SCREENING FOR NOISE-INDUCED HEARING LOSS IN RURAL FARMERS

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Screening for Noise-Induced Hearing Loss in Rural Farmers

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DOCTOR OF NURSING PRACTICE

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ABSTRACT

Noise-induced hearing loss (NIHL) is one of the most common occupational health diseases. Noise-induced hearing loss is also the second most common occupational illness or injury in the United States today (Centers for Disease Control and Prevention [CDC], 2013). While many different occupations are at risk for NIHL, hearing loss is especially prevalent amongst farmers and agricultural workers.

The purpose of this project was to bring awareness of noise-induced hearing loss and screening measures to farm and agricultural workers in North Dakota through the use of a screening tool to detect those individuals at risk. This was done through the use of the Better Hearing Institute's (BHI) Quick Hearing Check tool which offers individuals a quick and easy method for assessing hearing. The BHI's Quick Hearing Check is a 15 question tool using a 5-point Likert scale that has been developed based off of the American Academy of Otolaryngology Head and Neck Surgery's five minute hearing test (Kochkin & Bentler, 2010).

Analysis at the conclusion of this project included the overall results of the Quick Hearing Check tool and participant perception of hearing. Through the administration of the Better Hearing Institute's (BHI) Quick Hearing Check survey, 45 participants (52%) were found to be at risk for mild hearing impairment, 21 participants (24%) were at risk for moderate hearing impairment, and 21 participants (24%) were at risk for severe hearing impairment. Overall, the conclusion can be made that those that categorized their perceived hearing lower on the Likert-scale did indeed tend to have lower ratings on the post-survey. In addition, those that categorized their perceived hearing as higher on the Likert-scale did tend to have a higher result on the post-survey, indicating a high risk for hearing impairment. Results indicated that risk for hearing loss amongst rural North Dakota farm and agricultural workers is common while

perception of hearing ability is also accurate. The ultimate goal of this project was to find an effective screening tool that can be implemented into patient care and provider practice.

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CHAPTER ONE. INTRODUCTION

Background and Significance

Noise-induced hearing loss (NIHL) is one of the most common occupational health diseases. Noise-induced hearing loss is also the second most common occupational illness or injury in the United States today (Centers for Disease Control and Prevention [CDC], 2013). While many different occupations are at risk for NIHL, this type of hearing loss is especially prevalent amongst farmers and agricultural workers. The United States Department of Agriculture [USDA] estimates that there are about 3,281,000 farm operators along with over one million farm laborers in the United States. Among farm operators and laborers, exposure to hazardous levels of noise is common, while use of hearing protective devices is very rare (McCullagh, 2012). Hearing loss can impact a person in many ways and has also been show to decrease quality of life for farmers and farm families. While hearing loss from noise is permanent and irreversible, it can also be prevented (Great Plains Center for Agricultural Health [GPCAH], 2014). The key to preventing NIHL begins with screening those individuals who are at risk. The use of a self-administered questionnaire regarding hearing presents a simple and low-cost chance to evaluate and detect potential hearing problems that can indicate a need for further medical evaluation (McCullagh, 2012).

Statement of the Problem

Today, there are an estimated 30 million workers in the United States that are being exposed to dangerous levels of noise while at work, placing these workers at risk for developing NIHL. In the United States, noise-related hearing loss has been listed as one of the most common occupational health concerns for over 25 years (United States Department of Labor, 2014). Each year, thousands of individuals suffer from preventable, permanent hearing loss due

to high noise levels in the work place. In 1981, the Occupational Safety & Health Administration (OSHA) implemented new requirements that would protect industry workers from exposure to loud noises in the workplace and implemented the Hearing Conservation Program (United States Department of Labor, 2014). This program still exists today in work places where noise exposure is equal to or greater than 85 dB for an 8 hour work period. Some of the Hearing Conservation Program's requirements include necessitating employers to measure noise levels in the work place, provide free annual hearing exams, and provide free hearing protection and training (United States Department of Labor, 2014). While this program has been extremely beneficial to industry workers to prevent hearing loss, farm operators have no such policies or regulations in place to protect their hearing. Exposure to dangerous levels of noise has been found to be universal amongst farm operators, and the use of hearing protection is very rare (McCullagh, 2012).

Another significant problem lies in the fact that the prevalence of hearing loss is high, and there is a lack of evidence available regarding the use of screening techniques amongst primary care providers. Common practice today involves having the patient fill out a review of systems, which requires the patient to self-identify a problem with their hearing (McCullagh & Frank, 2012). This method of hearing assessment has been found to be inaccurate and unreliable due to the low connection between perceived and actual hearing loss. The United States Preventative Services Task Force [USPSTF] provides hearing screening guidelines for newborns and children, but states that there is insufficient evidence for routine screening of adolescents and adults of working age (McCullagh & Frank, 2012). The USPSTF further recommends that screening for NIHL from an occupational exposure should be performed by workplace programs, such as the Hearing Conservation Program mentioned previously. These types of programs

exclude farm and agricultural workers, resulting in a large gap in screening protocols which is a major problem (McCullagh & Frank, 2012).

Today, technological advances in farming have continued to intensify the level of noise exposure and potential for NIHL amongst farmers and farm operators. Hearing loss affects every aspect of one's life, and individuals with hearing loss have been shown to have a poorer quality of life, be less socially active, feel excluded or isolated, and have a negative self-image (Carruth, Robert, Hurley, & Currie, 2007). If this trend continues, farmers will continue to be exposed to dangerous levels of noise and their lives may potentially be negatively impacted from hearing loss; therefore, the phenomena of noise exposure among the farming population should be further evaluated.

Purpose of the Project

The purpose of this project was to bring awareness of noise-induced hearing loss and screening measures to farm and agricultural workers in North Dakota through the use of a screening tool to detect those individuals at risk. Assumptions have been made that farm and agricultural workers want to protect themselves from NIHL, and increased awareness of individuals risk for NIHL will positively impact the use of hearing protective devices.

The following objectives guided this project:

1. To provide rural farmers with an effective screening tool to detect those at risk for and/or suffering from noise-induced hearing loss.
2. To identify rural farmers at risk for and/or suffering from noise-induced hearing loss.
3. To increase awareness and screening for noise-induced hearing loss amongst members of the farm and agricultural community in North Dakota.

CHAPTER TWO. REVIEW OF LITERATURE AND THEORETICAL FRAMEWORK

Review of Literature

Impaired hearing (whether partial or complete hearing loss) results from an interference with the conduction of sound, its transformation to electrical impulses, or its conduction through the nervous system. There are three types of hearing loss: 1) conductive hearing loss, 2) sensorineural hearing loss, and 3) combined conductive and sensorineural hearing loss (Andreoli, Benjamin, Griggs, & Wing, 2010). Conductive hearing loss typically presents with a decrease of volume, especially low tones and vowels. Conductive hearing loss may also be caused by otosclerosis, exostoses, or glomus tumors (Cash & Glass, 2014). Otosclerosis is a disorder of the construction of the bony labyrinth, exostoses are bony excrescences of the external auditory canal, and glomus tumors are benign, vascular tumors of the middle ear (Andreoli et al., 2010).

In contrast, sensorineural hearing loss produces an impairment of the high-tone perception. Typically patients can hear people speaking, but have difficulty deciphering words because perception is poor. Sensorineural hearing loss may occur as the result of several factors including presbycusis, noise-induced hearing loss, drug-induced hearing loss, Meniere's disease, or acoustic neuromas (Cash & Glass, 2014). Presbycusisis is hearing loss that is associated with aging. Noise-induced hearing loss occurs as the result of chronic exposure to sound levels in excess of 85 to 90 decibels (Cash & Glass, 2014). Drug-induced hearing loss may occur as the result of medications such as aminoglycoside antibiotics, furosemide, ethacrynic acid, quinidine, or aspirin. Meniere's disease produces fluctuating, unilateral, low-frequency impairment and acoustic neuromas are a rare, benign tumor on the eighth cranial nerve (Cash & Glass, 2014).

Common complaints of patients suffering from hearing loss may include partial hearing loss, a total loss of hearing, or difficulty understanding the television, phone conversations, and

people talking. Other signs and symptoms of hearing loss that may be exhibited include unilateral or bilateral hearing loss, hearing noises such as "ringing" or "buzzing", and fullness in the ears (Cash & Glass, 2014). Hearing loss is often painless and with a gradual onset; therefore, many people may have no complaints (American Hearing Research Foundation [AHRF], 2014).

Sound

Noise-induced hearing loss is a permanent hearing impairment that is the result of sustained, repeated exposure to increased levels of noise. In order to fully understand NIHL, one must understand the definition of sound and how sound is measured (AHRF, 2014). Sound is measured scientifically using intensity and pitch, both of which affect the degree to which noise damages hearing. The intensity of sound is measured using decibels (dB) (AHRF, 2014). The scale runs from 0 dB, which is the faintest sound the human ear can detect, to over 180 dB, which is the noise at a rocket pad during launch. Normal conversations occur at about 60 dB and 90 dB includes noises such as a lawnmower or shop tools (AHRF, 2014). Gun muzzle blasts and jet engines are noises that occur around 140 dB, and even momentary exposure to these sounds may cause damage. Frequent exposure to noise above 85 dB will cause a gradual hearing loss in a substantial number of individuals (AHRF, 2014). Exposure to louder noises quickens this damage.

According to the National Ag Safety Database (2002), the decibel level inside an acoustically-insulated tractor cab that is performing typical field operations is at 85 decibels, which is not a risk for hearing damage regardless the length of time an individual is in the cab of the tractor. However, the acoustically-insulated tractor cab is not always the equipment used by farmers. Many farmers use cab-less tractors or older tractors in which corrosion may have deteriorated the exhaust system. That same acoustically-insulated tractor is now operating

around 100 decibels, which limits the safe operation of the equipment to two hours before damage to hearing may occur. Other farm equipment that operates around 100 decibels includes noisy tractors, power mowers, and all-terrain vehicles (National Ag Safety Database, 2002).

Pitch, another method of measuring sound, is measured using frequency of sound vibrations per second, called Hertz (Hz) (AHRF, 2014). A higher pitch results in a higher frequency. For instance, a low pitch (such as a deep voice) makes fewer vibrations per second than a high voice (AHRF, 2014). Typically, NIHL occurs at a pitch around 2000-4000 Hz. Besides intensity and pitch, duration of noise exposure is another factor that contributes to NIHL. The longer one is exposed to a loud noise, the more damaging it may be (AHRF, 2014).

Age and Hearing Loss

Research has also shown that the incidence of hearing impairment increases steadily with age (Andreoli et al., 2010). Recent studies show that approximately one in three people in the United States between the ages of 65 and 74 has some degree of hearing loss. Nearly half of those older than 75 also have difficulty hearing (National Institute on Deafness and Other Communication Disorders [NIDCD], 2014). Many factors can contribute to hearing loss that occurs with aging and it can be difficult to differentiate age-related hearing loss from hearing loss that may occur due to other reasons such as noise-induced hearing loss. Having trouble hearing can make it hard to do things such as hear telephones, doorbells, and smoke alarms. Hearing loss can also make talking with family and friends less enjoyable, which may in turn lead to feeling isolated (NIDCD, 2014). Research also shows that conditions that are more common as people age, such as hypertension and diabetes, may also contribute to hearing loss. In addition, some medications, such as some chemotherapy drugs, have also been found to contribute to hearing loss (NIDCD, 2014). At the current time, scientists and researchers don't

know how to prevent hearing loss that occurs with aging. However, hearing loss related to noise exposure can be prevented through the use of hearing protective devices and reducing the amount of time exposed to loud noise (NIDCD, 2014).

Diagnosis

In order to diagnose one with hearing loss, audiometry must be performed. An audiometry exam tests the ability to hear sounds based on their tone and intensity (American Academy of Family Physicians [AAFP], 2013). Audiometry is a relatively simple procedure that can be performed and interpreted by a trained healthcare professional. While audiometric testing is considered the gold standard for diagnosing hearing loss, the equipment, trained professionals, and costs of administering the tests is often prohibitive in many settings (McCullagh, 2012).

When hearing loss is suspected, pure-tone audiometry is often used to evaluate for any deficit. Pure-tone audiometry is performed by using an audiometer (AAFP, 2013). Handheld audiometers have been found to have a sensitivity of 92% and a specificity of 94% in detecting sensorineural hearing loss. There are many different types of audiometers available, but all operate similarly by allowing the tester to increase or decrease the intensity and frequency of the signal as necessary (AAFP, 2013). Pure-tone audiometry may be defined as screening or threshold searches. A screening audiometry test presents tones through the speech range (around 500-4,000 Hz) at the upper limits of normal hearing (AAFP, 2013). Results of the test may be recorded as pass or refer. A pass score indicates that the patient has a hearing level within normal limits; whereas a refer score indicates that hearing loss is possible and either a repeat screen test or a threshold search test is indicated (AAFP, 2013). Threshold search audiometry helps define the softest sound a person can hear at each frequency 50% of the time. The

threshold search test requires a larger amount of time and training expertise than the screening test (AAFP, 2013).

Pure-tone audiometry requires a quiet, controlled testing environment with low amounts of background noise. A quiet booth that has sound-absorptive materials is considered the standard practice for administration of pure-tone audiometry (AAFP, 2013). As mentioned previously, there are several types of audiometers available that range from handheld screening audiometers to those with full diagnostic abilities. The screening audiometers that are used in most offices typically test at frequencies in the range of speech, which is 500-4,000 Hz (AAFP, 2013). Prior to the administration of the audiometric test, an otoscopic examination of both ears should be performed to assess for patency of the external auditory canals (AAFP, 2013). According to the American Academy of Family Physicians (2013), the average reimbursement for pure-tone audiometry threshold diagnostic testing of both ears is $28.71.

One may become trained to be an audiologist through formal coursework; however, licensing requirements vary from state to state. In the state of North Dakota, there are several requirements that must be met prior to becoming an audiologist (North Dakota Legislative Branch, 2015). According to the North Dakota Legislative Branch, a person must be of good moral character, have a doctorate degree in audiology, and pass an examination approved by the board within one year of application. Once these requirements have been met, one may practice audiology in the state of North Dakota (North Dakota Legislative Branch, 2015).

Screening Tools

While the diagnosis of hearing loss is made through the use of audiometric testing, there are numerous screening questionnaires available to help identify at risk individuals. These tools are not meant to be diagnostic, but merely help detect those that may be at risk for or suffering

from hearing loss. While questionnaires are a cost-effective, quick, and convenient method of screening patients for hearing loss, they must be chosen carefully. Questionnaires are subject to bias, and there are few studies that exist that evaluate their validity (McCullagh, 2012). Several studies have been conducted regarding different screening tools and their validity and reliability in comparison to audiometry.

The National Institute for Deafness and Communication Disorders [NIDCD] has created a hearing ability questionnaire that is available through their website. The questionnaire consists of ten yes-no questions that focus on subjective areas that often present challenges to those that suffer with hearing loss (McCullagh, 2012). A study conducted by McCullagh (2012) studied the effectiveness of the questionnaire in comparison to audiometric screening at identifying those at risk for hearing impairment. McCullagh (2012) found that the questionnaire correctly identified persons as having hearing loss 80-89% of the time. On the other hand, the study identified that the percentage of non-hearing impaired people who would have been correctly identified as not having hearing loss ranged from 37-43%. The study concluded that the questionnaires effectiveness was fair to poor, and alternative screening methods should be used (McCullagh, 2012).

Perhaps one of the most well-known studies pertaining to hearing loss and farmers was that of Gomez, Hwang, Sobotova, and Stark in 2001. The researchers studied the comparison of a self-reported hearing loss test to audiometry in a cohort of New York farmers. Researchers used the New York State Farm Family Health and Hazard Surveillance Project (NYS FFHHS) hearing loss questionnaire for the purposes of their study (Gomez et al., 2001). The questionnaire consists of four yes-no screening questions along with a self-rating scale for hearing. The study compared the questionnaire to audiometry of both ears, what the participants

thought to be the better ear, and what they thought to be the worse ear. The audiometry was performed in low, mid, or high frequency. Sensitivity of the questionnaire varied from 61-79% and specificity varied from 69-87%. The study concluded that self-reported hearing loss using screening questions in conjunction with a self-rating scale is a moderately good measure of hearing impairment in comparison to audiometry (Gomez et al., 2001).

Tool Used For This Project

The Better Hearing Institute (BHI) has also developed a Quick Hearing Check tool to offer individuals a quick and easy method for assessing their hearing (Appendix A). The BHI's Quick Hearing Check is a 15 question tool using a 5-point Likert scale that has been developed based off of the American Academy of Otolaryngology Head and Neck Surgery's five minute hearing test (Kochkin & Bentler, 2010). The reliability of the tool has been validated in two different studies, and the tool has also demonstrated very high internal consistency with Cronbach's alpha scores of .94 and .95. The BHI Quick Hearing Check has also been correlated with pure tone audiometry threshold scores with correlations as high as .55 (Kochkin & Bentler, 2010). The tool has shown excellent validity and reliability through multiple studies, which is largely why the tool was used, with permission, for the hearing assessment of rural North Dakota farmers participating in this project (Appendix B).

Demographics of Hearing Loss in North Dakota

In 2005, researchers at North Dakota State University (NDSU) studied hearing impairment among North Dakotan's using a self-reported measure of hearing impairment. To date, this is the only known study of hearing loss amongst North Dakotan's that has been conducted. The researchers separated hearing impairment into two categories: the number of persons with a severe hearing impairment (equal with "a lot of trouble" or "deaf") and the

number of people with a low hearing impairment ("a little trouble") (Rathge & Danielson, 2005). Researchers estimated that 70,433 North Dakotans ages 15 and older had a hearing impairment in 2000. This number was expected to increase by 19.6% by 2010 and reach 84,235 by the year 2015 (Rathge & Danielson, 2005). Researchers found that the largest numbers of North Dakotans with hearing impairments were found in Cass, Burleigh, Grand Forks, and Ward Counties. Interestingly, the counties with the greatest proportion of residents with hearing impairments were several of North Dakota's more rural and sparingly populated counties (Rathge & Danielson, 2005).

The proportion of residents in North Dakota between the ages of 15 and 44 were expected to decline slightly by the year 2010, and since this age group was found to have a fairly consistent rate of hearing impairment, researchers projected that there will be a modest decline in the number of residents in North Dakota in this age group with hearing impairment by 2010 (Rathge & Danielson, 2005). On the contrary, the proportion of residents in the state between ages 45-64 and 65-74 is expected to increase modestly over the next 10 years. Expectedly, researchers also predict that there will be a modest increase in individuals in these age groups with hearing impairment (Rathge & Danielson, 2005).

Finally, one of the fastest rising age groups in North Dakota are those ages 75 and older. Since this is the age group where the highest prevalence of hearing impairment exists, the number of persons age 75 and older with a hearing impairment is expected to rise rapidly (Rathge & Danielson, 2005). Researchers estimate that by the year 2015, approximately 26,232 North Dakotans ages 75 and older will have a hearing impairment (Rathge & Danielson, 2005).

Overall, the World Health Organization states that over 5% of the world's population, about 360 million people, have disabling hearing loss (World Health Organization [WHO],

2015). Furthermore, of these 360 million people suffering from hearing loss, it is estimated that 328 million of those individuals are adults. The WHO also states that roughly one-third of people over the age of 65 are affected by hearing loss (WHO, 2015).

Theoretical Framework

The revised Health Promotion Model (HPM) created by Nola. J Pender was used as a conceptual framework for this project. Pender's model offers a guide to explore the complex processes that influence individuals to participate in behaviors directed towards improving health (Pender, Murdaugh, & Parsons, 2015). The HPM focuses on three main areas: individual characteristics and experiences, behavior-specific cognitions and affect, and behavioral outcomes. These three areas provide a guide for intervention that results in a behavioral outcome (Pender et al., 2015).

Figure 1. Health Promotion Model Adapted for Rural Farmers

The model depicted in Figure 1 illustrates the attitudes and beliefs that are hypothesized to influence hearing screening participation among rural farmers. The following concepts were predicted to have

relationship with the participation in hearing screening: 1) perceived barriers to participation in screening, 2) the individual's perceived self-efficacy, 3) perceived benefits of participation in hearing screening, and 4) interpersonal factors such as norms, modeling, and support for the participation in hearing screening. The Health Promotion Model helps illustrate the multidimensional nature of an individual's interpersonal and physical environments as they pursue health (Pender et al., 2015).

Logic Model

A logic model was also utilized as a guide in order to plot strategic objectives for the hearing screening project (Appendix C). The logic model displays the factors, activities, outputs, outcomes, and impacts that were used to guide the study (W.K. Kellog Foundation, 2004). Again, the purpose of this project was to bring awareness of noise-induced hearing loss and screening measures to farm and agricultural workers in North Dakota through the use of a screening tool to detect those individuals at risk.

Desired outcomes of the project focused on both short and long-term aims. A short-term outcome objective of the project was to provide participants with an effective screening tool to detect those at risk for and/or suffering from noise-induced hearing loss. The long-term outcome objective for the project was to increase awareness and screening for NIHL amongst members of the farm and agricultural community in North Dakota.

CHAPTER THREE. PROJECT DESCRIPTION

Design

The purpose of this project was to bring awareness of noise-induced hearing loss and screening measures to farm and agricultural workers in North Dakota through the use of a screening tool to detect those individuals at risk. This was performed by the administration of a self-administered questionnaire regarding hearing presented at a local farming expo (Appendix A). The questionnaire also included a pre-survey that collected demographic information and perceived hearing rating (Appendix D). This screening questionnaire allowed the opportunity for a simple and low-cost chance to evaluate and detect potential hearing problems that can indicate a need for further medical evaluation (McCullagh, 2012). Participants were also given one pair of ear plugs as an incentive for participation in the project. In addition, five pairs of ear muffs were also given out to every fifteenth participant.

Population

The population of interest in this study was a convenience sample of rural North Dakota farmers and/or agricultural employees in attendance at the 53rd Annual International Sugarbeet Institute Expo. The event was held on March 25th and 26th, 2015 at the FargoDome in Fargo, North Dakota. The expo was open to all farmers and agricultural workers across North Dakota. Study participants included males and females 18 years of age and older.

Data Collection

The self-administered hearing questionnaire was made available to members of the farming community at the 53rd Annual International Sugarbeet Institute Expo strictly on a volunteer basis. Upon approval from the North Dakota State University Institutional Review Board (IRB), attendees at the event were provided with the option to participate in the hearing

questionnaire anonymously, with gender and age being the only identifiable information obtained. Participants agreeing to partake in the survey were given a pre-test prior to completing the screening questionnaire. All data collection took place on March 25th and 26th, 2015 at the FargoDome.

Protection of Human Subjects

This project was conducted in accordance with North Dakota State University Institutional Review Board's policies and the protection of human subjects was of the utmost importance. For the purposes of this project, men and women over the age of 18 were be able to participate in the hearing screening questionnaire and receive education pertaining to noise-induced hearing loss. The potential risks of participating in this project were minimal and may include sociological risks pertaining to stigma/embarrassment of hearing loss. Risks of participation were no more than minimal and were be minimized by ensuring that privacy was protected and there were appropriately trained/qualified members of the project team available to discuss any questions or concerns. Participants were recruited randomly at the International Sugarbeet Expo. Participation was completely voluntary and no identifying data was obtained from participants. Potential benefits of the proposed project to the participants included: knowledge of noise-induced hearing loss, awareness of one's current risk factors for noise-induced hearing loss, and potential identification of problems with one's hearing. Intuitional Review Board approval was granted from North Dakota State University, see Appendix E.

CHAPTER FOUR. PLAN FOR EVALUATION

The plan for evaluation included survey of the participants prior to administration of the screening tool. During the pre-survey, participants were asked to fill out a questionnaire with their age, gender, occupation, and perceived hearing ability using a Likert scale (Appendix D). Upon completion of the pre-survey, participants were then given the Better Hearing Institutes Quick Hearing Check questionnaire (Appendix A). Once completed, the questionnaires were then scored by the author, and participants were given immediate access to the results. Education was given regarding the results of the survey and the appropriate action to take if needed.

Evaluation Using the Logic Model

The logic model was also utilized as a source of analysis of the hearing screening project for rural farmers. The logic model allowed each objective to be analyzed while using the model as a guide. The first objective of the hearing screening in rural farmers project was to provide rural farmers with an effective screening tool to detect those at risk for and/or suffering from noise-induced hearing loss. The logic model was able to address this objective through the time taken by the project developer to implement the hearing screening tool to farm and agricultural workers at the Sugarbeet Expo. The administration of the self-administered questionnaire took place at the North Dakota Sugarbeet Expo to help identify farm and agricultural works at risk for or suffering from NIHL. This activity also addresses the first objective of the project by providing participants with an effective screening tool to detect hearing loss. The second objective, to identify rural farms at risk for or suffering from NIHL, was also addressed by the logic model as the results of the survey were able to determine if the participants were suffering from NIHL. In addition, the third objective was also effected by the administration of the

questionnaire. The third objective was to increase awareness and screening for NIHL amongst members of the farm and agricultural community, which was achieved by administering the survey to participants.

CHAPTER FIVE. RESULTS

A total of 87 individuals agreed to participate in the study and completely filled out the pre and post survey. There were no survey questions left unanswered; therefore all responses were included in the overall analysis. All results were computed with assistance from a North Dakota State University statistician.

Demographics

The purpose of the pre-survey was to obtain demographic information about the participants as well as assess their perceived hearing level. There was a total of 87 participants in the study, with 85 (98%) being male and two (2%) female. The average age of all participants was 47 years of age, with the youngest participant being 21 and the oldest being 81 years of age. Table 1 displays the demographic information of the participants. Thirty-four participants were between the ages of 20 and 40, comprising 39% of the sample population. The largest group, at 45%, was those ages 41 to 60. Nine (10%) were ages 61 to 70 and 5(6%) were 71 years of age or over.

Occupation of the participants was also collected during the pre-survey and is displayed in Table 1. Twenty four (28%) of the participants were farm laborers and 36 (41%) were farm owner/operators. Twenty seven participants (31%) were in the 'other' category. Those individuals in this category included agronomists, farm equipment sales representatives, agriculture researchers, and agriculture equipment manufacturers.

Table 1

Demographics of Participants

Characteristic	n (%)
Demographics	
Age (in years)	**n = 87**
20-40	34 (39%)
41-60	39 (45%)
61-70	9 (10%)
71 and older	5 (6%)
Gender	**n = 87**
Male	85 (98%)
Female	2 (2%)
Occupation	**n = 87**
Farm Laborer	24 (28%)
Farm Owner/Operator	36 (41%)
Other	27 (31%)

Survey Results

Participants in the study were asked to think about their experiences with each of the questions on the survey without the use of hearing aids or other hearing devices. For each item, participants were requested to indicate the degree to which they agree or disagree with the question. Each question was answered using a Likert scale with scores ranging from 0 (strongly disagree) to 4 (strongly agree). Frequency tables of all responses can be found in Appendix F.

Question 1

Survey question one asked participants: "I have a problem hearing over the telephone". Results indicated that 17 participants strongly disagreed with this statement and rated their response at a 0. Thirty participants rated this question with a 1 and 23 responded with a rating of 2. Nine participants rated their response as a 3 and 8 responded with a 4, identifying that they strongly agree with the statement.

Question 2

Question two assessed conversational hearing and asked participants: "I have trouble following the conversation when two or more people are talking at the same time". Fifteen participants strongly disagreed and rated this question at a 0. Nineteen rated with a 1 and 20 rated the question as a 2. Twenty-four participants responded with a 3 and 9 responded with a four, strongly agreeing with the posed question.

Question 3

Question three asked participants: "I have trouble understanding things on TV". Results of this question were more representative of the disagreeing side with twenty three respondents rating this question at a zero, strongly disagreeing with the statement, and 30 responding with a

1. Twelve participants answered with a 2 and 16 with a 3. Six participants strongly agreed with the statement and replied with a 4.

Question 4

"I have to strain to understand conversations" was the scenario presented in question 4. Eighteen participants responded with a 0 and 28 responded with a 1, strongly disagreeing with the posed scenario. Twenty-two replied with a 2 and 12 with a 3, making this scenario more likely to occur. Seven respondents also rated this question at a 4, strongly agreeing with the statement.

Question 5

Question 5 asked participants: "I have to worry about missing a telephone ring or doorbell". Forty-three participants, or 49%, strongly disagreed with this statement and 24 answered with a 1. Ten participants answered with a 2 and 4 participants with a 3, making this scenario somewhat more likely to occur. Six participants also rated their responses as a 4.

Question 6

Responses to question six, "I have trouble hearing conversations in a noisy background such as a crowded room or restaurant", were answered closely throughout all ratings. Twelve participants strongly disagreed with this statement and answered with a 0. Twenty responded with a 1 and 18 answered with a 2, making this scenario somewhat more likely to occur. Nineteen participants replied with a rating of 3 and 18 with a rating of 4, stating this situation is more likely to occur.

Question 7

Answers to question 7 were more varied in their responses. The question asked: "I get confused about where sound comes from". Thirty-five and 32 participants responded with

ratings of 0 and 1, respectively. Nine participants answered with a 2 and 8 participants with a 3. Three participants strongly agreed with this statement, responding with a 4.

Question 8

Question 8 asked presented the participants with the scenario: "I misunderstand some words in a sentence and need to ask people to repeat themselves". Eighteen and 19 participants responded with a 0 and 1, respectively. Twenty-four rated this question with a 2 and 18 replied with a 3. Eight participants did strongly agree with the statement, responding with a 4.

Question 9

"I especially have trouble understanding the speech of women and children" was the statement given in question 9. Responses were rather evenly distributed by participants. Twenty-three strongly disagreed and responded with a 0. Twenty-seven participants also disagreed and replied with a 1. Sixteen participants and 11 participants felt this scenario was somewhat more likely and responded with a 2 and 3, respectively. Strongly agreeing with the question was 10 respondents, who rated this question as a 4.

Question 10

Responses to question 10 were more on the disagreeing spectrum with 81% of participants rating the question from 0-2. The question asked participants: "I have trouble understanding the speaker in a large room such as at a meeting place or place of worship". Twenty-five attendees strongly disagreed, responding with a 0. Thirty two participants and 13 participants also disagreed with the statement responding with a 1 and 2, respectively. Nine participants did responded that this scenario was more likely to occur, responding with a 3. Eight attendees also strongly agreed, rating their responses at a 4.

Question 11

Question 11 asked participants: “Many people I talk to seem to mumble (or don’t speak clearly)”. Responses to this question were also largely on the disagreeing end with 77% of participants rating their responses 0-2. Twenty-one participants and twenty-five participants rated this question with a 0 and 1, respectively. Twenty-one attendees also responded with a 2. Fifteen people responded with a 3 and 5 answered with a rating of 4, making this scenario more likely to occur.

Question 12

“People get annoyed because I misunderstand what they say” was the scenario presented in question 12. Eight-four percent of participants responded with a 2 or less, indicated this scenario is something they disagree with. Twenty-eight participants responded with a 0 and 24 responded with a 1. Twenty-one participants answered the scenario with a 2. Ten members also responded with a 3 and 4 with a 4, signifying this scenario is more likely to occur.

Question 13

Question thirteen responses also favored the disagreeing results with 70 participants (80%) answering with a 2 or lower. The question asked participants: “I misunderstand what others are saying and make inappropriate responses”. Twenty-three, 33, and 14 participants responded with 0, 1, and 2 respectively. Ten respondents answered with a 3 and 7 respondents with a 4.

Question 14

Responses to question 14 were also on the lower end with 72% of participants strongly disagreeing with the scenario and responding with a 0 or 1. The scenario asked participants: “I avoid social activities because I cannot hear well and fear I will reply improperly”. Forty-five

participants strongly disagreed, responding with a 0. Eighteen and 13 respondents also disagreed, answering with a 1 and 2, respectively. Eight participants could related to the scenario and rated this question with a 3 and 3 participants strongly agreed, answering with a 4.

Question 15

"Family members and friends have told me they think I may have hearing loss" was the final question asked on the survey. The responses were more evenly distributed for this question with 30 participants responding with a 0 and 16 with a 1. Seventeen respondents rated the question with a 2 and 13 with a 3. Eleven participants strongly agreed with the statement, responding with a 4.

Score and Age Correlation

A correlation matrix was also created to display the correlation between the participant's age and their total score on the survey. Two variables, age and score, were compared to determine their relationship. The average age of all participants in the study was 46 years of age. The mean score of all participants on the survey was 22. The correlation coefficient of age and score was found to be 0.44808, indicating that age and score were moderately positively correlated. The p-value associated with the correlation coefficient of 0.44808 was <.0001. This p-value indicates that the correlation coefficient is significantly different than zero. Table 2 displays the correlation matrix between age and score.

Table 2

Correlation Matrix

Simple Statistics

Variable	N	Mean	Std Dev	Sum	Minimum	Maximum
Age	87	46.26437	15.24258	4025	21.00000	81.00000
Score	87	21.75862	15.26736	1893	0	60.00000

Pearson Correlation Coefficients, N = 87
Prob > |r| under H0: Rho=0

	Age	Score
Age	1.00000	0.44808 <.0001
Score	0.44808 <.0001	1.00000

Cross Tabulations

An additional cross tabulation was completed to create a contingency table to assess for interrelation between the participants perceived hearing score on the pre-test to their overall score on the post-test. To assess for association between perceived hearing rating and overall score, a Chi-Square of Independence test was performed (Appendix G). The Chi-Square test of Independence will help determine the effectiveness of the screening tool used for the purposes of this project.

To perform this test, the final scores of the post-test were divided in order to allow for statistical significance for the Chi-Square of Independence test. The most effective way to

divide the final scores included separating them into three categories: mild, moderate, and severe hearing impairment. A total score of 0-19 indicated mild hearing impairment, 20-31 indicated moderate hearing impairment, and a total score of 32-60 indicated severe hearing impairment (Kochkin & Bentler, 2010). Each participants perceiving hearing score on the pre-test was then compared to their overall score on the post-test to help determine the effectiveness of the screening tool.

The Chi-Square of Independence showed that of those participants that rated their perceived hearing as 0, or strongly disagreeing that they had a problem with their hearing, 10 participants (22%) had an overall post-test score between 0 and 19 which indicates mild hearing impairment. Two participants (10%) had a total score in the range of 20-31, indicating moderate hearing impairment. There were no participants that rated their perceived hearing with a zero and had a total score of 31-60, or severe hearing impairment.

Those participants that rated their perceived hearing on the pre-test as a 1 showed similar results. Seventeen participants (38%) rated their perceived hearing as a 1 and had results on the post-test in the 0-19 category, indicating mild hearing impairment. There were no participants that rated their hearing on the pre-test as a 1 and received scores on the post-test in the moderate (20-31) or severe (31-60) categories.

The data for the pre-test rating of 2 showed some differing statistics than that of the 0-1 categories. Of the participants that rating their perceived hearing as a 2 on pre-test, 12 (27%) had post-test results in the mild category. Eight participants (38%) had results in the moderate category and 4 participants (19%) had a post-test score in the severe category.

For those participants rating their pre-test perceived hearing as a 3, 5 participants (11%) had results in the mild category on the post-test. Ten participants (48%) had post-test scores in

the moderate category and 7 participants (33%) had post-test scores in the severe category. Similar results were seen by those participants rating their perceived hearing as a 4, or strongly agreeing they had an impairment with their hearing. One participant (2%) had a post-test score in the mild category and 1 participant (2%) had a post-test score in the moderate category. Ten participants (48%) had results in the severe category.

To test the validity of the Chi-Square test a p-value was developed based on the findings. In order for the Chi-Square test to be valid, all of the cell frequencies need to be 5 or greater. Because there were several cells that had less than 5 observations, the p-value of the Fischer's Exact test was used for this study. The Fischer's Exact test showed a p-value of 2.256E-09, which was less than the alpha score of 0.05. Therefore, the conclusion can be made that there is a strong association between perceived hearing and the overall score obtained on the post-survey.

CHAPTER SIX. DISCUSSION AND RECOMMENDATIONS

Interpretation of Results

The overall aim of this project was to bring awareness of noise-induced hearing loss and screening measures to farm and agricultural workers in North Dakota through the use of a screening tool to detect those individuals at risk. The administration of the Better Hearing Institute's Quick Hearing Check in combination with the pre-survey provided North Dakota farm and agricultural workers with an opportunity to assess if they are at risk for hearing loss that may require referral for objective hearing tests and possible hearing solutions.

Objective One

The first objective of the hearing screening project included providing rural farmers with an effective screening tool to detect those at risk for and/or suffering from NIHL. Through the administration of the Better Hearing Institute's (BHI) Quick Hearing Check survey, 45 participants (52%) were found to be at risk for mild hearing impairment, 21 participants (24%) were at risk for moderate hearing impairment, and 21 participants (24%) were at risk for severe hearing impairment. The reliability of the BHI Quick Hearing Check has been validated in two different studies and the tool demonstrated very high internal consistency with Cronbach's alpha scores of .94 and .95. The BHI Quick Hearing Check has also been correlated with pure tone audiometry threshold scores with correlations as high as .55 (Kochkin & Bentler, 2010).

Objective Two

Objective two of the project focused on identifying rural farmers at risk for and/or suffering from NIHL. Again, through the administration of the Better Hearing Institute's (BHI) Quick Hearing Check survey, 45 participants (52%) were found to be at risk for mild hearing impairment, 21 participants (24%) were at risk for moderate hearing impairment, and 21

participants (24%) were at risk for severe hearing impairment. Review of recent literature found that an estimated 92% of farmers are exposed to extreme noise levels while performing farming activities and roughly 78% of these individuals suffer from hearing loss as a result (Hear-It, 2015). The large majority of participants in this project also likely suffer from some degree of hearing impairment, which can only be confirmed through further audiometric testing, which was outside the scope of this project.

Results of the project also indicated that there was a direct relationship between the age of participants and their overall score on the post-test. The correlation coefficient of age and score was found to be 0.44808, indicating that age and score were moderately positively correlated. These results are consistent with a recent review of literature, as the USPSTF (2015) has determined that aging is the most important risk factor for hearing loss.

Objective Three

The third objective of the project was to increase awareness and screening for NIHL amongst members of the farm and agricultural community in North Dakota. The pre-survey question "Do you feel that you have a problem with your hearing" allowed for an assessment of participants awareness and perception of their overall hearing prior to completing the BHI Quick Hearing tool. Comparison of the participant's pre-survey perceived hearing rating and their overall score on the post-survey was useful in identifying the association between rating and overall score. Overall, the conclusion can be made that those that categorized their perceived hearing lower on the Likert-scale did indeed tend to have lower ratings on the post-survey, indicating they were a low risk for hearing impairment. In addition, those that categorized their perceived hearing as higher on the Likert-scale did tend to have a higher result on the post-survey, indicating a high risk for hearing impairment. These findings were consistent with a

review of literature, which found that self-reported hearing loss is a moderately good measure of hearing impairment amongst farmers (Gomez et al., 2001). The provision of ear plugs to participants also offered an opportunity for increasing the awareness of NIHL and use of hearing protective devices as it gave each participant the necessary equipment to protect their hearing.

Limitations

The project had a relatively small sample size of 87 participants. The sample size was also not diverse, with 98% of participants being male. This project was also implemented in only one location, which limited the opportunity for comparison of the survey responses to other populations and settings. By having conducted this project in more than one location, the results of the project could have been strengthened.

The length of the survey and the time necessary for completion may have also been a limitation in the project. Although all pre and post tests were all fully completed, the time required for the whole process was approximately 15 minutes. Answers of the participants may have been subject to bias, as participants may have desired to appease the researcher.

The lack of additional demographic information on the pre-survey was also a limitation in the conduction of this project. Demographic information including age, gender, occupation, and perceived hearing were addressed on the pre-survey of this project; however, additional questions regarding hearing aid usage and history of previous hearing tests would have been beneficial in the data analysis.

Recommendations

Recommendations and room for improvement for future projects are also important to address for the hearing screening project. In the future, the hearing screening project should be conducted in more than one setting to allow for more variability in participants. In addition,

future projects should also collect more demographic information from participants such as current use of hearing protective devices while working on the farm, current use of hearing aids, and impact of the results of the hearing screening tool on the likelihood of increasing use of hearing protective devices while working on the farm.

The Health Promotion Model (HPM) was also a factor that positively aided in the conduction of this project. The HPM provided a guide to help explore the processes that influence individuals to participate in behaviors directed towards improving their health, such as participating in hearing screening. The model assisted in determining certain concepts that would have an effect on the participation in the hearing screening including: 1) perceived barriers to participation in screening, 2) the individual's perceived self-efficacy, 3) perceived benefits of participation in hearing screening, and 4) interpersonal factors such as norms, modeling, and support for the participation in hearing screening. Further research should include the use of Pender's Health Promotion Model as it helps illustrate the multidimensional nature of an individual's interpersonal and physical environments as they pursue health (Pender et al., 2015).

Implications for Practice

The results of this project support the need for incorporating hearing assessments into advanced nursing practice. Implications for advanced nursing practice should include the routine screening of all farm and agricultural workers in the clinic setting. A survey tool, such as the Better Hearing Institute's Quick Hearing Check, should be used in the clinic setting to screen individuals for hearing loss. If hearing impairment is suspected, further evaluation and referral to an audiology specialist would be warranted.

The dissemination component of research is an important way to distribute the results of this project and help improve practice amongst providers. The results of the hearing screening project will be disseminated at the 2016 North Dakota State University poster presentation. In addition, the results will also be disseminated at the 2016 Three Minute Thesis Competition at North Dakota State University. The researcher will submit this project for publication in the spring of 2016 and an executive summary of the hearing screening project can be found in Appendix H. Journals targeted for publication of this research will include those that are focused on rural health care and advanced nursing practice such as the Journal of Rural Health and the Journal of the American Association of Nurse Practitioners.

Implications for Future Research

Further research projects that focus on screening for NIHL amongst rural farmers could involve the use of a basic questionnaire or screening tool focusing on hearing difficulties with comparison of actual audiometric testing results to assess for any misrepresentations of self-reported hearing. This would allow for the assessment of the validity of the report of perceived hearing levels. In addition, future research should also include additional questions about whether or not the participants have had previous audiometric tests performed and if they currently use any hearing assistive devices. This would allow for the assessment of current hearing protective measures. Also, the use of a portable audiometer to assess participants' actual hearing levels would also be beneficial for future research.

Application to Nurse Practitioner Role

Application of the scientific principles for disease and disability prevention is common to nursing practice. Part of the role of a nurse practitioner focuses on understanding the available science while individualizing decision making to each specific patient and situation (United

States Preventative Services Task Force [USPSTF], 2015). Health promotion and disease prevention, along with the diagnosis and management of acute and chronic conditions has long been a part of the scope of practice of the nurse practitioner.

Part of the clinician's role involves tailoring the patients care to their needs. The USPSTF has created a set of recommendations that offer practical information for clinicians to provide preventative services to patients based on quality evidence. Each recommendation is associated to a letter grade from A (recommend the service) through D (recommends against providing the service). These grades are based on the magnitude of net benefit and the strength of evidence supporting the provision of the service (USPSTF, 2015).

The USPSTF has determined that aging is the most important risk factor for hearing loss. Other risk factors include a history of exposure to loud noises or ototoxic agents, including occupational exposures (USPSTF, 2015). Previous recurring inner ear infections, genetic factors, and certain systemic disease such as diabetes may also increase the risk for hearing loss. With these known risk factors, the most recent USPSTF has given a grade of "I' in 2012 which therefore concludes that the current evidence is insufficient to assess the balance of benefits and harms of screening for hearing loss in asymptomatic adults ages 50 and older (USPSTF, 2015). This recommendation does not apply to persons seeking evaluation for apparent hearing problems or those with symptoms that may be related to hearing loss. These persons should be assessed for hearing impairment and treated when indicated (USPSTF, 2015).

The decision to screen patients for hearing loss is largely based on the clinician's judgment of the risk factors and the patients need for screening. Therefore, providers need to become aware of the risk factors for hearing loss and the screening tools available for identifying patients at risk for hearing loss. Nurse practitioners in the community are in an ideal position to

educate and screen for noise-induced hearing loss amongst rural farmers and ranchers. They have frequent opportunities to educate patients, families, employees, and communities about hearing loss. Nurse practitioners also have the important role of reducing the risk of hearing loss by using consistent patient education, proper screening, and early detection of those at risk.

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APPENDIX A. QUICK HEARING CHECK

Quick Hearing Check

BETTER HEARING INSTITUTE

Introduction

The following hearing loss check is based on the Revised American Academy of Otolaryngology-Head & Neck Surgery (AAO-HNS) five-minute hearing test*. It is a means of quickly assessing if you possibly have a hearing loss requiring referral for an objective hearing test and possible hearing solution. This screener is related to objective measures of hearing loss using audiological equipment. In step #1 you are asked to respond to 15 items related to your hearing. In step #2 you will score your hearing and in step #3 you will be able to compare yourself to 2,304 adults with hearing loss.

Instructions — Step 1

With respect to your hearing, please think about your experiences with each of the following WITHOUT the use of hearing aids or other devices designed to help you hear better. For each item, indicate the degree to which you agree or disagree (select one number for each item).

	STRONGLY DISAGREE ←				→ STRONGLY AGREE
I have a problem hearing over the telephone	0	1	2	3	4
I have trouble following the conversation when two or more people are talking at the same time	0	1	2	3	4
I have trouble understanding things on TV	0	1	2	3	4
I have to strain to understand conversations	0	1	2	3	4
I have to worry about missing a telephone ring or doorbell	0	1	2	3	4
I have trouble hearing conversations in a noisy background such as a crowded room or restaurant	0	1	2	3	4
I get confused about where sounds come from	0	1	2	3	4
I misunderstand some words in a sentence and need to ask people to repeat themselves	0	1	2	3	4
I especially have trouble understanding the speech of women and children	0	1	2	3	4
I have trouble understanding the speaker in a large room such as at a meeting or place of worship	0	1	2	3	4
Many people I talk to seem to mumble (or don't speak clearly)	0	1	2	3	4
People get annoyed because I misunderstand what they say	0	1	2	3	4
I misunderstand what others are saying and make inappropriate responses	0	1	2	3	4
I avoid social activities because I cannot hear well and fear I will reply improperly	0	1	2	3	4
Family members and friends have told me they think I may have a hearing loss	0	1	2	3	4

Instructions — Step 2

Add up scores in each column scored 1-4 ___+___+___+___=___

Continued on reverse side ...

Instructions

Step 3

How Does Your Hearing Loss Score Compare to Adults with Hearing loss?

In adding up your responses to the 15 items you are now able to compare your scores to adults who have a hearing loss. The National Council on the Aging (NCOA) collected this information based on the responses from a representative sample of 2,304 people with hearing loss, ages 50 and above, using the National Family Opinion Panel in 1999.

First, locate your total score in column 1; Column 2 tells you how your hearing loss compares to adults with hearing loss; Column 3 tells how your significant other views the hearing loss; Column 4 tells you what hearing solution action is needed.

1 What is your hearing loss score?	2 How does your hearing loss compare to others?	3 How does your significant other describe your hearing loss?	4 Hearing Solution Action Needed
0-4	Lower 5%	Very Mild	None
5-9	Lower 10%	v	v
10-13	Lower 15%	Majority mild with some moderate	Hearing test may be necessary to monitor your hearing.
14-17	Lower 20%	|	|
18-19	Lower 25%	v	v
20-21	Lower 30%	Majority moderate with about a third mild	Hearing test recommended; hearing solution based on lifestyle
22-23	Lower 35%	|	v
24-25	Lower 40%	v	Hearing test recommended; hearing solution probably needed in many situations.
26-27	Lower 45%	Majority moderate with some mild	|
28-29	Middle 50%	|	|
30-31	Upper 45%	v	v
32-33	Upper 40%	Majority moderate to severe	Extensive communication difficulty requiring testing and hearing solution.
34-35	Upper 35%	|	|
36-37	Upper 30%	|	|
38-39	Upper 25%	|	|
40-42	Upper 20%	v	|
43-45	Upper 15%	Majority severe to profound	|
46-50	Upper 10%	|	|
51-55	Upper 5%	|	|
56-60	Upper 1%	v	v

**Source: Koike , J.; Hurst, M.K.; and Wetmore, S. J. Correlation between the American Academy of Otolaryngology- Head and Neck Surgery five-minute hearing test and standard audiological data, Otolaryngology – Head and Neck Surgery, Volume 111 (5), pp. 625-632.*

APPENDIX B. SURVEY USE PERMISSION

1/17/2016 RE: Survey use

MJ Matthew Jones <mjones@bostrom.com> Reply all |

To: Vanessa Lien; ... Fri 1/15/2016 3:06 PM

Inbox

You forwarded this message on 1/15/2016 3:13 PM

BHIhearingBoneIG-6.pdf
72 KB

Show all 1 attachment (72 KB) Download Save to OneDrive - North Dakota State University

Hi Vanessa,

Thank you for your email.

You have permission from the Better Hearing Institute to use our survey.

In addition, I have attached an infographic that we put together – feel free to print as much as you want.

Finally, here's a link to all our eGuides that you might find helpful.

Good luck,

Matthew Jones
Director of Programs
Better Hearing Institute
office. 202.449.1100 | direct. 202.712.9050 | fax. 202.216.9646 | mjones@bostrom.com
1444 I Street, NW, Suite 700, Washington, DC 20005 | www.betterhearing.org

APPENDIX C. HEARING SCREENING LOGIC MODEL

Assumptions:

1. North Dakota famers want to protect themselves from noise-induced hearing loss.
2. Increased awareness of risk for hearing loss will positively impact the use of hearing protective devices.
3. The individuals that encompass the sample are attentive to their health.
4. Attitudes and beliefs will influence the participation in hearing screening for noise-induced hearing loss.

INPUTS AND RESOURCES → ACTIVITIES → OUTPUTS → OUTCOMES → IMPACT

The following resources will be needed in order to accomplish the goals:	*Accomplishing the following activity will result in outcomes:*	*Accomplishing this activity will result in the evidence of progress:*	*Accomplishing the activities will allow participants to benefit in certain ways. Participants will:*	*If benefits to participants are achieved, then certain changes in communities may occur:*
Better Hearing Institute's Quick Hearing Check screening tool Time taken by project developer to administer the survey tool to participants	Administration of the Better Hearing Institute's Quick Hearing Check at the North Dakota Sugar Beet Expo	Bring awareness and identification of North Dakota agricultural workers at risk for and/or suffering from noise-induced hearing loss	Be provided with an effective screening tool to detect risk for noise-induced hearing loss (NIHL) Identify each participants risk for NIHL Become more aware of the importance to using hearing protective devices	<u>Long-term:</u> Increase in awareness and screening for noise-induced hearing lost agricultural workers <u>Short-term:</u> Provision of an effective screening tool for NIHL Awareness of risk for and identification of those suffering from NIHL

APPENDIX D. PRE-SURVEY QUESTIONS

Age: _____

Gender (circle): Male Female

I am a (choose all that apply):

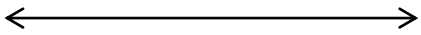
Farm owner/operator

Farm laborer

Other (please specify): _____

Do you feel that you have a problem with your hearing (please circle):

0 1 2 3 4



Strongly Disagree Strongly Agree

APPENDIX E. INSTITUTIONAL REVIEW BOARD APPROVAL

NDSU NORTH DAKOTA STATE UNIVERSITY

March 12, 2015

Dr. Dean Gross
Nursing
Sudro Hall 222F

Re: IRB Certification of Exempt Human Subjects Research:
Protocol #PH15190 , "Screening for Noise-Induced Hearing Loss in Rural Farmers"

Co-investigator(s) and research team: Vanessa Lien

Certification Date: 3/12/15 Expiration Date: 3/11/18
Study site(s): varied
Sponsor: n/a

The above referenced human subjects research project has been certified as exempt (category # 2) in accordance with federal regulations (Code of Federal Regulations, Title 45, Part 46, Protection of Human Subjects). This determination is based on the revised protocol submission (received 3/10/15).

Please also note the following:
□ If you wish to continue the research after the expiration, submit a request for recertification several weeks prior to the expiration.
□ The study must be conducted as described in the approved protocol. Changes to this protocol must be approved prior to initiating, unless the changes are necessary to eliminate an immediate hazard to subjects.
□ Notify the IRB promptly of any adverse events, complaints, or unanticipated problems involving risks to subjects or others related to this project.
□ Report any significant new findings that may affect the risks and benefits to the participants and the IRB.

Research records may be subject to a random or directed audit at any time to verify compliance with IRB standard operating procedures.

Thank you for your cooperation with NDSU IRB procedures. Best wishes for a successful study.
Sincerely,

Kristy Shirley Digitally signed by Kristy Shirley DN: cn=Kristy Shirley, o=NDSU, ou=SPA, email=kristy.shirley@ndsu.edu, c=US Date: 2015.03.12 10:41:38 -05'00'

Kristy Shirley, CIP, Research Compliance Administrator

For more information regarding IRB Office submissions and guidelines, please consult www.ndsu.edu/irb. This Institution has an approved FederalWide Assurance with the Department of Health and Human Services: FWA00002439.

INSTITUTIONAL REVIEW BOARD
NDSU Dept 4000 | PO Box 6050 | Fargo ND 58108-6050 | 701.231.8995 | Fax 701.231.8098 | ndsu.edu/irb
Shipping address: Research 1, 1735 NDSU Research Park Drive, Fargo ND 58102
NDSU is an EO/AA university

APPENDIX F. FREQUENCY TABLES

Question 1		
Rating	**Frequency**	**Percent**
0	17	20
1	30	35
2	23	26
3	9	10
4	8	9

Question 2		
Rating	**Frequency**	**Percent**
0	15	17
1	19	22
2	20	23
3	24	28
4	9	10

Question 3		
Rating	**Frequency**	**Percent**
0	23	26
1	30	35
2	12	14
3	16	18
4	6	7

Question 4		
Rating	**Frequency**	**Percent**
0	18	21
1	28	32
2	22	25
3	12	14
4	7	8

Question 5		
Rating	**Frequency**	**Percent**
0	43	49
1	24	28
2	10	12
3	4	5
4	6	7

Question 6		
Rating	**Frequency**	**Percent**
0	12	14
1	20	23
2	18	21
3	19	22
4	18	21

Question 7		
Rating	**Frequency**	**Percent**
0	35	40
1	32	37
2	9	10
3	8	9
4	3	4

Question 8		
Rating	**Frequency**	**Percent**
0	18	21
1	19	22
2	24	28
3	18	21
4	8	9

Question 9		
Rating	**Frequency**	**Percent**
0	23	26
1	27	31
2	16	18
3	11	13
4	10	12

Question 10		
Rating	**Frequency**	**Percent**
0	25	29
1	32	37
2	13	15
3	9	10
4	8	9

Question 11		
Rating	**Frequency**	**Percent**
0	21	24
1	25	29
2	21	24
3	15	17
4	5	6

Question 12		
Rating	**Frequency**	**Percent**
0	28	32
1	24	28
2	21	24
3	10	12
4	4	5

Question 13		
Rating	**Frequency**	**Percent**
0	23	26
1	33	38
2	14	16
3	10	12
4	7	8

Question 14		
Rating	**Frequency**	**Percent**
0	45	52
1	18	21
2	13	15
3	8	9
4	3	4

Question 15		
Rating	**Frequency**	**Percent**
0	30	35
1	16	18
2	17	20
3	13	15
4	11	13

APPENDIX G. CHI-SQUARE TEST OF INDEPENDENCE

Post-Test Score Category	Pre-test Rating 0	Pre-test Rating 1	Pre-test Rating 2	Pre-test Rating 3	Pre-test Rating 4	Total
Mild (0-19)	10 (22.22%)	17 (37.78%)	12 (26.67%)	5 (11.11%)	1 (2.22%)	45
Moderate (20-31)	2 (9.52%)	0 (0%)	8 (38.10%)	10 (47.62%)	1 (4.76%)	21
Severe (31-60)	0 (0%)	0 (0%)	4 (19.05%)	7 (33.33%)	10 (47.62%)	21
Total	12	17	24	22	12	87

Statistics for Table of Post- Test Score Category by Pre-Test Rating

Statistic	DF	Value	Prob
Chi-Square	8	54.0538	<.0001
Likelihood Ratio Chi-Square	8	59.1645	<.0001
Mantel-Haenszel Chi-Square	1	36.6415	<.0001
Phi Coefficient		0.7882	
Contingency Coefficient		0.6190	
Cramer's V		0.5574	

WARNING: 40% of the cells have expected counts less than 5. Chi-Square may not be a valid test.

Fisher's Exact Test

Table Probability (P)	8.848E-16
Pr <= P	2.256E-09

Sample Size = 87

APPENDIX H. EXECUTIVE SUMMARY

Background and Significance

Noise-induced hearing loss (NIHL) is one of the most common occupational health diseases. Noise-induced hearing loss is also the second most common occupational illness or injury in the United States today (Centers for Disease Control and Prevention [CDC], 2013). While many different occupations are at risk for NIHL, hearing loss is especially prevalent amongst farmers and agricultural workers. The United States Department of Agriculture [USDA] estimates that there are about 3,281,000 farm operators along with over one million farm laborers in the United States. Among farm operators and laborers, exposure to hazardous levels of noise is common, while use of hearing protective devices is very rare (McCullagh, 2012). Hearing loss can impact a person in many ways and has also been show to decrease quality of life for farmers and farm families. While hearing loss from noise is permanent and irreversible, it can also be prevented (Great Plains Center for Agricultural Health [GPCAH], 2014). The key to preventing NIHL begins with screening those individuals who are at risk. The use of a self-administered questionnaire regarding hearing presents a simple and low-cost chance to evaluate and detect potential hearing problems that can indicate a need for further medical evaluation (McCullagh, 2012).

Project Summary

The purpose of this project was to bring awareness of noise-induced hearing loss and screening measures to farm and agricultural workers in North Dakota through the use of a screening tool to detect those individuals at risk. This was done through the use of the Better Hearing Institute's (BHI) Quick Hearing Check tool which offers individuals a quick and easy method for assessing hearing. The BHI's Quick Hearing Check is a 15 question tool using a 5-

point Likert scale that has been developed based off of the American Academy of Otolaryngology Head and Neck Surgery's five minute hearing test (Kochkin & Bentler, 2010).

Results

Analysis at the conclusion of this project included the overall results of the Quick Hearing Check tool and participant perception of hearing. Through the administration of the Better Hearing Institute's (BHI) Quick Hearing Check survey, 45 participants (52%) were found to be at risk for mild hearing impairment, 21 participants (24%) were at risk for moderate hearing impairment, and 21 participants (24%) were at risk for severe hearing impairment. Overall, the conclusion can be made that those that categorized their perceived hearing lower on the Likert-scale did indeed tend to have lower ratings on the post-survey. In addition, those that categorized their perceived hearing as higher on the Likert-scale did tend to have a higher result on the post-survey, indicating a high risk for hearing impairment. Results indicated that risk for hearing loss amongst rural North Dakota farm and agricultural workers is common while perception of hearing ability is also accurate. The ultimate goal of this project was to find an effective screening tool that can be implemented into patient care and provider practice.

Recommendations

Through the conduction and completion of the hearing screening project, further recommendations for action have been identified in order to preserve the hearing of farm and agricultural workers. One recommendation to protect the hearing of farm and agricultural workers includes the need for workplace safety programs, such as the Occupational Safety & Health Administration (OSHA), to include this population of individuals in programs such as the Hearing Conservation Program. This would aid in ensuring that workers are protected from

exposure to loud noises in the workplace. The incorporation of a program such as this would likely require assistance from legislators at local, state, and national levels.

Furthermore, hearing screening tools, such as the Better Hearing Institute's Quick Hearing Check, should be incorporated into the routine practices of primary care providers. Hearing screening should be integrated by primary care providers into yearly physical exams for all individuals at risk for noise-induced hearing loss, especially farm and agricultural workers. This would allow for the early detection, referral, and treatment of hearing loss.