

Loud Music with Headphones/Earphones and Its Implications on Hearing Health in Human

*¹Dr Shirin Imam, ²Dr Niharika Shivhare & ³Dr Anita Gour

^{*1,2,3}Department of Chemical Sciences, Christian Eminent College, Indore (India)

ARTICLE DETAILS

Article History

Published Online: 08 January 2018

Keywords

Loud music, headphone, earphone, decibel, hearing loss

*Corresponding Author

Email: drshirin14@gmail.com

ABSTRACT

Technology is both a boon and a curse. Impact of listening music via headphone/earphone technology is moving ahead day by day leaving us all trapped in luxuries and comfort with hidden awful effects on health. Headphones and earphones are one such technology that is being used without considering the health issues associated with it. An effect of over-exposure to loud music from Headphone/Earphones is gaining concern. Headphones used at unsafe volumes for prolonged periods may result in hearing loss. Studies show that noise levels above 110 decibels damage the protective insulating myelin sheath of nerve cells which carry signals from the ear to the brain. Loss of the protective coating, called myelin, disrupts electrical nerve signals causing partial or complete deafness.

INTRODUCTION

Technology is moving ahead day by day, leaving us all trapped in luxuries and comfort with concealed bad effects on Health. Technology is both a boon and a curse. On one hand, it has made our life so much easier and convenient. But on the other hand, it comes with so many drawbacks and ill effects. Today we are going to discuss one such piece of technology which has made it super convenient for us to listen to our favorite music any time of the day (or night). But it is also responsible for our ignorant behavior as well. In this article, we are going to discuss with you the adverse effects of listening to music over headphones. World Health Organization (WHO) state, in a report released in the run up to International Ear Care Day on March 3rd. that around 1.1 billion teenagers and young

adults face this risk due to exposure to unsafe levels of sound. Individuals are said to have hearing loss if they are unable to hear as well as someone with normal hearing - hearing thresholds of 25 dBA or better in both ears. Disabling hearing loss is defined as having hearing loss greater than 40 dB in the better hearing ear for adults and 30 dBA for children.

How the Ear Works

From figure 1 we can understand how the sound travels through the external auditory canal, also known as ear canal, to the tympanic membrane or eardrum and makes it vibrate. Eardrum transfers the vibration to the 3 bones called Malleus, Incus and Stapes which amplify the sound.

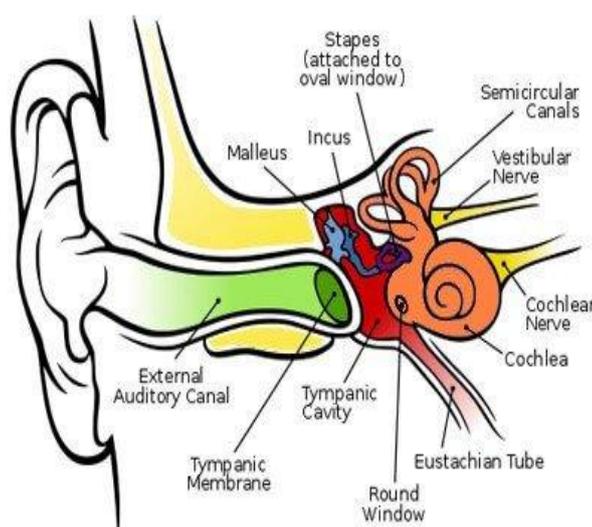


Figure-1 Anatomy of the Ear Explained

The last vibrating bone Stapes, which is also the smallest bone in the human body, is attached to the Cochlea which, with

the help of fluid and sound sensitive hair cells, transforms the vibration into electrical signals traveling to the brain.

Sound energy travels in waves and is measured in frequency and amplitude.

Amplitude measures how forceful the wave is. The level of sound is measured in Decibels or dBA of sound pressure. 0 dBA is the softest sound that a human being can hear. Normal speaking voice level is around 65 dBA. Sound level that are 85 dBA or above can permanently damage your ears.

Table-1 OSHA Regulation 1910.95[1]

Sound Level (dBA)	Max. hrs of exposure
90 dBA	8 hours
92 dBA	6 hours
95 dBA	4 hours
100 dBA	2 hours
102 dBA	1.5 hours
105 dBA	1 hour
110 dBA	0.5 hour
115 dBA	<0.25 hour

The above table shows how fast hearing damage can occur at different levels of volume. The louder the sound, the faster hearing damage occurs. OSHA (Occupational Safety and Health Administration) permits workplace noise levels of up to 90dBA for an 8-hour workday. Additionally, higher volume exposure is also permitted, but for shorter periods of time.

Table 2 Decibel Levels of Common Sounds²

Sound (dBA)	Sound Noise (with distance)
0 dBA	Hearing threshold
10 dBA	Distant rustling of leaves
20 dBA	whispers
30 dBA	Quiet rural area
40 dBA	Quiet library
50 dBA	Normal conversation inside house
60 dBA	Conversation in pub
70 dBA	Vaccum cleaner
80 dBA	Alarm clock
90 dBA	Lawn mower
100 dBA	Speaker in club
110 dBA	Vehicle Horn 1 m away
120 dBA	Chain saw
130 dBA	Jack Hammer
140 dBA	Jet Engine
160+ dBA	Ear drum rupture

DISCUSSION

Harmful Effects Of Using Headphones/Earphones On Human Health [2,3,4]

1. *Hearing loss/ Hearing complications [5,6]*
When you use headphones or earphones, the direct audio goes into your ears. Volume exceeding 90 decibels can result in hearing complication and even hear loss. All those who wear earphones and headphones are at higher risk of hearing loss and even complications in hearing. If anyone listens at more than 100 decibels for even 15 minutes, he can face hearing loss. So if you have to use headphone or earphones, make sure to give your ears some rest and do not listen music in high volume at any cost.
2. *Congested air passage*
To get the best audio experience, we need to insert the earphones directly into ear canals which result in no

air passage. Yes, the music sounds great but with no air passage, you are at higher risk of ear infections. people who use regular earphones and headphones experience more ear wax which results in tinnitus, ear infection and even problems in hearing.

3. *Ear infections*
As earphones are made for two ears, it is quite unavoidable that people share them. According to the Manchester Evening News, regular use of earphones can enhance the growth of harmful bacteria, and sharing or borrowing earphones may just cause the transfer someone else’s bacteria to your ears. Research leader, Dr. Chiranjay Mukhopadhyay, advises everyone to avoid sharing earphones. If it cannot be helped, sanitize them before using.
4. *Ear numbness*
Current studies have shown that people who use earphones or headphones most of the time in the day to hear loud music has felt numb ears. Their hearing abilities get numb for a while and then comes back to normal. This numbness of hearing can be dangerous and lead to deafness.
5. *Ear-ache*
Temporary deafness and tinnitus (a condition that presents itself as a noise such as ringing or buzzing in the ears) can be caused by noises louder than 110 decibels.
6. *Adverse effect on the brain*
The Electromagnetic waves produced by earphones and headphone can cause serious dangers for your brain. However, no strong medical evidence has yet been found to prove it. But people who are daily users of Bluetooth, headphones and earphones have been found more prone to brain related problems.

Experts from the University of Leicester have shown evidence for the first time that turning the volume on your headphones up too high can damage the coating of nerve cells, eventually causing temporary deafness. Dr. Hamann of the Department of Cell Physiology and Pharmacology, explains that The inner ear is directly linked to the brain, even a little infection in the inner ear can directly affect the brain and can lead to serious health issues.

The myelin sheath is a coating found on nerve cells that carry electrical signals from the ears to the brain, which helps the electrical signals travel along the cell. The cells become stripped of this coating with exposure to loud noises (noise over 100 decibels), which stops the electrical signals and no longer allows information to be successfully transmitted from the ears to the brain.

Fortunately, full hearing can return when the coating surrounding the nerve cells reform and allows the cells to function normally again. This means that hearing loss is sometimes only temporary.
7. *External threats*
Overusing using of earphones may also cause serious threats to your life. Getting too carried while listening to music, disconnects you from the rest of the world

and you may have to face severe consequences. The consequences may vary from small losses to really big ones. In fact, in the recent times, the number of accidents caused due to listening to music while being ignorant about the outer environment has increased drastically. Thus when you are in an alien surrounding especially outside, walking on the road, etc. avoid the use of headphones as much as possible.

How to Find Whether Your Headphone Sound Level Is Within Safe Range or Not

1. Applying the following simple test in a calm environment will enable you to find whether your headphones are too loud or within safe limit
2. Turn up the volume of headphones to your preferred level then take them off your ears and hold them in your hands extended in front of you. If you can still hear the music clearly, your headphones are too loud. This method works only in peaceful environment and don't give the right volume information in noisy places.
3. If you are using open-back headphones the good way to tell if your volume is healthy is the ability to have a normal conversation with another person nearby. As long as you can carry a conversation with open-back headphones on, your volume is low enough.

Headphone use on loud, busy streets is slightly different. A study conducted on music volume people use in a busy street showed many people increased the volume because of the environment noise to higher than 80 dB (up to 80 dB is not dangerous). Majority of people use dangerous levels of volume in noisy, public areas.

Method to Set Safe Volume with Headphones

The Fletcher-Munson loudness curve figure 2 [7] shows how the perception of music is changed at different loudness levels. Loudness depends on volume and frequency of the sound. This is why lower volumes are less fun to listen to. You can clearly see the non-linear curve in the picture above.

This explains why so many people want to increase volume for music that they like. With some tone rebalancing you can adjust the amplitude spectrum at lower volume levels to have a more pleasant sound. Unfortunately the dynamic filters needed to adjust the spectrum are not available to an average user and are only being used in professional production.

With the equalizers present in many modern playing devices you can adjust some frequencies to produce a more natural and more appealing sound. The adjustment of treble and bass, high and low frequencies will give you best results.

Setting a safe volume level with headphones depends on the type of headphones used and the environment. Since most people don't have a SPL (sound pressure level) meter just for figuring out the safe volume levels, you have to use different methods.

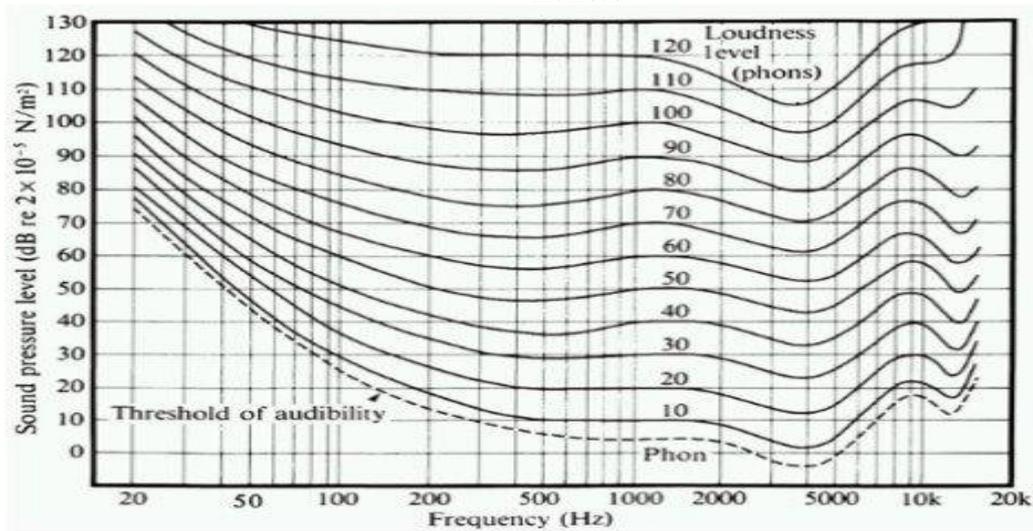


Figure-2 Fletcher-Munson loudness curve

Recommendation to protect your ears and still use Earphones/Headphones [8]

After knowing all the bad effects and health hazards of using earphones and headphones, one becomes scared, but we still don't want to let our favorite audio gadget go. Here are some simple recommendations to save our ears and all the bad effects of using Headphones and earphones.

1. Avoid using tiny headphones/earphones that directly go into the ear canals. Better those big headphones, the old ones which stay outside your ears.
2. Avoid sharing your earphones/headphones with others.
3. Make sure you change the sponge cover/ rubber cover of your headphones/earphones once a month. If your earphones/headphones doesn't have sponge covers, make sure you sanitize them.
4. Do not use earphones/headphones when you are travelling by car, train, metro or even walking.
5. No loud music ever when you use earphones/headphones.
6. To save your hearing from cumulative damage, get a pair of noise isolating ear buds or noise cancelling headphones. These types of headphones are good at removing unwanted background noise so you can enjoy your music without hurting your ears.

7. If you are using headphones for professional use, an audio limiter is a smart idea since it will protect you from over abusing your hearing in the long run, nevertheless, same principles apply, but you probably already know this if you are in the music business.

Whenever you experience any of the hearing loss symptoms, remember to lower the music volume or shorten the time you are being exposed to loud music. You can still enjoy your music with a pair of really good noise isolating or noise cancelling headphones which will help you keep the volume at healthy levels. In the end, just knowing that hearing loss with headphones can happen will probably make you more careful of how you use them.

CONCLUSION

The solution is to be conscious of the fact that headphones can be dangerous to your hearing if used in the wrong way.

REFERENCES

- [1] Occupational Noise Exposure, Occupational Safety and Health Administration, Department of Labor.
- [2] Hodgetts WE, Rieger JM, Szarko RA. The effects of listening environment and earphone style on preferred listening levels of normal hearing adults using an MP3 player. *Ear & Hearing*. 2007;28(3):290-7.
- [3] Keppler H, Dhooge I, Maes L, D'haenens W, Bockstael A, Philips B et al. Short-term auditory effects of listening to an MP3 player. *Arch Otolaryngol Head Neck Surg*. 2010;136(6):538-48.
- [4] Niharika Shivhare, Study of Noise Pollution in Indore City During Ganesh Utsav-A Case Study, *Global Journal of Engineering Science and Researches*, 4(12), 123-128, 2017.
- [5] Kyle, Jim, *Causes of Hearing Loss*, University of Bristol.
- [6] Shargorodsky J, Curhan SG, Curhan GC, Eavey R. Change in prevalence of hearing loss in us adolescents. *JAMA*. 2010;304(7):772-8. Vogel I,
- [7] Fletcher, H., and Munson, W. A. ~1933!. "Loudness, its definition, measurement and calculation," *J. Acoust. Soc. Am.* 5, 82-108.
- [8] Verschuure H, Ploeg CPB, Brug J, Raat H. Estimating adolescent risk for hearing loss based on data from a large school-based survey. *AJPH*. 2010;100(6):1095-100.