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Effectiveness verification of an educational program on hearing protection for noise-exposed workers

Verificação da efetividade de uma ação educativa sobre proteção auditiva para trabalhadores expostos a ruído

ABSTRACT

Purpose: To verify the effectiveness of an educational action in the form of training, emphasizing the importance of hearing protection for workers exposed to occupational noise. **Methods:** The study included 78 male individuals. All participants answered a questionnaire before they were submitted to audiological evaluation. For the second application of the questionnaire, participants were randomly divided into two groups: Research Group, constituted by 44 subjects that received educational training before the second questionnaire application, and Control Group, comprising 34 individuals that answered the questionnaire before the educational training. Training was based on material with graphic images and text, in the form of conversation. The topics covered included: the importance of hearing, noise effects on health, importance of preventing hearing loss and using hearing protection, conservation and cleaning of hearing protectors, levels of noise in the workplace and noise attenuation provided by hearing protectors. The questionnaire contained 14 multiple choice questions that addressed the same themes explored in the educational training. **Results:** There was a significant increase of correct responses in the second application of the questionnaire, only in the Research Group, in all comparisons. **Conclusion:** Educational action performed with workers exposed to occupational noise are effective, and the questionnaire is a stable and viable tool to evaluate the effectiveness of educational programs.

RESUMO

Objetivo: Verificar a efetividade de uma ação educativa de treinamento, com ênfase na importância da proteção auditiva, para trabalhadores expostos a ruído ocupacional. **Métodos:** Participaram 78 funcionários do gênero masculino. Todos os indivíduos passaram por avaliação audiológica completa e responderam a um questionário no momento do início do atendimento. Para a segunda aplicação do questionário, os participantes foram randomicamente divididos em dois grupos: Grupo Pesquisa, constituído por 44 funcionários, que responderam ao questionário após passarem por treinamento educativo, e Grupo Controle, constituído por 34 funcionários, que responderem ao questionário antes de passar por treinamento educativo. O treinamento foi feito com base em material gráfico com figuras e textos, sob a forma de conversa. Os temas abordados foram: importância da audição, efeitos do ruído sobre a saúde, importância da prevenção da perda auditiva e da utilização do protetor auditivo, conservação e higienização dos protetores, níveis de ruído no ambiente de trabalho e atenuação do ruído fornecida pelos protetores auditivos. O questionário continha 14 perguntas de múltipla escolha que abordavam os mesmos temas explorados no treinamento educativo. **Resultados:** Houve aumento significativo do número de acertos durante a 2ª aplicação do questionário, somente para o Grupo Pesquisa, em todas as comparações realizadas. **Conclusão:** Ações educativas realizadas com trabalhadores expostos a ruído ocupacional são efetivas. Além disso, o questionário é uma ferramenta estável e viável para a verificação da efetividade de programas educativos.

Study carried out at the Investigation Laboratory on Primary Care in Audiology of the Physiotherapy, Speech-Language and Hearing Science and Occupational Therapy of the School of Medicine, Universidade de São Paulo – USP – São Paulo (SP), Brazil.

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INTRODUCTION

Hearing Loss Prevention Program (HLPP) consists on a set of preventive measures developed with the aim of preventing the installation or the evolution of noise-induced hearing loss (NIHL)⁽¹⁾. Brazilian and international laws referring to the area of occupational health recommend that a HLPP must include noise monitoring, audiometric monitoring, use of hearing protection, training and education of workers, in addition to evaluation of the effectiveness of the program^(2,3).

It was concluded in study that examined the HLPP of four metallurgical industries in São Paulo that these programs are not being properly conducted because noise exposure continues to be excessive, the risk to NIHL is still high, and the training is not adequately offered to workers⁽⁴⁾. This is observed both at national and international levels⁽⁵⁻¹⁰⁾.

The reduction or elimination of noise would be the best strategy to eliminate or reduce risks of hearing loss. However, the use of personal hearing protection has been the strategy used by most employers. This is because this strategy is faster and less costly in a short term period⁽¹⁰⁾. Training and education of workers are essential for the successful use of hearing protection⁽¹¹⁾. However, such HLPP phase has not received the necessary attention from industries and researchers^(10,12).

It is noteworthy that in addition to implementing a program of structured training and education for workers exposed to noise, it is critical that the effectiveness of this program is periodically assessed^(2,3). There are few studies that use simple and objectives instruments for evaluating the effectiveness of educational activities within a HLPP^(1,12,13). The development of such instruments is essential so they can be incorporated into future phases of evaluating the effectiveness of the actions employed. This way, the programs will be increasingly enhanced as contents will be more appropriate to the reality of each work environment.

Thus, the aim of this study was to evaluate the effectiveness of an educational training focused on the importance of hearing protection for workers exposed to occupational noise.

METHODS

Casistry

This study was approved by the Ethics Committee of the University of São Paulo Hospital under protocol number 858-08. The study was developed within a HLPP for workers exposed to occupational noise. All participants signed a consent form.

Participants were 78 employees, all male, aged between 24 and 62 years (mean 42.66 years). Data collection was carried out at the time of audiological assessments.

Procedures

Graphic material containing illustrative figures and explanations was prepared. The figures and explanations served as basis for the educational training of workers. The training

was held in the form of conversation. The points addressed in the material were: the importance of hearing; noise effects on health; NIHL prevention; importance of use information on correct manner of placing the hearing protector; conservation and cleaning of protectors; noise levels in the work environment and noise attenuation provided by hearing protectors. Employees could ask questions during the training, which strengthened the educational process.

A questionnaire was designed based on previous studies^(1,2,14) to verify the effectiveness of training. The questionnaire contained 14 multiple choice questions that covered the same topics explored in the educational training. The questions were divided as follows: one question about the importance of hearing (Q1); three addressing the effects of noise on health (Q2, Q3, Q8); one related to the noise levels of the work environment (Q4); four on the sound attenuation of hearing protectors (Q5, Q6, Q10, Q11); two on the use of hearing protectors (Q7, Q9); and three relating to the conservation, cleaning or positioning of the hearing protector device (Q12, Q13, Q14) (Appendix 1).

All participants completed the questionnaire on two different conditions: the first application of the questionnaire was carried out at the beginning of audiological assessment - prior to the interview - for all individuals. The second application was carried out after periodic audiological assessment. For such, employees were randomly divided into two groups: Research Group (RG), consisting of 44 employees who responded to the questionnaire after the educational training; and a Control Group (CG), consisting of 34 employees who responded the questionnaire before the educational training (Chart 1).

It is noteworthy that questions were reproduced and explained if there were incorrect answers after the second administration of the questionnaire.

Chart 1. Organization of questionnaire application, assessment and training flow of the two groups (research and control)

Groups	Flow			
	Questionnaire 1 st application	Educational training	Audiological assessment	Questionnaire 2 nd application
Research group	Questionnaire 1 st application	Educational training	Audiological assessment	Questionnaire 2 nd application
Control group	Questionnaire 1 st application	Audiological assessment	Questionnaire 2 nd application	Educational training

Only data from the CG was considered to verify the reliability of the questionnaire – the first application was considered a “test” and the second application was considered a “re-test”. The kappa coefficient (k) was used to estimate the agreement level. The following cutoff points were adopted (15): almost perfect agreement (>0.80), strong or substantial agreement (0.61 to 0.80), moderate (0.41 to 0.60), average (0.21 to 0.40), low (0.01 to 0.20) and poor agreement (0.00).

The effectiveness of the educational training was assessed by comparing the scores obtained on the first and second administration of the questionnaire in both groups. It was stipulated that each correct answer would receive the value of one point (maximum of 14 points per questionnaire) to calculate the scores. Comparisons were made considering the mean accuracy

obtained by the individual in each of the applications (first and second) as well as the mean accuracy per question (considering the two applications of the questionnaire).

The statistical analysis was performed using ANOVA, chi-square and Mantel-Haenszel tests. The level of significance was set at 0.05 (5%).

RESULTS

Questionnaire reproducibility

Responses of the CG obtained on the first and second administration of the questionnaire were compared in order to verify the agreement among the answers. For this analysis, $k=0.8$ was observed indicating a strong agreement.

Individual average performance

The mean accuracy obtained by individuals in both groups during the two administrations of the questionnaire was com-

pared. A significant increase of mean accuracy was observed only for individuals from the RG (Table 1).

Average performance by question

When the mean accuracy per question as well as the overall accuracy for each group was considered, a significant score increase was observed for the RG. The mean accuracy of CG was not different when comparing the two applications (Table 2 and Figures 1 and 2). Moreover, the questions that presented an accuracy of 50% or less in the first application for both groups were Q3, Q4, Q5, Q6, Q7, Q11, Q12, Q14 (Figures 1 and 2). It was observed that only questions Q6 and Q7 have not reached more than 50% accuracy in the RG during the second application.

Accuracy and error type proportions in the two administrations of the questionnaire

We compared the numbers of correct responses and errors

Table 1. Group comparison of mean accuracy per individual on the two applications of the questionnaire

	Research Group				Control Group			
	1st application		2nd application		1st application		2nd application	
	n	%	n	%	n	%	n	%
Mean	7.13	50.92	9.79	64.28	7.38	52.71	7.85	56.07
SD	2.28		2.46		2.60		2.37	
p-value	<0.001*				0.439			

* Significant values ($p \leq 0.05$) - ANOVA

Legend: n = number of correct responses SD = standard deviation

Table 2. Group comparison of mean accuracy per question on the two applications of the questionnaire

	Research Group				Control Group			
	1st application		2nd application		1st application		2nd application	
	n	%	n	%	n	%	n	%
Mean	20.42	46.40	30.64	69.63	17.92	52.70	19.07	56.08
SD	9.32		8.99		7.86		7.79	
p-value	0.025*				0.702			

* Significant values ($p \leq 0.05$) - ANOVA

Legend: n = number of correct responses SD = standard deviation

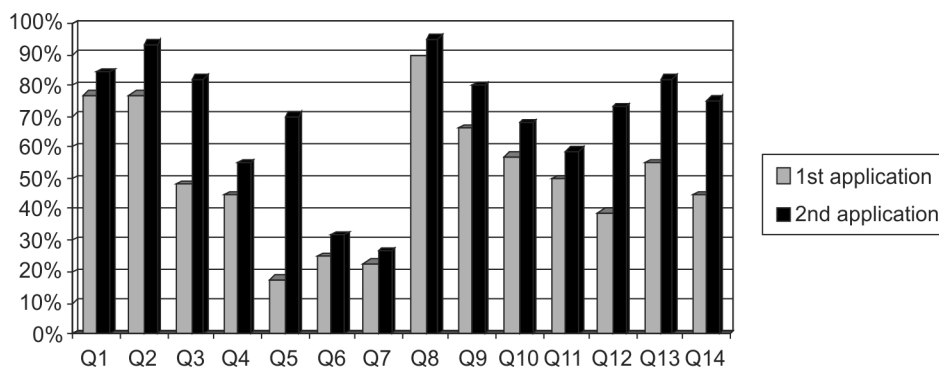


Figure 1. Mean percent accuracy per question on the 1st and 2nd applications of questionnaire for the research group

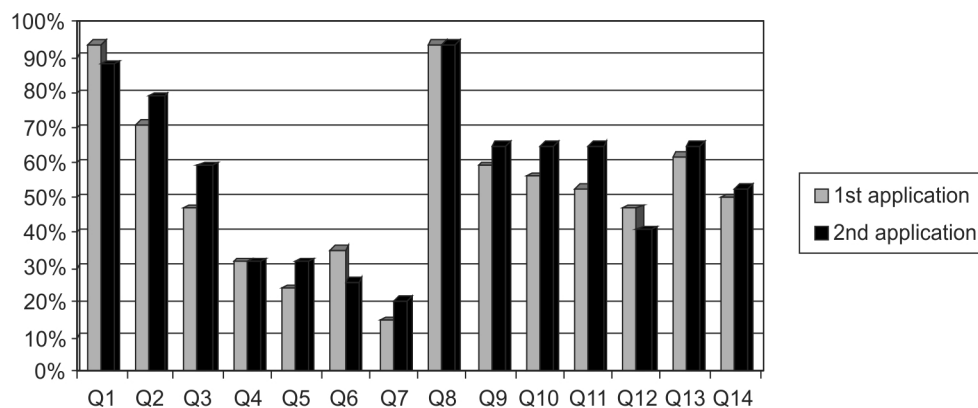


Figure 2. Mean percent accuracy per question on the 1st and 2nd applications of questionnaire for the control group

Table 3. Distribution of the number of correct responses and errors (raw scores) of the two groups on both applications of the questionnaire

Groups	Correct responses (n)	Errors (n)	Total (n)	p-value	
1st application	Control Group	251	225	476	0.564
	Research Group	314	302	616	
	Total	565	527	1092	
2nd application	Control Group	267	209	476	<0.001*
	Research Group	429	187	616	
	Total	696	396	1092	
Raw scores	Control Group	518	434	952	0.005*
	Research Group	743	489	1232	
	Total	1261	923	2184	

* Significant values ($p \leq 0.05$) - Chi-square test for first and second applications and Mantel-Haenszel test for raw scores

Legend: n = number

in each administration of the questionnaires, thus isolating the variable “application” (raw data) (Table 3). Note that in the first application the accuracy and error type proportions for the two groups are similar. A difference in these proportions with an increase in accuracy of RG on the second application was observed. There were also differences between the accuracy and error type proportions regarding the raw data presented by individuals from both groups – with higher accuracy observed for the RG.

DISCUSSION

This study aimed to evaluate the effectiveness of an educational training with emphasis on the importance of hearing protection for workers exposed to occupational noise by comparing the accuracy obtained in two applications of a questionnaire. Our findings showed a significant increase in accuracy at the time of the second application only for the RG – the group that had received previous training.

Questionnaire reproducibility

Initially, the instrument was evaluated regarding its reproducibility only for the CG (whose participants had not received training between the two administrations of the questionnaire). We observed a strong agreement⁽¹⁵⁾ among the questions. This justifies the use of the questionnaire to evaluate the effectiveness of the educational training within a HLPP as it showed

satisfactory stability. The average interval between the two administrations of the questionnaire for the CG was of 40 minutes. Future studies are needed to assess the reproducibility of the questionnaire with a longer interval between test and retest as this can influence the reproducibility level of the instrument⁽¹⁶⁾. Thus, the use of the questionnaires is possible both in further studies and in the routine assessment of HLPP effectiveness.

Individual average performance

The scores on the first application of the questionnaire were similar on the two groups. However, the RG performed better in the second application showing that the training conducted with this group was crucial to this result. The CG scores remained stable in both applications - the training for this group began only after the second administration of the questionnaire. Similar results, albeit with different instruments and approaches, were obtained in other studies in which improvements in the knowledge of workers after educational intervention were observed^(1,12,13,17).

Average performance by question

Similar to the above mentioned findings, a better performance in the second application of the questionnaire only was observed only for the RG. These results underscore the importance of training for the HLPP success. It also highlights the importance of the use of instruments that evaluate the

effectiveness of educational training programs that compose the HLPP^(2,4,8).

The following questions exhibited low accuracy index (less than or equal to 50%) in both groups at the first application: questions addressing the noise effects on health (Q3); noise levels at the work environment (Q4); noise attenuation by hearing protector (Q5, Q6, Q11); use of hearing protectors (Q7); conservation, cleaning and positioning of the hearing protector (Q12, Q14). For the RG, only Q6 and Q7 have not reached more than 50% accuracy after training (second application of the questionnaire). These results show that the discussion on some topics should be improved in future training programs, allowing an increase in the knowledge of workers about such themes. This is fundamental to the HLPP success. Similar findings were observed in a study that concluded that the use of hearing protectors and their effectiveness of protection should be one of the main focuses on trainings⁽¹⁾. One should also consider that Q7 addresses a situation in a work environment and, therefore, an improvement after training would probably be observed only at medium or long term – i.e. after a change in attitude of most workers of particular sector obtained as a result of a well-established HLPP.

Accuracy and error type proportions in the two administrations of the questionnaire

Once again, for this analysis, the results showed improvement only in the RG performance, emphasizing the crucial role of training on this change. These findings confirm those from previous analysis and corroborate to studies that demonstrate the importance of educational training as a way to modify the knowledge of workers about noise, its damages and prevention^(1,12,13,17).

Findings of the present study emphasize the need for the use of educational campaigns to improve the awareness of workers about the damage caused by noise, the use and efficiency of protectors for hearing loss prevention - as well as care of such devices, as a way to assist in the effectiveness the HLPP. Furthermore, the findings underscore the importance of evaluation of training to identify strengths and weaknesses of the program and thus adequate the program to the reality of each work environment.

Future studies should consider the use of instruments (questionnaires) and the assessment of knowledge of workers with a longer interval between the educational training and the second application of the questionnaire. Still, one can consider the same method used in this study, in addition to a third application after a longer interval.

The improvement of the instrument in question (questionnaire) should also be considered in order to verify whether the low accuracy questions were influenced by comprehension difficulties of workers. Moreover, the topics of training that had lower percentages of correct answers should be emphasized in future educational activities.

CONCLUSION

The present study allows the conclusion that educational activities carried out with workers exposed to occupational noise are effective. Furthermore, the questionnaire is a stable and viable instrument for verifying the effectiveness of educational programs.

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Appendix 1. Questionnaire for verification of educational training effectiveness^(1,2,14)

- | | |
|--|---|
| <p>1) Hearing is important for:</p> <p>a) Communication.</p> <p>b) Accident prevention.</p> <p>c) Working correctly.</p> <p>d) All of the above.</p> | <p>8) I believe that my ears may get used to the noisy with time and not be prejudiced.</p> <p>a) I agree.</p> <p>b) I do not agree neither disagree.</p> <p>c) I disagree.</p> <p>d) No response.</p> |
| <p>2) What can happen when people are daily exposed to excessive noise?</p> <p>a) Some people may develop hearing loss throughout time.</p> <p>b) Some people may present permanent tinnitus.</p> <p>c) Some people may become stressed due to the constant exposition to intense noise.</p> <p>d) All of the above.</p> | <p>9) I cannot use hearing protectors because I need to communicate with my co-workers during my activities.</p> <p>a) I agree.</p> <p>b) I do not agree neither disagree.</p> <p>c) I disagree.</p> <p>d) No response.</p> |
| <p>3) What is the lowest noise level that may cause hearing loss?</p> <p>a) 65 dBHL</p> <p>b) 85 dBHL</p> <p>c) An average of 85 dBHL for more than 8 hours.</p> <p>d) None of the above.</p> | <p>10) I am not able to listen to problems on my machine or tools if I am using hearing protectors.</p> <p>a) I agree.</p> <p>b) I do not agree neither disagree.</p> <p>c) I disagree.</p> <p>d) No response.</p> |
| <p>4) I know the noise level of my work environment.</p> <p>a) I agree.</p> <p>b) I do not agree neither disagree.</p> <p>c) I disagree.</p> <p>d) No response.</p> | <p>11) I work better when I use my hearing protectors.</p> <p>a) I agree.</p> <p>b) I do not agree neither disagree.</p> <p>c) I disagree.</p> <p>d) No response.</p> |
| <p>5) What is NRR?</p> <p>a) It is the radio noise level.</p> <p>b) It is the noise level of any noisy machine.</p> <p>c) It is the level of noise reduction of the hearing protector.</p> <p>d) It is a functioning measure of plug hearing protectors.</p> | <p>12) I know when my protectors type ear plug/shell need to be replaced.</p> <p>a) I agree.</p> <p>b) I do not agree neither disagree.</p> <p>c) I disagree.</p> <p>d) No response.</p> |
| <p>6) The type plug ear protectors better block the noise than the ones that are shell type.</p> <p>a) True.</p> <p>b) False.</p> <p>c) It depends on several factors.</p> <p>d) None of the above.</p> | <p>13) I know how to adequately position the hearing protector because I was already oriented about this (If response is "a" the evaluator should verify the information).</p> <p>a) I agree.</p> <p>b) I do not agree neither disagree.</p> <p>c) I disagree.</p> <p>d) No response.</p> |
| <p>7) Most of my co-workers use hearing protectors when:</p> <p>a) They are working with noisy machines.</p> <p>b) They are working in noisy environments.</p> <p>c) The supervisor is observing them.</p> <p>d) They do not use them.</p> | <p>14) I know how to correctly clean the hearing protector because I was already oriented about this (If response is "a" the evaluator should verify the information).</p> <p>a) I agree.</p> <p>b) I do not agree neither disagree.</p> <p>c) I disagree.</p> <p>d) No response.</p> |