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Auditory benefit self-assessment and speech recognition in cochlear implant users

Autopercepção do benefício auditivo e o reconhecimento de fala em usuários de implante coclear

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ABSTRACT

Purpose: To correlate the performance of unilateral cochlear implant users in speech recognition tests, in quiet and noise, with the answers to the Hearing Implant Sound Quality Index (HISQUI19) self-assessment questionnaire; also, to correlate the performance in speech recognition tests with the time of CI use and the implanted ear. **Methods:** A total of 27 unilateral CI users with postlingual hearing loss, who had been using the device for at least one year and had free-field pure-tone threshold lower than 40 dBA, participated in the study. All the participants were submitted to free-field pure-tone audiometry, answered the HISQUI19 questionnaire, and took speech recognition tests in quiet and noise. **Results:** The answers to the questionnaire were compared with the speech recognition tests in quiet and noise; there was no statistically significant difference. When comparing with the time of CI use, there was a statistically significant difference only for the speech recognition test in quiet. There was no significant correlation between speech recognition and the implanted ear. **Conclusion:** Regardless of the time of CI use and/or performance in the speech recognition tests, many participants classified the sound quality of their cochlear implant as moderate. Administering tests to measure the users' level of satisfaction and benefit should integrate the clinical routine in implantation centers.

Keywords: Cochlear implant; Speech perception; Noise; Questionnaires; Hearing; Self-assessment

RESUMO

Objetivo: Correlacionar o desempenho de usuários de implante coclear unilateral em testes de reconhecimento de fala, no silêncio e no ruído, com as respostas ao questionário de autoavaliação *Hearing Implant Sound Quality Index* (HISQUI19) e correlacionar o desempenho em testes de reconhecimento de fala com o tempo de uso do dispositivo e a orelha implantada. **Métodos:** Participaram 27 usuários de implante coclear unilateral com deficiência auditiva pós-lingual, que faziam uso do dispositivo há, pelo menos, um ano e apresentavam limiar tonal em campo livre menor que 40 dBA. Todos os participantes foram submetidos à audiometria tonal em campo livre, responderam ao questionário HISQUI19 e realizaram testes de reconhecimento de fala no silêncio e no ruído. **Resultados:** As respostas ao questionário foram comparadas com os testes de reconhecimento de fala no silêncio e no ruído e não houve diferença estatisticamente significativa. Na comparação em relação ao tempo de uso do implante coclear, só houve diferença estatisticamente significativa para o teste de reconhecimento de fala no silêncio. Não houve correlação significativa entre o reconhecimento de fala e a orelha implantada. **Conclusão:** independentemente do tempo de uso do dispositivo e/ou do desempenho nos testes de reconhecimento de fala, muitos participantes classificaram a qualidade sonora do implante coclear como moderada. A aplicação de testes que possibilitem mensurar a satisfação e o benefício dos usuários deve fazer parte da rotina clínica dos centros de implante.

Palavras-chave: Implante coclear; Percepção de fala; Ruído; Inquéritos e questionários; Audição; Autoavaliação

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Conflict of interests: No.

Authors' contribution: RM participated in designing the study, developing the project, collecting the data, analyzing and interpreting the results, and writing the article; BMC participated as research advisor; ADS and OLMC participated as research co-supervisors; CCS participated in collecting data and writing the article.

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INTRODUCTION

According to the World Health Organization (WHO)[1], 15% of the world's adult population have some type of hearing loss – 5.3% of them, an incapacitating hearing loss.

People with hearing loss have their frequency resolution and temporal envelope perception diminished, which causes them difficulties to code sounds and understand speech, especially in the presence of competing noise[2].

The cochlear implant (CI) stimulates the auditory nerve through electrical signs, and it can be used by both adults and children that have lost their hearing in either the pre- or postlingual period. The device was developed for people with severe-to-profound sensorineural hearing loss, who have no improvement with hearing aids (HA). Even though many studies have proven the effectiveness of the cochlear implant in auditory rehabilitation, the results of speech recognition when using the CI vary widely (interval mapping, audiometric tests before and after the CI, speech recognition in different situations, effective use, time of sensory deprivation, etc.)[3].

Listening environments are usually noisy, which significantly hinders the users' everyday communication. It must be kept in mind that there is a signal-to-noise ratio (SNR) – i.e., the difference between the speech signal and noise level –, whose ideal ratio for speech recognition some studies show to be +11.6 dB to +15 dB[4,5].

The benefits brought by the CI to its users, as well as the device's limitations, must be investigated through instruments that assess the everyday communication, social relationships, well-being and quality of life, and tests that quantify speech recognition and determine the auditory thresholds[6].

In Brazil, the self-assessment questionnaires that verify the level of satisfaction and auditory benefits are made for HA users[6,7]. Self-assessment questionnaires specific for the CI-using population are few – three were found in the literature, namely: Spatial Hearing Questionnaire (SHQ), Nijmegen Cochlear Implantation Questionnaire (NCIQ), and Hearing Implant Sound Quality Index (HISQUI19). The first one (SHQ) has not yet been translated into Portuguese[8], whereas the second (NCIQ) has been recently translated[9]. At the time of the research, only the HISQUI19 was available for use with the Brazilian population.

Hence, this study used the Hearing Implant Sound Quality Index (HISQUI19)[10], translated by Caporali et al.[8]. The pilot questionnaire (HISQUI35) was sent to implantation centers to be administered to CI users. After having administered it twice, six questions were removed, and the questionnaire was then called HISQUI29. The process was repeated, and it was verified that some questions were similar and that a shorter questionnaire would have more applicability in the routine of the implantation centers. Thus, 10 questions were eliminated, resulting in the HISQUI19 questionnaire (Annex 1).

The HISQUI19 was developed for adults to quantify the self-perception of auditory benefit furnished by the cochlear implant, based on the person's judgment regarding the sound quality of the device[8]. In the study that led to the translation and cultural adaptation of the questionnaire, the authors counted with a sample of 33 subjects of both genders, who classified the sound quality of the cochlear implant as good.

This study aimed to correlate the performance of unilateral CI users in speech recognition tests, in both quiet and noise, with their answers to the HISQUI19, and correlate the performance in speech recognition tests with the time of use of the device and the implanted ear.

METHOD

This study was approved by the Research Ethics Committee of UNIFESP/EPM, under number 1.192.382.

The study was conducted at the Speech-Language-Hearing Department of the Federal University of São Paulo/Paulista School of Medicine (UNIFESP/EPM), in partnership with the Cochlear Implant Program, of the Otorhinolaryngology and Head and Neck Surgery Department of that institution. The participants were patients that were already being followed up at the Center for the Person with Hearing Loss (CDA), of the Otorhinolaryngology and Head and Neck Surgery Department.

Sampling

The CI users selected were those who met the following criteria:

- Having lost their hearing in the perilingual and/or postlingual phase (after three years old);
- Using a unilateral cochlear implant;
- Having used the device for at least one year;
- Effectively using the device (at least eight hours a day);
- Free field auditory threshold, when using the cochlear implant, lower than 40 dBA, at the frequencies from 250 to 4000 Hz, enabling the tests to be conducted;
- Not having any other impairment that altered speech and/or language;
- Predominantly using Brazilian Portuguese as oral linguistic code for communication.

No minimum or maximum age was set for inclusion in the study; the patients selected were from 16 to 75 years old. Neither was post-CI use speech-language-hearing therapy an inclusion/exclusion criterion.

Procedures

The patients were invited to participate in the research, and all those who signed the Informed Consent Form were submitted to the following stages:

1. Anamnesis:
   - **a.** Full name;
   - **b.** Date of birth;
   - **c.** Time of acquisition or onset of hearing loss;
   - **d.** Date of cochlear implant surgery;
   - **e.** Implanted ear;
   - **f.** Date of activation.
2. Free-field audiometry with the cochlear implant: The patient was positioned at 0º azimuth, one meter

away from the loudspeaker, inside the sound booth, using only their voice processor in the everyday-use setting. Once these conditions were set, the free-field audiometry was conducted with the cochlear implant, at the frequencies from 250 to 4.000 Hz, with warble-tone and survey of speech reception threshold (SRT) using three-syllable words.

3. Research instruments:

   a. HISQUI19 questionnaire: Its purpose is to determine the self-perception of sound quality in everyday hearing experiences. It comprises 19 multiple-choice questions, with seven items each, on a Likert scale. The interviewee must choose from the seven items the one that best represents their everyday experience. The questionnaire was administered as an interview, in which the interviewee also had the option of answering "not applicable", in the case that they had not experienced the situation described in the question. This type of answer is given 0 (zero) in the score and is considered a missing value. Each subject is allowed only three missing values; those who exceeded this limit were excluded from the sample. The sound quality as perceived by the user is obtained through summing the score from the 19 questions. Each answer is given a different score: always (7 points), almost always (6 points), frequently (5 points), mostly (4 points), occasionally (3 points), rarely (2 points), never (1 point), not applicable (0 – zero). The minimum value is 19, and the maximum, 133 points. Five categories are used to classify the sound quality: very poor sound quality (<30 points), poor sound quality (≥30-60 points), moderate sound quality (≥60-90 points), good sound quality (≥90-110 points), and very good sound quality (≥110-133 points).

   b. List of Sentences in Portuguese (LSP): Developed by Costa[11], this test enables one's communicative skills to be measured in everyday situations, in both quiet and noise. It comprises a list of 20 sentences, seven lists of 10 sentences, and a speech-spectrum noise. In this study, one list of sentences was used as a demonstration (list 1B), and a different list was used for each threshold measurement: list 2B, for the threshold for sentence recognition in quiet (TSRQ); list 3B, for the threshold for sentence recognition in noise (TSRN); list 4B, for sentence recognition in quiet (SRQ); list 5B, for sentence recognition in noise (SRN). The material was recorded in a CD (compact disc); the sentences and the noise were recorded in independent channels.

   c. Threshold for sentence recognition in quiet (TSRQ): It determines the lowest sound pressure level in which the person can recognize, in quiet, 50% of the sentences presented. The intensity of 20 dB SL in free field was used as an initial test presentation level, considering the value obtained in the SRT survey. The list used in the TSRQ was the 2B (track 12). When the person got the sentence completely right, the stimulus was presented at a lower level; if not, it was presented at a higher level. The level was decreased or increased by 2 dB to the end of the list. The threshold value was established based on the mean of the intensities used after the first increase was necessary[5]. For instance, if the participant got the first three sentences right, and missed the fourth one, then, the threshold was obtained based on the intensities used from the fourth to the tenth sentence.

   d. Threshold for sentence recognition in noise (TSRN): It verifies the necessary relation between the sound levels of the main message and that of noise (signal-to-noise ratio) for the person to recognize 50% of the sentences presented. For this test, the list 3B was used (track 5). The sound level at which the noise was presented was 64 dBA; the sentence was initially presented at 74 dBA, in agreement with the literature researched that had a similar population[5]. The method to change intensities and calculate the threshold was the same used in the TSRQ.

   e. Sentence recognition in quiet (SRQ): It assesses the person's capacity to recognize sentences in quiet (condition ideal for conversation). The list 4B (track 14) was used for this stage, at the intensity of 65 dBA. In this test, the number of words correctly repeated was multiplied by 100 and divided by the total number of words of the list used (51 words), thus finding the percentage of success in sentence recognition in quiet.

   f. Sentence recognition in noise (SRN): It verifies the capacity to recognize sentences in noise (condition unfavorable to conversation). Here, list 5B (track 7) was used, in the +10 dB SNR – i.e., the sentences were presented at 65 dBA, while the noise was at 55 dBA. The percentage of success, in this case, was calculated the same way as that in the SRQ, except that this list has a total of 48 words.

4. Statistical data analysis: The results of the data collection were statistically treated. The descriptive analysis involved minimum, maximum, mean, and median values, and absolute and relative frequencies (in percentages), besides bidimensional dispersion graphs. The Pearson's linear correlation coefficient (p) was established correlating the answers to the HISQUI19 with the auditory performance in the speech recognition tests, as well as correlating the time of CI use with the performance in the speech recognition tests. The significance level of $p = 0.05$ was adopted. The Mann-Whitney test was used to verify the correlation between the implanted ear and the performance in the speech recognition tests.

RESULTS

A total of 27 patients, unilateral cochlear implant users (of three distinct CI manufacturers), aged from 16 to 75 years (mean age: 50 years), of both genders, were assessed (Table 1).

The lowest score found was 43 points (poor sound quality), whereas the highest was 124 points (very good sound quality) (Figure 1).

Table 1. Demographic data of the sample studied

Total number = 27			
Gender	Male	15	55.55%
	Female	12	44.44%
CI manufacturer	Cochlear	10	37.03%
	Med-El	12	44.44%
	Advanced Bionics	5	18.51%
Age (in years)	Minimum: 16	Maximum: 75	Mean: 50
Time of CI use (in years)	Minimum: 1	Maximum: 9	Mean: 4.6
Implanted ear	Right	16	59.25%
	Left	11	40.74%

Subtitle: CI = cochlear implant

Table 2. Performance in the speech tests according to the categories of the Hearing Implant Sound Quality Index (HISQUI19)

HISQUI19	Results	TSRQ (dB HL)	TSRN (dB HL)	SRQ (%)	SRN (%)
Poor (n = 3)	Minimum	40	76.2	50.98	0
	Maximum	54.4	81	100	56.25
	Mean	48.24	79	76.47	29.16
	Median	50.33	79.8	78.43	31.25
Moderate (n = 13)	Minimum	27.6	72.88	49.01	0
	Maximum	65.4	81.8	100	66.66
	Mean	46.91	79.4	80.68	24.35
	Median	49.28	81	92.15	16.66
Good (n = 5)	Minimum	31.42	74.6	41.17	2.08
	Maximum	64.2	81.8	84.31	56.25
	Mean	47.39	78.88	64.3	20.41
	Median	48.6	78.6	72.54	6.25
Very good (n = 6)	Minimum	27	74	76.47	20.83
	Maximum	51.66	78.6	100	72.91
	Mean	42.03	76.83	91.82	46.17
	Median	42.83	77.8	93.13	20.55
p-value (HISQUI19 × tests)		0.143	0.096	0.189	0.071

Subtitle: HISQUI19 = Hearing Implant Sound Quality Index; TSRQ = threshold for sentence recognition in quiet; TSRN = threshold for sentence recognition in noise; SRQ = sentence recognition in quiet; SRN = sentence recognition in noise; n = number of subjects

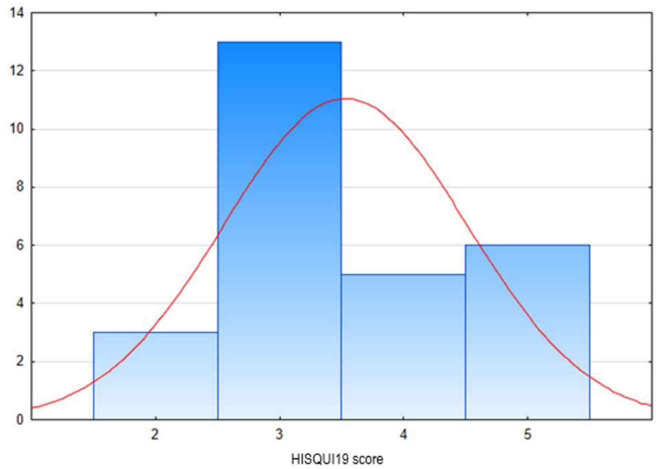

Figure 1. Distribution of sound categories obtained in the study (n = 27)
Subtitle: HISQUI19 = Hearing Implant Sound Quality Index; 2 = poor sound quality; 3 = moderate sound quality; 4 = good sound quality; 5 = very good sound quality

Regarding speech recognition, four tests were used – two in quiet (TSRQ and SRQ) and two in noise (TSRN and SRN).

The subjects that classified the sound quality as poor were those that had the worst performance in the TSRQ test, while those that classified it as very good were those who obtained the best performance in the same test. However, no statistically significant difference was found.

All the participants that had a good performance in the TSRQ reached a score of over 70 in the HISQUI19, which corresponds to the moderate sound category (Table 2).

Considering the time of CI use, the participant that had been using it for longer had the device activated nine years before, and the one that had been using it for the shortest time had it activated one year before (mean use of 4.6 years).

When the time of CI use was compared with performance in the speech recognition tests, there was a statistically significant difference only for the SRQ test ($p = 0.047$) (Figures 2 and 3). In the comparison of time of CI use with the answers to HISQUI19, there was no statistically significant difference.

Concerning implanted ear, 16 patients had the CI in the right ear, while 11, in the left ear. No statistically significant difference was obtained in any of the tests (Table 3).

DISCUSSION

Diverging from other studies, no statistically significant difference was found between the sound classifications. In other studies, the moderate sound quality was the most found – e.g., in

Table 3. Performance in the tests by ear

			n total = 27			
Test	Ear	Minimum	Maximum	Mean	Median	p-value
TSRQ (dBHL)	Right	27.6	65.4	47.67	47.74	0.3462
	Left	27	54.4	43.72	48.2	
TSRN (dBHL)	Right	72.88	81.8	78.8	78.4	0.7483
	Left	74.44	81.8	78.53	79.8	
SRQ (%)	Right	41.17	100	80.01	84.31	0.8628
	Left	49.01	100	79.14	84.31	
SRN (%)	Right	0	66.66	30.59	30.2	0.6871
	Left	0	72.91	26.7	20.83	

Subtitle: TSRQ = threshold for sentence recognition in quiet; TSRN = threshold for sentence recognition in noise; SRQ = sentence recognition in quiet; SRN = sentence recognition in noise; n = number of subjects

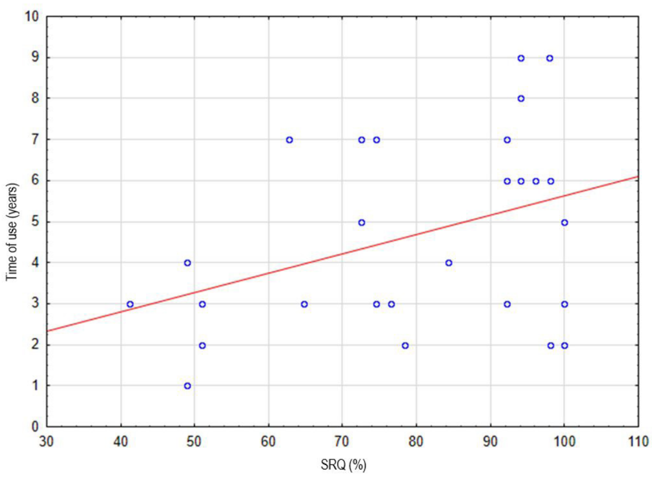

Figure 2. Time of cochlear implant use × performance in the test for sentence recognition in quiet
Subtitle: SRQ (%) = sentence recognition in quiet (percentage); p = 0.047

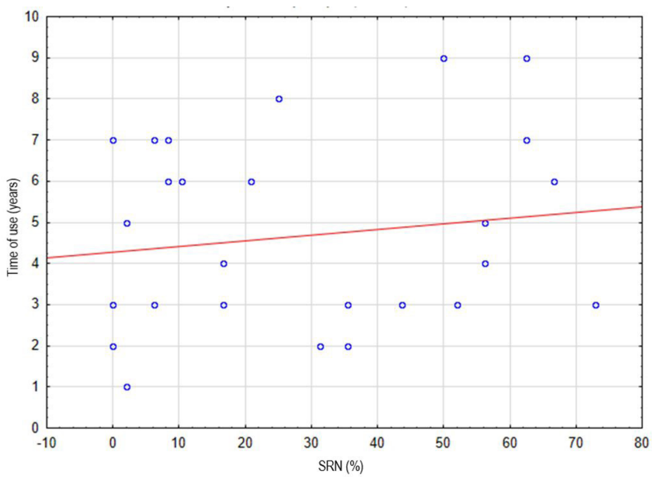

Figure 3. Time of cochlear implant use × performance in the test for sentence recognition in noise
Subtitle: SRN (%) = sentence recognition in noise (percentage); p = 0.482

the studies by Amann and Anderson[10], and Calvino et al.[12], in which 42.66% and 26.92%, respectively, classified their devices as moderate sound quality. In the study by Caporali et al.[8], most of the patients classified their devices as good sound quality. In this study, the mean score in HISQUI19 was 89.37 points (moderate sound quality). In the study by Amann and Anderson[10], the means was 75.7 points (moderate sound quality). In the studies by Calvino et al.[12], and Lassaletta et al.[13], the mean scores were 116.6 and 111.3 ± 36, respectively, both classified as moderate sound quality, as well.

As the literature pointed to moderate sound quality in most of the studies, there were various complaints from the participants, from not being able to maintain a conversation in noisy environments to not being able to talk on the phone. Hence, assessing their performance in different situations (quiet and noise), administering self-assessment and benefit questionnaires, and measuring hearing through objective tests are important and should be part of the routine in hearing health care services, to improve the quality of life of electronic device users[12,14,15].

In this study, it was noticed that oftentimes the users' expectation of their CI devices is too high. All the participants were interviewed regarding CI sound quality before the tests in the sound booth; it was verified that even those who classified their device's sound quality as poor had a good performance in the tests – both in quiet and in noise. It cannot be stated, though, that the tests conducted in the sound booth reflect a real situation of noise and conversation, which can lead to better scores in these conditions. The participants answer the questionnaires based on their everyday experience, which can be the reason for the discrepancy between the answers and the performance. According to Amann and Anderson[10], there is little correlation between subjective and objective tests in the literature; however, the authors suggest that it be conducted to measure self-assessment along with auditory performance.

For the tests in the sound booth, besides the free-field audiometry using the CI, the list of sentences developed by Costa[11] was used, which enables one's communicative skills to be measured in situations closer to everyday experience, as in quiet and noise.

For the TSRQ test, the mean value obtained was 46.06 dBA, very close to that found by Soares[5] (55.8 dBA), which demonstrates the participants' ability to maintain a conversation in a quiet environment.

As found in studies similar to this one, with peri- or postlingual adults, implanted for at least a year, the individuals had a good performance in the tests of sentence recognition in quiet. Bento et al.[16] found a score for sentence recognition in quiet of 71.3%; Martins et al.[17] obtained a maximum score for sentences in quiet of 73.69%; Buarque et al.[18], and Borger et al.[19], respectively, found scores of 68.26% and 94.4% in sentence recognition in quiet, after 12 months using the CI. In this study, the mean percentage of success in the same condition was 79.65%, which is a score similar to those found in the other studies in the literature.

In the SRQ test, some participants obtained a score of 100% right in the repeated sentences. Frederigue and Bevilacqua[20] assessed the differences in performance in quiet and noise with various types of signal processing strategies and found the mean score in quiet of 89.4%. In the study by Soares[5], a score of 88.3% was obtained. In the studies by Calvino et al.[12], Lassaletta et al.[13], and Wong et al.[21], scores of 92.6%, 95%, and 80% of success were respectively reached. The tests conducted in quiet have a low level of difficulty, as the CI user is in an acoustically treated sound booth (with no background noise), and the test is presented at an intensity chosen according to the auditory thresholds and/or fixed at an easily audible sound pressure level. This can be the reason behind the mean scores over 85% in studies with sentences in quiet.

Calvino et al.[12] found a significantly higher difference in relation to the performance in the tests in quiet when compared with the tests in noise. In this study's TSRN tests, the mean of 78.69 dBA was obtained, close to the results found by Soares[5] (80.2 dBA). Despite the technological improvements developed every year by CI manufacturers, the users' main complaint still is the difficulty in maintaining conversations in noisy environments. People need the signal-to-noise ration to be from +11.6 dB to +15 dB for good speech recognition – i.e., the main speech needs to be from 11.6 dB to 15 dB higher than the noise for it to be intelligible[4,5,16]. In the study conducted by Park et al.[14], the participants' mean intelligibility in noise was when the SNR was +19 dB.

In the SRN, some participants had a score of 0% – i.e., no word was correctly repeated in any of the ten sentences presented –, which agrees with the literature regarding the ability to recognize sentences in quiet while there is a difficulty to recognize them in noise[4,5,12,14,20].

In the studies by Frederigue and Bevilacqua[20], Soares[5], Calvino et al.[12], Lassaletta et al.[13], Wong et al.[21], Sharpe et al.[22], and Wayne et al.[23], all with tests for speech recognition in noise, the scores were 58.8%, 21%, 82.7%, 90.6%, 60%, 80%, and 60%, respectively. In this study, the mean of correct answers in the SRN was 29%.

The discrepancy between this study's mean of correct answers and those of other studies can be due to different SNR being used, which would make the speech recognition tests easier or harder. The tests in noise aim to measure the CI user's difficulty in a situation closer to real-life experience. Regardless of the abovementioned results, what makes evident their difficulty in speech recognition in background noise is the mean of correct answers, which in this type of situation remains below 70%.

As in the study by Lassaletta et al.[13], it was not possible to find statistically significant differences when comparing the HISQUI19 score with the performance in the sentence recognition tests. Calvino et al.[12] found a significant correlation between the questionnaire's score and the performance in tests in noise – i.e., the better the score, the better the performance in the speech recognition tests.

In this study, the time of CI use ranged from one to nine years (mean of 4.6 years). As in the studies by Santos et al.[9], Buarque et al.[18], Martins et al.[17], Meneses et al.[24], Calvino et al.[12], and Wong et al.[21], there was no statistically significant difference for the longer time of CI use in this study – except for the SRQ tests, in which the participants with the longest time of use had a better performance. It can be stated that only the SRQ had significance because the test was easier, presented in an audible sound pressure level, compatible with the audiometry, in a sound booth without any background noise – i.e., a condition ideal for conversation, easier for comprehension. For this study, the time of auditory deprivation was not considered, neither was audiological rehabilitation after CI use since it is known that both can alter the performance in conversation. This can be one of the determining factors why only the SRQ (conducted in quiet) had a statistically significant result.

Concerning the time of CI use and the HISQUI19 score, no statistically significant difference was found. However, it was observed that some of the participants that had been using it for longer had the highest scores. In the study by Calvino et al.[12], no relationship between the questionnaire's score and the time of use of the device was found either. Neither did the study by Santos[9], which conducted another test meant for the CI-using population (the NCIQ), find any correlation between the time of use and the results of the questionnaire.

Including self-assessment questionnaires in clinical routine, along with electrode mapping and audiological tests, is important to measure the users' satisfaction with their devices, as well as the difference that using the equipment makes in their lives.

It was observed that many users believed they would have intelligibility and good conversation only by using the device. Participants who reached great scores in the speech recognition tests classified their device's sound quality as good, although they had reported not listening well.

Despite there being studies that justify the CI in the right ear due to the information being crossed to the left hemisphere of the brain, neither in this study nor in that by Lassaletta et al.[13] was any difference found in auditory performance in relation to implanted ear. In the study by Sharpe et al.[22], though, a better performance was observed in older adults implanted in the right ear.

CONCLUSIONS

Regardless of the time of use of the device and/or performance in the speech recognition tests, many participants classified the sound quality of the cochlear implant as moderate. Along with administering objective tests to measure the users' audibility, tests that measure their level of satisfaction and benefit should integrate the clinical routine in implantation centers as well.

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Annex 1. Hearing Implant Sound Quality Index (HISQUI19)

Questionnaire for Subjective Sound Quality Detection

Please 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 you 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?								
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?								