

Noise as a cause of hearing loss in young people and adolescents

Angel Echevarría-Cruz^{1,*}, Mónica de la Caridad Arencibia-Álvarez²

1. University of Medical Sciences of Pinar del Río, Faculty of Medical Sciences "Dr. Ernesto Che Guevara de la Serna", Cuba

2. University of Medical Sciences of Santiago de Cuba, School of Medicine No. 2, Cuba

*Corresponding author.

Email address: anjel9802@gmail.com

Abstract: Introduction: hearing loss is the functional deficit that occurs when a person loses hearing capacity to a greater or lesser degree; currently being a disease on the rise among the young population. Objective: to describe the effect of noise as a causal factor of hearing loss in young people and adolescents. Method: an information search was performed in SciELO, Scopus and ClinicalKey. A total of 20 articles referring to the characteristics of hearing loss in young people and adolescents were selected. Development: hearing loss is a common disorder in society with incidence in all age groups. The age range of onset of hearing disorders has decreased considerably, which means that, over time, the young population is more affected by this disease. Although it is true that the population most affected is the elderly, the constant use of headphones and high levels of noise pollution have caused their increase in young people. Constant exposure to music at high volumes as well as other noises affect the integrity of the auditory pathway. Conclusions: hearing loss is an important health problem in young people and adolescents with a negative influence on the structuring of intelligence and social skills and psychological state. Exposure to high volumes in headphones, as well as noise pollution from noise and loud music are its main causes.

Key words: hearing loss; noise-induced; hearing loss; hearing disorders; noise ; ear diseases; noise; occupational

1 Introduction

Hearing loss is the partial loss of hearing ability; this loss can be 40 decibels or more. People with hearing loss use hearing aids to partially restore their ability to receive sound waves. The degree of hearing loss is defined according to the individual's ability to hear sounds of varying intensities. Their hearing threshold, therefore, is determined by the least intense stimulus that the individual is capable of detecting [1].

Thanks to the contributions of Alfonso Corti (1828–1888), the anatomy of the ear was nearly complete by the early 19th century. As for physiology, Flourens (1794–1867) suggested that the auditory nerve consisted of two parts: the cochlear portion, which was related to hearing, and the vestibular portion, which was related to balance. Further contributions were made by the German Hermann von Helmholtz, which led to advances in our understanding of the functions of the ear [2].

The earliest reference to the effect of noise on hearing is an observation recorded in the 1st century BCE by Pliny in his "Natural History," in which he mentions that people living near the Nile Falls "became deaf." By the late 19th century,

with the advent of the steam engine and the dawn of the Industrial Revolution, noise emerged as a major public health problem [3].

During this period, cases of hearing loss among exposed workers, such as blacksmiths and welders, began to be documented. In 1831, Fosbroke mentioned hearing loss among blacksmiths. In 1907, Wittmarck demonstrated the histological effects of noise on the ear. In 1946, Krisstensen referred to hearing loss among aviators and submarine crew members. William Wilde explained that there were two types: one caused by earwax, which was curable, and another that was incurable and whose cause was unknown [2].

Noise has negative effects on humans and their environment. It is now known that due to high noise levels, 75% of residents in industrialized cities suffer from some form of hearing loss; however, there is a lack of awareness regarding this problem [3,4].

Noise-induced hearing loss (NIHL) is a health problem that is on the rise, in parallel with the advancement of civilization. Exposure to high-intensity noise causes disorders such as the inability to communicate effectively, reduces the quality of life and social interaction, a phenomenon known as socioacusis [3,4,5].

Hearing loss is a significant health issue in children due to its impact on cognitive development, attention, memory, intellectual development, and social skills. In adulthood, individuals with hearing loss may feel socially excluded, in addition to the disability it entails [6].

It is estimated that approximately 10% of the adult population has some degree of hearing loss, and 33% of people over 65 years of age worldwide have hearing loss severe enough to require a hearing aid. International surveys have determined that 10% of the populations in Europe and the Americas have hearing loss [5]. For this reason, the present study aims to describe the causal factors of hearing loss in young people and adolescents.

2 Method

A narrative review was conducted using articles retrieved from SciELO, Scopus, and ClinicalKey during the period from January to March 2019.

Filters were used to select articles in English and Spanish, as well as articles published between 2016 and 2020. Articles outside this time frame were included due to their relevance to this study, ensuring that the research maintained an update rate of at least 90%.

The following terms were used: "pérdida auditiva provocada por ruido", "pérdida auditiva", "ruido", "trastornos de la audición", "enfermedades del oído", "ruido en el ambiente de trabajo," as well as their English translations: "hearing loss, "hearing disorders," "noise", "ear diseases", "noise, occupational"; all of which were extracted from Health Sciences Descriptors (DeCS). The 20 references that met the validity criteria—addressing the role of noise in the development of hearing loss—were selected.

3 Development

Hearing loss is currently one of the most common chronic conditions worldwide, and the trend toward its onset at younger ages is alarming. This means that, over time, the younger population is becoming more affected by this condition, challenging the popular belief that it is a disorder associated solely with aging. Despite the general perception that hearing loss is a problem that affects only the elderly, an increasing number of young people are beginning to experience hearing loss [5,6,7].

Among its causes is an excessive buildup of earwax, which directly affects the external auditory canal. Similarly, ear infections—which can leave fluid in the ear—as well as external factors such as maternal rubella during pregnancy and Rh incompatibility, can lead to hearing loss [5,6].

Scars or holes in the eardrum that may impair its function, foreign objects lodged in the external auditory canal, damage to the ossicles, and prolonged exposure to very loud and constant noise are reported to be associated with the development of hearing loss [4].

The first symptom in a patient exposed to loud noise is the onset of ringing (tinnitus) in the ears. High-frequency tinnitus is an unmistakable sign that some cells have begun to be damaged. Since this ringing usually disappears within hours or days, it is often dismissed as unimportant, and the patient does not seek early medical attention. However, it is a warning sign. Disabling hearing loss is defined as a hearing loss greater than 40 dB in the better ear in adults and greater than 30 dB in children. The critical frequency range for conversation is audible between 0.5 and 4 kHz, and it is estimated that after age 60, hearing declines by an average of 1 dB per year, with a greater loss observed in men than in women [5].

By the time a patient arrives at the clinic with persistent tinnitus, the damage is already irreversible. At that stage, a serious problem has already developed that limits the patient's quality of life in many ways: their social and academic relationships, and their ability to learn. The solution in these cases is to use hearing aids [6].

The WHO (World Health Organization) states that by 2050, 10% of the world's population will suffer from varying degrees of hearing problems due to prolonged exposure to loud noise. The impact of noise on health is an evident reality that has gone beyond the industrial context to become a major social problem. Modern society, driven by the use of technology, promotes the use of machinery and devices that generate noise; children and young people are exposed to its influence earlier than ever before [5,7].

Noise-induced hearing loss (NIHL) is defined as a partial or total, permanent, and cumulative sensorineural hearing loss in one or both ears that develops gradually, during and as a result of exposure to harmful levels of noise—whether continuous or intermittent—of relatively high intensity over a long period of time. It must be distinguished from acoustic trauma, which is considered an accident rather than a true occupational disease. NIHL is characterized by an insidious onset, a progressive course, and a predominantly bilateral and symmetrical presentation. Like all sensorineural hearing loss, it is an irreversible condition, but unlike these, NIHL can be prevented by maintaining proper hearing hygiene [7].

It has been estimated that one-quarter of people aged 20 to 69 suffer from some form of noise-induced hearing loss; as a result, it is currently considered one of the most common irreversible conditions among young people [8]. Similarly, it has been reported that hearing loss begins in one out of every five people before the age of 20 [9]. Noise-induced hearing loss develops gradually, so the patient does not notice it until it reaches a severe stage.

One of the most common ways teenagers and young adults listen to music is through personal devices (cell phones, tablets, MP3 players, etc.). This practice has become so widespread that, in some social circles and among certain age groups, virtually every teenager owns a device of this kind. It has been found that music is frequently listened to on these devices at high volume and for very long periods of time, which can lead to hearing loss. Currently, it is increasingly common for people to develop hearing problems at a younger age due to the greater amount of loud sounds and prolonged use of headphones to which we are exposing ourselves, exceeding recommended limits [7,8].

Music in nightclubs, concerts, or parties, traffic noise, and factory noise cause hearing loss, a problem exacerbated by the fact that people grow accustomed to noise, perceiving it as a natural part of their environment. Part of the reason for this lies in the fact that more and more young people are incorporating sound into their daily activities, especially those in the younger age groups. Thus, the data show that up to 50% of people under 35 work with music playing, and more than 60% prefer to relax with sounds rather than in silence [9,10].

In the case of music players (cell phones, MP3 players, etc.), sound levels can reach 130 dB, compared to the recommended limit of 50 dB. One hour of daily exposure to high-intensity sounds (105 decibels or more) progressively

damages the cells of the ear; therefore, it is recommended not to be exposed to any sound source—whether a phone or headphones—for more than 60 minutes a day, listen to audio devices at no more than 60% of their output capacity, and avoid earbuds that are inserted into the ear. Over-ear headphones with ear cushions are better, as they block out external noise and reduce the need to turn up the volume to hear the music [10].

Average sound pressure levels in nightclubs exceed 100 dB in all cases. Approximately 60% of nightclubs reach the pain threshold, hitting 110 dB. After being exposed to high sound levels, 45% of adolescents experience tinnitus [11,12].

In the city of Córdoba (Argentina), when a FIAT factory was established in 1999, out of a pool of 5,000 applicants, approximately 10%—aged 20 to 25—were rejected due to hearing loss. And of the 1,700 applicants to the Córdoba Provincial Police Academy in 2003, 21% aged 17 to 21 and 52% aged 21 to 25 were rejected due to noise-induced hearing loss [11].

According to the Better Hearing Institute, 65% of hearing loss cases occur in people between the ages of 18 and 44. This means that the age at which hearing problems first appear has decreased, as a result of noise pollution to which people are exposed in homes, public places, and workplaces [13].

About one-third of adolescents and young adults up to age 18 suffer from tinnitus, which often leads to hearing loss—a problem associated with lifestyle and habits [14].

While the average person is born with approximately 16,000 hair cells, up to 30–50% may be damaged or destroyed before any noticeable level of hearing loss is detected. Unfortunately, there is a limited ability to detect the early stages of noise-induced hearing loss. Hearing loss related to the destruction of hair cells in the inner ear is irreversible and cannot normally be restored by the use of a hearing aid [15].

Tinnitus is caused by temporary or permanent damage to the hair cells in the cochlea, located in the inner ear. These cells respond to sound vibrations and can be damaged by very loud noises [16,17]. Currently, the main cause is acoustic trauma: prolonged exposure to high-intensity noise [18].

Fanzo González and colleagues [15] warn of hearing damage among young people, particularly due to the use of portable music players. The maximum sound levels that should not cause damage range between 80 and 85 dB; however, modern music players reach much higher levels than the Discman or Walkman of the past, exceeding 120 dB.

Currently, there are specific solutions for treating hearing disorders, ranging from conventional hearing aids to more sophisticated technologies such as implantable hearing aids and cochlear implants. It is estimated that only about 20% of older adults with moderate to profound hearing loss perceive themselves as having a disability [18]; only 25% of potentially eligible patients obtain a hearing aid, and a significant percentage of those who have one do not use it [18].

It is estimated that only one in five people who could potentially benefit from hearing aid use has access to one. Based on data from the National Health and Nutrition Examination Survey (NHANES) in the United States, it is reported that one in seven people aged 50 or older with hearing loss uses a hearing aid [19].

The situation for people with hearing loss improves through early detection, the use of hearing aids, cochlear implants, and other assistive devices, as well as through the use of captions, learning sign language, and other educational and social support measures. Significant scientific advances have been reported, such as a miniature inner ear. This breakthrough could lead to the development of new treatments for hearing loss and vertigo. This three-dimensional structure contains hair cells—sensory cells covered with microscopic hairs—that play a key role in hearing [20].

Given that noise-induced hearing loss is a preventable condition, children and adolescents should be educated and made aware of the issue and the importance of hearing care, since one of the most obvious effects of hearing loss in childhood, for example, can be language development. It also has an impact on literacy, self-esteem, and social skills.

Untreated hearing loss is often associated with poor academic performance, which can lead to greater communication difficulties and psychological consequences that may affect the patient's emotional well-being. The impact on families is also negative. Similarly, it is recommended that young people and adolescents set the volume of devices placed directly in the ear to less than 60% of their maximum capacity [15].

Healthcare professionals, educators, and media professionals must work together to raise awareness and prevent the harmful effects of this condition. Avoiding exposure to very loud sounds, using headphones judiciously—for short periods and at moderate volumes—and wearing appropriate protective gear in the workplace if one works in noisy environments, such as airports, factories, or construction sites, are highly effective measures [18].

The impact of hearing loss can be significant, with potential consequences for the social, functional, and psychological well-being of the affected individual. This is because the disease process is not well understood, and there are no tools available to halt its progression. In this regard, the consequences of hearing loss on the quality of life of those affected should be considered, and their condition and progression should be assessed. This is compounded by the higher prevalence of certain conditions in people with hearing loss that themselves affect their quality of life, such as depression, anxiety disorders, and social isolation. This is because communication difficulties affect interaction with others, and this fundamental aspect of daily life can have a negative impact on quality of life. Only 39% of people with hearing loss report having an excellent overall quality of life [19].

It has been reported that hearing loss is underdiagnosed and undertreated. This may be due, first, to the fact that it is a slowly progressing condition or to the widespread belief that hearing loss is a normal part of aging, and, second, to the limited availability of treatment options or resistance to the use of hearing aids. Effective intervention in patients with hearing loss can improve social and emotional functioning, communication, cognitive functioning, and depression [17].

4 Conclusions

Hearing loss is a significant health problem among young people and adolescents, with a negative impact on the development of intelligence, social skills, and psychological well-being. Exposure to high volumes through headphones, as well as noise pollution from loud noise and music, are its main causes.

Conflicts of Interest

The author declares no conflicts of interest regarding the publication of this paper.

References

[1] José L. Prosper Ménière (1799-1862), Instituto de Historia de la Ciencia y Documentación (Universidad de Valencia - CSIC), Agosto de 2006. Disponible en: <http://www.historiadelamedicina.org/meniere.html>.

[2] Cardemil M, Mena G P, Herrera J, Fuentes E, Sanhueza D, Rahal E M. Prevalencia y causas de hipoacusia en una muestra de escolares de la zona sur de Santiago. *Rev. Otorrinolaringol. Cir. Cabeza Cuello* [Internet]. 2016 Abr [2019 Sep 15]; 76(1): 15-20. Disponible en: https://scielo.conicyt.cl/scielo.php?script=sci_arttext&pid=S0718-48162016000100003&lng=es.

[3] Haddad J, Keesecker S. Hearing loss. In: Kliegman RM, Stanton BF, St Geme JW, Schor NF, eds. *Nelson Textbook of Pediatrics*. 20th ed. Philadelphia, Elsevier; 2016.

[4] Márquez N, Santana E. Comportamiento de la hipoacusia no sindrómica en una familia del municipio de Urbano Noris. Holguín. *Gac Méd Espirit* [Internet]. 2017 Abr [citado 2019 Sep 15]; 19(1):51-61. Disponible en: www.revgespirituana.sld.cu/index.php/gme/article/view/1074.

[5] Toledo Valdés C, Pacheco Macías AR, Pérez García T, Contreras Álvarez PJ, Armstrong L. Características clínicoepidemiológicas de pacientes ancianos con Hipoacusia atendidos en el Hospital Calixto García. *Rev. hab. Cienc.*

Med [Internet]. 2018 [citado 2019 Sep 15] ;(3):427-39. Disponible en:

www.revhabanera.sld.cu/index.php/rhab/article/view/2152

[6] Borkoski BS, Falcón JC, Corujo C, Osorio Á, Ramos A. Detección temprana de la hipoacusia con emisiones acústicas. Rev. Otorrinolaringol. Cir. Cabeza Cuello [Internet]. 2017 Jun [citado 2019 Sep 15] ; 77(2): 135-143. Disponible en: https://scielo.conicyt.cl/scielo.php?script=sci_arttext&pid=S0718-48162017000200003&lng=es.

[7] Cárdenas Rodríguez AE, La Rosa Macía O, Rodríguez Pena A, Somano Reyes AJ. Incidencia de factores de riesgo para hipoacusia y su lateralidad en menores de un año. Medicentro Electrónica [Internet]. 2018 Jun [citado 2019 Sep 15] ; 22(2): 128-134. Disponible en: <http://revmedicentro.sld.cu/index.php/medicentro/article/view/180>.

[8] García Ortiz MJ, Torres Núñez M, Torres Fortuny A, Alfonso Muñoz E, Cruz Sánchez F. Audiometría de altas frecuencias: utilidad en el diagnóstico audiológico de la hipoacusia inducida por ruidos. AMC [Internet]. 2017 Oct [citado 2019 Sep 15] ; 21(5): 584-591. Disponible en: www.revistaamc.sld.cu/index.php/amc/article/view/5255.

[9] Cardemil M . Hipoacusia asociada al envejecimiento en Chile: ¿En qué aspectos se podría avanzar?. Rev. Otorrinolaringol. Cir. Cabeza Cuello [Internet]. 2016 [citado 2019 Sep 15] ; 76(1): 127-135. Disponible en: https://scielo.conicyt.cl/scielo.php?script=sci_arttext&pid=S0718-48162016000100018&lng=es.

[10] Hernández Martínez CT, Robles Bermeo N L, Medina Solís Carlo E, Jiménez Gayosso SI, Centeno Pedraza C. Manejo odontológico del paciente con hipoacusia neurosensorial profunda bilateral. Rev Cubana Estomatol [Internet]. 2017 [citado 2019 Sep 15] ; 54(3): . Disponible en: http://scieloprueba.sld.cu/scielo.php?script=sci_arttext&pid=S0034-75072017000300009&lng=es.

[11] Alfonso Muñoz E, Lorenzo González Y, Torres Nuñez MM. Importancia del test de METZ en el diagnóstico topográfico de las hipoacusias neurosensoriales. Revista Cubana de Tecnología de la Salud [revista en Internet]. 2015 Sep [citado 2019 Sep 15];6(4):[aprox. 61 p.]. Disponible en: <http://www.revtecnologia.sld.cu/index.php/tec/article/view/487>.

[12] Mattos Vélez MB, Morales Peralta E, Hernández Padilla XI, Quintana Mirabal SE, Álvarez Rivero MB, Martín García Y . Hipoacusia de causa genética en cubanos con implante coclear. Rev haban cienc méd [Internet]. 2014 Dic [citado 2019 Sep 15] ; 13(6):884-892.Disponible en: http://scieloprueba.sld.cu/scielo.php?script=sci_arttext&pid=S1729-519X2014000600009&lng=es.

[13] Barreras Rivera D, Peña Casal C L, Arnold Alfonso ML, Alfonso Rodríguez J, LLerena Suárez JA. Impacto biopsico-social del uso indiscriminado de dispositivos de audio. Rev Med Electrón. [Internet]. 2016 [citado 2019 Sep 15]; 38(5): 677-688. Disponible en: http://scieloprueba.sld.cu/scielo.php?script=sci_arttext&pid=S1684-18242016000500003&lng=es.

[14] Castro Pérez F, Ramos Cruz M, Martínez Caballero M, Cruz Menor M. Caracterización de la hipoacusia en casos con síndrome de Waardenburg. Rev Ciencias Médicas [Internet]. 2016 Abr [citado 2019 Sep 15]; 20(2):74-80.Disponible en: http://scieloprueba.sld.cu/scielo.php?script=sci_arttext&pid=S1561-31942016000200012&lng=es.

[15] Fanzo González P, Cornetero Mendoza D R, Ponce Linares R A, Peña-Sánchez E R. Frecuencia de hipoacusia y características audiométricas en pacientes con diabetes de un hospital de la ciudad de Chiclayo, Perú, 2015. Rev. argent. endocrinol. metab. [Internet]. 2016 Dic [citado 2019 Sep 15] ; 53(4): 157-162. Disponible en: http://www.scielo.org.ar/scielo.php?script=sci_arttext&pid=S1851-30342016000400006&lng=es.

[16] Bravo A, Kre M, Gómez F, García T María Francisca, Sandoval V Paula, Torrente A Mariela. Indicadores de calidad del Programa de Detección Precoz de Hipoacusia Permanente del Hospital Padre Hurtado. Rev. Otorrinolaringol. Cir. Cabeza Cuello [Internet]. 2017 Jun [citado 2019 Sep 15] ; 77(2): 117-123. Disponible en: https://scielo.conicyt.cl/scielo.php?script=sci_arttext&pid=S0718-48162017000200001&lng=es.

[17] Furones Araujo D, Gallego Fernández C, Asensi-Díez R. Hipoacusia asociada al tratamiento con paromomicina en un paciente con leishmaniasis visceral. *Farm Hosp.* [Internet]. 2017 Jun [citado 2019 Sep 15] ; 41(3): 433-434. Disponible en: http://scielo.isciii.es/scielo.php?script=sci_arttext&pid=S1130-63432017000300433&lng=es.

[18] Sosa H, Calvo A, Leiva N. Caso clínico 02-2017: Varón de 36 años con hipoacusia, proptosis y vértigo. *Rev Med Hered* [Internet]. 2017 [citado 2019 Sep 15] ; 28(2): 123-128. Disponible en: http://www.scielo.org.pe/scielo.php?script=sci_arttext&pid=S1018-130X2017000200010&lng=es.

[19] Díaz C, Goico M, Cardemi F. Hipoacusia incidencia, trascendencia y prevalencia. *Science.* [Internet]. 2016 [citado 2019 Sep 15]; 48(4)[aprox. 10 p.] . Disponible en: <http://revmedmilitar.sld.cu/index.php/mil/article/view/431>.

[20] Schaefer SA, Higashi AY, Loomis B, Schrepfer T, Wan G, Corfas G, Dressler GR, Duncan RK. From Otic Induction to Hair Cell Production: Pax2EGFP Cell Line Illuminates Key Stages of Development in Mouse Inner Ear Organoid Model. *Stem Cells Dev.* 2018 [citado 2019 Sep 15];27(4):237-251. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5813733/>.