The Effect of a Web-Based Occupational Noise-Induced Hearing Loss Prevention Program on Hearing Protection Device Behavior Among Thai Navy Officers: A Quasi-Experimental Study

Suthasinee Srinoon, Weeraporn Suthakorn, Petsunee Thungjaroenkul, Pratum Soivong, Atipong Sujiratana*

Abstract: Navy officers working on the coastal guard vessels risk hearing loss due to repeated exposure to high noise levels from ship engines. Therefore, proper use of hearing protection devices is important. In this study, a web-based hearing loss prevention program was developed to promote the behavior of the use of hearing protection devices among Thai navy officers working on coastal guard vessels. In total, 152 navy personnel were recruited based on selection criteria and randomly assigned to the experimental (n = 76) and control groups (n = 76). The participants in the experimental group received the hearing loss prevention program via a website over four weeks. After completing the program, hearing protection device behavior was evaluated by a self-report questionnaire immediately after and at eight weeks follow-up.

The results showed significantly increasing scores of the use of hearing protection devices behavior within the experimental group, both immediately and eight weeks after the program completion. However, there were no significant differences in the scores when comparing between groups, even though the scores of the experimental group were better than those in the control group. The restrictions could be explained by some emerging events during the implementation period, including the COVID-19 pandemic followed by a massive oil spill incident at sea. These put an extra workload on the study participants. Most importantly, there was a problem with the network connection that might have affected the continuation of participant attention to the program. Although this study found no effective results of the developed program due to some limitations, nurses can adopt this protective intervention to reduce the risk of occupational noise-induced hearing loss among Navy officers. Therefore, a recommendation for further study is to develop an intervention program that considers both the working context of the coastal vessels and appropriate participation methods that require more challenging efforts.

Keywords: Hearing devices behavior, Hearing protection, Motivation theory, Navy personnel, Web-based program

Received 4 April 2023; Revised 10 August 2023; Accepted 11 August 2023

Suthasinee Srinoon, *RN, MSc, Faculty of Nursing, Chiang Mai University, Chiang Mai, Thailand. E-mail: suthasinee_srinoon@cmu.ac.th*
Correspondence to: Weeraporn Suthakorn,* *RN, PhD, Associate Professor, Faculty of Nursing, Chiang Mai University, Chiang Mai, Thailand. E-mail: weeraporn.s@cmu.ac.th*
Petsunee Thungjaroenkul, *RN, PhD, Associate Professor, Faculty of Nursing, Chiang Mai University, Chiang Mai, Thailand. E-mail: petsunee.t@cmu.ac.th, petsunee@gmail.com*
Pratum Soivong, *RN, PhD, Dip APNMSN, Associate Professor, Faculty of Nursing, Chiang Mai University, Chiang Mai, Thailand. E-mail: pratum.soivong@cmu.ac.th, pratum90@gmail.com*
Atipong Sujiratana*, MD, MSc, Captain, Maritime Medicine Group, Somdech Phra Pinklao Hospital, Naval Medical Department. E-mail: dr_atipong@hotmail.com, dr.atipong@gmail.com*

Introduction

The prevalence of hearing loss is often between 20% and 60% higher in the military community than in the general population. Many people believe that noise exposure during service is the greatest risk factor for hearing loss.[1] The significant impact of exposure

DOI: 10.60099/prijnr.2023.262221

to intensive and continuous noise causes auditory fatigue and further damage to the hearing system. In the Royal Norwegian Navy, it was found that the prevalence and incidence of hearing loss were 35% and 23%, respectively.[2] In Thailand, in the Royal Thai Fleet, in a study, there were 46.5% of ship officers exposed to loud noises,[3] and 31.25% had hearing loss.[4] The impact of occupational noise-induced hearing loss (ONIHL) is a public health burden that affects individuals, the workplace, and the economy.[5]

Hearing conservation programs are defined as part of occupational safety policies in many countries. Occupational health nurses collaborate with other health-related personnel[6] to develop and maintain a hearing conservation program. A major role of nurses is protecting workers from noise hazards by promoting ONIHL prevention by providing knowledge based on hearing loss prevention activities for noise-exposed personnel and reducing the risk of ONIHL.[7] Hearing screening is the specific function of nurses to assess the individual hearing level and case finding of workers with abnormal hearing, as well as health surveillance efforts for identifying hearing loss from noise exposures.[8]

A hearing prevention program is considered an essential approach to preventing ONIHL of navy personnel while working on vessels. The Thai navy officers, whose working context is different from other occupations, did not have a specific hearing prevention program, so this population required urgent action to help prevent ONIHL. Thai navy officers need to receive early detection of noise-induced hearing loss and lack knowledge and awareness of noise hazards and the importance of hearing protection devices.[9] However, a previous study found that naval personnel had limitations about selecting hearing protective devices (HPD), which vary depending on an individual's working environment and physical needs.[10] The HPDs may not be used effectively. Poorly trained and unsupervised individuals led to not being able to achieve adequate attenuation when using HPDs.[11,12] In the Thai Navy, hearing conservation is implemented only with elements such as a walk-through survey to identify health risks and health examination based on the identified risks, providing large group health education about basic occupational health and occupational diseases.[4]

Computers can assist in providing health education by adapting communication methods that are designed based on the platforms of each website or software application.[13,14,15] Previous studies found that providing health education via those platforms improved understanding and enhanced attention regarding health information.[16,17] Therefore, the web-based occupational noise-induced hearing loss prevention program (WB-ONHL-PP) was developed. It tested the effectiveness of hearing protection devices (HPDs) behavior among Thai navy officers working on the coastal guard vessels.

Conceptual Framework and Literature Review

The protection motivation theory (PMT)[18] is used to understand fear appeals by focusing on how workers act and cope during exposure to intensive and continuous noise at the workplace. In the workplace, workers can be motivated to take a particular action and divert behavior through the threat of impending danger or harm by arousing fear. This study applied PMT to the ONIHL prevention program to enhance the wearing of HPDs among Thai navy officers working on the coastal guard vessels. PMT's key components include perceived severity, vulnerability, response efficacy, self-efficacy, and response costs. Individuals' perceived severity of exposure to loud noise in their workplace and their probability of occupational noise-induced hearing loss inhibited adaptive responses.

The program provides information to arouse the perceived vulnerability of ONIHL, and the aim is to cause Thai navy officers to recognize its seriousness as it can lead to the problem of hearing ability, changing hearing threshold shift, and even complete hearing loss. Perceived vulnerability of occupational noise-induced

hearing loss could increase if such officers see their audiometric tests and are provided meaningful feedback about their hearing results, which caused the Thai navy to perceive the likelihood of experiencing a risk from exposure to intensive and continuous noise while working on the coastal guard vessels. Regarding response, efficacy is the belief about the effectiveness of recommended hearing prevention action. The confidence that one can perform the recommended behavior increases the vulnerability of an adaptive response. Self-efficacy is the belief that one can achieve the recommended action and successfully execute hearing prevention. While perceptions of response efficacy and self-efficacy increase the probability of an adaptive response, response costs may decrease the use of HPD. Thus, increasing the response efficacy and self-efficacy to perform hearing protective behavior and decreasing response costs to perform hearing protective behavior were used in training and encouraging strategies.

Results from a meta-analysis showed that several programs led to significantly increased use of HPD among workers.[19] However, there are some limitations. When exposed to loud noise levels in the workplace, workers still do not always wear HPD.[13,17,20] Moreover, they had less perception to recognize high noise levels in the workplace, risk justification of excuses for not wearing hearing protection devices and HPD constraints to the uncomfortable nature of using HPD over time following the training program.[20] Some naval personnel found limitations in using HPD, such as selecting the type of HPD that is not appropriate for loud noise levels, fitting and cleaning the equipment, and using HPD when exposed to loud noise inconsistently.[9] Most of the progression of occupational hearing loss is gradual in which the timing of possible damage is uncertain and not visible.[21] Hence, enhancing the use of HPD by workers is a cost-effective prevention method.

Preventing strong noise exposure is very important. The prevention of ONIHL in the workplace focuses on individual prevention using hearing protective equipment.[22] Duration of program implementation was 30-60 minutes for education and training sessions.[17,20] Shortest follow-ups were conducted two months after completing the intervention.[23] These programs led to a significant increase in the use of HPDs. Nevertheless, there are some limitations of the program for improvement in the use of HPDs in naval personnel, which provides large group education, while operating via computer-based training and website is only one-way communication and lacks individual, meaningful feedback.[11,12]

Study Aim and Hypotheses

This study aimed to test the effectiveness of a Web-Based Occupational Noise-Induced Hearing Loss Prevention Program (WB-ONHL-PP). The following hypotheses were set: Thai navy officers working on the coastal guard vessels who received the WB-ONHL-PP would have a significantly higher score of behavior using HPD than those who did not receive the program measured immediately and eight weeks after completing the program, as well as significantly higher scores than before receiving the program.

Methods

Design: A quasi-experimental research design, pre-posttest design, was employed. The writing of this report was guided by the TREND Statement Checklist on Transparency Reporting of Evaluations with Nonrandomized Controlled Trials.

Sampling and Settings: The accessible populations were navy officers of the Coastal Guard Division working on coastal guard vessels' three sections at the Royal Thai Navy base in the Eastern region of Thailand. The inclusion criteria were 1) navy officers, who had experienced working on coastal guard vessels longer than six months, 2) had never participated in another hearing prevention program for at least six months, 3) had computers or smartphones, and 4) passed screening ability in using technology for learning more than 60% of the scores measured by Technology Proficiency Self-Assessment (TPSA).[24]

The sample size was calculated by using power analysis. The G*Power program was used to impose the sample size. The power was 0.8, the significance level was 0.05, and the effect size was 0.43.[23] The sample size was 68 per group. According to a previous study, a 10% dropout rate was added. Therefore, the sample size of each group was 76 participants. The participants who met inclusion criteria were stratified based on age group (3 levels: 21-30 years old, 31-40 years old, and 41-50 years old) and education level (lower than a bachelor's degree, equal to and greater than a bachelor's degree). After that, they were randomly assigned to the experimental and control groups in equal numbers. At the end of this study, 12 participants did not respond to the posttest, leading to the final number of study participants 140 (71 and 69 in the experimental and control groups, respectively), as shown in **Figure 1**.

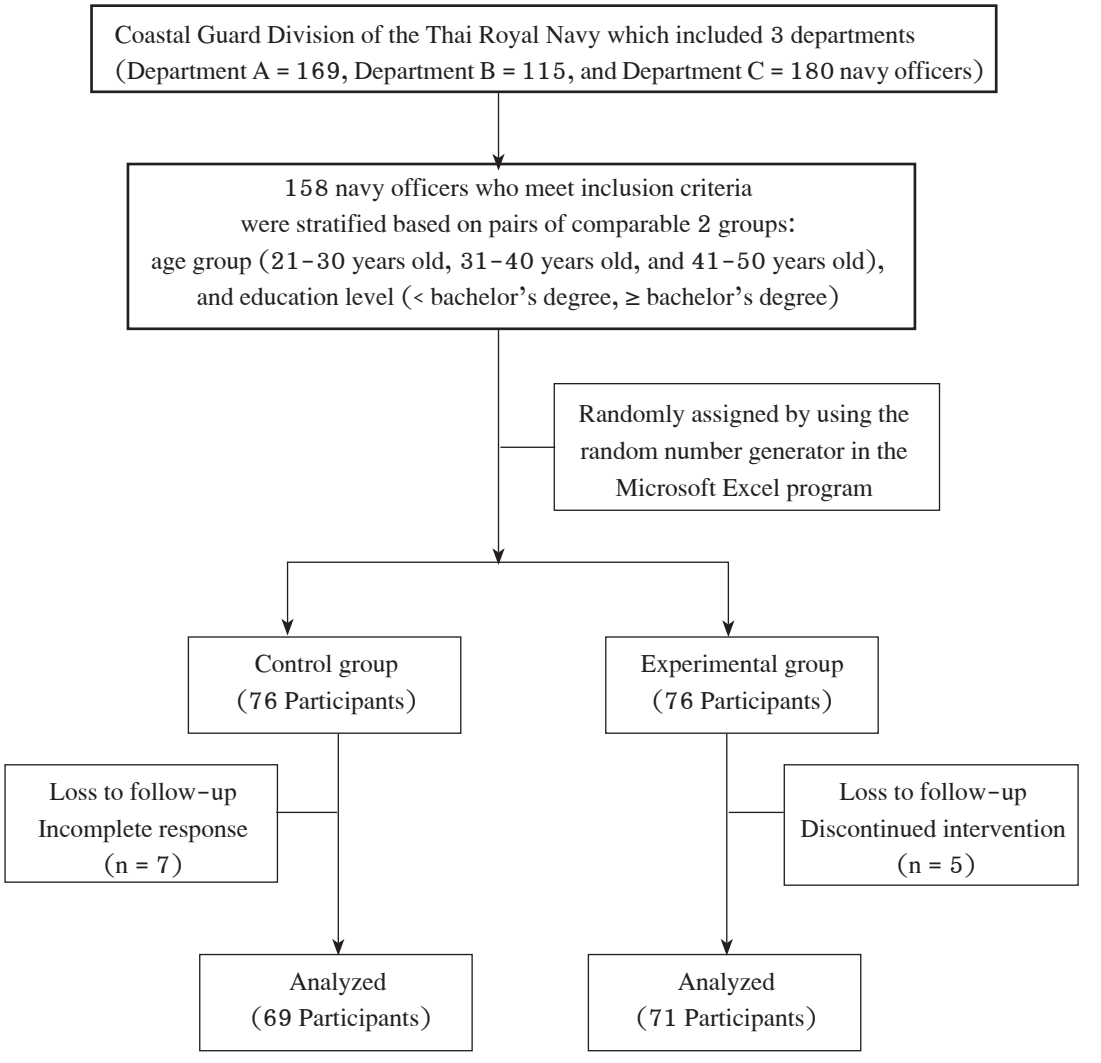

Figure 1. Flow diagram of participants of this study

Ethical Considerations: The Committee of Human Research of the Research Ethics Office approved the research proposal, Faculty of Nursing, Chiang Mai University (Study code: 2564-EXP088). All participants were informed about the study's purpose, research procedures, the time to complete the questionnaires, risks, and benefits. Before data collection, the participants gave written informed consent and had the right to refuse participation or withdraw at any point.

Research Instruments: These were of two parts: 1) the instruments for data collection and 2) the intervention program. Instruments for data collection were a demographic data form and the self-report questionnaire using HPD. The intervention program was the Web-Based Occupational Noise-Induced Hearing Loss Prevention Program (WB-ONHL-PP).

Demographic data included age, education levels, working positions, working experience on the vessels, and history of receiving other hearing prevention programs.

The Self-report Questionnaire of Hearing Protection Devices Behavior (SrQ-HPDB) This questionnaire was developed by Tantranont[25] and used to evaluate behavior using HPDs. It consists of seven items, including six positive and one negative item. An example of a positive item is "*You check the readiness of hearing protection devices before use,*" and of a negative item, "*When your hearing protection device is old or damaged, you continue using it.*" Responses for all items were based on three rating scales: 3 (consistently used), 2 (occasionally used), and 1 (never used). The negative item was reversed before summing the total score. The range of possible total scores was 7 to 21. There were three cut-off score levels: 17-21, 16-16, and 7-11, indicating high, moderate, and low levels of the use of HPDs behaviors, respectively. The reported content validity index (CVI) was 0.80.[25] Internal consistency reliability was tested in 30 navy officers working on coastal guard vessels with similar characteristics to the target population, and the value was 0.83.

The Web-Based Occupational Noise-Induced Hearing Loss Prevention Program (WB-ONHL-PP) was an interactive website providing health education and training skills in HPDs use. The program was developed based on the protection motivation theory.[18] Development process consisted of six steps:[26,27] 1) a literature review, 2) program design, 3) development of instructional strategies, 4) drawing on lessons learned, 5) program delivery, and 6) pilot testing.

This program consisted of three sessions over four weeks: Session 1 increased perceived vulnerability and severity, Session 2 increased self-efficacy, and Session 3 maintained self-efficacy and decreased response costs. This program applied four strategies: information dissemination, feedback, demonstration, and encouragement. The content validity was reviewed by six experts, including two nursing instructors, two occupational physicians, and two occupational health nurses. Recommendations from these experts were adopted to improve the content of the program. Details of the implemented session in the program are shown in **Appendix, Table 1.**

The WB-ONHL-PP was pilot-tested to evaluate satisfaction in 28 navy officers working on coastal guard vessels with similar characteristics to the target population. Results showed that 35.7% were most satisfied, and 53.6% were delighted with the program, including accessibility, content, and user-friendly characteristics. Therefore, the program was favorable and suitable for the study.

Data Collection: This study was conducted from November 2021 to July 2022. After receiving IRB approval, an official letter was written requesting permission from the Coastal Guard Division Director at the Royal Thai Navy to conduct a study. The letter described the research objectives, the process of the program, methods, research benefits, potential risks, and the protection of human rights. After receiving permission, the commanders of the target vessels were contacted and asked for their coordination and facilitation with the study program. An occupational health nurse at the Royal Navy hospital was trained as a research assistant to assist in the only process of data collection, both pre-and posttest. The experimental group participated in each session of the study program,

while the control group received only routine health services from an in-house healthcare setting. After completing the program, both groups were asked to complete posttest *SrQ-HPDB* twice, immediately after and eight weeks after. After data collection, participants in a control group were given educational material containing ONIHL information, related regulations, and preventive measures.

Data Analysis: Data were analyzed using descriptive statistics. The use of HPDs behavior scores was non-normal distributed. Therefore, the Mann-Whitney U test was used to compare the use of HPDs behavior scores within the experimental and control groups at baseline, immediately, and eight weeks after completing the intervention. In addition, the Friedman and Wilcoxon signed-rank tests were used to compare the use of HPDs behavior scores between groups.

Results

The participants were male, with an average age of 35.86 years for those in the experimental group and 35.11 years in the control group. Participants had obtained vocational certificates, 76.06% in the experimental and 75.36% in the control group. Most in both groups worked as navigators at 76.06% and 75.36%, respectively. Regarding the working duration, most in both groups had been working for 1- 5 years (60.56% for the experimental and 44.93% for the control groups), with an average working duration of 7.78 years for the experimental and 9.49 years for the control groups. A comparison of these characteristics between both groups using the chi-square test showed no significant differences, as shown in **Table 1.**

Table 1. Comparison of demographic characteristics between groups

Variables	Experimental group (n = 71)		Control group (n = 69)		χ^2	p-value
	Number	Percentage	Number	Percentage		
Age (years)					.161	.984
21-30	33	46.48	32	46.37		
31-40	7	9.86	6	8.70		
41-50	24	33.80	25	36.23		
51-60	7	9.86	6	8.70		
	Mean = 35.86	SD = 10.56	Mean = 35.11	SD = 10.44		
Education					.009	.924
Certificate	54	76.06	52	75.36		
Bachelor's degree	17	23.94	17	24.64		
Responsibility					1.403	.496
Navigators	27	38.02	33	47.82		
Communication	36	50.70	30	43.48		
Machinery	8	11.28	6	8.70		
Working period					3.528	.171
1-5 years	43	60.56	31	44.93		
6-10 years	10	14.09	15	21.74		
>10 years	18	25.35	23	33.33		
	Mean = 7.78	SD = 8.27	Mean = 9.49	SD = 8.92		

The median scores of the use of HPD behavior in the experimental group increased from 15 at baseline to 18 immediately after completing the program and slightly decreased in the following eight weeks. When comparing each point measurement within each group, the results indicated that median scores of the use of HPD behavior in the experimental group significantly increased immediately and eight weeks

after ending the program compared to the baseline. Similar results were also found in the control group, for which scores were significantly increased between baseline and immediately after the program ended (**Table 2**). Finally, comparing the use of HPDs behavior scores between those two groups, the results showed no significant differences at any measurement point (**Table 3**).

Table 2. Comparison of the use of HPDs behavior scores within the group at each point measurement

Group	Baseline	Immediately after completing the program	8 Weeks after completing the program	χ^2	p-value
	Median (IQR)	Median (IQR)	Median (IQR)		
Experimental Group	15.00	18.00	16.00	23.123	<.001
	3.00	4.00	3.00		
Control Group	15.00	17.00	16.00	6.617	.037
	3.00	4.50	4.00		

Note. IQR = interquartile range

Table 3. Comparison of the use of HPDs scores between the experimental and the control groups

Hearing protective behavior	Experimental group	Control group	Mann-Whitney U	p-value
Baseline				
Median	15.00	15.00	2396	.820
IQR	3.00	3.00		
Immediately				
Median	18.00	17.00	2230	.357
IQR	4.00	4.50		
At 8 weeks				
Median	16.00	16.00	2029	.076
IQR	3.00	4.00		

Note. IQR = interquartile range

Discussion

Results from this study showed that the hearing protection behaviors of the experimental and control groups were not significantly different after completing the program at the 4-week and 8-week follow-up points. The HPD scores within both groups increased immediately after completing the program but slightly decreased at eight weeks. This may be due to threat appraisal, the cognitive process that individuals use to estimate the level of threat.[28] The first-time participants received ONIHL information may have stimulated a high fear level, and led to increases in perceived severity and susceptibility, which had an effect on the score for using HPDs immediately after completing the program. When we followed up at eight weeks, participants had been receiving the same information for a while. Therefore, the fear level of harmful events involving excessive noise on the vessel may have decreased. These results are consistent with a systematic review of protection motivation theory. It was reported that the intervention message was effective at increasing

the severity of exposure to threats in the environment, but there was no impact on intention or behavior change.[18] Consistently testing the effect of the video message for increasing severity and susceptibility to threats from the environment did increase intention and protection behavior to reduce threats,[29] therefore, individuals with high fear levels reported less fear in post-experimental manipulation.[18] These results could be due to a major unexpected and uncontrolled event during the study. During the middle of the implementation of the study program, there was a massive oil spill in the Gulf of Thailand.[30] The study participants from both groups had to join the clean-up operation for several weeks. They were commanded to protect themselves well by wearing protective equipment, including HPDs when working on the ships. Military personnel were strictly trained from the first day to obey orders without question.[31] This led to higher scores of HPD use behavior in both groups right after the end of the study program. Their improved behavior resulted from the command of higher authorities, not from their internal perception of severity and vulnerability; their behavior scores dropped when the situation became normal, at about the follow-up point eight weeks after the study program. That means response efficacy may not have occurred since it is a belief in the effectiveness of recommended prevention action to perform the adaptive response.[18]

An additional uncontrolled event during the program implementation was the COVID-19 pandemic, which could be another issue affecting the attention span among participants in the experimental group. They had to participate in a series of online education sessions regarding self-protection at work, but some of them delayed or canceled taking the implemented program session as planned, especially in the last session at the 3rd and 4th weeks. These session activities were set for the maintenance of self-efficacy. A systematic review of factors influencing hearing protection device usage among industrial workers found that response efficacy and self-efficacy were low if the worker perceived high barriers.[32]

However, the internet signal in the vessels at that time was quite low due to heavy internet usage during the pandemic. This led to a problem with the ability of the logical algorithm system to provide interactive feedback. Although the website system was always available, the period for learning how to use it was limited, and the auto feedback function did not respond right away. Instead, alternative ways of communication, like the LINE application and text messages, were used to send a short message directly to the participants. Slow download speeds were associated with limited interest in the content and limited intention to act after they read the information and watched the videos. A study that could support this found that 40% of mobile users abandon a site if pages take over 3 seconds to load.[34] Moreover, only one-third of the participants were most satisfied with the WB-ONHL-PP. This might be one reason for low engagement with the program.

In conclusion, intervention findings from this study did not support the application of the PMT in promoting the use of HPDs among navy officers working on coastal vessels of the Royal Thai Navy. However, major external events intervened in the study implementation, leading to non-significant findings. Designing interventions to suit the working conditions of these participants is challenging. Understanding the context of the ship's work and involving the participants in the design of activities may help researchers design interventions appropriate for their work context.

Limitations

The limitation of this study comes from external factors that make the sample unable to participate in activities for the specified period. Although we tried to modify the program activities so that the participants could receive full intervention, interactive and feedback activities did not effectively occur, leading to insufficient persuasive communications. A further study should be well-planned to manage these gaps.

Conclusions and Implications for Nursing Practice

The findings have two significant implications for practice. Firstly, this study described the content explicitly focused on high-risk Thai navy officers working on coastal guard vessels, which was appropriate to their needs and the nature of working on ships. Military personnel or workers could access the website by smartphone. WB-ONHL-PP was designed to be learned within a fixed timeframe to enhance ease of availability and autonomous application. Secondly, this study provides information dissemination, feedback, demonstration, and motivation strategies to generate an effective program to enhance the use of HPD in military personnel exposed to exceedingly loud noises in their working environments. Even though the intervention was not effective in this study because of many limitations, further studies are required to attempt to implement the program in more controlled situations. After these, nurses working in occupational health departments may be able to integrate the intervention protocol of the program as a routine intervention.

Acknowledgments

The publication of this study was supported by the 1st International Conference in Palliative Care and Family Health Nursing, June 26-27, 2023, Faculty of Nursing, Thammasat University.

References

1. Orru H, Luha A, Pindus M, Jõgeva R, Vahisalu M, Lekk U, et al. Hearing loss among military personnel in relation to occupational and leisure noise exposure and usage of personal protective equipment. Noise Health.2020; 22(107):90-8. doi: 10.4103/nah.NAH_12_19.
2. Irgens-Hansen K, Baste V, Bråtveit M, Lind O, Koefoed VF, Moen BE. Hearing loss in the Royal Norwegian Navy: a longitudinal study. Noise Health. 2016;18(82):157-65. doi: 10.4103/1463-1741.
3. Chanchang C, Sithisarankul P, Sangsuwan S. Comparison of prevalence and associated factors of hypertension between ship officers and In-land officers of the Royal Thai Navy. RTNMD journal. 2018;45(1): 154-69 (in Thai).
4. Abhakornkiartiwong Hospital. Report of the working environmental assessment of Luang Samae San ship. Occupational Health Department Abhakornkiartiwong Hospital; 2019 (in Thai).
5. Neitzel RL, Swinburn TK, Hammer MS, Eisenberg D. Economic impact of hearing loss and reduction of noise-induced hearing loss in the United States. J Speech Lang Hear Res. 2017;60(1):182-9. doi: 10.1044/2016_JSLHR-H-15-0365.
6. Health Promotion and Productivity in the Workplace: The Occupational and Environmental Health Nurse Role in Supporting the Workforce Using NIOSH's Total Worker Health® Approach. Workplace Health Saf. 2021; 69(2):93-5. doi: 10.1177/2165079920967811.
7. Navy and Marine CORPS Public Health Center. Navy and Marine Corps Public Health Center Technical Manual: Navy Medicine Hearing Conservation Program Technical Manu. Portsmouth: Navy and Marine CORPS Public Health Center; 2020. Contract No.: MCPHC TM-6260.51.99-3.
8. Roger B. Occupational and environmental health nursing: concept and practice. 2 ed. Philadelphia: WB Saunders; 2003.
9. Klaiklueng C. Development of a hearing screening system for navy personnel. Naval War College, Thai Royal Naval Education Department; 2015 (in Thai).
10. Federman J, Karch SJ, Duhon C. How hearing conservation training format impacts personal attenuation ratings in U.S. Marine Corps Training Recruits. Int J Audiol. 2021;60(2): 151-9. doi: 10.1080/14992027.2020.1811407.
11. Beamer S, Gagne C, Chada N, Mehta H, Piper S, Wong G, et al. Effectiveness of hearing loss prevention education for active-duty military personnel: a preliminary study. Perspectives of the ASHA Special Interest Groups. 2020;5(3):684-98. https://doi.org/10.1044/2020_PERSP-19-00076.
12. Weathersby P, McCluskey J, Huebner H, Marshall L. Success of custom hearing protection devices within an enhanced hearing-conservation program aboard a US navy warship. Naval Submarine Medical Research Lab Groton CT. Groton United States;2018. Technical Report No.: AD1065317. Available from: https://apps.dtic.mil/sti/citations/AD1065317

13. Hong O, Chin DL, Fiola LA, Kazanis AS. The effect of a booster intervention to promote hearing protection behavior in operating engineers. Am J Ind Med. 2013;56(2): 258-66. doi: 10.1002/ajim.22091.
14. Im EO, Chang SJ. Web-based interventions in nursing. Comput Inform Nurs. CIN. 2013;31(2):94-102. doi: 10.1097/NXN.0b013e3182771868.
15. Gupta S, Xu X, Liu W, Zhang J, Kelly S. Integrating user voice in hearing care with focus on off-duty warfighter. Mil Med. 2021 Jan 25;186(Suppl 1): 709-15. doi: 10.1093/milmed/usaa307.
16. McCullagh MC, Ronis DL. Protocol of a randomized controlled trial of hearing protection interventions for farm operators. BMC Public Health. 2015 Apr 18;15:399. doi:10.1186/s12889-015-1743-0.
17. McCullagh MC, Banerjee T, Cohen MA, Yang JJ. Effects of interventions on use of hearing protectors among farm operators: a randomized controlled trial. Int J Audiol. 2016;55 Suppl 1(0):S3-12. doi: 10.3109/14992027.2015.1122239.
18. Kothe E, Ling M, North M, Klas A, Mullan BA, Novoradovskaya L. Protection motivation theory and pro-environmental behaviour: a systematic mapping review. Aust J Psychol. 2019 Nov; 71(4):411-32. doi: 10.1111/ajpy.12271.
19. El Dib RP, Mathew JL, Martins RH. Interventions to promote the wearing of hearing protection. Cochrane Database Syst Rev. 2012 Apr 18;(4):CD005234. doi:10.1002/14651858.CD005234.pub5.
20. Reddy R, Welch D, Ameratunga S, Thorne P. An ecological approach to hearing-health promotion in workplaces. Int J Audiol. 2017;56(5):316-27. doi: 10.1080/14992027.2016.1271467.
21. Natarajan N, Batts S, Stankovic KM. Noise-induced hearing loss. J Clin Med. 2023 Mar 17;12(6):2347. doi: 10.3390/jcm12062347.
22. Sliwinska-Kowalska M. New trends in the prevention of occupational noise-induced hearing loss. Int J Occup Med Environ Health. 2020 Oct 20;33(6):841-8. doi: 10.13075/ijomeh.1896.01600.
23. Tikka C, Verbeek JH, Kateman E, Morata TC, Dreschler WA, Ferrite S. Interventions to prevent occupational noise-induced hearing loss. Cochrane Database Syst Rev. 2017;7(7): Cd006396. doi:10.1002/14651858.CD006396.pub4.
24. Office of the Basic Education Commission. Technology Proficiency Self-Assessment questionnaire for screening ability in using technology for learning. Thailand: Office of the Basic Education Commission, Ministry of Education; 2013 (in Thai).
25. Tantranont K. Hearing loss of workers and the use of hearing protective devices: case study in large food canning industry [master's thesis]. [Chiang Mai, Thailand]: Chiang Mai University 2004. (In Thai).
26. Craig P, Dieppe P, Macintyre S, Michie S, Nazareth I, Petticrew M; Medical Research Council Guidance. Developing and evaluating complex interventions: the new Medical Research Council guidance. BMJ. 2008;337: a1655. doi: 10.1136/bmj.a1655.
27. Chee W, Lee Y, Chee E, Im EO. Practical guidelines for development of web-based interventions. Comput Inform Nurs. 2014 Oct;32(10):504-11. doi: 10.1097/CIN.0000000000000088.
28. Conner M, Norman P. Predicting and changing health behavior: research and practice with social cognition models. 3 ed. UK: Open University Press; 2015.
29. Chen M-F. Impact of fear appeals on pro-environmental behavior and crucial determinants. Int J Advert. 2016;35(1): 74-92. https://doi.org/10.1080/02650487.2015.1101908.
30. Perawongmetha A. Oil spill reaches shoreline in eastern Thailand. 2022 Jan 29 [updated UpToDate; 2023 [cited 2023 July 8]. Available from: https://www.reuters.com/world/asia-pacific/oil-workers-race-protect-beaches-spill-off-thai-coast-2022-01-28/
31. Bonadonna R. On obedience: contrasting philosophies for the military, citizenry, and community [book review]. Ethics Int Aff. 2021;35(2):313-5. Available from: https://doi.org/10.1017/S0892679421000319 Review of: Kaurin PS, editor. Annapolis: Naval Institute Press; 2020.
32. Capa-Aydin Y, Uzuntiryaki-Kondakci E, Ceylandag R. The relationship between vicarious experience, social persuasion, physiological state, and chemistry self-efficacy: the role of mastery experience as a mediator. Psychol Sch. 2018;55(10):1224-38. https://doi.org/10.1002/pits.22201
33. Fauzan NS, Sukadarin EH, Widia M, Irianto I, Ghazali I. A systematic literature review of the factors influencing hearing protection device usage among industrial workers. Int J Environ Res Public Health. 2023 Feb 8;20(4): 2934. doi: 10.3390/ijerph20042934.
34. Anderson S. How fast should a website load in 2023? 2023 July 31 [cited 2023 July 26]. Available from: https://www.hobo-web.co.uk

Appendix

Table 1. Intervention protocol of Web-Based Occupational Noise-Induced Hearing Loss Prevention

Session	Activities
Session 1. (Week 1) Increase perceived vulnerability and perceived severity. (20 minutes) **Objective** - To increase the perceived vulnerability to occupational noise-induced hearing loss - To increase perceived severity of exposure to exceeding noise	- Participants log in to the website and assess modules 1, module 2, and module 3 relatively. The detailed information consists of 3 modules and a quiz for each of the modules on the website as follows: 1) module 1: regulations relevant to noise at the workplace 2) module 2: the prevalence, risk ratio of ONIHL 3) module 3: the physics of sound and energy, hearing mechanism, hearing loss types - After that, participants watch the video and read the content of each model. They took the quiz after completing the examination. The automatically interactive system will show the score, animation graphics, and positive messages. - In case any participant does not visit the module, the researcher will send a reminder message. - Open the message board for all participants. - Share your opinion and feeling via the message board - Asked questions to evaluate the feeling after receiving information
Session 2. (Week 2) Increase self-efficacy (20 minutes) **Objective** -To increase response efficacy to perform hearing preventive behavior - To increase self-efficacy and inability to perform hearing-preventive behavior	Participants will learn by themselves via the website: - Read the information on the procedure of using each type of hearing protection devices and noise control techniques - Watch the video that demonstrated how to use each type of hearing protection device (earplugs and earmuffs) and how to do each technique of noise control - After that, participants watched the video of each model. They took a self-observation checklist form via the website after completing the examination. The automatically interactive system will show the score, animation graphics, and positive messages as giving persuasive messages to encourage the participants to believe that they can perform hearing protective behaviors and enhance mastery experience of using of hearing protection devices.
Session 3. (Week 3- 4) Maintain self-efficacy and decrease response costs. (30 minutes) **Objective** -To increase response efficacy to perform hearing preventive behavior	- Give the ear plugs and earmuffs as an incentive for increasing their use after a demonstration in the previous session - Ask the participants to practice by return demonstration to enhance mastery experience - Participants showed the step of using the earplugs and earmuffs via the camera of their smartphone or computer, which was recorded into video clips and uploaded to the interactive website. - Ensured that the participants submit their video clips. In case any participant did not submit the clip, the researcher sent reminder messages.

Table 1. Intervention protocol of Web-Based Occupational Noise-Induced Hearing Loss Prevention (Cont.)

Session	Activities
-To increase self-efficacy and inability to perform hearing-preventive behavior -To decrease response costs	- Showed a video clip of the proper use of earplugs and earmuffs of participants who obtain high scores on the website - Then, the researcher gave meaningful feedback and summative feedback about their return demonstration based on an observation checklist that showed the score of behaviors and suggestions via web-board. - The researcher sent reminder messages to encourage the participants to share experiences and opinions on the web board, as well as set personal goals to adopt hearing preventive behaviors and maintain their hearing ability.

ผลของโปรแกรมป้องกันการสูญเสียการได้ยินจากการทำงานผ่านทางเว็บไซต์ต่อพฤติกรรมการใช้อุปกรณ์ป้องกันเสียงในทหารเรือไทย: การวิจัยกึ่งทดลอง

สุธาสินี ศรีนุ่น วีระพร ศุทธากรณ์ เพชรสุนีย์ ทั้งเจริญกุล ประทุม สร้อยวงค์ อติพงษ์ สุจิรัตน์*

บทคัดย่อ: ทหารเรือที่ปฏิบัติงานในเรือตรวจการณ์ มีความเสี่ยงต่อการสูญเสียการได้ยิน เนื่องจากต้องทำงานอยู่ภายใต้สภาพแวดล้อมที่มีเสียงดังจากเครื่องยนต์ตลอดเวลา การใช้อุปกรณ์ป้องกันเสียงอย่างถูกต้องจึงมีความสำคัญ การวิจัยนี้จึงได้พัฒนาโปรแกรมป้องกันการสูญเสียการได้ยินจากการทำงานผ่านทางเว็บไซต์เพื่อส่งเสริมพฤติกรรมการใช้อุปกรณ์ป้องกันเสียงดังในทหารเรือที่ปฏิบัติงานบนเรือตรวจการณ์ ทำการคัดเลือกกลุ่มตัวอย่างตามเกณฑ์ที่กำหนดจำนวน 152 คน เพื่อสุ่มให้เป็นกลุ่มทดลองและกลุ่มควบคุมในจำนวนที่เท่ากัน กลุ่มทดลองเข้าร่วมโปรแกรมการส่งเสริมการใช้อุปกรณ์ป้องกันเสียงผ่านทางเว็บไซต์เป็นระยะเวลา 4 สัปดาห์ จากนั้นทำการประเมินพฤติกรรมการใช้อุปกรณ์ป้องกันเสียง โดยใช้แบบสอบถาม ภายหลังเสร็จสิ้นโปรแกรมทันทีและที่แปดสัปดาห์หลังจากเสร็จสิ้นโปรแกรม ผลการวิจัยพบว่า กลุ่มทดลองมีคะแนนพฤติกรรมการใช้อุปกรณ์ป้องกันเสียงเพิ่มขึ้นอย่างมีนัยสำคัญหลังจากเสร็จสิ้นโปรแกรมทั้งสองระยะ อย่างไรตามการเปรียบเทียบคะแนนระหว่างกลุ่มพบว่าไม่มีความแตกต่างกันอย่างมีนัยสำคัญทางสถิติ ถึงแม้ว่าคะแนนพฤติกรรมการใช้อุปกรณ์ป้องกันเสียงของกลุ่มทดลองจะสูงกว่ากลุ่มควบคุม ทั้งนี้พบว่าในช่วงของการทำการทดลอง มีปัจจัยที่เป็นข้อจำกัดเกิดขึ้น เช่น สถานการณ์การระบาดของโรคโควิด-19 ตามด้วยเหตุการณ์การรั่วไหลของน้ำมันจำนวนมากกลางทะเล นอกจากนี้ยังพบอุปสรรคจากการใช้สัญญาณอินเทอร์เน็ตที่อาจส่งผลให้กลุ่มตัวอย่างไม่สามารถติดตามการเข้าร่วมโปรแกรมได้อย่างต่อเนื่อง แม้ว่าโปรแกรมนี้จะไม่พบประสิทธิภาพของโปรแกรมเนื่องจากมีข้อจำกัดบางประการ พยาบาลสามารถดัดแปลงวิธีการป้องกัน เพื่อลดความเสี่ยงของการสูญเสียการได้ยินจากการทำงานในทหารเรือได้ ดังนั้นข้อเสนอแนะที่ได้จากการศึกษานี้คือการออกแบบกิจกรรมให้เหมาะสมกับสภาพการทำงาน รวมถึงการทำความเข้าใจบริบทของลักษณะการทำงานบนเรือและการมีส่วนร่วมของผู้เข้าร่วมการวิจัย ซึ่งเป็นเรื่องท้าทายสำหรับการทำการศึกษาในอนาคต

Pacific Rim Int J Nurs Res 2023; 27(4) 827-839

คำสำคัญ: พฤติกรรมการใช้อุปกรณ์ป้องกันเสียง การป้องกันการสูญเสียการได้ยิน ทฤษฎีแรงจูงใจในการป้องกัน บุคลากรกองทัพเรือ โปรแกรมเว็บไซต์

สุธาสินี ศรีนุ่น *นักศึกษาปริญญาเอก หลักสูตรปรัชญาดุษฎีบัณฑิต สาขาวิชาพยาบาลศาสตร์ คณะพยาบาลศาสตร์ มหาวิทยาลัยเชียงใหม่*
E-mail: suthasinee_srinoon@cmu.ac.th
ติดต่อที่: วีระพร ศุทธากรณ์ *รองศาสตราจารย์ คณะพยาบาลศาสตร์ มหาวิทยาลัยเชียงใหม่ E-mail: weeraporn.s@cmu.ac.th*
เพชรสุนีย์ ทั้งเจริญกุล *รองศาสตราจารย์ คณะพยาบาลศาสตร์ มหาวิทยาลัยเชียงใหม่ E-mail: petsunee.t@cmu.ac.th, petsunee@gmail.com*
ประทุม สร้อยวงค์ *รองศาสตราจารย์ คณะพยาบาลศาสตร์ มหาวิทยาลัยเชียงใหม่ E-mail: pratum.soivong@cmu.ac.th, pratum90@gmail.com*
อติพงษ์ สุจิรัตน์ นาวาเอก *โรงพยาบาลสมเด็จพระปิ่นเกล้า กรมแพทย์ทหารเรือ*
E-mail: dr_atipong@hotmail.com, dr.atipong@gmail.com