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ARÁN

Nutrición Hospitalaria

Alimentación en la prevención y control de diversas enfermedades

Impact of nutrition on hearing loss

Impacto de la nutrición en la pérdida auditiva

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Abstract

The incidence of hearing disorders is rising at an alarming rate, aggravated by increasing longevity, without sufficient social awareness and attention from public health officials. The etiology of hearing loss (HL) is multifactorial, including both genetic and environmental factors, such as noise, ototoxic drugs, and nutritional status. Therefore, it is necessary to expand knowledge about the relationship between the different factors involved as a first step towards prevention and potential repair of hearing damage before it becomes irreversible and significantly limits the quality of life. Our recent studies have demonstrated the interrelationship between nutrition and HL highlighting the strong need to implement prevention and nutritional intervention strategies aimed at promoting hearing health from the earliest stages of life.

Keywords:

Hearing loss. Auditory function. Nutrition. Folic acid. Homocysteine.

Resumen

La incidencia de los trastornos auditivos está aumentando de forma alarmante, especialmente agravada por el aumento de la longevidad, sin que exista la suficiente conciencia social y atención por parte de los responsables de salud pública. La etiología de la pérdida auditiva es multifactorial: intervienen factores genéticos y ambientales, como el ruido, las sustancias ototóxicas y el estado nutricional. Por ello, es necesario ampliar el conocimiento acerca de la relación existente entre los diferentes factores como primer paso para la prevención y potencial reparación del daño auditivo antes de que llegue a ser irreversible y límite de manera significativa la calidad de vida en el adulto mayor. Nuestros recientes estudios han demostrado una interrelación entre la pérdida auditiva y la nutrición que pone de manifiesto la necesidad de implementar estrategias de prevención y de intervención nutricional dirigidas a promover la salud auditiva desde las primeras etapas de la vida.

Palabras clave:

Pérdida auditiva. Función auditiva. Nutrición. Ácido fólico. Homocisteína.

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INTRODUCTION

Hearing loss (HL) is a public health problem that deserves global recognition and prioritization, as it clearly affects the quality of life, reduces labor productivity, and significantly increases the risk of dependency. The most recent Global Burden of Disease report (2019) indicated that 1.57 billion people, or 20.3 % of the world population, are affected by any kind of HL. This percentage rises to 62 % for people aged 50 and over (1).

Specifically, HL is a sensory impairment with multifactorial etiology (2,3). Genetic factors include mutations in genes or regulatory elements involved in the development, structure, and/or function of the ear, whereas environmental factors include noise exposure, ototoxic drug consumption, and/or nutritional deficiencies (4). In most cases, HL is potentially preventable and treatable, so making its prevention and early detection crucial, as it has been associated with numerous adverse physical and mental health outcomes. In fact, the World Health Organization (WHO) has recently called for urgent actions to address the needs of people with ear diseases and HL, in vulnerable population groups, including the 1.1 billion adolescents and young adults at risk of HL due to prolonged exposure to loud music (5).

Noise-induced HL (NIHL) is the second most common cause of HL after presbycusis (age-related HL), being the result of multifactorial damage to auditory structures following exposure to loud noise sources at work, in the environment or during leisure activities (6). Globally, NIHL is estimated to affect approximately 5 % of the population and is generally more common among adult men (7). Conversely, this data might be underestimated, as the prevalence of NIHL varies widely between populations and age-groups. Moreover, although NIHL is frequently irreversible, it is a largely preventable condition if appropriate precautions are taken. Interestingly, preventive measures seem to be effective in reducing the incidence of HL as a result of noise exposure (8,9). In this context of concern about the influence of noise exposure on health, it is important to point out the role of nutrition as a modifiable risk factor for HL (4,10). Therefore, there is an urgent need to deeply characterize the dietary impact on the management of NIHL in young adults, to potentially establish precision nutritional intervention strategies aimed at preventing and/or repairing hearing damage before it becomes irreversible.

In this regard, for example, some studies have demonstrated the role of certain specific nutrients in HL, with high intakes of saturated fats (11), simple carbohydrates (sugars) and certain minerals (4) being associated with HL. In addition, recent studies have linked vitamin D deficiency to several cardiovascular risk factors, that appear to be related to increased mortality and incidence of cardiovascular diseases, due to the role of vitamin D in blood pressure regulation by its action on endothelial cells (12,13). Moreover, recent studies also seem to associate vitamin D status with HL in the elderly (14) and with several HL disorders (15-17). To date, to the best of our knowledge, the mechanism involved is unclear, but it appears to be related to the key role of this vitamin in inflammation, regulating the expression of pro-inflammatory mediators (18).

Furthermore, insufficient folic acid (FA) levels have been correlated with HL onset when combined with low vitamin B_{12} concentrations or hyperhomocysteinemia (HHcy) (19-23). In this line, other studies have provided evidence of the potential protective effect of dietary supplementation with FA against HL (17). These B vitamins are directly or indirectly involved in homocysteine (Hcy) metabolism, which comprises the methionine and folate cycles, and the transsulfuration pathway. Hcy thus emerges as a hub of key pathways of the intermediary metabolism that has been mainly studied in the liver of experimental models (24). Interestingly, the cochlea is one of the few sensory organs in which the whole expression and protein profile of the methionine cycle and transsulfuration pathway has been reported (25). The proper functioning of these pathways depends on a continuous supply of key nutrients (methionine, vitamins B_{12}, B_6, and folate), whereas their insufficient consumption impairs the flux through these pathways and, in turn, the synthesis of key compounds for cell function (e.g. phospholipids, neurotransmitters, etc.) and important regulatory mechanisms (e.g. epigenetic methylations).

Based on the studies on HL, several supplementation studies carried out in humans have attempted to reduce systemic Hcy levels (26,27). In addition, two studies from our research group using mouse models have identified a relationship between Hcy metabolism, HL, and FA deficiency (25,28). For example, we have demonstrated that FA deficiency induces premature HL in animals from different genotypes, leading to alterations of the cochlear structure that correlate with changes in cochlear Hcy metabolism, associated with oxidative stress and increased levels of protein homocysteinylation (25). Furthermore, we have demonstrated in aviation pilots (exposed to noise pollution at their workplace) high prevalence of HL, which increased with age and flight hours at higher frequencies. These results showed a clear association between HL and flight hours, serum folate, and serum Hcy levels (29).

CONCLUSIONS

The high prevalence and incidence of HL, together with the lack of an effective treatment, as well as the associated co-morbidities makes the management of this condition one of the greatest global challenges of the 21st century. This is especially crucial in vulnerable population groups such as, young adults and adolescents exposed to loud music sources. In this context of concern, it is important to point out the role of nutrition as a modifiable risk factor for HL. Therefore, there is an urgent need to characterize not only nutrients´ effect on the auditory function but also the dietary impact on the management of HL in order to potentially establish precision nutritional intervention strategies aimed at preventing and/or repairing hearing damage before it becomes irreversible.

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