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ARTICLE

Application of the BASNEF Model in Safety Training in Automobile Manufacturing Plants

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ABSTRACT

After controls, including engineering and management, the final way to control noise is to use hearing protection devices. Due to the lack of a standardized questionnaire regarding investigating workers' use of hearing protection devices on the basis of the BASNEF behavioral model, the present study was conducted to investigate the effect of health education based on the BASNEF model on the use of hearing protection devices in workers of an automobile manufacturing plant in Iran. This quasi-experimental and prospective intervention study was performed on 80 workers at an automobile manufacturing plant who are exposed to noise levels above 85 decibels and do not use hearing protection devices. In this study, 40 people working in a cast iron foundry were selected as the intervention group, and 40 working in aluminum casting were chosen as the control group. Questionnaires were analyzed at the beginning of the intervention and three months after the intervention in the intervention and control groups. There was no significant difference between the intervention and control groups before the intervention. There was a significant difference between the intervention and control groups after the intervention in the area of knowledge. A significant correlation was observed between the intervention and control groups after the intervention program in all areas of the BASNEF educational model except behavioral intention. In this study, the effect of educational intervention on the use of hearing protection devices was investigated, and with the educational intervention, it was tried to get help from influential people and enabling factors in education based on the BASNEF model. The results showed that the educational intervention based on the BASNEF model can improve the knowledge of individuals in both the intervention and control groups.

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KEYWORDS

Health education; BASNEF model; hearing protection devices; automobile manufacturing plant

1 Introduction

Noise is considered the most common occupational exposure in developed and developing countries and is one of the most common physical damaging factors in the workplace [1]. When the noise level exceeds the allowable limit, it can have detrimental effects on the function of different body parts, such as hearing, blood circulation, fluency, and work efficiency [2]. There is a lot of evidence that workers who are exposed to excessive noise in the workplace have a higher risk of accidents [3]. Hearing loss is the most important and definite effect of noise [4]. Noise-induced hearing loss (NIHL) due to prolonged exposure to high levels of noise and age-related hearing loss (Presbycusis) are major health problems that are very common, and their lasting effects and impact on the quality of human life are impressive [5]. It is estimated that 10 million workers in the United States have a hearing loss of more than 25 decibels, and 16 percent of hearing loss worldwide is due to exposure to workplace noise [6,7].

Based on the available data, it has been determined that more than 2 million workers in Iran are exposed to harmful noise [8]. The principled use of hearing protection devices has been considered as a solution to reduce and control noise exposure [9]. According to research, the rate of hearing loss will be reduced by the continuous use of hearing protection devices [10,11]. On the other hand, recent studies have shown that a lack of adequate training and motivation has led to a lack of regular use of hearing protection devices among workers [11], which will cause human and financial losses to individuals and various industries [12]. The most important goal of health education is to change people's health behavior through their own participation. The first step in the planning process is selecting a suitable training model [13].

In recent days, researchers have developed practical and valuable models for achieving the goal of behavior change using various theories of occupational psychology and social sciences. In education, one helpful model is the Belief, Attitude, Subjective Norm, and Enabling Factors (BASNEF) model [14]. The BASNEF model was first introduced in 1993 by combining the components of the two models of logical operation theory and the precedence section of the Precede-precede model. The BASNEF model consists of various constructs, including abstract ideas, attitudes, and norms from the theory of rational action and the enabling factors of the Precede model. Attitude toward behavior has been described as the product of a person's obvious beliefs, and attitude toward behavior refers to the positive or negative evaluation of behavior. Mental norms refer to a person's beliefs about influential people and the source who thinks they should do something or not, which is based on social reflections and pressures. Enabling factors are resources and skills that allow a person's intention or desire to be transformed into behavior and action [15].

This study, using educational intervention based on the BASNEF model, has tried to increase workers' awareness about noise and their attitude towards using hearing protection devices by providing enabling factors, such as sufficient information about hearing protection devices and making them available and engaging the worker's friends and the factory manager, the workers use the hearing protection devices throughout the work shift.

Related studies have shown that BASNEF training intervention has a significant role in increasing the awareness and attitude of individuals as well as their behavior and performance in relation to the use of hearing protection equipment, which can increase the duration of use of the hearing protection devices and reduce changes in the hearing threshold of people exposed to excessive noise [16]. The results of another study showed that applying the BASNEF model compared to conventional education further enhances the level of awareness of individuals and is an effective tool for predicting behavior [17].

Noise pollution is one of the most important physical harmful factors in various industries in the country. To protect workers working in noisy environments, hearing protection training should be one of the priorities of various industries. The automobile manufacturing plant is one of the industries with high noise exposure levels one of the sectors with high noise exposure levels. It is better to include and implement a hearing protection program in its plans to protect workers working in noisy environments [18]. Most studies have been done to increase people's awareness of how to use hearing protection devices or clean and maintain them. This issue is how to train workers in a short time to come to the true belief that they use hearing protection devices all the time at the workplace, which needs a comprehensive investigation. Therefore, in this study, we tried to investigate the effect of educational intervention based on the BASNEF model on increasing the duration of workers' use of hearing protection devices in an automobile manufacturing plant.

2 Method

2.1 Participants

This study is a quasi-experimental and prospective intervention that has studied the effect of educational intervention based on the BASNEF model in increasing the duration of use of hearing protection devices in workers of an automobile manufacturing plant. The study population includes 80 workers exposed to noise levels above 85 decibels who do not use hearing protection devices. Individuals in case and control groups are assigned based on the randomization method. Fisher proposed this technique. Undoubtedly, using this technique is one of the most important ways to control experimental designs. Randomization means people are randomly assigned to defined groups to match the effects of external variables. One of the advantages of this type of randomization is that it places workers randomly in both experimental and control groups, protecting them from bias.

To select the members of each group, the first two of the factory's halls were chosen first, where people are exposed to noise above 85 decibels, and 40 people were randomly selected from each of them. In this way, the list of people in each hall was prepared and numbered, and then, using a table of random numbers, 40 people were selected from all the people working in each hall, and these numbers were selected as the training group (case group). The same procedure was used to select the control group. In this study, 40 people working in a cast iron foundry were selected as the case group, and 40 people working in aluminum casting were selected as the control group. All subjects were selected from workers of the automobile manufacturing plant from different work shifts and separate work halls. Workers are in the same situation regarding age, occupation, working conditions, and the degree of exposure to noise. In addition, their mean age is almost the same, and as much as possible, the contact between the two groups was minimized.

2.2 Study Design

After studying and realizing the importance of workers' hearing, especially the valuable role of hearing protective equipment in preventing and reducing occupational deafness and emphasizing the world health organization to carry out health promotion interventions to increase the duration of use of protective hearing protective devices, the subject was selected. Research purposes The BASNEF model was used in the present study, shown in Fig. 1, according to the stated objectives.

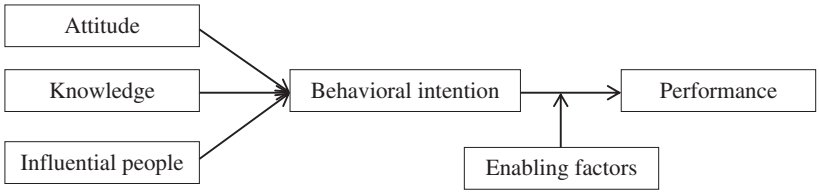

Figure 1: BASNEF model framework

The BASNEF model consists of elements of beliefs, attitudes, subjective norms, and enabling factors; e word BASNEF is composed of the first letters of these words and is the most comprehensive model used to study behavior and identify behavior and create new behaviors in society. This model consists of the Precede and the behavioral intention model. The tools used in the BASNEF model for data collection are done with the help of a questionnaire. The questionnaire is designed is an anonymous questionnaire that is organized into two main parts. The first part is about demographic information, which includes five questions about personal characteristics. The second part is about the components of the BASNEF model, which includes the awareness part with 12 questions (minimum score 0 and maximum score 12), the attitude section includes seven questions (minimum score 0 and maximum score 28), the Influential people section has seven questions (minimum score 0 and maximum score 28), enabling factors section has seven questions (minimum score 0 and maximum score 28), behavioral intention section with eight questions (minimum score 0 and maximum score 32), performance section has eight questions (minimum score 0 and maximum score 16).

2.3 Data Collection

Data were collected at the beginning of the intervention and three months after the intervention from the case and control groups. Before collecting the questionnaires, the workers were interviewed and explained the purpose of the study and the confidentiality of their answers. They were assured that their answers would not affect the evaluation of their work, and they were given informed consent. It should be noted that the control group does not receive any training.

The interventions were held in the form of 6 training sessions (theoretical-practical), each lasting 30–45 min based on the ability and desire of the workers, once a week. The first session discussed the distribution of educational brochures and a brief description of the generalities of workplace noise and the functioning of the human auditory system. In the second session, the occupational medicine specialist was invited to discuss the side effects of noise, hearing loss, and prevention and treatment of hearing loss with the workers. In the third session, with the distribution of educational pamphlets and a brief explanation about the importance of using hearing protection equipment and the hearing protection equipment's role, the types of hearing protection equipment through practical demonstration and the advantages and disadvantages of the hearing protection equipment were discussed. In the fourth session, a practical demonstration (role playing) on how to properly use the hearing protection equipment and select, preserve, and maintain the hearing protection devices were taught. In the fifth session, the workers' audiometry results were used in their training and motivation, and one of the workers who used the hearing protection devices during the whole shift was invited to explain the reason for using the hearing protection devices during the entire shift (Influential people). In the sixth session, the occupational health expert was present at the workers' workplace to provide face-to-face training to remind workers about the previous important topics and answer their questions about the training booklet, pamphlets, training sessions, and a summary of the points of the earlier sessions. In addition, the workers were also given the researcher's phone number to call in case of any questions or problems at any time. The workers' phone number was also taken so that once a week, a reminder SMS containing messages based on the main training points of the sessions was sent to the intervention group once a week from the end of the sixth session to three months after the intervention. They were asked to send a message based on receiving the SMS.

After the training sessions, posters were installed at the workers' place, which included messages about the types of hearing protection equipment and how to use hearing protection devices, as well as the main training tips. All training classes were designed based on the components of the BASNEF model in the form of constructs of knowledge, individual attitude and enabling factors, behavioral intention, and performance and were categorized and implemented with appropriate methods for each. The training was

conducted using a laptop and a whiteboard and included lectures, slide shows, practical demonstrations, group discussions, and questions and answers. Three months after completing the educational interventions, the questionnaire was completed again by individuals in both groups.

2.4 Data Analysis

The collected data was analyzed using SPSS software version 25. The Kolmogorov-Smirnov test was used to evaluate the normality of data distribution. The results of descriptive statistics (mean, standard deviation, and frequency) were presented, and statistical analyzes were applied using independent and paired *t*-tests, chi-square, and Pearson correlation coefficient tests. The significance level of all tests was considered 0.05.

3 Results

3.1 Demographic Variables

The descriptive statistics of the evaluation of demographic variables are presented in Table 1. Participants in the study had a mean age of 36.97 years for the case group and 36.52 years for the control group. The age range of the subjects was 22 to 50 years, and the average work experience was 11.53 years for the case group and 11.12 years for the control group. Work experience ranged from 1 to 23 years. Also, the statistical test results showed no significant difference between the two groups in terms of demographic variables.

Table 1: Descriptive statistics of evaluation of demographic variables

Variable		Intervention	Control
		Mean ± Standard deviation	
Age (year)		36.97 ± 4.99	36.52 ± 7.27
Work experience (year)		11.53 ± 7.36	11.12 ± 7.36
Height (cm)		175.47 ± 5.77	173.67 ± 6.32
Body weight (kg)		81.65 ± 13.16	82.97 ± 12.57
Body mass index (BMI)		23.21 ± 25.35	23.86 ± 3.33
Marital status	Single	5.1%	12.5%
	Married	94.9%	87.5%
Education level	Under diploma	30.8%	10%
	Diploma	66.7%	87.5%
	Undergraduate	2.6%	2.5%

The results of comparing the mean scores of BASNEF educational model domains in the two case and control groups before the intervention plan are presented in Table 2. According to statistical test results, there was no significant difference between the case and control groups before the intervention.

The results of comparing the mean scores of BASNEF educational model domains in the two intervention and control groups after the intervention program were presented in Table 3. According to the statistical test results, there was a significant difference between the intervention and control groups after the intervention in the area of knowledge. But there was no significant difference between the intervention and control groups after the intervention in other areas.

Table 2: Comparison of the mean scores of BASNEF educational model areas in the two intervention and control groups before the intervention program

BASNEF subscale	Intervention group		Control group		*p*-value
	Mean	Standard deviation	Mean	Standard deviation	
Knowledge	7.4	1.721	8.05	1.338	0.063
Attitude	18.95	2.782	19.1	2.589	0.804
Influential people	18.9	5.772	19.3	4.108	0.722
Enabling factors	17.1	6.188	17.55	6.135	0.745
Behavioral intention	23.42	5.710	25.72	5.458	0.069
Performance	11.8	4.064	10.45	5.257	0.203

Table 3: Comparison of the mean scores of BASNEF educational model areas in the two groups of intervention and control after the intervention program

BASNEF subscale	Intervention group		Control group		*p*-value
	Mean	Standard deviation	Mean	Standard deviation	
Knowledge	8.9	1.66	7.92	1.4	0.006
Attitude	18.97	2.91	18.85	2.58	0.840
Influential people	20.02	4.04	19.47	3.88	0.537
Enabling factors	17.67	4.75	17.65	6.04	0.984
Behavioral intention	30.55	35.00	24.67	4.30	0.295
Performance	11.85	4.69	10.17	5.52	0.148

The results of comparing the correlations of different domains of the BASNEF educational model before and after the intervention were presented in Table 4. According to the statistical test results, a significant correlation was observed between the intervention and control groups after the intervention program in all areas of the BASNEF educational model except behavioral intention.

Table 4: Comparison of correlations between different areas of the BASNEF educational model before and after intervention

BASNEF subscale	Correlation coefficient	*p*-value
Knowledge	0.428	0.0001
Attitude	0.492	0.0001
Influential people	0.614	0.0001
Enabling factors	0.745	0.0001
Behavioral intention	0.113	0.318
Performance	0.808	0.0001

4 Discussion

One of the effective measures to prevent hearing loss in workers facing noise levels higher than 85 decibels is the use of hearing protection devices. Because hearing loss occurs over a long period, people ignore this issue, and it is necessary to use approaches to teach this topic. Melamed al. [19] reported that noise-induced hearing loss should be prevented using internal and external protectors, which can be achieved with proper planning. Toppila et al. [20] also studied hearing protection programs in various occupations and concluded that using hearing protection devices are a relatively good control strategy against hearing loss. So, with this goal in mind, we looked into how workers in this industry used hearing protection after getting health education based on the BASNEF model.

In this study, to reduce the effect of confounding factors, the matching of case and control groups based on demographic characteristics was performed. The mean age and work experience of the two groups were 36 and 11 years, respectively. Unfortunately, many studies in this field have overlooked this important issue. In the Monazzam study, 46% of individuals were in the age range of 20 to 35 years, and 51% had more than 12 years of work experience [16]. The percentage of people using hearing protection devices in Melamed et al. [19], and Arabtali et al. [21], studies was about 40%. In the Tsukada et al. [22] study, 46% of people used hearing protection devices regularly. One reason for this is that loud noise slowly hurts hearing over time.

The results of the present study did not report a significant difference between the intervention and control groups before the intervention program, but in the three months after the intervention, a significant difference was observed between the two groups in the area of knowledge, which is consistent with the results of another study in melting factories [23]. The presentation of theoretical and practical educational materials to the intervention group in the field of noise exposure, its side effects, disadvantages, and advantages, and how to use hearing protection devices correctly through the BASNEF model has been influential in the area of awareness. Researchers showed that the mean score of BASNEF model domains after the educational intervention significantly increased compared to before the intervention [16].

Educational theories and models help researchers focus on the most appropriate areas for behavior change. One of the useful models in health education is the BAZNEF model that was used in this study [14]. This model focuses on the effect of awareness and attitude on behavior and draws on other factors, such as enabling factors and subjective norms. Most of the studies that have used educational models in teaching how to use a hearing protection device have used planned behavior and protection motivation [19,21,24]. In a study of miners, about six weeks after the intervention, the miners' perceived attitude and behavioral control improved toward using hearing protection devices [24]. The percentage of use of hearing protection devices in a study in a glass and gas factory was insufficient, and it was suggested to increase this percentage, to plan effective interventions based on the theory of protection motivation to improve perceptions of intensity, sensitivity, perceived costs, self-efficacy and perceived response efficiency [21]. The effectiveness of the BASNEF model was confirmed in many studies, but the results of this study did not show much effect and were almost opposite to the results of other studies [14,16]. In another study in the textile industry, the impact of a hearing protection training program on the noise disturbance of textile workers was investigated. After preparing an educational package based on the opinion of experts and the initial evaluation of the educational intervention, the results showed that this intervention affects the scores of knowledge, attitude, and practice and improves them. In contrast, the educational intervention had increased the noise annoyance among the workers of the case group [25].

Therefore, by preparing training packages, we can expect to increase the duration of using the hearing protection devices and reduce the change in the hearing threshold of the subjects under study [16], which is recommended that this critical issue be further explored in future studies. In the textile industry study, the

results showed that awareness of noise-induced hearing loss among adults in Jordan is very low [25]. Zaw et al. [26] also recommended the provision of occupational hazard training and the implementation of occupational safety regulations to reduce the level of noise exposure. The results of the present study indicate that people's awareness has increased due to education, and this alone will not change behavior in individuals. But for a fundamental change in behavior that leads to the use of hearing protection devices, the focus should be on all dimensions of BASNEF. Therefore, due to the contradictions between different studies, it is recommended to perform a survey to compare other theories, models, and the effect of different training packages on the duration of hearing protection device use.

5 Conclusion

In the present study, the effect of educational intervention on the use of hearing protection devices was investigated, and the educational intervention was tried to get help from influential people and enabling factors in education based on the BASNEF model. The results concluded that by conducting an educational intervention based on the BASNEF model, a significant difference was observed between the two intervention and control groups after the intervention program in the area of knowledge. Also, a significant correlation was observed between the intervention and control groups after the intervention program in all areas except behavioral intention. Therefore, the results concluded that raising awareness alone is not enough to change behavior in individuals. The model results can help raise people's awareness of hearing protection devices so that workers in noisy places can be safe.

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Author Contributions: Fereydoon Laal: study design, data collection, writing original draft, revising the article; Amir hossein Khoshakhlagh: writing original draft, revising the article; Esmaeil Zarei: revising the article, data collection; Rohollah Fallah Madvari: revising the article; Somayeh Farhang Dehghan: Study design, writing the original draft, project supervision.

Conflicts of Interest: The authors declare that they have no conflicts of interest to report regarding the present study.

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