EFFECTS OF A TRAINING AND EDUCATION PROGRAM ON KNOWLEDGE, ATTITUDE AND PRACTICE TOWARDS NOISE-INDUCED HEARING LOSS PREVENTION AMONG VECTOR CONTROL WORKERS

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Abstract

Noise-induced hearing loss (NIHL) is one of the most prevalent occupational diseases globally. The objective of this study was to determine the effectiveness of a training and education program in increasing knowledge, attitude and practice (KAP) towards NIHL prevention among vector control workers. The study used a cluster-randomized controlled trial design involving 183 vector control workers from 9 district health offices in the state of Perak, Malaysia. Both the intervention and control groups were followed-up for a period of 3 months. Changes in KAP score towards NIHL were measured at intervals of 1 month and 3 months post-intervention. Data was analyzed according to Per-Protocol (PP) principles. Both intervention and control groups showed an increase in mean scores for all 3 domains (knowledge, attitude and practice) after 1 month, but a larger improvement was seen in the intervention group for the attitude and practice domain in comparison to the control group. For the practice domain, the intergroup mean difference was 0.35% with a 95% CI of -5.2 to 4.5. The greatest improvement was seen in the attitude domain where the intergroup mean difference was 0.9% (95% CI -4.1, 2.3). At 3 months post-intervention, a greater improvement was observed in the intervention group compared to the control group for all 3 domains. The largest improvement was seen in the practice domain where the intergroup mean difference was -4.2 (95% CI -9.1, 0.7). The training and education program was effective in maintaining the existing knowledge, attitude and practice of vector control workers towards noise-induced hearing loss (NIHL). Continuous training and education are needed to cultivate good safety behaviour at the workplace.

Keywords: Health Education, Hearing Conservation, Noise-Induced Hearing Loss, Prevention, Training

Introduction

Occupational noise-induced hearing loss (NIHL) remains highly prevalent despite being preventable, particularly in developing countries. The global burden of NIHL and disability-adjusted life years (DALYs) due to occupational NIHL is reported to have increased from 3.3 to 6 million in the past 3 decades, with the highest growth occurring in low-income countries (1).

Occupational noise-related hearing disorders were the most prevalent occupational diseases recorded in Malaysia in 2021, accounting for 69% of all occupational diseases (2). In the year 2017, a total of 2,478 cases out of the 6,020 cases reported to the Department of Occupational Safety and Health Malaysia were occupational noise-related hearing disorders, which included noise-induced hearing loss, hearing impairment and permanent standard threshold shift (3). Workers in the manufacturing sector had a significant chance of getting NIHL, with the motor vehicle parts industry having the highest risk (32%). Despite being avoidable, NIHL continues to have a significant impact on public health because of the rising burden. It is closely related to the safety behaviour of workers especially with adherence to the use of hearing protection devices. Workers need to be equipped with adequate and accurate knowledge regarding the ill effects of excessive noise in order to improve their attitude towards it (4).

The findings reported in this article are part of a larger study in which a hearing conservation program was implemented and evaluated for its effectiveness in NIHL prevention by measuring changes in audiometric hearing threshold levels as the primary outcome. Meanwhile, changes in knowledge, attitude and practice were the secondary outcomes observed.

As part of the integrated vector control strategy suggested by WHO for the prevention and control of dengue, vector control workers are in charge of performing fogging activities. The thermal fogging machine and the ultra-low volume (ULV) fogging machine are the two primary types of fogging machine utilized during fogging operations. Workers run the risk of suffering from noise-induced hearing damage as a result of exposure to excessive noise emitted by the fogging equipment. At distance of 0.5 m, fogging machines create noise levels higher than 90 dB(A) (5). Meanwhile, personal noise exposure of workers handling the thermal fogging machine has been reported to be over 87 dB(A) for 8-hour Time Weighted Average (TWA), which puts them at high risk for developing NIHL (6).

Besides that, exposure to ototoxic chemicals used during fogging activities, such as organophosphate pesticides and diesel (diluent), synergistically exacerbate hearing loss (7, 8). In addition to the auditory impact, which includes hearing loss, exposure to excessive noise also increases the risk of anxiety, hypertension, cardiovascular illnesses, and cognitive impairment (9). NIHL also affects quality of life due to difficulties with social and emotional communication (10). There is still a dearth of research in Malaysia aimed at the prevention of NIHL despite its documented effects on health, safety, cost, and productivity (11, 12). A lack of training regarding NIHL has also been associated with poor knowledge, attitude and practice towards NIHL prevention in certain job sectors (13). In Malaysia, there is currently no structured formal training program on NIHL prevention designed specifically for vector control workers. The Industry Code of Practice (ICOP) for Management of Occupational Noise Exposure and Hearing Conservation 2019 only outlines the need to provide training but does not specify the module content, method of delivery and instruction for trainers (14).

Studies have also proven that training triggers learning, which in turn elicits a cascade of events that leads to behavioural change (15). Kirkpatrick's model, which includes 4 levels; reactions, learning, behaviour and results that are positively intercorrelated, clearly explains this phenomenon (16). A systematic review conducted by Supramanian et al. grouped strategies for prevention of NIHL into three main categories; the multifactorial approach or a combination of strategies, championed by leaders, and one-off training. The review found that, one-off training is less effective in comparison to continuous training and education, and that a comprehensive multifactorial intervention that combines multiple strategies is the method of choice for the prevention of NIHL (17).

In Malaysia, the daily noise exposure limit (NEL) is set at 85 dB(A) under the Occupational Safety and Health (Noise Exposure) Regulations 2019, and measures to reduce excessive noise are needed if this limit is exceeded (18). In addition to that, it is clearly stipulated under the Occupational Safety and Health (Noise Exposure) Regulations 2019 that when workers are exposed to noise levels above 82 dB(A), the employer shall provide them with annual training consisting of the following; adequate information relating to the effects of noise exposure on hearing and the requirement to undergo audiometric testing, and training and instruction on the proper usage of a personal hearing protector (18). A hearing conservation programme (HCP) is to be implemented if workers are exposed to levels above 85 dB(A) averaged over 8 working hours (19). An effective HCP generally consists of the following: noise exposure assessment, engineering and administrative control including training, audiometric testing and monitoring, record keeping and program evaluation (20, 21). Evidence shows that the HCP has been implemented in various industries including the agriculture, manufacturing and education sector (22-24).

The training and education of workers is one of the key components of an effective hearing conservation program to ensure workers are more motivated to adhere to safety and health practices. The objective of this study is to determine the effectiveness of a training and education program in increasing knowledge, attitude, and practice (KAP) towards NIHL among vector control workers.

Materials and methods

Participants

A total of 183 people made up the sample for this study, which was established using a relative risk of 0.49 for the effect of a hearing conservation program on noise-induced hearing loss based on a study by Davies et al (23). Nine district health offices in the Malaysian state of Perak were the source for the voluntary recruitment of participants. The inclusion criteria for participants in this study included the ability to communicate and read in Malay and being employed by the Ministry of Health (MOH) on both a permanent and contract basis in the field of vector control. This study received approval from the University of Malaya Medical Centre's Medical Ethics Committee (MREC ID: 2017220-4936), and has been registered with the National Medical Research Register and the Thai Clinical Trials Registry (TCTR2019010900).

Study design

This study adopted the cluster-randomized controlled trial (RCT) design, with district health offices (DHO) being the unit of randomization. Nine out of a total of 11 DHOs were randomly assigned to either the intervention or control group using computer generated random numbers. To ensure allocation concealment, each DHO was first coded prior to randomization and all vector control workers from each selected district health office were included in the study. It was not possible to blind the participants or researchers because the intervention entailed a training and education program that was conducted by the researcher.

Data collection

Participants in both the control and intervention groups were engaged at baseline (pre-intervention) and 3 months post-intervention to answer a self-administered questionnaire on sociodemographic characteristics and knowledge, attitude and practice (KAP) towards NIHL. The instrument used for data collection was a validated questionnaire in the Malay language that consisted of 42 items that covered 3 domains: knowledge (12 items), attitude (20 items) and practice (10 items) towards NIHL. The internal consistency for each domain, reported as Cronbach's alpha for knowledge, attitude and practice, was 0.67, 0.92 and 0.75 respectively (25). The effectiveness of the training and education program was evaluated by comparing the proportion of total percentage scores of 75% and above between the intervention and control groups. A score of 75% and above was considered to be satisfactory (25). The increase in number of participants (%) who responded correctly to the questions for the three domains (knowledge, attitude and practice) and the increase in number of participants with satisfactory scores at one month and three months post intervention would indicate that the program was effective.

Intervention

The training and education program was developed by incorporating information obtained from 3 key domains: a systematic literature review, comparison of local and international guidelines, and interviews with key stakeholders. The training module was also developed based on the requirements under the Industry Code of Practice for Management of Occupational Noise Exposure and Hearing Conservation by the Department of Occupational Safety and Health (DOSH) Malaysia (14). This training and education program was part of a Hearing Conservation Program (HCP) aimed at preventing noise-induced hearing loss (NIHL) among vector control workers who are exposed to noise emitted from fogging machines. The format of this training and education program consisted of Microsoft PowerPoint presentation slides, a video presentation on the proper care and use of ear muffs, and hands-on training on the proper use of ear muffs. The components of this training and education program included general information on noise exposure from fogging machines, noise-induced hearing loss, roles and responsibilities, hearing protection devices and relevant legislations. Pamphlets regarding NIHL were also distributed to the vector control workers in the intervention group. The training was delivered by the researcher himself and the total duration was approximately 4 hours.

Data analysis

Data was analysed using the Statistical Package for Social Science (SPSS) software desktop version 20.0. Level of significance was set at 0.05 with all variables being tested for normality. Changes in mean score for knowledge, attitude and practice towards noise-induced hearing loss (NIHL) were measured at 1 month and 3 months post-intervention for both the intervention and control groups. All analysis was done according to Per-Protocol (PP) principles to avoid over-estimation of the effect of the HCP. The effectiveness of the program was evaluated by comparing the intragroup and intergroup mean difference of percentage scores pre- and post-intervention using an independent t-test. In view of the cluster randomized design of this study, measures were taken into account for the clustering effect during analysis. The adjusted statistical values were calculated for the statistical test used by dividing the chi-squared and t-test value with design effect and, subsequently, the adjusted p-values were obtained by referring to the chi-square table. This method is known as patient level analysis and increases a study's statistical power by utilizing all patient level data while considering the intracluster correlation (ICC) (26).

Results

Recruitment and participant flow

The recruitment process took place over 3 months, from November 2017 till January 2018 (Figure 1). The training and education program that was given to participants in the intervention group as part of the intervention had a 100% response rate. The lost to follow-up rate for this study at 3 months was 3.3% for the intervention group and 22% for the control group. The main reason for this was either participants being moved to different units or simply being absent due to work, however the numbers were small.

'INSERT FIGURE 1 HERE'

Characteristics of participants

Table 1 shows the participants' characteristics, where the majority of participants (99.5%) were male, had a mean age of 37, and belonged to the job category of general worker (78%). Approximately half of the participants (48.6%) had experienced noise exposure in previous jobs, while the majority (83.6%) currently worked with fogging equipment. Meanwhile, a small percentage of participants were also engaged in activities that could result in hearing loss, such as diving and the use of guns or explosives (9.1%).

Attendance of participants at training and education programme

Attendance rates for the training and education sessions for participants from the intervention group are shown in Table 2 below. The intervention group participants (n = 60) from all 4 district health offices attended the training and education session, with a 100% attendance.

Table 1: Socio-demographic characteristics of participants

	All Frequency (%)	Intervention (n=60)	Control (n=123)	p-value
Gender				
Male	182 (99.5)	60 (100.0)	122 (99.1)	1.000[a]
Female	1 (0.5)	-	1 (0.9)	
Age (years) (Mean±SD)	37.3±8.4	37.7±1.3	36.6±7.0	0.279[b]
Duration of employment (years) (n=179) (Mean±SD)	8.6±11.2	7.5±0.9	9.3±1.3	0.656[b]
Job title (n=154)				
General worker	78 (50.6)	25 (43.1)	53 (55.2)	
Public Health Assistant	55 (35.7)	21 (36.2)	34 (35.4)	
Senior Public Health Assistant	3 (1.9)	1 (1.7)	2 (2.1)	
Assistant Environmental Health Officer	4 (2.6)	2 (3.4)	2 (2.1)	0.162[a]
Senior Assistant Environmental Health Officer	1 (0.7)	1 (1.7)	-	
Health Inspector	2 (1.4)	1 (1.7)	1 (1)	
Driver	9 (5.8)	7 (12.2)	2 (2.1)	
Contract worker	2 (1.3)	-	2 (2.1)	
Past occupational exposure to noise (n=183)				
Yes	89 (48.6)	33 (55)	56 (45.5)	0.271[a]
No	94 (51.4)	27 (45)	67 (54.5)	
Use of fogging machine (n=183)				
Yes	153 (83.6)	45 (75)	108 (87.8)	
No	30 (16.4)	15 (25)	15 (12.2)	0.034[a]
Living in a noisy residential area (n=154)				
Yes	11 (7.1)	3 (5.2)	8 (8.3)	0.537[a]
No	143 (92.9)	55 (94.8)	88 (91.7)	
Smoking history (n=183)				
Yes	54 (29.5)	21 (35)	33 (26.8)	0.301[a]
No	129 (70.5)	39 (65)	90 (73.2)	
History of diving/ using guns or explosives (n=154)				
Yes	14 (9.1)	5 (8.6)	9 (9.4)	1.000[a]
No	140 (90.9)	53 (91.4)	87 (90.6)	

[a]Chi-square test
[b]Independent t-test

Table 2: Attendance rate for training and education program among participants from the intervention group

District Health Offices	n	%
Batang Padang	26	100
Kampar	8	100
Muallim	11	100
Perak Tengah	15	100

Effectiveness of training and education program

Changes in knowledge, attitude and practice towards noise-induced hearing loss (NIHL) 1-month post-intervention

Both the intervention and control groups showed an increase in mean scores for all 3 domains (knowledge, attitude and practice) after 1 month, but a larger improvement was seen in the intervention group for the attitude and practice domain in comparison to the control group (Table 3). For the practice domain, the intergroup mean difference was 0.35% with a 95% CI of -5.2 to 4.5. The greatest improvement was seen in the attitude domain where the intergroup mean difference was 0.9% (95% CI -4.1, 2.3). All results were statistically not significant.

Changes in knowledge, attitude and practice towards noise-induced hearing loss (NIHL) 3 months post-intervention

Table 4 shows changes in the percentage scores for knowledge, attitude and practice towards noise-induced hearing loss (NIHL) 3 months after intervention for both groups. Both the intervention and control groups showed a reduction in knowledge scores after 3 months with a reduction of 0.6 and 1.1 respectively. The intervention group showed an increase in both attitude and practice scores by 3.5 and 1.4 respectively 3 months after intervention, with statistically significant findings in the attitude domain. However, the control group showed a marked reduction in mean practice score from 71.2 to 66.7 after 3 months. All other findings were statistically not significant. In comparison, between the intervention and control group, a negative mean difference score was observed in all 3 domains (knowledge, attitude and practice) indicating a greater improvement in the intervention group compared to the control group, with the greatest improvement seen in the practice domain where the intergroup mean difference was -4.2 (95% CI -9.1, 0.7). For the knowledge and attitude domains, the intergroup mean difference was -0.6 (95% CI -5.0, 3.9) and -1.5 (95% CI -4.9, 1.9). The mean difference between the intervention and control groups was statistically not significant for all 3 domains.

Table 3: Changes in knowledge, attitude and practice towards noise-induced hearing loss (NIHL) 1-month post-intervention

	Intervention group				Control group				Intergroup	
	Pre-intervention Mean (SD)	1-month post-intervention Mean (SD)	Intragroup mean difference (SD)	p value	Pre-intervention Mean (SD)	1-month post-intervention Mean (SD)	Intragroup mean difference (SD)	p value	Intergroup mean difference (95% CI)	p value
Knowledge	77.8 (10.7)	80.0 (12.3)	2.2 (12.6)	0.178	73.5 (11.7)	75.9 (10.9)	2.5 (14.3)	0.069	0.25 (-4.1,4.6)	0.910
Attitude	75.1 (9.9)	76.6 (9.8)	1.6 (10.1)	0.229	70.7 (10.9)	73.7 (10.3)	0.7 (10.1)	0.457	-0.9 (-4.1,2.3)	0.588
Practice	62.9 (16.6)	63.8 (15.5)	0.9 (15.7)	0.644	71.2 (14.3)	71.0 (13.4)	0.6 (15.1)	0.678	-0.35 (-5.2,4.5)	0.885

Note: Intragroup mean difference = mean post-intervention – mean pre-intervention; Intergroup mean difference = mean difference control group – mean difference intervention group

Table 4: Changes in knowledge, attitude and practice towards noise-induced hearing loss (NIHL) 3-months post-intervention

	Intervention group				Control group				Intergroup	
	Pre-intervention Mean (SD)	3-months post-intervention Mean (SD)	Mean Difference (SD)	p value	Pre-intervention Mean (SD)	3-months post-intervention Mean (SD)	Mean Difference (SD)	p value	Intergroup mean difference (95% CI)	p value
Knowledge	77.8 (10.7)	77.3 (11.8)	-0.6 (11.8)	0.713	73.5 (11.7)	72.2 (12.0)	-1.1 (14.6)	0.449	-0.6 (-5.0,3.9)	0.807
Attitude	75.1 (9.9)	78.2 (9.9)	3.5 (10.4)	0.011	70.7 (10.9)	74.0 (10.6)	1.3 (10.0)	0.141	-1.5 (-4.9,1.9)	0.378
Practice	62.9 (16.6)	63.6 (16.3)	1.4 (14.4)	0.441	71.2 (14.3)	66.7 (14.3)	-2.3 (14.6)	0.080	-4.2 (-9.1,0.7)	0.092

Note: Intragroup mean difference = mean post-intervention – mean pre-intervention; Intergroup mean difference = mean difference control group – mean difference intervention group

Changes in proportion of satisfactory and unsatisfactory knowledge, attitude and practice scores towards noise-induced hearing loss (NIHL) after 1 month and 3 months

Table 5 shows the scores for each domain (knowledge, attitude and practice) after being categorized according to satisfactory (≥75%) and unsatisfactory (<75%) scores based on the previous validation study of this questionnaire (25). One month after intervention, the proportion of intervention group participants with satisfactory scores for the knowledge domain remained unchanged at 71.7% while the proportion in the control group increased by 8.7%. Similar trends were observed in the intervention group for the attitude and practice domains with a reduction of 5% and 1.7% respectively 1 month after intervention. Meanwhile, 3 months post-intervention, both the intervention and control groups showed a 7.7% – 7.9% reduction in the proportion of participants with satisfactory scores for the knowledge domain. As for the attitude domain, a 0.3% increase in proportion of satisfactory scores was observed in the intervention group, while the control group showed a 0.3% reduction in the proportion of participants with satisfactory scores. For the practice domain, both groups displayed similar trends as found in the knowledge domain, with a reduction in the proportion of participants with satisfactory scores in both groups. However, the control group (15%) showed a larger reduction in the proportion of participants with satisfactory scores after three months as compared to the intervention group (4.3%). All results were statistically not significant.

Discussion

A review by Verbeek et al looking into effective occupational health interventions, including hearing conservation programs, proposed a model of primary preventive occupational health intervention that categorizes these interventions into 3 major classes mainly environmental, behavioural, and clinical (27). The training and education program in this study was a form of behavioural intervention targeting behaviour change strategies. Evidence has shown that training and education programs are highly effective in improving the knowledge, attitude and practice of workers (27-31). Increasing awareness regarding the risk and health effects of excessive noise improves workers self-perceived severity, susceptibility and benefits as explained by the health belief model (32). The training and education program also showed a marked effect in improving workers' attitude in terms of health seeking behaviour, and preventive and risk-taking attitudes towards noise-induced hearing loss. Similar observations were seen in other studies evaluating the effectiveness of NIHL training programs, however 1 study found that the mode of delivery via an interpersonal, interactive educational intervention proved to be more effective, which is comparable to the hands-on training on proper use of earmuffs in this study (33, 34). In terms of practice, the

Table 5: Changes in proportion of satisfactory and unsatisfactory knowledge, attitude and practice scores towards noise-induced hearing loss (NIHL) at 1-month and 3-months post- interventionNote: satisfactory score (≥75%) and unsatisfactory score (<75%)

	Pre-intervention			1-month post-intervention			3 months post-intervention		
	Intervention N (%)	Control N (%)	p-value	Intervention N (%)	Control N (%)	p-value	Intervention N (%)	Control N (%)	p-value
Percentage total knowledge score									
Unsatisfactory	17 (28.3)	52 (42.3)		17 (28.3)	38 (33.6)	0.498	21 (36.2)	48 (50.0)	0.132
Satisfactory	43 (71.7)	71 (57.7)	0.076	43 (71.7)	75 (66.4)		37 (63.8)	48 (50.0)	
Percentage total attitude score									
Unsatisfactory	25 (41.7)	65 (52.8)		28 (46.7)	55 (48.7)	0.873	24 (41.4)	51 (53.1)	0.185
Satisfactory	35 (58.3)	58 (47.2)	0.161	32 (53.3)	58 (51.3)		34 (58.6)	45 (46.9)	
Percentage total **practice score**									
Unsatisfactory	45 (75)	75 (61.0)		46 (76.7)	67 (59.3)	0.029	46 (79.3)	73 (76.0)	0.695
Satisfactory	15 (25)	48 (39.0)	0.069	14 (23.3)	46 (40.7)		12 (20.7)	23 (24.0)	

workers showed changes in behavioural practice towards the prevention of noise-induced hearing loss. One of the key reasons for these changes was the inclusion of hazard communication in the training program, which included noise exposure monitoring results, noise attenuation achieved with hearing protectors and effects of noise and health. This furnished the workers with the information required to make an impact on their perception of severity of and susceptibility to NIHL as well as the benefits of preventive measures that would translate into better safety and health practices. However, the validity of the findings for the practice domain needs to be treated with caution, as information on the use of hearing protection devices that is obtained from a survey or is self-reported may be biased, as observed in a similar study conducted in the construction sector (35).

Improvements in all 3 domains were observed at 1-month post-intervention, however there was a marked reduction after 3 months, mainly in the knowledge and practice domains, indicating that continuous training is needed to ensure the retainment of improved knowledge, attitude and practice towards NIHL (36). Maintenance of behaviour change or improved job performance following training is highly dependent on the degree to which workers effectively apply the knowledge, skills and attitudes gained during training (37). An immediate effect might also have been significantly found if immediate post-intervention measurement was conducted instead of 1-month post-intervention. In this study, the lack of a significant difference between the intervention and control groups could be attributable to the one-off training and the lack of readily accessible materials for quick reference at any time. There is strong evidence suggesting that continuous training is more effective, especially in retaining knowledge, compared to one-off training (17, 38, 39). Another important factor contributing to these findings is possibly the absence of continuous direct supervision to ensure proper practice, because the supervisors were not always around. This is further supported by the Hawthorne effect, in which workers' safety behaviour is influenced when being observed (40, 41). Hence, it is important that training programs be provided continuously to workers and not as a one-time only intervention. This could explain the reduction in knowledge scores of workers observed at 3 months post-intervention. Continuous training is needed to ensure the updating of existing knowledge as well as the refreshing of knowledge gained from previous training sessions. However, there is evidence that how health training is conducted also affects the outcome. Workers who are engaged and actively participate during training programs show better outcomes as compared to those in passive type training programs.

In recent years, development in safety and health training methods has brought about a shift from information-based to computer-based and performance-based techniques or hands-on workshops (42). This shift from the usual reactive approach to a more proactive approach is the result of increasing research looking into effective training methods, as it has been recognized in recent years that passive methods seem to be less effective. The training program in this study involved the individual participation of workers during the hands-on workshop, in which each worker was required to practice the proper use and care of hearing protection devices as well as to perform the fit-test (43, 44).

An important factor to ensure effective training sessions with a good response rate from workers is to provide easily accessible on-site training. Full attendance was achieved in this study as the training sessions were held at the respective district health offices without participants needing to travel. Besides that, worker participation in designing the training program is also important, for instance in this study, workers were engaged prior to training in order to understand the challenges faced during fogging activities. This would help with creating targeted training programs that address the issues faced by specific job categories (43).

The randomised cluster methodological design used in this study offers the highest level of evidence in terms of evidence-based practice, particularly when establishing the effectiveness of an intervention. By hiding the participants' groups' identities from the individuals who would be evaluating the results, randomization lowered the possibility of selection bias. In addition to that, concealment of the allocation of DHOs to either the intervention or the control group also further decreased the risk of selection bias. A major limitation of this study is that only single blinding was achieved due to the nature of the intervention, which included a training session which was delivered by the researcher, thus making it impossible to blind the participants from both groups. As a result, only the data collectors and outcome assessors, mainly personnel performing audiometry tests, were blinded in this study. Although the intervention group showed better improvement in all three domains compared to the control group, no statistically significant results were found between both groups at both measurement time-points, and this could be attributable to performance bias as the participants were not blinded. Future trials need to implement greater methodological rigour with both assessor and participant blinding to confirm the true effectiveness of the interventions (45). However, since both the intervention and control groups consisted of DHOs that were geographically separated, cross contamination between the different districts was unlikely. The other limitation of this study is external validity in terms of generalizing results from this cluster-randomized trial to populations of vector control workers with different cultural and occupational exposure characteristics from the population studied. It is also important to understand that any changes in work process, such as a change in the model or type of fogging machine used, would require area and personal noise monitoring to be repeated. Overall, this study suggests good internal validity. It was a prospective study which allowed the researcher to determine allocation and administration of the intervention to a chosen population and reduce allocation bias.

Conclusion

The training and education program was able to sustain the existing knowledge, attitude and practice of vector controls towards noise-induced hearing loss (NIHL), however its effectiveness in improving KAP towards NIHL will require further research as no statistical significances were found in this study. Despite that, continuous training and education is needed to improve knowledge, attitude and practice in relation to cultivating good safety behaviour at the workplace in order to prevent noise-induced hearing loss (NIHL). Although there were no statistically significant findings in this study, future trials using rigorous research design methods are needed to investigate the long-term effectiveness of this training program.

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Competing interests

The authors declare that they have no competing interests.

Ethical Clearance

Ethical approval was obtained from the Medical Ethics Committee, University Malaya Medical Centre, Malaysia (MREC ID: 2017220-4936) and registered with the National Medical Research Register of Malaysia (NMRR-17-375-34724) prior to conducting the study**.**

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