

ORIGINAL ARTICLE

Profile of risk factors for acoustic trauma in 105 Howitzer Cannon shooter students

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ABSTRACT

Acoustic trauma is hearing loss caused by short periods of high-frequency noise. Hearing loss can occur in the military because it uses the main tools of the weaponry system, such as guns, military vehicles, and explosions. This research aims to determine the description of risk factors for acoustic trauma, patterns of hearing protector use, and ear complaints among students of Pusat Pendidikan Artileri Medan (Pusdik Armed) who performed 105 Howitzer Cannon shooting practice. This study used a descriptive method with a cross-sectional design on the students of the Pusdik Armed who practised shooting with 105 Howitzer Cannons. The sampling technique used was total sampling with 103 students. The research instrument is data from questions and blood pressure checks. The results showed a description of the risk factors for acoustic trauma in Pusdik Armed Students who performed Howitzer 105 Cannon shooting practice, which were primarily due to high noise exposure, smoking history, use of PLDs, failure to wear protectors (a small percentage), and use of ototoxic drugs; no one had hypertension and a family history of hearing loss. The patterns of wearing hearing protection during the 105 howitzer cannon firing exercises were gathered from the students who carried out the practice. Additionally, some wore them throughout practice. When it came to ear complaints prior to practice, the majority of students had none before or after cannon shooting practice. Therefore, using ear protective equipment for cannon shooters is necessary.

Keyword: Acoustic trauma, Howitzer Canon, military practice, military students, noise.

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INTRODUCTION

Hearing loss is a condition in which people cannot hear as well as they normally do. According to the World Health Organization (WHO), a person is considered to have hearing loss if they have a hearing threshold greater than 20 dB.¹ Hearing loss can occur in military ranks because their work uses the main tools of the weapon system, such as rifles, military vehicles, and explosions. Hearing loss can be caused by congenital abnormalities, infections, neoplasms, trauma, noise, and other conditions such as cerumen buildup, foreign bodies in the external acoustic canal, and medication use.² Noise risk factors that can cause hearing loss are the intensity of noise, the frequency of noise, and the duration of noise exposure. The amount of noise exposure is directly correlated with hearing loss.³ Other risk factors that interact with noise include age, gender, individual vulnerability, history of hypertension, family history of hearing loss, hearing protector use, Personal Listening Devices (PLDs) use, smoking, and ototoxic drug use.^{2,4,5}

Hearing loss due to noise can cause a Temporary Threshold Shift (TTS) and a Permanent Threshold Shift (PTS).^{6,7} Ear complaints that can occur due to noise include decreased hearing, tinnitus, ear fullness, ear pain, and vertigo. Therefore, someone with risk factors for noise-induced hearing loss needs to take precautions with the use of hearing protectors that work to reduce noise intensity. Types of hearing protectors that can be used are earplugs, earmuffs, and helmets.^{6,8} Hearing loss can occur in military ranks because their work uses the main tools of the weapon system, such as rifles, military vehicles, and explosions.^{9,10} The maximum limit of noise exposure intensity that can be heard, according to the Occupation Safety and Health Administration (OSHA), is 90 dB, with a maximum duration of 8 hours per day.¹¹ Meanwhile, according to the Regulation of the Ministry of Employment Republic

Indonesia in 2018 concerning Occupational Safety and Wellbeing of the Work Environment, it is 85 dB with a maximum duration of 8 hours per day.¹² The intensity of the weapons used by soldiers is above the normal threshold. The average noise frequency generated by the assault rifle is 107.66 dB.¹³ The noise frequency of the 105 Howitzer Cannon is 148.6 dB, with a frequency that fades to 60 dB in about 2 seconds. Short periods of high-frequency noise exposure can result in acoustic trauma and loss of hearing.¹⁰

According to research conducted on conscripted personnel in Finland, 1617 conscripted personnel experienced hearing loss caused by acute acoustic trauma, with 88% of conscripted personnel not using hearing protectors. Tinnitus was the most commonly reported symptom.¹⁴ According to research conducted on 186 soldiers who participated in the war in Israel in 2017, 45% of soldiers experienced acoustic trauma due to not using hearing protectors, with tinnitus being the most common problem.⁶ According to a report from the French Military Epidemiology Surveillance System (MESS), during 2007-2014, there were 10,487 cases of acoustic trauma in French Armed Forces soldiers due to shooting practice.¹⁵ *Pusat Pendidikan Artileri Medan* (Pusdik Armed) performed the 105 Howitzer Cannon shooting practices as part of the curriculum for military students. Based on the results of previous studies and to help implement the National Strategy Plan for overcoming hearing loss and deafness designed by the Ministry of Health of the Republic of Indonesia to achieve Sound Hearing 2030, researchers are interested in doing research with the title "Description of Acoustic Trauma Risk Factors in 105 Howitzer Cannon Shooter Students at the Pusdik Armed-Cimahi".

METHODS AND SUBJECT

This research is a descriptive cross-sectional study conducted on May 20th and 27th, 2023, to determine the description of

acoustic trauma risk factors and patterns of hearing protection use among Pusdik Armed students who carried out the Howitzer 105 cannon shooting practice.

The inclusion criteria used in this study were the Pusdik Armed-Cimahi students who were willing to fill out questionnaires regarding risk factors for acoustic trauma, patterns of use of ear protective equipment, and ear complaints before and after shooting practice.

RESULT AND DISCUSSION

Data was collected from a questionnaire held on May 20th and 27th, 2023. Respondents were male, with an age

range between 18 and 22 years. In this study, 103 people fulfilled the inclusion and exclusion criteria.

Description of Risk Factors for Acoustic Trauma

Table 1 describes the risk factors for acoustic trauma among Pusdik Armed-Cimahi students who participated in Howitzer 105 cannon shooting practice, including the use of personal listening devices (PLDs), hearing protectors, smoking history, hypertension, a family history of hearing loss, and the use of ototoxic drugs.

Table 1. Description of risk factors for acoustic trauma

Variable	N	%
Personal Listening Devices use		
Yes	61	59,2
No	42	40,8
Total	103	100
Hearing protector use		
Yes	90	87,4
No	13	12,6
Total	103	100
Smoking history		
Yes	62	60,2
No	41	39,8
Total	103	100
Hypertension		
Yes	0	0
No	103	100
Total	103	100
High noise exposure history		
Yes	66	64,1
No	37	35,9
Total	103	100
Family history of hearing loss		
Yes	0	0
No	103	100
Total	103	100
Ototoxic drug use		
Yes	2	1,9
No	101	98,1
Total	103	100

Based on Table 1, a description of the use of PLDs was obtained, which shows that most students used PLDs. The safe use of PLDs is 60 minutes per day with a maximum volume of 60%, which can be called the 60-60 rule.¹⁶ This shows the risk of acoustic trauma due to the use of PLDs. In accordance with Kristianti and Nurrokhmawati's 2020 research, 4.2% of students at SMPN 3 Cimahi who conducted audiometric examinations showed sensorineural hearing loss due to PLD use.¹⁷

Smoking history describes that most students smoked. This data indicates a risk factor for acoustic trauma due to smoking because, according to the research of Ningsih et al. (2018), someone with cigarette consumption of more than 10 cigarettes per day is more at risk of hearing loss than someone with cigarette consumption of less than 10 cigarettes per day.¹⁸ Furthermore, based on the results of a meta-analysis of research by Li et al. (2020), it was confirmed that active smokers or former smokers have a higher risk of hearing loss than non-smokers.¹⁹

A total of 103 student shooters (100%) had blood pressure below 140/90 or were not hypertensive. According to research at Bhayangkara Medan Hospital (2020), the risk of hearing loss in people with hypertension is six times greater than in people without hypertension.²⁰ And in accordance with the research of Wang et al. (2018), workers in Jiangsu Province, China, who are exposed to occupational noise have higher hearing thresholds than workers with hypertension, and the degree of hearing loss shows a response to the level of hypertension.²¹ This suggests that the student shooters in this study are not at risk of acoustic trauma due to hypertension.

There was a description of hearing protector use; most students used hearing protectors, and there were a number of students who did not use hearing protectors during the Howitzer 105 cannon shooting practice. According to the research of

Sasongko and Suteja in 2015, the incidence of acoustic trauma in cannon shooters of the Pusdik Armed-Cimahi without hearing protectors was 23.5%.¹⁰

There was a description of the risk of acoustic trauma due to a history of high-noise exposure. Most students had a history of high noise exposure, and some of them had no history of high noise exposure. OSHA states that the maximum daily noise exposure for 8 hours should not exceed 90 dB.¹¹ According to Peraturan Menteri Tenaga Kerja Republik Indonesia (Permenaker RI), in 2018, the occupational safety and welfare of the working environment is 85 dB with a maximum duration of 8 hours per day.²² Repeated noise exposure can lead to noise-induced hearing loss. From the data of this study, it shows that there are risk factors for acoustic trauma based on a history of high noise exposure.

There was a family history of hearing loss that was a risk factor for noise-induced hearing loss. There was no familial history of hearing loss among all students. A family history of hearing loss can be a risk factor for acoustic trauma associated with congenital sensorineural hearing loss and polymorphism of the tip link of stereocilia.^{2,5,23} The results of this study indicate that student shooters are not at risk of acoustic trauma due to a family history of hearing loss.

There was a description of ototoxic drug use in shooting students. Two shooting students had a history of ototoxic drug use, and most students had no history of ototoxic drug use. The use of ototoxic drugs is a risk factor for acoustic trauma because ototoxic drugs can cause toxic reactions to the cochlea and vestibular tissue. This condition can make the cochlea more vulnerable to noise.²⁴ The use of ototoxic drugs is a risk factor for acoustic trauma because ototoxic drugs can cause toxic reactions to the cochlea and vestibular tissue.

Some drugs are ototoxic, such as aminoglycosides for tuberculosis treatment,

non-steroidal anti-inflammatory drugs (NSAIDs), quinolone, and anti-tumor drugs.²³⁻⁵ Based on research by Yulianti and Mahdiani (2015), sensorineural hearing loss occurred in 20.8% of multidrug-resistant tuberculosis (MDR-TB) patients at Hasan Sadikin Hospital.²⁵ Also, based on research by Benokri (2022), sensorineural hearing loss was found in the MDR-TB group who received aminoglycoside therapy for 6 months.²⁶ The results of this study show that student

shooters are at risk of acoustic trauma based on the use of ototoxic drugs.

The pattern of hearing protector use

Table 2 shows that the pattern of using ear protective equipment from 90 shooting students (87.4%) who used hearing protector, 75 shooting students (72.8%) used it during training, and 15 shooting students (14.6%) used it in a removable way.

Table 2. Patterns of hearing protector use

Patterns	N	%
During Exercise	75	72,8
Take off the pairs	15	14,6
Total	90	87,4

Hearing protectors can reduce noise exposure, which is a risk factor for acoustic trauma. Ear plugs can reduce noise intensity by 20-30 dB, ear muffs by 25-40 dB, and helmets by 40-50 dB.²⁷ The use of hearing protectors in accordance with the duration of training will optimize hearing protection against noise exposure.

The noise frequency of the 105 Howitzer Cannon is 148.6 dB, with a frequency that fades to 60 dB in about 2 seconds. Hearing protectors can preserve hearing function from acoustic trauma,

which is hearing loss due to short periods of high-frequency noise exposure.¹⁰

Ear Complaints

Table 3 shows the description before shooting practice: 18 student shooters (17.5%) had ear complaints, and 85 student shooters (82.5%) had no ear complaints. The description after shooting practice is that 24 shooting students (23.3%) had ear complaints, and 79 shooting students (76.7%) had no ear complaints.

Table 3. Description of ear complaints before and after doing cannon shooting practice

Ear complaint	Before practice		After practice	
	N	%	N	%
Yes	18	17,5	24	23,3
No	85	82,5	79	76,6
Total	103	100	103	100

Ear complaints from acoustic trauma can have symptoms such as decreased hearing, tinnitus or ringing in the ears, fullness in the ears, pain in the ears, and

vertigo.⁶⁻⁸ In this study, ear complaints were found in the forms of hearing loss, tinnitus, ear blocking, and balance disturbances. The results of the study show

that some shooting students with ear complaints were students who did not use hearing protectors.

The incidence of acoustic trauma at the Pusat Pendidikan Artileri Medan-Cimahi (Pusdik Armed-Cimahi) was found in cannon shooters at 23.5%.¹⁰ This article showed that the history of using hearing protectors was the main risk factor for hearing loss.

Ear plugs can reduce noise intensity by 20-30 dB, ear muffs can reduce noise intensity by 25-40 dB, and helmets can reduce noise intensity by 40-50 dB.²⁷ In addition to reducing noise, hearing protectors are proven not to interfere with the performance of sound localization and speech perception for users. As a result, the benefits to those who utilize ear protection in high-noise environments, such as military personnel and factory workers, are evident.²⁸ The use of hearing protectors in accordance with the duration of training will optimize protection against noise exposure.

CONCLUSION

According to the study results, the risk factors for acoustic trauma in PUSDIK ARMED-Cimahi students who practiced Howitzer 105 Cannon shooting were primarily due to high noise exposure, smoking history, use of PLDs, failure to wear protectors (a small percentage), and use of ototoxic drugs. Furthermore, no one had hypertension or a family history of hearing loss. The patterns of wearing hearing protection during the 105 howitzer cannon firing exercises were gathered from the students who carried out the practice. Additionally, some wore them throughout practice. When it came to ear complaints prior to practice, the majority of students had none before or after cannon shooting practice.

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DECLARATION OF INTEREST

There is no conflict of interest in this scientific article.

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