DOI: 10.1590/2317-1782/20162015119

Original Article

Artigo Original

Priscila Faissola Caporali[1]
Sueli Aparecida Caporali[2]
Érika Cristina Bucuvic[3]
Sheila de Souza Vieira[1]
Zeila Maria Santos[1]
Brasília Maria Chiari[1]

Cross cultural translation and adaptation to Brazilian Portuguese of the *Hearing Implant Sound Quality Index Questionnaire* - (HISQUI19)

Tradução e Adaptação Transcultural para o Português Brasileiro do Questionário Hearing Implant Sound Quality Index - (HISQUI19)

Keywords

Questionnaire
Translation
Hearing Impairment Rehabilitation
Cochlear Implantation
Adult

ABSTRACT

Purpose: Translation and cross-cultural adaptation of the instrument *Hearing Implant Sound Quality Index* ($HISQUI_{19}$), and characterization of the target population and auditory performance in Cochlear Implant (CI) users through the application of a synthesis version of this tool. **Methods:** Evaluations of conceptual, item, semantic and operational equivalences were performed. The synthesis version was applied as a pre-test to 33 individuals, whose final results characterized the final sample and performance of the questionnaire. The results were analyzed statistically. **Results:** The final translation (FT) was back-translated and compared with the original version, revealing a minimum difference between items. The changes observed between the FT and the synthesis version were characterized by the application of simplified vocabulary used on a daily basis. For the pre-test, the average score of the interviewees was 90.2, and a high level of reliability was achieved (0.83). **Conclusion:** The translation and cross-cultural adaptation of the $HISQUI_{19}$ questionnaire showed suitability for conceptual, item, semantic and operational equivalences. For the sample characterization, the sound quality was classified as good with better performance for the categories of location and distinction of sound/voices.

Descritores

Questionários
Traduções
Reabilitação da Deficiência Auditiva
Implante Coclear
Adulto

RESUMO

Objetivo: Traduzir e adaptar transculturalmente o instrumento *Hearing Implant Sound Quality Index* ($HISQUI_{19}$), e caracterizar a população e o desempenho auditivo em usuários de Implante Coclear (IC) pela aplicação da versão síntese. **Método:** Realizou-se a avaliação das equivalências conceitual, de item, semântica e operacional. A versão síntese foi aplicada como um pré-teste que contou com 33 sujeitos no resultado final, caracterizando a amostra e o desempenho do questionário. Os resultados foram analisados estatisticamente. **Resultado:** A tradução final (TF) foi retrotraduzida e comparada à versão original, mostrando diferença mínima entre itens, e as modificações da TF para a versão síntese caracterizaram-se pela aplicação de vocabulário simplificado utilizado no cotidiano. No pré-teste, o escore médio entre os entrevistados foi de 90,2 e confirmou-se alto grau de confiabilidade interna (0,83). **Conclusão:** A tradução e a adaptação do questionário HISQUI19 mostraram adequação para as equivalências semântica, cultural, conceitual e de item. Na caracterização da amostra, a qualidade de som foi classificada como boa com melhor desempenho nas categorias de localização e distinção de sons/vozes.

Correspondence address:
Priscila Faissola Caporali
Universidade Federal de São Paulo – UNIFESP
Rua Borges Lagoa, 783, conj 21, São Paulo (SP), Brazil, CEP: 04038-901.
E-mail: pricaporali@gmail.com

Received: May 10, 2015

Accepted: October 06, 2015

Study conducted at the Department of Speech and Hearing Sciences, Universidade Federal de São Paulo – UNIFESP - São Paulo (SP), Brazil.

[1] Universidade Federal de São Paulo – UNIFESP - São Paulo (SP), Brazil.

[2] Widex A/S - Lynge, Denmark.

[3] Hospital de Reabilitação de Anomalias Crânio Faciais, Universidade de São Paulo – USP - Bauru (SP), Brazil.

Financial support: notinhg to declare.

Conflict of interests: nothing to declare.

INTRODUCTION

The cochlear implant (CI) has been an effective auditory rehabilitation device to promote hearing and psychosocial benefits which improve the quality of life for the hearing impaired[1].

Although a very effective technology, the CI has limitations in certain auditory situations. The most frequent complaint is the difficulty for the user to understand speech in the presence of background noise[2,3]. Therefore, evaluating the performance of the CI users in various contexts of speech perception is extremely important to measure the degree of patient satisfaction[4].

The evaluation of CI benefits to the user can be determined by testing speech perception and self-assessment questionnaires that subjectively assess hearing loss associated with communication problems and life style[5].

In national and international literature, studies can be found on the performance of CI users associating mapping of electrodes, auditory training, mapping change, perception tests with speech self-assessment questionnaires[6-9] as well as comparative studies of self-assessments in pre and post use of CI[1,10].

Self-assessment questionnaires specifically developed for the assessment of CI users are still scarce. There are three questionnaires in international literature, "The Nijmegen Cochlear Implantation Questionnaire" (NCIQ), "Spatial Hearing Questionnaire" (SHQ) and "Hearing Implant Sound Quality Index" ($HISQUI_{19}$)[11-13] which have not yet been translated into the Brazilian context.

Audiology in Brazil requires an approved instrument that tracks the hearing impairment difficulties in adult CI patients. In this sense, the $HISQUI_{19}$ was the instrument selected to be developed for the adult CI population, which measures how good or how bad the individual considers the sound quality of the hearing implant to be in various everyday situations.

This paper analyzes the translation and cultural adaptation of the $HISQUI_{19}$ questionnaire, fulfilling the study of conceptual, item, semantic and operational equivalences, in addition to characterizing the population and the auditory performance of a group of implant users through the application of $HISQUI_{19}$.

METHODS

This study was approved by the Research Ethics Committee of Brazil Platform, under number 451 624, without any conflict of interest, with the need for a Consent Statement, according to Resolution 196/96 of the National Health Council, which was signed by the research participants. Permission for the use of $HISQUI_{19}$ questionnaire was requested and approved by the investigators of the original instrument (Annex A).

The process of this study involved the following steps: translation and cross cultural adaptation of the $HISQUI_{19}$ according to Field Research[14-16] in the area and by applying the pretest and sample characterization.

Translation and cross-cultural adaptation

The item and conceptual equivalence were simultaneously evaluated by a panel consisting of three competent evaluators in the CI health and rehabilitation area. As an initial step, the evaluators discussed whether the questionnaire represented the target population and the importance of measuring the results of the electronic device sound quality in its practical use. Subsequently the items of the original article were individually analyzed and discussed in the Brazilian scope and context.

The semantic equivalence was initiated by three independent translations of the original instrument from English to Brazilian Portuguese by health professionals born in Brazil. The three translated versions were synthesized into a single version by two professionals which generated version "T1.2.3". Consequently, the translated version "T1.2.3" was sent to a sixth professional with knowledge of the English and of the brazilian Portuguese language to perform the back-translation, "R1.2.3" version. This occurred independently and without prior knowledge of the original questionnaire. The back-translated version "R1.2.3" was compared with the original version based on the literal meaning and the general meaning of each item. The results of the comparison were observed and discussed among the professionals who had also participated in the item and conceptual evaluation, producing the synthesis version "S1" in Brazilian Portuguese with the correct modifications.

The Operational equivalence was assessed by researchers who evaluated the procedure in which the test content, questions and instructions were conducted.

As for the application method, the researchers of the original study sent the questionnaire to the participants and received the completed form back through the post.

The operational procedure of the original study was not considered feasible for this particular population. The questionnaire was chosen to be completed individually as an interview with the items read out loud. A table with seven response options were inserted in a Linkert-type scale together with the respective percentage, in which the respondent had to choose the options that were equivalent to their performance in listening situations as described.

Pretest application

Thirty-five patients were selected who were being accompanied and monitored in the *Centro do Deficiente Auditivo do Departamento de Otorrinolaringologia da Escola Paulista de Medicina*. All selected patients were adults over the age of 18, unilateral or bilateral CI users, acquisition of hearing impairment in pre-lingual or post-lingual stage, and the $HISQUI_{19}$ questionnaire was activated after at least three months of CI use.

There were no restrictions on the brand or model of external electronic devices and internal components, nor in relation to gender, level of education, socio-economic and / or cultural level of patients.

Of the thirty five patients, two were excluded from the sample as they had more than three questions marked as "not applicable"

which based on the original questionnaire disqualifies the use of the responses from these patients in the sample.

As such, the final sample consisted of thirty-three patients, 16 males and 17 females, who varied in terms of implant use (right ear, left ear and bilateral) and three different CI companies (Cochlear, Medel and Advanced Bionics).

After the questionnaire was performed (Annex A) the total score was obtained, derived from the sum of 19 questions: in each question the options "always (99%)", "almost always (87%)", "often (75%)", "generally (50%)", "occasionally (25%)", "rarely (12%)", "never (1%)" and "not applicable" received the scores of 7, 6, 5, 4, 3, 2, 1 and 0, respectively.

The total score ranged from a minimum value of 19 and a maximum of 133 points, minimum meaning very bad sound quality and maximum meaning very good sound quality. The score values were correlated with age variables, level of education, implant activation time and hearing loss time.

Finally, the 19 questions were grouped into the following seven categories of daily listening: location of sounds, distinction between different voices, identifying musical sounds, understanding telephone conversations, speech understanding of television and radio programs with background noises, speech understanding in noisy public environments and understanding conversations in noisy backgrounds, to clarify situations of greater or lesser hearing ease.

Statistical procedures

The results were statistically analyzed with the aid of STATISTICA program version12 and each hypothesis test a 0.05 level of statistical significance was determined. In addition, Cronbach's alpha was used to determine the degree of reliability of the instrument studied by measuring the internal consistency of the observed values.

RESULTS

Each question was analyzed by comparing the original and the back-translation "R.1.2.3" and the translation "T.1.2.3" and the synthesis version "S1", as shown in Table 1. Items 1, 2, 5, 9, 10, 12, 13 and 18 showed equal words used between the original and back translation, besides there being full correspondence between the translation text and synthesis version.

Items 3, 11, 15 and 17 had equal representation of words between the original and the back-translation, with the simple difference between the translation and the synthesis version. In item 3, the word "simultaneously" was changed to "the same time" to be a simpler term. In item 11, the noun "members" was replaced by "people" to simplify the sentence according to the context. In item 15, the word "bank" was removed in order to avoid redundancy. In item 17, the term "talk to" was translated as "falar" (to speak) and changed to "conversar" (to converse), as "conversar" is considered more appropriate considering the context of the question.

For items 4, 6, 7, 8, 14, 16 and 19 of Table 1, there were changes between the original version and the back-translation due to words used in the translation. Even so, there was no change in the sense of denotative and connotative meaning between the two versions.

In the comparison between the original and the back-translation, item 4 showed the term "is present" translated to "há" (there is), generating "there are" in the back translation; item 16 the expression "acoustic help only" was translated to "apenas sua audição" resulting in "your hearing only" in the back translation; The only modification of items 8 and 14 was the insertion of the preposition "of" in exchange of "from" in item 8, and "family members" to "members of your family" in item 14.

Between the translated and the synthesized version, item 4 simplified the expression "friends or family members" to "people you know"; item 16 summarized the expression "the background noise of a sound source" to "a specific sound"; item 14, the term "friends or family members" was simplified to "people you know".

As for items 6, 7 and 19 there was a significant change between the terms of the original and back-translation version, however the real meaning was maintained. In item 6, the term "single instrument" was translated to "os instrumentos que estão tocando" and back-translated to "the instrument playing." For the final version, only the word "familiar" was changed to the word "known".

However, in item 7 the word "provided" in the original version and "considering" in the back-translated version, both words being acceptable for the translation of the word "consider", thus keeping the translation of this item in the final version. In Item 19, the expression "effortlessly follow" in the original version was translated to "facilmente"(easily) and back-translated as "easily follow." For the synthetic version, the term "facilmente" was replaced with "sem esforço"(without effort) and "simultaneamente" was simplified to "at the same time."

The analysis of the questionnaire scores indicates that most respondents presented results for good sound quality with an average of 90.2 points.

It was found that question 13, "Can you hear the phone ringing effortlessly?" was elected by the participants as the easiest hearing situation, followed by questions 1, "Can you effortlessly distinguish between a male and a female voice?"; 5, "Can you easily hear the noise of a falling key, the whistle of the microwave or the purring of a cat?"; and 10, "Can you easily distinguish between a female voice and a child's voice?", with a predominance of responses being between "always" and "almost always".

The degree of reliability of the questionnaire confirmed high reliability, with the value 0.83, with minimum and maximum values of coefficient of variation between 0.81 and 0.83, respectively. The minimum amount refers to Question 2, "When talking on the phone, can you easily understand the voices of familiar people?", and the maximum amount refers to question 13, "Can you effortlessly hear the phone ringing?".

The analysis of grouped items in the same category showed performance variations in auditory tasks with the CI. The sound location categories (Figure 1) and different voices and speakers

Table 1. Comparison between original and back translations and translated version and final $HISQUI_{19}$ instrument

Question	Original version	Back translation version	Translated version T1.2.3.	Synthesis version S1
3	When listening to music, can you effortlessly distinguish whether one or more instruments are played simultaneously?	similar to the original version	Quando escuta música, você consegue sem esforço distinguir se um ou vários instrumentos estão tocando ***simultaneamente***?	Quando escuta música, você consegue sem esforço distinguir se um ou vários instrumentos estão tocando ***ao mesmo tempo***?
4	When background noise ***is present***, can you effortlessly participate in a conversation with friends or family members (e.g. at a party/ in a restaurant)?	When ***there are*** background noises, can you effortlessly participate in a conversation with friends or family members (e.g. at a party or in a restaurant?	Quando há ruído de fundo, você consegue sem esforço participar de uma conversa com ***amigos ou membros da família*** (por exemplo, numa festa / em um restaurante)?	Quando há ruído de fundo, você consegue sem esforço participar de uma conversa com ***pessoas conhecidas*** (por exemplo, numa festa / em um restaurante)?
6	Can you effortlessly distinguish ***single instruments*** in a familiar piece of music?	Can you effortlessly distinguish ***the instruments playing*** in a familiar piece of music?	Você consegue sem esforço distinguir os instrumentos que estão tocando em um trecho de uma música ***familiar***?	Você consegue sem esforço distinguir os instrumentos que estão tocando em um trecho de uma música ***conhecida***?
7	You are watching a movie on TV and music is playing in the background. ***Provided*** that the volume of the TV is loud enough, can you effortlessly understand the movie's text?	You are watching a movie on TV and a music is playing in the background. ***Considering*** that the volume of TV is loud enough can you effortlessly understand the movies text?	Você está assistindo a um filme na TV e está tocando uma música de fundo. Considerando que o volume da TV esteja alto o suficiente, você consegue sem esforço entender as falas do filme?	Você está assistindo a um filme na TV e está tocando uma música de fundo. Considerando que o volume da TV esteja alto o suficiente, você consegue sem esforço entender as falas do filme?
8	When talking on the phone, can you effortlessly understand the voices ***of*** unfamiliar people?	When talking on the phone can you effortlessly understand the voices ***from*** unfamiliar people?	Quando fala ao telefone, você consegue sem esforço entender as vozes de pessoas desconhecidas?	Quando fala ao telefone, você consegue sem esforço entender as vozes de pessoas desconhecidas?
11	At home when other family members are having a conversation and you are listening to the news on the radio, can you effortlessly understand the news?	similar to the original version	Em casa quando outros ***membros*** da família estão conversando e você está ouvindo as notícias no rádio, você consegue sem esforço entender as notícias?	Em casa quando outras ***pessoas*** da família estão conversando e você está ouvindo as notícias no rádio, você consegue sem esforço entender as notícias?
Question	Original version	Back translation version	Translated version T1.2.3.	Synthesis version S1
14	You are listening to friends or ***family members*** talking to each other in quiet surroundings. Can you effortlessly identify the talker?	You are listening friends or ***members of your family*** talking to each other in quiet surrounds; can you effortlessly identify who is the talker?	Você está ouvindo ***amigos ou membros da família*** conversando entre si em um ambiente silencioso. Você consegue sem esforço identificar quem está falando?	Você está ouvindo ***pessoas conhecidas*** conversando entre si em um ambiente silencioso. Você consegue sem esforço identificar quem está falando?
15	You are seated on the back seat of a car and the driver in the front is talking to you. Can you effortlessly understand the driver?	similar to the original version	Você está sentado no banco de trás do carro e o motorista ***no banco da frente*** está falando com você. Você consegue sem esforço entender o motorista?	Você está sentado no banco de trás do carro e o motorista ***na frente*** está falando com você. Você consegue sem esforço entender o motorista?
16	Can you effortlessly allocate background noise to a specific sound source (e.g. toilet flushing or vacuum cleaner) using ***acoustic help*** only??	Can you effortlessly allocate background noise to a specific sound source (e.g. toilet flushing, or vacuum cleaner) using ***your hearing*** only?	Você consegue sem esforço localizar o ***ruído de fundo de uma fonte sonora específica*** (por exemplo, descarga do banheiro ou aspirador de pó) utilizando apenas sua audição?	Você consegue sem esforço localizar ***um som específico*** (por exemplo, descarga do banheiro ou aspirador de pó) utilizando apenas sua audição?
17	When other people in your close surrounds are having a conversation (e.g. talking to a salesperson, bank clerk at the counter or a waiter in a busy restaurant, can you effortlessly talk to another person?	similar to the original version	Quando outras pessoas estão conversando próximo a você (por exemplo, conversando com um vendedor, um funcionário no guichê do banco ou um garçom em um restaurante movimentado), você consegue sem esforço ***falar*** com outra pessoa?	Quando outras pessoas estão conversando próximo a você ***em um ambiente movimentado*** (por exemplo, um vendedor, um funcionário no guichê do banco ou um garçom) você consegue sem esforço ***conversar*** com outra pessoa?
19	When multiple people are talking simultaneously, can you ***effortlessly follow*** discussions of friends and family members?	When multiple people are talking simultaneously, can you ***easily follow*** the discussions of friends and family members?	Quando várias pessoas estão falando ***simultaneamente***, você consegue ***facilmente*** acompanhar as discussões dos amigos e membros da família?	Quando várias pessoas estão falando ao ***mesmo tempo***, você consegue ***sem esforço*** acompanhar as discussões dos amigos e membros da família?

Table 2. Statistical values and references between the score HISQUI19 and the categories gender, cochlear implant manufacture and implantation side

		n	Average	Median	Minimum	Maximum	standard deviation	p
Gender	Male	16	93.7	98.5	69	115	14.8	0.2275
	Female	17	86.9	94.0	50	110	18.5	
Cochlear Implants Manufacture	Medel	19	94.2	96.0	69	115	13.9	0.2139
	Cochlear	11	87.0	96.0	50	107	20.2	
	Advanced Bionics	3	76.7	68.0	65	97	17.7	
Implantation side	Right	21	90.3	96.0	65	97	16.3	0.6158
	Left	8	85.4	95.0	50	105	21.1	
	Bilateral	4	99.0	97.0	92	110	7.7	

Caption: N= number of participants P Value of Coefficient of variation correlation (Spermann)

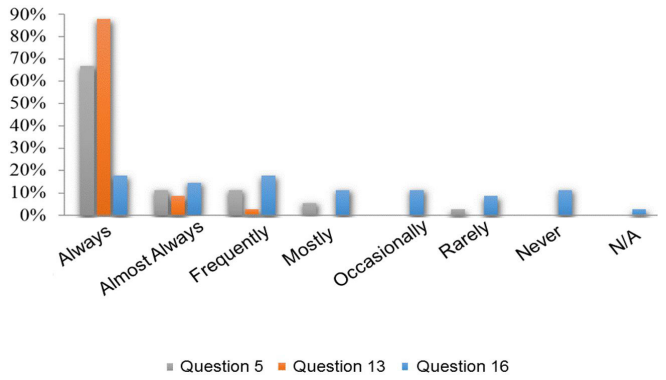

Figure 1. Graphic of questions in relation to Location of Sound category
Caption: Question 5 "Can you effortlessly hear noises such as falling keys, the beeping of the microwave or the purring of a cat?"; Question 13 "Can you effortlessly hear the ringing of the phone?"; Question 16 "Can you effortlessly allocate background noise to a specific sound source (e.g. toilet flushing or vacuum cleaner) using acoustic help only?"

showed the best performance with the highest percentage of responses of "always" on the Linkert scale.

The answers obtained for the identification of categories of musical sounds, understanding on the phone, speech understanding of television and radio programs with background noises, speech understanding in noisy public environments, understanding conversation in noisy backgrounds ranged evenly on the seven point Linkert scale.

As shown in Table 2, there were no statistically significant differences between female and male samples ($p = 0.23$). In the cochlear implant brand category, Medel company had the most representation and the best performance in the survey even though there was no statistically significant difference between companies ($p = 0.21$). As for the implant side, the bilateral implant showed better performance, but it was not statistically significant ($p = 0.61$).

In the correlation between the score of $HISQUI_{19}$, age variable, level of education, hearing loss time and activation time, there was no significance ($p > 0.05$).

DISCUSSION

Self-assessment questionnaires provide subjective data that enable practicing professionals the knowledge of difficulties in hearing impaired patients in specific daily[17] situations, allowing CI mapping in the rehabilitation process in accordance with different technologies and performance of each individual in particular. One can minimize or even solve some of these difficulties in order to provide the CI users a better quality of life.

As for the HISQUI questionnaire in particular, this study further concludes that the questions and structure of the HISQUI are well designed and appropriately elaborated to incorporate the concepts related to hearing impairment and the analysis of satisfaction of CI users. Taking into consideration the specific scenario of the Brazilian population, of any social class or region of the country, all items remained without concept modification from the original version, which confirms its versatility from a cross cultural perspective.

As a questionnaire for the hearing impaired population, common words used in everyday life were chosen.

The pretest was an easy and quick application. The items questions were read out loud to analyze the possible difficulties of the participants, proper understanding of all questions were observed, which shows loyalty in the process of translation and back translation. The table presented with seven options of responses associated to the percentage of situation occurrences facilitated the respondent to adequately answer the questions.

By analyzing the pretest values, it was found that 70% of respondents had results between good sound quality and very good in relation to the CI. This can be considered as positive for the performance of speech perception with the CI. The patients with bilateral implants indicated the best performance in the survey with an average of 99 points. However although the good performance of the bilateral implant patients, there was no statistically significant difference when compared with other implantation side, which is most likely a result of the reduced sample number of bilateral implant patients ($n = 4$).

However, the worst performers in the survey were two individuals with unilateral CI and of the same age. One of the respondents had the lowest activation time, which justified the communication difficulties at the time of test administration; and the other, with more than five years of activation, consistently commented on the difficulty of understanding speech in a noisy environment.

Hearing performance was grouped according to the original[13] study. It was found that the categories of location of sound and distinction of voices and speaker, showed the best performance

(highest percentage in the option "always"). This leads to the conclusion, as discussed in other studies[12,18], that rehabilitation through CI allows adults to easily and quickly develop the same auditory tasks, in this study, whether a unilateral or bilateral CI user.

The answers in the categories that involve communicating with noise are far more varied in hearing performance, which reveals the difficulty in conversations with noisy backgrounds[18], regardless of whether the implant enables effective communication.

Despite technological advances, patients still have difficulty in understanding speech in noisy environments, speech understanding on the phone and musical perception[7,8,18-20]. For this reason, there has been an attempt to lessen these difficulties in understanding through the use of auxiliary resources such as frequency modulation (FM) system, a specific accessory which helps in speech perception in noisy environments.

In self-assessment skills or daily hearing difficulties, the $HISQUI_{19}$ (Annex A) becomes an important tool to be used at the beginning of the process and during the use of the CI to measure self-improvement in auditory perception.

CONCLUSION

The translation and adaptation of the questionnaire $HISQUI_{19}$ showed suitability for semantic, cultural, item and conceptual equivalence.

In the sample characterization, the sound quality was rated as good with better performance in the location and distinction of sounds / voices categories and greater difficulty for the tasks of speech understanding on the phone.

For future research and effective validation purposes of the Brazilian population, it is suggested to apply the translated and adapted questionnaire into a broader sample and compare the future results with those that formed the basis of this work and with those of other countries.

ACKNOWLEDGEMENTS

Thanks to the Department of Speech Language Pathology, Universidade Federal de São Paulo in making this research possible which generated this dissertation. Thanks to the Center of the Hearing Impaired, Department of Otorhinolaryngology, Universidade Federal de São Paulo that allowed the collection of data with their patients. Thanks to translation employees. Ms. Zeila Santos, Ms. Sheila Vieira, PhD. Erika Bucuvic and partner of PhD Sueli Caporali and PhD Brasilia Maria Chiari in the production of the study.

REFERENCES

1. Andrade S, Peixoto C, Alves M, Martins JH, Verissimo MT, Quadros J, et al. Reabilitação auditiva por implante coclear na população geriátrica. Cad. Otorrinolaringol. 2012;18:1-6.
2. Ricketts TA, Grantham DW, Ashmead DH, Haynes DS, Labadie RF. Speech recognition for unilateral and bilateral cochlear implant modes in the presence of uncorrelated noise sources. Ear Hear. 2006;27(6):763-73. http://dx.doi.org/10.1097/01.aud.0000240814.27151.b9. PMid:17086085.
3. Santos KTP, Fernandes JC, Amorim RB, Bevilacqua MC. Avaliação da percepção da fala no ruído em diferentes posições em adultos com implante coclear. Int Arch Otorhinolaryngol. 2009;13(1):16-23.
4. Granço FS, Fernandes NF, Morettin M, Costa OA, Bevilacqua MC. The relationship between the speech perception and the degree of satisfaction among adult users of cochlear implants. Int Arch Otorhinolaryngol. 2013;17(2):202-7. PMid:25992014.
5. Garstecki DC, Erler SF. Older adult performance on the Comunication Profile for the Hearing Impairment: gender difference. J Speech Lang Hear Res. 1999;42(4):785-96. http://dx.doi.org/10.1044/jslhr.4204.785. PMid:10450900.
6. Magalhães ATM, Goffi-Gomez MVS, Hoshino AC, Tsuji RK, Bento RF, Brito R. Converted and upgraded maps programmed in the newer speech processor for the first generation of multichannel cochlear implant. Otol Neurotol. 2013;34(7):193-200. PMid:23921918.
7. Soares AD. Contribuição da percepção auditiva no mapeamento de processadores de fala em usuários de implante coclear [tese]. São Paulo: Universidade Federal de São Paulo; 2014.
8. Fuller C, Free R, Maat B, Baskent D. Musical background not associated with self perceived hearing performance or speech perception in postlingual cochlear implant user. J Acoust Soc Am. 2012;132(2):1009-16. http://dx.doi.org/10.1121/1.4730910. PMid:22894221.
9. Laske RD, Veraguth D, Dillier N, Binkert A, Holzmann D, Huber AM. Subjective and objective results after bilateral cochlear implantation in adults. Otol Neurotol. 2009;30(3):313-8. http://dx.doi.org/10.1097/MAO.0b013e31819bd7e6. PMid:19318885.
10. Perreau A, Ou H, Tyler R, Dunn C. Self reported spatial hearing abilities across different cochlear implant profiles. Am J Audiol. 2014;23(4):374-84. http://dx.doi.org/10.1044/2014_AJA-14-0015. PMid:25093507.
11. Hinderink JB, Krabbe PFM, Van Den Broek P. Development and application of a health- related quality-of-life instrument for adults with cochlear implants: The Nijmegen Cochlear Implant Questionnaire. Otolaryngol Head Neck Surg. 2000;123(6):756-65. http://dx.doi.org/10.1067/mhn.2000.108203. PMid:11112975.
12. Tyler RS, Perreau AE, Ji H. The Validation of the Spatial Hearing Questionnaire. Ear Hear. 2009;30(4):466-74. http://dx.doi.org/10.1097/AUD.0b013e3181a61efe. PMid:19494777.
13. Amann E, Anderson I. Development and validation of a questionnaire for hearing implant users to self-assess their auditory abilities in everyday communication situations: the Hearing Implant Sound Quality Index (HISQUI19). Acta Otolaryngol. 2014;134(9):915-23. http://dx.doi.org/10.3109/00016489.2014.909604. PMid:24975453.
14. Guillemin F, Bombardier C, Beaton D. Cross-cultural adaptation of health related quality os life measure: literature review and proposed guidelines. J Clin Epidemiol. 1993;46(12):1417-32. http://dx.doi.org/10.1016/0895-4356(93)90142-N. PMid:8263569.
15. Beaton DE, Bombardier C, Guillemin F, Ferraz MB. Guidelines for the Processo of Cross-Cultural Adaptation of Self-Report Measures. Spine. 2000;25(24):3186-91. http://dx.doi.org/10.1097/00007632-200012150-00014. PMid:11124735.

16. Reichenheim ME, Moraes CL. Operacionalização de adaptação transcultural de instrumentos de aferição usados em epidemiologia. Rev Saude Publica. 2007;41(4):665-73. http://dx.doi.org/10.1590/S0034-89102006005000035. PMid:17589768.

17. Noble W, Tyler RS, Dunn CC, Bhullar N. Younger- and older-age adults with unilateral and bilateral cochlear implants: speech and spatial hearing self-ratings and performance. Otol Neurotol. 2009;30(7):921-9. http://dx.doi.org/10.1097/MAO.0b013e3181b76b3b. PMid:19692936.

18. Gatehouse S, Noble W. The speech, spatial and qualities of hearing scale (SSQ). Int J Audiol. 2004;43(2):85-99. http://dx.doi.org/10.1080/14992020400050014. PMid:15035561.

19. Nascimento LT, Bevilacqua MC. Avaliação da percepção de fala com ruído competitivo em adultos com implante coclear. Rev Bras Otorrinolaringol. 2005;71(4):432-8. http://dx.doi.org/10.1590/S0034-72992005000400006.

20. Lassaletta L, Castro A, Bastarrica M, Pérez-Mora R, Herrán B, Sanz L, et al. Musical perception and enjoyment in post lingual patients with cochlear implant. Acta Otorrinolaringol Esp. 2008;59(5):228-34. http://dx.doi.org/10.1016/S0001-6519(08)73300-4. PMid:18501158.

Author contributions

PFC participated as the main researcher; SAC participated in the questionnaire back translation process and assisted in the development of the research; ECB participated in the questionnaire translation process; SSV participated in the questionnaire translation process; ZMS participated in the questionnaire translation process; BMC participated as the research supervisor.

Annex A. Questionnaire $HISQUI_{19}$ and score of the assessment performance

***Hearing Implant Sound Quality Index* (HISQUI$_{19}$)**

Check the answer boxes which correspond the closest to your everyday experiences. Each answer option also includes a percentage value. This percentage value will help the patients answering the questions. If a specific situation/statement is not applicable, please check the box "N/A = not applicable".

	Always (99%)	Almost always (87%)	Frequently (75%)	Mostly (50%)	Occasionally (25%)	Rarely (12%)	Never (1%)	N/A
1. Can you effortlessly distinguish between a male and a female voice?								
2. When talking on the phone, can you effortlessly understand the voices of familiar people?								
3. When listening to music, can you effortlessly distinguish whether one or multiple instruments are being played simultaneously?								
4. When background noise is present, can you effortlessly participate in a conversation with friends or family members (e.g. at a party/ in a restaurant)?								
5. Can you effortlessly hear noises such as falling keys, the beeping of the microwave or the purring of a cat?								
6. Can you effortlessly distinguish single instruments in a familiar piece of music?								
7. You are watching a movie on TV and music is playing in the background. Provided that the volume of the TV is loud enough, can you effortlessly understand the movie's text?								
8. When talking on the phone, can you effortlessly understand the voices of unfamiliar people?								
9. Can you effortlessly understand a speech/ lecture in a hall (e.g. lecture hall, church)?								
10. Can you effortlessly distinguish between a female voice and a child's voice (6-10 years of age)?								
11. At home when other family members are having a conversation and you are listening to the news on the radio, can you effortlessly understand the news?								

Annex A. Continued...

	Always (99%)	Almost always (87%)	Frequently (75%)	Mostly (50%)	Occasionally (25%)	Rarely (12%)	Never (1%)	N/A
12. Can you effortlessly understand the announcement in a bus terminal, a train station or an airport?								
13. Can you effortlessly hear the ringing of the phone?								
14. You are listening to friends or family members talking to each other in quiet surroundings. Can you effortlessly identify the talker?								
15. You are seated on the back seat of a car and the driver in the front is talking to you. Can you effortlessly understand the driver?								
16. Can you effortlessly allocate background noise to a specific sound source (e.g. toilet flushing or vacuum cleaner) using acoustic help only?								
17. When other people in your close surrounding are having a conversation (e.g. talking to a salesperson, a bank clerk at the counter or a waiter in a busy restaurant), can you effortlessly talk to another person?								
18. When background noise is present (e.g. in the office, printer, copier, air conditioning, fan, traffic noise, in busy restaurants, at parties, noisy children), can you effortlessly participate in a conversation with multiple people?								
19. When multiple people are talking simultaneously, can you effortlessly follow discussions of friends and family members?								

Annex A. Continued...

Calculation of the Total score (to be filled out by the tester):

The total $HISQUI_{19}$ score lies between 19 and 133 points. Each response option corresponds to a numerical value (see below).

7 Always (99%)	6 Almost always (87%)	5 Frequently (75%)	4 Mostly (50%)	3 Occasionally (25%)	2 Rarely (12%)	1 Never (1%)	0 N/A

Please enter the numerical value of each of the 19 questions in the $HISQUI_{19}$ evaluation matrix shown below. If a question was not answered or the answer was "not applicable" (N/A), that question should be treated as a missing value. In the appropriate box in the $HISQUI_{19}$ evaluation matrix mark the field concerned with an X.

$HISQUI_{19}$ Evaluation Matrix			
Question 1		Question 11	
Question 2		Question 12	
Question 3		Question 13	
Question 4		Question 14	
Question 5		Question 15	
Question 6		Question 16	
Question 7		Question 17	
Question 8		Question 18	
Question 9		Question 19	
Question 10			
	Total Score		

The total $HISQUI_{19}$ score is obtained by adding the numerical values of all 19 questions. The score achieved overall indicates how good or poorly you find the sound quality in your personal, everyday listening situation with your hearing implant. The table should help you to interpret your individual result	Achieved Total Score	
	very poor sound quality	< 30
	poor sound quality	30-60
	moderate sound quality	60-90
	good sound quality	90-110
	very good sound quality	110-133