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The benefit of hearing aids in adults with hearing loss during the Covid–19 pandemic

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Ethics Committee Approval
This research was approved by the Ethics Committee of the Ankara Yildirim Beyazit University and implemented according to the Helsinki Declaration (approval no: 16739).
All procedures in this study involving human participants were performed in accordance with the 1964 Helsinki Declaration and its later amendments.

Conflict of Interest
No conflict of interest was declared by the authors.

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Abstract

Background/Aim: Hearing aids, cochlear implants, and guidance are highly effective in improving communication skills and the quality of life of individuals with hearing loss. During the Covid-19 pandemic, patients with hearing loss, especially those living far from city centers, faced insufficient device use due to their inability to go to the hospitals and device centers. This study aimed to evaluate the effects of remote monitorization of sound amplification in adults using cochlear implants and/or hearing aids during the lockdown period.
Methods: In this cross-sectional study, we recruited 98 individuals with post-lingual cochlear implants (n=38) and hearing aids (n=60). Patients on hearing aids followed before the Covid-19 pandemic were guided with a remote computer connection during the pandemic. All participants filled out the Spatial Hearing Questionnaire (SHQ), the short version of Speech Spatial Quality of Questionnaire (SSQ12), Short Form-36 quality of life questionnaires (SF-36), Satisfaction with Amplification in Daily Life Questionnaire (SADL), and the Coronavirus 19 Phobia Scale (C19P-S) via google questionnaire.
Results: During the lockdown period, there were significant increases in the spatial perception scores (SSQ12) of cochlear implant and hearing aid users (P<0.05). A moderate correlation was found between SSQ12 and SHQ scores in cochlear implant (r=0.482, P=0.021) and hearing aid users (r=0.512, P=0.011). During the lockdown period, the SADL overall scores were significantly higher among cochlear implant users (P<0.05). When the subscales of SF-36 for both cochlear implant and hearing aid users were compared with the normative values of these subtests (energy/vitality, role limitations due to physical dysfunctions and emotional problems, mental health, and pain), it was observed that there was a significant improvement in the scores of individuals using hearing aids and cochlear implants (P<0.05).
Conclusion: During the lockdown period, hearing performance, quality of life, and hearing aid satisfaction of patients using cochlear implants and hearing aids increased after tele-audiology guidance.

Keywords: Cochlear Implantation, Tele-Audiology guide, Covid-19 pandemic, Speech Spatial Quality of Questionnaire (SSQ)

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Introduction

There are approximately 360 million people with hearing loss worldwide. Hearing loss was associated with social life, professional status, and economic detriment [1]. In developing countries with a high prevalence of hearing loss, access to auditory health services may be limited, especially in extreme situations such as a pandemic [2].

The 2019 coronavirus disease (SARS-CoV-2), a novel coronavirus type (2019-nCoV) that causes severe acute respiratory disease, first presented with cases of pneumonia of unclear origin in the Chinese city of Wuhan on December 31, 2019, and rapidly affected the world [3-5]. The world health organization (WHO) declared the new coronavirus outbreak as an international global health emergency on January 30, 2020 [6]. The first case in Turkey was reported on March 11, 2020 [7]. New coronavirus 2019 (Covid 19) was seen in 179.241.734 people, and the number of people who died was 3.889.723 by June 24, 2021. The number of positive cases continues to increase day to day [7]. In our country, people tried to continue their everyday lives under prohibitions and restrictions, such as decreasing social relations, and staying home as much as possible, while being continuously exposed to an information flow about the disease [8].

Auditory rehabilitation, cochlear implants, and/or hearing aids, are electronic devices that are effective in improving communication and the quality of life of patients with hearing loss [9, 10]. These patients had difficulties in reaching the hospitals during the pandemic. Since the Covid-19 pandemic began, many patients using hearing aids could not be followed up in hospitals. For this reason, the audiology guidance of patients using cochlear implants or hearing aids was performed remotely.

Telemedicine is useful for providing health-related services and information to poorly serviced areas through telecommunications technology [11]. It enables audiologists to connect safely, efficiently, and effectively to hearing-impaired patients in remote areas with geographical and economic barriers, while allowing clinicians to perform diagnostic tests, or hearing aid/cochlear implant placement/fitting and training safely [12, 13].

Our current study investigates the effects of sound amplification on the quality of life of the patients who began using hearing aids or cochlear implants before the pandemic. It was also determined how much the patients' satisfaction was affected after the pandemic.

Materials and methods

In this study, the effects of sound amplification were investigated remotely during the pandemic among patients who received hearing aids or cochlear implants before the pandemic. This research was approved by the Ethics Committee of the Ankara Yildirim Beyazit University and implemented according to the Helsinki Declaration (approval no: 16739). Informed consent forms were signed by all participants.

Participants

Sixty individuals (27 M+33 F) with a mean age of 52.12 (10.7) (range: 18-75) years using hearing aid(s) with moderate (n=30) or moderate to severe (n=30) sensorineural hearing loss in both ears and 38 adult patients (20 M+18 F) with a mean age of 33.30 (15.41) (range: 22-51) years who were using a cochlear implant with severe or severe sensorineural hearing loss in both ears, according to the classification of Clark et al. (Clark 1981), were included in this study. The pure-tone average was assessed at 500, 1000, and 2000 Hz. All participants had a history of post-lingual hearing loss and were regularly followed up for cochlear implants or hearing aids for at least one year. The demographic characteristics of the participants are summarized in Table 1. The short version of Speech Spatial Quality of Questionnaire (SSQ12), Speech Hearing Questionnaire (SHQ), 36-Item Short Form Survey (SF-36), Satisfaction with Amplification in Daily Life (SADL) questionnaire, and Coronavirus Anxiety Scale were administered to all individuals participating in the study. There had been SSQ12 and SADL data of participants from 2017 to July 2020 to assess participants' cochlear implant and hearing aid(s) satisfaction before the pandemic. We called all participants within an average of 1 month after guidance and asked them to fill out the questionnaires online. Two participants with cochlear implants were using both hearing aids and cochlear implants. During the pandemic, the patients were contacted via zoom to provide guidance.

Table 1: Demographic data of the participants

Features	Cochlear Implant (n=38)	Hearing Aid (n=60)
Age, median (years)	22-51 (33.30)	18-75 (52.12)
Female (%)	18 (47.3)	33 (55)
Male (%)	20 (52.6)	27 (45)
Pure-tone average, median dB)	65.7 (61.5 - 80.4)	58.1 (48.2 - 68.7)
Device usage time (month) (SD)	17.4 (9.07)	12.8 (17.4)

Pure-tone average at 0.5, 1, and 2 kHz in the better-hearing ear, SD: Standard Deviation

Tele-Audiology guide procedure

A video conference system (Zoom) was used to guide the patients (Tele-Audiology Guide). Nvidia antivirus application was used on our computer and the computers communicating. After comfortable communication was established with the patients by checking the internet connections of both sides, guidance was initiated. According to Penteado and others, antivirus and firewall protection were temporarily turned off to improve connection performance. For this purpose, access to sites other than these applications was blocked to protect against viruses. In each session, basic strategies, training, and recommendations were given to the patient. Using visual and sensory data, we aimed to improve speech intelligibility with voiced and consonant monosyllabic words. Each patient was interviewed separately by the same audiologist once a week for 8 weeks, and 45-minute guidance was provided about device use and difficulties encountered during communication.

A short form of Speech, Spatial and Qualities of Hearing Questionnaire (SSQ12)

SSQ yields an audiological measurement of the individual's hearing loss by assessing the direction, distance, and movement components and how this loss affects the individual's life (i.e., disabilities or participation restrictions). The original full version of SSQ has three different subscales and 49 items evaluating speech perception and hearing quality (voice clarity and listening effort), as well as spatial hearing [14]. There are many short versions of SSQ available. However, the SSQ12 short version was preferred because it contains the same number of questions as the hearing-impaired questionnaire in clinical settings [15]. It has nine pragmatic subscales: Speech in Quiet, Speech in Noise, Speech in Speech Contexts, Multiple Speech Flow Listening, Localization, Distance and Movement, Decomposition, Identification of Sound, Quality and Naturalness, and Listening Effort. Each question is scored between 0-10 ("0" indicates that the specified status is not possible, "10" indicates that the specified status is excellent) [15].

Satisfaction with Amplification in Daily Living (SADL)

The SADL questionnaire is a highly reliable questionnaire for evaluating the benefit of hearing aids [16]. The 15-question questionnaire includes the subscales of positive impact, service and cost, negative impact, and personal image (7-point Likert-type). The most critical aspect of the SADL questionnaire is that the patient satisfaction from amplification can be scored manually. We used the Turkish version of the SADL questionnaire [17].

SF 36 Quality of Life Scale

SF 36 quality of life scale, one of the most common scales used to evaluate life quality, was developed in 1992 by Ware et al [18]. We used the Turkish version of this scale, developed by Demiral et al [19]. The SF36 scale consists of 36 items and the following 8 subscales: Physical function (10 items), social function (2 items), role limitations due to physical functions (4 items), role limitations due to emotional problems (3 items), mental health (5 items), energy/vitality (4 items), pain (2 items) and general health perception (5 items). While only the second question in the scale includes the perception of change in health in the last 12 months, other questions are evaluated considering the last four weeks. The fourth and fifth questions of the scale are answered with yes/no. The other questions (3, 5, and 6) are evaluated with Likert-type scores. The subscales evaluate health between 0 and 100, and 0 indicates unhealthiness, while 100 indicates being healthy [18].

Coronavirus 19 Phobia Scale (C19P-S)

Coronavirus 19 Phobia Scale (C19P-S) is developed to measure the fear reactions experienced by individuals during the Covid-19 pandemic. The five-point Likert type scale consists of seven items (1: Strongly disagree – 5: Strongly agree). The C19P-S consists of four sub-scales: Psychological, Somatic, Social, and Economic status. The total C19P-S score is obtained by the sum of the sub-dimension scores and ranges from 20 to 100 points. The higher the score, the higher the level of anxiety related to the Covid-19 pandemic [20].

Statistical analysis

Statistical analyses were performed with the Statistical Package for the Social Sciences (SPSS 23.0 for Windows; SPSS Inc., Chicago, IL, USA SPSS). The impact of the guidance on hearing and amplification in cochlear implant and hearing aid users was assessed by comparing the scores before and after the pandemic. The cochlear implant and hearing aid groups (before and after) were compared with the paired sample t-test with Bonferroni correction. The relationship between SSQ12 and SHQ was assessed with the Pearson correlation coefficients. The sample size required for each hearing aid group (cochlear implant and hearing aid) to achieve a clinically relevant sample in the original efficacy trial using the main outcome measure with a two-sided significance level of 0.05, an effect size of 0.5, and a power of 90% (G*Power Version 3.1) was 24 participants.

Results

The time spent giving guidance and information, and the overall consultation time for each individual was measured.

The SSQ12 scores of the cochlear implant users (P=0.001) and hearing aid(s) users (P=0.024) significantly increased after the pandemic compared to the SSQ12 scores obtained pre-pandemic (Table 2).

Table 2: Average scores and standard deviations of Spatial Hearing Questionnaire (SHQ), short form of Speech, Spatial and Qualities of Hearing Scale (SSQ12) over time and Satisfaction with Amplification in Daily Life (SADL) questionnaire scores.

	CI (n=38)		MHL (n=30)		MSHL (n=30)	
	M	SD	M	SD	M	SD
SSQ12 overall scores	4.57	0.31	5.37	0.76	4.12	1.53
In the process of covid 19						
SSQ12 overall scores	6.14	0.88	7.01	0.87	6.92	1.75
SHQ overall scores	59.4	8.07	62.54	13.10	60.52	12.28
SADL positive effect	38.8	4.20	41.1	3.72	40.53	4.74
SADL personal image	14.2	1.41	12.7	2.93	12.7	2.14
SADL adverse features	5.23	1.24	6.02	0.89	5.42	1.12
SADL service and cost	2.88	0.47	4.71	0.28	4.56	0.54

CI: Cochlear Implant, MHL: Moderate Hearing Loss, MSHL: Moderate- Severe Hearing Loss, M: Mean, SD: Standard Deviation, SSQ12: Short Form of Speech, Spatial and Qualities of Hearing Scale, SHQ: Spatial Hearing Questionnaire, SADL: Satisfaction with Amplification in Daily Life

The data of the participants using hearing aid(s) and/or cochlear implants, the SSQ12, SHQ, SADL scores, and their comparisons are shown in Table 2. The mean SHQ and SSQ12 scores of patients using cochlear implants during the pandemic were 59.46 (SD: 8.07, min: 43, max: 80.28), and 6.14 (SD: 0.88, min: 4.3, max: 8.07), respectively. The mean SHQ and SSQ12 scores of all individuals using hearing aid(s) were 61.3 (SD: 12.63, min: 49.2, max: 79.2), and 6.96 (SD: 1.30, min:1.3, max:8.47), respectively.

A moderate correlation was found between SSQ12 and SHQ scores of cochlear implant (r=0.482, P=0.021) and hearing aid (r=0.512, P=0.011) users.

The SADL overall score and positive impact scores of cochlear implant users before the pandemic were significantly lower than the SADL scores during the pandemic (P<0.05). However, no significant difference was observed among the patients using hearing aids (P>0.05). The overall SADL scores were similar with regards to remote and face-to-face guidance (P>0.05) and among patients using hearing aids (P>0.05).

SF36 results of both hearing aid and cochlear implant users were compared according to the normalization results performed by Jenkinson et al. in healthy individuals. The subscale mean scores of the SF-36 and the normative data of healthy individuals by Jenkinson are shown in Table 3 [21].

Table 3: Average scores of SF-36 in individuals using cochlear implants and hearing aid (s) and healthy individuals (normative data)

Eight variables of SF36	Patient scores (CI)		Patient scores (HA)		Normative data	
	M	SD	M	SD	M	SD
PF	88.1	13.6	71.4	10.1	89.4	16.1
RLPH	95.3	17.2	83.6	17.1	84	32
RLEP	84.2	21.5	84.1	14.2	80.3	33.6
EF	60.2	11.5	57.5	22.7	58.2	19.9
EP	66.2	10.1	78.7	10.7	80.3	33.6
SF	87.7	12.1	92.4	12.7	86.7	20.5
P	95.7	9.2	87.2	8.73	79.4	22
GH	72.5	9.3	78.5	14.5	74.1	20.3

PF: Physical Functioning, RLPH: Role Limitations due to Physical Health, RLEP: Role Limitations due to Emotional Problems, EF: Energy/Fatigue, EP: Emotional Problems, SF: social functioning, P: pain, GH: general health, CI; Cochlear implantation, HA: Hearing

There was no significant difference between the physical function (P=0.655), social function (P=0.06), and general health perception subscales (P=0.225) and the normative values of SF-36 among the cochlear implant users.

Among our study population, significant differences were found between the role limitations due to physical functions (*P*=0.001), role limitations due to emotional problems (*P*=0.039), mental health (*P*=0.018), energy/vitality (*P*=0.045), and pain subscales (*P*=0.001) and the normative values of the SF-36.

The physical function (*P*=0.027), role limitations due to emotional problems (*P*=0.019), social function (*P*=0.001), pain subscale (*P*=0.012), and general health perception (*P*=0.001) of hearing aid users significantly differed from the normal values of SF-36.

The SF-36 scores of both hearing aid and cochlear implant users did not differ with age or gender (*P*>0.05).

C19P-S scores of individuals using hearing aids (41.6 (14.3)) and cochlear implants (47.6 (15.17)) were above the normal limit (20-100). The mean psychological, somatic, social, and economic subscale scores of hearing aid users were 12.1 (4.9), 9.55 (2.3), 11.7 (4.3), and 8.2 (3.5), respectively. Among cochlear implant users, the mean scores of the subscales in the same order were 13.1 (4.9), 12.42 (2.3), 11.8 (4.3), and 10.3 (3.5), respectively.

Discussion

It should be ensured that patients' follow-ups continue routinely and reliably despite the clinical difficulties associated with social distancing during the pandemic. Therefore, specialists of various fields began exploring new methods to continue providing the required health services. Telehealth aims to provide health services to those who have no or inadequate access to these services across the world using information technology, and functions in the same way as face-to-face healthcare services [22, 23]. Tele-Audiology Guide can be used for cochlear implants or traditional hearing aid users, especially in areas far from practitioners during the pandemic.

In our study, the SSQ12 scores of cochlear implant and hearing aid users were lower before Covid-19 compared to scores obtained during the Covid-19 pandemic. According to the study of Zhang et al. [24], the SSQ49 and SHQ scores improved from the first 6 months until the first year of the implant and plateaued thereafter. The increase in SSQ12 scores in our study after the guidance was given showed that patients continued to benefit from cochlear implants. This finding was supported by the study of Zhang et al. [24], which showed that SHQ12 scores increased between the 12^{th}-24^{th} months of receiving implants [24].

In our study, a moderately significant relationship was observed between overall SSQ12 and SHQ scores, while in the study of Zhang et al. [24], the two were strongly correlated. This may be related to individual differences.

During Covid 19, the SF-36 questionnaire was used to assess the general health of patients using cochlear implants and hearing aid(s). Although the SF-36 does not have a scale to measure hearing and communication impairment [25], it is important because it provides detailed information about the overall health assessment of patients. Cochlear implants and/or hearing aid(s) can be affected by many factors while helping to regain quantitative improvements in auditory perceptions of individuals with hearing impairment. One of these factors is the psychological state of cochlear implant and hearing aid users. In many studies, cochlear implants are reported to have a positive effect on the patients' quality of life [26, 27]. Additionally, significant differences were observed in SF-36 general health scores after receiving hearing aids with regards to the amount of hearing loss, attention, and gender [28].

According to the study of Olze et al. conducted in 2011, the psychological conditions of individuals with unilateral hearing loss and using cochlear implants significantly affect their quality of life [26]. Demiral et al. reported that the pre-implantation SF-36 physical score (52.07) was higher than post-implantation scores (45.21) and the SF-36 psychological score (42.91) increased after cochlear implant use (48.33) (19). In our study, although there was a significant increase in the patients' role limitations due to physical functions, role limitations due to emotional problems, and pain average scores, cognitive abilities also increased, and fatigue decreased. This showed the success of getting guidance, while also revealing some deficiencies. This may be because cochlear implant users place more emphasis on hearing health than hearing aid users. This finding was compatible with that of the study by Ou et al. [29].

The relatives of only two patients (71 and 64 years old) who had problems with internet connection and communication with the device during the interviews helped.

In our study, the patients' C19P-S sub-scales scores (fear of getting the disease) were moderate. However, after guidance by the audiologist, an increase was observed in the general quality of life and hearing health in most patients.

Limitations

The hearing function of the patients could not be assessed both objectively and subjectively, because tele-audiology or telemedicine was not fully widespread in Turkey. Another limitation is the inability to make age-specific evaluations due to the lack of age differences in the patient population participating in our study. Future studies should research telerehabilitation with a more developed network structure and standardized methods.

Conclusion

Tele-medicine and tele-audiology are used in many countries for hearing aids, cochlear implants, and directive guidance for device use among patients with hearing loss and have been used primarily to reach patients in rural areas, far from hospitals. The observation of a positive increase in the overall scores of the SSQ12, SHQ, SADL questionnaires, and the SF-36 general quality of life scale showed the benefit of guidance, even in adverse situations. These findings are important in terms of preparing the ground for developing useful tele-audiology guides or telerehabilitation practices, such as an Internet-Based Tele-audiometry system in Turkey.

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