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Evaluation of hearing loss parameters in workers and its relationship with baseline blood glucose levels☆

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KEYWORDS
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Abstract
Introduction: Hearing loss due to noise is considered within the prevention plans of the most common occupational diseases. In addition to evaluation of working conditions, other personal factors increasing the risk of hypoacusis, such as diabetes, should be taken into account.
Objectives: To explore hearing loss in the workplace and its relationship to impaired fasting baseline blood glucose levels.
Methods: An observational, cross-sectional study enrolling 1636 workers from service companies was conducted. Full audiometric evaluation was performed at different frequencies: high frequency (HF), early loss index (ELI), speech average loss (SAL), and monaural and binaural loss. Results were categorized by baseline blood glucose levels: G1 (<100 mg/dl), G2 (100–125 mg/dl), and G3 (>125 mg/dl).
Results: Based on both HF and ELI, 11% of workers had clear indication of deafness. Women with G3 levels showed significant differences in the results of HF and ELI indexes as compared to the G1 group ($p = .038$ and .046, respectively). A positive association was found between hearing loss and G3 blood glucose levels in HF (OR: .338; $p = .002$), ELI (OR: .407; $p = .007$), and the monaural test in the left ear (OR: 4.77×10^{-5}; $p = .006$).
Conclusions: Despite the methodological limitations of this study, there is evidence for an increased risk of high frequency hearing loss in workers with high baseline blood glucose levels.

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PALABRAS CLAVE
Pérdida auditiva;
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Ruido;
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Prevención terciaria

Evaluación de los parámetros de hipoacusia laboral en trabajadores activos y su relación con los niveles de glucemia basal

Resumen
Introducción: La hipoacusia ocupacional por ruido se considera dentro de los planes de prevención de enfermedades profesionales más comunes. Además del examen de las condiciones laborales se deben tener en cuenta otros factores personales que aumentan el riesgo de hipoacusia, como la diabetes.
Objetivos: Explorar la pérdida de audición en el ámbito laboral y su relación con las alteraciones de las cifras de glucemia basal en ayunas.
Métodos: Se realizó un estudio observacional y transversal en el que se incluyeron 1.636 trabajadores de empresas del sector servicios. Se hicieron audiometrías tonales completas midiendo: alta frecuencia (AF), índice de pérdida precoz (ELI), índice promedio conversacional (SAL) y pérdida pérdida monoaural y binaural. Los resultados se categorizaron según las cifras de glucemia basal: G1 (< 100 mg/dl), G2 (100-125 mg/dl) y G3 (> 125 mg/dl).
Resultados: Según la AF y el ELI el 11% de los trabajadores en cada caso presentaron claro indicio de sordera. Las mujeres con niveles G3 obtuvieron diferencias significativas en los resultados del índice AF y ELI respecto al grupo G1 (p = 0,038 y 0,046, respectivamente). Se encontró una asociación positiva de hipoacusia y niveles de glucemia G3 en las pruebas de AF (OR: 0,338; p = 0,002), ELI (OR: 0,407; p = 0,007) y monoaural del oído izquierdo (OR: $4{,}77 \times 10^{-5}$; p = 0,006).
Conclusiones: Pese a las limitaciones metodológicas de este estudio, existen indicios para pensar que los trabajadores con niveles elevados de glucemia basal podrían presentar un mayor riesgo de padecer hipoacusia de altas frecuencias.

Introduction

Occupational hearing loss is characterized by sensorineural deafness caused by continuous exposure to noise with a daily loudness level of 80 decibels or higher in the A scale (dB A).[1] Although some ototoxic drugs and exposure to other agents, such as chemical substances and vibrations, may cause deafness in a worker, noise is considered to be the most important factor. Exposure to noise causes trauma in the sensory epithelium of the cochlea.[2] Vascular, chemical, and metabolic changes are initially reversible, and hearing is recovered with time. However, if noise exposure persists, irreparable damage occurs due to the permanent loss of stereocilia and the destruction of sensory cells.[2] The greatest problem associated with sensorineural deafness is that hearing loss occurs slowly and gradually, and it is therefore difficult for the worker to identify it before it is irreversible.

Some individual characteristics may increase the risk of developing hypoacusis, including advanced age, female sex, and diseases such as diabetes mellitus (DM).[3–6] The chronic course of diabetes is usually associated with vascular, neurological, and metabolic complications.[3,7] The metabolic consequences of DM with a hearing impact include microangiopathy, primary neuropathy, and a trend to blood hyperviscosity.[8,9] Microangiopathy and primary neuropathy are associated with hearing impairment in the longer term and, in patients with DM, lead to bilateral sensorineural damage with progressive loss of the higher frequencies.[7,10,11] Some research suggests that diabetes could be related to sudden hearing loss affecting the low and middle frequencies.[8] The increased blood viscosity that may suddenly occur in diabetic patients is of significance regarding this effect. The physiology of cochlear circulation is involved in this process, because it consists of narrow, long terminal vascular beds where increased blood viscosity may affect normal flow.[8,12]

It therefore appears clear that DM should be included among the risk factors associated with hearing loss, and should be taken into account in otoneurological examination protocols as part of the programs for preventing occupational hypoacusis.

The aim of this study was to assess hearing loss parameters in a sample of workers from companies in the services sector in Spain not exposed to noise >80 dB A by evaluating audiometric indices in the different frequencies (low, middle, high, and very high), and relating them to fasting baseline blood glucose levels.

Subjects and methods

An observational, cross-sectional study was conducted from November 2010 to November 2011. Data were collected from workers at a single visit during regular health check-up examinations at services and healthcare companies located in Valencia, Castellón, Palma de Majorca, and Ibiza. Subjects at risk due to occupational risk exposure (>80 dB A), intake of ototoxic drugs, or a family history of deafness were excluded. The study was conducted in compliance with the regulations for the prevention of occupational risk applicable in Spain[13] and with the knowledge of the safety and health committees of the companies.

After signing an informed consent, patients underwent tone air conduction threshold audiometry in the different frequencies (low, middle, high, and very high) using calibrated audiometric equipment (Sibelmed Mod. AS5-AOM). The procedure for the audiological examination and the