

Evaluation of satisfaction measures of analog and digital hearing aid users

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Key words: hearing aid, self-assessment measures, handicap.

Summary

Aim: the objective of this study was to investigate the satisfaction measure of analog and digital hearing aid users. **Study design:** clinical with transversal cohort. **Material and Method:** Among the 40 interviewed subjects, 20 were analog hearing aid users (Group I) and 20 were digital hearing aid users (Group II). The subjects had mild to moderate sensorineural hearing impairment, and were aged 45 to 95 years old. **Results:** The inventory of self-assessment completed by the hearing aid users was the International Outcome Inventory for Hearing Aids (IOI-HA – Portuguese version) proposed by Cox et al. (2002). The users of Group II used the hearing aid longer every day than the analog hearing aid users (Group I). The users of Group II have fewer difficulties with the amplification at some situations than the users of Group I. Despite the fact that users of Group I have presented mode deficit than the users of Group II, the results agree that all the subjects reported satisfaction with their hearing aids.

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INTRODUCTION

Hearing is an essential sense in life, performing an important role in society, because it is the basis for development of human communication. A subject who has auditory disability may also suffer damage in his social, psychological and professional life, leading to feelings of insecurity, fear, depression, isolation and tension in the family environment, owing to lack of attention that hearing disabled people normally have.

Cochlear lesions affect a number of skills of the auditory system, hindering the acoustic and speech signal processing and consequently, communication skills. Among these skills we can include frequency selectivity, perception of intensity and resolution of intensity, temporal resolution and speech perception.¹

Sensorineural hearing loss may lead to significant perceptual effects, such as increase of auditory threshold, reduction of dynamic field, loss of discrimination and higher sensitivity to noise.²

The problems caused by sensorial deprivation may be minimized with the use of hearing aids, which enable the restoration of speech sound perception, in addition to environmental sounds, promoting improvement of communication skills. Current hearing aids are classified into analog and digital depending on the technology of electronic circuits.

Hearing aids of analog technology use conventional electronic components that convert the sound wave collected through a microphone into an analog electrical signal that in the circuit is amplified and filtered, once again converted into sound wave. To present, there are advantages in its use, such as low cost, low power consumption and miniaturization of components.³

Digital hearing aids use dozens to thousands of transistors that enable acoustic signal processing that is much better than with analog technology. The aid consists of electronic circuits and transducers, which are named hardware and software, to digitally control the circuits with refined precision.³

In the literature, it is possible to find references to many advantages of digital aids over analog ones, such as for example the programming capacity, higher precision in adjustment of electroacoustic parameters, control of acoustic realignment, noise reduction, better reproducibility, in addition to automatic control of signal and less internal noise.^{4,5}

If the cosmetic factor is a criterion to be considered in hearing aid selection, digital aids seem to meet the requirements but we should not consider cosmetic elements to be more important than performance.^{6,7}

New strategies were incorporated into hearing aids to make audibilization of hearing loss patients easier, but it is still questionable whether there is speech perception improvement with the use of digital technology aids.

Moreover, amplification per se of all sounds may cause auditory discomfort, especially in cases of recruitment of sensorineural losses, or even with normal range dynamic hearing field.⁸

Acoustic comfort with sound amplification may occur with the use of a system of adjustment compression according to the environment, such as the WDRC system, commonly adapted to digital technology, which allows users to have greater amplification of weak sounds and less amplification of loud sounds.

It is important to point out that subjects with hearing loss, when they decide to have a hearing aid, they are not doing it for the hearing loss but rather for the suffering, and if it is high enough, the subject becomes a potential candidate for hearing aid use. In view of that, it is possible to find in clinical practice good, fair and poor candidates to use amplification, based only on audiological assessment.⁹

The moment of decision is to use a hearing aid as part of the auditory handicap self-perception. Adult subjects many times tend to hesitate concerning the acceptance of hearing loss, normally attributing the auditory difficulties to the inappropriate environment or third party communications. Elderly subjects tend to tolerate any type of deficiency, whose main justification is aging.¹⁰

Based on the model proposed by the World Health Organization in 1980, the handicap represents the negative impact on wellbeing and quality of life of the subjects. In addition to non-auditory consequences of hearing loss, it is the disadvantage imposed by the hearing loss or disability that limits the psychosocial functioning of the subject. It represents social and emotional manifestations resulting from auditory deficit and disability, which may affect the hearing impaired, his family and/or society and the measures that involve the relation between the deficits, disabilities, life habits and social-cultural and physical environment of the patients.¹¹

We can consider that there is no correlation between level of hearing loss and auditory handicap given that it is impossible to determine the handicap using audiometric data, because there is no correspondence between audiometric measurements and self-assessment of the auditory handicap.⁸

There are many factors that contribute to the successful use of amplification. Age, level of loss and type of hearing loss, physical factors (size of the ear and manual dexterity), auditory processing skills, previous use of hearing aids and extension of hearing loss, which together perform an essential role for the acceptance of amplification. Added to it, the perception of auditory handicap, cost, personal expectations, satisfaction, performance and benefits may indicate whether we will have a happy and satisfactory user of hearing aids or not.¹²

During the process of individual counseling of hearing impaired subjects we should be concerned about three pro-

cesses of psychological motivation related with use of hearing aids: acceptance, benefit and satisfaction.⁶

Acceptance can be characterized in two different ways: either the hearing aid is accepted or rejected, but it may also be characterized as a psychological process of coping with the idea and sensation of the sound amplification, at the same time it incorporates the hearing aid into patients' life style. The satisfaction is built according to the subjects' impressions. Thus, it is clear that unless accepted, there will never be satisfaction. Similarly, acceptance and benefits are not enough parameters to ensure satisfaction. Whereas the benefit can be shown using objectives tests, satisfaction is a very personal assessment of value of hearing aids after some time of use.¹³

We can state that checking procedures, such as functional gain and insertion measurements is not enough to assess users' satisfaction with hearing aids in daily communication situations. There has been growing interest in development of validation procedures that would enable assessment of the benefit of users outside the clinical environment, which led to the creation of a self-assessment questionnaire.¹⁴

Self-assessment questionnaire is a simple, quick and effective procedure that enables the assessment of subjects in the process of hearing aid fitting. This procedure compares hearing aids and/or regulations, and assessment of benefit of use of the same hearing aid with time compared with auditory difficulties and psychosocial disadvantages. Thus, using questionnaires that enable measurement and analysis of these auditory difficulties or handicap, it is possible to optimize the period of fitting to amplification.¹⁵

There are many assessment instruments that consist of scales to assess the level of satisfaction of subjects, given that there are many factors that influence different dimensions related to use of sound amplification aids.¹⁵

In Brazil, some self-assessment questionnaires, among which APHAB (Abbreviated Profile of Hearing Aid Benefit), HHIE (Hearing Inventory for the Elderly) and HHIA (Hearing Handicap Inventory for the Adults), were translated and adapted to the reality of our country, investigating the level of satisfaction of users, benefits obtained with the use of hearing aids and the reduction of auditory disability with the use of hearing aids, in addition to others that focused on the comparison between benefits of technological differences and the verification of hearing aid fitting using objective and subjective measures.¹⁶⁻¹⁹

In this study, we used the *International Outcome Inventory for Hearing Aids* – IOI-HA developed as a product of an international workshop about self-assessment measurements in auditory rehabilitation.^{20,21}

The present study aimed at investigating the level of satisfaction and the handicap of hearing aid users of both analog and digital technology.

MATERIAL AND METHOD

Characterization of the sample

The sample of the present study comprised 40 subjects, users of unilateral hearing aids, 18 male and 22 female subjects. They all had bilateral moderate sensorineural hearing loss, with flat configuration and were users of Oticon hearing aids.

The sample was divided into Group I, for users of analog hearing aids (NA=20) and Group II for users of digital hearing aids (NA=20). The age range varied from 45 to 95 years and the distribution of ages is described in Table 1.

We asked all subjects whether they wanted to participate in the study when they came to a visit with the audiologist at the hearing aid center where they had bought the aids. They answered the questionnaire individually without any third party intervention. Data collection was made from June to August 2003.

Assessment instrument

The *International Outcome Inventory for Hearing Aids* – IOI-HA is the result of an international workshop about self-assessment measurements in auditory rehabilitation^{20,21}. Thanks to the cooperation of researchers and professionals in rehabilitation programs from different centers, the questionnaire was translated into 21 languages by qualified people in the area of Audiology, and each translator tried to be faithful to the original version.

To facilitate the assessment of questions about hearing aid fitting, concerning satisfaction level and handicap of the subjects, the questions were prepared for low cognitive skills and easy reading level for subjects to answer without the help of third party.

We used the version in Portuguese, and Annex I shows the original in English.

RESULTS

As to Question 1, referring to time of aid use, most subjects in Group II had used the hearing aids for more hours every day, as shown in Figure 1.

Question 2 asks the subject to think about situations he wanted to have improved before the hearing aid use

Table 1. Distribution of the age range of subjects in the sample (NA = 40).

Age range	Male	Female
41-50	2	0
51-60	1	5
61-70	3	5
71-80	3	6
81-90	8	5
91-100	1	1

and how much it has helped him in such situations. Out of all users in Group I, 90% (18) marked the items that corresponded to a very satisfactory benefit with the use of amplification (helped a lot and very much) and 10% (2) reported that the aid had helped moderately, whereas 100%

(20) users of digital aids, in Group II, referred maximum benefit, meaning the hearing aids had helped them very much.

In Question 3, the subjects should think about the same situation and mark the level of difficulty with the use

ANNEX 1. INTERNATIONAL OUTCOME INVENTORY – HEARING AIDS (IOI-HA)

1. Think about how much you used your present hearing aid(s) over the past two weeks. On an average day, how many hours did you use the hearing aid(s)?

none ()	less than 1 hour a day ()	1 to 4 hours a day ()	4 to 8 hours a day ()	more than 8 hours a day ()
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2. Think about the situation where you most wanted to hear better, before you got your present hearing aid(s). Over the past two weeks, how much has the hearing aid helped in that situation?

helped not at all ()	helped slightly ()	helped moderately ()	helped quite a lot ()	helped very much ()
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3. Think again about the situation where you most wanted to hear better. When you use your present hearing aid(s), how much difficulty do you STILL have in that situation?

very much difficulty ()	quite a lot of difficulty ()	moderate difficulty ()	slight difficulty ()	no difficulty ()
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4. Considering everything, do you think your present hearing aid(s) is worth the trouble?

not at all worth it ()	slightly worth it ()	moderately worth it ()	quite a lot worth it ()	very much worth it ()
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5. Over the past two weeks, with your present hearing aid(s), how much have your hearing difficulties affected the things you can do?

affected very much ()	affected quite a lot ()	affected moderately ()	affected slightly ()	affected not at all ()
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6. Over the past two weeks, with your present hearing aid(s), how much do you think other people were bothered by your hearing difficulties?

bothered very much ()	bothered quite a lot ()	bothered moderately ()	bothered slightly ()	bothered not at all ()
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7. Considering everything, how much has your present hearing aid(s) changed your enjoyment of life?

worse ()	no change ()	slightly better ()	quite a lot better ()	very much better ()
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English Version

Translations of the International Outcome
Inventory for Hearing Aids (IOI-HA)

Cox/Stephens/Kramer

of amplification, which should provide references about their auditory handicap. Out of the analog aid users, in Group I, 40% (8) still had moderate difficulty with hearing aid use. Out of all digital users, most did not find any difficulty. These results are shown in Figure 2.

In Question 4, subjects reported the acceptance of hearing aids related to the benefit it provided when they answered if amplification was worth having. Only one (1) subject in group I answered that it was moderately worth it, whereas all the others (95%) responded that it was quite a lot/very much worth it, which characterized a highly satisfactory acceptance. In Group II, 100% (20) of the users of digital aids responded that it was very much worth to wear aids.

Question 5 addressed the investigation of the handicap, to what extent the hearing loss, despite hearing aid use, affected the daily life of subjects in the sample. Out of all users of analog hearing aids in group I, 80% (16) said it affected very much. To 35% (7) users in group II, the affection was more significant. Figure 3 shows these results.

Question 6 addressed the same element but concerning other people. In Group I, 30% (6) said it affected

moderately. In Group II, most (70%) said it did not affect other people at all. The results are shown in Figure 4.

The level of satisfaction of hearing aid use was approached in the 7th and last question, in which there was no statistically significant difference among users of both groups, because 95% (19) users of analog aids reported that the use of hearing aids had improved their life and 5% (1) said that his life got better. As to group II, 100% (20) users of digital hearing aids said that the use of aids had improved their life.

DISCUSSION

Every professional that works with rehabilitation of hearing impaired subjects, in addition to the need to be updated concerning technology to be provided to patients, should question the real benefit that the latest technology can provide to auditory needs of each subject. Many studies have considered this issue, approaching the real benefit that digital technology provides in comparison to analog technology, based on subjective or objective

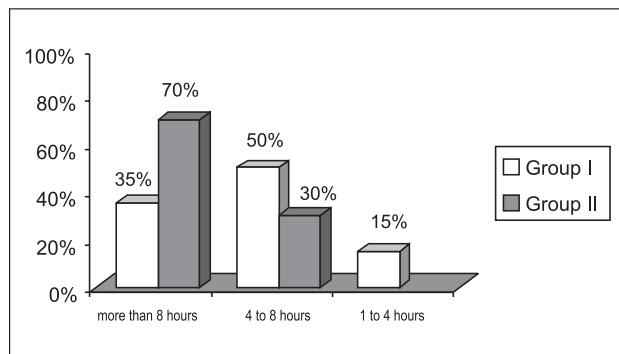


Figure 1. Distribution of the percentage of analog (Group I) and digital (Group II) hearing aid users concerning hours of daily use.

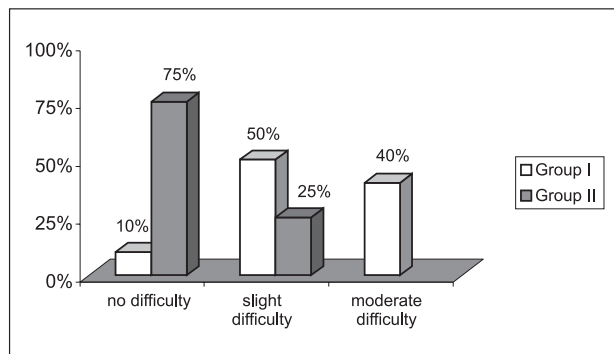


Figure 2. Distribution of the percentage of analog (Group I) and digital (Group II) hearing aid users concerning level of difficulty they present with hearing aid use.

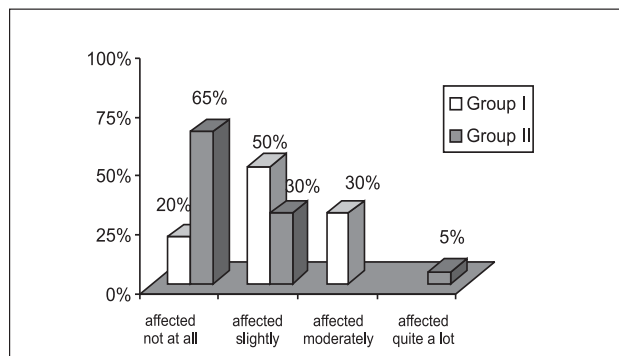


Figure 3. Distribution of the percentage of analog (Group I) and digital (Group II) hearing aid users concerning to what extent the hearing loss affected their life.

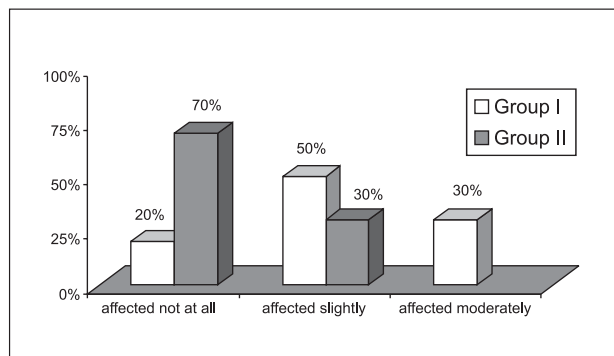


Figure 4. Distribution of the percentage of analog (Group I) and digital (Group II) hearing aid users concerning to what extent the hearing loss affected their relationship with people.

measurements.²²⁻²⁵

We should recognize that the perception of auditory disability may vary a lot from subject to subject, if we consider the factors such as age, social-economic status and acceptance of hearing loss by the subjects and his/her family members.

The correlation between use of hearing aids in daily activities and adaptation to amplification is very strong. The fact that a subject does not reject the use of an aid is directly related with the use of amplification. According to the literature, the acceptance may be characterized in two ways: either the aid is accepted or rejected, but it may also be characterized as a psychological process that deals with the idea and the sensation of sound amplification, at the same time it incorporates the aids in their life style. This attitude may imply satisfaction or not. The acceptance, as a dynamic process, proposes the construction of satisfaction because it depends on subjects' impressions.¹³

In our study, it was possible to see that most users of digital hearing aids used it for more than 8 hours a day, whereas users of analog aids used it for 4 to 8 hours. Comparing these results with age distribution we observed that users of analog aids used them for less time, which can be justified by the age of users, given that 100% of the people in group I were aged over 61 years. The elderly years are typically characterized as being a less active stage, comprising fewer work and social activities,

The studied literature is against these results, reporting that the daily use of analog hearing aid users was longer.²⁶

As to the benefit that the hearing aid provides, the results unanimously revealed that all users of digital aids stated that the aids help a lot, despite the fact that the differences are not significant, because only 10% (2) users of analog aids answered that it gave a moderate benefit. These results agree with the results of another study that found statistically significant differences concerning benefit and satisfaction between users of analog and digital aids, despite the fact that the author assumed that the simplicity of the used questionnaire had not revealed the key advantages of the new technology²⁵. However, a recent comparative study reported by the previous study identified very high expectations concerning the effect of analog and digital hearing aids, excluding the unreal expectations as the main reason for a small proportion of subjects that reported fewer benefits with digital aids compared to the benefits of analog hearing aids.

Figure 2 described the results referring to level of difficulty that subjects still presented with use of amplification. Most subjects with analog aids belonging to group I realized more difficulty than users of digital aids in group II. It is assumed that the difference implies a more accurate verification of the type of compression system using aids in each subject, because we should recognize that acoustic comfort in noisy environment and the capacity to

recognize speech in the presence of noise are essential factors for the subject to have a satisfactory fitting process and acceptance of the need to use amplification.

In some systems with signal digital processing, low thresholds of understanding enable the users to listen to lower sounds than they would listen with analog aids. It contributes to speech recognition from longer distances, as well as to early identification of environmental sounds, such as danger warnings.⁷

Conversely, other researchers suggested that analog aids with WDRC compression circuits can promote a very satisfactory performance, which does not require digital aids, but digital technology is capable of providing other benefits, such as cancellation of feedback and for some subjects it may be the key reason for indication of the use of digital technology.²⁴

The investigation of the deficit is again addressed by questions 5 and 6, whose results are illustrated in Figures 3 and 4, respectively. In Question 5, subjects marked the item that corresponded to how much the hearing loss affected their daily activities and it was possible to observe statistically significant difference in relation to the item that corresponded to minimum persistent level of handicap, in which only 20% (4) users of analog aids reported that the loss did not affect them at all, against 65% (13) with digital aids. In Question 6, we approached the deficit concerning other people and we also observed statistically significant difference relative to the item that corresponded to the minimum level of affection, in which only 20% (4) of the users in group I considered that their loss did not affect the other people, against 70% (14) users in Group II. These results should also be more accurately assessed concerning duration of fitting of each subject to better represent the sample.

It is expected that in a first self-assessment, 15 days after fitting, the subjects had more significant deficit than in the second self-assessment, after 2 or 3 months of aid use. In clinical practice, it is possible to observe many reluctant subjects, especially elderly patients, when they are first fitted with the aid, having difficulties to deal with their hearing deficit and trying to hide the fact that they need a hearing aid.

In 2002, a study concluded that subjects with hearing loss presented a natural trend to change the answers within time when they responded to the self-assessment questionnaire. New experiences may lead to changes in perception. Subjects with hearing loss, for example, may follow relatively well a conversation in group, whereas after fitting of aids, they may state that without the aids, they could understand only half of the conversation. They notice that the deficit before the aids was much more marked. It confirms the possibility that with time, people learn how to adapt to their physical problems.²⁷

The public healthcare system in Brazil offers serious restrictions to rehabilitation, ranging from diagnosis of hearing

loss to counseling of subjects with hearing aids. We agree that Brazil is a developing country, with high prevalence of hearing loss, and in such cases digital aids may represent a barrier for rehabilitation process because of the price of the aids, the equipment necessary for fitting and the extensive training required for qualified professionals. It is believed that in the near future most if not all aids will be digital, and the prices will automatically drop. Greater flexibility of technology should result in better strategies of fitting, increasing the benefits of users and reducing the costs both for healthcare services and for consumers, who normally pay themselves for their hearing aids.²⁵

To close the discussion, given that satisfaction is exclusively defined by the user, all measures to assess it are necessarily subjective and they should be perceived as static measurements. The satisfaction of the subject with the hearing aid is not always proportional to the changes observed in hearing disabilities or changes in attitudes that may reflect improvement in quality of life. To that end, we should always consider the satisfaction of the subjects based on the quality of services provided to final value of equipment.¹³

In this study, the last issue addressed the satisfaction of subjects with a very personal way of asking how aids influenced their enjoyment of life. Thinking that satisfaction depends on acceptance of the subject with hearing loss, our sample was unanimous to report that the use of hearing aids has provided enjoyment of life, regardless of the technology.

We consider that the self-assessment IOI-HA questionnaire is easy to apply and understand and requires little attention from subjects to respond it. It is important to point out that users' handicap and satisfaction with the use of aids should be further studied and is not at all exhausted by the systematization of assessment procedures and the application of questionnaires.

In our opinion, the digital technology enables the learning of more information about amplified signal, from speech or environmental noise, so that we can supply the individual auditory needs. The skill to manipulate many different performance parameters, together with the skill to modify them separately, is a strong argument in favor of digital technology to continue to be employed to supply the acoustic needs of people with hearing loss.⁷

The professionals who work with human communication disorders should be aware of the importance of hearing for the maintenance of interpersonal relationships in the society, which should be the main objective of an efficient auditory rehabilitation program.

CONCLUSION

Users of Group I had the hearing aids for less time, which can be explained by the fact that they were over 61 years of age.

User of both groups perceived benefits with the use of hearing aids in situations in which they wanted to hear better, despite the fact that users of Group I had revealed more marked deficit, reporting that they still had difficulty to use amplification in such situations. Most users in group I presented deficit concerning their hearing loss and how much it affected their daily activities and how much it affected their relationship with the others.

We concluded that the self-assessment IOI-HA questionnaire is easy to apply and understand, requiring little time from subjects to have it answered.

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