

Profile of metabolic damages in occupational hearing loss

Perfil das doenças metabólicas na perda auditiva ocupacional

Perfil de enfermedades metabólicas en la pérdida auditiva ocupacional

Francine Varlete Leopoldina Barcelos¹ 

Karina Mary De Paiva¹ 

Marcos José Machado¹ 

Patricia Haas¹ 

Abstract

Introduction: Early diagnosis of hearing loss is essential to minimize the social impact in relation to work routine and quality of life. **Objective:** Analyze the association between hearing loss in workers and metabolic diseases. **Method:** Retrospective cross-sectional study of secondary data on the use of medications in metabolic diseases, the data were collected in two occupational health clinics (C1 and C2) in Florianópolis - Santa Catarina (Brazil), from January 2020 to December 2022, considering references from exams from the year 2005. The data were organized in Microsoft Excel® spreadsheets and subsequently exported and analyzed using the MedCalc® statistical software version 22.006. **Results:** The data of 97 patients (71 men and 26 women) exposed to occupational noise ($p = 0.0047$), diagnosed with at least one metabolic disease (41.20%) and prevalence of ATC H class medications ($p = 0.0465$) and Losartan® (OR = 1.6976). **Discussion and Conclusion:** Occupational noise is the main auditory risk factor, and the presence of metabolic disease can influence hearing thresholds. To reduce the vulnerability of this population, it is necessary to promote, raise awareness and educate, using approaches related to health aspects at work.

Keywords: Induced Noise Hearing Loss; Adults; Metabolic Syndrome; Occupational Noise.

¹ Universidade Federal de Santa Catarina, Florianópolis, SC, Brazil.

Authors' contributions:

FVLB: contributed to the conception and design of the study, data collection, writing, final version for publication, in addition to assuming responsibility for the entire study.

KMP: contributed to the conception and design of the study, writing and review; and approved the final version for publication, in addition to assuming responsibility for all aspects of the study.

MJM: contributed to the study design, data analysis and interpretation, writing and review.

PH: contributed to the conception and design of the study, writing and review; and approved the final version for publication, in addition to assuming responsibility for all aspects of the study.

E-mail address: Patricia Haas - patricia.haas@ufsc.br

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Resumo

Introdução: O diagnóstico precoce quanto às perdas auditivas é essencial para minimização do impacto social em relação à rotina laboral e na qualidade de vida. **Objetivo:** Caracterizar a associação entre a perda auditiva em trabalhadores com doenças metabólicas. **Método:** Estudo transversal retrospectivo de dados secundários de prontuário com o tratamento das doenças metabólicas, os dados foram coletados em duas clínicas de saúde ocupacional (C1 e C2) em Florianópolis - Santa Catarina (Brasil), no período de janeiro de 2020 a dezembro de 2022, considerando exames referenciais a partir do ano de 2005. Os dados foram organizados em planilhas do programa Microsoft Excel® e, posteriormente, exportados e analisados no software MedCalc® Statistical Software versão 22.006. **Resultados:** Foram analisados dados de 97 pacientes (71 homens e 26 mulheres), expostos ao ruído ocupacional ($p = 0,0047$), com diagnóstico de ao menos uma doença metabólica (41,20%) e prevalência de medicamentos da classe ATC H ($p = 0,0465$) e Losartana® (OR = 1,6976). **Conclusão:** O ruído ocupacional é o principal fator de risco auditivo nas empresas analisadas, e a presença de doença metabólica poderá influenciar em alterações dos limiares auditivos. Para reduzir a vulnerabilidade dessa população, é necessário a promoção, educação e conscientização dos trabalhadores nos aspectos de saúde.

Palavras-chave: Perda auditiva provocada por ruído; Adulto; Síndrome Metabólica; Ruído ocupacional.

Resumen

Introducción: El diagnóstico precoz de la pérdida auditiva es fundamental para minimizar el impacto social en la rutina laboral y la calidad de vida. **Propósito:** Analizar la asociación entre pérdida auditiva en trabajadores y enfermedades metabólicas. **Metodología:** Estudio transversal retrospectivo de datos secundarios sobre el uso de medicamentos en enfermedades metabólicas; Los datos fueron recolectados en dos clínicas de salud ocupacional (C1 y C2) en Florianópolis - Santa Catarina (Brasil), de enero de 2020 a diciembre de 2022, considerando referencias de exámenes del año 2005. Los datos fueron organizados en hojas de cálculo Microsoft Excel®. y posteriormente exportados y analizados. utilizando el software estadístico MedCalc® versión 22.006. **Resultados:** Se analizaron los datos de 97 pacientes (71 hombres y 26 mujeres) expuestos a ruido ocupacional ($p = 0,0047$), diagnosticados con al menos una enfermedad metabólica (41,20%) y prevalencia de medicamentos clase ATC H ($p = 0,0465$). y Losartan® (OR = 1,6976). **Discusión y Conclusión:** El ruido ocupacional es el principal factor de riesgo auditivo y la presencia de enfermedad metabólica puede influir en los umbrales auditivos. Para reducir la vulnerabilidad de esta población es necesario promover, sensibilizar y educar utilizando enfoques relacionados con aspectos de salud en el trabajo.

Palabras clave: Pérdida Auditiva Inducida por Ruido; Adultos; Síndrome metabólico; Ruido Ocupacional.

Introduction

Hearing loss epidemiology plays a key role in identifying risk factors, developing prevention strategies, and planning hearing health services. Furthermore, educational strategies regarding hearing health issues and guidance and early identification of hearing loss are of extreme importance for minimizing negative health outcomes^{1,2}.

Hearing loss is a condition that affects millions of people worldwide and can result from a variety of factors, including genetic or acquired causes, chronic and ear diseases, factors associated with aging, and occupational exposures, such as noise and vibrations in the environment, work environment or the practice of recurrent use of personal hearing devices in young subjects^{3,4,5,6}. However, the emergence of hearing loss in subjects with metabolic actions can be justified by modifications occurring within the inner ear such as alterations in cochlear vascularization and decreased irrigation of internal hair cells and glycogen suppression, causing cell apoptosis^{7,8,9}.

The use of medications in the treatment of metabolic diseases is commonly used and does not control the disease^{10,11}. The classification of medicines according to the Anatomical Therapeutic Chemical (ATC) classification facilitates communication, prescription, and access to information regarding medications among health professionals, researchers, and regulators worldwide, making it possible to understand the therapeutic action of each medicine and its standardization^{12,13}.

Considering the possible hearing changes due to the association of metabolic diseases, this study sought to analyze the association of hearing loss in workers with metabolic changes.

Methodology

Study Type

Retrospective cross-sectional study with analysis of secondary data from two occupational health clinics in the city of Florianópolis - Santa Catarina (Brazil), considering medical records from 2005

onwards. With the purpose of classifying the collection quality, indicators were considered regarding clinical history information, hearing diseases, the use of medication to treat metabolic diseases, as well as the presence of sensorineural hearing loss, according to the degree of loss proposed by the World Health Organization¹⁴.

Data Collection and Analysis

Data collection was carried out through access to each company's medical records software, after approval by CAAE/CEP UFSC. The collected data was stored in Microsoft Excel® spreadsheets, exported and analyzed by *MedCalc® Statistical software*, version 22.006. For data analysis, descriptive statistics were used for both quantitative (numeric) and categorical variables, using calculations of the mean, median, minimum, maximum, and standard deviation, and for adequate presentation of the results obtained using simple tabulations and double entry, referring to absolute and relative frequencies according to the study purpose.

Inclusion Criteria

Data from subjects aged between 21 and 60 years old, of both sexes, exposed to noise as an occupational risk, as determined by the Medical Control and Occupational Health Program (PCMSO) were used. With record of the occupational audiometry exam, normal or altered, with the report of sensorineural hearing loss specifying the degree and configuration and undergoing treatment for Systemic Arterial Hypertension (SAH), Diabetes Mellitus (DM), Dyslipidemia (Cholesterol or Triglycerides altered), and changes in thyroid hormone (TSH) diseases.

Exclusion Criteria

For the exclusion criteria, data from workers who did not report a minimum time of exposure to noise, without recording at least four (04) audiological exams, with a history of otological treatment or surgery, and without records relating to drug treatment was removed.

Results

The study has a total of 97 records, characterized by 71 male subjects (OR = 3.4554), regarding the level of instruction and schooling are also represented by the significant value of P (0.0027), for fundamental education, medium and technical. Noise as an occupational exposure presents

a significant P value (P = 0.0042) and when additional hearing risks are considered, suggestive P values are obtained when motorcycle use is considered, not daily travel (P = 0.0161) and use of an individual hearing device (Headphones) (P = 0.0763). Suggestive parameters in the analyses, or value of triggering (P = 0.0114) and aggravation (P = < 0.0001) of hearing loss (PA) (Table 1).

Table 1. Gross OR regarding the socio-demographic and health characteristics of the workers investigated as a whole (n=97).

Variable	Raw OR*	95%CI	P value
Sex			
Female	1		
Male	3.4554	1.3240-9.0176	0.0113
Educational Level			
Higher Education	1		
Elementary/High School or Technical	10.7187	2.2815-50.3570	0.0027
Noise			
No	1		
Yes	3.6364	1.5041-8.7915	0.0042
Motorcyclist			
No	1		
Yes	6.7692	1.4256-32.1428	0.0161
Hearing Complaints			
No	1		
Yes	3.8298	0.4122-35.5862	0.2377
Tinnitus Complaint			
No	1		
Yes	2.6037	1.0295-6.5850	0.0432
Headset			
No	1		
Yes	0.3778	0.1287-1.1085	0.0763
Triggering of HL			
No	1		
Yes	39.4932	2.2859-682.3190	0.0114
Worsening of HL			
No	1		
Yes	90.00	11.4089-709.9704	P < 0.0001

Caption: P value for Chi-square test; Headset: Use of a hearing device for work activity; HL: Hearing loss.

Table 2 presents the statistical value regarding the prevalence of subjects with hearing loss in relation to the use of the Headset, as a work instrument (P = 0.0763).

Table 2. Association of subjects who use hearing devices in subjects with hearing loss (2020 to 2022).

Variable	Raw OR*	95%CI	P value
Headset			
Yes	1		
No	2.6471	0.9021-7.7672	0.0763

Caption: Headset: Use of a hearing device for the work activity.

There is no prevalence of analysis with respect to metabolic diseases, however it is observed that 77.30% of the two subjects refers to the treatment of non-minimal metabolic diseases and if referring to patients with hearing loss, we find this relationship in 41.20% of the two little Guys. In relation to the

amount of drugs in the treatment of metabolic diseases, 54.60% of the subjects report using a single drug and, when associated with patients with PA, a total of 30.90% of the subjects have an association of one or two hearing losses of complaints in these subjects (2.10%) (Table 3).

Table 3. Distribution of absolute (n) and relative (%) frequencies for health variables for subjects with Hearing Loss (HL) or without HL (2020 to 2022).

Variable	Total		Without HL		With HL		P* value
	n	%	n	%	n	%	
No. of diseases							
One	75	77.30%	35	18.60%	40	41.20%	0.5217
Two	18	18.60%	8	28.90%	10	10.30%	
Three	4	4.10%	3	3.10%	1	1.00%	
Total	97	100.00%	46	47.50%	51	52.50%	
No. of complaints							
None	92	94.80%	45	46.40%	47	48.50%	0.3456
One	3	3.10%	1	1.00%	2	2.10%	
Two	2	2.10%	0	0.00%	2	2.10%	
Total	97		46 (47.4%)		51 (52.6%)		
No. of medicines							
One	53	54.60%	23	23.70%	30	30.90%	0.2188
Two	28	28.90%	13	13.40%	15	15.50%	
Three	13	13.40%	9	9.30%	4	4.10%	
Four	2	2.10%	0	0.00%	2	2.10%	
Five	1	1.00%	1	1.00%	0	0.00%	
Total	97	100	46	47.40%	51	52.60%	

Caption: P* - P value for Chi-square test; No.: number.

There is no significant statistical value in the analysis of the referred questions, however, the subjects refer to the treatment of diseases: Hypothyroidism (OR = 0.5674), Systemic Arterial Hypertension (OR = 0.6429), Diabetes Mellitus

(OR = 1.1077), Dyslipidemia (OR = 2.2803), and other disease category (OR = 0.898), medications for psychosomatic diseases, arthritis, and others were analyzed.

Table 4. Analysis of metabolic diseases being treated..

Variable	Raw OR*	95%CI	P value
Hypothyroidism			
No	1		
Yes	0.5674	0.1495-2.1530	0.4049
Hypertension			
No	1		
Yes	0.6429	0.2478-1.6678	0.3637
Diabetes			
No	1		
Yes	1.1077	0.4268-2.8747	0.8335
Dyslipidemia			
No	1		
Yes	2.2803	0.5532-9.3993	0.254
Other diseases			
No	1		
Yes	0.898	0.1213-6.6472	0.9161

Caption: P value for Chi-square test; Other diseases: Depression, Anxiety, Arthritis, others.

There was a prevalence (P = 0.0465) in the use of ATC H (systemic hormonal preparations, excluding sex hormones and insulins) (Table 5).

Table 5. Analysis of medication variables in the 97 patients (2020 to 2022).

Variable	Raw OR*	95%CI	P value
Losartan® and similar			
No	1		
Yes	1.6976	0.7423-3.8823	0.2099
ATC A			
No	1		
Yes	2.1714	0.8273-5.6993	0.1153
ATC H			
No	1		
Yes	0.3385	0.1165-0.9834	0.0465
ATC C			
No	1		
Yes	0.8814	0.3970-1.9568	0.7564
ATC M			
No	1		
Yes	0.2945	0.01170-7.4107	0.4576
ATC N			
No	1		
Yes	0.1728	0.008080-3.6961	0.2613

Caption: P value for Chi-square test; ATC A: digestive system and metabolism; ATC H: systemic hormonal preparations, excluding sex hormones and insulins; ATC C: cardiovascular system; ATC M: musculoskeletal system; ATC N: nervous system.



In the statistical relationship regarding the type of service performed and the subjects with hearing loss, the sample showed a predominance in electronic surveillance and elevator maintenance service companies (19.60%), energy supply companies (12.20%), and in early childhood education

segments (9.60% and 5.20%). Relating the type of service and subjects with hearing loss, there is also a prevalence in the electronic surveillance and elevator maintenance sectors (12.40%) and in the energy supply sector (9.30%) (Table 6).

Table 6. Industry sector in the labor market of the companies analyzed and the prevalence of hearing loss in the subjects (2005 to 2022).

Business	Total n (%)	Without HL n(%)	With HL n (%)	P* value
Electronic Surveillance and Elevators	19 (19.60%)	7 (7.20%)	12 (12.40%)	P = 0.1166
Energy Supply	12 (12.40%)	3 (3.10%)	9 (9.30%)	
Sports Club	3 (3.10%)	0 (0.00%)	3 (3.10%)	
Parking Franchise	3 (3.10%)	0 (0.00%)	3 (3.10%)	
Child Education	9 (9.30%)	6 (6.20%)	3 (3.10%)	
Aluminum Company	2 (2.10%)	0 (0.00%)	2 (2.10%)	
Landscaping and Gardening	2 (2.10%)	0 (0.00%)	2 (2.10%)	
Early Childhood Education 1	5 (5.20%)	3 (3.10%)	2 (2.10%)	
Telecommunications 1	4 (4.10%)	3 (3.10%)	1 (1.00%)	
Medical Clinic 1	1 (1.00%)	0 (0.00%)	1 (1.00%)	
Commercial Condominium	1 (1.00%)	0 (0.00%)	1 (1.00%)	
Print Shop	1 (1.00%)	0 (0.00%)	1 (1.00%)	
Supermarket and Butcher Shop 1	1 (1.00%)	0 (0.00%)	1 (1.00%)	
Air Conditioning Company	1 (1.00%)	0 (0.00%)	1 (1.00%)	
Civil Construction 1	1 (1.00%)	0 (0.00%)	1 (1.00%)	
Supermarket and Butcher Shop 2	1 (1.00%)	0 (0.00%)	1 (1.00%)	
Auto Electrical and Mechanic Shop	1 (1.00%)	0 (0.00%)	1 (1.00%)	
Sea Tours	3 (3.10%)	2 (2.10%)	1 (1.00%)	
Civil Construction 2	1 (1.00%)	0 (0.00%)	1 (1.00%)	
Class 1 Union	1 (1.00%)	0 (0.00%)	1 (1.00%)	
Auto Electrical and Mechanic Shop	1 (1.00%)	0 (0.00%)	1 (1.00%)	
Glass and Frames 1	2 (2.10%)	1 (1.00%)	1 (1.00%)	
Medical Clinic 2	1 (1.00%)	0 (0.00%)	1 (1.00%)	
Sports Club	1 (1.00%)	1 (1.00%)	0 (0.00%)	
Industrial Engineering	1 (1.00%)	1 (1.00%)	0 (0.00%)	
Software Company	1 (1.00%)	1 (1.00%)	0 (0.00%)	
Medical Clinic 3	1 (1.00%)	1 (1.00%)	0 (0.00%)	
Medical Clinic 4	3 (3.10%)	3 (3.10%)	0 (0.00%)	
Medical Clinic 5	1 (1.00%)	1 (1.00%)	0 (0.00%)	
Medical Clinic 5	1 (1.00%)	1 (1.00%)	0 (0.00%)	
Industrial Products	1 (1.00%)	1 (1.00%)	0 (0.00%)	
Supermarket 3	2 (2.10%)	2 (2.10%)	0 (0.00%)	
Glass and Frames 2	1 (1.00%)	1 (1.00%)	0 (0.00%)	
Hospital Products	1 (1.00%)	1 (1.00%)	0 (0.00%)	
Medical Laboratory	2 (2.10%)	2 (2.10%)	0 (0.00%)	
Medical Clinic 6	1 (1.00%)	1 (1.00%)	0 (0.00%)	
Medical Clinic 7	1 (1.00%)	1 (1.00%)	0 (0.00%)	
Telecommunications	1 (1.00%)	1 (1.00%)	0 (0.00%)	
Class 2 Union	1 (1.00%)	1 (1.00%)	0 (0.00%)	
Glass and Frames 3	1 (1.00%)	1 (1.00%)	0 (0.00%)	
Total	97 (100%)	46 (47.4%)	51 (52.6%)	

Caption: P value for Chi-square test.



Discussion

The prevalence of the male population in this study may be associated with social and biological factors considering the male figure in the job market. The literature suggests that issues related to leadership positions and more technical sectors may be linked to gender stereotypes that influence professional choices and the specificities of certain professions, where exposure to toxic substances and physical risks are often associated with the health risks^{15,16,17}.

The relationship between low education and positions exposed to occupational risks is supported by the study by Gomes *et al.*¹⁸, considering the lack of training and disuse of PPE. Other study confirms that the modernization of work activities directly influences the increase in demands regarding intellectual capabilities and associates a low level of education with occupations with a higher level of precariousness¹⁹. Occupational noise continues to be the most common risk factor for workers' health. This data contributes to the literature that suggests that exposure to high levels of noise represents a potential risk to hearing health and impacts on workers' health, emphasizing the importance of hearing preservation and health promotion measures in the workplace^{20,21}.

The association of the existence of hearing risk in relation to the use of motorcycles, in the performance of work tasks, is confirmed considering that the noise exposure limits, added to the urban noise present in traffic, can exceed the recommended daily dose, causing Possible hearing damage in motorcyclists²². Tinnitus as a hearing complaint in workers exposed to noise is widely reported in the literature, especially as a symptom of hearing loss^{20,23,24,25,26}.

The use of a headset or headphones can represent an important risk for triggering hearing loss. This data is scarce in the literature, however, some authors confirm this finding^{27,28}. The prevalence of triggering and worsening hearing loss in the sample is in line with the literature, especially when occupational noise issues are associated and the need for dissemination regarding health education and adherence to hearing conservation programs^{4,20}.

The prevalence of subjects with hearing loss associated with at least one metabolic disease agrees with the literature, with the inference that hearing loss and cardiovascular changes are two

of the three most epidemiologically recurrent diseases within workers' health^{2,7,8}, which can also be confirmed in this study by the prevalence of the Losartan® drug use. Even without statistical relevance, the prevalence of Diabetes Mellitus and Dyslipidemia diseases corresponds to the literature, especially when together, they characterize a metabolic syndrome with a potential risk of hearing changes⁸.

The prevalence of medications classified as ATCH H in this study may be associated with the control and treatment of diseases related to the Thyroid Hormone. The literature suggests that there may be a worsening of auditory functions and the perception of auditory symptoms such as vertigo and tinnitus in these subjects²⁹. Data analyzes were stipulated in adults under the age of 60 so that issues related to aging would not interfere with the analyses, thus, they observed that the median age for subjects with hearing loss was 51 years. The WHO associates an increase in hearing changes in younger populations when related to exposure to recreational noise; however, the relationship with occupational exposure may increase hearing changes, especially within the natural aging process⁴.

Regarding the positions analyzed in association with the prevalence of subjects with hearing loss, workers in electronic surveillance and elevator maintenance companies and in the energy supply sector may be at greater risk for hearing loss due to the deficient use of personal protective equipment (PPE), lack of health education strategies and guidelines regarding hearing health. Thinking about health and safety at work is not just about promoting the use of ear protectors and personal protective equipment, although important. There is also a need to promote awareness and educational approaches, effective and comprehensive training with the effective participation of subjects, in addition to the combined use of environmental control measures^{15,20}.

Using data from secondary medical records can help healthcare professionals identify health patterns, monitor chronic disease progression, and evaluate treatment effectiveness over time, as well as help healthcare professionals identify preventive interventions and personalize treatment according to the individual needs of each patient^{30,31}. Although the literature points out the importance of the information collected in the anamnesis in

clinical practice, this study showed the lack of standardization of the information related to the medical records of the subjects analyzed, mainly in the use of secondary data collection subjected to health software, the use of this data could be used to improve health information and provide data in future research.

Conclusion

Noise is the most significant auditory risk factor for workers' health, especially when related to the male gender, the complexity of occupational risks, the educational instruction level, and the means of transport and locomotion. The diagnosis of at least one metabolic disease may contribute to hearing changes and issues related to complaints of auditory symptoms.

It is necessary to address worker's health and its complexity globally; metabolic changes can occur at any stage of human development, therefore, it is necessary to have adequate records in relation to clinical care and anamnesis with more complete guidelines in mind, since several factors are responsible for health changes, as well as the dissemination of educational strategies to consciously prevent them. The need for awareness and health education may contribute to the reduction and vulnerability of this population, highlighting the importance of developing actions that promote awareness of the health aspects at work.

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