well as positively influencing attitudes and intended behaviors related to prevention (Griest et al., 2007; Griest, 2008; Clark, 2013). Due to the prevalence of permanent hearing damage due to exposure to loud sounds in children, there is a need to educate this population about the effects noise can have on their hearing. According to Niskar et al. (2001), approximately 5.2 million children between the ages of 6-19 have suffered from permanent hearing damage due to exposure to loud noises. Noise-induced hearing loss, however, is not just a problem among children. Excessive noise exposure can cause hearing loss in adults, teenagers, and unique populations such as the military. Disabilities of the auditory system, including hearing loss and tinnitus, are the third most common injury experienced by veterans (Helfer, Canham-Chervak, Canada, & Mitchener, 2010).

With the excessive number of veterans reporting hearing related injuries, there is a need to disseminate hearing loss prevention programs in order to reduce the incidence rate of veterans who suffer from hearing related injuries. If these veterans can be targeted early, even in their adolescent years, hearing loss may be prevented. Faris (1981) studied the relationship between a father's military status and their child's likelihood of enlisting in the military. Results from this study found that children from military families are more likely to go into the military than those children from families who do not have familial ties to the service. Further, Stander and Merrill (2000) studied the relationship between naval recruits and the military status of their parent(s). Results indicated that 52% of naval recruits identified at least one of their parents was a veteran. This percentage was compared to the other 36% of recruits who came from civilian families. Due to the findings of Faris (1981) and Stander and Merrill (2000) it is worth considering that there is a chance that these same children will potentially lead a life of military service in the future. If they can be properly informed at a young age of the damages that can occur to their hearing, there is more hope of preventing the noise-induced hearing loss to begin with.

Purpose

The purpose of this study was to investigate the effectiveness of the Dangerous Decibels hearing loss prevention program in children from military families in hopes of targeting children who may be more likely to enlist in the military in the future than other children. Because this population may be more likely to enlist in the military and research has shown that disabilities of the auditory system are the third most common injury of veterans, there is a need to educate children early in adolescence, particularly those who may enlist in the future. The program was also presented to children who are not from military families in hopes of comparing the outcomes between the two populations and the overall outcomes as a whole group. Children from military families may have more prior knowledge about hearing health, sources of loud sound, and/or hearing protective strategies than their civilian counterparts, which is why the program was delivered to both populations. Through the use of pre and post surveys, the effectiveness of the Dangerous Decibels program on knowledge, attitudes, and intended behaviors related to hearing health was measured in children attending the program, both from military families and those not from military families. Given the evidence favoring the success of hearing loss prevention programs for children, the following research questions were asked and hypothesized:

Q1 Will there be a change in knowledge related to hearing health for children from military families who participate in the Dangerous Decibels classroom program immediately following program delivery and at 3 months post-delivery?

H1 Children from military families who participate in the Dangerous Decibels classroom program will have increased knowledge related to hearing health.

Q2 Will there be a change in attitudes related to hearing loss prevention for children from military families who participate in the Dangerous Decibels classroom program immediately following program delivery and at 3 months post-delivery?

H2 Children from military families will have positive attitudes regarding hearing loss prevention upon completion of the Dangerous Decibels classroom program.

Q3 Will there be a change in intended behaviors related to the use of hearing protection devices for children from military families who participate in the Dangerous Decibels classroom program immediately following program delivery and at 3 months post-delivery?

H3 Children from military families will positively change their intended behaviors related to hearing protection devices after participation in the Dangerous Decibels classroom program.

Q4 How do changes in knowledge, attitudes, and intended behaviors compare in children from military families to children who are not from a military family prior to program delivery, immediately following program delivery and at 3 months post-delivery?

H4 There will be differences in knowledge, attitudes, and intended behavior scores between children from military families and children not from military families.

Q5 Is there a change in overall score for knowledge, attitudes, and intended behaviors related to hearing health and hearing loss prevention, from immediately before Dangerous Decibels program delivery to immediately after and at 3 months following program delivery?

H5 There will be changes in overall knowledge, attitude, and intended behavior scores immediately following program delivery and at the 3 month follow-up.

CHAPTER II

REVIEW OF THE LITERATURE

According to the National Institute on Deafness and Other Communication Disorders (NIDCD), approximately 15% of Americans (26 million)-between the ages of 20 and 69- have a hearing loss that was attributed to excessive noise levels either at work or during leisure activities that resulted in a noise-induced hearing loss (NIHL) (NIDCD, 2015). NIHL is not only a problem among the 20-69 age range, but it is also a problem affecting people of all ages and populations including children, adolescents, the elderly, and the military. An estimated 12.5% of children (5.2 million)-between the ages of 6-19- have suffered from permanent hearing damage due to exposure to loud noises (Niskar et al., 2001).

Research has shown that exposure to hazardous noise is also problematic for individuals in the military. An estimated 60% of veterans returning home from war have a hearing loss (Centers for Disease Control and Prevention, 2013). What needs to be considered is the impact that noise exposure during military service has had on veterans in civilian life. Hearing loss is often associated with depression, social-isolation, and anxiety. It can effect personal relationships and employment (Saunders & Griest, 2009). The financial and clinical burdens for the VA should also be taken into consideration. The cost of compensation for the VA for hearing and tinnitus-related disabilities in the fiscal year 2006 was over $1.2 billion and the cost for audiological services in the fiscal year 2007 was $147.1 million (Saunders & Griest, 2009). This cost has increased. In the fiscal year 2010, the VA spent $227.4 million on audiological services (Folmer et al., 2012). These outcomes may be prevented with early education about NIHL and dissemination of prevention programs. Disabilities related to the auditory system, including hearing loss and tinnitus, make up nearly 10 percent of the total number of disabilities reported by veterans (Humes, Joellenback, & Durch, 2006, p. 15).

Noise-Induced Hearing Loss in the Military

In military settings, there are many sources of dangerous noise levels. As far back as World War II, handguns, rifles, artillery rockets, ships, aircraft carriers, vehicles, communications devices, and many more, have been sources of potentially damaging noise levels (Humes et al., 2006, p. 201). Hearing is critical to the performance of military personnel, and NIHL is a severe impairment that could reduce military effectiveness. Several studies have been conducted to document reports of military hearing loss and tinnitus and effects due to noise (Helfer et al., 2010; Humes et al., 2006; Wells et al., 2015).

Helfer et al. (2010) used the ICD-9-CM diagnosis codes to provide a comprehensive view of noise-induced hearing injury (NIHI) among active duty military personnel between 2003 and 2005. NIHI was identified in the Defense Medical Surveillance System (DMSS). Individuals who came in for multiple visits within 60 days of the initial visit were excluded from the study so as to reduce the chance of overestimation of rates. Deployed military personnel data were not included. Results from the study showed a total number of 88,285 hearing impairment and NIHI-related visits—unspecified hearing loss, tinnitus, perforations of tympanic membrane, acoustic trauma, impairment of auditory discrimination, etc. (Helfer et al., 2010). Men accounted for more visits than women. Ages 40 years and older had higher visit rates than those between the ages of 17-19. The most frequent number of visits came from occupational groups such as gun crews/infantry and electrical mechanical equipment repairers (Helfer et al., 2010). Overall, NIHI visits were reported for 9.6 per 1000 personnel (men and women combined).

Noise-Induced Hearing Loss in Children

Adult hearing loss has always been a cause for concern, however, children are just as susceptible to NIHL. It is a public health issue that is slowly becoming recognized as a problem and efforts to address the concern date back decades (National Institutes of Health, 1990).

Brookhouser, Worthington, and Kelly (1992) conducted a study examining children with sensorineural hearing loss from the Boys Town National Research Hospital. Out of 2,284 children, 114 (under the age of 19) had an identified SNHL with probable NIHL based on their audiometric configurations. A detailed case history was given to all participants/families in order to evaluate potential noise exposure history and to exclude children not meeting the qualifications of the study. Participants were excluded from the study if there were any issues related to the following: stressful delivery or NICU admission, familial hearing loss, head trauma, meningitis, prenatal infections, mumps, recurrent otitis media or treatment with ototoxic drugs. To be a part of the NIHL group, thresholds had to be worse than 25 dBHL for at least one audiometric frequency. Seventy-two children had bilateral hearing losses with positive noise exposure, 22 children had unilateral losses with positive noise exposure, and 20 children had a unilateral loss but no case history of noise exposure could be determined because of changes in home addresses. However, audiometric testing showed the classic 4-6 kHz noise notch in this set of children. Researchers also found that males had a higher prevalence of NIHL than girls, 90.3% and 9.7%, respectively, consistent with Niskar et al. (2001). Of the 94 children whose parents stated that noise exposure was a possible etiology, 70 could identify a particular incident that resulted in the NIHL.

In an analysis conducted by Niskar et al. (2001), researchers estimated the prevalence of noise-induced threshold shift (NITS) among U.S. school-aged children using data from the Third National Health and Nutrition Examination Survey (NHANES III) conducted between 1988-1994. They evaluated audiometric thresholds, middle ear compliance testing, and household interview data from the survey. A total of 5,249 children between the ages of 6 and 19 were included in the final analysis of the data. NITS was determined using a combination of criteria in which all conditions were met in at least one ear: 1) threshold values at .5 and 1kHz were better than 15 dBHL, 2) the poorest threshold value at 3, 4, or 6 kHz was at least 15 dB poorer than the best threshold value for .5 and 1 kHz, 3) the threshold at 8 kHz had to be at least 10 dB lower than the poorest threshold value for 3, 4, or 6 kHz. Researchers concluded that among U.S. children, 12.5% (5.2 million) children have a NITS in one or both ears. Within the group of children meeting the criteria for a NITS, 14.6% showed an audiometric noise notch for both ears. Boys were found to have a higher NITS than girls, 14.8% and 10.1% respectively. This was thought to be due to the fact that girls do not participate in as noisy of activities as boys. Individuals in the age range of 12-18 year olds had a prevalence estimate of 15.5%, a greater prevalence than the 6-11 age range. This was expected as the older age range has been exposed to noise for more years of their life. Other researchers have referred to the NITS criteria as a high frequency notch (HFN) as there is no actual “shift” in hearing that can be ascertained from the NHANES data set (Meinke and Dice, 2007).

Henderson, Testa, and Hartnick (2011) examined the prevalence of NITS using NHANES III data as well as NHANES 2005-2006 data. Data was collected through household interviews followed by physical examinations. From the NHANES III survey, there were 3,441 subjects between the ages of 12 and 19. For the NHANES 05-06 survey, there were 2,228 subjects in the 12 to 19 age range. Tympanometry and audiometry were completed on the subjects. All subjects who were interviewed and examined were eligible for inclusion. Exclusion criteria included missing audiometric and tympanometric data and failure of compliance testing. A total of 4,305 subjects from NHANES III were included and 1,791 from NHANES 05-06 were included. NITS was determined using a combination of criteria in which all conditions were met in at least one ear: 1) threshold values at .5 and 1kHz were better than 15 dBHL, 2) the poorest threshold value at 3, 4, or 6 kHz was at least 15 dB poorer than the best threshold value for .5 and 1 kHz, 3) the threshold at 8 kHz had to be at least 10 dB lower than the poorest threshold value for 3, 4, or 6 kHz. Results from the study indicated no significant increases in rates of NITS between the two surveys. The NHANES III data shows that 15.9% of adolescents between 12 and 19 had NITS compared to NHANES 05-06 data showing 16.8% of adolescents with NITS. Researchers did state that the finding that was more concerning was the overall prevalence of exposure to loud noise or listening to music through headphones—a percentage increase from 19.8% on the NHANES III to 34.8% on the

NHANES 05-06. There was no association between the exposure of loud music and the prevalence of NITS.

Recommendations for Education to Address Issues of Noise-Induced Hearing Loss

The prevalence of NIHL in both military and child populations demonstrates a need for educating military personnel and their children about the dangerous effects of excessive noise levels. The National Institutes of Health has recommended that existing hearing conservation programs be disseminated as well as development of a comprehensive program of education about NIHL specifically for school-age children (1990). More recently, Healthy People 2020 has added goals and objectives to "increase the quality, availability, and effectiveness of educational and community-based programs designed to prevent disease and injury, improve health, and enhance quality of life" (2016). Objective 4.6 specifically addresses the need to increase the proportion of elementary, middle, and high schools that provide school health education in ways that address vision and hearing loss to promote personal health and wellness (Healthy People 2020, 2016). Presently, there are several educational programs, campaigns, and resources available to the public that are designed specifically to educate children and adults about NIHL. Programs for soldiers have also been developed. Many of these programs focus on changing the knowledge, attitudes, and intended behaviors related to hearing health and have been developed based on what is known as health behavior science.

Health Behavior Science

For many years, it has been the goal of researchers studying health promotion to understand the determinants of health behavior and health behavior changes. It can be highly beneficial before planning a health program to consider the different types of health communication theories which help explain processes related to changing and encourage the desired health behaviors and also consider the social and physical environments effecting those behaviors (National Cancer Institute, 2005). Using a theoretical basis for program planning and development not only provides a road map for developing interventions and evaluating success, but also can help identify appropriate audiences for targeting interventions, methods for fostering change, and outcomes measures for program evaluation (National Cancer Institute, 2005). In order for hearing loss prevention programs to be of upmost success, they should be based on a theoretical perspective. The following sections will further inform the reader regarding the theoretical basis of the Dangerous Decibels program.

Theory of Reasoned Action and Theory of Planned Behavior

The Theory of Reasoned Action (TRA) and the Theory of Planned Behavior (TPB) describe the relationship between behavior and one's beliefs, attitudes, and intentions (Fishbein & Azjen, 1975). Both theories assume that behavioral intention will determine behavior change. Furthermore, behavioral intention is highly influenced by an individual's attitude toward a behavior and the individual's beliefs about whether or not people close to them will approve or disapprove of the behavior change. The TPB differs from the TRA in that the TPB also involves an individual's perceived control over changing the unhealthy behavior. Henceforth, an individual's beliefs that they can control a certain behavior might motivate them more to make a desirable behavior change.

Health Belief Model

In the Health Belief Model (HBM), motivation is the central focus. There are six main constructs that influence an individual's decision to prevent, screen for, or control an illness (National Cancer Institute, 2005). First, the person must believe that he/she is susceptible to a condition (perceived susceptibility). Second, the person must believe that the condition has serious consequences (perceived severity). Third, he/she must believe that taking action would reduce one's susceptibility to the condition (perceived benefit). Fourth, the individual must believe that the benefits outweigh the costs of taking action (perceived barriers). Fifth, the person must be exposed to factors that will prompt an action (cue to action). Sixth, he/she must be confident in their ability to perform an action successfully (self-efficacy). These six constructs together can provide a useful framework for designing short term and long term health behavior change strategies.

Stages of Change: Transtheoretical Model

The basic premise of the Stages of Change Model (SCM) is that behavior change is a process not an event (National Cancer Institute, 2005). As a person attempts to change their behavior, he/she moves through five stages. Stage one is precontemplation. In this stage, a person has no intention of taking action within six months, however they are aware of a need to make a change. Stage two is contemplation. At this point, an individual has become motivated and intends to take action within six months. In the third stage, preparation, the individual has begun implementing goals. In this stage, the individual plans to take action within thirty days. Stage four is action in which the individual has consciously taken action to make a behavioral change. However, the change has only been for less than six months. Stage 5 is maintenance. In the maintenance stage, behavior has changed for more than six months. It is important to note that in the SCM all individuals may not progress through the stages at the same rate. The process is circular, not linear, meaning that an individual may enter one stage then regress or progress to another stage more than once (Prochaska & DiClemente, 1983).

Social Cognitive Theory

The Social Cognitive Theory (SCT) describes a process in which personal factors, environmental factors, and behavior interact together. It states that there are three main factors effecting the likelihood that an individual will change their behavior: 1) self-efficacy, 2) goals, and 3) outcome expectancies (National Cancer Institute, 2005). In the SCT, behavior is influenced by six factors. The first concept is reciprocal determinism. This concept explains that behavior, personal factors, and environment all influence each other. Behavioral capability, the second concept, states that a person must know what to do and how to do it in order to perform a behavior. The third factor is expectations, or the anticipated outcomes of the behavior. The fourth concept is self-efficacy and thought to be the most important. Observational learning/modeling, the fifth concept, is described as learning from the actions of others rather than through one's own experiences. And lastly, reinforcements is the sixth factor of the SCT. Reinforcements influence whether or not a person will perform the behavior again.

Ecological Model

The Ecological model emphasizes the interactions between people and their social and physical environments. It highlights determinants of an individual's health, including risk factors, social relationships, living conditions, neighborhoods and communities, and social and economic policies (National Cancer Institute, 2005). There are two key concepts that play a major role in the ecological perspective: 1) "behavior both affects, and is affected by, multiple levels of influence and 2) individual behavior both shapes, and is shaped by, the social environment" (National Cancer Institute, 2005, p. 10). There are five levels of influence that make up the model: 1) intrapersonal—self-awareness, 2) interpersonal—family, friends, peers, 3) organizational—workplace, schools, 4) community—cultural values, norms, and 5) policy—laws, regulations, etc. (McLeroy, Bibeau, Steckler, & Glanz, 1988).

Health Promotion Programs and Their Effectiveness

Due to the prevalence of noise-induced hearing loss and tinnitus in the military and youth populations, there is a need to positively change the knowledge, attitudes, and behaviors regarding hearing health in military personnel, their spouses, and their children. Additional education in prevention practices is essential in order to prevent NIHL and tinnitus before it occurs. With the development of educational campaigns, public health programs, and interventions targeting the prevention of NIHL, several different hearing loss prevention programs have been examined for their effectiveness in changing the knowledge, attitudes, and intended behaviors regarding hearing health. Thorough program evaluations are not only necessary, but are key in developing a successful and long lasting program as well as identifying areas that need improvements or revision (Griest, 2008).

Health Promotion Programs for Military

At the end of World War II, people began taking a serious interest in hearing conservation when an extensive number of soldiers returned home with a hearing loss (Humes et al., 2006, p. 147). However, hearing conservation programs were considered low priority at the time. Of even more importance during the post-war recovery period was the development of aural rehabilitation programs. In the fall of 1946, in an arrangement between the Navy Department and the Veteran's Administration (VA), veterans began being admitted as patients at VA healthcare facilities (Nixon, 1998). Many universities with speech, hearing, and audiology services began providing government-sponsored aural rehabilitation services to veterans. These centers led to the emergence of hearing-health professionals who would play a large role in prevention-oriented programs in the military (Humes et al., 2006, p. 147).

In 1947, the U.S. Air Force was established as a separate branch of military from the Army Air Corps. The introduction of the jet engine aircraft in the late 1940s and early 1950s raised concerns about hazardous noise and was one of the most important occurrences to the subsequent development of hearing conservation programs (Nixon, 1998). No sound of the jet engine's magnitude had ever been routinely experienced in the military or by civilians. In 1952, the Navy conducted a study to evaluate the effects of the jet engine noise on personnel aboard the aircraft carrier USS Coral Sea. The study verified the seriousness of the high-intensity noise problem. In response to the problem, the NAS-NRC Armed Services Committee on Hearing and Bioacoustics (CHABA) was established in 1952 (Nixon, 1998). It was their job to examine the areas of (a) effects and control of noise, (b) auditory discrimination, (c) speech communications, (d) fundamental mechanisms of hearing, and (e) auditory standards. CHABA members were at the forefront of HCP development. They began sponsoring and publishing reports related to noise in the military. They went on to publish a Memorandum No. 2 on "Hearing Conservation Data and Procedures" in 1956. The Memorandum described components of a hearing conservation program and provided recommendations for their implementation.

In 1956, the Air Force was the first to establish a comprehensive hearing conservation program—Air Force Regulation 160-3 (Nixon, 1998). The Regulation was revised in 1973. Both were model programs after which many organizations within and outside the government were created (Nixon, 1998). In 1978, the Department of Defense Instruction (DODI) 6055.3 was published and contained requirements that attempted to make all hearing conservation programs uniform across services. By 1980, the three branches (Air Force, Army, and Navy) had established hearing conservation programs in compliance with the DODI (Nixon, 1998). In 1987, the DODI was revised. The most current DODI is 6055.12, and ensures that all services have a program implemented and these programs should include: a) sound measurements, b) engineering control measures, 3) noise labels in hazardous areas/on equipment, d) issuance of hearing protective devices, e) appropriate education to all personnel working around hazardous noises, f) routine audiometric testing which is to be stored in the Defense Occupational and Environmental Health Readiness System (DOEHRS), g) access to materials, h) record keeping through DOEHRS, and i) program performance evaluations (Department of Defense [DOD], 2010).

Veteran's Affairs Hearing Loss Prevention Program. The Veterans Affairs National Center for Rehabilitative Auditory Research (NCRAR) developed the Hearing Loss Prevention Program (NCRAR-HLPP) which uses constructs based on the Health Belief Model to target veterans returning from military service (Folmer et al., 2012). The first version of the program was developed specifically for veterans, however, modules targeting active military personnel were included. The goal of the program is to motivate individuals to change their behaviors related to hearing health and make appropriate decisions regarding hearing protection strategies. The NCRAR-HLPP is a self-administered, computer based program consisting of different modules targeting different areas related to hearing. Participants watch a two minute introduction video and are then free to navigate between modules from the main menu. The veteran's portion focuses mainly on quality of life and communication barriers whereas the part targeting the active soldiers includes examples of noise exposure and the importance of hearing readiness for duty and ability to carry out missions (Folmer et al., 2012).

The Veterans Affairs National Center for Rehabilitative Auditory Research (NCRAR) conducted a formative evaluation of the program. They used the KAB (Knowledge, attitudes, and behaviors) questionnaire to assess the knowledge, attitudes, and behaviors of participants before and after visiting the booth and completing the modules. Researchers also hoped to identify what makes an effective program in terms of likes, dislikes, usability, applicability, etc. Twenty-five male and four female veterans between the ages of 25 and 65 were included the evaluation. Data from the KAB questionnaire showed that knowledge scores increased, on average, by 13% and attitudes became more desirable on all scores except the perceived susceptibility score ($p=.673$) where $p\leq.005$ is statistically significant. For questions regarding knowledge and perceived severity, increases were statistically significant ($p<.001$). Participants stated that the NCRAR-HLPP had several positive features including ease of use, inclusion of multimedia content, personal relevance, and emotional descriptions of hearing loss making it easy to effectively communicate the impacts of hearing loss. Some participants, however, stated that learning from a computer was impersonal, they would have liked to have been able to ask follow-up questions, and/or did not feel they had the computer skills necessary to take full advantage of the program. These advantages and disadvantages are critical to keep in mind in developing and progressing new and current hearing loss prevention programs (Saunders, Vachhani, Galvez, & Griest, 2015).

Army Hearing Program. The Army Hearing Program (AHP) is geared toward soldiers as well as civilian workforce and aims to maintain a high state of readiness and protect hearing without compromising the effectiveness of the soldier (United States Army Public Health Command, 2008). The AHP was designed around four pillars: Hearing Readiness, Operational Hearing Services, Clinical Hearing Services, and Hearing Conservation. In the Hearing Readiness portion of the program, the purpose is to identify early changes in hearing and provide education, counseling, and hearing protection to prevent further damage. (United States Army Public Health Command, 2008). In the Clinical Services part of the program, audiological evaluations are given and a readiness classification is determined. In the Operational Services portion, soldiers are given information about noise sources and noise levels. Hearing protection and the different types of hearing protection devices (HPDs) are discussed. The Hearing Conservation portion of the program aims to educate individuals about the dangers of NIHL (United States Army Public Health Command, 2008). The program is implemented with the help of many individuals, including but not limited to, the installation commander, the Medical Treatment Facility, Occupational Health and/or Medicine personnel, and brigade commanders (Department of the Army, 2015). All soldiers will receive a baseline audiogram upon entry into basic training. Some soldiers will receive annual hearing evaluations depending on their job duties. All soldiers and civilian personnel will be enrolled in the hearing conservation portion of the AHP if they are occupationally exposed to intermittent noise, continuous noise, ototoxins, etc. Upon departure of government services (exiting the military), a termination audiogram must be completed. All audiometric data is stored in the DOEHRS system (Department of the Army, 2015). All four components of the AHP are in effect during an individual's time in the military.

Health Promotion Programs for Children

Operation BANG. Operation BANG (Be Aware of Noise Generation) was started at McClellan Air Force Base in 1989 in California by then Air Force Capt. Theresa Schulz (Shultz, 1991). The program is designed to be a three day (one hour/day) hearing loss prevention campaign for fifth graders. Day one teaches children about the anatomy and physiology of the ear as well as the science of sound and noise. Day two the children get to experience hazardous types of noise. Day three is hearing appreciation day where the children learn about the effects of noise on their hearing and the importance of protecting their ears. The program can be condensed into a 45 minute presentation if necessary. Two basic concepts are taught throughout program delivery: 1) 3 ways to protect your ears—turn it down, walk away, and cover your ears) and 2) The 3-foot rule—if you have to raise your voice to be heard at arm's length, the noise is too loud.

It's a Noisy Planet: Protect Their Hearing. Sponsored by the NIDCD, *It's a Noisy Planet, Protect Their Hearing,* was created as a public campaign in an effort to prevent NIHL in children. It was developed as an outreach program to raise awareness for parents of children ages 8-12 about NIHL. The campaign uses sound level meter demonstrations, exhibits, interactive presentations, and distributes copies of more than 20 publications, as well as posts information on their website and Facebook page in order to disseminate information (It's A Noisy Planet, 2013).

In 2012, in an attempt to evaluate whether the Noisy Planet campaign was reaching its intended audience, whether it was achieving its objectives, and who was using the resources, the NIDCD conducted an evaluation of the campaign. A customer satisfaction survey was used to collect information on who had ordered materials for the campaign. A survey was used to collect parent feedback about in-school presentations of the campaign to their children. Noisy Planet's partner organizations were also interviewed, and an analysis was done on the campaign website and social media usage. The available data from the evaluation showed that more than 6 million U.S. citizens were potentially reached through Noisy Planet messages via broadcast media, social media, conferences, material dissemination, and other mechanisms. According to the data, approximately 2,708 children in the U.S were exposed to the Noisy Planet campaign via classroom presentations, 916,000 people were reached through social media, 73,583 people were reached through material distribution, and 16,200 through conferences/exhibit attendees. Overall, the campaign reached several populations including preteens, parents, adults, and the general public. It was concluded that the campaign was effective in reaching target audiences. The surveys also revealed that, of the population of individuals who ordered materials, more than 80% said they had used them, and 57% said they specifically used them to encourage their teens to use healthy hearing practices.

Following results from the evaluation, recommendations were made to improve the Noisy Planet campaign. These recommendations included: enabling parents and teachers to order materials in larger quantities, developing educational tools and materials specifically, optimizing the campaign website, expanding the campaign to disadvantaged communities, and tailoring materials to physician and school health offices. Most importantly, it was recommended that the data collection procedures must be improved in order to identify the campaign's success to more closely align with Noisy Planet's goals and objectives. It was suggested that regular reports be produced in order to determine whether goals are being reached.

Sound Sense™. Developed out of the Hearing Foundation of Canada, Sound Sense is a 45 minute educational program targeting preteens. It teaches children about the anatomy of the ear, etiology, consequences of NIHL, and prevention practices. The Sound Sense program meets learning outcomes for 4^{th} grade science units and supports grades 5 and 6 healthy living curricula. Trained facilitators present the program engaging students with interactive questions, a sound level meter demonstration, and a ten minute video. Students receive earplugs, stickers, and take-home materials at the conclusion of the program.

Neufeld, Westerberg, Nabi, Bryce, and Bureau (2011) assessed the efficacy of the Sound Sense educational program on changing the hearing loss prevention behaviors in elementary school children. Participants included 856 sixth grade students from 16 schools in Vancouver, Canada. Four hundred thirty nine students were included in the control group, and 351 students were in the intervention group. All students included in the study completed a behavioral baseline questionnaire including items such as music player listening habits, noise exposure duration, noise intensity levels, and earplug use. Prior to the delivery of the Sound Sense program, the intervention group completed a baseline questionnaire. They then completed the same questionnaire at both two weeks and six months after delivery. The control group received the same questionnaires at the same times, however they did not receive the classroom program. Each questionnaire item was analyzed separately using three different models: Model A-only those students at all three sittings (baseline, 2 weeks, 6 months), Model B-only those present at baseline and 2 weeks, and Model C-only those present at baseline and 6 months. Results were analyzed using a mixed analysis of variance. All analyses were interpreted using a Greenhouse-Geisser correction.

Researchers concluded that dissemination of the Sound Sense program had significant short- and long-term efficacy in changing the hearing health behaviors in elementary school children. The intervention group for Model A had a significant interaction effect for improvements in earplug use at school dances (P=.004), car racing events (P=.047), rock concerts (P=.004), and for protection from other noises (P=.028). For Model B, a significant interaction effect was found for improvements in earplug use at school dances (P=.019), rock concerts (P=.001), with percussion instruments (P=.002), electric guitars (P=.028), and other noises (P=.001). For Model C, a significant interaction effect was also found at the six month follow-up for improvements in earplug use at school dances (P=.041), rock concerts (P=.0024), with power lawn mowers (P=.043), and other noise sources (P=.022). However, although significant, outcomes were limited to a 1%-6% rate of improvement at two weeks and a 1%-3% rate of improvement at six months. In spite of this minimal rate of improvement, the researchers concluded that presentation of the Sound Sense educational program helps improve behaviors related to hearing loss prevention.

Hearing conservation program for elementary school children. Chermak, Curtis, and Seikel (1996) measured the effectiveness of a hearing conservation program (HCP) in 48 fourth grade children in Spokane, WA. The HCP was presented to two classrooms in two 1-hour sessions separated by one week. Teachers gave the presentations. One classroom did one activity ("What is Sound") and the other integrated three activities interspersed between HCP sessions. Several hands-on, interactive activities reinforced with brief presentations were included. The "Listen Up! For the Sounds of Your Life" video was also presented, along with a hearing screening demonstration, question and answer discovery learning periods, and distribution of earplugs and a pamphlet about noise and hearing loss. Two questionnaires, one regarding knowledge of hearing and hearing loss, the other assessing noise exposure and prevention practices, were administered just before receiving the program and 1 week following the program. It should be noted that the questionnaire regarding noise exposure and prevention practices differed at pre and post program delivery.

Increases in knowledge related to NIHL and hearing conservation practices were observed in both classes after receiving the HCP. More gain (49%) in knowledge was seen among those students who received three teacher-led supplemental activities as compared to a 35% increase in knowledge for those receiving a single teacher-led activity. When engaged in the depicted noisy activities, 82% of children expressed intention to use ear protection. Data from these questionnaires were not subject to statistical analysis because questionnaire formats were different at pre and post regarding noise exposure and prevention practices. However, both classes showed an increase in understanding of appropriate hearing conservation practices after the HCP was delivered.

Researchers concluded that this HCP was effective in increasing knowledge about NIHL and hearing conservation practices.

Hear 4 Tomorrow. The Hear 4 Tomorrow (H4T) educational program was designed in Australia to target primary school children and teach them about hearing health. The content is flexible and can be taught in one lesson or spread out among many. H4T is taught using four modules, each one targeting a different area of hearing health. The program outline, supporting information, and other resources are available for free to download from the H4T website. The program explains how the ear works, teaches about how noise damages hearing, teaches children to recognize potential risks to hearing health and minimize or avoid risks through protective behaviors (Addison & Gilliver, 2012). Hear 4 Tomorrow was created under the basis of health communication theory and uses activities that have been established as effective in promoting hearing health messages.

Addison and Gilliver (2012) evaluated the effectiveness of the Hear 4 Tomorrow educational program regarding hearing health. A total of 398 students within eight schools in Australia-five public schools, two Catholic schools, and one independent school- were included in the study. Students and teachers were asked to complete questionnaires before receiving the program and immediately after. A three-month follow up questionnaire was also part of the study. All three questionnaires included questions about identifying loud sounds, sounds that could be damaging to their ears, ways to protect their hearing, and if music could damage their hearing. On the pre-program questionnaire, students were also asked to identify why they thought their hearing was important. On the post-program questionnaire students were asked to provide feedback about the program. The follow-up questionnaire measured application of hearing health knowledge. Each classroom received the 45-minute H4T program via the same educator.

Overall, teacher feedback indicated that H4T is a well presented and informative program. It kept children engaged and focused throughout the presentation. Results from the student questionnaires indicated that overall, students had an improved awareness of loud noise, knowledge of protection strategies, and understanding of what decibels were. Thirty-one percent of students reported that they had increased their awareness of noise and how loud things are. Eighty percent of students increased their knowledge of noise and how it affects hearing. From pre to post delivery of the program, there was a significant increase in the number of students who could correctly identify dangerous activities from a list ($p<.001$). These data were reported using a one-way anova comparing the childrens’ ability to correctly identify risky situations in the pre, post, and follow-up. Seventy-eight percent of students thought listening to music could damage their hearing and recognized that if played over 85 dBA it would be damaging. Results pertaining to whether or not children could make informed decisions about how to protect their hearing, data revealed that the percentage of correct identification of effective strategies significantly increased ($p<.001$) when comparing pre to post and follow-up. As a whole, the H4T program for children was effective in changing knowledge about noise, hazardous noises and their effect on hearing, and knowledge about strategies that could be used to protect their hearing.

Dangerous Decibels®. Dangerous Decibels is a public health program designed with the goal to reduce the prevalence of NIHL and tinnitus by changing the knowledge, attitudes, and intended behaviors of children regarding hearing health. It was created by collaborators from the Oregon Hearing Research Center (OHRC), the Oregon Health and Science University (OHSU), Portland State University (PSU) Department of Health Communications, the Oregon Museum of Science and Industry (OMSI), the NCRAR, and the American Tinnitus Association (ATA) (Griest et al., 2007). It is currently supported through a collaborative dissemination effort between Oregon Health & Science University, the University of Northern Colorado and the National University of Singapore. Dangerous Decibels conveys basic knowledge and hearing loss prevention practices through dissemination of several different mediums. These mediums include 1) a 50 minute group or "classroom" interactive hearing loss prevention program; 2) an online virtual museum exhibit accessed through the Dangerous Decibels website (http://www.dangerousdecibels.org/virtualexhibit/); and 3) a 2-day educator training workshop for educators, trainers, and all other professionals interested in delivering the classroom program for the prevention of hearing loss and tinnitus (Griest et al., 2007).

Dangerous Decibels classroom program. Keeping in mind the goal of Dangerous Decibels, the classroom program targets three educational messages: What are the sources of dangerous sounds? What are the consequences of being exposed to dangerous sounds? How do I protect myself from dangerous sounds? The program also focuses on three main strategies to use when exposed to dangerous sounds: turn it down, walk away, and protect your ears (Martin, Meinke, Sobel, Griest, & Howarth, 2008). The Dangerous Decibels classroom program is interactive and addresses the physics of sounds, mechanisms of hearing, how loud sounds damage hearing, consequences of hearing loss, and hearing loss prevention strategies (Griest et al., 2007). It is a 50 minute presentation that can be adapted and modified for grades K-12, however it was originally intended for children (Meinke et al., 2008). More recently, it has been adapted for adults in the workplace and delivered to parents (Reddy, 2014; Clark, 2013). Participants learn about decibels, experiment with tuning forks, and get to experience what a hearing loss would sound like via computer simulations (Martin et al., 2008).

The program was developed using the underlying principles of health behavior science in order to effectively change knowledge, attitudes, and intended behaviors related to hearing health (Sobel & Meikle, 2008). The four health communication theories that were incorporated into Dangerous Decibels are the Theory of Reasoned Action and the Theory of Planned Behavior, the Health Belief Model, the Stages of Change: Transtheoretical Model, and the Social Cognitive Theory (Sobel, 2015). Reddy (2014) made modifications to the program using the Ecological Model in order to target individuals in the workplace.

Dangerous Decibels educator training workshop. Dangerous Decibels provides a two-day educator training workshop for anyone interested in the prevention of hearing loss and tinnitus. The workshop was originally developed with funding from the National Institute of Health (NIH) and lead by experts in hearing science, hearing loss prevention, and health communication (Dangerous Decibels, 2015). It was designed to prepare individuals to present the 50 minute program that has been proven effective in changing students' knowledge, attitudes, and intended behaviors regarding their hearing (Dangerous Decibels, 2015). This workshop provides the knowledge, practice and feedback necessary to ready those who take the training to walk right into the classroom and deliver an effective Dangerous Decibels presentation (Dangerous Decibels, 2015). All of the materials needed to deliver the classroom program are provided in a "kit" for the workshop attendees. Individuals learn about the anatomy and physics of sound, effects of dangerous sounds, and how to protect their hearing over the course of the two day training. It even includes a portion on classroom management and an opportunity to practice program delivery to instructors (Dangerous Decibels, 2015). After successful completion of the two day training workshop, individuals are certified and equipped as a Dangerous Decibels educator.

Dangerous Decibels effectiveness. Dangerous Decibels was first evaluated in order to determine the effectiveness of the program by means of formative and summative evaluations. Formative evaluations are used to provide information regarding what is and is not working during the early stages of designing and implementing the program. Summative evaluations are conducted in order to determine if the program is accomplishing its goals of improving knowledge, changing attitudes, and impacting intended behaviors regarding hearing health.

Formative evaluations were conducted by two teams; an internal staff team and a contracted external professional evaluation team. These two teams collected data from teacher and student focus groups, surveys, interviews, and self-assessment questionnaires completed by presenters. Two formative evaluations were conducted. The first formative evaluation was comprised of 304 students, 14 teachers, and 3 presenters. Data collection revealed largely positive outcomes, and students and teachers both had constructive suggestions to provide that could redirect the program planning and design. A major change resulting from the first formative evaluation was the elimination of a cartoon style video clip used to simulate the effects of hearing loss (Griest, 2008). A second formative evaluation was completed following the initial changes. The second formative evaluation was done on 400 students. Data collection revealed similar findings to the first formative evaluation, again with largely positive outcomes. Several students and teachers agreed, saying things like "The program was interesting" and "I liked the hearing program presented today" (Griest, 2008).

The summative evaluations were given to fourth and seventh grade students. Both grade levels were split into study (n=507) and comparison groups (n=521) matched by grade level, gender, ethnicity, and geographic region. All students were given a baseline questionnaire prior to program presentation to assess the children's knowledge, attitudes, and intended behaviors regarding hearing loss and tinnitus prevention (Griest, 2008). The study groups were given an immediate post-presentation questionnaire following the Dangerous Decibels presentation. All students, e.g. both study group participants and control group participants, completed a follow-up questionnaire three months following the study. Researchers concluded that the Dangerous Decibels program significantly improved the knowledge, attitudes, and intended behaviors of students in the study groups when compared to those in the comparison groups. There was an increase of 10-52% improvement in knowledge, 13-23% improvement in attitudes, and when asked about intended behavior to wear hearing protection at a concert, 44% said yes compared to the baseline percentage of 15%. All increases from baseline to post were statistically significant ($p<0.01$). Results from the 3 month follow-up revealed that 4th grade students maintained these increases across all categories, however, seventh grade students only maintained these increases for knowledge, while attitudes and intended behaviors returned to baseline results. These outcomes lead researchers to consider making more changes to the program in order to make it more effective for older students. The possibility of implementing a booster activity, like visiting the OMSI museum exhibit, was considered. Other considerations made by researchers were to implement the program at a younger age, include varied instructional modalities, and/or provide multiple interventions throughout a child's education (Griest, 2008).

In another summative evaluation, Griest et al. (2007) measured the effectiveness of the Dangerous Decibels educational program in increasing knowledge and positively changing attitudes and intended behaviors related to hearing and hearing loss prevention in fourth and seventh grade students. Four hundred seventy-eight fourth grade students and 550 seventh grade students from Oregon and Washington schools were included in the study. Classrooms were assigned to be a part of either the study group or control group. Two hundred twenty-three fourth-grade students and 284 seventh-grade were part of the study group. Control groups consisted of 255 fourth graders and 266 seventh graders. Baseline questionnaires were given to all students. Study group students were given a post-presentation questionnaire immediately following the Dangerous Decibels program. Then, a three month follow-up questionnaire was administered to all students in both control and study groups.

Based on results, researchers found that fourth grade students significantly improved in their knowledge related to sources of dangerous sounds, consequences of dangerous sounds, and how to protect oneself from dangerous sounds. At baseline 34% said stereo headphones were a source of loud sounds. Following the program, 82% identified stereo headphones as a source of potentially dangerous sounds. At the three month follow-up, fourth graders retained significant increases in knowledge items. Seventh grade students also exhibited significant improvements in knowledge items specifically, there was a 46.1% increase in the ability to identify sources of loud sounds and a 63.5% increase in identifying sounds over 85 dB that are damaging to our hearing. On the three month follow-up, seventh grade students retained significant increases in knowledge for 11 out of 13 items. Regarding intended behaviors related to hearing protection, 44% of seventh grade students said they would wear hearing protection at a concert compared to 15.1% at baseline. However, at three months, there was no significant difference from the baseline, 16.2% respectively. Overall, researchers concluded the Dangerous Decibels classroom program to be effective in changing knowledge, attitudes, and intended behaviors related to hearing loss and prevention.

More research evidence showed that Dangerous Decibels was not only effective in changing knowledge, attitudes, and intended behaviors in children, but also effective for parents, as well as children with parental involvement. Clark (2013) measured the effectiveness of the program in rural children with parental involvement. Children participating in the study were between the ages of 8 and 12 years old. The adult participants were parents or legal guardians of a child participant who shared household daily living arrangements at least 50% of the time. There were two groups, a control group (children only, n=23) and an experimental group (parent and child together, n=22). Baseline, post, and three month follow-up questionnaires were used. Questions were worded appropriately for both populations. Baseline data was collected for both groups. Child and parent members of the experimental group each filled out their own questionnaire. Control group children and parents also filled out their own questionnaire but in different rooms. Then both groups received the program. All participants from both groups then completed an immediate post questionnaire, excluding parents of the children in the control group because they did not receive the program.

According to results from the study, researchers indicated that parental involvement did in fact prove to be beneficial to the experimental pair group. Regarding knowledge, a significant improvement was seen on the post and three month follow-up questionnaire for “hearing an extremely loud sound even one time can cause you to lose your hearing” for all groups receiving the program. Only the experimental group, however, maintained statistical significance at three months. A statistical significance was also found at the post and three month follow-up for the youth group and parent group for the question “if my hearing is damaged I might hear ringing in my ears”. There were no improvements for the control groups, indicating that parental involvement is beneficial related to tinnitus. For intended behaviors regarding using hearing protection when operating a lawn mower, all groups showed positive change and there was a statistical significance for the parent group and youth study group which was maintained at the three month follow-up. Both parent and youth study groups demonstrated statistical significance for the intended behavior “if you were around loud machinery with a child/adult present, would you use hearing protection” at post and three month follow-up. Clark (2013) concluded that Dangerous Decibels is an effective program for changing knowledge, attitudes, and intended behaviors related to hearing health in children with parental involvement.

Reddy (2014) modified the Dangerous Decibels program using an ecological model approach to target audiences in the workplace rather than children. The goal of the study was to understand the factors influencing hearing conservation behavior in workers and to develop an intervention that promotes hearing health in noisy workplaces. He explains how different behavioral, societal, and environmental factors influence one another in order to create a positive change. He used this understanding to modify the Dangerous Decibels program to target workers. Reddy used a mixed methods design: interviews (qualitative), a cross-sectional survey—the Hearing Protection Assessment 2 (HPA-2) (quantitative), and a pilot intervention implementation and evaluation (2014). The interviews consisted of questions related to an understanding of factors influencing hearing protection behavior in workers, perception of noise levels in the workplace, HPD use, and barriers against hearing protection behavior. Responses from the interviews dictated the questions implemented on the HPA-2 used for the qualitative data. The intervention program used was a modified Dangerous Decibels program that was guided by an ecological model and behavior change theories (Reddy, 2014).

Results from this study demonstrated that Dangerous Decibels could be modified to reach different audiences, including adults in the workplace. Fifty three workers from five different workplaces were included in the research. All participants were required to complete the HPA-2 questionnaire at baseline, one week after the intervention, and 2 months later. The program lasted approximately 30 minutes. Results showed that there was a significant effect on the “behavior motivations” subscale and “safety culture” measures over time. There was also a significant effect on knowledge, attitudes, and behaviors over time as well as self-reported use of HPDs. Researchers also conducted interviews post-delivery of the program and found that it was well received and accepted within the workplace.

Listen Up!. Sponsored by the Pindrop Foundation, Listen Up! was created in order to address the growing issue of NIHL in New Zealand's youth. Resources for Listen Up! were derived from the U.S. public health initiative, Dangerous Decibels, in order to prevent NIHL in children (Listen Up!, 2015). It is the same 50 minute, interactive outreach program that teaches children between the ages of 8 to 12 about NIHL as used in the U.S.

Children in Military Families

Although NIHL in children and individuals in the military has been a concern for many years, still there is no requirement for an educational program related specifically to the prevention of NIHL in these populations. According to Humes et al. (2006), individuals may not be aware of the effects noise can have on their hearing; recognition of a change in hearing may be delayed after exposure to the noise (p. 204). In other words, there is a lack of knowledge and a need for further education related to the implications of early noise-induced hearing loss on an individual's future. Young adults with a slight NIHL, one that is not likely to cause much difficulty with communication, will likely exhibit greater hearing loss with age when compared to those young adults with normal hearing (Humes et al., 2006, p. 204). By the age of 50 or 60, a slight noise-induced hearing loss acquired as a child or young adult combined with hearing loss associated with age can become a moderate hearing loss. This type of hearing loss is sufficient enough to effect communication and everyday life (Humes et al., 2006, p. 204).

In addressing the issue of NIHL in children and in the military, it is important to consider what links these two populations. Faris (1981), conducted research regarding the relationship of fathers' military service to child enlistment. Data from the study revealed that children who have a father in the military are twice as likely as their peers to enlist in the military. Data also revealed that in addition to enlisting, being a member of a military family also increases the likelihood of making the military a career (Faris, 1981). Stander and Merrill (2000) examined the demographic characteristics of children of veterans versus first generation recruits. Results indicated that 52% of the recruits in the study population reported that at least one of their parents was a veteran. It was implied that family military background encouraged them to serve whereas first generation recruits were highly influenced by fluctuations in economic and employment trends (Stander & Merrill, 2000).

These findings indicate the importance of children, specifically those from military families, and military personnel understanding the implications of NIHL. It is also important for them to recognize the need for prevention education related to hearing health and thus is the focus of my study. As Reddy (2014) demonstrated, taking a successful educational program and adapting it to a particular audience can be effective. With appropriate adaptations to the Dangerous Decibels program in order to target children from military families, successful changes in knowledge, attitudes, and intended behaviors related to hearing health may be possible.

CHAPTER III

METHODOLOGY

The purpose of this study was to investigate the effectiveness of a hearing loss prevention program in changing knowledge, attitudes, and intended behaviors in children, specifically children from military families. More precisely, are there changes in knowledge, attitudes, and intended behaviors immediately following the Dangerous Decibels program and/or 3 months after program delivery? This research was conducted under an approved University of Northern Colorado Institutional Review Board (IRB) protocol (see Appendix A).

Participants and Recruitment

Children were contacted to participate in the study through an educational contact and school nurse from Edna and John W. Mosley P-8 School. The school nurse was contacted upon referral from a former teacher in the surrounding Aurora, CO area. The school nurse then took information related to the study to the administration staff and teachers. With the permission of the school administration, the Teacher on Special Assignment, and the interest of the 4th grade teachers, participants were recruited. This was a convenience sample and was not a controlled randomized sample for this initial inquiry into the research questions.

Participants for this study were recruited from four different 4th grade classrooms at Edna and John W. Mosley P-8 School. The participants were children, both male and female, ages 9 and 10 years old. They were expected to be able to read and write in English and had to be enrolled in an age-appropriate classroom grade level in order to participate in the study. Participation in the study was dependent on parental consent and participant assent/verbal assent. It should be noted that participants who did and did not have a parent(s) in the military received the program in order to measure effectiveness of the adapted program across both populations. A total of 53 children were recruited for this study.

Parent consent forms were sent home with students prior to the date of program delivery. They had to be signed and returned in order for students to participate in the research study. There was information on the parent consent form stating that parents could contact the researcher directly via phone or email if there were questions about the study. There was also a question included at the end of the parent consent form asking about the parents' military status. Parents did not participate in any experimental data collection other than the question included at the bottom of the consent form indicating if they are military. The responses to this question were used to experimentally group the student participants as being from military families or civilian families. All parent consent forms were also signed by the primary researcher. Participant consent forms/verbal assent forms were given to only those students who had parental consent forms signed and returned. The participant consent and assent forms were handed out by the classroom teachers and the primary researcher. A description of the study was read aloud to the children and they had the opportunity to ask questions prior to signing their consent/assent form. Consent forms for children ages 10 and older were signed by the participants themselves. Verbal assent forms for participants under the age of 10 were signed by the participants themselves after giving a verbal assent to participate. This was done in the presence of a witness, the witness being the classroom teacher. Then, all consent/assent forms were signed by the primary researcher. Only those students with both a signed parental consent form and a signed participant consent/assent form were allowed to partake in the study. At the bottom of all the consent/assent forms, there was a statement asking for permission to take photos. The photos were used to document the interactions of the children throughout the program since it is fun and interactive. Photos were selected by the researcher to include during research presentations and/or publications at the conclusion of the study. All forms were collected and stored in a secure location (Gunter Hall 010 filing cabinet) for the remainder of the study.

Dangerous Decibels Program

Adaptations

In targeting a specific population of children, the Dangerous Decibels program was adapted in order to enhance those parts of the program that are relevant to the specific population of children from military families. Adaptations were incorporated into the program because it was assumed that children from military families have more knowledge about military-type noise sources and are potentially more exposed to noise than a child from a civilian family.

The approach to modifying the program was to review each educational objective for each classroom activity. Each classroom activity was evaluated for relevancy to the risk of noise-induced hearing loss from loud sources, specifically those that related to military noise exposures. Topic areas such as sound pressure levels and military noise sources were added while still including original Dangerous Decibels noise sources.

Risks of acoustic trauma were also added to the program due to the fact that military noise sources, such as guns, can create acoustic trauma with just one shot. Incorporating a demonstration of electronic hearing protection was also included in order to relate to the target population as hearing protection in the military might include active/electronic hearing protection devices in order to communicate. Any and all adaptations were included with consideration to the overall length of the program as a whole. The goal was to keep the program to 50 minutes. Consequently, because of the addition of new content, it was necessary to substitute, replace, or adapt the current program content without sacrificing the previously reported efficacy of the program. The goal for adapting the program was to maintain an inquiry-based approach by keeping specific content and related activities from the original program, yet modified enough to incorporate the unique content in order to target this specific population.

Program Delivery

The Dangerous Decibels classroom program was delivered to the participants following an adapted Dangerous Decibels curriculum as described above. The program was delivered by the researcher, who is a certified Dangerous Decibels educator and also has experience working as a classroom educator. The program was scheduled during regular school hours at Edna and John W. Mosley P-8 School under the supervision of the 4th grade classroom teachers and the research team (comprised of the primary researcher, research advisor, and volunteers). The 50 minute classroom program was designed to be inquiry-based and involved interactive, hands-on activities for the participants that addressed the physics of sound, mechanisms of hearing, how loud sounds damage hearing, consequences of hearing loss, and hearing loss prevention strategies. The program addressed the following three messages: What are sources of dangerous sounds? What are consequences of exposure to dangerous sounds? How do I protect myself from dangerous sounds? The program also taught three main strategies that can be used in response to dangerous noise levels: Walk away, turn it down, and protect your ears. A standardized script was followed to ensure that program delivery was consistent. See Appendix B for an outline of the Educational Objectives.

Instrumentation

Survey Instrument

For this study, a baseline, post, and three-month follow-up survey was used to assess the knowledge, attitudes, and intended behaviors in children and children from military families related to NIHL and prevention (Griest, 2008). The surveys were developed originally as paper and pencil questionnaires by Dangerous Decibels creators in collaboration with a specialist in preventive health education. During summative evaluation of the Dangerous Decibels classroom program, pilot testing on questionnaires was conducted to evaluate clearness of questionnaire items, sensitivity to measuring change, and age-appropriateness of the questions (Griest, 2008). The Dangerous Decibels questionnaire was entered into an online survey format for this study and was built using Qualtrics software. The survey included items regarding participants' current hearing health behaviors, current exposures to loud noises, knowledge regarding the hearing mechanisms, attitudes toward hearing loss and prevention, and intended hearing health behaviors. The questions on the survey were given in different formats, including Likert scale, multiple choice, and multiple answer. Each of the three surveys had the same questions. The questions were not randomized on each survey due to the high number of questions thus reducing response bias. The lengthy amount of time between post and follow-up surveys, again, was thought to reduce response bias. The questionnaire inputted into Qualtrics was slightly modified from the original questionnaire created by the OHSU research team. Modifications, substitutions, and added questions were incorporated in order to include relevant questions related to the background of the children included in the study and to assess the military status of their parents. Although slightly modified, no extreme deviations in questions from the original questionnaire were made on the uploaded Qualtrics survey. The questions on the original questionnaires have been used previously in research with the Dangerous Decibels program and are at age-appropriate reading level for the intended program age, which is why no major deviations were incorporated (Griest, 2008). The surveys were estimated to take approximately 15 minutes to complete. Appendix C provides a sample of the survey.

Survey Administration

As online technology is a readily accessible resource, the questionnaires were delivered in an online survey format via a survey program called Qualtrics. Qualtrics is a web-based survey software tool used by universities to conduct evaluations and assessments. In a study conducted by Mangunkusumo et al. (2005), researchers found that web-based health questionnaires given to children ages 13-17 were positively evaluated and generally resulted in equal scores of health status/health behavior when compared to a pen and paper mode. For this reason, it can be assumed that online survey administration will be equally as reliable as pen and paper mode, which is how the Dangerous Decibels questionnaire is typically administered.

Baseline surveys were completed by participants on the same day as program delivery right before receiving the classroom program. Participants used individual classroom computers to complete the online survey. Immediately following delivery of the program, participants completed the post survey on their same computers. This survey was also completed online and had the same questions and the baseline survey. Participants completed a follow-up survey 3 months after program administration. This was done at the start of the following school year in the same manner as the baseline and post surveys, using individual classroom computers.

Data Collection Procedures

For collection of all surveys, each participant was assigned a subject identification number that was entered specifically for each participant on all three surveys. Course rosters with participant names were provided by the teachers to the researcher before beginning the study so that each student on the participant roster could be assigned their subject ID number. This number was entered into the survey as the first question and helped correspond responses from each participant at baseline to post and follow-up responses. The participant roster with subject IDs was destroyed after the follow-up surveys were completed. It was kept by the researcher on a password protected computer during the data collection period and was not connected to the survey responses in any way.

On the day of program delivery, teachers were instructed to have participants bring their individual classroom computers into the science lab where the study was conducted. Students accessed the baseline survey via their "Google Classroom" login. The researcher had sent each teacher the survey links to the baseline and post survey immediately before bringing students to the science lab. The teacher then uploaded the baseline and post survey links to the "Google Classroom" page where participants were able to access them. Participants were given strict instructions to follow before, during, and after survey administrations. Participants were to login to their "Google Classroom" page, click the link to the baseline survey, then go no further. Students were then given their subject ID numbers. They were instructed to carefully enter their ID number and then before moving on to the next question, have someone from the research team or their teacher ensure that the ID was properly entered. This step was implemented to make sure that each ID could later be properly matched from baseline to post and follow-up. After entering their subject ID numbers, participants were instructed to move to the next question. Each question on the survey was read aloud by the researcher to ensure that each participant understood the questions as the survey progressed. The participants followed along with the researcher and were only told to move forward on the survey once each participant had answered each question. During all data collection times, participants were supervised by the research team including the primary researcher, the research advisor, volunteers, and the 4th grade teachers. Supervision of the students was implemented to ensure that questions were answered without peer or adult input, and to clarify questions or vocabulary confusion. The research team did not provide any additional content when answering questions that might have influenced the participants' responses.

The surveys took less than fifteen minutes to complete. Responses were kept in the online software and were only accessible to the primary researcher and the research advisor. Baseline surveys were collected on the same day as program delivery but were done immediately before the program, following the above protocol. After program delivery, participants completed the post survey following the same procedures—the teacher posted the post survey link to “Google Classroom” where it was accessible to students. Participants then followed the same steps to complete the post survey. All 53 participants completed the baseline and post surveys. The three month follow-up survey was given to students upon their arrival back to school in August, following the same procedures. The participants took the follow-up survey in their newly appointed 5th grade classrooms within the first few weeks of school being back in session. Forty-one of the original 53 participants completed the follow-up survey.

Data Analysis Procedures

The items on the surveys were specifically designed to assess knowledge, attitudes, and intended behaviors of participants related to hearing health. Upon completion of the surveys, response data were summarized using the Qualtrics Survey Software in which it was created. Descriptive statistics were utilized. The Qualtrics software can generate reports detailing the number of surveys taken, the total percentages of various responses, and the time taken for each survey. The results are available for each question and for the survey as a whole and can be downloaded as response summaries. Each participant was given an assigned identifier to aid in matching results for each participant from baseline to post, baseline to follow-up, and post to follow-up surveys. Personal identifiers from each survey were only available to the researcher and were destroyed upon participant completion of the follow-up survey.

In order to analyze the survey responses for each participant over time (from baseline to post, baseline to follow-up, and post to follow-up), data responses from

Qualtrics for each survey were downloaded and exported to SPSS. All questions included in the data analysis were collapsed and coded to a 3-point Likert scale (incorrect versus correct in terms of positivity toward healthy hearing). For example, Likert-scale questions that assessed the level of agreement or disagreement were collapsed as Agree, Not sure/Don't know, and Disagree. This adjustment was utilized to increase the statistical power due to the small number of subjects in this limited-scope research study. Questions that were phrased negatively and had an answer scale weighted in the opposite direction were reverse scored. After recoding was completed, separate construct scores for knowledge, attitude, and intended behavior were created. These scores were created based on the fact that these constructs (knowledge, attitude, and intended behavior) should actually be measured as an entity, not on an individual question-by-question basis. Participants from military families were given an identifier in order to compare data between groups (military versus non-military).The three data sets (baseline data, post data, and follow-up data) were then merged together and participants were linked by their identifier in order to analyze changes over different points in time. In order to compare changes in individual participant responses at the three different time points, a repeated measures ANOVA was done on 41 of the 53 original participants because SPSS could only merge data if all three sets of data were included. Therefore, an individual samples t-test was done to compare responses between two groups (participants only present at baseline and post versus participants present at all three time points), to see if there were differences between the groups at baseline and/or at post. Based on results from the individual samples t-test, no significant differences were found between the groups. Therefore, there was no reason to assume that the 12 participants not present at follow-up had an effect on the overall scores. For this reason, only 41 participants were included in the overall analysis. These measures were chosen to evaluate whether there were significant changes in participant knowledge, attitudes, and intended behaviors after participation in the program. The long-term effectiveness of the program was evaluated by comparing the baseline and post data to the 3 month follow-up data.

Data Handling Procedures

Data collected online was stored on the Qualtrics server and was only accessible to the primary researcher and the research advisor. Qualtrics reports were downloaded and summary data was stored on the researcher's personal laptop computer, which is password-protected. All consent forms were stored in a locked laboratory (Gunter Hall 010) file cabinet and were only accessible to the primary researcher and the research advisor. All survey data with personal identifiers was destroyed upon completion of the follow-up survey and final data collection.

CHAPTER IV

RESULTS

Study Participants

Fifty-three children were recruited for participation in the Dangerous Decibels classroom program. Participants were recruited from four 4th grade classrooms from a large, diverse, community with a strong military presence due to the proximity of a military base within 5 miles. Participants were grouped as either military or non-military based on the military status of their parent(s)/guardian. Twenty-one percent (n=11) of the children were from military families and 79% (n=42) were from non-military families. For program delivery, as well as baseline and post survey, participants were combined within their usual 4th grade classroom. Four separate small group presentations of the Dangerous Decibels classroom program were delivered over the course of two days. Each of the four groups consisted of at least 10 participants which maintained the interactive component of the program. The classroom teacher accompanied each group of participants throughout the duration of the program and data collection.

Baseline and post program delivery surveys were completed by all 53 participants. Forty one (77.3%) of the original 53 participants completed the 3 month follow-up survey. For follow-up data collection, the participants had advanced to 5th grade and were reassigned to one of three 5th grade teachers. Therefore, final data collection was done with participants in three separate classrooms. Twelve participants did not complete the follow-up survey (three out of the original 11 military and nine of the original 42 non-military). The 12 participants lost at follow-up were not enrolled at the school for 5th grade. Service members are often relocated and move frequently and this was thought to contribute to the absence of the three military children.

Participant age, gender, and ethnicity are summarized in Table 1 and are categorized by military versus non-military status.

Table 1

Demographics (%) reported from baseline surveys (n = 53).

	Military (%) *n = 11*	Non-military (%) *n = 42*	Total (%) *n = 53*
Gender			
Male	55	62	60
Female	45	38	40
Self-reported ethnic/racial background			
Hispanic/Latino	18	50	43
American Indian, Eskimo, Aleutian	0	2	2
White	36	14	19
Asian or Pacific Island	0	2	2
Black/African American	9	19	17
Not sure	36	12	17
Age			
9	18	41	36
10	82	59	64

Participation in Noisy Activities

Figure 1 summarizes the student's self-reported participation in noisy activities experienced during the past year reported at baseline and 3 month follow-up. Greater than 50% of participants reported potentially hazardous noise exposure related to use of personal headphones, setting off fireworks, or going to a concert or loud sporting event. Exposure to fireworks increased from 65% at baseline to 73% at follow-up which is most likely due to the 4^{th} of July holiday occurring over summer break. More than 30% reported noise exposure at either baseline or follow-up from riding on a tractor or other farm equipment, riding on a jet-ski, four-wheeler, snowmobile, or motorcycle, as well as from firing a gun, using a lawnmower, or going to a tractor pull, monster truck show, or motorcycle/car/truck race. The noisy activity reported by almost all participants was use of personal headphones (94% at baseline, 93% at follow-up). The activities with the lowest percentages of self-reported noise exposures were going to air shows or air races (17% at follow-up), playing in a musical band (17% at follow-up), and going to loud military events, or riding in loud military vehicles (21% at baseline).

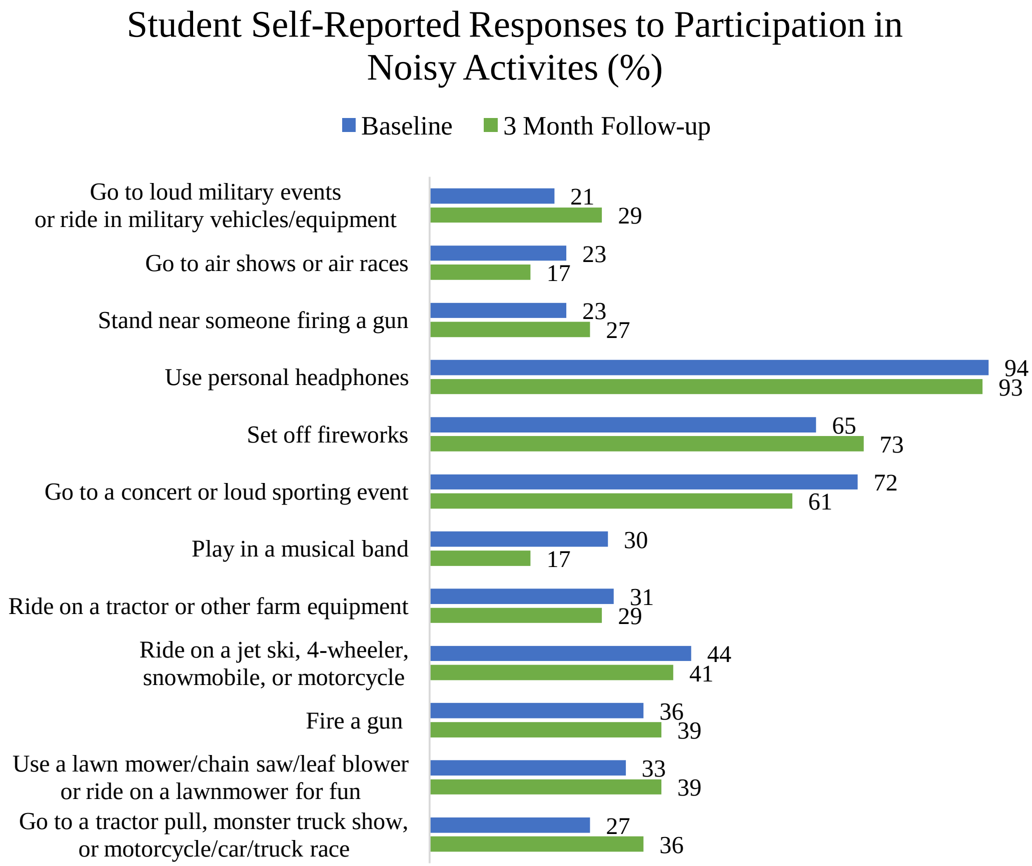


Figure 1. Cumulative self-reported participation in noisy activities experienced by participants during the past year as reported at baseline and at 3 month follow-up.

Participants also answered the question, "During the past year, have you been around loud sound that made your ears hurt?" While the type of noisy activity that made their ears hurt was not specified for this question, 47% of participants responded 'Yes', 34% of participants responded 'No', and 19% of participants responded 'Not sure' at baseline. For the question related to participants experiencing "ringing in their ears" in the past year right after hearing a loud sound, 43.4% said 'Yes, 26.4% said 'No', and 30.2% said 'Not sure'.

Hearing Protective Strategies and Actions

The survey instrument included questions related to the participants' self-reported hearing protective strategies, as well as inquiries related to their observations of strategies taken by adults around them to protect their hearing. Figure 2 summarizes the reported behaviors to the questions, "If YOU go target shooting/hunting/to loud military events, how often do you wear earplugs or earmuffs" for participants reporting doing these activities. Over 60% of participants reported having never participated in these types of activities, and therefore have not had the opportunity or the need to wear earplugs or earmuffs for the three activities specified. However, for the children who did participate in these activities, 44% (target shooting), 18% (hunting), and 11% (military events) reported always or most of the time using hearing protection.

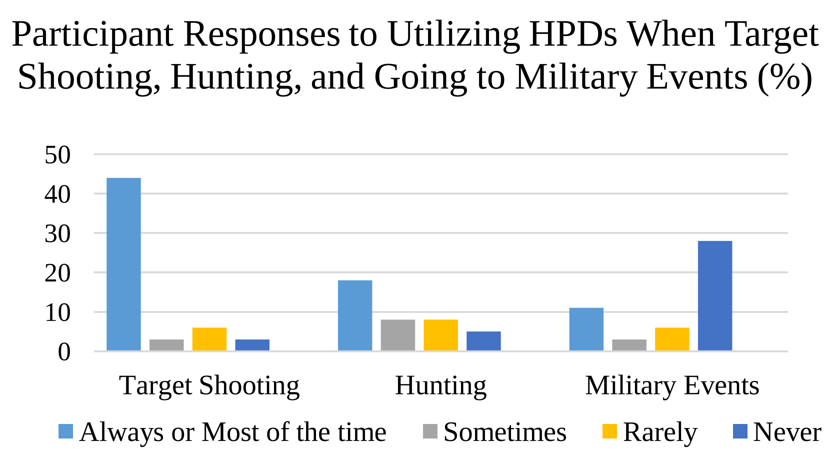


Figure 2. Percent of participant responses at baseline to, "If YOU go target shooting/hunting/to loud military events, how often do you wear earplugs or earmuffs" for participants who participated in the three activities.

The participants were asked about their intention to utilize hearing protection when in particular situations where hearing protection use would be indicated. A high percentage of participants (74% at baseline, 76% at follow-up) said that if they were around someone firing a gun, they would use hearing protection. The majority of participants at both baseline (85%) and follow-up (88%) indicated that they would use HPDs if they were firing a gun while target shooting. A high percentage (74-83%) at baseline and follow-up respectively, reported that if they were at an air show/air race they would use hearing protection. When asked about the types of hearing protection strategies participants have tried in the past year, at baseline, 66% tried turning down the volume (73% at follow-up), 42% used earplugs (51% at follow-up), 53% walked away (68% at follow-up), and 43% used earmuffs (46% at follow-up). Five participants did not try any of the above strategies, and six participants said they were not around loud sound.

Of the questions regarding adults' behavior and use of hearing protection, at baseline, 24.5% of participants said their mom or dad uses hearing protection when doing noisy activities, and 50% said that when target shooting, the adults around them always wear hearing protection. Overall, 66% of participants at baseline said they know what they need to do to protect their hearing. This percentage increased to 98% after receiving the Dangerous Decibels program. At follow-up, participant responses remained similar with 95% of participants continuing to report they know what to do to protect their hearing. Figure 3 illustrates these changes between the three time points and shows that participant attitudes toward this questions were maintained at 3 month follow-up.

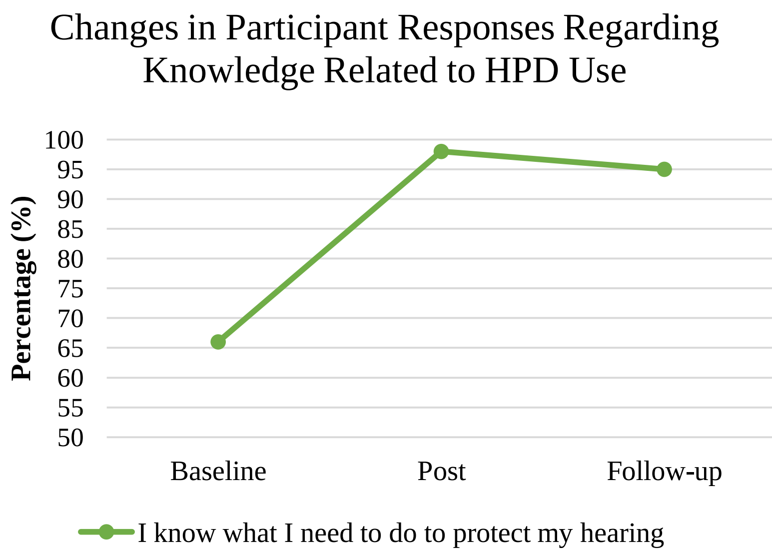


Figure 3. Percent of participant responses to the statement, “I know what I need to do to protect my hearing.”

Dangerous Decibels Program Intervention Outcomes

Knowledge

The Dangerous Decibels surveys included items that addressed participant knowledge related to hearing loss prevention and NIHL. Table 2 summarizes the knowledge questions by group, time point, and percent correct.

Table 2

Percent correct for survey questions categorized by knowledge.

		Baseline (%)		Post (%)		Follow-up (%)	
#	**Knowledge Questions**	Non-military (*n* = 42)	Military (*n* = 11)	Non-military (*n* = 42)	Military (*n* = 11)	Non-military (*n* = 33)	Military (*n* = 8)
2.7	Which of the following types of sounds can be loud enough to damage your hearing?						
2.7_A	Personal headphones with a music player	40.5	45.5	69.0	72.7	57.6	87.5
2.7_B	Concert	50.0	54.5	83.3	81.8	60.6	87.5
2.7_C	Washing machine	81.0	100.0	88.1	100.0	87.9	100.0
2.7_D	Paper rustling	92.9	90.9	95.2	90.9	87.9	100.0
2.7_E	Fireworks	54.8	63.6	92.9	100.0	72.7	100.0
2.7_F	Sporting event	42.9	45.5	83.3	90.9	72.7	87.5
2.7_G	Jet Plane (flying overhead)	71.4	90.9	88.1	100.0	72.7	100.0
2.7_H	Normal conversation	97.6	90.9	97.6	100.0	97.0	100.0
2.7_I	Rifle	66.7	81.8	90.5	90.9	69.7	87.5
2.10	Which of the following are good ways to protect your hearing when you are around loud sounds?						
2.10_A	Walk away from the sound	78.6	54.5	100.0	100.0	87.9	87.5
2.10_B	Use earplugs or earmuffs	73.8	100.0	100.0	100.0	84.8	100.0
2.10_C	Turn down the volume	64.3	27.3	92.9	100.0	81.8	50.0
2.10_D	Wear a sweatshirt or coat with the hood	69.0	100.0	92.9	100.0	90.9	100.0
2.10_E	Put cotton balls or Kleenex in your ears	85.7	90.9	100.0	100.0	97.0	100.0
2.10_F	Listen to music with headphones to block out loud noise	71.4	81.8	85.7	81.8	87.9	62.5
2.11	Have YOU ever heard of electronic hearing protection?	16.7	27.3	81.0	90.9	48.5	37.5
2.12	Hearing an extremely loud sound even one time can cause you to lose some of your hearing.	47.6	63.6	92.9	100.0	69.7	87.5
2.13	Sound that is too loud can damage the tiny hair cells of the inner ear (cochlea).	45.2	36.4	95.2	100.0	87.9	100.0
2.14	Being around loud sounds a lot will help your ears get used to it and protect your hearing.	57.1	54.5	90.5	100.0	57.6	75.0
2.20	I know what kind of hearing protection is best for shooting sports and/or military members.	28.6	90.9	90.5	100.0	63.6	75.0

Table 2, continued:

#	**Knowledge Questions**	Baseline (%) Non-military (*n* = 42)	Baseline (%) Military (*n* = 11)	Post (%) Non-military (*n* = 42)	Post (%) Military (*n* = 11)	Follow-Up (%) Non-military (*n* = 33)	Follow-Up (%) Military (*n* = 8)
2.22	If my hearing is damaged, I might hear ringing in my ears all the time.	40.5	63.6	69.0	63.6	45.5	25.0
2.23	People in the military are able to use special hearing protection that lets them talk to each other and hear important sounds.	33.3	72.7	95.2	100.0	66.7	75.0
2.25	The more time I spend around loud sound without hearing protection, the worse my hearing will be.	73.8	81.8	97.6	100.0	90.9	100.0
2.26	I know where to get earplugs or earmuffs or who to ask for some.	57.1	63.6	97.6	81.8	72.7	75.0
2.28	If my hearing is damaged, I might not be able to fly an airplane, join the military, or get the job I want when I am old enough.	45.2	36.4	71.4	63.6	54.5	100.0
2.29	I DO NOT know when I should use earplugs to be safe from loud sounds.	57.1	63.6	88.1	100.0	54.5	62.5
2.30	Having good hearing is important for safety, equipment and vehicle operation, and talking with people.	81.0	81.8	97.6	90.9	63.6	87.5
2.32	It is okay to shoot one time without hearing protection on and my hearing will not be damaged.	28.6	45.5	90.5	90.9	51.5	75.0
2.33	If my hearing is damaged, it will be hard to understand people talking to me.	76.2	100.0	92.9	100.0	87.9	100.0
	Subtotal of Knowledge for Groups Combined	61.5		90.6		75.3	

Note: Red font denotes 100% correct scores

The majority of the differences that stand out occurred for the knowledge section. For the question of which types of sound can be loud enough to damage your ears, the military group had more correct responses for all noise sources. Specifically, for a jet plane flying overhead, 90.9% of military participants knew this sound was loud enough to damage their hearing at baseline, compared to 71.4% of the non-military participants. (It is worth noting that for this particular school and air base, the planes fly overhead at low altitude and at high sound pressure levels). This trend was maintained at post and follow-up with the military group reaching 100% at post and follow-up compared to 88.1% and 77.2%, respectively for the non-military group at post and follow-up. When asked if participants knew what kind of hearing protection is best for shooting sports/military members, 90.9% of the military population reported yes at baseline compared to 28.6% of the non-military population. Responses to the question, "People in the military are able to use special hearing protection that lets them talk to each other and hear important sounds," indicated that the military group had higher initial knowledge at baseline with 72.7% correct compared to the non-military group at 33.3% correct. At follow-up, 100% of the military population knew that if their hearing was damaged, they might not be able to fly an airplane, join the military, or get the job they want when they are old enough, whereas only 54.5% of participants in the non-military population reported this statement as correct. The military population scored 100% at all three time points and knew that if their hearing is damaged, it will be hard to understand people talking to them. This is compared to the 76.2% of non-military participants at baseline, 92.9% at post, and 87.9% at follow-up. For the behavior question regarding what to do to protect their hearing, the military group scored 90.9% correct at baseline compared to the non-military group at 59.5% correct.

Attitude

Questions pertaining to attitude are summarized in Table 3, which includes the descriptive statistics of percent correct for all attitude questions on the survey.

Table 3

Percent correct for survey questions categorized by attitude.

		Baseline (%)		Post (%)		Follow-up (%)	
#	**Attitude Questions**	Non-military (*n = 42*)	Military (*n = 11*)	Non-military (*n = 42*)	Military (*n = 11*)	Non-military (*n = 33*)	Military (*n = 8*)
2.15	Wearing earplugs around your friends (when no one else is wearing them) would be:	50.0	45.5	71.4	54.5	60.6	75.0
2.21	Earplugs are hard to put in my ears.	38.1	63.6	76.2	81.8	57.6	75.0
2.24	My hearing will stay healthy because I protect it.	81.0	72.7	95.2	100.0	81.8	100.0
2.27	I would encourage my friends to use hearing protection when they are around loud sounds.	78.6	72.7	92.9	81.8	78.8	87.5
	Subtotal of Attitude for Groups Combined	62.3		83.0		72.6	

Note: Red font denotes 100% correct scores

Intended Behavior

The surveys also included items related to participant intended behaviors. A summary of intended behavior questions can be found in Table 4, which also includes the percent correct for all behavior questions.

Table 4

Percent correct for survey questions categorized by intended behavior.

		Baseline (%)		Post (%)		Follow-up (%)	
#	**Intended Behavior Questions**	Non-military (*n = 42*)	Military (*n = 11*)	Non-military (*n = 42*)	Military (*n = 11*)	Non-military (*n = 33*)	Military (*n = 8*)
2.3	I know what I need to do to protect my hearing.	59.5	90.9	97.6	100.0	93.9	100.0
2.4	If YOU go target shooting, how often do YOU wear earplugs or earmuffs?	-	-	-	-	-	-
2.5	If YOU go hunting, how often do YOU wear earplugs or earmuffs?	-	-	-	-	-	-
2.6	If YOU are at loud military events, how often do YOU wear earplugs or earmuffs?	-	-	-	-	-	-
2.16	If YOU were firing a gun while target shooting would YOU use hearing protection?	85.7	81.8	92.9	81.8	87.9	87.5
2.19	If YOU were around somebody firing a gun, would YOU use hearing protection?	85.7	81.8	97.6	81.8	90.9	87.5
2.31	If YOU were at an airshow/air race and around engine noise, would you wear hearing protection?	73.8	81.8	97.6	81.8	81.8	87.5
	Subtotal of Intended Behavior for Groups Combined	77.8		94.3		89.0	

Note: Red font denotes 100% correct scores

Differences between Military and Non-Military Youth

Baseline, post, and follow-up results between children from military families and those from non-military families are presented in Table 5. Using an independent samples *t-test* to compare the means of the two groups (military versus non-military) across the different constructs and the 3 time points, no significant differences were found between the two groups between any constructs at any time. Because multiple tests were run, a

Bonferroni correction was applied to alpha. After the correction, statistical significance was determined using an alpha of $p < .005$. However, even without the Bonferroni correction using an alpha of $p < .05$, statistical significance was not met. Because there were no significant differences between the two groups on any outcome measures at any of the time points, children from military families should be considered no different than the non-military population. For instance, if growth of knowledge for the entire study population from baseline to post is measured, it should be assumed that both populations (military and non-military) are behaving with similar growth trajectories. For this reason, when running the repeated measures ANOVA, a fixed military factor was not included, and therefore, the two groups will not be discussed separately when analyzing the overall outcomes of the program beyond this point.

Table 5

Statistical summary for individual t-tests comparing the means between children from military families and non-military families.

Knowledge	N	Group	Mean	Std. Deviation	Significance *(p< .005)*
Baseline	11	Military	72.5	7.5	.064
	42	Non	68.3	6.1	
Post	11	Military	83.5	3.2	.449
	42	Non	82.1	5.4	
Follow-up	8	Military	79.8	5.7	.117
	33	Non	74.8	8.3	
Attitude					
Baseline	11	Military	9.9	1.2	.928
	42	Non	10.0	1.4	
Post	11	Military	11.0	0.8	.957
	42	Non	11.0	1.4	
Follow-up	8	Military	11.1	1.1	.219
	33	Non	10.4	1.5	
Intended Behavior					
Baseline	11	Military	10.7	2.4	.984
	42	Non	10.7	1.7	
Post	11	Military	11.5	1.0	.157
	42	Non	11.8	0.6	
Follow-up	8	Military	11.6	1.0	.594
	33	Non	11.4	1.3	

Changes in Knowledge

Changes in knowledge were analyzed using a repeated measures ANOVA. In order to analyze all of the knowledge questions as a whole construct, all responses to the knowledge questions were combined to create a total score. As mentioned in Chapter 3, the knowledge questions were all collapsed to a 3-point Likert scale due to the small n. Therefore, with 29 knowledge questions, the minimum score possible could have been a 29 and the maximum score an 87. The higher the score, the more accurate the hearing health knowledge base. The construct score for knowledge was analyzed in the ANOVA across all three time points.

There were 41 participant responses included in the repeated measures ANOVA in order to analyze changes in knowledge. Twelve participants were not present at the final data collection time point. However, it was concluded using an independent samples *t*-test that there were no significant differences between the participants that were present at baseline and post compared to those present for all three data collections. Therefore, it can be assumed that the participants who were not present at follow-up would not behave any differently and further would not have affected the overall findings other than increasing the power for achieving statistical significance.

The analyses indicate that the mean scores for knowledge at baseline (68.6 ±6.7) post (81.9 ±5.1), and 3 month follow-up (75.7 ±8.1) were significantly different at $p < .05$. Specifically, there was a significant difference in knowledge between baseline and post ($p < .05$) indicating that knowledge scores improved, evidenced by an increase in the mean score. There was also a significant difference in knowledge between baseline and follow-up ($p < .05$) indicating that knowledge scores improved between these two time points, evidenced by an increase in the mean score. Finally, there was a significant difference in knowledge between post and follow-up ($p < .05$). A summary of these results can be found in Table 6.

Table 6

Statistical significance for knowledge questions across the three time points.

Knowledge		N	Mean	Std. Deviation	Significance
Baseline		41	68.6	6.7	-
	Post	41	81.9	5.1	<.001*
	Follow-up	41	75.7	8.1	<.001*
Post		41	81.9	5.1	-
	Follow-up	41	75.7	8.1	<.001*

*$p < .05$

Although results indicate less improvement in knowledge from post to follow-up compared to from baseline to post, the follow-up mean is still higher than the mean at baseline. This indicates that although knowledge was not fully maintained from post to follow-up, knowledge still improved from baseline to follow-up. Therefore, we can conclude that the program was effective in changing knowledge and students maintained that knowledge when re-evaluated 3 months after delivery of the Dangerous Decibels program.

Changes in Attitude

Changes in attitude were analyzed using a repeated measures ANOVA. Like the knowledge questions, attitude was measured as a whole construct by combining all responses to the attitude questions to create a total score. With four attitude questions, the minimum possible score could have been a four with a possible maximum of 12. Higher scores reflect more positive hearing health attitude. A statistical summary for the attitude questions can be found in Table 7.

There were 41 participant responses included in the repeated measures ANOVA in order to analyze changes in attitude for the same reasons mentioned above. Twelve participants were not present at the final data collection time point. The results indicate that the mean scores for attitude at baseline (10.0 ±1.4) and post (10.9 ±1.4), and baseline and 3 month follow-up (10.6 ±1.4) were significantly different ($p < .05$). Specifically, there was a significant difference in attitude scores between baseline and post ($p < .05$) indicating that attitude scores improved, evidenced by an increase in the mean score. There was also a significant difference in attitude scores between baseline and follow-up ($p < .05$) indicating that attitude scores improved between these two time points, evidenced by an increase in the mean score. Finally, there was no significant difference in attitude scores between post and follow- up. Because there was no significant difference between these two time points, it can be determined that participants maintained a positive attitude toward hearing health and hearing loss prevention through the 3 months following post data collection. Therefore, we can conclude that the program was effective in changing attitude and maintaining participant attitudes 3 months after delivery of the Dangerous Decibels program.

Table 7

Statistical significance for attitude questions across the three time points.

Attitude		N	Mean	Std. Deviation	Significance
Baseline		41	10.0	1.4	-
	Post	41	10.9	1.4	.001*
	Follow-up	41	10.6	1.4	.042*
Post		41	10.9	1.4	-
	Follow-up	41	10.6	1.4	.726

*$p < .05$

Changes in Behavior

Intended behavior questions were also analyzed using a repeated measures ANOVA, and like knowledge and attitude questions, were measured as a whole construct rather than question-by-question. Similar to the attitude construct, four intended behavior questions would yield scores between 4 and 12. Again, a higher score indicates positive intended behaviors for hearing health. A statistical summary for the intended behavior questions can be found in Table 8.

There were 41 participant responses included in the repeated measures ANOVA in order to analyze changes in intended behavior. Twelve participants were not present at the final data collection time point. The results indicate that the mean scores for intended behavior at baseline (10.6 ±2.0) and post (11.7 ±0.8), and baseline and 3 month follow-up (11.4 ±1.2) were significantly different ($p < .05$). Specifically, there was a significant difference in intended behavior scores between baseline and post ($p < .05$) indicating that intended behavior scores improved, evidenced by an increase in the mean score. There was also a significant difference in intended behavior scores between baseline and follow-up ($p < .05$) indicating that intended behavior scores improved between these two time points, evidenced by an increase in the mean score. Finally, there was no significant difference in intended behavior between post and follow- up measures. Because there was no significant difference between these two time points, it can be determined that participants sustained higher scores at follow-up indicating that participants maintained their intended behaviors to utilize hearing protection through the 3 months following program delivery. Therefore, we can conclude that the program was effective in changing intended behaviors and maintaining those intended behaviors 3 months after delivery of the Dangerous Decibels program.

Table 8

Statistical significance for intended behavior questions across the three time points.

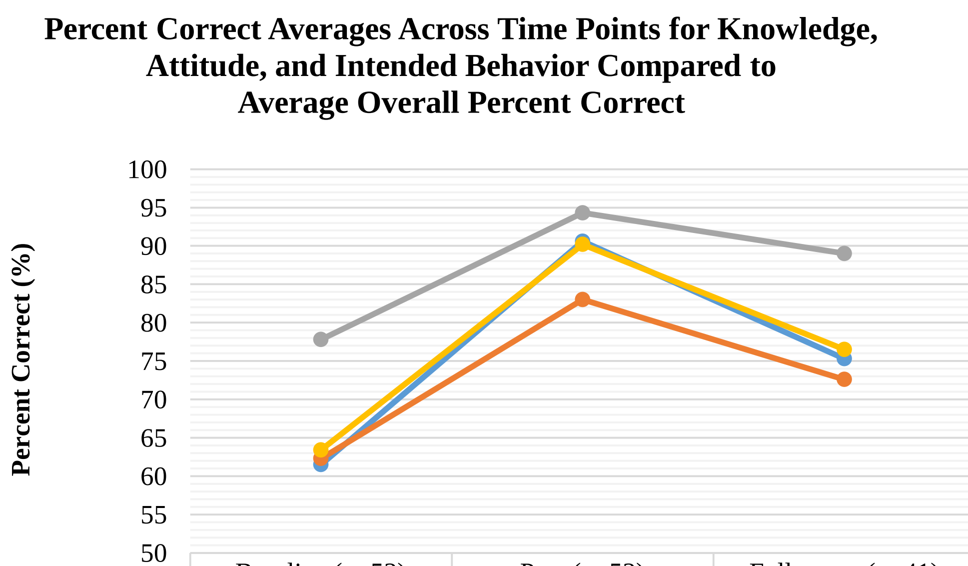
Intended Behavior		N	Mean	Std. Deviation	Significance
Baseline		41	10.6	2.0	-
	Post	41	11.7	0.8	<.001*
	Follow-up	41	11.4	1.2	.026*
Post		41	11.7	0.8	-
	Follow-up	41	11.4	1.2	.368

*$p < .05$

Overall Changes in the Dangerous Decibels Program Effectiveness Across Time Points

An overall survey score was created by combining all responses to knowledge, attitude, and intended behavior questions to get an overall score measuring the Dangerous Decibels program effectiveness. With a total of 37 questions included in the analysis, the minimum possible score could have been 37 with a possible maximum score of 111. Therefore, a higher score indicates more effectiveness of the program across all constructs. A post-hoc *t*-test was used to analyze cumulative changes in scores from baseline to post, post to follow-up, and baseline to follow-up. Results from the post-hoc analysis indicate that there were statistically significant differences between the means from baseline (89.8 ±8.1) to post (105.2 ±6.1), baseline (89.2 ±8.5) to follow-up (97.7 ±9.1), and post (104.5 ±6.3) to follow-up (97.7 ±9.1), all reaching significance with $p < .05$. From these results, it can be concluded that overall scores of combined knowledge, attitude, and intended behavior constructs were significantly different at all three time points. More specifically, the average score for baseline improved at post and at follow-up. Although the average score improved less from baseline to follow-up compared to from baseline to post, the follow-up score was still significantly higher than the average score at baseline. Therefore, it can be concluded that the Dangerous Decibels program was effective.

Average percentages for the raw scores of percent correct for knowledge, attitude, and intended behavior questions were also calculated in order to compare changes in each of the individual constructs as compared to the survey as a whole at the three time points. By using the raw scores from the descriptive statistics to find the percent correct for each question by group, a subtotal score was calculated for knowledge, attitude, and intended behavior. The subtotal for each construct at baseline, then post, then follow-up were then summed together to create an overall percent correct average for the survey questions combined at the three different time points. These subtotals can be found in Tables 2, 3, and 4 (see above). Figure 4 illustrates the percent correct changes in constructs at the three time points compared to the overall percent correct changes from baseline to post to follow-up.



	Baseline (n=53)	Post (n=53)	Follow-up (n=41)
Knowledge	61.5	90.6	75.3
Attitude	62.3	83	72.6
Intended Behavior	77.8	94.3	89
Overall Average	63.4	90.2	76.5

Figure 4. Percent correct averages for each construct, calculated by averaging the responses to get a calculated percent correct average for knowledge, attitude, and intended behavior at baseline, post, and 3 month follow-up compared to the combined overall percent correct average for the survey questions combined.

The subtotal of percent correct for knowledge questions at baseline was 61.5%. This increased to 90.6% at post and 75.3% at follow-up. It can be concluded that although the subtotaled percent correct score for knowledge was not maintained from post to follow-up, the follow-up percentage was still higher than at baseline. The same trend was evident for attitude with an average starting percent correct of 62.3% which increased to 83% at post and 72.6% at follow-up. The intended behaviors subtotal followed suit starting at a percent correct of 77.8% at baseline increasing to 94.3% at post, and then 89% at follow-up. These similar patterns indicate that the program was effective in improving knowledge, attitude, and intended behavior related to hearing health and hearing loss prevention and are in agreement with trends found from the repeated measures ANOVA.

Results Summary

Although there were no significant differences between the children from military families and those not from military families, there were some responses to individual questions that differed when considering the two experimental groups. As might be expected, children from the military group tended to have more initial knowledge on the military related questions. Because there were no significant differences between the groups, the entire study population was analyzed as a whole in order to conclude if the Dangerous Decibels program was effective in changing knowledge, attitudes, and intended behaviors related to hearing health and hearing loss prevention in the study population of 4th graders. Statistical significance for knowledge ($p<.05$) was evident from baseline to post and baseline to follow-up, as well as from post to follow-up. However, the difference between post and follow-up was a decrease in knowledge.

Although not maintained at follow-up, knowledge was still higher than initially at baseline. Statistical significance ($p < .05$) was found between baseline and post and baseline and follow-up for both attitude and intended behavior constructs. Unlike knowledge, there were not significant differences between post and follow-up indicating that higher scores for attitude and intended behaviors were maintained 3 months following program delivery. Further, there were significant improvements in overall survey scores used to measure the overall effectiveness of the Dangerous Decibels program as a whole from baseline to post, post to follow-up, and baseline to follow-up. These same findings were evident in the raw score percent correct averages for the survey as a whole. These results suggest that the Dangerous Decibels program is in fact effective in improving knowledge, attitudes, and intended behaviors related to hearing health and hearing loss prevention in 4^{th} grade students attending a school near a military base.

CHAPTER V

DISCUSSION AND CONCLUSION

The purpose of this study was to measure the effectiveness of the Dangerous Decibels hearing loss prevention program in children from military families in hopes of educationally targeting children who may be more likely to join the military in the future than other children. The program was also presented to children who are not from military families in order to compare the outcomes between the two populations and the overall outcomes as a whole group. Through the use of pre, post, and follow-up surveys, the effectiveness of the Dangerous Decibels program on changing knowledge, attitudes, and intended behaviors related to hearing health was measured within and across the two groups.

Informal Observations

During each Dangerous Decibels presentation, children from all four classrooms were engaged and interacting. Many students wanted to give their input about the prior knowledge they had related to sound and hearing loss while others had additional questions besides those included in the program. Their eagerness to learn was very apparent throughout the duration of the program. However, there was a noticeable difference between the behaviors of the participants in the morning sessions versus the afternoon sessions. The children from the morning sessions were more alert and awake, whereas those in the afternoon sessions seemed slightly sluggish, yet still excited. For future dissemination of the program, it might be wise to consider doing the classroom program in the morning versus the afternoon if there is a choice of times.

Activities and Actions

Noise Exposure

When considering the types of noisy activities specified in the survey, it becomes evident that many children did not participate in many of the noisy activities listed. Upon completion of the Dangerous Decibels program, the researcher took it upon herself to ask the question, “What other types of noise are you exposed to regularly?” This question was asked in order to consider other types of noisy activities that might be more relevant to children at this age/in this area and further be integrated into the lessons taught. Responses included roller coasters, the cafeteria, the gym, field day, a movie theater, go karting, riding on the school bus, and carnivals. If these types of noise sources were included in the survey, many children may have reported more exposure to noisy activities than were reported in the current research findings. This should be taken into consideration if there are to be any adaptations or changes done to the overall program or perhaps revisions done to the questions regarding noisy activities for future program evaluations.

Hearing Protection Device Use

As reported in the results, over 60% of participants reported never having participated in target shooting, hunting, or loud military events. This finding is slightly higher than the 49% (n=4496) of 9-10 year olds who reported “never” using hearing protection while participating in a research study conducted during a visit to the Dangerous Decibels museum exhibit at the Oregon Museum of Science and Industry

(Dangerous Decibels, 2016). This also brought the percentage down for the number of participants reporting the use of HPDs because they simply have not been in a situation to wear them. In the future, it might be worth inserting an open-ended question on the survey asking children to describe a time or event that they utilized earplugs or earmuffs or where they might utilize earplugs or earmuffs in the future so as to not limit the extension of the intended behavior.

A study done by Stewart, Meinke, Snyders, and Howerton (2014) also reported on the use of HPDs when participating in target shooting and/or hunting. Researchers found that participants indicated inconsistent use of HPDs for both activities and were less likely to use HPDs for hunting when compared to target shooting. A similar trend was found in the current study with more participants reporting the use of HPDs more often and more consistently when target shooting compared to hunting. Stewart et al. also found that 26% of participants reported knowing about the existence of electronic hearing protection (2014). This is somewhat similar to the 19% of participants reporting knowing about electronic hearing protection in the current study. Wise (2016) also reported on use of HPDs in youth when target shooting and hunting. Findings from this study were higher for the percentage of youth reporting always or usually using HPDs when target shooting (68.4%) compared to 44% in the current study. Wise (2016) also found a higher percentage (47.4%) of participants, compared to 18% in the current study, reported the use of HPDs when hunting. This could be due to the Wise (2016) study population which intentionally consisted of youth recreational firearm users and the associated likelihood of these youth being more likely to utilize firearms for target shooting and hunting as opposed to a general population of youth.

Dangerous Decibels Intervention Outcomes

Differences Between Children from Military Families and Children from Non-military Families

Given the research done by Faris (1981) and Stander and Merrill (2000), children who had a parent in the military were twice as likely to join the military as their civilian counterparts. Therefore, it was suggested that having a family military background encouraged these children to serve in the future, whereas first generation recruits were highly influenced by fluctuations in economic and employment trends. These findings support the assumption that children from military families might be more likely to lead a military life. Further, hearing loss and tinnitus are common injuries among veterans, and therefore, there is a logical rationale to target this population early and educate this group of children about the importance of hearing health and hearing loss prevention. It was hypothesized that children from military families would have differing initial knowledge related to hearing health behaviors. They might know more about sources of dangerous sounds, how to protect their hearing, and possibly more knowledge related to hearing protective actions and strategies due to differing experiences relating to parental and military influences.

This influence was not confirmed. There were no significant differences between the group of military children and non-military children. Low statistical power and a small sample size likely contributed to this inability to detect differences between these two populations of youth. This study was pilot student research and a small convenience sample had to be used with only access to schools near one military base and there was a limited amount of time to recruit participants and execute the study within school calendar timelines. Therefore, a small sample size in each group limited the statistical power. Additionally, the analysis technique may have decreased the ability to detect differences. By collapsing the questions and categorizing them by construct averages, a strong difference in one question may have been diluted by other questions with minimal response differences. If doing a question by question analysis, there were a few questions that, based on percent correct, may have shown significance. The following are a few examples. For the question related to knowing what kind of hearing protection is best for shooting sports/military members, 90.9% of the military population reported yes at baseline compared to 28.6% of the non-military population. Next, the military group had higher initial knowledge at baseline with 72.7% correct compared to the non-military group at 33.3% correct for the question regarding people in the military being able to use special hearing protection that lets them talk to each other and hear important sounds. Also, for the behavior question regarding what to do to protect their hearing, the military group scored 90.9% correct at baseline compared to the non-military group at 59.5% correct. Finally, on the question related to noise exposure, of the 21% of participants reporting they had gone to military events or rode in military vehicles/equipment, military participants made up 82% of this total (nine out of 11). Based on these observations, there is a chance that if the questions were analyzed individually, significant differences between the two groups may have been revealed.

Knowledge, Attitude, and Intended Behavior Outcomes

There were sixteen knowledge questions, four attitude questions, and four behavior questions on the survey used to assess changes in participants' knowledge, attitudes, and intended behaviors related to hearing health and hearing loss prevention. As stated previously, all of the questions related to each construct were grouped and analyzed categorically. Then, all of the survey questions relating to each of the three constructs were combined and analyzed to measure overall effectiveness of the Dangerous Decibels progam. Outcomes for each type of analysis follow similar trends over time. There were increases in knowledge, attitudes, and intended behavior from baseline to post, and smaller increases in knowledge from baseline to follow-up but follow-up scores remained higher than initially at baseline.

From the subtotaled averages for percent correct responses using the raw data, there was an increase of 29.1% in knowledge from baseline to post, and a smaller 13.8% increase from baseline to follow-up. Griest (2008) showed similar results related to increases in knowledge from baseline to post-intervention. Fourth and 7^{th} graders in that study showed improvement across all knowledge items ranging from a 10-52% increase in correct responses. In the current study, attitude and intended behavior questions followed suit with a 20% increase in attitudes from baseline to post, and a smaller 10.3% increase from baseline to follow-up and a 16.5% increase in intended behavior from baseline to post, and a smaller 11.2% increase from baseline to follow-up. Griest (2008) found improvement in correct responses for attitude ranging from 13-23%. Seventh graders improved on intended behavior responses from baseline to post by 29%, however this increase was not maintained at 3 month follow-up.

When the subtotaled averages for each construct were combined to create an average percent correct value for the survey as a whole at each time point, results were similar to the trends seen for the subtotaled averages. From baseline to post, knowledge increased by 26.8% and from baseline to follow-up there was a lower increase of only

13.1%. The post-hoc *t-test* analysis of the survey used to measure overall effectiveness of the program revealed similar findings. There was an increase in the mean score of 15.4 from baseline to post and then only an 8.5 mean increase in the score from baseline to follow-up. Due to the fact that other related studies have not used this type of analysis to results from the current study cannot be compared elsewhere.

Analysis of each construct individually using the ANOVA indicates that the knowledge construct followed the same pattern as discussed above, however, positive attitudes and intended behavior constructs were actually maintained at 3 month follow-up. This trend was similar to results from a study done by Griest et al. (2007). Researchers found that in a population of 4^{th} graders, on all but one of the knowledge questions included in their study there was an increase from baseline to post and a smaller increase from baseline to follow-up. They also found that 4^{th} graders showed an increase in positive attitudes from baseline to post and then maintained those positive attitudes at 3 month follow-up. However, 7^{th} graders included in the study did not maintain their positive attitudes and intended behaviors at 3 month follow-up.

Griest et al. (2007) suggests that the greatest issue in health education for youth is getting them to change their high-risk behaviors. It is also worth reiterating, based on health communication science, youth need to believe that they are at risk. This thinking follows health behavior science theories which have been implemented into the Dangerous Decibels curriculum. One needs to believe that they are susceptible to NIHL, that there are consequences of being exposed to loud noise, and that there are strategies that can be used to prevent NIHL. The Dangerous Decibels program effectively covers all of these principles and has effectively demonstrated that youth are capable of changing their behaviors, as evidenced by the current research findings.

Need for Educational Programs to Address Noise-Induced Hearing Loss in Children and the Military

The results from the current study reinforce the need for evidence-based educational programs to address the current and growing issue of NIHL in today's youth. After program delivery, there were significant changes in knowledge, attitudes, and intended behaviors related to hearing health and hearing loss prevention in this small sample of 4^{th} graders. As stated previously, approximately 5.2 million children between the ages of 6-19 have suffered from permanent hearing damage due to exposure to loud noises (Niskar et al., 2001). However, noise exposure can cause hearing loss in adults, teenagers, and unique populations such as the military. Disabilities of the auditory system, including hearing loss and tinnitus, are the third most common injury experienced by veterans (Helfer et al., 2010). Significant findings in the current study illustrate the ability for educational interventions to positively change knowledge, attitudes and intended behaviors in children. Further, the program has been shown to be effective in other populations where there is a need to address NIHL, such as adults in the work place (Reddy, 2014) and with youth firearm shooters (Wise, 2016) when appropriately adapted to meet the needs of each specific population. Therefore, the Dangerous Decibels program, if appropriately adapted, can effectively be implemented in the classroom at varying grade levels and perhaps during the course of military training in hopes of teaching young children and military hopefuls the importance of protecting their hearing.

Strengths and Limitations

Strengths

There were many strengths to this study, the first being that there was consistent program delivery across the four classrooms. The same materials, activities, and information were disseminated at each presentation. The experience of the researcher is considered a strength as well, due to the fact that the researcher is Dangerous Decibels certified and had experience presenting the program before presenting it for the study. A final strength of the study was that the survey was developed from previously developed and standardized Dangerous Decibels questionnaires.

The teachers and the school were highly cooperative and provided an optimal environment and reasonable timelines to conduct the research. The children were well versed in computer technology, and collecting the data using online survey techniques rather than paper and pencil surveys was a strength. For one, there were less material resources to work with. Also, the survey software was very easy to access and the survey was easy to input into Qualtrics. Additionally, when doing data analysis, there was no possibility of data entry errors to occur because the software directly captured participant responses, and the researcher was able to download the results directly to computer files which eliminated human error at this stage. Moreover, data summary across the different time points for each participant was easily reviewed. It is also important to note that, in the past, researchers have had issues with participants not answering all the questions when using paper-and-pencil. The online survey software allowed for the questions to be forced responses, therefore all questions were answered by all participants. Furthermore, the online survey used a familiar interface that students used daily in the classroom.

Limitations

One of the main limitations to this study was the small number of participants in the military group of children. Unfortunately the school where participants were recruited from is located near only one military base. Perhaps if the recruiting area for the study could have been expanded, a higher number of children from military families would have been possible. Further, because there was such a low number of participants in the overall sample, there was lower statistical power. A post-hoc *t-test* power analysis indicated that for all conditions, power was low (< .1). A higher statistical power in each condition in future research studies is more likely to detect significant differences between the two experimental groups (children from military families and those not from military families).

Another limitation was the loss of participants at follow-up. It is quite common for military families to be re-located, therefore the study population was at higher risk to lose participants to begin with. In the future, it might be wise to consider including more children from military families than non-military because of this trend. Children from non-military families were also lost at follow-up. The proportion of participants lost from both groups in proportion to the overall sample size was essentially the same (21% military and 79% non-military at baseline, compared to 20% military and 80% non-military at follow-up). This might suggest that over-enrollment in participants for both experimental groups in the future is needed.

Future Direction/Dissemination

Future research should include a larger study population of children from both military and non-military populations. The overall sample size for this study was relatively small and in the future should include equal and larger groups of students for both experimental groups. Also, future research might include exploring the differences across differing military installations, including nearby schools.

Another direction for research might include disseminating the Dangerous Decibels classroom program only to children from military families with the inclusion of their parent(s) who are/were in the military. Clark (2013) found differences in knowledge, attitude, and intended behavior for children receiving the program simultaneously with their parent(s) when compared to those children whose parent did not attend the program. This might have the added benefit of supporting and/or enhancing the changes in knowledge, attitudes and intended behaviors in adults enrolled in military mandated hearing loss prevention programs.

Future directions for Dangerous Decibels might include evaluating the program in order to help target areas where the program can be improved in hopes of maintaining knowledge, attitudes, and intended behaviors at follow-up. This might include a requirement as part of the program to include additional activities that are done to reinforce what was taught in the program. Griest et al. (2007) suggested use of multiple, repeated interventions in different formats to increase long-term effectiveness. For instance, if the 4th graders had received a visit from a Jolene educational mannequin to address music player listening levels, or accessed the online Dangerous Decibels Virtual Exhibit interactive games, carryover from post to follow-up may have been greater. In addition, if the military base or school had held an event where the use of hearing protection was encouraged and made available, the outcomes may have also been further supported and positively influenced. Additional activities to integrate specifically into the school curriculum are available in the Dangerous Decibels Educator Resource Guide and should be considered as booster activities. Also, program evaluation might include looking at the survey questions and modifying them to be more relatable and more current to the evolving population of children.

Finally, another future direction for the Dangerous Decibels classroom program might include adapting it to be disseminated as a requirement during military training or in ROTC programs in high schools and colleges. Reddy (2014) successfully adapted the program for individuals in the workplace in order to target adults working in noisy environments which supports the idea that the program can be modified for different populations and remain effective. Because the military is a population with high noise exposure levels, targeting this population is logical. Further, as hearing loss and tinnitus are among the most common injuries of veterans, there is a need to educate these populations about the dangers of excessive noise levels. Incorporating Dangerous Decibels into military training and ROTC programs could make these populations more aware of the hazards of dangerous noise levels and further encourage them to be proactive about their hearing health early in their military career paths.

Summary

The Dangerous Decibels classroom program was delivered to children from military families and non-military families and was effective at significantly increasing knowledge, positively affecting attitudes, and positively influencing intended behaviors related to hearing health and hearing loss prevention in both populations. Although there were no significant differences between the two groups of children for knowledge, attitude, and intended behavior, the program still positively influenced children from military families at post and follow-up when compared to baseline measures. When considering the effectiveness of the program as a whole, and not broken down by its three constructs, overall scores for both groups of children improved from baseline to post and follow-up, indicating the significance of the program as a whole to positively impact hearing health in 4^{th} grade students. Dangerous Decibels is a unique, fun, and interactive program addressing the need for educational programs related to hearing health and can be implemented for children from military families and non- military families.

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APPENDIX A

INSTITUTIONAL REVIEW BOARD APPROVAL

UNIVERSITY OF
NORTHERN COLORADO

Institutional Review Board

DATE:	April 18, 2016
TO:	Danielle O'Dorisio, B.S. and B.A.
FROM:	University of Northern Colorado (UNCO) IRB
PROJECT TITLE:	[887560-2] Effectiveness of the Dangerous Decibels Program® In Children from Military Families
SUBMISSION TYPE:	Amendment/Modification
ACTION:	APPROVED
APPROVAL DATE:	April 18, 2016
EXPIRATION DATE:	April 18, 2017
REVIEW TYPE:	Expedited Review

Thank you for your submission of Amendment/Modification materials for this project. The University of Northern Colorado (UNCO) IRB has APPROVED your submission. All research must be conducted in accordance with this approved submission.

This submission has received Expedited Review based on applicable federal regulations.

Please remember that informed consent is a process beginning with a description of the project and insurance of participant understanding. Informed consent must continue throughout the project via a dialogue between the researcher and research participant. Federal regulations require that each participant receives a copy of the consent document.

Please note that any revision to previously approved materials must be approved by this committee prior to initiation. Please use the appropriate revision forms for this procedure.

All UNANTICIPATED PROBLEMS involving risks to subjects or others and SERIOUS and UNEXPECTED adverse events must be reported promptly to this office.

All NON-COMPLIANCE issues or COMPLAINTS regarding this project must be reported promptly to this office.

Based on the risks, this project requires continuing review by this committee on an annual basis. Please use the appropriate forms for this procedure. Your documentation for continuing review must be received with sufficient time for review and continued approval before the expiration date of April 18, 2017.

Please note that all research records must be retained for a minimum of three years after the completion of the project.

If you have any questions, please contact Sherry May at 970-351-1910 or Sherry.May@unco.edu. Please include your project title and reference number in all correspondence with this committee.

APPENDIX B

EDUCATIONAL OBJECTIVES

EDUCATIONAL OBJECTIVES

Educational Objectives of the Dangerous Decibels Classroom Presentation

- *Students will distinguish between safe and dangerous decibels.*
- *Students will learn the sources of many dangerous decibels and what the effects of dangerous decibels are to their hearing.*
- *Students will know three ways to protect their hearing.*

TIME:

1. Introduction………………………………………………………………… 3 min

Educational Objective:

- To familiarize the class with the educator, educator expectations, and purpose of the visit.

2. What Is Sound?.. 5 min

Educational Objectives:

Students will know that:

- Sound is a result of vibrations.
- Sound vibrations are called sound waves.
- You cannot have sound without vibrations.
- The sound vibrations are what can cause damage to our ears

3. How Do We Hear?.. 2 min

Educational Objective:

- Students will have a general understanding of how sound waves and vibrations travel through the parts of the ear to enable hearing.

4. How Do We Damage Our Hearing?.. 12 min

Educational Objectives:

- Students will know loud sounds create strong vibrations that can permanently damage hair cells in the cochlea
- Students will know that unprotected firearm gunshots and explosions can produce instant damage to the cochlea

5. What's that Sound?.. 5 min

Educational Objectives:

- Students will understand one of the consequences of being exposed to dangerous sound levels
- Students will understand what it is like to try to identify sounds with a high frequency hearing loss

6. How Loud is Too Loud?.. 10 min

Educational Objectives:

- Students begin to associate different sounds with decibel levels.
- Students identify which method of hearing protection is the best to practice when exposed to dangerous decibels from different sources.
- Students identify and discuss the social norms and challenges associated with practicing hearing protection.

7. Measuring Decibels with Sound Level Meters……………………………… 4 min

Educational Objectives:

- Students measure sound intensities with a sound level meter.
- Students learn how effective walking away from dangerous sound levels can be to reduce their exposure to dangerous sound.

8. How to Use Ear Plugs………………………………………………………… 6 min

Educational Objectives:

- Students will observe the proper technique and fitting of pre-formed earplugs.
- Students will have the opportunity to practice fitting earplugs in their ears.
- Students will learn about electronic hearing protection and combat arms ear plugs.

9. Rock Your World: Time to Act!... 3 min

Educational Objectives:

- To bring awareness to peer pressure that a person can encounter when practicing smart hearing.
- Students practice making personal decisions on individual behavior in social settings and discuss their answers with the class and educator.

TOTAL: 50 min.

APPENDIX C

SURVEY

DANGEROUS DECIBELS BASELINE SURVEY

1.1 Please enter your **SUBJECT ID** number:

2.1 During the **past year,** approximately how often did YOU do each of the following activities? (*check the box that best describes your experience*)

	Never	1-3 times **per year**	1-3 times **per month**	1-3 times **per week**	Almost every day
Go to a tractor pull, monster truck show, or motorcycle/car/truck race	○	○	○	○	○
Use a gas-powered lawnmower/chain saw/leaf blower or ride on a lawnmower for fun	○	○	○	○	○
Fire a gun	○	○	○	○	○
Ride on a jet-ski, 4-wheeler, snowmobile, or motorcycle	○	○	○	○	○
Ride on a tractor or other farm equipment	○	○	○	○	○
Play in a musical band	○	○	○	○	○
Go to a concert or loud sporting event	○	○	○	○	○
Set off fireworks	○	○	○	○	○
Use personal headphones (for an iPod, MP3, smart phone, etc.)	○	○	○	○	○
Stand near someone firing a gun (such as when target shooting or hunting)	○	○	○	○	○
Go to airshows or air races	○	○	○	○	○
Go to loud military events or ride in military vehicles/equipment	○	○	○	○	○

2.2 During the **past year**, have **YOU** been around loud sound that made your ears hurt?

○ Yes

○ No

○ Not Sure

2.3 I know what I need to do to protect my hearing.

- ◯ Strongly agree
- ◯ Agree
- ◯ Don't know
- ◯ Disagree
- ◯ Strongly disagree

2.4 If **YOU** go target shooting, how often do YOU wear earplugs or earmuffs?

- ◯ Always
- ◯ Most of the time
- ◯ Sometimes
- ◯ Rarely
- ◯ Never
- ◯ I have never gone target shooting

2.5 If **YOU** go hunting, how often do YOU wear earplugs or earmuffs?

- ◯ Always
- ◯ Most of the time
- ◯ Sometimes
- ◯ Rarely
- ◯ Never
- ◯ I have never gone hunting

2.6 If **YOU** are at loud military events, how often do YOU wear earplugs or earmuffs?

- ○ Always
- ○ Most of the time
- ○ Sometimes
- ○ Rarely
- ○ Never
- ○ I have never gone to a military event

2.7 Which of the following types of sounds can be loud enough to damage your hearing? (*check all that apply*-- *you can pick more than one*)

- ☐ Personal headphones with a music player (iPod, smart phone, MP3)
- ☐ Concert
- ☐ Washing machine
- ☐ Paper rustling
- ☐ Fireworks
- ☐ Sporting event
- ☐ Jet Plane (flying overhead)
- ☐ Normal conversation
- ☐ Rifle

2.8 Does your mom or dad wear hearing protection when doing noisy activities?

- ○ Yes
- ○ No
- ○ Not sure

2.9 During the **past year,** have **YOU** been around loud sound that gave you "ringing" in your ears right after?

- ○ Yes
- ○ No
- ○ Not sure

2.10 Which of the following are good ways to protect your hearing when you are around loud sounds? (*check all the apply-- you can pick more than one*)

- ☐ Walk away from the loud sound
- ☐ Turn down the volume
- ☐ Put cotton balls or kleenex in your ears
- ☐ Use earplugs or earmuffs
- ☐ Wear a sweatshirt or coat with a hood
- ☐ Listen to music with headphones to block out loud noise

2.11 Have **YOU** ever heard of electronic hearing protection?

- ○ Yes
- ○ No
- ○ Not sure

2.12 Hearing an extremely loud sound even one time can cause you to lose some of your hearing.

- ○ Yes
- ○ No
- ○ Not sure

2.13 Sound that is too loud can damage the tiny hair cells of the inner ear (cochlea).

- ○ Yes
- ○ No
- ○ Not sure

2.14 Being around loud sounds a lot will help your ears get used to it and protect your hearing.

◯ Yes

◯ No

◯ Not sure

2.15 Wearing earplugs around your friends (when no one else is wearing them) would be:

◯ Very embarrassing

◯ Somewhat embarrassing

◯ A little embarrassing

◯ Not at all embarrassing

2.16 If **YOU** were firing a gun while target shooting would YOU use hearing protection?

◯ Definitely yes

◯ Probably yes

◯ Might or might not

◯ Probably not

◯ Definitely not

2.17 During the **past year,** if YOU were around loud sounds, did YOU try any of the following? (*you can pick more than one if you've tried more than one*)

- ☐ Turn down the volume
- ☐ Use earplugs
- ☐ Walk away from loud sound
- ☐ Use earmuffs
- ☐ None of the above
- ☐ I was not around loud sound

2.18 If **YOU** go shooting, do the adults around you wear earplugs or earmuffs?

- ○ Always
- ○ Most of the time
- ○ Sometimes
- ○ Rarely
- ○ Never
- ○ I do not go shooting

2.19 If **YOU** were around somebody firing a gun, would YOU use hearing protection?

- ○ Definitely yes
- ○ Probably yes
- ○ Might or might not
- ○ Probably not
- ○ Definitely not

2.20 I know what kind of hearing protection is best for shooting sports and/or military members.

- ◯ Yes
- ◯ No
- ◯ Not sure

2.21 Earplugs are hard to put in my ears.

- ◯ Strongly agree
- ◯ Agree
- ◯ Don't know
- ◯ Disagree
- ◯ Strongly disagree
- ◯ I have never tried

2.22 If my hearing is damaged, I might hear ringing in my ears all the time.

- ◯ Yes
- ◯ No
- ◯ Not sure

2.23 People in the military are able to use special hearing protection that lets them talk to each other and hear important sounds.

- ◯ Yes
- ◯ No
- ◯ Not sure

2.24 My hearing will stay healthy because I protect it.

◯ Yes

◯ No

◯ Not sure

2.25 The more time I spend around loud sound without hearing protection, the worse my hearing will be.

◯ Strongly agree

◯ Agree

◯ Don't know

◯ Disagree

◯ Strongly disagree

2.26 I know where to get earplugs or earmuffs or who to ask for some.

◯ Strongly agree

◯ Agree

◯ Don't know

◯ Disagree

◯ Strongly disagree

2.27 I would encourage my friends to use hearing protection when they are around loud sounds.

- ◯ Definitely yes
- ◯ Probably yes
- ◯ Might or might not
- ◯ Probably not
- ◯ Definitely not

2.28 If my hearing is damaged, I might not be able to fly an airplane, join the military, or get the job I want when I am old enough.

- ◯ Strongly agree
- ◯ Agree
- ◯ Don't know
- ◯ Disagree
- ◯ Strongly disagree

2.29 I **DO NOT** know when I should use earplugs to be safe from loud sounds.

- ◯ Strongly agree
- ◯ Agree
- ◯ Don't know
- ◯ Disagree
- ◯ Strongly disagree

2.30 Having good hearing is important for safety, equipment and vehicle operation, and talking with people.

- ◯ Strongly agree
- ◯ Agree
- ◯ Don't know
- ◯ Disagree
- ◯ Strongly disagree

2.31 If **YOU** were at an airshow/air race and around engine noise, would you wear hearing protection?

- ◯ Definitely yes
- ◯ Probably yes
- ◯ Might or might not
- ◯ Probably not
- ◯ Definitely not

2.32 It is okay to shoot one time without hearing protection on and my hearing will not be damaged.

- ◯ Strongly agree
- ◯ Agree
- ◯ Don't know
- ◯ Disagree
- ◯ Strongly disagree

2.33 If my hearing is damaged, it will be hard to understand people talking to me.

- Strongly agree
- Agree
- Don't know
- Disagree
- Strongly disagree

3.1 Are you a:

- Boy
- Girl

3.2 How old are you?

- 8
- 9
- 10
- 11
- 12

3.3 Are you:

- Hispanic/Latino
- American Indian, Eskimo, or Aleutian
- White
- Asian or Pacific Island
- Black, African American
- Not sure

3.4 I want to join the military (Air Force, Army, Coast Guard, Marines, or Navy) when I am old enough.

- ◯ Yes
- ◯ No
- ◯ Maybe
- ◯ Never thought about it