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Original Article

Artigo Original

Perception of hearing protectors by workers that participate in hearing preservation programs: a preliminary study

A percepção sobre protetores auriculares por trabalhadores participantes de programas de preservação auditiva: estudo preliminar

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Keywords

Health Programs
Occupational Health
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ABSTRACT

Purpose: To evaluate and compare the workers' perception of comfort and use aspects regarding two types of hearing protectors (shell and earplug), in three units from a lumbering company, with different implantation times for Hearing Preservation Programs. **Methods**: This is a cross-sectional study comparing 440 workers' perception of hearing protectors, from three companies in Paraná State (Brazil), with different times for Hearing Preservation Programs. Two closed questionnaires were applied (9 and 10 questions, respectively), with a scale of answers varying from 1 to 5 (Likert's scale) regarding the perception of the comfort of hearing protectors. Then, audiometry results were analyzed. **Results:** About 17.5% presented audiogram examinations with alterations. With regard to the questionnaire about the comfort perception, the importance of noise attenuation (mean of 4.25) was the most relevant aspect, followed by communication possibility (mean of 4.15). In the protector assessment, Unit A with more Hearing Preservation Program time presented better scores for both the worker's perception of important aspects regarding hearing protector and for the assessment of the used hearing protector. There was a significant difference on communication difficulty with the use of a hearing protector among workers with normal and altered audiograms (p=0.0371). With regard to the global comfort in the comparison of workers using the shell-type hearing protector with those using insert-type hearing protectors, there was no difference (p=0.2264), irrespective of the type of the unit. **Conclusion**: In general, the unit workers presented a good perception of the important aspects about the hearing protection use of both types of hearing protectors.

Descritores

Programas de Saúde
Saúde do Trabalhador
Perda Auditiva Provocada por Ruído
Controle de Ruído

RESUMO

Objetivo: avaliar e comparar a percepção de trabalhadores sobre aspectos de conforto e uso de dois tipos de protetores auriculares (tipo concha e inserção) em três unidades de uma empresa madeireira com tempos diferentes de implantação de Programas de Preservação Auditiva (PPA). **Métodos:** trata-se de um estudo transversal, que comparou a percepção de 440 trabalhadores de três unidades de empresa do estado do Paraná, com tempos diferentes de Programa de Preservação Auditiva, sobre protetores auriculares. Foram aplicados dois questionários fechados (9 e 10 questões) com escala de respostas de 1 a 5 (escala Likert) sobre percepção de conforto de protetores auriculares e analisadas as audiometrias. **Resultados:** 17,5% apresentaram audiogramas alterados. Em relação ao questionário de percepção de conforto, a importância da atenuação do ruído (média 4,25) foi o aspecto mais relevante, seguido da possibilidade de comunicação (média 4,15). Na avaliação do protetor utilizado, a Unidade A com mais tempo de PPA apresentou pontuações melhores tanto para a percepção dos aspectos importantes do protetor auricular pelos trabalhadores quanto na avaliação do protetor auricular utilizado. Houve diferença significativa sobre a dificuldade de comunicação com o uso de protetor auricular entre trabalhadores com audiogramas normais e alterados (p=0,0371). Quanto ao conforto global na comparação dos trabalhadores usuários do protetor auricular do tipo concha com os do tipo inserção, não houve diferença (p=0,2264) independente da Unidade. **Conclusão:** Em geral, os trabalhadores das unidades apresentaram uma boa percepção de aspectos importantes da proteção auditiva para a utilização de ambos os tipos de protetores auriculares.

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INTRODUCTION

High noise exposure is one of the risk factors for hearing health; however, it is still present in work environments.

Noise-induced hearing loss (NIHL) at work assails many workers in different activity areas, being considered a public health issue because of not only its amount of assailed workers but also its impact on different sectors of society activity such as economic, political, or health aspects[1-3].

However, NIHL can be avoided by controlling noise exposure. Until the sound source is controlled or eliminated, occupational intense noise exposure can be minimized with the use of a hearing protection equipment of individual use: the hearing protectors.

The Brazilian labor laws, through Regulatory Standard no. 6, require the use of hearing protectors if sound pressure levels are equal to or higher than 85 dB(A) during 8 hours of exposure.

Although the use of hearing protectors may be a temporary solution within Hearing Preservation Programs (HPP), the choice of protector type and model and the practice for its correct use are the aspects that deserve certain care by health professionals[4,6,7].

The variety of hearing protectors found in the market has been significantly increasing in the last 40 years. However, the main question remains the same, that is, do workers' make proper use of these protectors throughout the entire intense noise exposure[8]. To succeed in this issue, effective awareness actions should be implemented as part of the HPP[9,10].

Correct use of the most appropriate hearing protector for each labor situation is a hard task to the team developing the HPP, because it involves aspects such as the ability to work with people, communication and motivation art, use of supervision and control, and ergonomic issues associated with the hearing protector[11,12]. Some studies show that the hearing protector attenuation may be restricted based upon the worker's emplacement[13].

Notwithstanding, the best noise attenuation criterion may not always be enough to choose the hearing protector, because comfort, communication need, weather and labor conditions, cost and durability should be prioritized, in addition to educational actions that make the workers' aware of its proper use[14].

A fundamental aspect to consider when choosing the hearing protectors is comfort, because it will define its constant or inconstant use. This selection process must include the workers in the choice, taking into consideration their perception of comfort, which will be definitive for its constant use[4,9] . In addition to noise attenuation, comfort sensation when using hearing protectors involves several aspects: hearing protector weight, ear pressure, texture, capacity to dissipate generated heat and to absorb sweat, interference of hearing protector in performing work tasks and in oral communication, and how to place it[15,16].

Thus, it is important to develop programs that motivate and stimulate the correct use of hearing protectors at work environments. We must consider that discomfort from protector use should be minimized or excluded, whenever is possible[4].

Studies show a better use of hearing protectors after educational actions that not only share information but also aim at educating workers on the need of protecting themselves against an intense noise exposure[5,12,17].

Proposals of educational actions to workers as a part of the HPP, which stimulate a reflection about the noise impact and its effects in professional and social environments, through daring, objective, and integrative strategies that promote a space for speaking, hearing, and exchanging information and favor the awareness and adoption of more preventive attitudes regarding health[17,18].

The objective of this study was to evaluate and compare the workers' perception of comfort and use aspects regarding two types of hearing protectors, in three units from a lumbering company, with different implantation times for HPP.

METHODS

This is a cross-sectional study approved by the Research Ethics Committee, under the number 182.412. Procedures were performed after subjects' voluntary participation and signature of the free informed consent.

Four hundred and forty workers from both genders, who worked in three units of the same lumbering company, located in three different municipalities in Paraná State countryside, took part in the study. Subjects were invited to participate in the research voluntarily, during an educational action in the company about the Noise Awareness Day.

The same team of speech language pathologists implemented HPP in the units, with a participative proposal of workers in educational actions but with different implantation times. The actions developed in the units were inspections of hearing protector use in work places; pure tone audiometry performance; individual training on how to put the hearing protector; and three educational actions for a year in each unit about hearing loss preservation.

The characteristics of each manufacturing unit are described as follows:

1. Unit A: This unit included 381 workers, but only 223 of them participated in this study. This unit produces wood-fiber panel in medium density fiberboard (MDF); has the HPP for 6 years; and presents a noise level between 72 and 105 dBA.
2. Unit B: This unit included 392 workers, but only 159 of them participated in this study. This unit also produces wood-fiber panel in MDF; has the HPP for 4 years; and presents a noise level between 52 and 102 dBA.
3. Unit C: This unit included 84 workers, but only 58 participated in this study. This unit produces resin for manufacturing MDF plates; has the HPP for only 1 year; and presents a noise level between 56 and 98 dBA.

The assessed models/types of hearing protectors were those used in the units: shell-type with noise reduction level NRRsf=22 dB and premolded insert-type with NRRsf=15 dB. Shell- and insert-type models were available to workers from Units A and B, and only the insert-type model was available

to workers in Unit C. All participating workers of the study were exposed to sound pressure levels above 80 dB(A) during 8 hours of exposure daily, and the companies made the use of hearing protectors obligatory as part of the HPP proposal.

It was applied in two questionnaires (Appendix) that were originally structured by Abelenda[15] and adapted by the investigators, in which Questionnaire 1 analyzed the perception about the importance of aspects regarding hearing protectors, and Questionnaire 2 assessed the aspects of the hearing protector use by the worker.

The following aspects of the hearing protector were analyzed: noise attenuation, hearing protector weight, hearing protector ear pressure, hearing protector texture, capacity to dissipate heat, capacity to absorb sweat, hearing protector interference/discomfort in performing work tasks, and interference in oral communication.

All hearing protector aspects associated with a 1-5 scale (Likert's scale) were analyzed in Questionnaire 1, in which a score of 1 corresponded to the "insignificant" perception and 5 to "very important" perception. In Questionnaire 2, the same aspects were associated with a 1–5 scale, where a score of 1 corresponded to a positive judgment and 5 to a negative one regarding the hearing protector. A question in Questionnaire 2 about the global comfort sensation of hearing protector, but with an inverse classification to the previous ones, was included, in which a score of 1 corresponded to the most uncomfortable situation and 5 to the most comfortable one.

Both questionnaires were validated to Brazilian and Portuguese in each pilot study, and instrument reliability analysis was based on questions through the Cronbach's alpha test. Thus, Cronbach's alpha test was 0.8967 and 0.8812 for Questionnaires 1 and 2, respectively, being both considered appropriate.

The pure-tone audiometry examinations conducted in the year that the questionnaire was applied to 440 workers were also analyzed. Speech language pathologists from the HPP team of the units performed the audiometry examinations in acoustic booths, with MAICO MA41 audiometer, and calibrated following the ISO 389/64 standards and TDH39 earplugs.

For data analysis, audiograms were classified as normal examinations, when the pure-tone hearing thresholds in all frequencies were equal to or lower than 25 dBNA, and altered examinations, when the answers to pure-tone hearing thresholds did not fit in the previous description. Data about service time in the unit (in years) and participation time in the HPP (in years) were also surveyed. Statistical procedures were used to analyze the answers in Questionnaires 1 and 2. The ANOVA test was used to compare the mean values of age and service time, and Sheffé test was applied to identify the differences in service time. Kruskal–Wallis ANOVA test was used to analyze the scores of questionnaire aspects to verify the existence of significant differences in the answers. When there were significant differences, the multiple comparison was applied to check in which units, two by two, the differences were. A 0.05 level of significance (5%) was considered.

RESULTS

Three units in a lumbering company with 440 workers were part of the study. The workers' age varied from 18 to 55 years (mean of 31.43 years; standard deviation, SD=7.79), and no differences were observed between the mean of workers' ages in the manufacturing units A, B, and C (p=0.2572, ANOVA test). Service time in the units varied from 1 year to 36 years, and the service time mean in Unit A was 3.56 (SD=4.03) years, whereas it was 4.38 (SD=4.01) years in Unit B and 5.16 (SD=5.60) years in Unit C. A significant difference (ANOVA test, p=0.0208) was observed between the mean service times in the units. The Scheffé test identified a significant difference between the mean times of Units A and C (p=0.0407).

With regard to the time of workers' participation in the HPP, it was seen that, in Unit A, 170 (76.23%) workers participated in the HPP since its implementation, totaling 6 years; in Unit B, 85 (53.46%) workers participated for 3 years; and in Unit C, 24 (41.38%) participated during a year.

As to the hearing profile of 440 analyzed subjects, 17.5% workers presented altered audiograms. Through the proportion difference test, no significant differences were found (p>0.05) in the proportion of workers with altered audiograms between the three companies (between Units A and B, p = 0.1854; between Units A and C, p = 0.7692; and between Units B and C, p = 0.2330).

Workers' perception about the importance of analyzed aspects regarding the hearing protector (Questionnaire 1) is discussed further.

In the general analysis of the participants' answers, the mean score in Questionnaire 1 was higher than 3.19 points. There were significant differences in the mean score in all the hearing protector aspects (Kruskal–Wallis ANOVA, p=0.0000), and the most important aspect considered by the participants was noise attenuation by the hearing protector (mean score of 4.25 and SD=1.01), followed by oral communication possibility (mean of 4.15 and SD=1.04). The aspect with the lowest mean score considered as the least important was hearing protector weight (mean of 3.80 and SD=1.23).

Table 1 shows the results of workers' perception about the importance of hearing protector aspects (Questionnaire 1), distributed in manufacturing unit and hearing protector type.

It was seen that, among the users of shell-type hearing protectors, there were differences in the perception of all aspects considered in this study, and the mean values in the manufacturing Unit A were higher (therefore, the assessed aspects were considered more important than in Unit B). Hearing protector attenuation and oral communication were the two most important aspects in Unit A, whereas attenuation and pressure of hearing protector plugs were the most important in Unit B.

In the perception comparison about important aspects for users of the insert-type hearing protector, there were some differences for noise attenuation aspects, hearing protector pressure in the hearing/plug channel, capacity to absorb sweat, discomfort in performing tasks, and oral communication

(Kruskal-Wallis ANOVA). In the multiple comparison analysis, there were differences between Units A and B, and the mean values in Unit A were also higher. In Unit A, the most important aspect was hearing protector attenuation; in Unit B, protector positioning; and in Unit C, discomfort in performing chores.

Results of Questionnaire 2 about aspect assessment of the hearing protector used by the worker were found later.

The general analysis of Questionnaire 2 with all workers showed that the mean score was not higher than 2.42 points. There were significant differences in the mean evaluation of all hearing protector aspects (Kruskal-Wallis ANOVA, p=0.0000). The aspect with the highest mean score (mean of 1.48 and SD=0.90) was hearing protector placing. Considering the score provided in the Questionnaire that varies from 1 (easy) to 5 (difficult), workers considered easy to place the hearing protector.

Table 2 presents the distribution of results from assessment scores of the hearing protector used by workers, company, and type of protector (shell and insert).

Among the users of the shell-type hearing protector, there were differences in the assessment of all protector aspects, and the mean values in Unit A were lower. The aspects with the best evaluations among users of the shell-type protector were, in Unit A, easy placing and good hearing protector attenuation. In Unit B, the best-assessed aspects were easy placing and softness (texture) of the hearing protector.

Among insert-type hearing protector users, there was no difference in the evaluation between the units only for the placing aspect (easy placing), with the best second mean score per unit. There were differences for the other aspects (Kruskal-Wallis ANOVA): in Unit A, the hearing protector obtained a better assessment than in the others. In the three units, the best-assessed aspect was hearing protector weight (light) and the worst-assessed aspect, in Unit A, was the capacity to absorb heat; in Unit B, hearing protector attenuation; and in Unit C, pressure in the hearing channel.

The aspect assessment of the hearing protector used by workers was analyzed per unit using audiograms, as presented in Table 3.

There was a significant difference between workers with normal and altered audiograms only in Unit A, regarding oral communication easiness (Mann-Whitney's test, p=0.0371), which received the worst assessment by workers with altered audiogram.

Regarding the assessment of hearing protector global comfort, when comparing workers who use the shell-type with those who use the insert-type, regardless of the unit, no difference was found (p=0.2264, Mann-Whitney's test). The analysis was also done per unit and is presented in Table 4.

The analysis done per unit presents differences in hearing protector global comfort assessment for the shell-type hearing protector between Units A and B, being better evaluated in Unit A. There was a difference between the three units for the insert-type hearing protector (p=0.0207, Kruskal-Wallis ANOVA), which was also better evaluated in Unit A.

DISCUSSION

This study analyzed the comfort perception of two types of hearing protectors used in three units in a lumbering company in Paraná, with different HPP implantation times.

Table 1. Perception of the importance of hearing protector aspects by unit and type of hearing protector (mean score and standard deviation), n=440

Aspects/type	Unit A (n=152)	Unit B (n=127)	Unit C (n=0)	p-value
	Mean±SD	Mean±SD	Mean±SD	
SHELL				
Attenuation	4.47±0.91	4.12±0.95	–	0.0006*
Pressure	4.24±0.95	4.06±0.92	–	0.0445*
Weight	4.07±0.96	3.63±1.10	–	0.0007*
Texture	4.12±1.01	3.78±1.06	–	0.0039*
Capacity to dissipate heat	4.18±0.92	3.90±1.00	–	0.0039*
Capacity to absorb sweat	4.20±0.89	3.72±1.03	–	0.0124*
Discomfort in doing chores	4.15±1.09	3.47±1.24	–	0.0001*
Placement	4.21±1.21	3.84±1.26	–	0.0031*
Oral communication	4.44±0.80	3.86±1.10	–	0.0000*
INSERT	Unit A (n=71)	Unit B (n=32)	Unit C (n=58)	
Attenuation	4.38±1.05	3.78±1.10	4.09±1.14	UA≠UB 0.0116*
Pressure	4.25±1.09	3.78±0.94	3.76±1.35	UA≠UB 0.0352*
Weight	3.82±1.52	3.19±1.53	3.81±1.34	0.0525
Texture	4.13±1.22	3.75±0.92	3.76±1.30	0.0528
Capacity to dissipate heat	3.96±1.30	3.62±1.26	3.67±1.32	0.1730
Capacity to absorb sweat	4.04±1.25	3.47±1.05	3.81±1.38	UA≠UB 0.0219*
Discomfort in doing chores	4.15±1.21	3.38±1.45	4.07±1.32	UA≠UB 0.0218*
Placement	4.30±1.06	3.81±1.20	4.05±1.18	0.0637
Oral communication	4.30±1.07	3.63±1.26	4.05±1.17	UA≠UB 0.0028*

*0.05 level of significance (5%)

Caption: UA = Unit A; UB = Unit B

A total of 440 subjects participated in this study, and 17.5% of them presented altered audiograms. Other studies in lumbering industries found different hearing alteration percentages. An example is a study in Federal District, Brazil[19], which assessed 54 workers from three lumbering companies and found 48.1% audiograms with audiometric notches. There is

Table 2. Assessment comparison of the hearing protector used by worker per unit and type of hearing protector (mean score and standard deviation), n=440

Aspects/type	Unit A (n=152)	Unit B (n=127)	Unit C (n=0)	p-value
	Mean±SD	Mean±SD	Mean±SD	
SHELL				
Attenuation	1.54±0.89	2.21±1.16	–	0.0000*
Pressure	1.58±0.80	2.11±1.06	–	0.0000*
Weight	2.18±0.99	2.18±1.01	–	0.0003*
Texture	1.72±0.87	2.07±0.91	–	0.0000*
Capacity to dissipate heat	2.34±0.98	2.95±1.05	–	0.0002*
Capacity to absorb sweat	2.49±1.04	2.97±1.02	–	0.0002*
Discomfort in doing chores	1.76±0.86	2.09±0.91	–	0.0000*
Placement	1.40±0.84	1.56±0.98	–	0.0013*
Oral communication	1.78±0.96	2.27±1.05	–	0.0000*
INSERT	Unit A n=71	Unit B n=32	Unit C n=58	
Attenuation	1.65±0.93	2.06±1.11	1.84±0.97	UA≠UB 0.0000*
Pressure	1.66±0.86	2.00±0.92	2.05±1.07	UA≠UB 0.0000* and UA≠UC 0.0131*
Weight	1.34±0.83	1.37±0.61	1.41±0.96	UA ≠UC and UB ≠UC 0.0000*
Texture	1.52±0.88	1.78±0.71	1.57±0.80	UA≠UB 0.0001* and UA≠UC 0.0020*
Capacity to dissipate heat	1.68±0.95	1.78±1.04	1.84±1.12	UA≠UB and UB≠UC 0.0000*
Capacity to absorb sweat	1.90±1.14	1.91±0.96	1.95±1.18	UA≠UB and UB≠UC 0.0000*
Discomfort in doing chores	1.62±0.92	1.69±0.86	1.76±1.03	UA≠UB 0.0051*
Placement	1.39±0.80	1.50±0.76	1.62±1.04	0.1283
Oral communication	1.69±0.90	1.97±1.06	1.97±0.99	UA≠UB and UA≠UC 0.0000*

*0.05 level of significance (5%)
Caption: UA = Unit A; UB = Unit B; UC = Unit C

Table 3. Mean scores regarding the classification of used hearing protector aspects per unit and audiogram result, n=440

Aspects	UA		UB		UC	
	Normal n=180	Altered n=43	Normal n=137	Altered n=22	Normal n=46	Altered n=12
Attenuation	1.52	1.79	2.12	2.55	1.80	2.00
Pressure	1.59	1.67	2.11	1.95	1.98	2.33
Weight	1.92	1.88	2.04	1.91	1.28	1.92
Texture	1.65	1.67	1.99	2.14	1.46	2.00
Capacity to dissipate heat	2.13	2.09	2.68	2.95	1.76	2.17
Capacity to absorb sweat	2.29	2.35	2.75	2.77	1.93	2.00
Discomfort in doing chores	1.72	1.70	2.02	1.91	1.65	2.17
Placement	1.36	1.58	1.55	1.55	1.54	1.92
Oral communication	1.67*	2.07*	2.18	2.41	1.89	2.25
Global comfort	4.23	4.00	3.64	3.45	3.89	3.33

*0.05 level of significance (5%)
Caption: UA = Unit A; UB = Unit B; UC = Unit C

Table 4. Global comfort assessment of the used hearing protector by workers due to the company, n=440

Type of hearing protector	Unit A (n=223)	Unit B (n=159)	Unit C (n=58)	p-value
	Mean±SD	Mean±SD	Mean±SD	
Shell	4.17±0.95	3.60±1.00	–	UA≠UB 0.0000*
Insert	4.29±1.02	3.69±1.22	3.78±1.27	UA≠UB≠UC 0.0207*

*0.05 significance level (5%).

also a study in Rondônia[20] that assessed 53 workers from three lumbering companies and found audiometry results of 31.25% with audiometric notch, in which 13.5% suggested NIHL and 6.25% had other audiometric alterations. Moreover, a study carried out in a lumbering company in Distrito Industrial de Maracanaú, in Ceará[21] with 25 workers, where the authors found altered audiometric results in 24% of them. Nevertheless, there were no references in the above-mentioned studies about the existence or nonexistence of a HPP, therefore, it is more difficult to analyze if the existence of a HPP in the company of this study contributed for the lower percentage of hearing alterations.

The units of the studied lumbering company are similar regarding the mean age of the analyzed subjects and hearing profile; however, they are different regarding the level of noise (Unit A showed more intense maximum levels, Unit B intermediate noise levels, and Unit C less intense noise levels in the unit comparison); the mean of service time (Units A and B presented similar mean service times, but a different service times from Unit C); and the mean of HPP implantation time.

In the workers' assessment about the importance of hearing protector aspects, subjects considered noise attenuation offered by the protector as very important, with a higher mean score than the other aspects. On the basis of literature, the objective of a hearing protector is to minimize the intensity of the noise that reaches the internal ear[9,15], which the subjects in this study identified as very important. A study in Taiwan about the perception of workers regarding the hearing protector important aspects also found noise attenuation referred by workers as the most important aspect in a hearing protector[22].

Oral communication was the second most important aspect considered by workers, with a high mean score. Difficulties in oral communication when using hearing protectors are common complaints among workers[10,22], which are considered by many authors as one of the main reasons so that workers do not use hearing protectors[10,12]. That is probably the reason why workers considered the oral communication aspect as important in this study. Since labor tasks, in many activities, are based upon oral communication among workers, these may become more difficult when the worker is in a noisy place, using hearing protectors[23]. So, the choice of a hearing protector with enough attenuation to protect hearing but that at the same time allows speaking, not isolating the worker[31], is necessary.

A hearing protector works as a sound barrier that falls upon the internal ear, and given the characteristics per frequency attenuation of the hearing protectors that are proper to industrial use in Brazil, which attenuate mainly high frequencies, workers presenting NIHL would go through more communication difficulties when using a hearing protector[24]. The NIHL worker will present speaking comprehension difficulties in environments that are not acoustically favorable, owing to the hearing acoustic notch in high frequencies, which would worsen with the use of a hearing protector.

The above-described situation can be understood from the results shown in Table 3, where it is possible to observe that workers with altered audiograms in Unit A (the one presenting a higher amount of workers with hearing alteration (43) and where the environment sound pressure level is higher than the others, which would contribute to difficulties of speaking perception in the noise) evaluated the use of a hearing protector as negative with regard to communication. Other studies also report worker's communication difficulty when using a hearing protector, because the environment noise associated with the sound barrier produced by the hearing protector makes it difficult the perception of environmental and communicational sounds[10,12,25].

With regard to Questionnaire 1, about the importance given by workers to each aspect of the hearing protectors assessed in this study, the analysis was done per manufacturing unit and the type of hearing protector used (Table 1). Results show that, among users of shell-type hearing protectors, all assessed aspects presented differences between the units, in which Unit A, with more HPP implantation time (six years), had higher scores. Thus, workers from Unit A consider that all aspects are more important for comfort when using the protector than for workers from Unit B (with four years of HPP).

On the other hand, workers using the insert-type hearing protector presented a difference regarding the aspects: noise attenuation, hearing protector pressure, capacity to absorb heat, discomfort, and oral communication. Weight of the hearing protector was considered important for the workers who used the insert-type hearing protector in the three units. The insert-type hearing protector has a small size and is light when compared with the shell-type hearing protector, which is an aspect that is valued among workers[26]. The use of small and light hearing protectors facilitates mobility at work environment and use of other individual protection equipment, such as masks, glasses, helmets, among others. The mean scores of relevant aspects regarding the hearing protector in Unit A were higher. Presumably, the higher the level of worker's awareness about the importance of hearing prevention, provided by the years accumulated in the manufacturing unit HPP, the higher the importance given to the aspects of the hearing protector. Other studies indicate the importance of awareness about the hearing loss prevention, contributing thus for a better assessment and acceptance of hearing protectors by workers who are exposed to intense noise[9,12,17,27-29].

With regard to the assessment of aspects regarding hearing protectors used by workers (Questionnaire 2), it has been seen, in general, that the best-assessed aspect was hearing protector placement (considered as the closest to judging as "easy placing," according to the questionnaire scale). If analyzed by the manufacturing unit and the type of hearing protector used, among the users of the shell-type protector, the best-assessed aspect was the easy placement of the protector, with a different evaluation in Unit A, which valued this aspect even more than in Unit B.

However, among insert-type hearing protector users, there were no differences between the three units regarding the placement of hearing protector, which was the second aspect with the best score. Among insert-type hearing protector users, the best-assessed aspect was hearing protector

weight. Hearing protector placement has been the focus of health professionals and work safety, as there is a consensus about the importance of a correct orientation to the workers[5,25]. A study with 13 workers from a metallurgical company from São Paulo countryside, who used the insert-type hearing protector, observed that 100% of them reported that the hearing protector was easy to be placed[10]. Guidance about the proper use of the protectors is the employers' responsibility in the Brazilian laws. It is also an aspect that has been widely discussed and recommended as part of the HPP[9,30]. Studies have shown that workers taking training programs to learn the proper placement of hearing protectors achieve a better attenuation and comfort use offered by the protectors, therefore resulting in a better acceptance[4,5,11,30].

With regard to the evaluation of the used hearing protector as to its global comfort, the hearing protectors of this study received good classifications (scores higher than three, which is the median value of the answer possibilities), without differences of perception between shell-type and insert-type hearing protector users. On the other hand, other studies report that workers notice differences in comfort evaluation of different types of hearing protectors, considering the shell-type hearing protector as the most comfortable one[4,12]. Analysis of the hearing protector type and manufacturing unit found a difference in global comfort evaluation of the hearing protector for the shell-type hearing protector between Units A and B, but being best evaluated in Unit A. The insert-type hearing protector received a difference between the three units, but the global comfort evaluation mean of the hearing protector was better in Unit A. The global comfort issue can be associated with the worker's unit, in which Unit A was the one with a longer time of HPP implantation (6 years).

The comfort perception of the hearing protector may also vary owing to acoustic environment, and Unit A presents a higher noise level[4]. However, no studies associating exposure to higher levels of noise with workers' worry in protecting them were found. Many studies report that workers, even in an intense exposure to noise, do not really concern about hearing protection; therefore, constant educational programs are necessary[9,16].

CONCLUSION

This study showed that the most relevant parameters for workers, with regard to hearing protectors, were attenuation of protector and oral communication. Among workers who used the shell-type hearing protector, attenuation was the most relevant parameter; whereas the protector weight was more prevalent among the insert-type hearing protector users.

The assessment of the hearing protector used by workers showed that easy placement was the best-assessed aspect, especially between workers who uses the shell-type hearing protector.

The manufacturing unit with longer HPP time (implemented for six years) presented higher scores, both for worker's perception of important aspects of the hearing protector and in the evaluation of the used protector. It was noticed that, in manufacturing units with HPP that included in their actions worker's participation and guidance about the importance of hearing protectors, discomfort is not a problem anymore, regardless of the type of hearing protector used.

Workers included in HPP with all their components of the studied manufacturing units present a good perception regarding the important aspects of hearing protection for both types of hearing protectors.

A future study intends to analyze the evolution of workers' auditory profile in the units owing to the effective use of hearing protectors.

**CGOG contributed with project elaboration, data collection and analysis, structure of text; DL collaborated with data analysis, literature review, and text review; DSG contributed with data collection, literature review, and text review; EJA contributed with literature review, data analysis, and text review; JMM collaborated with method structure, data analysis, and text review.*

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APPENDIX

Questionário 1 – Avaliação dos Parâmetros de Conforto

Nome:

Função: Setor:

Classifique, segundo a sua opinião, a relevância de cada um dos parâmetros de conforto de um protetor auditivo, considerando uma escala de 1 a 5, em que:

Atenuação	Insignificante	1	2	3	4	5	Muito Importante
Pressão abafadores – exercida pela haste tampões – no canal auditiva	Insignificante	1	2	3	4	5	Muito Importante
Peso	Insignificante	1	2	3	4	5	Muito Importante
Textura	Insignificante	1	2	3	4	5	Muito Importante
Capacidade de dissipar o calor gerado	Insignificante	1	2	3	4	5	Muito Importante
Capacidade de absorver o suor	Insignificante	1	2	3	4	5	Muito Importante
Incômodo na realização de tarefas	Insignificante	1	2	3	4	5	Muito Importante
Colocação	Insignificante	1	2	3	4	5	Muito Importante
Comunicação Verbal	Insignificante	1	2	3	4	5	Muito Importante

Obrigada pela colaboração!

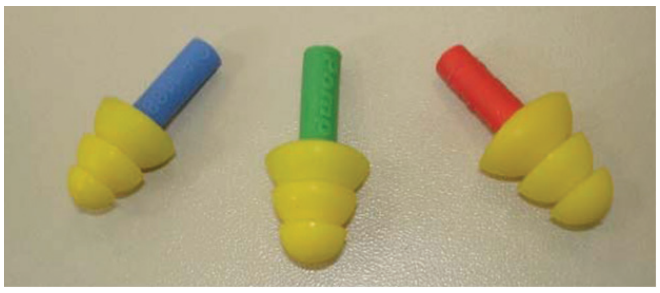
Questionário 2 – Avaliação do Protetor Individual Auditivo

Nome:

Função: Setor:

Selecione o protetor auditivo utilizado:

☐



☐

Classifique o protetor auditivo que você utiliza quanto aos itens que se apresentam abaixo.

Atenuação	Boa	1	2	3	4	5	Má
Pressão abafadores – exercida pela haste tampões – no canal auditiva	Adequada	1	2	3	4	5	Inadequada
Peso	Leve	1	2	3	4	5	Muito pesado
Textura	Macia	1	2	3	4	5	Áspera
Capacidade de dissipar o calor gerado	Boa	1	2	3	4	5	Má
Capacidade de absorver o suor	Boa	1	2	3	4	5	Má
Incômodo na realização de tarefas	Nenhuma	1	2	3	4	5	Muita
Colocação	Fácil	1	2	3	4	5	Difícil
Comunicação Verbal	Fácil	1	2	3	4	5	Difícil

Globalmente, como classifica o protetor auditivo usado?

Desconfortável	1	2	3	4	5	Confortável