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Original Article

Artigo Original

Self-reported outcomes after hearing aid fitting in Minas Gerais, Brazil

Autoavaliação de resultados após adaptação com aparelhos auditivos em Minas Gerais, Brasil

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Keywords

Hearing Loss
Hearing Aids
Patient Satisfaction
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ABSTRACT

Purpose: To analyze the self-reported outcomes after hearing aid fitting among individuals in the northern region of Minas Gerais and associated factors. **Methods:** A cross-sectional and analytical study with a random sample of adults and elderly attending the public health care service was conducted in the northern region of Minas Gerais (86 municipalities), Brazil. Study's participants answered International Outcome Inventory for Hearing Aids (IOI-HA) questionnaires. Data were analyzed descriptively and analytically with Poisson regression analysis. **Results:** We interviewed 272 adults and 112 individuals reported not using their hearing aids regularly. The mean of IOI-HA global score was lower than expected. The individual's relationship with their hearing aid (Factor 1) was worse than the individual's relationship with their environment (Factor 2). Lower global scores were statistically associated with no work. **Conclusions:** The observed scores for the study's population are lower than those recorded in other studies. The results suggest that there are limitations in the fitting and follow-up of individuals who received hearing aids.

Descritores

Perda Auditiva
Auxiliares de Audição
Satisfação do Paciente
Autoavaliação
Avaliação de Resultados (Cuidados de Saúde)

RESUMO

Objetivo: Analisar os resultados da autoavaliação após adaptação com o aparelho de amplificação sonora individual entre indivíduos do norte de Minas Gerais e os fatores associados. **Métodos:** Estudo transversal e analítico com amostra aleatória de adultos e idosos atendidos no serviço público de atenção à saúde auditiva, conduzido na região norte de Minas Gerais (86 municípios), Brasil. Os participantes do estudo responderam ao questionário *International Outcome Inventory for Hearing Aids* (IOI-HA). Os dados foram analisados descritivamente e analiticamente por meio da regressão de Poisson. **Resultados:** Foram entrevistados 272 adultos e 112 indivíduos relataram não usar seus aparelhos auditivos regularmente. A média do escore global do IOI-HA foi abaixo do esperado. A relação do indivíduo com o seu aparelho (Fator 1) mostrou-se pior do que a relação do indivíduo com o ambiente (Fator 2). Escores globais mais baixos se mostraram estatisticamente associados com o fato de não trabalhar. **Conclusão:** Os escores observados para a população avaliada são menores do que os registrados em outros estudos. Os resultados sugerem que existem limitações no processo de adaptação e acompanhamento dos indivíduos que receberam aparelhos de amplificação sonora.

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INTRODUCTION

Hearing loss has a great impact on human communication because it undermines the ability to recognize speech[1], thus compromising social relationships[2]. According to Brazil's 2010 census, more than 9.5 million inhabitants have some type of hearing loss[3]. This number is very high, and may be an underestimate because hearing problems are not always perceived and can be denied by some people[4]. With the increasing longevity of the population, hearing loss' prevalence may increase and require diagnostic services and specific care for the impaired hearing[5].

In Brazil, health care democratization has been increasing since the implementation of the Unified Health System (UHS), which had positive impacts on the general population. Based on the principles of health as a citizen's right and duty of the State, the UHS aims to provide a comprehensive and universal, preventive and curative care, by means of decentralized management and provision of health services[6]. This system also led to the institution of the new National Hearing Health Care Program (NHHCP), which encompasses hearing health promotion and speech therapy for people at all stages of life. This program has been deployed across 86% of the country[7].

The services enabled by the Brazilian Ministry of Health must ensure that the person with hearing loss get the best use of their residual hearing. For this, the rehabilitation process must cover the selection and fitting in hearing aids, with verification of performance and benefit provided by the device, the application of speech perception protocols and questionnaires to evaluate the benefit and satisfaction of the patient and/or family, guidance and training of the handling of hearing aids, speech therapy for development of the user's auditory and language skills, and periodic monitoring of hearing loss and amplification[8]. Despite having auditory rehabilitation guaranteed by UHS, there are costs involved in maintaining the hearing device that are the responsibility of the patient, such as the purchase of batteries.

With the implementation of the NHHCP, it has become necessary to evaluate the effects of individual hearing aid use to ensure effective treatment[9]. To facilitate the comparison of results obtained by different researchers around the world, an assessment tool that is widely accepted and standardized is required[10]. To this end, an evaluation has been proposed, which uses the International Outcome Inventory for Hearing Aids (IOI-HA) questionnaire[11]. This questionnaire contains seven self-assessment items (use, benefit, residual activity restriction, satisfaction, residual participation restriction, impact on others and quality of life). Each question offers a choice of five graded responses ranging from 1 (worst) to 5 (best). IOI-HA has been translated into different languages and facilitates comparisons between different investigations and clinical service models. In assessing the psychometric properties of the IOI-HA translated into Portuguese, the questionnaire showed moderate internal consistency of 0.69, measured by Cronbach's α coefficient, and reliability in 6 questions[12]. The value of Cronbach's $\alpha$for the questionnaire in English was 0.78[10].

The analysis of the IOI-HA still allows the extraction of two factors. The grouping of the questions 1, 2, 4 and 7 consists of Factor 1, related to introspection of the patient with hearing aids, and Factor 2, which refers to the influence of hearing aid in the individual's interaction with the world, includes questions 3, 5 and 6[10].

Several studies have used the IOI-HA instrument to measure hearing aid user's satisfaction and outcomes[10,13-18]. Although the term satisfaction is already enshrined in literature in similar studies, it is worth noting that it has a polysemic connotation and different values and beliefs define different perceptions for the term. Most of the time, patient's satisfaction in such studies is taken as the difference between expectations and perceptions of experience, and, in a complementary way, as something that adds value to the quality of life. In general, these studies indicate that patients have good outcomes with their hearing aids. In a Swedish study[13], the average scores for the individual items lie between 3.5 and 4.3, and less than 5% of the responses received a score of 1, for all items. Similar results have been previously reported by another Swedish study[18]. In the study conducted with 1,653 Australian hearing aid users[15], for items 1 (aid use) and 4 (satisfaction), the highest score of 5 was the most frequently selected. For the remaining items, 4 was the most common score. In an American study[10], the mean scores fall between 3.5 and 4.1. This seems to be indicative of a subject group that is relatively happy with their fitting outcomes, on the whole. In the other hand, in the study conducted in João Pessoa, northeastern of Brazil[14], hearing aid users had difficulties in the use and handling of hearing aids, which negatively influences on IOI-HA outcomes.

There are only a few published studies investigating factors associated with better outcomes of IOI-HA in hearing aid users. Higher mean IOI-HA scores were most strongly associated with greater satisfaction with hearing aid's attributes of aid fit/comfort, clarity of tone and sound, and comfort with loud sounds and with satisfaction in the listening situations of conversation with one person, in small groups, in large groups, and outdoors[15].

For Brazil, no studies have evaluated the factors associated with the results of the IOI-HA. The present study was developed to analyze the self-reported outcomes after hearing aid rehabilitation among individuals in the northern region of Minas Gerais, Brazil, and associated factors.

METHODS

This is a cross-sectional, quantitative, and analytical study that was conducted in the northern region of Minas Gerais, from January 2010 to August 2011. This region, which covers 86 municipalities and has an estimated population of 1.5 million inhabitants, is poor and includes many cities that have a low Human Development Index (HDI). A sample of individuals attending the only public hearing health care service of northern Minas Gerais was taken using the official database. Study's participants were selected at random. Patients were numbered and the selection was made from a list of random numbers. Inclusion criteria for the study were as follows: age ≥18 years, fitted with a hearing aid for at least four months, and agreement to participate in the study. The sample size's calculation was performed considering the total number of assisted individuals (2,440), a margin of error of 5%, a confidence level of 95% and the frequency of the expected event of dissatisfaction (worst

outcomes) of 30%, based on prior national studies[14]. By means of the addresses, the researchers traveled to 29 cities in the north of Minas Gerais, where the patients lived. Data were collected during home visits by researchers who were not associated with the hearing health care service. The researchers first introduced themselves, explained the goals and procedures of the study, and then got the interviewee's permission, by signing the Informed Consent, which was signed by a responsible person, in cases the interviewee was illiterate and could not sign. Individuals who could not complete the questionnaire and those who admitted that they could not judge their hearing aid outcomes were excluded from the study. Patients who were not located in their homes after three attempts were also excluded.

IOI-HA questionnaires were administered by trained staff to ensure that participants understood the questions. When necessary, questionnaires were read by the researchers. The IOI-HA questionnaire consists of seven questions that evaluate seven domains: (1) Use, (2) Benefit, (3) Residual activity limitation, (4) Satisfaction, (5) Individual participation restriction, (6) Impact on other people, and (7) Quality of life[11]. Patients were instructed to choose only one answer for each question of the questionnaire that best characterizes their fitting to their electronic hearing device. The global score is the sum of the scores from each of the seven items, with a minimum possible score of seven points and a maximum possible score of 35 points. A higher score indicates greater hearing aid outcomes than a lower score. The IOI-HA also allows separate assessments of the relationships between the individual and the hearing aid (Factor 1, "me and my hearing aid", items 1, 2, 4, and 7) and between the individual and the environment in which they live (Factor 2, "me and the rest of the world", items 3, 5, and 6).

A questionnaire was applied consisting of questions involving gender, age, education, job, type of hearing loss, degree of hearing loss, type and category of the hearing aid, hearing aid fitting configuration (monaural or binaural), whether he/she was currently using the device and, if not, the reasons for that.

Results were descriptively and analytically analyzed. The mean and standard deviation (SD) were calculated for each item in the questionnaire, as well as the global score, and Factors 1 and 2. To evaluate factors associated with hearing aid worst outcomes, the dependent variables (global score, Factor 1 and Factor 2) and independent variables (socio-demographic variables) were transformed into dichotomous variables. Cut-offs used for the global score, Factor 1 and Factor 2 were the medians of users' answers.

For the bivariate analysis, we used the χ^2 test. Variables with p-values <0.30 were included in the multivariable model. For multiple regression analysis, we used the Poisson regression model with robust error variance, and we estimated prevalence ratios with their respective confidence intervals. We adopted a significance level of 5% ($p<0.05$). For statistical analysis of the data, we used the Statistical Package for the Social Sciences (SPSS) version 19.0. This study was approved by the Research Ethics Committee of the Universidade Estadual de Montes Claros, under report 2888/11. Participants were informed of and agreed to the research's objectives when they signed the Informed Consent.

RESULTS

Characteristics of study's participants

We visited 302 domiciles and interviewed 272 individuals attending the public hearing health care service select at random in 29 of 86 municipalities of northern Minas Gerais, Brazil. Thirty visits did not result in interviews (25 seniors and five adults were excluded because they were not located after three attempts or were not able to evaluate the results of the hearing aid). Most of the participants were older patients (69.9%). Regarding education, 45.3% did not complete elementary school and 24.6% were illiterate (Table 1).

Table 1. Participant's characteristics prior to hearing aid fittings (n=272)

Characteristics	n	%
Gender		
Female	147	54.0
Male	125	46.0
Age group (years old)		
19 to 59	82	30.1
60 to 79	119	43.8
≥80	71	26.1
Education		
Graduated	15	5.5
Completed high school	38	13.9
Completed elementary school	29	10.6
Did not complete elementary school	123	45.3
Illiterate	67	24.6
Work activity		
Working	62	22.8
Not working/unemployed	31	11.4
Retired	179	65.8
Type of left ear hearing loss		
Conductive	11	4.0
Sensorineural	81	29.8
Mixed	47	17.3
No hearing loss	5	1.8
No information	128	47.1
Degree of left ear hearing loss		
Mild	12	4.4
Moderate	84	30.9
Moderately severe	14	5.1
Severe	19	7.0
Profound	12	4.4
No hearing loss	5	1.8
No information	126	46.3
Type of right ear hearing loss		
Conductive	13	4.8
Sensorineural	80	29.4
Mixed	46	16.9
No hearing loss	7	2.6
No information	126	46.3
Degree of right ear hearing loss		
Mild	13	4.8
Moderate	79	29.0
Moderately severe	11	4.0
Severe	24	8.8
Profound	14	5.1
No hearing loss	7	2.6
No information	124	45.6
Currently using a hearing aid		
Yes	160	58.8
No	112	41.2

Information regarding the numbers, types and categories of hearing aids received are available in Table 2. Most users were binaurally fitted (89.7%) with behind-the-ear (76.8%) hearing aids.

Of the individuals interviewed, 112 (41.2%) were not currently using the hearing aids. The reasons reported by the interviewees were: difficulty to adapt to the device due to discomfort, noise, pain in the ear, headache and rash (n=41); technical defects in the device (n=21); absence of benefit (n=19); financial difficulties, or in access, to acquire the battery (n=13); difficulties in operating the device (n=7); tube or mold defects (n=4); other reasons (n=7).

Outcome scores and associated factors

Table 3 shows means and SDs for IOI-HA items, global scores, and Factor 1 and Factor 2 scores from this study, compared to two national studies, and two international studies. The mean of Factor 1 was significantly higher than the mean of Factor 2 ($p<0.001$), in our study.

Relationships between participant's characteristics and IOI-HA scores are available in Table 4. Using a Poisson regression model with robust error variance and $p<0.30$, we found that only work inactivity was significantly associated with low IOI-HA global scores.

Table 5 presents the bivariate and the multivariate analyses between the socio-demographic characteristics and Factors 1 and 2. Using a Poisson regression model with robust error variance and $p<0.30$, we found that gender, work activity and hearing aid fitting configuration were associated with Factor 1. No characteristics showed significant associations with Factor 2.

Table 2. Features of hearing aids provided to participants

Hearing aid features	n	%
Hearing aid type		
BTE	209	76.8
ITE	3	1.1
ITC	56	20.6
CIC	4	1.5
Hearing aid category/technology		
C	147	54.0
B	46	16.9
A	33	12.1
No information	46	16.9
Hearing aid fitting		
Binaural	244	89.7
Monaural	28	10.3

Caption: BTE = behind-the-ear; ITE = in-the-ear; ITC = in-the-canal; CIC = completely-in-the-canal; C = digital programmable, nonlinear, WDRC multichannel compression; B = digital programmable or non-programmable, WDRC mono- or multichannel compression; A = non-programmable, linear, single-channel compression

DISCUSSION

This study provides information on hearing aid outcomes among patients in Minas Gerais, Brazil. In general, mean scores observed in our study were lower than mean scores in similar studies[13,17,18]. The exception is the study performed by the UHS in João Pessoa, Brazil[14], which showed a lower mean score in five of the seven items assessed by the questionnaire. In our study, item scores ranged from 2.81 to 4.35 (out of a maximum 5), indicating slightly positive adjustments to the hearing aid fittings[14]. Probably, this score is lower than expected due to the large number of people who did not use their hearing aids for the two weeks prior to the survey. In some studies[10,13,15,18], the scores on items 1 and 2 were higher than those observed in the present study, which impacted on global score. In those studies, the subjects were mostly elderly, but they varied in sample size, in participant's characteristics and features of hearing aids.

Global IOI-HA scores from Chinese study were similar[19]. Other national research studies found higher global scores compared to scores in our study[16]. However, the comparable national studies had small sample sizes. For example, the study conducted in São Paulo[17] used a convenience, rather than a

Table 3. Means and standard deviations of International Outcome Inventory for Hearing Aids items, global scores, and Factors 1 and 2 from this and other studies

	Present study		International studies				Brazilian studies			
	n=272		Brännström and Wennerström[13]		Öberg et al.[18]		Morettin[17]		Buriti and Oliveira[14]	
			n=199		n=154		n=43		n=32	
IOI-HA	Mean score	SD	Mean score	SD	Mean score	SD	Mean score	SD	Mean score	SD
Use	3.07	1.82	3.9	1.1	3.9	1.1	4.44	0.81	3.13	1.191
Ben	2.81	1.67	4.0	1.1	4.1	0.9	3.95	0.92	2.88	1.116
RAL	3.68	1.24	3.5	1.2	3.6	1.0	3.83	0.87	2.71	0.908
Sat	4.03	1.38	4.3	1.0	4.3	1.0	4.48	0.59	3.25	1.225
RPR	4.03	1.31	4.1	1.1	4.3	0.9	4.46	0.82	3.50	1.351
Ioth.	4.35	1.11	3.9	1.1	4.0	1.0	4.44	0.95	3.50	1.251
QoL	3.76	1.21	3.8	1.0	3.7	1.0	4.09	0.92	3.38	1.173
Global	25.74	7.09	27.7	5.2	27.9	4.8	29.86	3.86		
Factor 1	13.67	5.13					17.11	2.29		
Factor 2	12.07	2.95					12.74	2.12		

Caption: IOI-HA = International Outcome Inventory for Hearing Aids; SD = standard deviation; Use = usage; Ben = benefit; RAL = residual activity restriction; Sat = satisfaction; RPR = residual participation restriction; Ioth = impact on others; QoL = quality of life

Table 4. Participant's characteristics and their associations with International Outcome Inventory for Hearing Aids scores

Characteristics	Dissatisfied participants (scores ≤27)	Satisfied participants (scores >27)	Bivariate analysis	Poisson regression	
	n (%)	n (%)	p-value	PR (95%CI)	p-value
Gender					
Female	73 (49.7)	74 (50.3)			
Male	75 (60.0)	50 (40.0)	0.088	1.23 (0.9–1.52)	0.061
Age group					
19–59	41 (50.0)	41 (50.0)			
60–100	107 (56.3)	83 (43.7)	0.337	–	–
Education					
≥ High school	44 (53.7)	38 (46.3)			
Other	104 (54.7)	86 (45.3)	0.870	–	–
Work activity					
Working	26 (41.9)	36 (58.1)			
Not working	122 (58.1)	88 (41.9)	0.025	1.41 (1.03–1.92)	0.033
Hearing aid fitting					
Binaural	134 (54.9)	110 (45.1)			
Monaural	14 (50.0)	14 (50.0)	0.621	–	–
Hearing aid type					
BTE	115 (55.0)	94 (45.0)			
ITE/ITC/CIC	33 (52.4)	30 (47.6)	0.712	–	–
Hearing aid category					
C	74 (50.3)	73 (49.7)			
A/B	46 (58.2)	33 (41.8)	0.257	1.13 (0.88–1.44)	0.336

Caption: PR = Prevalence Ratio; BTE = behind-the-ear; ITE = in-the-ear; ITC = in-the-canal; CIC = completely-in-the-canal; C = digital programmable, nonlinear, WDRC multichannel compression; A = non-programmable, linear, single-channel compression; B = digital programmable or non-programmable, WDRC mono- or multichannel compression

Table 5. Participant's characteristics associated with International Outcome Inventory for Hearing Aids Factor 1 and factor 2 scores

Characteristics	Factor 1 scores			Poisson regression		Factor 2 scores			Poisson regression	
	≤15 n (%)	>15 n (%)	p-value (crude)	PR (95%CI)	p-value (adjusted)	≤13 n (%)	>13 n (%)	p-value (crude)	PR (95%CI)	p-value (adjusted)
Gender			0.051		0.026			0.896		
Female	72 (49.0)	75 (51.0)				87 (59.2)	60 (40.8)			
Male	76 (60.8)	49 (39.2)		1.27 (1.03–1.58)		73 (58.4)	52 (41.6)		–	–
Age group (years old)			0.136		0.677			0.385		
19–59	39 (47.6)	43 (52.4)				45 (54.9)	37 (45.1)			
60–100	109 (57.4)	81 (42.6)		1.07 (0.78–1.47)		115 (60.5)	75 (39.5)		–	–
Education			0.337		–			0.816		
≥High school	41 (50.0)	41 (50.0)				35 (42.7)	47 (57.3)			
Other	107 (56.3)	83 (43.7)		–		84 (44.2)	106 (55.8)		–	–
Work activity			0.025		0.016			0.229		
Working	26 (41.9)	36 (58.1)				23 (37.1)	39 (62.9)			
Not working	122 (58.1)	88 (41.9)		1.47 (1.07–2.02)		96 (45.7)	114 (54.3)		1.03 (0.80–1.33)	0.83
HA fitting			0.131		0.011			0.615		
Binaural	129 (52.9)	115 (47.1)				108 (44.3)	136 (55.7)			
Monaural	19 (67.9)	9 (32.1)		1.41 (1.08–1.84)		11 (39.3)	17 (60.7)		–	–
HA type			0.511		–			0.186		
BTE	116 (55.5)	93 (44.5)				96 (45.9)	113 (54.1)			
ITE/ITC/CIC	32 (50.8)	31 (49.2)		–		23 (36.5)	40 (63.5)		0.90 (0.69–1.17)	0.44
HA category					0.136			0.555		
C	73 (49.7)	74 (50.3)				61 (41.5)	86 (58.5)			
A/B	48 (60.8)	31 (39.2)	0.111	1.20 (0.94–1.52)		36 (45.6)	43 (54.4)		–	–

Caption: PR = Prevalence Ratio; BTE = behind-the-ear; ITE = in-the-ear; ITC = in-the-canal; CIC = completely-in-the-canal; C = digital programmable, nonlinear, WDRC multichannel compression; A = non-programmable, linear, single-channel compression; B = digital programmable or non-programmable, WDRC mono- or multichannel compression

random, sample. Of the 100 selected patients, only 43 returned to the clinic for the hearing aid outcomes evaluation. The study conducted in João Pessoa city[14] also presented a restricted sample, and it was not possible to infer each individual's allocation process.

In this study, the hearing aid benefit item has the lowest mean score of all the IOI-HA items, indicating that many participants received no benefit from hearing aid use. For other participants, the hearing aids helped only modestly. In contrast, satisfaction with the hearing aid, assessed by questionnaire's item 4, had a high mean score, indicating contradictory perceptions. This discrepancy between the benefit and satisfaction may be explained by patients' feelings of gratitude upon receiving free hearing aids[20]. Thus, the patients may not have felt "worthy" of dissatisfaction[16]. In the United States, patients who utilized public health services had higher levels of hearing aid satisfaction than patients who utilized private health services[21].

The mean score for item 7 that addresses the "quality of life", although not high, demonstrates that the hearing aid brought some joy to the lives of the participants in the study. Even some respondents who did not report benefits from hearing aid use reported positive perceptions regarding their post-fitting quality of life. People who know that they are part of a scientific research study may score higher as a result of this knowledge[13]. Moreover, this perception may be a result of gratitude for the provided services or the benefit obtained when participants used the hearing aids.

The IOI-HA allows the assessment of two factors: an individual's relationship with their hearing aid (Factor 1) and with their environment (Factor 2). The mean score for the respondents' relationships with their environment was significantly better than their relationships with their hearing aids. This finding suggests that limitations presented by individuals after amplification, such as difficulties in understanding speech, did not negatively affect their social life or their daily activities. The high mean score for item 6 (impact on others) also supports this. In another study, participants' relationships with their hearing aids were significantly better than their relationships with their environment[22]. In other studies[13,14,17,18], the individuals' relationships with their hearing aids and with their environments were similar. Our results also showed that the low mean score for Factor 1 was likely due to the number of people who did not use their hearing aids at least for the last two weeks. Therefore, these patients did not receive benefits derived from hearing aid use. Many people, especially the elderly, do not effectively use their hearing aids. Moreover, even when they use them effectively, some still retain hearing difficulties[23]. A potential explanation for the high Factor 2 score is that most of the participants were elders, who often have a less-active social life and whose everyday lives consist of activities within the home that do not require much communication with others. However, the age with the cut-off used in this study was not a variable that remained in the final model.

Work activity was the only factor to be significantly associated with overall worst outcomes. Individuals who did not work reported worst outcomes with hearing aid use. In a Swedish study, work activity was not included in the analysis, and the global IOI-HA score was not significantly associated with any of the characteristics analyzed[13]. Perhaps the communication needs of individuals who work are greater and, therefore, they are more cognizant of the benefits provided by the hearing aids. Another hypothesis could be related to financial matters, since the patient's income depends on their job performance. These questions were not investigated in this study.

Gender, work activity, and hearing aid fitting configuration were also significantly associated with IOI-HA Factor 1. Male individuals who did not work and were fitted with monaural hearing aids had the lowest scores for the items related to an individual's relationship with their hearing aid. In a study conducted in the United States, gender did not influence the results of the IOI-HA Factor 1 scores[24]. The study conducted with 8,389 hearing aid users[25] showed differences between genders; the women in the study used their hearing aids more regularly than the male participants. In a Swedish study, only hearing loss type significantly affected the IOI-HA scores. Although there were no significant differences among individuals fitted with monaural or binaural hearing aids, the monaurally fitted individuals had lower IOI-HA scores[13]. Research conducted in Australia with 1,653 participants found that qualities of hearing aids (i.e. comfort, clarity of tone, comfort with loud sounds, and effective dialogue with one person, in small groups, in large groups, and outdoors) were associated with higher IOI-HA scores[15].

Numerous individuals in our study did not use their hearing aids regularly. Many identified "discomfort" as their reason for abandoning the hearing aids. Thus, due to poor fittings and improper adjustments, many hearing aids remained unused. Furthermore, most of the study's participants were over 60 years old. Older people have more difficulty handling hearing aids and remembering hearing aid use instructions[26].

In this study, hearing aid technology (type A, B and C) had no influence on hearing aid outcomes. Similar scores were reported by individuals who received hearing aids with improved technology as by those who received hearing aids with simpler technology. A study that assessed satisfaction between analog and digital amplification technology users found no significant difference between these two groups[27]. Another study suggested that advanced hearing aid technology positively affected patient's satisfaction scores[24].

In addition to using individual hearing aids, auditory rehabilitation can be done through individual or group communication programs. Decisions regarding the best intervention should be made by patients and their health professionals[28]. Research has shown that rehabilitation, which includes listening skill training, guidance and counseling, assists individuals in the hearing aid acclimatization period, minimizing the negative effects of hearing loss and reducing hearing aid discomfort[29]. Other essential procedures to ensure effective hearing aid fittings are annual patient monitoring, hearing loss monitoring, and hearing aid evaluations. However, the number of follow-ups conducted in Brazil has declined over the years, leading researchers to question whether health services provided speech therapy

and whether patients adhered to the hearing rehabilitation process[6]. A possible solution to minimize hearing aid abandonment would be to partner audiologists with the health service providers, in addition to provide basic guidelines (e.g. changing batteries, maintenance, cleaning and handling of the hearing aid) to users; they could also refer patients to an audiologist for therapy if necessary.

Hearing aid selections and fittings should continue to be evaluated. Longitudinal studies, such as the ecological momentary assessment, are feasible methods to evaluate difficulties faced by hearing aid users and to provide audiology services that can offer a better quality of life[30]. It is necessary to identify individuals who are less satisfied with their hearing aids and intervene in their behalf, so that they can achieve higher levels of satisfaction and hearing health resources can be optimized. Further studies are also needed to assess, in more detail, hearing aid benefits by using an instrument such as the Abbreviated Profile of Hearing Aid Benefit (APHAB) questionnaire.

This study had some limitations. It was not possible to compare hearing aid satisfaction between people with different degrees of hearing loss because many participants did not have this information. Other factors not analyzed in this study were the associations between hearing loss type and degree with hearing aid satisfaction. The demographic characteristics evaluated explain some of the variability of the satisfaction results, but the most relevant contributors to hearing aid fitting need to be identified in future studies. Older people with low levels of educational attainment often found the IOI-HA instrument difficult to understand. Nevertheless, this study is the first to evaluate hearing aid satisfaction among people of Minas Gerais, Brazil.

The observed results highlight aspects that had not been studied in Brazil with a so significant sample in a wide and poor area. The Hearing Health Care Service needs to adopt measures to increase patient compliance with the monitoring service and to minimize hearing aid abandonment.

CONCLUSIONS

We analyzed the self-reported outcomes after hearing aid fitting among individuals in the northern region of Minas Gerais and found that the mean of IOI-HA global score was lower than expected. We also found that gender, work activity and hearing aid fitting configuration were associated with the individual's relationship with their hearing aid (Factor 1). No characteristics showed significant association with individual's relationship with their environment (Factor 2). The hearing aid outcomes were lower than other studies, perhaps because many individuals were not using their hearing aids, at least, for the last two weeks.

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