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# CURRENT STATUS OF HEARING LOSS, ITS RELATED FACTORS AND THE EFFECTIVENESS OF PREVENTION BY SUPPLEMENTING Mg-B6 AMONG THE SOLDIERS OF ARMORED TANK ARMY IN 2017-2018

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# A. THESIS INTRODUCTION

## 1. Necessity of the thesis

Hearing loss is still a big problem in society today. WHO estimates that around 430 million people (5.5% of the population) in the world have hearing loss (HL) and it is expected that this number will increase to 700 million by 2050. Viet Nam currently has no complete data about rate of hearing loss.

There are many causes of hearing loss, including age-related noise increases the prevalence of hearing loss; diseases of the ear- nose-throat and other diseases that might also affect hearing. In addition, other factors such as genetics, use of drugs that are toxic to the inner ear, lifestyle habits such as smoking, overuse of headphones, etc. also have a significant impact on hearing. According to WHO, 50% of hearing loss cases are preventable based on public health measures.

Exposure to loud and prolonged noise causes hearing loss among the workers and soldiers of the military. WHO estimates that around 360 million people worldwide have severe hearing loss and around 1.1 billion young people (aged 12 to 35 years) are facing noise-induced hearing loss.

Hearing plays an important role in soldier's performance of duties as well as command processing in practical trainings. In many cases, the noise intensity in the military exceeds the permissible threshold, so even though "dual" hearing is protected, hearing is still affected. Unlike civilian labor, soldiers are forced to complete their duties under all circumstances. Soldiers in some special services such as artillery, submarines and armored vehicles are often exposed to high-intensity noise. The sound intensity of the light anti-tank gun is 184 dB, the

noise in the ship's cabin is 130-160 dB, and that of the tank is 90-120dB, all exceed the 85 dB allowable threshold.

Although the soldiers of the Tank Army have the measures to protect hearing by wearing combat vehicle crewman helmet, there is still a significant rate of hearing loss. Therefore, scientists have been making efforts to study drugs that have the effect of preventing hearing damage from noise such as N-Acetylcysteine, Methionine, Ebselen, Magnesium, vitamins. Mg-B6 has long been used in the symptomatic treatment of clinical anxiety. On the other hand, magnesium is also effective in preventing and protecting hearing against the impact of noise based on its neuroprotective mechanism and vasodilator effect reducing the impact of oxidative radicals. There have been studies on the world on hearing protection effect of magnesium with positive results. However, in Vietnam up to now, there is no facility that uses drugs to prevent hearing loss caused by noise.

What is the current state of hearing loss and related factors among the soldiers of Armored Tank Army? Can Mg-B6 be used to prevent hearing loss? To answer these questions, we have carried out the study on "The current status of hearing loss, its related factors and the effectiveness of prevention by supplementing Mg-B6 among the soldiers of Armored Tank Army in 2017-2018".

**2. Study objectives**

- To describe the current status and some factors related to hearing loss among the Armored Army soldiers in 2017
- To evaluate the effectiveness of Mg-B6 supplementation in preventing hearing loss among the soldiers of Armored Tank Army in 2018

**3. New contributions of the thesis**

The thesis is a scientific research with practical and urgent value and this is the first study to evaluate the effectiveness of using Mg-B6 drug to prevent hearing loss in the soldiers of Tank Armed Forces. The study assessed the status of hearing loss, its related factors, then evaluated the effectiveness of supplemental prophylaxis with Mg-B6 among the soldiers of Tank Armed Forces.

***Actual noise condition of armored tanks***: The average overall sound pressure level measured on the armored tank training ground was 76.08 ± 25.66 dBA.

***Status of hearing loss among armored tank soldiers***: The rate of hearing loss in one ear was 17.78% and 45.08% in both ears. The most common clinical symptoms were tinnitus (78.4%), sore throat (69.8%) and dizziness (61%).

***Factors related to hearing loss:*** Rate of hearing loss was found increasing proportionally by age and by military age, $p<0.05$. Symptoms of tinnitus, insomnia, ear discharge, cardiovascular disease have increased the risk of hearing loss. Cardiovascular factors has increased the risk of hearing loss with OR = 1.63 (95% CI: 1.1 - 2.66)

**Supplementing with Mg-B6 was effective in preventing hearing loss among study subjects:** Reduced the symptoms of tinnitus, hearing loss, fatigue, headache, nervousness, insomnia, dizziness in the study group compared with that of the control group with $p<0.01$. Significantly reduced the rate of hearing loss: The rate of hearing loss in the control group was 26% and in the intervention group was 4% with the significant difference ($p <0.001$). The relative risk of hearing loss was 15.38% (95% CI: 0.06-0.42), or the hearing loss rate was

reduced by 84.62% in the intervention group compared with the control group.

**4. Thesis value**

Study results provided scientific evidence contributing to the current situation of hearing loss and its related factors among the Armored Tank soldiers. This is the first thesis that evaluated the effectiveness of using Mg-B6 to prevent noise-induced hearing loss.

**5. Thesis structure**

The thesis composed of 121 pages, including 2 pages of Introduction, 34 pages of Literature Review, 15 pages of Study subjects and methods, 24 pages of Results, 21 pages of Discussion, 3 pages of Conclusion and 3 pages of Recommendation. The thesis used 120 reference scientific articles, of which 14 articles were in Vietnamese and 106 were in English. In addition, the thesis has 33 tables, 13 figures and 5 appendices attached.

## B. THESIS CONTAIN

### Chapter 1. LITERATURE REVIEW

#### 1.1. The concept of hearing loss

Hearing loss: When the person's hearing threshold is above 20 dB in one or both ears. Hearing loss can be mild, moderate, severe and deaf, causing difficulties in communication, especially in noisy environments.

#### 1.2. Situation of hearing loss in the military environment

- Overseas: Yong and Wang (2015) have conducted the study on the effects of noise on hearing in the military, they mentioned a number of preventive measures such as using noise-prevention hats and earplugs and some drugs such as Magnesium, N-Acetyl-cysteine,

Methionine, Ebselen. Gordon (2017) et al. studied the hearing loss status among veterans. Their results showed 29% having hearing loss (HL), determined with the mean hearing threshold of >20 dB; 42% showed to have HL at high frequencies. Some of the factors found to be associated with hearing loss include age, military type, years of service, noise exposure, tinnitus, and stress.

- In Vietnam: Ho Xuan An (2003) studied noise effects caused by tanks and armored vehicles on the hearing of soldiers. The resulting hearing loss rate was 12.5%. Armored tank noise: 90-115 dB. Nguyen Van Chuyen (2016) assessed the HL status in HQ011, HQ012 sailors. He found the HL rate in HQ011 and HQ012 crew members of 19.15%, of which 17.02% HL cases was due to the noise. The older the profession, the higher the rate of hearing loss and the more severe the degree of hearing loss.

**1.3. Factors related to hearing loss**

- In the general population: diseases of the ear, diseases of the outer ear, noise, vibration, drugs-chemicals, receptivity, age.
- In the Armored Tank Army: noise, acceleration, temperature, high CO2 concentration, smoke, limited observation,

### 1.4. Measures to prevent hearing loss

- Individuals: health assessment, physical training, nutrition assurance, hearing protection equipment, healthy lifestyle.
- Collective measures: technology, environmental sanitation
- Medical measures: periodic examination, early detection of hearing loss.
- Use of drugs to prevent hearing loss: based on the reason that the use of ear protection tools in the military does not provide adequate hearing protection due to inadequate use and lower protection in actual conditions compared with laboratory conditions. In addition, earplugs interfere with the perception and communication of the surrounding environment.

**Effects of Mg-B6:** Current theories of metabolic harm, of the formation of reactive oxygen species (free radicals, ROS) due to excessive noise exposure, followed by signal activation "programmed suicide". Free radicals appear immediately after exposure to noise and persist 7-10 days later, spreading throughout the basement membrane of the organ of Gorlgi, thereby enlarging the lesion area. The delay in lesion spread is an important feature of noise-induced hearing loss because it presents the “window of opportunity” to intervene post-exposure and prevent progressive hearing loss. The protective effect of magnesium supplementation increases blood flow. Mg can reduce calcium overflow into cells, locking the process of "programmed death" of hair cells; it can also limit ischemia by causing vasodilation of the cochlear artery. Therefore, long-term use of $Mg^{2+}$ after exposure to gunshot-pulse noise improves the hearing threshold.

Vitamin B6 is involved in many biological functions of the nervous, circulatory, and physical. The vitamin B6 loss can cause tired and uncomfortable feelings.

## Chapter 2. STUDY SUBJECTS AND METHODS

### 2.1. Study subjects

**- Objective 1: Current situation of hearing loss and some related factors among soldiers served in Armored Tank Force**

*+ Working environment*

The noise level of the tank T54 during the vehicle standing but engine and running on the training ground

*+ Soldiers*

*a) Selection criteria:*

- Male soldiers that are working at the units of Armored Tank Force and have been exposed to noise at a harmful level of >85dB and have worked for more than 6 months.
- Have a complete record of health managed at the military medical unit

*b) Exclusion criteria:*

*- Those were not present at the unit during the study period*

**Objective 2: The effectiveness of Mg-B6 supplementation in preventing hearing loss**

*a) Selective criteria*

*- New male soldiers, the rookies working in units of Armored Tank Army participated in the crew training course.*

*- Have no ear diseases*

*a) - Monotone hearing test, normal tympanic volume*

*b) Exclusion criteria*

- Have chronic ENT disease

b) Criteria for selection of control group

Same as the study group, participated in the same training section.

*c) Case definition of hearing loss after training:*

- Has a listening threshold of > 20dB at any frequency of 500, 1000, 2000 and 4000Hz.
- Examination of the outer and middle ear was normal with the normal tympanic volume.

**2.2. Research methods**

- Objective 1: a cross-sectional descriptive study design was used.
- Objective 2: Community intervention using double-blind, controlled design

**2.3. Sample size and sample selection method**

**- Objective 1:**

**+ *Sample size***

*The sample size of military soldiers was determined by the following formula:*

$$n = \frac{z^2_{1-\frac{\alpha}{2}} p(1-p)}{d^2}$$

In which: p = 0.125 (rate of hearing loss found by Ho Xuan An's study in armored tank drivers); α = 0.05, $z^2_{1-\frac{\alpha}{2}}$ =1.96; d: the accepted absolute error level is 0.04. The calculated sample size is 263, in fact we collected 315 objects.

**+ *Sample selection***

Selection of environmental noise samples: Measure 15 positions {in the vehicle: position of vehicle commander, driver, gunner and loader (4); outside the vehicle: on the vehicle front (2), on the back part of vehicle (2), turret (1), 10m away from the vehicle (4), 100m away from

the vehicle (1), 200m away from the vehicle (1)} for each time of starting the engine and at the distance from the tank, the average value of noise intensity was taken.

Select sample of soldiers: make a list of soldiers in the unit with numbering. Select a simple random sample using Stata 14 randomization software based on the compiled list.

**- Objective 2:**

***+ Sample size***

The formula for estimating the difference of the two rates according to WHO was applied as follows:

$$n_1 = n_2 = \frac{(Z_{1-\frac{\alpha}{2}}\sqrt{2p(1-p)} + Z_{1-\beta}\sqrt{p_1(1-p_1)+p_2(1-p_2)})^2}{(p_1-p_2)^2}$$

Where: n was the minimum sample size of each intervention and control group; $p_1$ was the rate of hearing loss of the control group after the intervention, p1 = 0.15 was the results from a study by Gordon on hearing loss among the conscripts after training, p2 was the rate of hearing loss of the intervention group at the time of intervention, estimated to be 0.03; p is the mean of hearing loss change rate, $p= \frac{p_1+p_2}{2}$; $Z_{1-\frac{\alpha}{2}}$ = 1,96 (corresponding to reliability of 95%), $Z_{1-\beta}$ = 0,80 (corresponds to a sample force of 80%).

Filling in the values, we have a calculated sample size for each group of 89 subjects. In fact 100 soldiers per group was taken.

***- Sample selection***

+ Out of 2 battalions of armored tank soldiers, one battalion was randomly assigned to the intervention group and other one battalion to the control group.

+ At each selected battalion, a list of recruits was made, then 100 soldiers were randomly selected by computer for each group.

**2.4. Data processing**

Data entry and management system was established. The collected questionnaires were cleaned and entered into the Epi Data 3.0 program. Data were entered twice independently.

Data were analyzed using the STATA 14.0 program. Continuous variable data were checked for normal distribution before analysis. Data with a small sample size (n ≤30) and with non-normally distributed data using non-parametric statistical tests such as the difference between two mean values were tested by the Mann-Whitney test and the Wilcoxon test. Comparison between rates was performed using test $\chi 2$. Univariate and multivariable logistic regression models were also analyzed to find out the model of related factors.

Research results were presented as ratios (%), odds ratios (ORs) in univariate and multivariate analyzes with confidence interval (CI): 95%. $\chi 2$ test, Fisher's exact test were used to find the significant difference.

Incidence rate, relative risk (RR), confidence interval (95% CI) and $\chi 2$ test were calculated to assess the effectiveness of the intervention.

**2.5. Research ethics**

The study has been accepted voluntarily by the study subjects. All subject information is committed to be kept confidential and used for research purposes only. The study design was approved by the Scientific Council of the Armored Tank Command and by the Ethics

Committee in Biomedical Research of the Institute of Hygiene and Epidemiology through IRB-VN01057-26/2017.

## Chapter 3. RESULTS

### 3.1. The current situation of hearing loss and some related factors

3.1.1. ***Actual situation of noise of armored tank vehicles***: The number of noise samples exceeding the accepted standards according to the common sound pressure level at the training ground of the Armored Technical Training School was rated 60.95%. The average overall sound pressure level was 76.08 dBA

3.1.2. General characteristics of the research subject group: The mean age of the study group was 18.94 ± 5.6, of which the highest was 35 years and the lowest was 2 years. Most of the soldiers in the study group had more than 10 years of service in the army, with 94.28% having served in the army for 11-30 years.

3.1.3. Situation of hearing loss among the soldiers served in the Armored Tank Army: Of the 315 soldiers of the armored army, there were 56 people with hearing loss in one ear (17.78%) and 142 people with hearing loss in both ears (45.08%). The rate of hearing loss in both ears increased gradually with age. Rate of hearing loss in both ears was 45.08%. All of soldiers aged over 50 years old have hearing loss. The soldiers of age group of 41 - 50 years old showed to have a high rate of binaural schizophrenia (25.71%) and those of age group of 31 - 40 years old has a high rate of normal hearing capacity (22.54%). The rate of bilateral hearing loss increases gradually with serving age in army. The group of over 30 years serving in army all had hearing abnormalities. The soldiers having more than 11 years of

serving in army has the rate of bilateral hearing loss nearly half (43.81%) and those having single ear hearing loss rated about 17.46%.

**Table 3.10 Clinical symptoms of the soldiers**

| Symptoms | n | % |
|---|---|---|
| Tinnitus | 247 | 78.41 |
| Ear pain | 107 | 33.97 |
| Poor hearing | 187 | 59.37 |
| Headache | 188 | 59.68 |
| Dizzy | 192 | 60.95 |
| Insomnia | 174 | 55.24 |
| Ear discharge | 34 | 10.79 |
| Runny nose | 166 | 52.7 |
| Sore throat | 220 | 69.84 |
| Nervous, heart beating fast | 133 | 42.22 |

Among the symptoms collected through the questionnaire, the tinnitus was with the highest rate (78.41%), and ear discharge accounted for the lowest rate (10.79%).

***3.1.4. The relation between hearing loss rate and some factors***

**Table 3.24. Univariate regression analysis of the relation between hearing loss and some entity factors**

| Factors | | n | % | OR | 95%CI | p |
|---|---|---|---|---|---|---|
| Age group | 21 - 30 | 21 | 6.67 | 0.32 | 0.12 – 0.81 | 0.017 |
| | 31 - 40 | 157 | 49.84 | 0.42 | 0.26 – 0.69 | 0.001 |
| | > 41 | 137 | 43.49 | 1 | | |
| Military serving time | ≤ 10 | 13 | 4.13 | 0.21 | 0.06 – 0.7 | 0.011 |
| | 11 - 20 | 168 | 53.33 | 0.41 | 0.25 – 0.68 | 0.001 |
| | > 21 | 134 | 42.54 | 1 | | |
| History of noise exposure | | 37 | 11.75 | 0.75 | 0.37 – 1.5 | . |

| | | | | | |
|---|---|---|---|---|---|
| Tinnitus | 247 | 78.41 | 2.69 | 1.56 – 4.66 | 0.0004 |
| Ear pain | 107 | 33.97 | 1.85 | 1.12 – 3.05 | 0.017 |
| Headache | 188 | 59.68 | 0.99 | 0.62 – 1.58 | 0.967 |
| Dizzy | 192 | 60.95 | 1.2 | 0.76 – 1.92 | 0.42 |
| Insomnia | 174 | 55.24 | 1.69 | 1.07 – 2.69 | 0.024 |
| Ear discharge | 34 | 10.79 | 3.05 | 1.22 – 7.6 | 0.017 |
| Runny nose | 166 | 52.7 | 1.44 | 0.91 – 2.27 | 0.121 |
| Sore throat | 220 | 69.84 | 1.04 | 0.64 – 1.72 | 0.85 |
| Nervous, heart beating fast | 133 | 42.22 | 1.81 | 1.12 – 2.9 | 0.015 |
| Smoking | 121 | 38,41 | 1,12 | 0,69 - 1,79 | 0,641 |

Among the physical factors listed above, rate of hearing loss was found increased proportionality with age and military serving time with $p<0.05$. The symptoms of tinnitus, insomnia, purulent ear discharge, and cardiovascular disease were significantly associated with hearing loss with $p <0.05$ as the result of univariate logistic analysis.

**Table 3.26 Multivariate regression analysis the association between SGTL with some factors**

| Factors | OR | 95%CI | p |
|---|---|---|---|
| History of noise exposure | 0.79 | 0.39 – 1.62 | 0.53 |
| Insomnia | 1.54 | 0.96 – 2.47 | 0.07 |
| **Symptoms of cardiovascular disease** | **1.63** | **1.1 – 2.66** | **0.04** |
| Smoking | 1.13 | 0.7 – 1.8 | 0.61 |

Result of multivariate regression analysis showed only cardiovascular disease associated with hearing loss, in particular this health problem has which increased the risk of hearing loss 1.63 times (95% CI: 1.1 - 2.66).

### 3.2. Evaluation the effectiveness of Mg-B6 supplement in prevention of hearing loss

**Table 3.27 Common characteristics of control and intervention group**

| Characteristics | Intervention group (n = 100) | | Control group (n = 100) | | p1 |
|---|---|---|---|---|---|
| Mean age | 21.01 ± 1.59 | | 21.17 ± 2.25 | | 0.86 |
| Noise exposure length (hr.) | 0.69 ± 0.74 | | 0.5 ± 0.39 | | 0.02 |
| | n | % | n | % | p2 |
| There is a case of HL in the family | 5 | 5 | 5 | 5 | 1 |
| History of noise exposure | 34 | 34 | 36 | 36 | 0.882 |
| History of head trauma | 5 | 5 | 6 | 6 | 1 |

The average age, family with hearing loss case, history of noise exposure, history of head trauma were not found statistically significant difference between the two groups. Regarding the duration of noise exposure, the statistical significance difference was found between the intervention group and control group.

**Table 3.28. Clinical characteristics of the two groups after the intervention**

| Symptoms | Intervention gr. (n = 100) | | Control gr. (n = 100) | | p |
|---|---|---|---|---|---|
| | SL | % | SL | % | |
| Tinnitus | 37 | 37 | 63 | 63 | 0.002 |
| Poor hearing | 26 | 26 | 53 | 53 | 0.0001 |
| Tired | 44 | 44 | 64 | 64 | 0.005 |
| Headache | 34 | 34 | 63 | 63 | 0.0004 |
| Stress | 25 | 25 | 49 | 49 | 0.0004 |
| Insomnia | 27 | 27 | 53 | 53 | 0.0002 |
| Dizzy | 15 | 15 | 51 | 51 | 0.00001 |
| Stomachache | 17 | 17 | 23 | 23 | 0.29 |
| Diarrhea | 5 | 5 | 10 | 10 | 0.18 |

After the intervention, the symptoms of tinnitus, hearing loss, fatigue, headache, nervousness, insomnia, dizziness in the study group were statistical significantly less than that of control group with ($p<0.01$). However, there was no difference in symptoms of abdominal pain and diarrhea between the two groups.

**Table 3.31. Level of hearing loss of each ear after intervention**

| Hearing loss | Intervention gr. (n = 100) | | | | Control gr. (n = 100) | | | | p (1,2) |
|---|---|---|---|---|---|---|---|---|---|
| | Before Interv. | | After Interv.(1) | | Before Interv. | | After Interv(2) | | |
| | n | % | n | % | n | % | n | % | |
| Right ear | | | | | | | | | |
| Normal | 100 | 100 | 98 | 98 | 100 | 100 | 81 | 81 | 0.0001 |
| Mild | 0 | 0 | 2 | 2 | 0 | 0 | 17 | 17 | 0.0001 |
| Moderate | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 2 | |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Severe | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| Left ear | | | | | | | | | |
| Normal | 100 | 100 | 97 | 97 | 100 | 100 | 78 | 78 | 0.0001 |
| Mild | 0 | 0 | 3 | 3 | 0 | 0 | 20 | 20 | 0.0004 |
| Moderate | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 2 | |
| Severe | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |

The level of hearing loss of each ear between the two groups after intervention was significantly different for mild (21 - 40dB) and for moderate (41 - 60dB).

**Table 3.33. Level of hearing loss of the two groups before and after intervention**

| **Hearing** | **Intervention gr. (n = 100)** | | | | **Control (n = 100)** | | | | **RR (1,2) 95% CI** |
|---|---|---|---|---|---|---|---|---|---|
| | **Before interv.** | | **After interv.(1)** | | **Before interv.** | | **After interv.(2)** | | |
| | **n** | **%** | **n** | **%** | **n** | **%** | **n** | **%** | |
| Normal | 100 | 100 | 96 | 96 | 100 | 100 | 74 | 74 | |
| HL in 1 ear | 0 | 0 | 3 | 3 | 0 | 0 | 11 | 11 | |
| HL in 2ears | 0 | 0 | 1 | 1 | 0 | 0 | 15 | 15 | |
| Total HL | 0 | 0 | 4 | 4 | 0 | 0 | 26 | 26 | 0.15 (0.06-0.42) |

There was a significant difference between the two groups after the intervention in the hearing loss rate. The rate of hearing loss in the control group was 26% and in the intervention group was 4% with the significant difference ($p < 0.001$).

- Rate of hearing loss after intervention of intervented group was 0.04;
- Rate of hearing loss after intervention of control group was 0.26;
- Relative risk RR= $\frac{0,04}{0,26}$ x 100%= 15.38%

The relative risk of hearing loss was 15.38% (95%CI: 0.06-0.42), or the rate of hearing loss was reduced by 84.62% in the intervention group compared with the control group.

# Chapter 4. DISCUSSION

## 4.1. Current situation of noise, hearing loss and related factors among armored tank soldiers in 2017

### *4.1.1. Current situation of noise*

The result of the overall sound pressure measured on the armored tank training ground was 76.08±25.66dB. From the measurement sites and times (total 105 sites of noise intensity measurement), 4/7 sites showed to have negative sound pressure level and 60.95% of measuring points have noise intensity exceeding the allowable threshold (> 85dB). This result showed that the training environment of the research group is largely affected by harmful noise.

### *4.1.2. Status of hearing loss*

*4.1.2.1. General characteristics of the study group*

The average age of the study group was 38.67 ± 5.8. Their mean military serving time was 18.94 ± 5.6. Most of the soldiers have a relatively long working time in the army, with many positions such as teaching staff at the departments, directly training trainees on training grounds, participating in repair the tanks and vehicles … Hearing loss in old age is also called senile hearing. Every year, senile hearing loss can cause 0.5 to 1dB loss of hearing in a person over the age of 50. In the group of >50 years old, there were only 2 cases, accounting for

0.63%, so the influence of senile hearing on the rate of hearing loss was not much.

*4.1.2.2. Rate of hearing loss*

The hearing loss in one ear among study subjects was rated 17.78% and hearing loss in both ears accounted for 45.08%. If consider only the number of binaural hearing loss, we find this number significantly higher than the rate of 12.5% reported in the study of Ho Xuan An when investigated the hearing of 240 crew members of the same armored tank unit in 2003. Toh's study (2002) conducted on 818 Singaporean conscripts showed a hearing loss rate of 3.67% (95% CI 2.48-5.19). Joseph's study (2016) implemented on 16,500 marines showed to have a hearing rate of 39%, lower than rate of hearing loss found in our study. To explain the difference in the results of the reports, we think that because our study examined all the working positions of the three armored units. Besides, the actual hearing loss could be caused by many different causes, not just noise, such as ear, nose and throat diseases; acute or chronic otitis; had surgery on ear due to infection...

***4.1.3. Some related factors to hearing loss***

When analyzing univariate regression with age, military serving time as well as history of noise exposure, we have not found the main cause of hearing loss from these factors. Similarly, the results of Toh's study in 2002 showed that the risk of hearing loss did not differ across age groups, education level, race and frequency of personal audio device use among 818 Singaporean conscripts. According to Leensen (2011), when the noise intensity increased from 80dB to 96dB, the rate of hearing loss increased slightly and the occupational deafness appeared clearly after 10 or more years of working. The factor of noise exposure time was the better predict than the noise intensity.

According to statistics of the US Army in 2012 with 115 638 subjects (9.7%) having symptoms of tinnitus. Research done by James in 2021 on 690 US conscripts and veterans, showed 8% of hearing loss at low frequency (250Hz-2kHz); 20% at high frequency (3-8kHz) and 39% at very high frequency (9-16kHz); tinnitus rate was 53%. Older age and years of service were proportional to hearing loss and tinnitus.

The prevalence of tinnitus in our study was 78.41% and associated with hearing loss according to the results of univariate regression analysis with OR: 2.69 (95% CI 1.56-4.66). The prevalence of tinnitus in our study was much higher than the studies mentioned above. This shows the specific characteristics of the armored tank troops, in addition to the noise emitted by the large-capacity engine, the collision of the chains when the vehicle is running has created a high-intensity noise and affected the ratio of hearing loss as well as symptoms of tinnitus increased. Therefore, in addition to the measures such as using ear caps to protect hearing, it is necessary to develop the measures to reduce engine noise, improve equipment as well as research on proactive preventive drugs to protect hearing for soldiers serving at armored tank force.

Using multivariate regression analysis the relation between some risk factors such as history of noise exposure, insomnia, cardiovascular disease, smoking and hearing loss, we found cardiovascular disease as the associated factor with hearing loss with OR 1.63 (95% CI 1-2.66) and $p < 0.05$. The other factors such as age, military serving age and ENT disease were not included into the analysis to avoid interference effects. According to the literature in the world, many studies have confirmed the relationship between cardiovascular disease and hearing loss. Rostam et al. (2019), through

a meta-analysis from 149 articles related to the risk factors for hearing loss, came to conclusion that the combined effects of the factors were divided into 4 groups: chemical, physical, individual, and occupational such as vibration, CO gas, cardiovascular disease, smoking, age, gender, aging... are related to hearing loss depending on the level. David et al. (2021) have studied 6318 Canadian subjects of 20 - 79 years old and showed the relation between cardiovascular pathology and hearing loss based on blood pressure, biomarkers of cardiovascular disease.

## 4.2. The effectiveness of intervention with Mg-B6 supplement for prevention of hearing loss among the soldiers of the Armored Tank Corps

### *4.2.1. The characteristics of intervention and control groups*

The study subjects included two groups: intervention and control. For each group, the soldiers were randomly selected from 2 battalions of trainees. Concerning the age, both groups were the soldiers participating the same training at the Armored Tank Training Centers so there was not much difference in age ($p>0.05$). In terms of health, they all were known in good health condition through military recruitment examination and health check-up when returning to the unit. All subjects underwent ENT examination, excluding diseases affecting hearing such as ear infections, rhinosinusitis... Exploiting genetic factors, history of noise exposure, history of head injury, no different observation was found between the two groups.

### *4.2.2. The effectiveness of Mg-B6 supplement in prophylaxis treatment for hearing loss due to the noise*

Results of analysis of symptoms after the intervention showed that the subjects in an intervention group that used Mg-B6 supplement have the symptoms such as tinnitus, hearing loss, fatigue, headache,

stress, insomnia, dizziness with significantly lower rate in comparison to that of the control group. For example, tinnitus is a common symptom when exposed to harmful noise. After the intervention, 37% soldiers have had tinnitus in the group using Mg-B6 supplement while those in control group accounted for 63%. According to James (2021), the symptoms of tinnitus were observed among 53% subjects. Mg-B6 drug consists of two components Mg and vitamin B6. Mg has the effect of protecting hearing against the harmful effects of noise due to its neuroprotective and vasodilatory effects, reducing oxidative radical products. Therefore, the rate of symptoms such as hearing loss, fatigue, headache, nervousness, insomnia, dizziness in the Mg-B6 supplement used group were significantly lower than in the control group.

The mean monophonic hearing analysis at 4 PTA frequencies in the two study groups did not show the difference. This is understandable because it takes 6-10 years to develop the occupational deafness [3], [67], so after 6 months of training, there could not be obvious effect on frequencies too be detected. If considering the average value of hearing intensity at 4 representative frequencies, 500Hz, 1kHz, 2kHz and 4kHz, the PTA value was found at normal hearing level. Therefore, it is necessary to study the change in each frequency to be able to detect early cases of "potential deafness" and promptly take appropriate treatment measures.

Thus, if analysis the hearing loss by frequency but not by PTA, the rate of hearing loss by frequency in the Mg-B6 uptaken group was 4% and in the control group was 26% with $p<0.001$. If based on the tympanic results of indirect assessment of middle ear condition, the majority of type A tympanic morphology results are normal, indicating

that the cause of poor hearing at each frequency was due to the cause in the inner ear and to the effect of noise dynamics because both groups were selected without hearing loss risk factors before the training.

According to the results obtained by Attias (2004) et al. in the study conducted on 300 recruits who were exposed to sound when firing a gun with an intensity of 164 dB for the duration of <1ms, there was a permanent increase in hearing threshold - PTS >25 dB at least at 1 frequency of 11.5% in the control group compared to 1.2% in the intervention group. An another study done by Attias et al. in 2003 on 300 recruits with normal hearing who underwent 2 months of basic military training. The subjects were exposed to repeated loud noise levels at training but were equipped with earplugs. They have received either a daily supplement of 167mg of magnesium aspartate or a placebo. Results showed that hearing loss in the placebo group was 28.5% compared with 11.2% in the magnesium uptaken group. The results of our study are more favorable when used with a therapeutic dose of Mg-B6 and continuously monitored for 6 months. Thus, these researches also analysis the change in hearing according to frequency and due to the characteristics of the armored tank troops, there is a difference with the subjects involed in above mentioned studies.

In summary, the effect of Mg-B6 supplement has proven by the reduce of relative risk of hearing loss in the intervention group by 15.38% of that of control group, or the risk of hearing loss decreased by 84.62% in the intervention group compared with that of the control group.

## CONCLUSION

### 1. Current status of hearing loss and related factors in the soldiers of Armored Tank Troops in 2017

***The actual noise condition of armored tanks***

- The average sound pressure level measured on the armored tank training ground was 76.08 ± 25.66 dBA.
- At the time when tanks were running, the measured noise obtained in the tank was the highest (111 dB), followed by noise level a of negative 102 dBA measured in the car when the tanks were at the place but started engine. At the time of firing with real bullets, the noise levels measured at all frequencies exceeded the measuring range of the machine (>120dB) and were all at a noise level that is harmful to hearing.

***Common characteristics of study subjects***

- The mean age of the soldiers participating in this study was 38.67 ± 5.8. The majority of them was between the ages of 31 and 50 years old (92.7%).
- The mean service duration length of the soldiers was 18.94 ± 5.6 years with the majority of them had more than 10 years of service in the military (94.28%).

***Current status of hearing loss among the soldiers of armored tank army***

- Rate of hearing loss in one ear was 17.78% and in both ears was 45.08%, poor hearing in at least one ear was 62.86%.
- Rate of hearing loss in both ears increases with age and military service duration length. Hearing loss at all frequencies was mild, but at 4000Hz, the hearing threshold has the greatest reduction value. Pure-tone average (ATP) measurement of both ears indicated the hearing loss of mild level. There was no difference in hearing loss between right and left ear ($p > 0.05$). Most of the soldiers (>49%) was observed with mild hearing loss (21 - 40dB).

- The most common clinical symptoms were tinnitus (78.4%), sore throat (69.8%), and dizziness (61%).

***The knowledge, attitude and practice of the armored tank soldiers:***

- The rate of soldiers understanding about the harmful effects of occupational deafness on health in general as well as on hearing in particular was high (88 - 89%), however, 26.03% indicated that occupational deafness can be cured.
- Although most of soldiers (97.78%), claimed that the annual health check-up is necessary, but only 0.3% express the necessarily of periodical hearing examination.
- The percentage of research subjects who sometimes or do not wear hearing protection helmets when performing work was quite high (30.15%). 15.24% evaluated the poor quality of the helmet.

***The factors related to hearing loss***

- Rate of hearing loss was found increased proportionally with age and military service duration ($p < 0.05$).
- The symptoms of tinnitus, insomnia, ear discharge, cardiovascular disease showed to increase the risk of hearing loss, in univariate analysis. With multivariate analysis, there was only one factor, cardiovascular disease manifestations increase the risk of hearing loss with OR = 1.63 (95% CI: 1.1 - 2.66)

**2. Supplementation of Mg-B6 was evaluated effective in preventing hearing loss**

- It reduced symptoms of tinnitus, hearing loss, fatigue, headache, nervousness, insomnia, dizziness in the intervention group compared with the control group ($p<0.01$)

- It significantly reduced hearing threshold of the subjects in the intervention group ($p<0.01$).
- It reduced the rate of hearing loss of each ear after the intervention

It significantly reduced the rate of hearing loss in the intervention group (4%) compared with that in the control group (26%) ($p<0.001$). The relative risk of hearing loss was 15.38% (95% CI: 0.06-0.42), or the rate of hearing loss was reduced by 84.62% in the intervention group compared with the control group.

## RECOMMEDATION

1. It is necessary to strengthen communication in order to improve the knowledge, attitude and practice of the soldiers serving in the Armored Tank Troops on the prevention of hearing loss.
2. Military personnel at high risk of exposure to noise should be screened for hearing loss every 6 months, maintained in management records, and monitored for long-term audiometric results for early detection of cases with clinical manifestations and hearing loss for timely treatment.
3. Use the Mg-B6 supplement for people at risk of exposure to harmful noise to prevent noise-induced hearing loss.

## LIST OF PUBLISHED SCIENTIFIC ARTICLES RELATED TO THE THESIS

1. Nguyen Tai Dung, Doan Thi Thanh Ha, Nguyen Tran Hien. "Current status and some factors related to hearing loss among soldiers of armored tank troops in 2017" – *Journal of Vietnam Preventive Medicine, Vol.*28 (11), 2018.

2. Nguyen Tai Dung, Doan Thi Thanh Ha, Nguyen Tran Hien. “The effectiveness of intervention for prevention of hearing loss using Mg-B6 supplement among the armored tank forces” – Journal of Vietnam Preventive Medicine, Vol. 30 (5), 2020.