ORIGINAL ARTICLE

Effect on Hearing due to Amplified Music Exposure

Yojana Sharma[1], Girish Mishra[2], Deepanjali A Mahida[3]

Abstract

Introduction: Recently with technology boom, the prevalence of mobile phones and listening to music with earphones/headphones has increased in young adults. This study will help us to understand music-listening habit in Indian population and correlate with hearing loss with their music-listening habit.

Methods: This is an observational study including 100 participants who underwent self-filled questionnaire regarding their music-listening habits. Pure-tone audiometry was conducted on them. Their hearing loss was correlated with duration of usage, volume, and type of transducer using Fischer's test.

Results: Out of 100 participants, 61% were males and 39% were females, all of 18–25 age-group. In the type of devices, earphones, headphones, and speaker were used by 82, 10, and 8%, respectively. Hearing loss was present in 41%. Bilateral mixed hearing loss was in 59.2%. Isolated right and left side sensorineural loss was 7 and 5, respectively. Out of 100 participants, 31 were considered exposed, out of which 71% developed mild hearing loss, which was statistically significant (p-value <0.001), and 65.8% had bilateral hearing loss. Isolated right-sided and isolated left-sided hearing loss was present in 19.5% and 14.6% of participants, respectively.

Conclusion: Listening to music with personal listening device that causes hearing loss is a known fact. A significant number of participants had bilateral hearing loss. Sensorineural hearing loss (SNHL) is the commonest form of hearing loss due to amplified music exposure. Listening to amplified music for more than 2 hours, every day, and for more than 2 years was significantly associated with hearing loss.

Keywords: Hearing loss, Music-listening habit, Personal listening device, Pure-tone audiometry.

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Introduction

The prevalence of mobile phones and listening to music with headphones/earphones has increased over the period. Exposure to high-intensity sound for 15 minutes is sufficient for auditory changes to occur.[1] Hearing loud noise for longer time will lead to damage the hair cells, which are required for high-frequency sounds.[2] Destruction of hair cells in the organ of Corti within the cochlea of the inner ear leads to noise-induced hearing loss.

Hence, we are conducting this study to assess the hearing loss to amplified music exposure by associating their music-listening habits with hearing threshold. Hearing threshold was measured with the help of pure-tone audiometry. Music-listening habit was assessed by the self-filled questionnaire.

Methods

This observational study was carried out at the Department of Ear, Nose and Throat (ENT) and Head and Neck Surgery at Shree Krishna Hospital, Karamsad (Anand), over the period of January 2019–May 2020. A total of 100 participants aged 18–25 years were included in this study. All the participants filled up the self-filled questionnaire regarding their music-listening habit, which included the type of music and device they listen to, duration of music listening in terms of per year, week, and day. Our questionnaire consisted of 10 questions. The exposed and unexposed groups were determined on the basis of responses of question number 5, 6, and 7. Participants who were listening to amplified music more than 2 hours, every day, and more than 2 years of duration were considered as high-risk listening behavior (exposed), while participants whose responses did not consist of the above-mentioned variables of high-risk listening behavior were considered as low-risk listening behavior (unexposed) for analysis purpose. The participants underwent pure-tone audiometry from which hearing acuity was assessed at different frequencies and was compared with their music-listening habit. Participants with history of use of ototoxic drugs, preexisting conductive hearing loss, and ear-related disease were excluded. We have represented data in the form of frequencies and proportions. Fischer's test was used as test if significance for qualitative data.

Results

A total of 100 participants were subjected with pure-tone audiometry and self-filled questionnaire regarding music-listening habit. The demographic data showed that 61% were males and 39% were females, all of 18–25 age-group. Earphones were used by 82% of them, headphones were used by 10%, and speaker was used by 8%. Most (56%) of them preferred to keep volume more than external noise. Out of 100 participants, 41 developed hearing loss. Bilateral mixed hearing loss was in 59.2%. Isolated right- and left-sided sensorineural loss was 7 and 5, respectively.

[1–3]Department of ENT (Otorhinolaryngology), Pramukhswami Medical College, Anand, Gujarat, India

Corresponding Author: Deepanjali A Mahida, Department of Otorhinolaryngology, Pramukhswami Medical College, Anand, Gujarat, India, Phone: +91 7069784070, e-mail: drdeepanjalimahida@gmail.com

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Participants listening to music more than 2 years, every day, and more than 2 hours per day were considered as exposed (high risk). Out of 100 participants, 31 were considered exposed. From 31 exposed participants, 22 (71%) developed mild hearing loss, which was statistically significant (p-value <0.001). Bilateral hearing loss was present in 65.8%. Isolated right-sided and isolated left-sided hearing loss was present in 19.5 and 14.6% of participants, respectively.

Discussion

Music from MP3 music player or cell phone or smart phone has become one of the most common devices for listening to music for both adults and teens. School and college students commonly use their ear phones to disconnect themselves from the outer world. In current era, access to cell phones has made this music-listening habit very widespread. In India, most of the students are able to use mobile phones and other personal listening devices (PLD) more freely after starting their college life; hence, we have focused on age-group of 18–25 years that is more of college-going students.

In the study conducted by us, 61% were males and 39% were females. Another study conducted by Naik et al.[3] observed that 57.5% were males and 42.5% were females. On contrary, Chung et al.[4] observed that females constituted 65% and males 35%. Also, Balanay et al.[5] in their study observed that majority were females (64.6%) and 34.9% were males, with majority being in the age-group of 19 years (43.1%). Age-group included in our study is 18–25 years with a mean age of 21 years. Even the above-mentioned study conducted by Naik et al.[3] included age-group of 18–30 years. Hence, most of the studies, including ours, have conducted various hearing assessments on younger age-group. On the basis of multiple studies, including ours, we concluded that high-volume music-listening habit is more prevalent in males.

In our study of 100 participants, 41 had hearing loss. Out of which, 27 (65.8%) participants have bilateral hearing loss. Isolated right-sided hearing loss was noted in 8 (19.5%) participants and isolated left-sided hearing loss was noted in 4 (14.6%) of them. The majority of them (59.2%) had mixed hearing loss in both right and left ears (Fig. 1). Data regarding the prevalence of noise-induced hearing loss due to recreational noise/music have revealed inconsistent results. In our study, 59 participants having normal audiogram probably might have a minimal hearing loss, which was not picked up on an audiogram. Contrary to our observation, in the study performed by Mostafapour et al.[6–8] which included 50 subjects, they could not find an association between music exposure and hearing loss by pure-tone audiometry (PTA) as out of 50 subjects, only one subject had hearing loss and they concluded that the prevalence of early signs of noise-induced hearing loss is more due to environmental noise rather than PLD. In addition, the authors quoted the drawbacks of their study as not generalizable with normal population since it included a small cohort of certain age-group of people and also the different methods of recording used along with the self-filled questionnaire, which is subjective in nature.

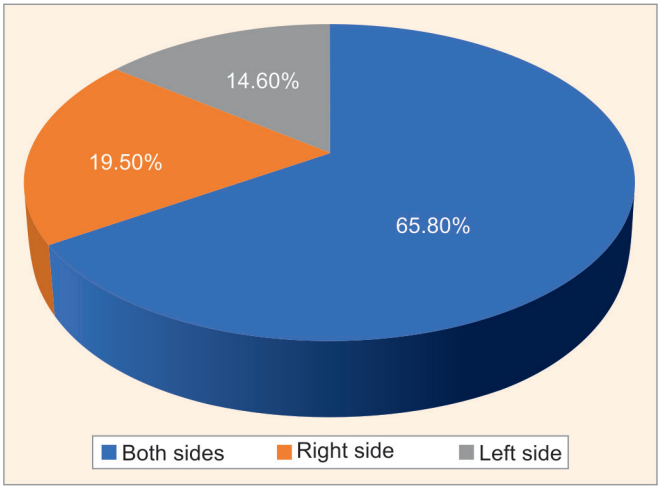

Fig. 1: Pie diagram showing hearing loss distribution

Among the exposed (N = 31), 22 (71%) had hearing loss, and the rest 9 did not have hearing loss. Hence, it was observed that there was statistically significant hearing loss among the exposed group (p-value <0.001) (Table 1). A similar study conducted by Mori et al.[9] included 120 music listeners and 55 non-listeners where it was observed that there were more high-frequency hearing impairments among the music listeners than among non-listeners. Mean hearing losses of the music listener's ears were 4.73 dB at 4000 Hz and 9.24 dB at 6000 Hz. Three factors, viz., monthly listening hours, duration of listening to music, and favorite type of music, contributed to the high-frequency hearing loss. However, in our study, number of years, duration of listening per week and per day contributed to hearing loss significantly.[9] In their comparative study, explored the noise exposure effect on cochlear and saccular functions among an experimental group of 20 policeman where they underwent PTA in 1997 and after 10 years again in 2007. It was observed that the mean hearing threshold at the frequencies of 500 Hz till 4000 Hz had deteriorated considerably in both ears. Although the left ear displayed more hearing loss than the right ear, difference was not statistically significant. However, in our study, right ear was more affected (19.5%) compared to left ear (14.6%), and 65.5% of participants had bilateral hearing loss. Wu et al., also performed vestibular evoked myogenic potential (VEMP) along with repeat PTA in 2007, where 75% of their participants had abnormal VEMP along with the statistically significant deterioration of their PTA. They concluded that high-volume noise exposure can lead to damage to saccule and cochlear.

In our study, we observed that there was statistically significant hearing loss in participants who listened to music for more than 2 hours in a day (p-value <0.001). Out of the 47 participants who listened to music for more than 2 hours per day, 32 (68.1%) developed hearing loss (Table 2). Hence, we can conclude that from 41 participants who had hearing loss (right, left, or bilateral), 78% were listening to music more than 2 hours per day. However, there was no significant association between other characteristics of music exposure and hearing loss. In our current study, 89% have been using PLD and mobile phones frequently (Table 2). Levey et al.'s[10] study included 189 college students who reported the type of PLD and earphones used, and duration per day and days per week they used their PLD. Among

Table 1: Association between hearing loss with exposed and unexposed participants (N = 100)

	Hearing loss present N (%)	*Hearing loss absent N (%)*	*Total*
Exposed participants	22 (71%)	9 (29%)	32
Unexposed participants	19 (27.5%)	50 (72.5%)	68
Total	41	59	100

Table 2: Association between hearing loss and amplified music exposure ($N = 100$)

	Hearing loss		
	Present	*Absent*	
	Number (%)	*Number (%)*	*p value*
Do you have a habit of frequently using headphones to listen to music?			
Yes	35 (39.3%)	54 (60.7%)	0.333
No	6 (54.5%)	5 (45.5%)	
Which device you prefer to listen to music?			
Earphone	35 (42.7%)	47 (57.3%)	0.727
Headphone	3 (30.0%)	7 (70.0%)	
Speakers	3 (37.5%)	5 (62.5%)	
Do you usually attend environments with loud sound as shows, concerts, parties?			
Yes	12 (42.9%)	16 (57.1%)	0.814
No	29 (40.3%)	43 (59.7%)	
Do you keep sound of your earphone/headphone enough to exceed the external noise?			
Yes	25 (44.6%)	31 (55.4%)	0.403
No	16 (36.4%)	28 (63.6%)	
How long you have this habit of listening to music using headphones?			
>2 years	32 (42.1%)	44 (57.9%)	0.689
<2 years	9 (37.5%)	15 (62.5%)	
How often do you listen to music using headphones?			
Everyday	33 (43.4%)	43 (56.6%)	0.381
<3 days per week	8 (33.3%)	16 (66.7%)	
On average, how many hours you usually listen to?			
Over 2 hours per day	32 (68.1%)	15 (31.9%)	<0.001
Less than 2 hours per day	9 (17%)	44 (83.0%)	
What type of music you normally listen to?			
Rock	22 (51.2%)	21 (48.8%)	0.200
Classical	9 (33.3%)	18 (66.7%)	
Others	10 (33.3%)	20 (66.7)	
How often do you go to places with loud music?			
<1 month	41 (41.0%)	59 (59.0%)	—
Is your residence near noisy area like railway station?			
No	41 (41.0%)	59 (59.0%)	—

the participants, 58.2% exceeded 85 dB sound levels; similarly in our study, 56% of the participants preferred to keep the volume more than external noise. In the above-mentioned study, 51.9% of PLD users exceeded their weekly sound exposure limits (Table 2). Similarly, in our study, 76% of participants preferred to listen to amplified music every day. In the above-mentioned study, the majority of PLD users exceeded recommended sound exposure limits, suggesting that they were at an increased risk for noise-induced hearing loss. Thus, their study concluded that in spite of knowledge of the effect of amplified music in hearing loss, the use of PLD has not decreased. PLD use, mainly in young generation like our study, allows them to elude from noisy and crowded environment and personal music to otherwise mundane activities. Similarly, in 1995, a study concluded that 5% of the young people they tested could have a permanent hearing loss of 20 dB after 5 years of use of personal music players. Restricting the maximum output level of personal music players up to 90 dB would therefore limit the risk of hearing loss. In our study, 41% of the participants had hearing loss either bilateral or unilateral and 56% of the participants chose to keep volume more than external noise[3,11] (Fig. 1 and Table 2).

Fligor BJ et al.[12] observed that loud music can cause damage to the coating of nerve cells, which, in turn, can lead to temporary deafness and hearing loss. Indeed, it was revealed that earphones or headphones on personal music players can reach noise levels similar to those of jet engines. All noises that register louder than 110 decibels are known to cause hearing problems and can lead to a need for digital hearing aids to cope with problems such as tinnitus and can also lead to underlying cell damage. Nerve cells that carry electrical signals from the ears to the brain have a coating

called the myelin sheath, which helps the electrical signals travel along the cell. Exposure to loud noises noise over 110 decibels can strip the cells of this coating, disrupting the electrical signals. This means the nerves can no longer efficiently transmit information from the ears to the brain.

From the literature, it is clearly evident that exposure to high-level music produces several physiological changes in the auditory system that leads to a variety of perceptual effects. Damage to the outer hair cells within the cochlea leads to a loss of sensitivity to weak sounds, loudness recruitment (a more rapid than normal growth of loudness with increasing sound level), and reduced frequency selectivity. Damage to inner hair cells and/or synapses leads to degeneration of neurons in the auditory nerve and to a reduced flow of information to the brain. This leads to poorer auditory discrimination and may contribute to a reduced sensitivity to the temporal fine structure of sounds and to poor pitch perception.

In our study, we observed that participants used various kinds of PLD like earphones, headphones, and speaker. Maximum participants preferred to use earphones (82%), followed by 10% of them using headphones, and rest preferring speaker (Table 2). A study conducted by Kim et al.[13] included 490 Korean adolescents who were interviewed about the use of PLD, including the type of PLD and music, and PTA was performed on each subject. They surveyed that maximum individuals preferred to use earphones (81.4%) as their PLD similar to our study (Table 2). Likewise, only 10.8% of subject preferred using headphone in the above-mentioned study. Participants listening to music through earphones or headphones had significantly higher hearing threshold compared to those listening to speaker. Similarly, in our study, the maximum hearing loss was present in participants using earphones as their PLD (42.7%). Earphones are normally preferred over other PLDs as they are smaller in size, more convenient, and more comfortable to wear compared to headphones. Unlike speaker, earphones and headphones can be used in public spaces. Therefore, earphones are more preferred by the participants (82%) (Table 2). Since earphones completely block the external auditory canal, earphones can elevate the output power by 7–9 db[14] compared to headphones. Headphones have a similar effect like earphones but not greater than earphones. Individuals using earphones and headphones also tend to keep volume more than environmental noise as compared to ones using speaker. Thus, earphone and headphones have more detrimental effect on hearing compared to speakers.

Conclusion

Listening to music with PLD that causes hearing loss is a very well-known fact. Hearing loss due to exposure to amplified music does not have gender preponderance. A significant number of participants had bilateral hearing loss. Sensorineural hearing loss is the commonest form of hearing loss due to amplified music exposure. Listening to amplified music for more than 2 hours, every day, and for more than 2 years is significantly associated with hearing loss. Other characteristics of the amplified music, viz., keeping the volume more than external noise, type of music, did not have a significant association with hearing loss.

Orcid

Deepanjali A Mahida https://orcid.org/0000-0002-5252-6229

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