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Occupational noise and its impact on hearing disorders in oil drill workers

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ABSTRACT

Introduction: Occupational noise in the oil industry can have adverse effects on workers' hearing health, ranging from temporary hearing loss to permanent conditions, affecting hearing ability, work performance, communication, and operations. The main objective of this study was to establish the relationship between exposure to occupational noise and hearing disorders in the personnel of 9 oil drills in the Amazon region of Ecuador. Methods: Observational, cross-sectional, analytical, prospective and relational research was carried out with a population of 153 workers. The primary method was to measure occupational noise levels and assess hearing disturbances using audiometric tests. For the inferential analysis, the Kendall Correlation test was used. Results: The results revealed that 35% of the workers were exposed to medium noise levels and 17% to very high noise. Regarding hearing health, 17% of the workers had normoacusis, 17% acoustic trauma and 20% hearing loss. Kendall's correlation analysis obtained a coefficient of 0.15 with a significance value of 0.028, indicating a weak positive correlation between the variables evaluated. Conclusions: It was concluded that there is a low positive correlation between the study variables, that is, the greater the occupational exposure to noise, the greater the presence of hearing disorders in the personnel working in the reconditioning drills.

KEYWORDS: Occupational Noise; Hearing Disorders; Oil And Gas Industry; Hearing Loss.

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INTRODUCTION

In recent years, there has been an increasing interest in understanding the impact of workplace noise on employee health, particularly in industrial sectors such as oil (1). Continuous exposure to high levels of noise, in the absence of appropriate technical measures or the limited use of adequate hearing protectors, can result in a range of hearing problems, including temporary hearing loss and permanent damage such as hearing loss caused by noise (2).

The presence of noise in the work environments of the oil industry has been shown to cause hearing damage, which has a negative impact on the efficiency and quality of work. This phenomenon can result in an escalation in complaints, strained interpersonal relations among colleagues, elevated rates of absenteeism, and a decline in operational safety (3). Consequently, employees face not only a compromise in their auditory capacity but also in their performance, communication abilities, and overall well-being (4).

In the petroleum industry, workers operating workover drills play a crucial role and are constantly exposed to working environments with high noise levels (5). This exposure not only poses a risk to hearing but can also have negative effects on the nervous system, contributing to the onset of fatigue, stress, and an increased risk of accidents at work. These findings underscore the necessity of implementing effective measures to regulate occupational noise.

Loud noise in work environments, particularly in industries such as oil, has been the subject of numerous studies due to its detrimental effects on employees' hearing health (7). However, at the local level, there is a paucity of recent research that accurately analyses noise exposure levels and the actual prevalence of hearing disorders in this working population. This dearth of information hinders the formulation and implementation of suitable preventive and corrective measures (8).

Noise is defined as an unwanted sound propagation that is annoying to the human ear, interfering with normal activities or rest, and that, when it reaches high levels, can cause hearing damage.(9) In the occupational environment, occupational noise corresponds to noise emissions generated by the operation of machinery, equipment, and operational processes, the intensities of which may represent an agent of risk to the worker's health.(10) In drills, the main sources of noise include equipment such as generators, pumps, systems, motors, winches, among others (11).

Hearing impairment is a condition that is closely associated with the intensity and duration of noise exposure, with the potential to result in temporary or permanent hearing loss (12). The likelihood of developing this pathology is increased in individuals who are professionally exposed to noise levels exceeding 85 decibels for extended periods, typically exceeding eight hours on a daily basis. Among these conditions, hearing loss manifests itself progressively over time, in contrast to acoustic trauma, which occurs abruptly after a single exposure to a high-intensity sound event (13).

Within the oil and gas sector, drilling and well workover and rehabilitation operations are notable for their high personnel attendance and high noise levels. The execution of these tasks, due to the operational characteristics of the utilized equipment and the conditions of noise exposure, constitutes a risk scenario. Consequently, there is a higher probability that workers will experience a greater incidence of noise-induced hearing disorders compared to other economic activities (14).

Non-invasive hearing disorders remain the most prevalent occupational diseases on a global scale. Researchers estimate that exposure to noise in the workplace is responsible for 16% of cases of disabling hearing loss in the adult population. While these conditions do not typically result in premature mortality, they do lead to a considerable degree of disability. The consequences of exposure to occupational noise represent a considerable economic and health burden, affecting both the worker and the employer (15).

In Ecuador, noise-induced sensorineural hearing loss was the fourth most prevalent occupational disease in 2024. Despite the absence of precise data concerning hearing loss in the Oil & Gas sector, the potential for a considerable impact is presumed, possibly attributable to an underestimation of the problem.(16) A study conducted in Colombia among workers in the oil sector revealed that between 42% and 50% of employees exposed to noise experienced hearing impairments, despite noise levels remaining within the limits stipulated by international bodies (17).

The workers with the highest daily exposure to noise are primarily operatives, such as machinists and wedges, as well as maintenance personnel, including mechanics and electricians. This exposure is primarily to drilling and reconditioning equipment. This high exposure is attributable to the fact that their functions are carried out directly in the areas where the highest levels of noise are generated. A study conducted in Colombia identified that these groups experience elevated noise levels, with weighted equivalent values greater than 85.1 decibels (18).

A study of 1.9 million audiograms revealed that individuals employed in the mining and oil and gas extraction industries exhibited a higher prevalence of hearing problems compared to other workers. Oil and gas extraction exhibited a prevalence of 14%.(19) Moreover, a report by the Centers for Disease Control and Prevention (CDC) indicated that 17% of workers in the mining, quarrying, and oil and gas extraction sectors suffer from some degree of hearing impairment (20).

A study encompassing 58,821 workers exposed to noise in industrial environments, evaluated by audiometric tests, determined that 19,234 of them, equivalent to 32.75%, had hearing damage related to such exposure. The most prevalent form of involvement was sensorineural hearing loss, with a higher incidence observed among individuals aged 30 to 50. Furthermore, it was observed that 94.84% of the workers were exposed to noise levels ranging from 91 to 100 dB, while 4.50% were exposed to levels between 86 and 90 dB (21).

A study of 384 oil refinery employees who were chronically exposed to noise levels ranging from 73 to 89 dB revealed that those exposed to noise levels below 85 dB exhibited a slight decrease in hearing at high frequencies. Conversely, individuals who reported symptoms associated with hearing loss exhibited impairment in both low and high frequencies. Furthermore, a significant increase in hearing thresholds was observed among workers with over 15 years of chronic exposure to noise (22).

A study was conducted in which the doses of noise exposure were evaluated in 200 workers from 90 industries. All of the subjects were exposed to levels of 90 dB for eight-hour periods. The results of the audiometry tests revealed that 27.8% of the participants had some degree of hearing damage, and 7.7% suffered from severe hearing loss. Furthermore, a correlation was identified between the duration of occupational exposure to noise and the subsequent development of hearing impairment. The prevalence of hearing impairment exhibited an almost exponential increase in proportion to the duration of exposure to noisy environments (23).

A study focused on retired workers analyzed health problems linked to their previous occupations and revealed that those who worked in the mining industries and in oil and gas extraction had a higher incidence of various adverse health conditions compared to retirees from other sectors. Among the most salient findings was a considerably elevated adjusted prevalence of hearing loss, as well as an aggregate deterioration in health status (24,25).

The objective of this study is to establish a correlation between noise exposure and hearing disorders. The findings will enable the oil company to develop a more nuanched understanding of the effects of occupational noise on its workforce. Moreover, the findings will serve as a basis for developing more effective occupational health programs. Such programs will be focused on minimizing hearing risks and promoting worker well-being.

METHODS

The research was conducted using a relational, observational approach, as the researchers did not implement any direct interventions. A cross-sectional design was employed, as the variables were measured at a single time point. The study was prospective in nature, as the data collection was meticulously planned, and of an analytical nature. The population under study consisted of 153 workers. The research hypothesis posited that there is a direct correlation between occupational noise exposure and the prevalence of hearing disorders among employees operating reconditioning drills for an oil company.

A range of theoretical methods were employed in the study. The historical-logical method enabled the examination of extant research on noise and its effects on hearing, thereby establishing a frame of reference. The analytical-synthetic method was employed to decompose the variables into different dimensions for the purpose of analyzing them separately and understanding their relationship. The research hypothesis was formulated and guidelines for developing the study were proposed using the hypothetical-deductive method.

The empirical approach entailed the direct measurement of noise levels in the workplace and the assessment of hearing disorders using audiometric tests. To analyze the relationship between both variables, Kendall's correlation was used, a suitable method for ordinal variables with different categories. The inclusion criteria for the study were as follows: workers with a dependent relationship who signed the informed consent, with the exclusion of those who decided not to voluntarily participate in the study. To assess noise exposure, an EXTECH 407780 Integrative Sound Level Meter was employed, a tool capable of quantifying sound pressure levels in accordance with international standards without the need for additional validation. The noise dose was accumulated during the day using personal dosimeters and subsequently classified into six ranges: very low (< 55 dB), low (55–60 dB), medium (60–65 dB), medium high (65–70 dB), high (70–75 dB), and very high (> 75 dB).(26) Prior to and following each monitoring session, the equipment was calibrated with an acoustic calibrator to ensure data accuracy.

The audiometric diagnosis, which is employed to evaluate the variable pertaining to the degree of hearing impairment, does not necessitate additional validation. This is because it is predicated on previously defined theoretical parameters concerning the severity of hearing loss in relation to the frequencies affected. This evaluation was conducted employing the Klockhoff scale, a system that categorizes outcomes into three distinct classifications: normal hearing (normoacusis), acoustic trauma, and hearing loss.

In the month of December 2024, a data collection initiative was conducted. This initiative entailed the measurement of noise levels and the execution of audiometric evaluations on the participating personnel. Prior to the initiation of the study, all participants were duly informed of its objectives, and the protocol had obtained formal approval from the relevant company authorities.

The collected data were initially organized in Microsoft Excel and subsequently transferred to SPSS version 23 statistical software for processing. With regard to the statistical analysis, frequencies and percentages corresponding to the sociodemographic variables and the variables were calculated. For the inferential analysis, the Kendall correlation test was applied, a suitable method for ordinal variables with different numbers of categories.

Regarding ethical considerations, the 153 participants were thoroughly informed about the objectives and scope of the study through the process of informed consent. The participants consented to partake in the study voluntarily and with full knowledge of the situation. Throughout the investigative process, confidentiality and anonymity of the information were ensured. It was emphasized that the data collected would be used exclusively for the purpose of improving the working conditions of the personnel.

RESULTS

With regard to the results, the frequencies and percentages of both the sociodemographic data and the primary variables of the study were calculated. Subsequently, the preparation of contingency tables was initiated, and the results obtained from the correlation tests were subsequently presented.

Table 1. Descriptive results of sociodemographic data.

	Frequency (n=153)	Percentage %
Gender		
Male	153	100 %
Female	0	0%
Age		
Between 20 and 30 years old	31	20 %
Between 31 and 40 years old	73	48%
Between 41 and 50 years old	39	25%
More than 50 years	10	7%
	Mean=37.12	SD=8.15
Marital status		
Bachelor	32	20 %
Married	76	51 %
Divorced	15	10%
Common-law marriage	30	19%
Antiquity		
Under 5 years old	59	39 %
Between 5 and 10 years old	39	25%
Over 10 years old	55	36 %
Charge		
Machinists	27	17%
Wedges	54	35%
SSA	18	12%
Electrical	18	12%

Mechanical	18	12%
Forklift Operator	18	12%

With regard to the sociodemographic data, Table 1 demonstrated that the sample comprised exclusively male participants. The mean age was 37.12 years, with the 31-to-40 age group representing the largest proportion of the sample at 39%, followed by the 20-to-31 age group with 31%. Regarding marital status, 51% of respondents were married, while 20% were unmarried. With respect to the positions held, the cuñeros constituted the predominant group, representing 35% of the sample. This was followed by the train drivers, who comprised 17% of the sample.

Table 2. Descriptive Noise Results

	Frequency (n=153)	Percentage %
Very Low Noise (less than 55 dB)	18	12%
Low noise (between 55 and 60 dB)	18	12%
Medium noise (between 60 and 65 dB)	54	35%
Medium High noise (between 65 and 70 dB)	18	12%
High noise (between 70 and 75 dB)	18	12 %
Very High Noise (greater than 75 dB)	27	17%

Table 2 presents the descriptive results corresponding to the noise level measurements. In these cases, it was observed that 35% of the workers were exposed to noise levels that were considered medium, ranging from 60 to 65 dB. Seventeen percent of the participants reported exposure to elevated noise levels, with measurements exceeding 75 dB. Conversely, only 12 percent of the participants reported being in environments characterized by minimal noise levels, with measurements falling below 55 dB.

Table 3. Descriptive results of hearing disorders

	Frequency (n=153)	Percentage %
Normocacusis	96	64%
Acoustic trauma	26	17 %
Hearing loss	31	20 %

As illustrated in Table 3, the descriptive results concerning hearing disorders indicate that 64% of the workers have normal hearing (normoacusis). Furthermore, 20% of the workers suffer from hearing loss, and 17% suffer from acoustic trauma.

Table 4. Contingency table of the study variables.

	Frequency (n=153)	Percentage %
Low noise (less than 55 Db)	15 (9,8%)	1 (0,6%)
Low noise (between 55 and 60 Db)	10 (6,5%)	6 (3,9%)
Medium noise (between 60 and 65 Db)	39 (25,5%)	6 (3,9%)
Low Noise (between 65 and 70 Db)	10 (6,5%)	3 (1,9%)
High noise (between 70 and 75 Db)	12 (7,8%)	5 (3,2%)
Very High Noise (greater than 67 Db)	10 (6,5,8%)	14 (9,1%)

As indicated by the findings presented in Table 4, 25.5% of individuals exposed to average noise levels demonstrated normal hearing (normoacusis). Furthermore, 9.1% of the subjects experienced acoustic trauma, and 5.8% of those exposed to medium noise levels exhibited hearing loss during audiometric evaluations.

Table 5. Relationship of variables.

	Value	Approximate significance
Kendall's Tau-c		0,028
Correlation coefficient	0,15	
N of valid cases	153	

To test the hypotheses, Kendall's Tau C correlation test was applied. The results of this test, presented in Table 5, showed a significance value close to P=0.028, which led to the rejection of the null hypothesis and the validation of the research hypothesis. Furthermore, the obtained correlation coefficient, Tau, yielded a value of 0.15, thereby suggesting a low positive correlation between the variables.

DISCUSSION

With respect to sociodemographic data, the profile of the participants is analogous to that of other studies both locally and internationally. In this study, the sample was exclusively male, with an average age of 37.12 years. In terms of marital status, the most prevalent groups were married and single. The final determination of the workforce composition revealed that the cuñeros constituted the largest group, followed by the machinists.

In regard to the descriptive results of occupational noise, it was observed that 35% of the participants were exposed to medium noise levels, while 17% were exposed to very high noise levels. With regard to hearing impairments, 37% of the workers exhibited some form of condition in this domain. These findings are consistent with those of a study conducted by Guerra and Araque in workers in the oil sector in Colombia, where a prevalence of hearing problems between 42% and 50% was reported (2).

The present study found that 20% of the participants had hearing loss, which differs from the results of a study by Zhou et al. In that study, 58,821 workers exposed to industrial noise were found to have hearing damage, with 32.75% of them having sensorineural hearing loss (18).

In relation to workers exposed to very loud noise, 11% demonstrated hearing impairment. These results are consistent with a report by the Centers for Disease Control and Prevention (CDC), which revealed that 17% of employees in the oil and gas extraction industry have some form of hearing impairment (10). In the case of workers exposed to medium noise, 10% were observed to have hearing problems, which coincides with a study carried out by Flores in Colombia, where between 15% and 30% of workers exposed to noise levels within the permissible limits reported hearing damage (4).

In the context of the relational analysis between noise and hearing disorders, the Kendall's Tau C Correlation test was employed, yielding a significance value of 0.028. This result permitted the rejection of the null hypothesis and the validation of the research hypothesis. Furthermore, a correlation coefficient of 0.15 was obtained, indicating a modest correlation between the variables examined. At the local level, there are no related studies; however, sensorineural hearing loss is among the four most common occupational diseases in Ecuador in 2024.(3) At the international level, several studies have confirmed the relationship between the study variables, given the pathogenesis of the disease (16).

The population most susceptible to hearing impairment is exposed to noise levels that exceed 85 decibels; however, hearing impairment has also been identified in individuals exposed to noise levels that fall within the established permissible limits. In a study conducted by Zhou et al., 58,821 workers exposed to noise were analyzed, and it was found that 19,234 workers had hearing damage, with the prevalence in the age groups between 30 and 50 years being especially relevant (18).

The findings of this study indicate that exposure to occupational noise continues to be a salient risk to hearing health, even when levels are within permitted limits. The correlation between noise and hearing disorders, while not strong, was statistically significant, thereby validating the existence of a relationship between the two variables. These findings underscore the imperative for the implementation of preventive measures, the enhancement of noise control measures in work environments, and the periodic evaluation of hearing. It is also recommended that research be promoted at the national level in order to address this problem in greater depth.

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REFERENCES

1. Li X, Dong Q, Wang B, et al. The influence of occupational noise exposure on cardiovascular and hearing conditions among industrial workers. Sci Rep. 2019;9(1):11524. doi:10.1038/s41598-019-47901-2.
2. Guerra-Reinoso J, Araque-Muñoz L. Perfil de exposición ocupacional a ruido en trabajadores de empresas de perforación y reacondicionamiento y rehabilitación de pozos en el sector de petróleo y gas, Colombia 2011-2017. Rev Panam. 2019;1(2):34-5. doi:10.48713/10336_18115.
3. Villacrés-López M, Noroña-Salcedo D, Leiton-Urresta A. Prevalencia de enfermedades profesionales en Ecuador durante el periodo 2017-2023. Rev Asoc Esp Espec Med Trab. 2024;33(3):328-37. doi:10.1016/j.ram.2024.10.003.
4. Flores-Pilco D. Daño auditivo en trabajadores por exposición a ruido laboral. Rev Univ Soc. 2021;13(S2):117-22. Available at: https://www.piensoenlatinoamerica.org/storage/pdf-articles/1625551023-2%20Art%C3%ADculo%20original.pdf
5. Casal-Pardo B, Jasso-Gascón N, Preciados-Sola R, Reinoso-García K. Pérdida auditiva y exposición laboral a ruido en minería: Una revisión sistemática. Med Segur Trab. 2022;68(266):36-55. doi:10.4321/s0465-546x2022000100004.
6. Atmaca E, Peker I, Altin A. Industrial noise and its effects on humans. Pol J Environ Stud. 2005;14(6):721-6. Available at: https://www.pjoes.com/pdf-87814-21673?filename=Industrial%20Noise%20and%20Its.pdf
7. Chen J, Tsai J. Hearing loss among workers at an oil refinery in Taiwan. Arch Environ Health. 2023;58(1):55–8. doi:10.3200/AEOH.58.1.55-58.
8. Tan Y, Fang Y, Zhou T, Gan V, Cheng J. BIM-supported 4D acoustics simulation approach to mitigating noise impact on maintenance workers on offshore oil and gas platforms. Autom Constr. 2019;100:1-10. doi:10.1016/j.autcon.2018.12.019.
9. Morata T, Engel T, Durão A, Costa T, Krieg E, Dunn D, et al. Hearing loss from combined exposures among petroleum refinery workers. Scand Audiol. 1997;26(3):141-9. doi:10.3109/01050399709074987.

10. Themann C, Masterson E, Peterson J, Murphy W. Preventing occupational hearing loss: 50 years of research and recommendations from the National Institute for Occupational Safety and Health. Semin Hear. 2023;44(4):351-93. doi:10.1055/s-0043-1769499.
11. Dutta M. Electric workover rigs – A technology in transition. SPE/IADC Middle East Drilling Technology Conference and Exhibition. 2023. doi:10.2118/214516-MS.
12. Bastos I, Faria M, Koopmans F, Alves L, Mello A, David H. Risks, injuries, and illnesses among professionals working on offshore platforms: An integrative review. Saf Health Work. 2020;11(4):453-63. doi:10.1016/j.shaw.2020.07.003.
13. Alzamzam W, Alfaghi W. Noise evaluation in oil and gas fields and associated risk assessment. Euro-Mediterr J Environ Integr. 2021;6:78. doi:10.1007/s41207-021-00249-4.
14. 14. Saha P, Monir M, Sarkar S. Noise pollution from oil, gas, and petrochemical industries. Elsevier; 2023;419-34. doi:10.1016/B978-0-323-95154-8.00012-8.
15. Atanas J, Simmons R, Rodrigues C. Optimal scheduling to minimize noise exposure in an oil and gas field. Noise Vib Worldw. 2019;50(4):124-32. doi:10.1177/0957456519839405.
16. Sun R, Shang W, Cao Y, Liu X, Chen Q. A risk model and nomogram for high-frequency hearing loss in noise-exposed workers. BMC Public Health. 2021;21:747. doi:10.1186/s12889-021-10730-y.
17. Setyawan F. Prevention of noise induced hearing loss in worker: A literature review. J Kedokt Kesehat Indones. 2021;12(2):182-190. doi:10.20885/JKKI.Vol12.Iss2.art12.
18. Zhou J, Shi Z, Zhou L, Hu Y, Zhang M. Occupational noise-induced hearing loss in China: A systematic review and meta-analysis. BMJ Open. 2020;10(9):e039576. doi:10.1136/bmjopen-2020-039576.
19. Chen K, Su S, Chen K. An overview of occupational noise-induced hearing loss among workers: Epidemiology, pathogenesis, and preventive measures. Environ Health Prev Med. 2020;25:65. doi:10.1186/s12199-020-00906-0.
20. Lawson S, Masterson E, Azman A. Prevalence of hearing loss among noise-exposed workers within the Mining and Oil and Gas Extraction sectors, 2006-2015. Am J Ind Med. 2019;62(10):826-837. doi:10.1002/ajim.23031.
21. Thai T, Kučera P, Bernatik A. Noise pollution and its correlations with occupational noise-induced hearing loss in cement plants in Vietnam. Int J Environ Res Public Health. 2021;18(8):4229. doi:10.3390/ijerph18084229.
22. Almahdy I, Kholil M, Yasin M. A case of study on correlation between age, noise level, and productivity at barge in oil industry. IOP Conf Ser Mater Sci Eng. 2018;453(1):012009. doi:10.1088/1757-899X/453/1/012009.
23. Sheppard A, Ralli M, Gilardi A, Salvi R. Occupational noise: Auditory and non-auditory consequences. Int J Environ Res Public Health. 2020;17(23):8963. doi:10.3390/ijerph17238963.
24. Teixeira L, Pega F, Abreu W, Almeida M, de Andrade C, Azevedo T, et al. The prevalence of occupational exposure to noise: A systematic review and meta-analysis from the WHO/ILO Joint Estimates of the Work-related Burden of Disease and Injury. Environ Int. 2021;154:106380. doi:10.1016/j.envint.2021.106380.
25. Natarajan N, Batts S, Stankovic K. Noise-induced hearing loss. J Clin Med. 2023;12(6):2347. doi:10.3390/jcm12062347.
26. Pretzsch A, Seidler A, Hegewald J. Health effects of occupational noise. Curr Pollut Rep. 2021;7(4):344-358. doi:10.1007/s40726-021-00194-4.