

Masters of Public Health: Field Experience and Final Project

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Abstract

Service related tinnitus and hearing loss has been a steadily growing cost and concern for veterans and soldiers over the past few decades. The current protocols for education and hearing protection, while an improvement, are not enough to stop the high incidence of hearing loss among military personnel. The purpose of this survey among soldiers at Ft Riley was to determine the sources of compliance issues, as well as the major concerns for wearing hearing protection in the field. The survey results were then compared to the potential for improvement if the concerns were addressed with new technology that has recently become available with active or intelligent hearing protection devices. Results showed that the top concerns were effective communication and the ability to hear important environmental sounds. These concerns correlate with the abilities of the active listening protection and communication systems. Recommendations to improve hearing protection compliance and to reduce hearing loss among soldiers would be to utilize this technology, or similar if available, in training and while soldiers are deployed.

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Part 1: Field Experience

The field experience at Ft. Riley was broken into two sections, the first of which was an exposure to all the different branches of Public Health on post accompanied by a checklist to ensure all areas were covered in depth. This first section was completed by all students working on their final field experience while the second section was an individual project, which differed from student to student. The different branches are nursing, environmental health, industrial hygiene, occupational health, army hearing program, and veterinary services. The approach to experiencing each branch was to break them up by day of the week and follow the public health workers for as many weeks as necessary to finish the checklist. Some departments only took two weeks, others took five or six.

Nursing was one of the shorter time commitments. The checklist of information included child and youth services health inspections, health education with the soldiers, STDs tracking and management, and immunization screening and review of vaccination policies. The child and youth services health inspections included an orientation to the Army requirements as well as a walkthrough of procedures--essentially to inspect those working with the youth as well as the facilities and if any special needs existed. The health education for soldiers was more in depth and included information on tuberculosis screening, orientations in health education for soldiers, motivational interviewing in tobacco cessation counseling, and community outreach programs. STD surveillance and rate comparisons were discussed as a group, along with procedures in investigation of communicable diseases and epidemiological tracking. The immunization screening regarding current regulation and policies was a short overview of the CDC immunization charts and the Kansas school age standards for immunization.

Environmental health had a short checklist but a long experience, due to the time consuming nature of the branch. This area covered food service sanitation and inspections, water quality surveillance, vector surveillance, hospital waste management, and child development center sanitation

and inspections. The most time was spent going to various food service locations and running through the inspections. The first few were just observation and explanations of breaches and what to look for. Then a couple were done with the students looking first to see if they could find any problems before they were pointed out. The other time consuming task was learning to identify mosquitoes and other potential disease vector species by microscopic examination.

Industrial hygiene took the longest to complete. This area of public health included ventilation procedures, noise measurement procedures, air sampling, ergonomics, indoor air quality assessments, and a review of several standards including toxicities. This branch did a lot of traveling around post and there were many 'field trips' involved for the students. These field trips included performing assessments of ventilation and noise exposure at various locations as well as calls for testing for air quality for people suspicious of mold.

Occupational health, responsible for making sure all employees including both soldiers and civilians, had on record regular physicals as well as proper worksite evaluations and safety. This was a quick orientation. The public health workers reviewed the protocols and the procedures of that branch for a few hours and then ran the students through basic tests such as hearing and vision screening as well as a spirometry test to give examples.

The Army hearing program was a quick overview of the regulations for hearing protection as well as a review of noise abatement, administrative controls, monitoring, and training programs. Emphasis was made on education of soldiers as well as readiness for deployment. A brief overview was given of the different types of hearing protection in the field.

Lastly, the veterinary services branch is also responsible for food and sanitary inspections, mainly at the commissary but also at other food facilities, as well as inspection of food items such as MREs (meals ready to eat), and audits of commercial food processing facilities. Outside of food safety,

the veterinarians are also responsible for control of zoonotic diseases and rabies reports. Since most of these processes are not constantly flowing, many protocols and programs were discussed in detail but were not specifically performed for the student's observation.

Part 2: Hearing Protection

Section 1—Literature Review

Introduction

“Say what?” “I’m sorry, I can’t understand you....can you enunciate please?” While most of us encounter these requests to repeat what we say from family members in older generations, there also is a high number of military personnel who make the same requests, as a result of service-related impaired hearing.

Noise exposure in the military has many sources which are as varied as the duties performed¹. These sources include industrial environments such as vehicle and aircraft maintenance, vehicles, weapons, as well as combat. Noise exposure in combat is hard to quantify and control due to the inherent unpredictability of environments and the use or disuse of hearing protection. Sources and levels of noise exposure in the military have been compiled and published in several locations^{1,2}. Some examples include the level inside an Abrams tank travelling at 30mph averages 114 dB, the cockpit of a Chinook helicopter averages 102.5 dB, and shooting an M16A2 5.56mm rifle reaches an impact noise level of 157 dB². In order to reduce the damage done by these loud noises, as well as others, hearing protection has become imperative.

However, despite the hearing protection protocols currently in place, there is still a high level of hearing impairment among military personnel. This study will look at current hearing protection use, concerns among soldiers, and the potential to address these concerns with improved hearing protection technology.

History

Today's military is well aware of the concerns and issues with hearing; hearing impairment and hearing loss has been a concern for the Army for decades. Hearing conservation programs have been in place since 1948, when the Air Force first issued guidelines³. The Navy/Marine Corps and Army followed suit in 1955 and 1956 respectively³. These guidelines came about after a study in 1941 that was conducted to examine the general attitude of the early 1900's that hearing loss could be prevented by developing a tolerance to loud noises⁴. The institution of regulations and guidelines was expedited following the introduction and use of the jet engine after World War II, when it became rapidly apparent that permanent hearing loss came about rapidly when exposed to extreme noise⁴.

In the late 1960s and early 1970s the Army recruited audiologists to work clinically and in hearing conservation. The efforts implemented resulted in a marked decrease in hearing loss in Army personnel over time⁴. The National Institute for Occupational Health (NIOSH) and the Occupational Safety and Health Administration (OSHA) also were created around this time. OSHA, in the U.S. Department of Labor, released a recommendation of 85 dB exposures for 8 hours as being acceptable, with a 5 dB exchange rate. This means that for every 5 dB increase in intensity the noise level essentially doubles and the acceptable exposure is halved; for example, 90 dB would be acceptable for 4 hours before hearing damage was incurred. The exchange rate currently used in the Army is 3 dB, a more stringent requirement than that set by OSHA¹.

The current military hearing conservation programs aim to address the main principles necessary to be effective (in accordance with the criteria set forth by OSHA): noise control, sound surveys, hearing protection, audiometric monitoring, recordkeeping, and education and training¹. The Army Hearing Program has also been established with four pillars of service: operational hearing services, hearing conservation, clinical services, and hearing readiness⁴. These programs are relatively

new, and are constantly changing and adjusting to meet the demands and challenges with which they are presented with.

Current Costs

While hearing protection protocols are currently in place, there are still a vast number of soldiers who develop hearing loss every year. According to 2011 VA Benefits Report⁵, over 140,000 new cases of service disability pay were for tinnitus or hearing loss, totaling 18.4% of all new cases of disability pay. Impaired auditory acuity makes up 12.8% of all disabilities for veterans receiving compensation at the end of fiscal year 2011, second only to musculoskeletal problems. Tinnitus and hearing loss are the most prevalent disability among all veterans categorized by period of service with the exception of the Vietnam era, which has diabetes mellitus as the most prevalent. In total, over \$39 billion was given out as disability compensation in fiscal year 2011. The total cost breakdown by body system was not available, but based on the number of those receiving compensation who have hearing loss or tinnitus, 12.8%, it is safe to say a large amount of that is going to help alleviate this problem.

Section 2—Survey Results

Introduction

In order to run an effective hearing conservation program the Army needs to know what the concerns are among soldiers. There is no sense addressing problems without gaining input from soldiers in the field. Along with establishing concerns and exposures to loud noise, noncompliance with issued hearing protection is a growing issue. In order to combat this problem it is imperative that reasons for the sub-par use of hearing protection be identified. New technology is now available that may greatly improve compliance with hearing protection if it addresses the appropriate concerns. Therefore the purpose of this survey was to identify the concerns, as well as assess the use of various types of hearing protection currently available, and the potential of new technology to meet or possibly correct the concerns soldiers have with the current hearing protection available to them.

Objectives

1. Assess current problems with the use of hearing protection
2. Establish if further research into improved electronic technology would be beneficial

Methods

The population surveyed consisted of volunteers among soldiers waiting for their medical readiness review at building 7671A on Ft. Riley. The survey was developed by the author in consultation with CPT Young, the audiologist on Post, and approved for offering by the K-State IRB (Proposal # 6321). Questions were modified from an example survey found by CPT Young, and were narrowed down and edited to include the information desired as well as to keep to one page. The surveys were distributed when the soldiers arrived and were collected at the end of their readiness review. The surveys were distributed over two different weeks, August 17th through the 23rd and September 4th through the 10th. According to the schedule on post, no single unit or special group went through at the same time and those that did go through were typical of any week.

After the surveys were collected they were separated into “useable” and “non-useable” categories. The criterion for a survey to be useable was for the fourth question, “If it were possible to develop improved hearing protection systems, please rank order the following problems with your current hearing protector that would be most important to address (1 most important, 10 least):”, to be fully answered. Since this question asked the soldiers to rank their concerns with hearing protection in a 1-10 fashion. If they simply marked one or two with an ‘x’ or didn’t use a number system it was not possible to adequately add these to the count, as the top 5 ranked concerns were recorded from each survey. In all 73 out of 114 surveys ended up being useable.

Results

Questions 1, 2, 3, and 5 were simple selection type questions. Question 4 was a ranking question and has a greater depth of information.

Question 1: “During your deployment, what kinds of loud sounds have you been exposed to when you were not wearing hearing protection?”

Most responders marked more than one answer, and the breakdown is as follows:

Exposure	Percent of respondents
My own weapon fire	42.4%
Another squad member’s weapon	41%
A nearby IED or other explosion	47.9%
Loud machinery, generator or vehicle noise	76.7%

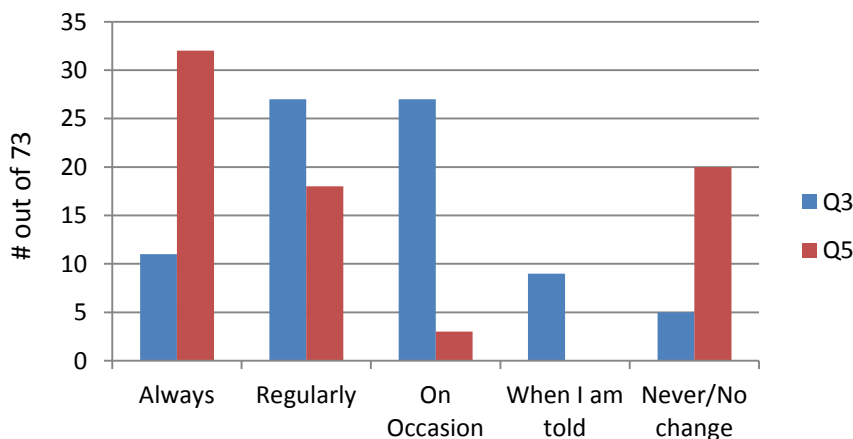
Question 2: “What type of hearing protection did you use during your deployment?”

The top three, in order: Combat Arms Earplug, Foam or Flanged Earplug, Headset mounted in vehicle

Question 3: “How often do you use your current hearing protection?”

Question 5: “If the top ranked problems from [question 4] were addressed, how would that affect your use of hearing protection?”

These questions are tied together so here is a side-by-side graphical representation of responses:



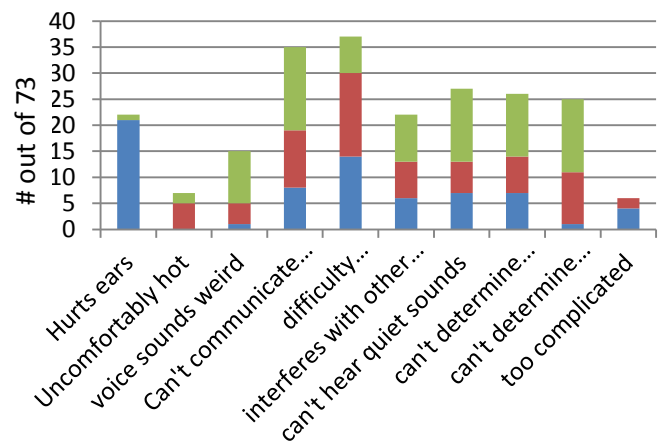
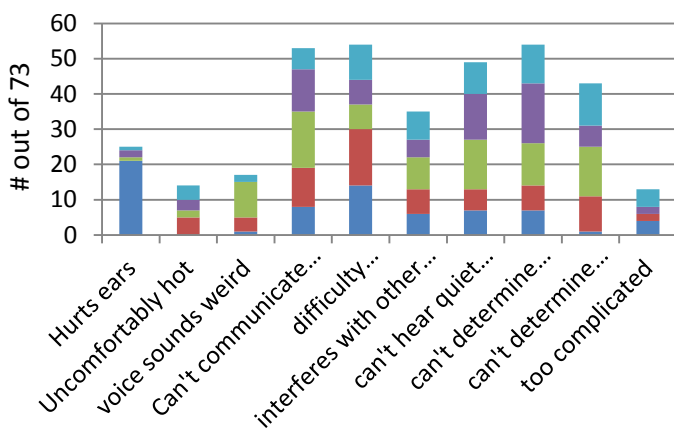
It should be noted that, of the 20 who responded “no change” to question 5, two had marked “always” for question 3, seven had marked “regularly”, five marked “on occasion”, four used hearing protection when they were told, and two never reported using their hearing protection.

Question 4: “If it were possible to develop improved hearing protection systems, please rank order the following problems with your current hearing protector that would be most important to address (1 most important, 10 least):”

Choices were as follows:

- My hearing protector hurts my ears
- My hearing protector is uncomfortably hot
- My own voice sounds weird when I wear the hearing protector
- I am not able to communicate on the radio when I wear my hearing protector
- I have difficulty communicating with the other members of my squad when I wear the hearing protector
- My hearing protector interferes with the other equipment I need to use for my mission
- I am unable to hear quiet sounds in the environment when I wear my hearing protector
- I am unable to determine the direction of sounds in the environment when I wear my hearing protector
- I am not able to determine how far away sounds are when I wear my hearing protector
- My hearing protector is too complicated or is hard to use properly

Below are graphs of those marked 1-5 and those just marked 1-3, the ranks are determined by the colors on the graphs with #1 being the blue on the bottom.



Discussion

The results of the survey, pertaining to particular noise exposure, convey that a lot of noise exposure while deployed comes from different sources, some of which is predictable and some of which is not. The type of hearing protection used, when compared to the primary concerns with the current hearing protection, has some interesting results. 40% who marked that their hearing protector hurts their ears as their primary concern marked foam or flanged earplugs as their hearing protection; 30% chose combat arms earplug; and interestingly enough 30% answered that they didn't use any type of hearing protection. All of those who marked that they didn't use any hearing protection stated that it hurt their ears as their number one problem, which shows that comfort is something to be considered in conjunction with compliance even though it was not among the top three overall concerns.

As demonstrated in chart 1, there is a mild shift in use from regularly and on occasion to always and regularly if issues are addressed. This was simply in place to assure that if efforts were made to improve hearing protection, there would be a likely increase in compliance. The responses reflect that an increase in compliance may result, which legitimizes looking into the primary concerns with the current hearing protection.

When looking at the top 5 concerns of all those surveyed, both *difficulty in determining the direction sounds are coming from* and *difficulty communicating with other members of the squad* were the most prevalent responses. 73.9% of those surveyed had these choices in their top 5. This was followed closely by *difficulty communicating on the radio* (72.6%), *difficulty hearing quiet sounds* (67.1%), and *difficulty telling how far away sounds are* (58.9%). When considering the just the top 3 concerns both *difficulty in communicating with other members of the squad* and *difficulty communicating on the radio* remained very common (50.6% and 47.9% respectively) and *difficulty hearing quiet sounds, determining direction, and determining distance* were close but not as common as

the other two responses (36.9%, 35.6%, and 34.2% respectively). This supports that the ability to communicate effectively is the most common concern, followed by hearing what is going on in the environment.

The survey itself has room for improvement. The demographics of those who responded are unknown, in keeping with the intended anonymity, but potential questions such as rank or years of service, both deployed and at home, could be included. It also might have improved results if the order of responses for the question concerning current problems (question 4) had been randomized. It may also have helped to determine if the respondent had hearing loss or not, as it may have influenced how he or she responded to questions leading to recall bias. Other potential sources of bias include those affected by who chooses to respond, as well as those affected by the generally low sample size.

Section 3—New technology

Information/types/current use

As is evidenced by the current rate of hearing loss and tinnitus among veterans and soldiers, the current hearing protection is not sufficient. Compliance is a large part of the problem, but in order to address that as well as improve the efficacy of hearing protection other types of hearing protection are worth consideration Tactical Communicative and Protective Systems (TCAPS) are the latest technologically advanced hearing protection. The concept behind the different systems of TCAPS is to provide reduced exposure to loud noises, expected and unexpected, in an environment while still allowing for easy and clear communication⁶.

TCAPS enhance communication in a way that blocks out other noise and allows soldiers to speak at a normal level and still be clearly understood, even when there are high levels of environmental noise. Some types of TCAPS have a built in noise dosimeter that measures the exposure levels coming

into the microphones and blocks the high noise levels accordingly. Therefore quiet sounds are not blocked, which permits the wearer to hear normal conversations as well as sounds like snapping twigs or footsteps. This level of hearing is essential for soldiers to be at their best. Different systems offer compatibility with many radios, phones, headsets, and other equipment to make integration and use quick and easy.

Potential to address results of survey

Hearing protection that can be used to improve communication, while affording the needed protection from expected and unexpected noises, turns hearing protection from a hindrance to a tactical advantage in the field. These points also address perfectly the most common concerns among the soldiers surveyed. Intelligent hearing devices improving communication, aiding in the location of sounds in the environment, as well as making detection of quiet sounds in the environment easier than not wearing any hearing protection can change the mentality of hearing protection from something that soldiers grudgingly have to do to prevent possible future into something that can improve their performance in the short run as well as protect for the long run.

Conclusions/recommendations

Education on hearing loss, while essential for everyone, is not sufficient in increasing the use of hearing protection and reducing the incidence of tinnitus and hearing loss among soldiers. Getting down to the root of the issue is imperative. When looking at the top concerns of soldiers when it comes to wearing hearing protection obviously steps should be taken to address those concerns in the field. Based on the results of this survey, and the potential breakthroughs with active listening devices, the recommendation would be to try to integrate this new technology. Not only does it afford the hearing protection needed to prevent long term hearing loss among soldiers, but it has the potential to change the attitude and compliance as well simply by also enhancing hearing along with protecting it.

References

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5. Annual Benefits Report Fiscal Year 2011, *U.S. Department of Veteran Affairs*
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Appendix A: Copy of Survey

The following are a few questions dealing with hearing protection for a research project to assess current problems and potential solutions. The survey is completely voluntary and the responses are kept anonymous.

- 1) During your deployment, what kinds of loud sounds have you been exposed to when you were not wearing hearing protection (Mark all that apply)
 - A) My own weapon fire
 - B) Another squad member's weapon fire
 - C) A nearby IED or other explosion
 - D) Loud machinery, generator, or vehicle noise

- 2) What type of hearing protection did you use during your deployment:
 - A) None, none was needed
 - B) None, I wasn't able to use the hearing protection I was issued
 - C) Combat Arms Earplug
 - D) Foam or Flanged Earplug
 - E) Passive Earmuffs
 - F) Headset mounted in vehicle (CVC or Aviation)
 - G) Electronic Earplug (NACRE)
 - H) Electronic Earmuff (ComTac or Peltor)
 - I) Other

- 3) How often do you use your current hearing protection?
 - Always
 - Regularly
 - On Occasion
 - When I am told
 - Never

- 4) If it were possible to develop improved hearing protection systems, please rank order the following problems with your current hearing protector that would be most important to address (1 most important, 10 least):
 - My hearing protector hurts my ears
 - My hearing protector is uncomfortably hot
 - My own voice sounds weird when I wear the hearing protector
 - I am not able to communicate on the radio when I wear my hearing protector
 - I have difficulty communicating with the other members of my squad when I wear the hearing protector
 - My hearing protector interferes with the other equipment I need to use for my mission
 - I am unable to hear quiet sounds in my environment when I wear my hearing protector
 - I am unable to determine the direction of sounds in the environment when I wear my hearing protector
 - I am not able to determine how far away sounds are when I wear my hearing protector
 - My hearing protector is too complicated or is hard to use properly

- 5) If the top ranked problem(s) from the previous question were addressed, how would that affect your use of hearing protection?
 - more likely to always use hearing protection
 - more likely to regularly use hearing protection
 - more likely to use hearing protection on occasion
 - more likely to use hearing protection when told
 - No change

Appendix B

Below is a simple table comparing the noise reduction ratings, size or weight, and individual costs of different hearing protection devices approved by the Army.

Name	NRR	Dimensions	Cost (in dollars)
Sound Guard foam plugs	29	One size	.14-.20
EAR foam plugs	29	One size	.14-.20
Combat Arms Earplugs	7 when open, 22 when closed	3 sizes	N/A
Battleplugs	9 when open, 24 when closed	3 sizes	N/A
Sure Fire Sonic Defenders	24	3 sizes	14-20
COMTAC Advanced Communication Headset	21	343 grams	600-700
Peltor Soundtrap Headset	21	249 grams	66-91
Peltor Basic Headset	20	353 grams	198-230
QuietPro	30	36 grams (headset)	1400-1600
Silnyx	N/A	45 grams (headset)	1800-2200