

# EFFECT OF EARPHONES/IPODS ON HEARING LOSS

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**Abstract:** It is well known that exposure to noise can persuade hearing loss. As we all know, noise is defined as any unwanted or disagreeable sound and is often denied as a blister. In this modern era, we see many younger generation using earphones and iPods. Some use it to release stress while some use it for fashion. People use earphones to eliminate the noise around us. The users should sensibly control their listening duration and intensity to avoid developing hearing loss. The intimidating part is once hearing is lost there is no way to regain it back. Fortunately, before hearing loss could occur, symptoms will occur. Treatments are there only for early stage. With the help of steroids, hearing can be repaired in the first few days of being affected. There are advantages as well as disadvantages in using earphones. The higher is the volume, the lesser the amount of time the ear can take it. Constant exposure to loud noise can lead to deafness. Henceforth portable music player should not plugged in constantly.

**Keywords:** Hearing loss, noise, decibels (dB), noise-induced hearing loss, deafness, earphones, ear

## INTRODUCTION:

Nowadays portable music players like IPod, MP3, Walkman, mobile phones and earphones has become more popular amongst the younger generation. Due to this, hearing loss has become the most prevalent chronic condition affecting the older adults. In this modern era, portable music players are plugged in constantly.[1] Usage of headphones can lead to deafness depending upon the decibels. Deafness doesn't happen overnight. The larger the number of decibels, the higher the volume and more harmful is to our ears. A continuous exposure to noise may affect a child's physical and psychological health which includes learning as well as behavior. Noise-induced hearing loss (NIHL) is common but it is a preventable disability.[2] Once the hearing ability is lost there is no way to regain it back. Walking with earphone is a fashion for peoples but it causes many problems to our health.[3] Hearing loss is defined by the pure-tone average (PTA) of 0.5, 1, 2, and 4 kHz, with tones presented by air conduction in the better-hearing ear. A PTA of less than 25 dB indicates normal hearing while 25 to 40 dB, denotes mild loss; 41 to 70 dB moderate loss; and greater than 70 dB indicates severe loss.

## HOW THE EAR WORKS:

The ear is divided into three parts—the outer ear, middle ear, and inner ear. This three part work together to enable us to hear sound. The OUTER EAR acts like a funnel to direct sound waves from the air to the eardrum (tympanic membrane). Sound causes the eardrum to vibrate, which causes three bones (malleus, incus, and stapes) in the MIDDLE EAR to move mechanically. The middle ear then sends these mechanical vibrations to the INNER EAR (cochlea), where they are picked up by small sensory hair cells and sent as electrical impulses along the auditory nerve to the brain.[4] Noise-Induced Hearing Loss causes damage or loss of tiny hair cells which are present after prolonged exposure to high levels of noise or sudden high-level noise, such as a fireworks explosion.[2]

## MECHANISM OF NON-INDUCED HEARING LOSS:

The ear is injured by noise in 2 different ways, depending on the type of exposure. High-level, short duration exposures which exceeds 140 dB would stretch the delicate inner ear tissues beyond their elastic limits, then rip or tear them apart. This type of damage-acoustic trauma occurs rapidly and results in an immediate, permanent hearing loss.[5] The organ of Corti becomes detached from the basilar membrane, deteriorates, and is replaced by scar tissue. Because the ear is damaged mechanically by impulsive sounds, the maximum sound pressure level (SPL) is more important than the duration of the exposure.[6] Noises in the environment capable of producing acoustic trauma usually come from explosive events, such as a firecracker detonating near the head (170 dB SPL), a toy cap gun fired near the ear (155 dB SPL), or a shotgun, high-powered rifle, or pistol shot (160-170 dB SPL).[7]

Exposure to noise between 90 and 140 dB<sub>A</sub> damages the cochlea metabolically rather than mechanically thereby causing damage relative to the level and duration of exposure. Noise-induced hearing loss, in contrast to acoustic trauma, develops slowly over years, is caused by any exposure regularly exceeding a daily average of 90 dB<sub>A</sub>, and proceeds in 3 stages.[8]

In the first stage, sensory cells within the cochlea are killed by excessive exposure. These cells do not regenerate; they are replaced by scar tissue.[9] In the second stage, after weeks to years of excessive exposure, hearing loss can be detected via audiometrically. Early loss occurs in the high-frequency range, for example around the highest C note played on a piano.[10] Speech comprehension is not significantly affected; hence, this loss is seldom noticed unless hearing is tested for some other reason. [6]

#### DISADVANTAGES OF USING EARPHONES:

One of the main side effects of listening to loud music is hearing loss. People who listen to music at a volume exceeding 90dB can suffer temporary loss of hearing or could eventually leads to permanent hearing loss, especially to teenagers who wear their earphones for long periods of time. [11] Earphones are made for two years, it is quiet inexorable that people share them. Regular usage of earphones, sharing or borrowing earphones could enhance the growth of harmful bacteria.[12] Dr Chiranjay Mukhopadhyay advises everyone to avoid sharing earphones or else sanitize the earphone.[13]

Loud noise is a major risk factor for hearing loss. Employees exposed to loud noises in industrial workplaces are established as high-risk group for developing hearing loss.[14-16] However, with the recent increasing availability of smartphones and MP3 players, the usage of personal sound equipment (earphone) is on the raise,[17,18] and this causes the population to be exposed to non-occupational noise. Long-term usage of earphone can induce hearing loss, and a few studies have suggested that hearing loss can occur from earphone overuse, regardless of occupational noise exposure.[19,20] Ototoxic chemicals induce hearing loss [21] and also enhance the extent of hearing impairment due to noise. Jones et al. suggested that lead (Pb) is an ototoxic heavy metal and that exposure to lead (pb) induces degeneration of inner ear receptor cells and restricts auditory nerve conduction.[22]

Other disadvantages of using earphones are[23]

- when we cross the road with earphone there is a chance of accident
- it make us addicted itself
- concentration losses when with earphones.

#### ADVERSE HEALTH EFFECTS:

**INTERFERE WITH SPEECH AND LANGUAGE:** constant exposure to noise may affect a child's acquisition of speech, language and others such as reading and listening.[24]

**IMPAIR LEARNING:** a child may not able to concentrate in a noisy environment which affects the child's capacity to pay attention to class.[24]

**IMPAIR HEARING:** Tinnitus (ringing or buzzing in the ears) is one of the symptoms associated with hearing loss. According to study by Hemashree et al, it said that patients with longer duration of diabetics had less hearing sensitivity.[25] Cigarette smoking may affect hearing through its effects on antioxidative mechanisms or on the vasculature supplying the auditory system. Correlation between cigarette smoking and hearing loss among adults has been found in various clinical studies. Weiss in his study stated that that men who smoked more than 1 pack per day had worse hearing thresholds at 250-1000Hz than nonsmokers, apparently there is no difference at higher frequencies.[26]

**AFFECT THE CARDIOVASCULAR SYSTEM:** due to exposure to loud noise elevated blood pressure and other cardio vascular ailments can be usually found in children.[25]

**DISTURBANCE IN SLEEP:** A child can be easily disturbed while sleeping due to loud noise.[25]

#### SYMPTOMS:

Audiologist or otolaryngologist can be consulted if any of the symptoms is experienced. Audiologist is a person who treat those with hearing loss and proactively prevent related damage while an otolaryngologist are physicians trained in the medical and surgical management and treatment of patients with diseases and disorders of the ear, nose, throat (ENT), and related structures of the head and neck. They are commonly referred to as ENT physicians.[27] Suppressed hearing and a feeling that our ear is plugged. Difficult in hearing in the presence of background noise. Raising the volume of tv or radio than in the past. Tinnitus-ringing or buzzing of the ear. Irritation and agony in the ear. Ask people to repeat themselves. Misunderstand what is said to them and appear inattentive to tasks involving listening.[28]

#### NOISE EXPOSURE AND DANGEROUS LEVELS:

According to Portnuff et al, devices that can produce sounds up to 120 decibels can cause hearing loss within one hour and 15 minutes. At 95 dB, damage will occur after 4 hours of exposure per day. At 100dB, damage will occur after 2 hours of exposure per day. At 105dB, damage will occur after 1 hours of exposure per day. At 110dB , damage will occur after 30 minutes of exposure per day. At 115 dB, damage will occur after 15 minutes of exposure per day. At 120-plus dB, damage occurs almost immediately.[29] Sound at 85dB or below is considered safe. Exposure to sound greater than 90dB for an average of eight hours per day without any hearing protection, would lead a person to hearing loss. Deafness is common among people who go for concerts and clubs. Deafness doesn't happen overnight.[30] The ear warns before things can really get bad with tinnitus. According to Vinay et al, people moving from an extremely loud place to an extremely quiet place can be more damaging than exposing oneself to higher decibels for longer period of time.[30]

Hearing loss is related to dementia, through exhaustion of cognitive reserve, social isolation, environmental deafferentation, or a combination of these pathways. Cognitive reserve reflects inter-individual differences in neuro-cognitive processing that allows some individuals to cope better with neuropathology when compared with others with similar neuropathology. Functional magnetic resonance imaging studies showing interindividual variation in efficiency of task-related neural processing provide some evidence in support of this concept. Cognitive reserve has been used to explain discrepancies

between the extent of neuropathology seen during autopsy and clinical expression of dementia. The potential effect of hearing loss on cognitive reserve is suggested by studies demonstrating conditions where auditory perception is difficult (ie, hearing loss), greater cognitive resources are dedicated to auditory perceptual processing to the detriment of other cognitive processes such as working memory. This reallocation of neural resources to auditory processing could deplete the cognitive reserve available for other cognitive processes and can also possibly lead to the earlier clinical expression of dementia.[31] Communication impairments as a result of hearing loss can act as a factor that leads to social isolation in older adults.[32,33] Some epidemiologic and neuroanatomic studies have demonstrated and emphasised the associations between poor social networks and dementia.

#### DIAGNOSIS:

To determine hearing loss, a doctor will first perform certain test and may also look in the ears with a small device called an otoscope.

Audiometry is a test which measures hearing loss using an electronic device. Otoacoustic emissions testing were used to find out whether infant or child have profound hearing loss. Auditory brain stem response testing is performed in case an infant or child fails otoacoustic emission test. Various Research had been done using otoacoustic emissions as biomarkers for cochlear damage due to overuse of PLDs . LePage and Murray in their study identified decreased click evoked OAE levels in some group of personal stereo users compared to similar, nonexposed peers. [34]

In a study conducted among 490 middle and high school students, Kim et al identified significant worsening of hearing thresholds at 4kHz in students who reported PLD use for more than 5 years compared to those who reported no PLD usage. When exposure to PLD use is evaluated, the actual exposure measured over time should be considered. If the output levels of a device exceed the recommended exposure level (REL) for a specified damage-risk criterion (DRC), some concern arise which makes the user at risk of hearing loss. While several damage-risk criteria exist for industrial noise exposure across the world, there is no specific DRC established for recreational noise exposure, music or exposure.[35]

Several studies attempted to evaluate listeners' chosen listening levels (CLLs) via direct measurement techniques. Multiple researchers have evaluated this under a naturalistic environment, such as stopping PLD users on the street and taking measurements of their devices. Williams in his study, measured the CLLs of adult PLD users passing through noisy public areas by placing earphones on a mannequin. He recorded a mean CLL of 86.1 dBA. When self-reported listening times were employed, 25% of users exceeded 100% noise dose.[36]

Prevalent hearing loss in a cohort of older people may be caused due to reasons other than presbycusis. For example, the hearing loss may have developed at a younger age or can represent noise induced hearing loss. Cigarette smoking is a well-recognized factor when associated with other lifestyle and socioeconomic factors adversely affect health. For example, people who smoke are more likely to be exposed to noisy environment and leisure activities, and hence more likely to have more exposure to consume alcoholic beverages, and are more prone to develop chronic conditions such as heart disease which is associated to hearing loss.[37]

Neurological tests including a magnetic resonance imaging (MRI) test or a computerized tomography (CT) scan may be performed to check for possible tumours involving the auditory (hearing) nerve, especially for people with hearing loss that is significantly worse in one ear.[38]

General screening test is a test which will be asked to cover one ear at a time to see how well you hear words spoken at various volumes and how you respond to other sounds.[39]

Tuning fork test is a test which helps to assess the type of hearing loss incurred and is performed by placing the stem of a vibrating tuning fork at the center of the persons forehead. If the patient has normal hearing then the perceived sound is found to be same in both ears. However, if the patient has sensorineural loss which is known as the total or partial inability hearing sound in one or both the ears , then the unaffected ear perceives the sound as louder.[39]

#### SOUND-EXPOSURE LEVELS FROM PLD USE:

When exposure from PLD use is to be evaluated, the actual exposure measured over time should also be taken into account.[40] If the output levels of a device exceed the recommended exposure level (REL) for a specified damage-risk criterion (DRC), concerns arise that put users at risk of hearing loss. While several damage-risk criteria exist for industrial noise exposure across the world, there is dearth of specific DRC for recreational noise exposure or music exposure. For this purpose, risk of hearing loss will reference the DRC established by the US National Institute for Occupational Safety and Health (NIOSH).[41]

The NIOSH REL is set at a maximum exposure to 85 dBA for 8 hours a day with a 3 dB time-intensity trading ratio (exchange rate), which is representing the increment of decibels that results in a halving of exposure time. Using the DRC, an individual's exposure can be represented as a noise dose, a 100% noise dose is equivalent to 8-hour exposure at the REL. Noise dose is a cumulative measure, exposures from individual activities within a given day are added to calculate a total noise dose. Noise doses exceeding 100% will be considered to place the individual at a higher-than-normal risk of acquiring hearing loss. Therefore, while it is accurate to conclude that exposure to high levels of sound (.85 dBA) increase the risk of MIHL, knowing an individual's actual exposure is critical for assessing the true potential for MIHL.[41]

## **ATTITUDE TOWARDS NOISE AND MUSIC**

Individual attitudes toward noise and hearing loss have an effect on the levels the listeners choose for their PLDs. In order to investigate attitudes regarding noise, Widén and Erlandsson proposed the Youth Attitudes to Noise Scale (YANS). The primary use of the YANS is to evaluate attitudes of individuals toward environmental sound exposure.[42]

Several trends appear in the limited research aiming at adolescent attitudes toward PLD use. First, there is a relatively high number of students who report understanding that high levels of sound can cause hearing loss, and that PLDs are capable of producing that level of output.[43] Young adults tend to perceive hearing loss as a significant problem, though the level of concern about MIHL tends to be relatively lower. Furthermore, several studies have suggested that teenagers and young adults have a sense of invulnerability to hearing loss. [44] In a series of structured interviews, Vogel et al asked adolescents about their PLD use and found that the teenagers underestimated their risk and vulnerability towards MIHL.[45]

Moreover, though the teenagers reported that problems related to hearing loss would be severe, few also reported regular concern regarding MIHL due to their own use patterns.[46] The lack of concern for MIHL in students who had not experienced symptoms of hearing loss is in line with Widén's theory that a sense of vulnerability comes from experience. However, some interviewees who reported having experienced temporary symptoms, such as tinnitus, assumed that the symptoms were always temporary, rather than considering it as an indicator of ongoing damage to the auditory system.[47] The lack of concern in this subgroup suggests that an individual's change in mindset towards vulnerability of acquiring hearing impairment requires a more permanent impact from PLD use to trigger a feeling of vulnerability.[48]

## **PSYCHOLOGICAL ASPECTS OF MUSIC LISTENING:**

A wide variety of theoretical bases for the appeal favouring loud music have been presented from a large set of sources. As a part of youth culture, the volume of music functions as a way to express deviance and separation from an older generation.[49] Anecdotally, adolescents and young adults have a higher tolerance and enjoyment of music played that are played at a high volume than children and older adults. Loud music can also be a defining characteristic for the identity of "youth" .[50] Music is a powerful stimulus capable of altering mood, and can even be used as treatment for auditory hallucinations.[51,52] A PLD is used by an individual to drown out external noise and allow for the exertion of control over the individual's auditory environment. In the urban environment, PLD use allows the individual to shape their experiences through music.[53] Furthermore, PLD users report using their music as a tool to regulate affect such as moods and emotions.[54] Beyond an individual's perception, Héту and Fortin described the experience of listening to amplified music such as in a discotheque as an immersion in a shared musical sound field. In the discotheque, music is classified as a type of "mechanoacoustic arouser" that is energizing for the young people. Dance-club music tends to have a more salient low frequencies and a rapid rhythm, the pulsation of music is perceived by the auditory and proprioceptive systems as acoustic and vibratory sensations. [55] As the vestibular (balance) system is sensitive to loud auditory input, as seen in the vestibular-evoked myogenic response, loud music stimulates a pleasurable sensation from the saccule and utricle, the gravity-sensing organs of the vestibular system.[56]

Furthermore, movement is capable of influencing the auditory system's perception of meter and rhythm, which is mediated by the vestibular system[57]. Loud music is recognized as having similar properties like addictive substances, such as drugs and alcohol. Certainly, loud music has commonalities with the major properties of addictive substances as described by Donovan capacity to induce rapid changes in mood and level of arousal, to reduce negative states, and the ability to induce the experience of craving.[58] Adorno described an addiction to the distraction provided by music that comes from constant listening to music. One PLD user described her devices as "like a psychotropic drug", and described the development of craving when she did not have her device for an extended periods of time. To examine listening to music as an addictive behavior, Florentine et al adapted a validated alcoholism-screening test to propose the Northeastern Excessive Music Listening Survey. Of the 90 participants who completed the survey, eight scored in a range which is suggestive of maladaptive behavior, that is consistent with addiction.[59]

## **PREVENTION:**

There are many ways to prevent our self from deafness. In the first few days of being affected, hearing can be repaired with the help of steroids, eventually only a few people spot the defect so soon. By using the hearing protection one can avoid to noise exposure. Wearing ear protection when exposed to loud noise at clubs, sporting events and workplaces. The time spent at noisy events and in noisy environment should be reduced. Should educate the people about the consequences of using earphones and ipods. In case of children, hearing test should be taken if the child participates in noisy activities such as playing an instrument, during noisy activities and events. Create a quiet learning and sleeping environment. Hung et al. reported that participants with high levels of selenium had better auditory function. As selenium is considered to have a positive effect on ear, people with high selenium level might add a protective effect against developing hearing impairments.[60]

The use of isolator-style earphones can significantly reduce LLs in noisy environments. Isolator-style earphones seal the ear canal and physically block out background noise. In most cases, CLL is related to the background-noise level rather than the absolute level of the playing device, and listeners prefer a significant, positive signal-to-noise ratio in order to hear and appreciate music. Indeed, in an 80 dBA environment, listeners choose an average level of 93 dBA, with over 80% of listeners choosing levels above 85 dBA in the ear. In a noisy environment, the signal-to-noise ratio can be improved by reducing background noise through



the use of isolator-style earphones, which physically block out background noise. Use of these earphones in a loud environment like an aircraft cabin or public transit can significantly reduce CLL.[61]

#### TREATMENT:

**Hearing aids:** If hearing loss is due to damage to your inner ear, a hearing aid can be helpful by amplifying sounds and therefore making it easier to hear. An audiologist will discuss the potential benefits of using a hearing aid, recommend a device and fit you with it.[62]

**Cochlear implants:** For severe hearing loss, cochlear implant may also be an option. a cochlear implant compensates for damaged or nonworking parts of the inner ear whereas hearing aid amplifies sound and directs it into ear canal.[63]

#### CONCLUSION:

Hearing loss is usually undiscovered until damage to the inner ear is advanced. The risk of hearing damage depends on sound level and exposure. Hearing professionals can help patients understand the importance of preserving hearing into later life and the steps that can be taken to prevent hearing loss. Therefore music players such as ipods, MP3 and etc should be played at lower volume. Finally to avoid hearing loss, one must limit the time spent in noisy activities.

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