



CLINICAL STUDY

SPEECH RECOGNITION AND QUALITY OF LIFE IN COCHLEAR IMPLANT USERS

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SUMMARY

Objective: To investigate the relationship between speech recognition performance and self-perceived quality of life in adult cochlear implant (CI) users.

Methods: Twenty-one postlingually deaf unilateral adult CI users were evaluated at least one year after implantation. Speech recognition test (SRT) was assessed in quiet under both auditory-only and auditory-visual (A+V) conditions. Self-perceived quality of life was measured using the Turkish version of the Nijmegen Cochlear Implant Questionnaire (NCIQ). The relationship between SRT scores and NCIQ total scores was analyzed using Spearman's correlation.

Results: A strong positive correlation was found between auditory-only speech recognition scores and total NCIQ scores ($r = 0.73$, $p < 0.001$), while a moderate correlation was observed for auditory-visual speech recognition and total NCIQ scores ($r = 0.52$, $p = 0.016$).

Conclusion: The findings suggest that speech recognition ability, particularly under auditory-only conditions, may be associated with the subjective quality of life of CI users. The NCIQ may serve as a potentially useful tool for evaluating patient-centered outcomes and could provide insights that contribute to the planning of individualized rehabilitation programs.

Keywords: Speech recognition; quality of life; cochlear Implant; nijmegen cochlear implant questionnaire

KOKLEAR İMPLANT KULLANICILARINDA KONUŞMA TANIMA VE YAŞAM KALİTESİ ÖZET

Amaç: Bu çalışmanın amacı, postlingual işitme kaybı olan yetişkin koklear implant (Kİ) kullanıcılarında konuşma tanıma performansı ile yaşam kalitesi arasındaki ilişkiyi araştırmaktır.

Yöntem: Çalışmaya, unilateral Kİ kullanan ve implantasyonun üzerinden en az bir yıl geçmiş 21 yetişkin birey katılmıştır. Konuşma tanıma testi, sessiz ortamda yalnızca işitsel ve işitsel-görsel koşullarda uygulanmıştır. Katılımcıların yaşam kalitesi düzeyleri, Nijmegen Koklear İmplant Ölçeği'nin (NKİÖ) Türkçe versiyonu ile değerlendirilmiştir. Konuşma tanıma testinden elde edilen puanlar ile NKİÖ toplam puanları arasındaki ilişki Spearman korelasyon analizi ile incelenmiştir.

Bulgular: İşitsel koşuldaki konuşma tanıma ve yaşam kalitesi skorları arasında güçlü bir pozitif korelasyon tespit edilmiştir ($p = 0.73$, $p < 0.001$). İşitsel-görsel koşulda ise konuşma tanıma ve yaşam kalitesi skorları arasında orta düzeyde pozitif bir ilişki bulunmuştur ($p = 0.52$, $p = 0.016$).

Sonuç: Elde edilen bulgular, özellikle işitsel koşuldaki konuşma tanıma becerisinin Kİ kullanıcılarının subjektif yaşam kalitesi ile ilişkili olabileceğini göstermektedir. NKİÖ'nün, hasta odaklı sonuçların değerlendirilmesinde potansiyel olarak faydalı bir araç olabileceği ve bireyselleştirilmiş rehabilitasyon programlarının planlanmasına katkıda bulunabilecek bilgiler sağlayabileceği düşünülmüştür.

Anahtar Sözcükler: Konuşma tanıma, Yaşam kalitesi, Koklear İmplant, Nijmegen Koklear İmplant Ölçeği

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INTRODUCTION

Cochlear implantation (CI) is a widely accepted and effective intervention for adults with severe-to-profound postlingual sensorineural hearing loss. Over the past two decades, CI technology and clinical outcomes have markedly improved, leading to greater speech perception, enhanced communication, and improved quality of life (QoL) in adult users^{1,2}. Despite these advancements, there remains considerable variability in auditory outcomes among CI recipients, often influenced by demographic, audiological, and cognitive-linguistic factors^{3,4}.

To evaluate CI benefit, clinicians frequently use speech perception tests. In Turkish clinical practice, the open-set Speech Recognition Test (SRT) is commonly administered pre- and postoperatively to assess



sentence-level recognition under auditory-only and audiovisual conditions⁵. While such performance-based measures are essential, they may not fully capture the lived experience of CI users or reflect the social and emotional dimensions of hearing restoration. In response to this gap, patient-reported outcome measures (PROMs) such as the Nijmegen Cochlear Implant Questionnaire (NCIQ) have gained prominence. The NCIQ is specifically designed for adult CI users and evaluates six dimensions of functional and psychosocial well-being. The Turkish adaptation of the NCIQ has demonstrated strong psychometric properties, and is increasingly used to assess real-life benefit from implantation beyond audiometric thresholds⁶.

Although the relationship between auditory performance and quality of life in cochlear implant users has been explored in previous studies, research specifically examining this relationship using open-set speech recognition tests under both auditory-only and audiovisual conditions remains limited. Prior research has shown that subjective benefit and objective speech understanding do not always align^{7,8}, underscoring the need for integrated outcome assessments. Investigating the association between open-set sentence recognition tests and PROMs, which reflect individuals' real-life experiences, may help provide a more complete understanding of cochlear implant outcomes and may inform the development of auditory training programs. This study aims to explore the association between speech recognition performance and self-perceived quality of life in adult CI users who have used their device for at least one year.

MATERIAL and METHODS

This study received ethical approval from the Anadolu University Health Science Ethics Board (No: 867665).

Participants

We enrolled 21 postlingual unilateral CI users, including 12 women and 9 men aged between 18 and 66 years (mean: 37.4 ± 12.8). Of the 21 participants, 2 were university graduates, 6 had completed high school, and 13 had completed primary school. All participants had been using their cochlear implants for at least one year, with an average usage duration of $5.2 \pm$

4.3 years. All individuals diagnosed with bilateral profound hearing loss voluntarily underwent cochlear implantation and confirmed regular use of their implants since initial activation.

Participants were included in the study if they had no diagnosed neurological, neurocognitive, or psychological disorders and had experienced the onset of hearing loss in the postlingual period. All participants had been using their cochlear implant consistently for at least one year and were literate enough to complete the assessment protocols. In addition, regular participation in auditory rehabilitation was required for inclusion.

The initial activation was performed by an audiologist two days after implantation. During each programming session, sound field audiometry was used to verify aided hearing thresholds. Sound detection thresholds were measured at 0.25, 0.5, 1, 2, and 4 kHz using warble tones or narrowband noise. Across sessions, aided thresholds were maintained between 25- and 40-dB HL.

Speech Recognition Assessment

Speech recognition abilities were assessed postoperatively using an open-set Speech Recognition Test (SRT), routinely administered in our clinic. The test consists of two forms (A and B), each comprising 20 sentences and 100 words. Testing was conducted by the researcher in a quiet environment under two conditions: auditory-only and auditory-visual (A + V). Participants were instructed to repeat each word verbally. Words that could not be repeated were marked as incorrect and deducted from the total score. Results were calculated as a percentage of correctly repeated words.

Quality of Life Assessment

Self-perceived quality of life was assessed using the Nijmegen Cochlear Implant Questionnaire (NCIQ), a standardized patient-reported outcome measure specifically developed for adult cochlear implant users. The NCIQ evaluates six domains: (1) basic sound perception, (2) advanced sound perception, (3) speech production, (4) self-esteem, (5) activity and (6) social interactions. Each item is rated on a 5-point Likert scale, with higher scores



indicating better perceived outcomes. Domain scores are normalized to a scale of 0 to 100.

The Turkish version of the NCIQ, adapted and validated by Alnıçık et al. (2022), was used in this study⁶. The Turkish adaptation demonstrated high internal consistency and construct validity across all subdomains, and has been widely employed in clinical and research contexts within Turkish-speaking populations. The questionnaire was self-administered by the participants in a quiet environment, with assistance provided if necessary.

All participants were living with family members (spouse or first-degree relative) at the time of the study. Individuals living alone were excluded, due to the potential impact of social isolation on self-perceived quality of life outcomes.

Statistical Analysis

Descriptive statistics (median, interquartile range, minimum-maximum values) were calculated for all variables due to the non-normal distribution of the data, as confirmed by the visual (histograms and probability plots) and Kolmogorov-Smirnov/Shapiro-Wilk test. The relationship between speech recognition scores obtained under auditory-only and auditory-visual (A+V) conditions and the NCIQ scores was analyzed using Spearman's correlation coefficient (Spearman's rho). A p-value less than 0.05 was considered statistically significant. All

statistical analyses were conducted using IBM SPSS Statistics for Windows, version 26 (IBM Corp., Armonk, NY, USA).

RESULTS

Descriptive statistics, including the median, 25th-75th percentiles, and minimum-maximum values, are presented in Table 1.

A strong positive correlation was observed between the auditory-only speech recognition scores and the NCIQ total scores (Spearman's $r = 0.73$, $p < 0.001$), indicating that individuals with higher auditory-only sentence recognition scores reported better overall quality of life. Figure 1 shows the scatterplot illustrating the relationship between auditory-only Sentence Recognition Test and the total scores of the NCIQ.

Additionally, a moderate positive correlation was identified between the auditory-visual (A+V) speech recognition scores and the NCIQ total scores (Spearman's $r = 0.52$, $p = 0.016$). This finding suggests that audiovisual speech perception also contributes meaningfully to perceived benefit. Figure 2 represents the scatterplot between auditory-visual Sentence Recognition Test and NCIQ total scores.

The correlations between speech recognition scores and NCIQ scores are presented in Table 2 with their 95% confidence intervals.

Table 1. Descriptive statistics of Sentence Recognition Test performances and NCIQ total scores.

	Median	25th Percentile	75th Percentile	Minimum- Maximum
SRT Auditory-only	56.25	22.75	71.0	0-100
SRT Auditory-visual	91.25	58.13	94.5	20-100
NCIQ Total Scores	58.0	38.0	79.0	20-80

Table 2. Correlations between Sentence Recognition Test scores and NCIQ total scores.

	Spearman's r	95% CI	p
SRT Auditory-only NCIQ	0.73	0.44 - 0.88	< 0.001
SRT Auditory-visual NCIQ	0.52	0.11 - 0.78	0.016

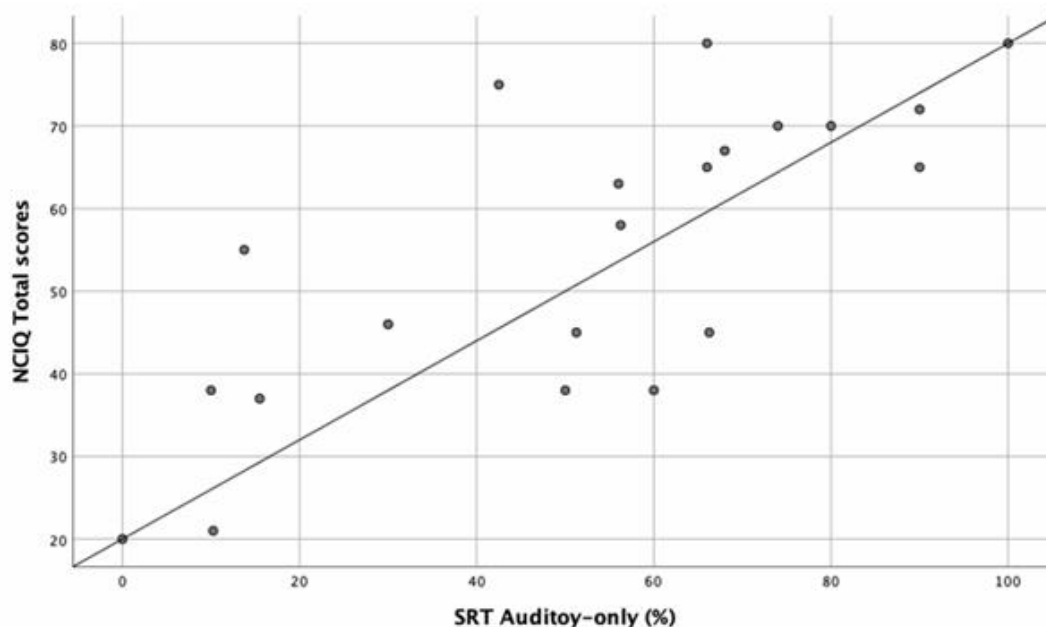


Figure 1: Correlation of auditory-only Sentence Recognition Scores with total NCIQ scores.

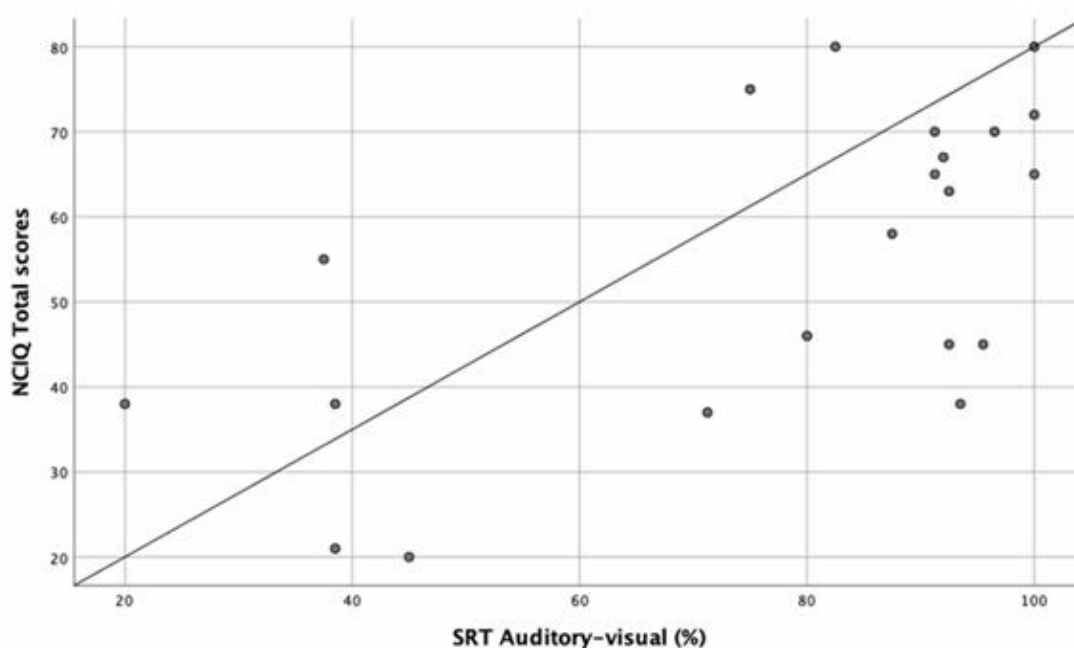


Figure 2: Correlation of auditory-visual Sentence Recognition Scores with total NCIQ scores.

DISCUSSION

This study investigated the relationship between objective speech recognition performance and self-perceived quality of life in adult cochlear implant users using the open-set

SRT and the NCIQ. The findings revealed a strong positive correlation between auditory-only sentence recognition and NCIQ total scores, and a moderate positive correlation for auditory-visual sentence recognition scores. These results



suggest that speech perception abilities, particularly in auditory-only conditions, are closely associated with subjective benefit and quality of life outcomes following cochlear implantation.

The strong association observed under auditory-only conditions may indicate that individuals derive greater perceived benefit when they are able to rely primarily on auditory input, which is often essential in everyday communication settings. This finding is consistent with previous studies that emphasize the impact of auditory speech recognition on emotional well-being, autonomy, and communicative confidence in CI users^{1,2}.

In contrast, although audiovisual cues significantly support speech understanding, they may not fully reflect the complexity of real-life listening environments. In the present study, the correlation between audiovisual SRT scores and NCIQ outcomes was weaker compared to auditory-only conditions. One possible explanation is that visual cues can temporarily compensate for auditory deficits during testing, creating a performance profile that does not fully reflect daily communicative challenges. In real-world situations, communication often unfolds in dynamic environments where visual access is limited, background noise is present, and contextual and cognitive demands are high^{9,10}. Under such conditions, CI users may be less able to rely on audiovisual integration and must depend primarily on auditory and cognitive resources to manage speech comprehension. Studies have shown that while audiovisual speech perception enhances intelligibility in noise, it may not be sufficient to overcome broader communicative limitations that influence self-perceived benefit^{11,12}.

Patient-reported outcome measures such as the NCIQ provide a multidimensional evaluation of cochlear implant users by addressing not only auditory functioning but also psychosocial and daily-life aspects. Due to its capacity to reflect patient expectations and real-life experiences, the NCIQ can help guide individualized rehabilitation planning. Furthermore, its strong concordance with objective auditory performance measures, as

demonstrated in the present study, underscores its value as a clinically relevant and reliable assessment tool.

Several limitations of this study should be noted. The relatively small sample size may reduce the generalizability of findings. In addition, although speech recognition was assessed in quiet under both auditory-only and audiovisual conditions, no speech-in-noise test was included. This is a limitation of the present study as speech understanding in noisy, dynamic environments is a critical predictor of real-world communicative success. Future studies incorporating adaptive speech-in-noise paradigms will provide a more comprehensive understanding of CI user performance under realistic auditory demands. Furthermore, longitudinal studies are needed to track changes in both speech perception and self-reported outcomes over time, offering deeper insight into the dynamics of auditory rehabilitation and patient adjustment.

In conclusion, the findings demonstrate that speech recognition abilities-particularly under auditory-only conditions-are significantly associated with perceived quality of life in adult CI users. These findings reinforce the importance of patient-reported outcome measures, which offer meaningful insight into the real-life experiences of cochlear implant users.

CONCLUSION

This study demonstrated that speech recognition performance, particularly under auditory-only conditions, is significantly associated with self-perceived quality of life in adult cochlear implant users. The findings highlight the clinical utility of the NCIQ as a patient-reported outcome measure that aligns well with objective speech perception scores while also capturing the broader psychosocial and functional impact of cochlear implantation. Given its multidimensional scope and concordance with clinical test results, the NCIQ may serve as a valuable tool to support individualized rehabilitation planning and monitor long-term outcomes in adult CI users.



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