Noise-Induced Hearing Loss Caused by Earphones: A Literature Review

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Abstract

Noise-induced hearing loss (NIHL) refers to a type of hearing impairment that arises from the extended exposure to elevated levels of noise. This condition primarily affects the sensory cells and nerves responsible for auditory perception. It is the second most prevalent component behind presbycusis, commonly impacting both ears bilaterally. Noise-induced hearing loss (NIHL) is a condition that arises when an excessive level of sound intensity is transmitted via the auditory system.

Keywords: Noise Induced Hearing Loss, Earphones, Medicine

1. Introduction

Noise-induced hearing loss (NIHL) is a sensorineural hearing impairment caused by prolonged exposure to high noise levels. Risk factors associated with increased potential for harm include the presence of weapons, motorbikes characterized by high noise emissions, exposure to loud music, and attendance at loud events. Earphones, widely used by students as a communication aid; however, usage patterns show variability. There exists a segment of the population that possess limited knowledge regarding the potential hazards associated with high levels of auditory stimulation, leading them to surpass the typical threshold of sound intensity. Earphone usage behavior includes duration of use, loudness power, and frequency of use. [1].

2. Epidemiology

Estimated number of sufferers of the disorder worldwide hearing increases from 120 million in 1995 people became 250 million people in 2004.[2]. More than 5% of the world's population has hearing loss (328

million adults and 32 million children).[3]. In Indonesia, the prevalence of deafness is 4.6% or as many as 16 million people and disruption hearing is about 16.8% of the number Indonesian population.[4] Very strong noise is greater than 90 dB can cause physical interference on the ear organs. [4]. Hearing loss due to noise according to several studies influenced by several factors such as noise intensity, length of exposure time, age, gender, duration of exposure, area of site work and use of personal protective equipment.[4].

3. Pathogenesis

Noise-induced hearing loss is a condition that arises when there is an excessive transmission of sound intensity via the auditory system. The external auditory canal, often known as the ear canal, is responsible for receiving an auditory input, such as that emitted by a radio, which subsequently traverses the tympanic membrane (eardrum), inducing vibrations in the membrane. When the tympanic membrane is subjected to vibration, the stapes, malleus, incus, and ossicles of the middle ear all vibrate in unison with the tympanic membrane at the same time. The ossicles of the middle ear are responsible for facilitating the passage of mechanical energy to the cochlea. This allows the stapes footplate to exert stress against the oval window of the cochlea, which in turn results in the sound signal being amplified. [9].

The auditory stimulation induces the displacement of the perilymph and endolymph fluids within the cochlea. The movement of fluid within the cochlea induces a corresponding movement of hair cells, which are sensory cells responsible for auditory perception. The ensuing movement initiates the transmission of an electrochemical signal via the vestibulocochlear nerve (CN VIII), often referred to as the auditory nerve, to the central auditory system situated in the brain. The cerebral area responsible for the processing and interpretation of auditory stimuli is often known as the auditory cortex. Hair cells have diverse reactions to various frequencies. [10].

Higher frequency noises are especially sensitive to hair cells at the cochlea's base. Lower frequency noises, on the other hand, are particularly responsive to hair cells toward the apex (National Institute on Deafness and Other Communication Disorders, 2015). Excessive noise has the capacity to generate noise-induced hearing loss (NIHL) via two basic pathways: the impairment of stereocilia, which are located atop hair cells and are responsible for sound detection, and the impairment of synapses inside the auditory nerve. This phenomenon is commonly known as "hidden hearing loss.". [5]

4. Earphone as the Cause of Noise Induced Hearing Loss

Noise-induced hearing loss (NIHL) may develop as a consequence of either a single occurrence of exposure to a very powerful "impulse" sound, such as an explosion, or by a persistent exposure to loud sounds

over an extended time, such as the noise created in a carpentry shop. NIHL is an abbreviation for "noise-induced hearing loss.".

Decibels serve as the standard units for quantifying sound. Hearing loss is improbable to occur even with extended exposure to sounds that are at or below 70 A-weighted decibels (dBA). Extended or repeated exposure to sounds at or over 85 dBA, however, can lead to auditory impairment. The more intense the sound, the shorter the duration required for the onset of noise-induced hearing loss (NIHL).

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The main issue with earphones is loudness since they may emit incredibly loud sounds very close to the ear. Given that loud noises are bad for the ears, this poses a risk to hearing. When sound waves are introduced into the auditory canal, they elicit vibrations in the tympanic membrane.[13]. The transmission of this vibration occurs through a series of minuscule ossicles to the cochlea located within the inner ear. The cochlea, located in the inner ear, is a chamber filled with fluid and contains numerous microscopic hair cells. The fluid within the cochlea undergoes vibrations as a result of sound waves, hence causing displacement of the hair cells. The amplification of sound waves results in vibrations that induce the displacement and increased mobility of hair strands. Hair cells exhibit reduced sensitivity to vibration following prolonged exposure to excessively loud sounds. The repetition of loud noises induces cellular folding and flexion. This is the reason for the perception of "temporary hearing loss." The intense vibrations brought on by loud noise require time for the hair cells to adjust. Occasionally, though, the cells fail to heal. It's possible that they're too damaged to carry on regularly. Hearing loss is permanent as a result of this. According to the Oklahoma Hearing Center (2020), this kind of noise-induced hearing loss is essentially permanent.[6].

Among students' earphones are one of the most favored communication aids technologies. It has functions ranging from listening to music, watching videos or movies, making phone calls, etc. From these, its duration varied from person to person. Some people are unaware of the dangers of using earphones too loudly and may use them far exceed the average volume intensity. Earphone use behavior includes the type of earphones that they use, the duration that they wear per day, their volume intensity, and their frequency of earphone usage.

5. Diagnosis

Hearing loss that occurs due to noise is a type of sensorineural deafness, this type is generally irreversible. Some clinical findings that can be found in individuals who have lost their hearing include tinnitus, ringing in the ears, or roaring in the ears or head.[14]. Tinnitus may improve, but sometimes it persists throughout life. This can occur in one or both ears. In addition, continuous exposure to impulses or loud sounds sometimes also causes temporary hearing loss that disappears 16 to 48 hours later.[7].

If the hearing loss occurs bilaterally and has been suffered for a long time, the sound of the sufferer's conversation is usually louder and gives the impression of a tense atmosphere compared to normal people. This difference is more obvious when compared with the soft voice of otosclerosis sufferers.[15]. Sufferers have more difficulty interpreting or hearing sounds or conversations in a noisy atmosphere. There is a history of head trauma, acoustic trauma, history of use of ototoxic drugs, or previous systemic disease. On physical examination or otoscopy, the external ear canal and eardrum membrane appear normal. In the hearing function test, namely the whisper test, sufferers cannot hear whispered conversations at a distance of five meters and have difficulty hearing words that sound high pitched.[15]. In a positive Rinne tuning fork test, air conductivity is better than bone conduction. Weber's test shows lateralization towards the healthy ear. Schwabach's test shows shortening of the bone conduction.[8].

6. Management of NIHL

Noise-induced deafness is permanent cochlear nerve deafness (irreversible), if hearing loss has resulted in difficulty communicating at normal conversational volumes, a hearing aid (ABD) can be tried [17]. If the hearing is still severe even after using ABD the patient could not communicate adequately, psychotherapy needs to be done so that the patient can accept the situation. Hearing training (auditory training) can also be carried out so that patients can use residual hearing with ABD efficiently, assisted by lip reading, facial expressions, and limb movements as well as sign language to be able to communicate. [16].

7. Prevention

Protects ears completely using earmuffs directly can reduce interference between 25-40 dB. Controlling noise from the source this can be done by installing a damper sound and placing noise (machines) in a room separate from workers. Hearing tests need to be carried out periodically and carried out noise analyzer by assessing intensity noise, noise frequency, duration and distribution exposure and total noise exposure time. The main tool in noise measurement is a sound level meter.[18].

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