KTO KARATAY ÜNİVERSİTESİ
SAĞLIK BİLİMLERİ DERGİSİ
KTOKÜSB-D
• Cilt/Vol:1 • Sayı/No:3 • Aralık/December 2020

Cilt 1 (2020) Sayı 3 7-13

Kulaklık Kullanan Genç Popülasyonun Kısa Süreli İşitme Cihazı Deneyimi ile Kulaklık Kullanımına Bakış Açısının Değerlendirilmesi

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Özet

Amaç: Kronik gürültüye maruziyet ve oluşan koklear travma, işitme kaybına ve tinnitusa neden olur. Müzik, eğlence olarak kullanıldığında bile işitme hasarına neden olabilir. Bu çalışmanın amacı, yüksek sesli müziğin etkilerini ölçmek ve bireylere olası sonuçları göstererek farkındalık yaratmaktır.
Yöntem: Düzenli olarak kişisel müzik aletlerinden yüksek sesle müzik dinleyen ve daha önce işitme cihazı deneyimlememiş 30 genç yetişkin dahil edildi. Tüm katılımcılara odyolojik değerlendirme yapıldı. Katılımcıların müzik dinledikleri şiddet seviyesi tespit edildi ve katılımcılar işitme cihazı kullanımını deneyimledi. Sonrasında katılımcıların bakış açılarını değerlendiren bir anket uygulandı.
Bulgular: Yüksek ses seviyesinde müzik dinleyen katılımcılarda odyogram eşiklerinde ve emisyon değerlerinde azalma görülmüştür.
Sonuçlar: İşitme cihazı deneyimi, normal işiten bireylerde yüksek sesle müzik dinlemede caydırıcı bir etkiye sahiptir.

Anahtar Kelimeler

İşitme Cihazı
Gürültüye Bağlı İşitme Kaybı
Koklear Travma

Makale Hakkında

Gönderim Tarihi: 24.09.2020
Kabul Tarihi: 17.12.2020
E-Yayın Tarihi: 31.12.2020

Evaluation of The Young Adults' View to Headphone Use After Hearing Aid Experience

Abstract

Objectives: Chronic noise exposure and the resultant cochlear trauma cause hearing loss and tinnitus. Music, even when used as an entertainment, can cause hearing damage. The purpose of this study is to detect effects of loud music and show possible consequences to individuals. This study aims to make an awareness of results of headphone use in young adults.
Method: 30 young adults who regularly listen to loud music from personal musical devices and never used hearing aid before were included. Audiological measurements were performed on all participants. The level of volume the participants were listening to was determined. And the participants tried on the

Keywords

Hearing aid
Noise-induced Hearing Loss
Cochlear Trauma

Article Info

Received: 24.09.2020
Accepted: 17.12.2020
Online Published: 31.12.2020

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hearing aid. Then a survey was applied to evaluate the experience of the participants.
Results: In some frequencies air conduction and bone conduction hearing threshold increase and Otoacustic emissions decrease were observed at subjects who listen to music at high volumes.
Conclusion: The experience of hearing aids has a deterrent effect on listening to loud music in individuals with normal hearing.

1. Introduction

Noise-induced hearing loss (NIHL) is the second cause of hearing loss after presbycusis (Charlton, 2007). It has been suggested that 12% or more of the global population is at risk for hearing loss caused by noise, which equates to well over 600 million people (Alberti et al., 1979). The World Health Organization (WHO) estimated that one-third of all cases of hearing loss can be attributed to noise exposure ("Noise and hearing loss. National Institutes of Health Consensus Development Conference.," 1990). Chronic noise exposure and the resultant cochlear trauma cause hearing loss and tinnitus (Kirchner et al., 2012). Music, even when used as an entertainment, can cause hearing damage (Clark, 1991; Ivory et al., 2014).

Previous studies have demonstrated both auditory and non-auditory health effects of noise (Basner et al., 2014). Audiological problems, such as temporary and permanent hearing threshold shifts as well as temporary or permanent tinnitus have been reported after acute or long-term exposure to high sound levels when listening to personal music devices (PMDs). The increased accessibility of PMDs, the integration of PMDs in cell/smart phones, lower prices and technical improvement regarding sound quality has made the use of these devices extremely common worldwide (C., 1996; Kim et al., 2009).

There are growing concerns over noise exposure through PMD usage without adopting necessary caution. Loud music exposure for an extended period of time can cause a risk of permanent hearing loss, ringing in the ears, difficulties in understanding speech in noisy surroundings, memory issues, and learning problems (Kumar et al., 2009; Vogel et al., 2008).

According to the literature data, the levels of exposure to sounds from using PMD on regular basis range widely from 60 to almost 120 dB(A) among the users. When transformed to A-weighted field equivalent sound pressure levels (SPLs), sound levels are on average from 75 to 85 dB, indicating that up to 25% of this population is at risk of developing hearing loss when listening to music at this level for 8 hours, over a long period of time (Sulaiman et al., 2014).

The affected individual is unaware of the noise damage in the initial stages because the noise affects the frequencies higher than speech range initially before hearing threshold changes in the speech frequencies (Attias et al., 2001; Sulaiman et al., 2014, 2015; Vogel et al., 2008). Hence, it is mandatory that a person exposed to loud noise undergo audiological screening programs (Niskar et al., 2001).

Noise trauma can result in two types of injury to the inner ear, depending on the intensity and duration of the exposure: temporary threshold shift (TTS), or a permanent threshold shift (PTS) (Iso, 1990). The characteristic pathological feature of NIHL with PTS is the loss of hair cells, particularly the prominent loss of outer hair cells at the basal turn, while loss of inner hair cells was limited (Wang et al., 2002).

Early or moderately advanced NIHL usually results in the typical notch at 4 kHz, with a spread to the neighbouring frequencies of 3 kHz and 6 kHz (Rabinowitz et al., 2006) and some hearing recovery at 8 kHz (Kirchner et al., 2012; Le et al., 2017). The fact that frequencies around 4 kHz are most affected by noise is most likely due to the resonance frequency of the outer ear/ear canal as well as mechanical properties of the middle ear (Pierson et al., 1994). With further noise exposure, the notch can get deeper and wider eventually involving lower frequencies such as 2 kHz, 1 kHz and 0.5 kHz (Hong et al., 2013; RR et al., 2000). Hearing loss induced by noise exposure is quoted to be on average no greater than 75 dB in the high frequencies and no greater than 40 dB in the lower frequencies (Kirchner et al., 2012). However, chronic noise exposure can in some individuals cause severe to profound sensorineural hearing loss (SNHL) (Attias et al., 2014).

Otoacoustic emissions (OAEs) have the necessary features to serve as an objective, sensitive, and easy-to-administer tool for the diagnosis of NIHL (Hamernik and Qiu, 2000). Owing to their objectivity and sensitivity, OAEs are effective in detecting the NIHL even before the changes are seen in auditory sensitivity and hence is an ideal tool to assess auditory effects of noise before or after noise exposure (Airo et al., 1997; Hodgetts et al., 2007).

The purpose of present study is measure effects of loud music and show possible consequences to individuals. We aim that make an awareness on young population.

2. Material and Method

2.1 Participants

30 young adults who regularly listen loud music from PMDs and never experienced hearing aid before were included. Participants' ages were between 18-27 (Mean=21,4 ± 1,9). 16 of the participants were female (%53.3) and 14 of the participants were male (%46.6). All participants had Type A tympanogram and ipsilateral acoustic reflexes were under 95 dB.

As the control group, 30 young adults who stated that they do not listen to loud music from PMDs were included (Mean= 21,2 ± 1,7).

Study protocol was approved by Ethics Committee of Uskudar University in 24.01.2019 (61351342-/2019-59).

2.2 Instruments

The external ear canal and the tympanic membrane were visualized by using an otoscope. The immittance analysis was performed using the Interacoustics Titan/IMP440 Tympanometer (CAN/ CSA). The hearing thresholds were assessed by using Interacoustics AC40 audiometer (Assens, Denmark) with Interacoustics TDH39 headphones.

A computer based Interacoustics Otoacoustic Emission Instrument (ILO 292, UK) was used to record the Transient Otoacoustic Emissions (TEOAE) and Distortion Product Otoacoustic Emissions (DPOAE).

Interacoustics AC40 audiometer (Assens, Denmark) and TDH39 headphones also were used to measure the sound levels from PMDs used by the participants.

Phonak Target (Version 6.0) program was used to adjust the hearing aid which was Receiver in the Ear (RIE) model (Phonak AudeoQ70).

2.3 Procedure

Firstly, subjects' external ear canal and tympanic membrane were observed by using an otoscope, then immittance measurements were done. This was followed by an audiometric hearing threshold assessment of the frequency range between 125-8000 Hz.

After that, we connected our personal music player to AC40 with an intermediate cable to measure the estimated sound levels that prefered by subjects. Subjects chose a song they usually listen, and that song was presented to them via TDH39 headphones. At the same time, the sound level of the song was increased. Subjects pressed the button when the sound level reached the level they typically use. Subjects were listening to music over 75 dBHL participated in the study.

Later, DPOAE and TEOA tests were applied to subjects. The DPOAE frequency range was 1-8 kHz. F2/F1 frequency ratio was 1,22 and the intensity values of the F1 and F2 were 60 and 55 dBSPL, respectively. TEOAE frequency range was 1-4kHz.

Then, the research questionnaire were filled by subjects.

After completing audiological tests, the subjects experienced the hearing aid. In order not to disturb the participant and prevent any damage to their hearing, the hearing aid was adjusted to a mild hearing loss.

Finally, after the hearing aid experience is done, the last question of the questionnaire was applied again to subjects.

2.4 Questionnaire

The questionnaire included questions such as “Do you have tinnitus?”, “How many years have you been using headphones?”, “How many hours do you use headphones a day?”.

The final question which was asked again after the hearing aid experience was “What is your perspective on using headphones after trying a hearing aid?” There were three answers to this question: “I will continue to use my headphones in the same way”, “I can't stop using the headphones, but I will turn down the volume”, “I will never use headphones again”. Participants pointed to their preffered option.

3. Results

Figure 1 and Figure 2 show right ear and left ear means for PMD users. PMD users means and control group means were compared by using independent sample T-test. Statistical analysis was shown in Table1. A statistically difference was found between the subjects and control group at right ear air conduction thresholds at 125Hz, 6kHz and left ear air conduction thresholds at 1kHz, 6kHz. Also right and left ear bone conduction thresholds at 1kHz were significantly different (Table1).

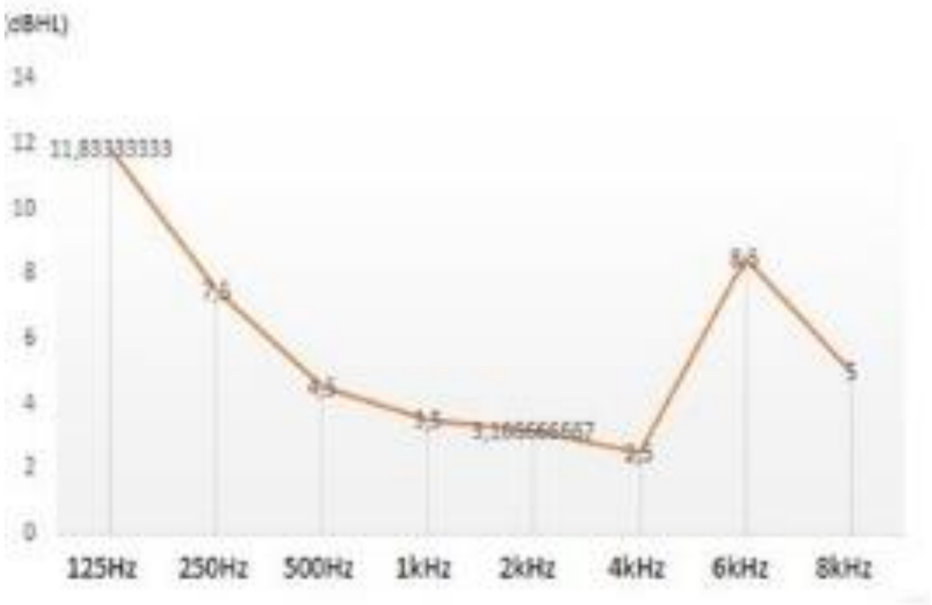

Figure 1: Right ear means for PMD users.

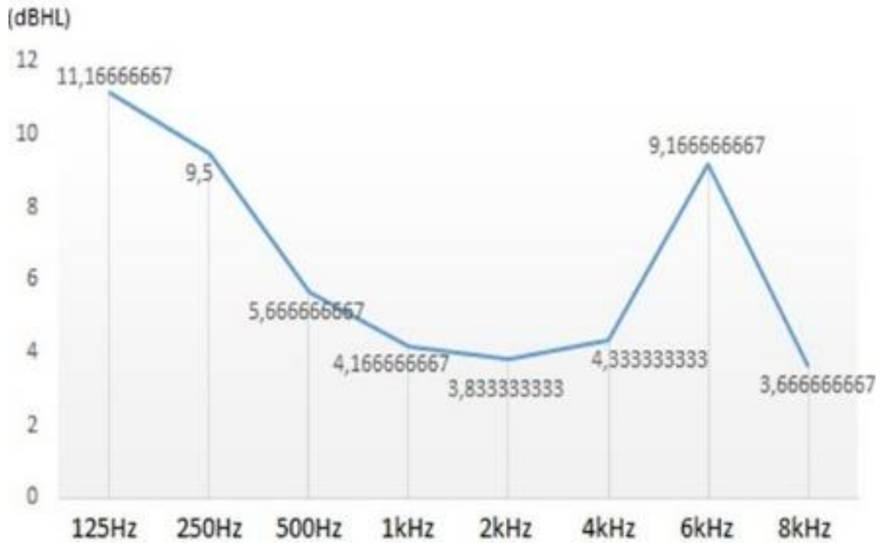

Figure 2: Left ear means for PMD users.

Table 1: Pure tone audiometry threshold analysis for left and right ear.

		n	Mean ± SD	p value
Right Ear Air C. 125Hz	PMD Users	30	11.8 ± 7.4	**p<0,05**
	Control Group	30	7.8 ± 4.6	
Right Ear Air C. 6kHz	PMD Users	30	8.5 ± 7.7	**p<0,01**
	Control Group	30	3.6 ± 5	
Right Ear Bone C. 1kHz	PMD Users	30	0.1 ± 3.8	**p<0,01**
	Control Group	30	4 ± 3.5	
Left Ear Air C. 1kHz	PMD Users	30	4.1 ± 3.9	**p<0,05**
	Control Group	30	6.3 ± 3.4	
Left Ear Air C. 6kHz	PMD Users	30	9.1 ± 8.6	**p<0,05**
	Control Group	30	4.3 ± 4.8	
Left Ear Bone C. 1kHz	PMD Users	30	1.1 ± 4.2	**p<0,05**
	Control Group	30	4.8 ± 3.8	

SD: Standart Deviation Independent Samples T test

In the independent sample T test, the TEOAE results were not significantly different between the subjects and the control group.

In the DPOAE test, the means of the subjects and the control group were compared using independent sample T test. 4 kHz and 6 kHz in the right ear, 4 kHz and 6 kHz in the left ear were found statistically significant. Table 2 shows DPOAE analysis.

According to Test of Homogeneity of Variances, these frequencies were not homogenous (right 4kHz, 6kHz; left 4kHz, 6kHz).

Table 2: DPOAE analysis for left and right ear.

		n	Mean ± SD	p value
Right DPOAE 4kHz	PMD Users	30	14.7 ± 9.7	**p<0,05**
	Control Group	30	19.1 ± 6.2	
Right DPOAE 6kHz	PMD Users	30	14.9 ± 10.3	**p<0,05**
	Control Group	30	19.6 ± 4.5	
Left DPOAE 4 kHz	PMD Users	30	14.4 ± 10.7	**p<0,05**
	Control Group	30	20 ± 5.4	
Left DPOAE 6kHz	PMD Users	30	12 ± 10.3	**p<0,01**
	Control Group	30	18.3 ± 7.2	

SD: Standart Deviation Independent Samples T test

Table 3 shows the numerical distribution of responses to survey questions of the young adults using headphones at high levels. In this study, the relationship between the question of "Do you have tinnitus?" and the question of "How many years have you been using it?" were examined and no statistically significant result was found.

Table 3: Numerical distribution of responses to survey questions.

		n
Tinnitus	Yes	7
	No	23
Time (per day)	0-4 hours	17
	4-8 hours	13
Howmany years?	1-5 Years	5
	5-15 Years	20

	15+ Years	5
Music Type	Classical	2
	Rock-Metal	9
	Jazz	1
	Pop	9
	Rap-R&B	9

In Figure 3, the response to the last question of the questionnaire was compared before and after the hearing aid experience.

The number of people who said “I will continue to use my headphones in the same way” before the experience of hearing aids was 30, but this number dropped to 7 after hearing aid experience. Also, the number of people who said “I can't stop using the headphones, but I will turn down the volume” before the experience of hearing aids was 0, but this number increased to 22 after hearing aid experience. The number of people who said “I will never use headphones again.” was 0 before the hearing aid experience, but after the experience it was 1.

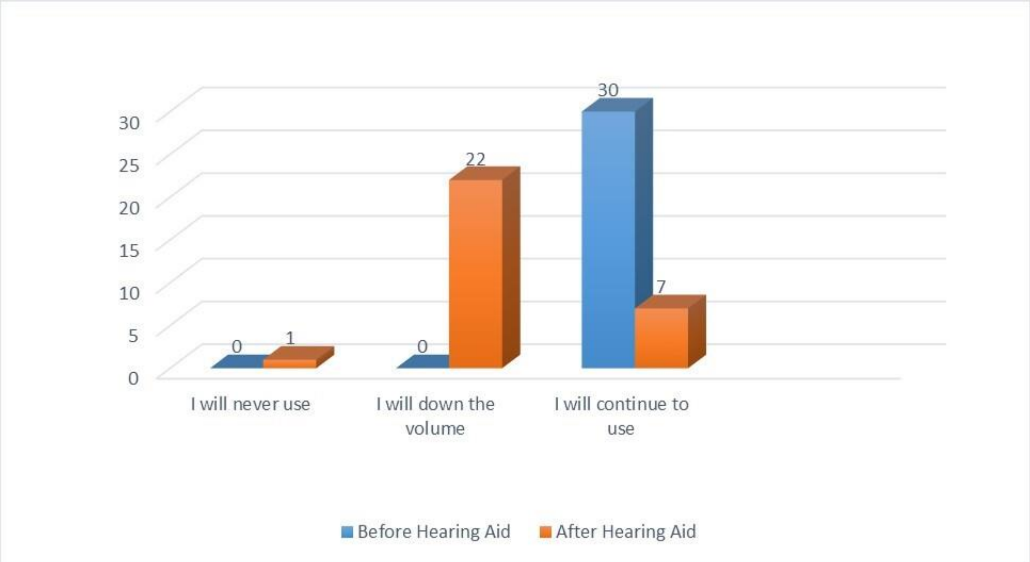

Figure 3: Comparison of the perspectives of the subjects on the headphones before and after the hearing aid.

The last question of the questionnaire was analyzed using visual analog scale (VAS). According to VAS, the answers to the question were given numerical values. The answer “I will never use headphones again” was 1 at VAS, the answer “I can’t stop using headphones but I will turn down the volume” was 5 at VAS and the answer “I will continue to use my headphones in the same way” was 10 at VAS.

As a result, the VAS score of the participants before the hearing aid experience was 10 and the VAS score after the hearing aid experience was 6,03. This difference was statistically significant ($p < 0.01$). Figure 4 shows comparison of the VAS values of the participants before and after the hearing aid experience.

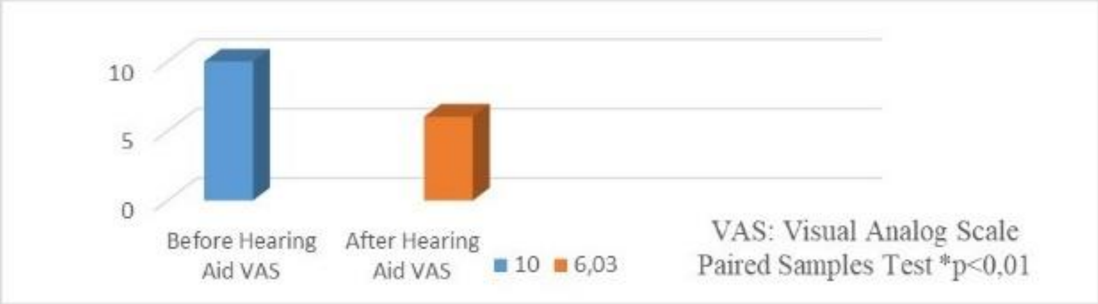

Figure 4: Comparison of the VAS values of the subjects before and after the hearing aid experience. (Paired Samples Test)

4. Discussion

In this study, the hearing health of the young adults listening to loud music with headphones was evaluated. Various audiologic tests were applied to these young adults, and the effect of listening to loud music was observed. At the same time, which aspects of the use of hearing aids have changed by providing subjects with a hearing aid experience was investigated. At the same time, how their point of view has changed by providing subjects a hearing aid experience was investigated.

Our results support our hypothesis that the use of earphones at high volume adversely affects hearing health.

Sliwinska-Kowalska and Davis stated that personal music players are one of the main sources of exposure to noise in young adults. They also concluded that 5-10% of young listeners of personal music devices have a higher risk of developing hearing loss after the exposure in 5 or more years (Sliwinska-Kowalska and Davis, 2012).

Between the subjects and the control group, there was a statistically significant difference between the right ear air conduction thresholds at 125-6kHz and left ear air conduction thresholds at 1-6 kHz. In addition, right and left ear bone conduction thresholds were significantly different at 1 kHz. Similarly, Rawool indicated that there was a decrease in the region of 3000-6000 Hz in the early period of NIHL (Kirchner, 2012).

Another study examined the noise exposure of professional pop, rock and jazz musicians. The study found a positive correlation between the extent of exposure to amplified music and hearing thresholds of 3-6 kHz. The more experience professional pop/rock/jazz musicians had (i.e. the more exposure to amplified music), the poorer their hearing thresholds were (Halevi-Katz et al., 2015).

In our study, it was thought that the significant results of some frequencies (the right ear air conduction threholds at 125 Hz, the left ear air conduction threholds at 1 kHz, the right and left ear bone conduction threholds at 1 kHz) could be due to the small number of subjects in the study. Further research is needed on this subject.

In our emission results, there was a statistically significant difference at 4 kHz and 6 kHz in the right ear and 4 kHz and 6 kHz in the left ear. The signal noise ratios of the participants listening to music at high volume were lower than the value of the control group. This shows that exposure to music with high volume cause a decrease in emission results.

Potentially, OAEs testing has the necessary features to serve as an objective, sensitive and a quick tool for the diagnosis of NIHL. The emissions are believed to be evoked by the outer hair cells situated within the cochlea, the first site affected by noise. OAEs are also highly vulnerable to cochlear trauma, such as exposure to ototoxins or loud noises, which are also known to affect hearing thresholds ("Noise and hearing loss. National Institutes of Health Consensus Development Conference.," 1990).

One of the findings of Attias et al. is that OAE results are more susceptible to noise damage than audiograms. Noise-induced emission loss was found in people with normal audiograms and a history of proven noise exposure. On average, noise-induced emission loss is primarily two-sided, which affects high frequencies.

OAE can reveal subtle cochlear changes that can be ignored by the audiogram and thus complete behavioral tests for the diagnosis of NIHL (Attias et al., 2001). OAE begin to decrease before hearing thresholds increase, and therefore OAE can help in predicting future hearing loss (Manley et al., 2007).

In our study, there was no significant correlation between how many years they have been using their headphones and whether they had tinnitus complaints.

On the contrary, Dana et al. found a significant positive correlation between professional pop/rock/jazz musicians' experience of noise exposure and subjectively-reported variables of tinnitus and hyperacusis. The extention of time exposure to loud music caused subjective symptoms to be reported more frequently (Halevi-Katz et al., 2015).

When the answers to the last question of the questionnaire were analyzed using VAS, the VAS score was 10 before the hearing aid experience and the VAS score was 6,03 after the hearing aid experience. This difference was statistically significant. These results show that young adults who listen to music with high volume became more conscious of the use of headphones after experiencing the hearing aid. These results were obtained when the hearing device was programmed according to mild hearing loss. We believe that awareness can be raised on the subjects if the setting of the hearing aid was programmed according to the moderate hearing loss.

The popularity of headphone usage is increasing among young adults. Therefore, it is necessary to raise awareness in young adults in order to provide conscious use of headphones.

Because of the small number of subjects in our study, these results should be supported by more comprehensive research involving more participants.

5. Conclusion

In this study, it was observed that the young adults who listened to loud music with headphones changed the way they use headphones after the short-term hearing aid experience. The young adults stated they will reduce the volume level while listening to music with headphones or will use it for a shorter period of time.

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