Revista CEFAC

eISSN 1982-0216

DOI: 10.1590/1982-0216/20232552023 | Rev. CEFAC. 2023;25(5):e2023

Original articles

Hearing health of adults and the elderly: effectiveness of remote educational actions for Community Health Agents

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ABSTRACT

Purpose: to assess the evolution of educational actions on hearing health, in the remote format, for Community Health Agents from Santa Maria, RS, Brazil, and to identify if there is a relationship between the level of knowledge acquired and the variables age, length of service and education.

Methods: a quantitative and interventional research, carried out with 44 Community Health Agents, who participated in three meetings, via Google Meet. In the first, data on the professionals' knowledge were collected and, in the second and third meetings, there was training on 1) hearing, 2) hearing health and disorders, 3) organization of the Hearing Health Service, 4) use/hygiene of hearing aids and 5) importance of users' follow-up at the service, and the collection of knowledge acquired on these topics. Such collection took place through Quizzes, elaborated in Google Forms. The statistical tests Chi-square and Two-sample Test of Proportions were used to statistically analyze the data, with a significance of 5%.

Results: there was a difference in the rate of correct answers in the post-training Quiz and the acquisition of knowledge was more evident when compared to the performances "worse" and "mistake" in themes 1, 2, 3 and 4. No relationship was found between the level of knowledge acquired and the studied variables.

Conclusion: the educational actions proved to be effective and the level of knowledge acquired on the topics is not related to the studied variables.

Keywords: Hearing; Community Health Workers; Health Education; Effectiveness; Public Health

A study conducted at Federal University of Santa Maria - UFSM, Santa Maria, Rio Grande do Sul, Brazil.

Financial support: Nothing to declare.

Conflicts of interests: Nonexistent.

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Received on: March 30, 2023
Accepted on: September 25, 2023

INTRODUCTION

According to recent data from the World Health Organization, more than 1.5 billion people have some degree of hearing loss, which corresponds to almost 20% of the global population. Of these, 430 million have disabling hearing loss[1]. In Brazil, according to data from the National Health Survey carried out in 2019, there were 2.3 million people (1.1%) with hearing loss, a percentage that increases proportionally with age, reaching 5.4% of the population aged 65 and over. Of the 1.1% of people with hearing loss, 0.8% used hearing aids[2].

In 2004, the National Policy on Hearing Health Care (*Política Nacional de Atenção à Saúde Auditiva, PNASA*) was established in Brazil, created by Ministerial Ordinance No. 587 of October 7, 2004, with the intention of promoting broad national coverage in the care of individuals with hearing loss[3]. At the end of 2011, the National Plan for the Rights of People with Disabilities - Living without Limits (*Plano Nacional dos Direitos da Pessoa com Deficiência - Viver sem Limite*)[4] was launched, which was the basis for Ordinance No. 793, of April 24, 2012, establishing the Care Network for People with Disabilities (*Rede de Cuidados à Pessoa com Deficiência*) within the SUS. This network aimed to create, expand and coordinate points of care for individuals with temporary or permanent, progressive or stable, intermittent or continuous hearing disabilities[5], replacing the previous policy in effect until that time.

However, many people with hearing loss do not access these services and do not know where to turn, as shown in a study that evaluated a hearing healthcare service from the user's perspective. It found that the domain "access to the healthcare service" had the lowest score[6], possibly due to a lack of knowledge about the necessary procedures to access these services.

Given that community health agents (CHAs) are the cornerstone of the family health strategy (FHS) and bridge the gap between the community and health professionals, it is believed that, with the necessary theoretical knowledge and support, they can identify hearing disorders in the population and make appropriate referrals. They can also reach out to users of hearing aids (HAs) who are not attending follow-up appointments at the hearing healthcare service. Hence, continuous updating and training of these professionals are crucial, enabling them to effectively address the diverse needs of different users, as they are considered knowledge multipliers[7].

The need for continuing education strategies is already provided for by the National Primary Health Care Policy (*Política Nacional de Atenção Básica*, PNAB), introduced in 2012, which establishes standards for the organization of Primary Health Care within the Public Health System (*Sistema Único de Saúde*, SUS)[8]. These strategies should include updating knowledge and learning from the challenges encountered in the work process of the professionals involved. Furthermore, they go beyond the educational dimension, contributing to the management of Primary Health Care services, since they bring about changes in their organization, promoting the desired health practices in the daily lives of users[8].

Currently, the municipality of Santa Maria, Rio Grande do Sul, Brazil, has 34 Primary Healthcare Units (PHU), 20 of which are FHS teams and 14 are primary healthcare teams (PHT)[9]. During the period when this study was carried out, there were 112 CHAs in these teams.

Educational actions aimed at CHAs on topics related to hearing health enable these professionals to work effectively to promote health, prevent and identify late onset or acquired hearing loss, as well as supporting families in adhering to the process of audiology diagnosis and hearing (re)habilitation.

The Brazilian literature includes several studies that have developed educational actions for CHAs on comprehensive aspects of speech therapy, including the various areas of this profession[10-13], as well as training CHAs on hearing health in general[7,14] and especially on hearing health with a focus on children[15-18].

Faced with the need for social isolation imposed by the COVID-19 pandemic, remote learning, which has been widely promoted in recent years, has gained strength. According to recent literature, there is no difference in the effectiveness of remote teaching when compared to face-to-face teaching[19], as long as appropriate and highly interactive tools are used[20]. Remote training enables a wider reach and greater participation in continuing education proposals, as it facilitates the involvement of a larger number of professionals who may be in different locations.

In order to make the process collaborative, active teaching methodologies in health education can be an important tool, since, through them, professionals become the protagonists of their own training process. Problematization is one of the proposals for active methodologies and is based on the assumptions of Paulo Freire and the critical social pedagogy of

content[21]. The act of problematizing makes individuals seek solutions to existing adversities in reality, while, by transforming their own actions, they themselves undergo a transformation, starting to identify new problems and seek other changes[22].

Above all, it is important to assess whether the educational activities are effective and promote information acquisition and the building of new knowledge, which are applied in their work routines.

The needs and assumptions outlined above, combined with the lack of studies focusing on aspects related to the hearing health of the adult and elderly population in a remote context, motivated the conduction of this study, which aimed to assess the effectiveness of educational actions for CHAs in the municipality of Santa Maria, Rio Grande do Sul (RS), Brazil, regarding the hearing health of adults and the elderly. It also aimed to identify if there is a relationship between the level of knowledge acquired and the variables age, length of service and education.

METHODS

This is a quantitative, descriptive, prospective and interventional study carried out with CHAs in the municipality of Santa Maria, RS, Brazil. The sample was obtained through the Center for Continuing Health Education (*Núcleo de Educação Permanente em Saúde, NEPeS*) and the Superintendency of Primary Healthcare of the municipality, which confirmed the feasibility of the study and the participation of these professionals. This study was approved by the Human Research Ethics Committee of the Federal University of Santa Maria, Brazil, under No. 4.847.070 and CAAE No. 48120921.1.0000.5346.

This study used convenience sampling, according to the following eligibility criteria: CHAs in the municipality of Santa Maria, RS who were active during the data collection period, who attended the three proposed meetings, logged in individually, and who agreed to participate by signing the Informed Consent Form (ICF). CHAs who did not answer the evaluation quiz, applied before and after immediate training, were excluded. Throughout the course of the activities, a total of 73 CHAs participated on at least one of the proposed days. Of these, based on the eligibility criteria, 44 CHAs working in different regions of the municipality of Santa Maria, RS remained in this study.

Three previously scheduled synchronous meetings between August and October 2021, using the Google Meet digital platform, a resource that enables videoconferencing with several people simultaneously, were planned and carried out. These meetings lasted approximately two hours and took place during working hours. It is noteworthy that these professionals are granted permission to participate in training activities related to their work.

The first meeting was aimed at explaining the objectives and procedures involved in the study, signing the ICF and applying the quiz to collect prior knowledge data, as well as the variables involved in the study. The second and third meetings were dedicated to educational activities, in which the following topics were presented and discussed: hearing, hearing health and disorders, organization and functioning of the hearing healthcare service (HHS), notions about the use, handling and hygiene of HAs and the importance of users' follow-up at the hearing healthcare services. Each of these compiled specific theoretical issues (Chart 1). These topics were addressed and discussed using an active teaching methodology, utilizing quizzes with problem-solving scenarios as a strategy (Figures 1 and 2), with the aim of generating problematization and building knowledge in a more interactive way. This methodological approach is based on the concepts of problematizing pedagogy, proposed by Paulo Freire and which was adapted for this study, according to the possibilities of the remote format. It is a methodology that aims to solve problems by means of previously prepared cases, based on a specific aspect of reality associated with the topic[23]. Problematization was used to encourage active participation and constant dialogue with the professionals attending the meetings, placing them at the center of their learning process.

Chart 1. Content covered in each topic

MEETINGS	TOPICS	SUBJECTS COVERED
2nd meeting	1. Hearing	• Anatomophysiology of hearing; • Central Auditory processing; • Hearing and cognition.
	2. Hearing health and disorders	• Types of hearing loss; • Ear hygiene and guidance on preventing hearing loss; • Some types of otitis (otitis external, acute otitis me-dia, secretory otitis media, chronic otitis media); • Noise-induced hearing loss; • Ménière's disease; • Systemics diseases (hypertension and diabetes); • Presbycusis; • Central Auditory processing.
3rd meeting	3. Organization and functioning of the Hearing Healthcare Service	• Flowchart of the organization and functioning of the HHS.
	4. Notions about the use, handling and hygiene of HAs	• Types of HAs de AASI; • Proper placement and removal of HAs in the ear; • Guidance on care and hygiene; • Types of batteries, when and how to change them; • Device buttons.
	5. The importance of users' follow-up at the hearing healthcare services	• Raising awareness of the importance of the speech therapy; • When and how to schedule appointments.

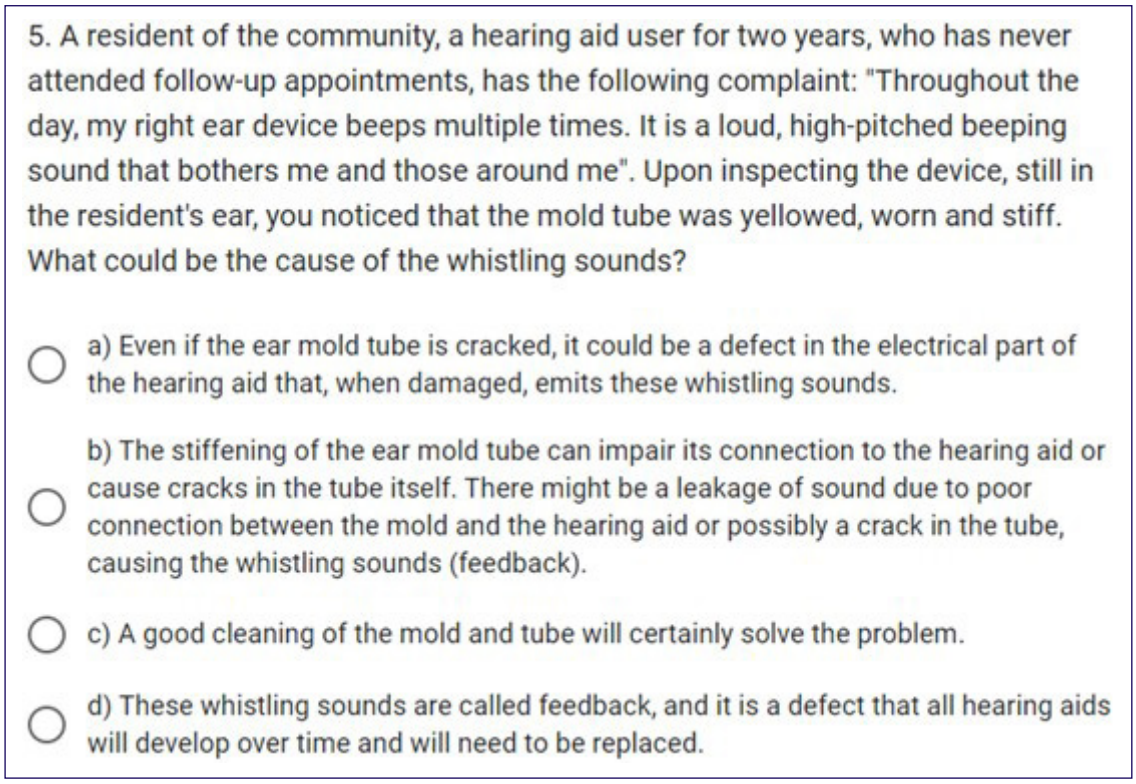
Caption: HHS = Hearing Healthcare Service; HA = hearing aid

2. During a home visit, the CHA responsible for Mr. Antônio's area, who is 70 years old, was told that he had been experiencing forgetfulness, losing track of time and mental confusion, among other clinical signs of dementia. Analyze the statements below and select the one you think is CORRECT:

- ○ a) Based on these symptoms, it is not considered important to question Antônio's hearing.
- ○ b) It is important to question his hearing, as hearing problems always cause symptoms of dementia, such as those mentioned above.
- ○ c) Hearing issues typically do not exacerbate the conditions imposed by dementia, but it is still important to inquire about his hearing regardless.
- ○ d) It is important to investigate Antônio's hearing and make the appropriate referrals, because if there is hearing loss, the symptoms related to dementia can be exacerbated.

Source: The authors

Figure 1. Model of problem-solving scenario used during the educational actions to stimulate discussions and engage the professionals during the meetings


5. A resident of the community, a hearing aid user for two years, who has never attended follow-up appointments, has the following complaint: "Throughout the day, my right ear device beeps multiple times. It is a loud, high-pitched beeping sound that bothers me and those around me". Upon inspecting the device, still in the resident's ear, you noticed that the mold tube was yellowed, worn and stiff. What could be the cause of the whistling sounds?

a) Even if the ear mold tube is cracked, it could be a defect in the electrical part of the hearing aid that, when damaged, emits these whistling sounds.

b) The stiffening of the ear mold tube can impair its connection to the hearing aid or cause cracks in the tube itself. There might be a leakage of sound due to poor connection between the mold and the hearing aid or possibly a crack in the tube, causing the whistling sounds (feedback).

c) A good cleaning of the mold and tube will certainly solve the problem.

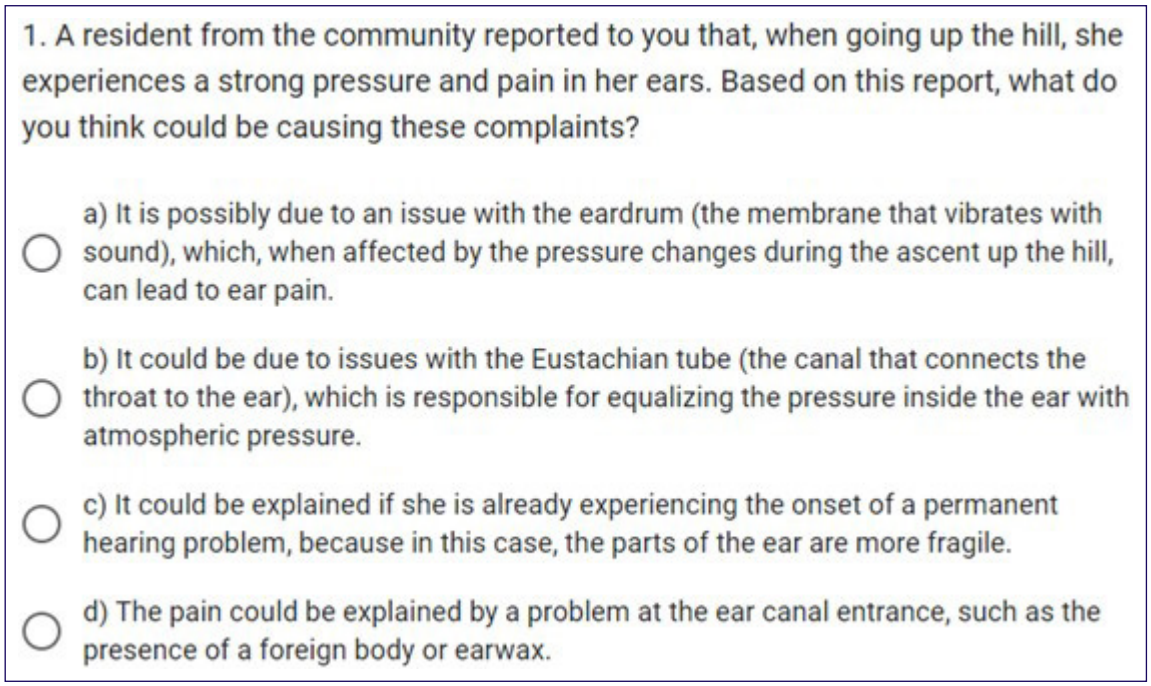
d) These whistling sounds are called feedback, and it is a defect that all hearing aids will develop over time and will need to be replaced.

Source: The authors

Figure 2. Model of problem-solving scenario used during the educational actions to stimulate discussions and engage the professionals during the meetings

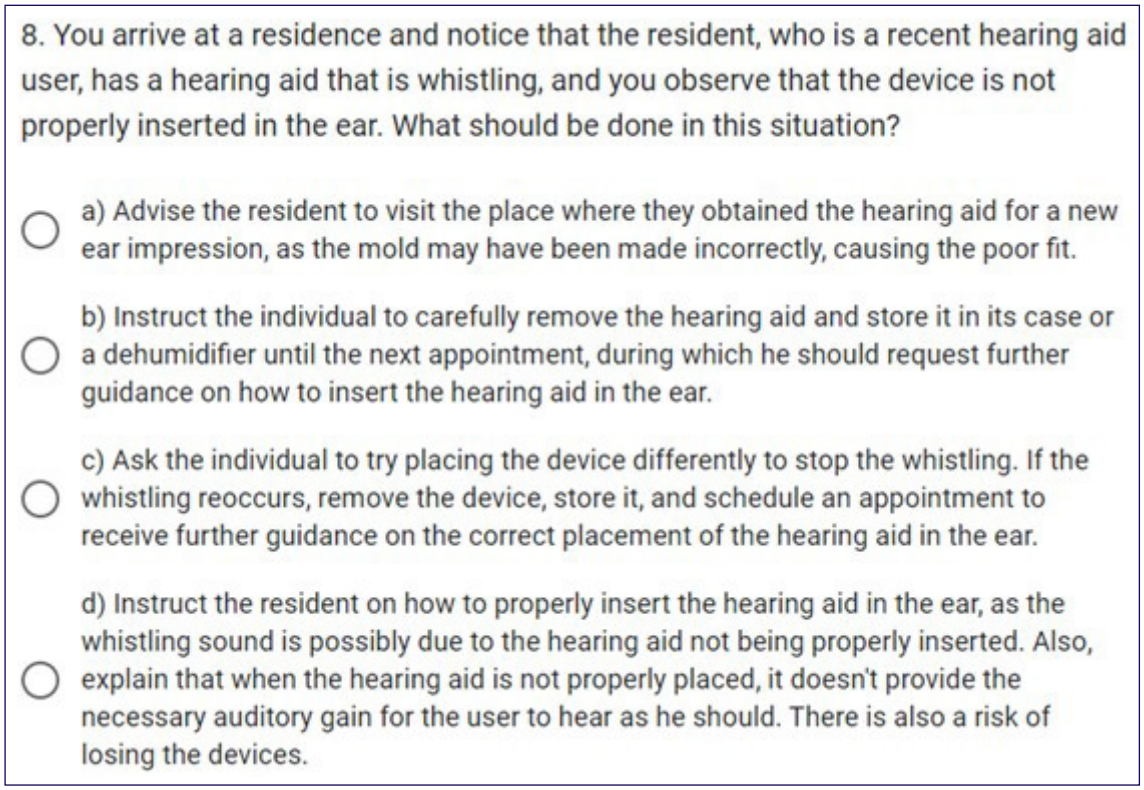
With regard to the didactic materials, it should be noted that they were prepared on digital graphic design platforms, containing diagrams and illustrations, in order to make it easier for professionals to understand the content pertinent to the themes. At the end of these meetings, the same quiz was applied to assess the acquired knowledge immediately after the actions.

The quiz used to assess the prior knowledge of the CHAs, as well as their knowledge after the educational actions, consisted of ten problem-solving scenarios, two of which dealt with each topic covered in the actions, formulated in simple, accessible language. Each problem-solving scenario from the professionals' daily lives contained four answer options (Figures 3 and 4)



Source: The authors

Figure 3. Model of a problem-solving scenario used in the evaluation quiz



Source: The authors

Figure 4. Model of a problem-solving scenario used in the evaluation quiz

The quiz was prepared and made available to the CHAs through the interactive tool Google Forms, which is a digital resource for creating online forms. The participants accessed the quiz individually from their devices, using the link that the researchers provided via chat. The same researchers presented the problem-solving scenarios in the quiz orally, to ensure the quality of data collection and understanding by all CHAs. They were then instructed to choose one of the four possible answers for each situation.

The data compiled from the pre- and post-educational action quizzes were transferred to an Excel spreadsheet and subjected to statistical analysis. This analysis aimed to compare the pre and post-educational action scores, assess the level of knowledge acquired by topic, and examine whether there was a relationship between the knowledge acquired and variables age, length of service and education. Regarding "age", the CHAs were grouped into age groups of 29 to 39 years, 40 to 49 years and over 50 years. As for the variable "length of service", they were grouped into less than 10 years, 10 to 15 years and more than 15 years. To analyze the variable "education", the professionals were divided into high school and higher education.

The level of knowledge was measured by means of an intra-subject analysis of the correct answers before and after the educational activities, for each question. It was considered that knowledge acquisition occurred when a subject answered a particular problem-solving scenario incorrectly before the educational actions, and correctly after these actions, referred to in this study as "improve." In addition, some answered incorrectly before and after the actions, referred to as "mistake"; those who got one or more problem-solving scenarios right from the quiz before the actions, referred to here as "correct"; and those who got it right in the pre-action quiz but got it wrong in the post-action quiz, referred to as "worse".

The statistical tests used were Chi-square and Two-sample Test of Proportions, both with a significance level of 5% (p-value<0.05).

It is worth noting that the evaluation quiz consisted of two questions for each of the topics, totaling 88 responses for each of the themes.

RESULTS

A total of 73 CHAs participated in at least one of the days of the actions. Of these, 29 were excluded because they did not meet the eligibility criteria. Finally, this study's sample consisted of 44 CHAs working in different regions of the municipality of Santa Maria, RS, Brazil, 37 of whom were female (84.1%), and seven were male (15.9%), with an average age of 48.7 years.

When comparing the score of correct answers in the quizzes before and after the activities, there was a difference in the number of correct responses to the problem-solving scenarios related to the topics of hearing, hearing health and disorders, organization and functioning of the HHS, and notions about the use, handling and hygiene of HAs. There was a higher rate of correct answers in the topic of notions about the use, handling and hygiene of HAs when comparing the quiz before the educational actions with the one after the actions (Table 1).

Table 1. Comparison of correct answer scores, by topic, in the quiz before and after the educational actions

Topic	Prior		Immediately after		p-value
	n	%	n	%	
Hearing	46	52.0	66	75.0	0.002*
Hearing health and disorders	55	62.5	74	84.1	0.001*
HHS organization	60	68.2	81	92.0	<0.001*
HA use and hygiene	45	51.1	76	86.4	<0.001*
Importance of follow-up	71	80.7	73	83.0	0.696

Statistical test: Two-sample Test of Proportions
Captions: n = number of correct answers; % = percentage; HHS = Hearing Healthcare Service; HA = hearing aid

In addition, it was found that the acquisition of knowledge was more evident when compared to the "worse" and "mistake" performances on the topics of hearing, hearing health and disorders, organization and functioning of the HHS and notions about the use, handling and hygiene of HAs (Table 2).

Table 2. Level of knowledge acquired by community health agents according to each topic covered

Perf.		n	%	p-value
Hearing	Improve	27	30.7	Reference
	Worse	7	8.0	<0.001*
	Correct	39	44.3	0.062
	Mistake	15	17.0	0.034*
Hearing health and disorders	Improve	25	28.4	Reference
	Worse	6	6.8	<0.001*
	Correct	49	55.7	<0.001*
	Mistake	8	9.1	0.001*
HHS organization	Improve	24	27.3	Reference
	Worse	3	3.4	<0.001*
	Correct	57	64.8	<0.001*
	Mistake	4	4.5	<0.001*
HA use and hygiene	Improve	36	40.9	Reference
	Worse	5	5.7	<0.001*
	Correct	40	45.5	0.543
	Mistake	7	8.0	<0.001*
Importance of follow-up	Improve	11	12.5	Reference
	Worse	9	10.2	0.635
	Correct	62	70.5	<0.001*
	Mistake	6	6.8	0.202

Statistical test: Two-sample Test of Proportions
Captions: n = sample number; % = percentage; HHS = Hearing Healthcare Service; HA = hearing aid; Perf. = Intra-subject performance in the evaluation before and after educational actions; Improve = Mistake in the pre-quiz and correct in the post-quiz (there was knowledge acquisition); Worse = Correct answer in the pre-quiz and mistake in the post-quiz (no knowledge acquisition); Correct answer = Correct in both the pre- and post-quiz (maintained knowledge); Mistake = Mistake in both the pre- and post-quiz (no knowledge acquisition)

Furthermore, there was no relationship between the level of knowledge acquired after the educational activities and the variables age, length of service and education (Tables 3, 4 and 5).

Table 3. Relationship between level of knowledge acquired and age group

Topic	Perf.	From 29 to 39 years		From 40 to 49 years		Over 50 years		Total		p-value
		n	%	n	%	n	%	n	%	
Hearing	Improve	3	30.0	18	56.3	18	39.1	39	44.3	0.314
	Worse	2	20.0	5	15.6	8	17.4	15	17.0	
	Correct	3	30.0	6	18.8	18	39.1	27	30.7	
	Mistake	2	20.0	3	9.4	2	4.3	7	8.0	
Hearing health and disorders	Improve	8	80.0	17	53.1	24	52.2	49	55.7	0.476
	Worse	0	0.0	3	9.4	5	10.9	8	9.1	
	Correct	2	20.0	8	25.0	15	32.6	25	28.4	
	Mistake	0	0.0	4	12.5	2	4.3	6	6.8	
HHS organizati-on	Improve	5	50.0	21	65.6	31	67.4	57	64.8	0.469
	Worse	0	0.0	2	6.3	2	4.3	4	4.5	
	Correct	4	40.0	7	21.9	13	28.3	24	27.3	
	Mistake	1	10.0	2	6.3	0	0.0	3	3.4	
HA use and hygiene	Improve	6	60.0	15	46.9	19	41.3	40	45.5	0.932
	Worse	1	10.0	2	6.3	4	8.7	7	8.0	
	Correct	3	30.0	13	40.6	20	43.5	36	40.9	
	Mistake	0	0.0	2	6.3	3	6.5	5	5.7	
Importance of follow-up	Improve	6	60.0	22	68.8	34	73.9	62	70.5	0.197*
	Worse	0	0.0	1	3.1	5	10.9	6	6.8	
	Correct	1	10.0	5	15.6	5	10.9	11	12.5	
	Mistake	3	30.0	4	12.5	2	4.3	9	10.2	

Statistical test: Chi-Square
Captions: n = sample number; % = percentage; HHS = Hearing Healthcare Service; HA = hearing aid; Perf. = Intra-subject performance in the evaluation before and after educational actions; Improve = Mistake in the pre-quiz and correct in the post-quiz (there was knowledge acquisition); Worse = Correct answer in the pre-quiz and mistake in the post-quiz (no knowledge acquisition); Correct answer = Correct in both the pre- and post-quiz (maintained knowledge); Mistake = Mistake in both the pre- and post-quiz (no knowledge acquisition)

Table 4. Relationship between the level of knowledge acquired and length of service

Topic	Perf.	Less than 10 years		10 to 15 years		More than 15 years		Total		p-value
		n	%	n	%	n	%	n	%	
Hearing	Improve	11	45.8	11	45.8	17	42.5	39	44.3	0.945
	Worse	3	12.5	4	16.7	8	20.0	15	17.0	
	Correct	7	29.2	7	29.2	13	32.5	27	30.7	
	Mistake	3	12.5	2	8.3	2	5.0	7	8.0	
Hearing health and disorders	Improve	15	62.5	12	50.0	22	55.0	49	55.7	0.920
	Worse	1	4.2	3	12.5	4	10.0	8	9.1	
	Correct	6	25.0	8	33.3	11	27.5	25	28.4	
	Mistake	2	8.3	1	4.2	3	7.5	6	6.8	
HHS organization	Improve	12	50.0	15	62.5	30	75.0	57	64.8	0.197
	Worse	2	8.3	2	8.3	0	0.0	4	4.5	
	Correct	10	41.7	6	25.0	8	20.0	24	27.3	
	Mistake	0	0.0	1	4.2	2	5.0	3	3.4	
HA use and hygie-ne	Improve	10	41.7	9	37.5	21	52.5	40	45.5	0.857
	Worse	2	8.3	3	12.5	2	5.0	7	8.0	
	Correct	10	41.7	11	45.8	15	37.5	36	40.9	
	Mistake	2	8.3	1	4.2	2	5.0	5	5.7	
Importance of fol-low-up	Improve	15	62.5	15	62.5	32	80.0	62	70.5	0.059
	Worse	0	0.0	3	12.5	3	7.5	6	6.8	
	Correct	4	16.7	2	8.3	5	12.5	11	12.5	
	Mistake	5	20.8	4	16.7	0	0.0	9	10.2	

Statistical test: Chi-Square
Captions: n = sample number; % = percentage; HHS = Hearing Healthcare Service; HA = hearing aid; Perf. = Intra-subject performance in the evaluation before and after educational actions; Improve = Mistake in the pre-quiz and correct in the post-quiz (there was knowledge acquisition); Worse = Correct answer in the pre-quiz and mistake in the post-quiz (no knowledge acquisition); Correct answer = Correct in both the pre- and post-quiz (maintained knowledge); Mistake = Mistake in both the pre- and post-quiz (no knowledge acquisition)

Table 5. Relationship between level of knowledge acquired and education

Topic	Perf.	High School		Higher Ed.		Total		p-value
		n	%	n	%	n	%	
Hearing	Improve	27	40.9	12	54.5	39	44.3	0.585
	Worse	13	19.7	2	9.1	15	17.0	
	Correct	21	31.8	6	27.3	27	30.7	
	Mistake	5	7.6	2	9.1	7	8.0	
Hearing health and disorders	Improve	34	51.5	15	68.2	49	55.7	0.368
	Worse	6	9.1	2	9.1	8	9.1	
	Correct	20	30.3	5	22.7	25	28.4	
	Mistake	6	9.1	0	0.0	6	6.8	
HHS organization	Improve	43	65.2	14	63.6	57	64.8	0.990
	Worse	3	4.5	1	4.5	4	4.5	
	Correct	18	27.3	6	27.3	24	27.3	
	Mistake	2	3.0	1	4.5	3	3.4	
HA use and hygiene	Improve	31	47.0	9	40.9	40	45.5	0.941
	Worse	5	7.6	2	9.1	7	8.0	
	Correct	26	39.4	10	45.5	36	40.9	
	Mistake	4	6.1	1	4.5	5	5.7	
Importance of follow-up	Improve	46	69.7	16	72.7	62	70.5	0.315
	Worse	3	4.5	3	13.6	6	6.8	
	Correct	10	15.2	1	4.5	11	12.5	
	Mistake	7	10.6	2	9.1	9	10.2	

Statistical test: Chi-Square
Captions: n = sample number; % = percentage; HHS = Hearing Healthcare Service; HA = hearing aid; Perf. = Intra-subject performance in the evaluation before and after educational actions; Improve = Mistake in the pre-quiz and correct in the post-quiz (there was knowledge acquisition); Worse = Correct answer in the pre-quiz and mistake in the post-quiz (no knowledge acquisition); Correct answer = Correct in both the pre- and post-quiz (maintained knowledge); Mistake = Mistake in both the pre- and post-quiz (no knowledge acquisition)

DISCUSSION

This study corroborated the effectiveness of the educational actions proposed in the remote modality, since it was possible to observe an improvement in the rate of correct answers after the intervention, and the acquisition of knowledge was more evident when compared to the "worse" and "mistake" performances on four of the five topics covered. These findings were in line with other studies that aimed to assess the knowledge of CHAs after educational interventions on topics related to hearing[7,14,15,17], as well as other aspects of speech therapy[10-13], all of which showed that the proposed actions were successful.

When analyzing the group's performance in this study, a difference in the comparison between the scores of correct answers before and after the intervention was identified, on the following topics: hearing, hearing health and disorders, organization and functioning of the HHS, and notions about the use, handling and hygiene of HAs. The biggest difference was in relation to the topics of organization and functioning of the HHS and use, handling and hygiene of HAs. This is possibly due to the fact that the professionals are more interested in these subjects, since motivation is pointed out in the literature as a determining factor in the learning process[24-26]. The willingness and interest of individuals who are exposed to new knowledge makes them delve deeper into certain content and, consequently, relate it to the knowledge they already have[24]. Furthermore, there is a recognized need for clarity regarding the guidance of users within the public service, as this information is essential to provide better direction. This may have kept the CHAs more attentive to the provided information. Moreover, the content about sound amplification devices was presented using practical demonstrations on how to handle and sanitize them, which may justify a greater assimilation of the content. Both topics refer to subjects that have greater applicability in the routine and work of the professionals, as they are more practical and tangible.

With regard to the professionals' individual performance, it was found that knowledge acquisition was more evident when compared to "worse" and "mistake"

performances on the topics of hearing, hearing health and disorders, organization and functioning of the HHS, and notions about the use, handling and hygiene of HAs. In this study, the number of problem-solving scenarios answered correctly since the assessment of prior knowledge was predominant in all subjects. This raises the question of a potential weakness of the instrument, which may not have been sensitive enough to measure the knowledge of the CHAs. The problem-solving scenarios in question were designed with accessible language and the aim of being easily understood by professionals. Thus, it is possible that some of the answer choices were indeed very straightforward, leading the professionals to select the correct response due to the ease of eliminating the incorrect options. The level of education of the CHAs in this study should also be taken into account, as they had at least completed high school, which confirms their full understanding of the presented questions.

The topic of "the importance of users' follow-up at the hearing healthcare services" was the only one on which there was no evidence of knowledge acquisition, both when analyzing the score of correct answers of the entire sample, before and after the actions, and in the intra-subject performance analysis. This finding is possibly due to the professionals' high level of prior knowledge on the subject, which is evident from the high rate of correct answers even before the educational activities took place. It is believed that professionals can infer that any irreversible condition, including most hearing losses, requires continuous and permanent treatment, which includes regular follow-up visits to the healthcare system. Therefore, the importance of keeping the population in contact with the service and attending follow-ups is evident, which explains the high rate of correct answers on this subject.

Considering the variables studied in this research (age, length of service and education), it was seen that they did not have a relationship with knowledge acquisition, thus indicating a uniform learning process among the professionals.

The lack of a relationship between the knowledge acquired and the variable age diverges from what is reported in the literature, as some researchers have suggested that younger professionals are less resistant to changes,

being more open to new ideas and innovations, which can favor the training process[27].

Furthermore, in recent years, it has become necessary for CHAs to have a higher level of education, considering the increasing complexity of the tasks assigned to these professionals. The higher the level of education, the greater the likelihood of them acquiring new knowledge and meeting the demands of their daily work effectively[27]. The majority of CHAs, as the analyzed studies indicate, have completed high school, with some of them pursuing or already having completed higher education[28-31]. This pattern was also evident in this research and likely explains the lack of a relationship between knowledge retention and the educational level of the CHAs in this study, as all professionals in the sample had, at least, completed high school.

Regarding the variable "length of service," which was found to be independent of the level of knowledge acquired, there is a contrast with a study conducted with 236 CHAs in the municipality of Caruaru, Pernambuco, Brazil. That study found a relationship between prior knowledge about some of the topics covered in a breastfeeding workshop and the variable "length of service"[31]. It is possible that this discrepancy may have occurred because the mentioned study investigated the correlation between the length of service and prior knowledge of the CHAs, while in this research, the focus was on the correlation of the studied variables with the knowledge acquired. Furthermore, in the aforementioned study[31], the sample was divided into two groups based on the length of service (less than 8 years and more than 8 years), while in this study, the sample was stratified into different work periods (less than 10 years, 10 to 15 years, and more than 15 years). This difference in grouping might also explain the observed discrepancy.

Thus, the results of this study indicate the effectiveness of this remote educational action proposal, supporting what was found in a systematic literature review regarding the effectiveness of educational actions for CHAs on child hearing health. The review observed that all modalities, whether in-person or remote (videoconferences or CD-ROM), have demonstrated effectiveness in terms of knowledge retention[32]. However, it is important to note that, in the Brazilian literature, there is a scarcity of studies that include synchronous remote teaching as a methodological strategy for CHAs. Most studies that aimed to assess the effectiveness of educational actions were conducted face-to-face[13,14,31,33,34].

A study carried out in Alaska (USA) showed that CHAs were interested in a remote course on cancer. The participants considered this approach convenient

and flexible, with 84% (n=60) of them stating they would participate in the course in this modality. However, when they had the opportunity to take the same course in a face-to-face format, 75% of them stated that they did not participate. This suggests that, although the topic is of interest, the teaching modality influences the decision to participate. In addition, the CHAs expressed their belief in the proposal because they had previously had positive experiences with distance education. They also mentioned technological accessibility for engaging in online learning, as most of them have daily internet access[20]. This has become the reality for many healthcare professionals, especially after the COVID-19 pandemic.

The educational actions in this study were developed through active teaching methodologies, using supporting didactic materials and quizzes with real-world problem-solving scenarios encountered by professionals to stimulate discussions during the meetings. The literature shows that this methodological format has proved effective in the teaching-learning process[7,13,20,33]. Problematization was chosen because it is a resource that instigates reflection, reasoning and self-questioning[23] as it exposes individuals to doubts. This enables a greater understanding of the reality of a context. Considering the vital importance of health education in imparting knowledge to the population, the strategic tool of problematization aims to promote critical thinking, autonomy and responsibility in social participation. Individuals in a certain region are exposed to the challenges of their locality and are consequently encouraged to reflect and engage in dialogues about potential plans and solutions, thus supporting knowledge building[35,36].

Regarding the professionals' adherence to the proposal for hearing health education, it was observed that, at some point in this study, there were 73 CHAs participating, representing all regions of the municipality. This fact showed that the remote teaching methodology provided an opportunity for the participation of a satisfactory number of professionals, considering that there were a total of 112 during the data collection period. It is thought that in a face-to-face format, the participation of so many professionals would not have been possible, as it would have required them to travel, which, in turn, would require more time and resources for them to be physically present. Furthermore, these actions were carried out during the pandemic, and, given the implications of the social isolation caused by COVID-19, remote educational actions facilitated the participation of professionals who could attend the meetings from various locations, thus enabling a broader reach and adherence to the proposal.

As for the 29 professionals who did not attend all the scheduled meetings in this research but participated in the actions at some point, this sporadic participation may be attributed to concurrent work activities, such as the COVID-19 vaccination campaigns that took place during the period of these actions. Regarding the 39 CHAs who did not participate in any educational actions, despite being invited, it is possible that they may not have been interested in the proposal or the topics covered.

One study outlined potential justifications for understanding the lack of participation in group educational actions related to public healthcare for SUS users, and among these, the most recurring reason was people's disinterest in the activities. Furthermore, the study indicated that difficulties in adherence reveal the necessary challenges, emphasizing the need to review the work process and recognize that changes are slow, gradual and subject to both progress and setbacks[37]. Regarding the participation of healthcare professionals in continuing education activities, obstacles such as working hours and administrative logistics within the sectors have been described in the literature[38]. Additionally, factors such as a lack of promotion, incentives, and personal demotivation have been noted[39].

Considering the effectiveness of remote educational actions for CHAs demonstrated in this study, the implementation of education proposals in this format on a larger scale is encouraged. This can decentralize actions from major educational centers and make knowledge accessible even to remote communities. The development of longitudinal studies, which are scarce in the literature, in order to assess the effectiveness of the actions in the long term, given the importance of acquiring and maintaining quality knowledge, is suggested as well.

CONCLUSION

The results of this study allow concluding that the educational actions aimed at CHAs in the municipality of Santa Maria, RS, Brazil, have proven to be effective. This is shown by the increase in the post-training quiz scores and the level of knowledge acquired when compared to the "worse" and "mistake" performances, on the topics of hearing, hearing health and disorders, organization and functioning of the HHS, and notions about the use, handling and hygiene of

HAs. Furthermore, the level of knowledge acquired was independent of the age, length of service and educational background of the professionals.

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