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ORIGINAL ARTICLE

Association Between High Blood Pressure and Occupational Hearing Loss: A Study in an Industrial Setting

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ABSTRACT

Background: Workplace noise is one of the most significant occupational hazards and can adversely affect workers' health. This study investigated the prevalence of noise-induced hearing loss (NIHL) and its association with blood pressure (BP) among workers in an Iranian oilfield.

Methods: This cross-sectional study included 670 male workers, excluding those with cardiovascular conditions or specific ear-related symptoms. Noise exposure and hearing thresholds were assessed. BP was recorded using a digital sphygmomanometer, with hypertension defined as systolic BP (SBP) ≥140 mmHg or diastolic BP (DBP) ≥90 mmHg.

Results: A 12.7% prevalence of NIHL was observed, including mild (6.2%) and moderate (2.1%) cases. Workers with NIHL had significantly higher mean SBP (118.16 vs. 115.81 mmHg, $p = 0.01$) and DBP (77.45 vs. 75.53 mmHg, $p = 0.001$) compared to those without NIHL. The prevalence of hypertension was 2.7%.

Conclusion: The findings suggest that chronic noise exposure may contribute to both cardiovascular and auditory damage, likely due to noise-triggered stress responses.

KEYWORDS: *Noise, Noise-induced hearing loss, Blood pressure, Oilfield*

INTRODUCTION

Noise exposure is a major occupational hazard, as long-term exposure to sounds above 85 dB can cause permanent hearing impairment [1, 2]. The National Institute of Deafness reports that approximately 15% of Americans aged 20 to 70 suffer from high-frequency hearing loss, which could be linked to workplace noise exposure [3]. This form of occupational hearing impairment is a significant public health issue with notable economic impacts [4]. Noise pollution is also a major environmental concern in urban areas [5]. Exposure to excessive noise has detrimental health effects [6], and prolonged exposure to sound levels beyond recommended limits can cause noise-induced hearing loss (NIHL) [7].

While many occupations carry a risk of NIHL, workers in sectors such as agriculture, mining, construction, manufacturing, transportation, healthcare, and the

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military face a significantly higher danger due to prolonged exposure to hazardous noise levels [8]. Thus, it is evident that noise stands as the most prevalent occupational hazard in work environments [9]. Exposure to noise elevates adrenaline and noradrenaline levels, triggering the body's stress response [10]. Although many workers face the risk of NIHL in their jobs [8], some studies show that little attention has been paid to this issue in the oil and gas industry [9, 11]. Occupational noise exposure, particularly in industrial settings, often leads to irreversible hearing damage [12].

Additionally, research indicates that some individuals with NIHL may also develop balance-related issues [13], tinnitus [14], permanent hearing loss [15], communication and social difficulties, fatigue and stress [16], and hyperacusis (reduced sound tolerance) [17].

Noise pollution is a major concern in oil production operations, primarily caused by equipment such as pumps, compressors, and gas processing units. It stands as a leading contributor to occupational health hazards in the industry [9, 11]. A study conducted in an oilfield revealed that generator noise levels can exceed 95 dB within a 5-meter range of the machinery [18]. A separate study measured the noise emitted by air compressors, recording levels of 101 dB [9]. Another study found that the primary noise sources in operational zones were high-pressure gas compressors and fluid (gas) flow through pipelines, with sound levels surpassing 85 dB [11].

The oil sector and its associated industries play a vital and strategic role in Iran. Given the substantial workforce employed in these fields, along with existing research on the harmful effects of noise, further studies on noise control measures are critically needed [11]. While numerous studies have explored this issue, few have specifically addressed the relationship between noise-induced hearing loss and blood pressure among oil and gas workers, despite the high levels of occupational noise exposure in this industry. This study aims to assess the prevalence of NIHL and its relationship with blood pressure among workers in oil production plants.

MATERIALS AND METHODS

Study design and participants

The oil field under study is located in western Iran. During each work shift, approximately 450 employees work at the site. This cross-sectional study included 670 male workers, selected using convenience sampling. Participants with a history of cardiovascular diseases (e.g., heart failure, myocardial infarction, or stroke), uncontrolled diabetes, congenital ear abnormalities, active ear infections, or prior use of ototoxic medications (e.g., certain antibiotics or chemotherapy drugs) were excluded. Additionally, individuals with a history of ear surgery or pre-existing sensorineural hearing loss unrelated to hypertension were excluded from the study.

Noise measurement

To assess noise pollution in operational areas, the exposure duration of occupational groups—including safety officers, operational technicians, and maintenance personnel—was first evaluated based on their job descriptions and consultations with unit managers. Given that safety officers had the highest average on-site presence (approximately 6 hours in a 12-hour shift), they were selected to determine the maximum noise exposure dose.

Noise dosimetry was conducted using a CEL-360 device, capable of measuring both Dose (%) and Leq (equivalent continuous sound level). According to standard exposure limits, permissible noise exposure should result in a dose percentage of ≤100%. The noise dose was calculated using Equation 1, based on the prevailing standard in Iran:

Eq.1: $Dose (\%) = 12.5 \Sigma t_i \text{ anti log} [SPL_i - 85 / 10]$

Blood pressure measurement

Blood pressure (BP) was measured using a digital sphygmomanometer (Omron, Japan) after a five-minute resting period in a seated position, with readings taken from the right arm. Measurements were performed twice, with a minimum interval of two minutes between readings, and the average of the two values was used for analysis. Hypertension was defined as a systolic blood pressure (SBP) ≥140 mmHg and/or diastolic blood pressure (DBP) ≥90 mmHg [19].

Individuals' hearing status assessment

Pure-tone air and bone conduction audiometry was utilized to assess individuals' hearing status. Evaluations were conducted using a Triveni TAM 500 audiometer within a noise-insulated environment. The air and bone conduction thresholds for pure tones were measured at frequencies of 0.5, 1, 2, 3, 4, 6, and 8 kHz for each ear by a trained audiology specialist. Hearing loss was determined by calculating the mean pure-tone

Table 1. Sound equivalent level (Leq)

Sample No.	Leq. (dBA)	12-hour dose percentage	Comparison with std.
1	92.3	806.5	More than OEL
2	92.0	752	More than OEL

Table 2. Prevalence of noise-induced hearing loss by severity level

Hearing loss	Right ear Frequency (%)	Left ear Frequency (%)
Without hearing loss	679 (91.7)	684 (90.0)
Mild	47 (6.2)	58 (7.6)
Moderate	16 (2.1)	17 (2.2)
Sever	-	1 (0.1)

Table 3. Association between blood pressure and noise-induced hearing loss

Blood Pressure	NIHL		p-value
	Yes	No	
SBP	118.16 ± 10.39	115.81 ± 7.89	0.008*
DBP	77.45 ± 5.35	75.53 ± 6.46	<0.001*
NIHL			
Yes	5 (5.7)	16 (2.5)	0.162§
No	83 (94.3)	625 (97.5)	

SBP: Systolic blood pressure, DBP: diastolic blood pressure, HTN: Hypertension, Data are reported as Mean ± standard deviation or frequency (percentage), *Independent sample t-test, §Chi-square test

threshold at these frequencies for each ear. Individuals were categorized based on their hearing ability as follows: those without hearing loss (hearing threshold below 25 dB), those with mild hearing loss (threshold between 25 and 40 dB), those with moderate hearing loss (threshold between 40 and 60 dB), and those with severe hearing loss (threshold exceeding 60 dB) [20]. Additionally, individuals exhibiting a hearing threshold above 25 dB at any single frequency were classified as having hearing loss.

Statistical analyses

Mean ± standard deviation and frequency (percentage) were used to describe quantitative and qualitative variables, respectively. The Mann–Whitney U test was applied to compare quantitative variables. All statistical analyses were performed using SPSS software. P-values less than 0.05 were considered statistically significant.

RESULTS

The data presented in Table 1, based on measurements from two consecutive 12-hour shifts, showed that the 8-hour received dose within the operational range exceeded the allowable limit by 5.5 to 6 times, as recorded by the pre-study team (safety staff).

This research involved 670 male participants (230 individuals were excluded), with an average age of 36.38 years (SD = 6.15). The study found that 12.7% of the participants had noise-induced hearing loss (NIHL). The average systolic blood pressure (SBP) was 116.27 mmHg (SD = 8.21), while the average diastolic blood pressure (DBP) was 75.63 mmHg (SD = 6.31). Hypertension was present in 2.7% of the participants.

According to Table 2, no cases of severe NIHL were observed. The prevalence of moderate and mild NIHL was recorded at 2.1% (16 people) and 6.2% (47 people), respectively. The majority of participants (91.7%) had no NIHL.

According to Table 3, the mean of SBP and DBP were significantly higher in participants with NIHL than those without NIHL ($p<0.05$). However, no statistically significant association was observed between HTN and NIHL ($p=0.162$).

DISCUSSION

Noise exposure in industrial settings remains one of the most critical occupational hazards today. Chronic exposure to high sound pressure levels not only leads to noise-induced hearing loss (NIHL) but can also trigger a cascade of nonauditory effects, most notably alterations in blood pressure (BP) and cardiovascular stress.

In our study, conducted in an oil field in western Iran with heavy industrial operations, 670 male workers were evaluated. The findings revealed that 12.7% of the workers had NIHL. Those with NIHL demonstrated significantly higher mean systolic and diastolic blood pressure compared to those without NIHL (SBP: 118.16 vs. 115.81 mmHg, p = 0.01; DBP: 77.45 vs. 75.53 mmHg, p = 0.001). These results align with the growing body of evidence suggesting that chronic noise exposure in high-risk industries not only compromises auditory health but may also contribute to elevated cardiovascular risk.

The observed NIHL prevalence of 12.7% is comparable to findings from other industrial sectors. For example, Masterson et al. [8] conducted a large-scale study across various industries in the United States, reporting variable prevalence rates, with sectors such as manufacturing and transportation showing particularly high rates. Similarly, Kakavandi et al. [3] documented significant hearing impairment among workers in automotive parts manufacturing plants in Kermanshah, Iran, underscoring that occupational noise is a pervasive issue in both heavy and light industrial settings.

An important aspect of our study is the significant association between noise-induced hearing loss (NIHL) and blood pressure (BP). Several mechanisms may explain this relationship. Long-term exposure to noise triggers the body's stress response, activating the hypothalamic–pituitary–adrenal axis and the sympathetic nervous system. As a result, catecholamine levels increase, leading to vasoconstriction and elevated BP [10]. Hahad et al. [10] demonstrated that environmental noise can raise stress hormone levels and oxidative stress, both of which contribute to vascular dysfunction. Moreover, the 2020 global hypertension guidelines by Unger et al. [19] emphasize that even modest chronic elevations in BP among noise-exposed workers may signal an increased risk for cardiovascular diseases. Hence, our finding of higher systolic and diastolic BP in workers with NIHL strengthens the evidence suggesting that the auditory and cardiovascular systems are intricately linked under conditions of prolonged noise stress.

The oil and gas industry poses unique challenges in terms of noise exposure. Workers in this field are frequently subjected to noise levels that exceed Occupational Exposure Limits (OEL) by 5 to 6 times—as demonstrated by our dosimetry measurements. Yet, studies in this industry remain scarce compared to those in conventional manufacturing or construction sectors. Askari et al. [2, 4] have previously underscored the prevalence of hazardous exposures in oilfields, noting an urgent need for comprehensive risk assessment and the implementation of control measures. Our study further highlights that NIHL is not only a significant concern in the oil and gas sector but may also serve as an early indicator of cardiovascular strain.

It is important to acknowledge that the relationship between noise exposure, NIHL, and BP is likely multifactorial. Individual differences—including genetic predisposition, personal health history, and lifestyle factors such as smoking, diet, and physical activity—may modulate the risk. Some research indicates that genetic polymorphisms may predispose individuals to the deleterious effects of noise [15]. Additionally, the psychological stress caused by incessant noise may lead some workers to adopt unhealthy coping mechanisms (e.g., increased tobacco or alcohol use), which could further elevate BP. Unfortunately, such factors were beyond the scope of our current study but should be considered in future research efforts.

From a public health perspective, the findings underscore the need for comprehensive occupational health programs that integrate both auditory and cardiovascular risk assessments. First, periodic audiometric testing should be mandatory in high-noise industries, and workers should be provided with high-quality hearing protection devices. In addition, real-time noise monitoring, regular machinery maintenance, the installation of acoustic barriers, and engineering controls are essential strategies to reduce overall noise exposure [9, 15]. Second, given the association with blood pressure (BP), it is advisable for occupational health programs to include regular cardiovascular screenings. Early detection of elevated BP can facilitate timely interventions—potentially reducing the long-term risk of serious cardiovascular events.

Given the complex interactions between noise exposure and health outcomes, future studies should adopt a longitudinal design to explore the temporal relationships between chronic noise exposure, the onset and progression of noise-induced hearing loss (NIHL), and subsequent cardiovascular changes. Expanding the sample size and including workers from varied industrial settings would enhance the external validity of these findings. Research examining potential modifiers such as genetic susceptibility and lifestyle choices may further our understanding of how noise impacts individual health. International collaborative studies could also help elucidate how regional differences in industrial practices and regulatory standards affect occupational noise-related health outcomes.

Globally, countries with robust occupational health regulations are beginning to see the benefits of implementing stringent noise control measures—including reductions in NIHL prevalence and improved cardiovascular outcomes. Conversely, in regions where such preventive measures are not rigorously enforced, noise remains a pervasive hazard. The current study's findings, particularly the significant differences in BP among those with NIHL, call for an urgent reassessment of workplace safety policies in the oil and gas industry. Addressing these challenges will not only enhance worker health and productivity but may also reduce the social and economic costs associated with occupational diseases.

CONCLUSION

In summary, our study demonstrates that workers exposed to high levels of industrial noise in the oil and gas sector exhibit a notable prevalence of noise-induced hearing loss (NIHL) at 12.7%, which is associated with modest yet statistically significant increases in both systolic and diastolic blood pressure. These findings reinforce the understanding that chronic noise exposure has multifaceted health implications—extending beyond auditory damage to include adverse cardiovascular effects.

Given the strategic importance of the oil and gas industry and the substantial workforce at risk, the implementation of rigorous noise control strategies, regular audiometric evaluations, and cardiovascular monitoring is imperative. Such measures would not only safeguard the auditory health of workers but also help mitigate long-term cardiovascular risks, ultimately contributing to a healthier, safer, and more productive workforce.

Strengths and Limitations

Our study's merit is strengthened by the use of precise dosimetric equipment (CEL-360 device) to capture real-time noise exposure levels and by adhering to standardized audiometric procedures using the Triveni TAM 500 audiometer within an acoustically isolated environment. Furthermore, by excluding individuals with known confounding conditions—such as pre-existing cardiovascular diseases, congenital ear abnormalities, or a history of ototoxic medication use—we minimized bias and ensured that the observed associations were most likely attributable to occupational noise exposure.

However, several limitations should be acknowledged. The cross-sectional design restricts our ability to establish causality between noise exposure and elevated blood pressure. Additionally, the focus on a single oil field in western Iran may limit the generalizability of our findings. Future studies employing longitudinal designs and incorporating more diverse populations are needed to validate and expand upon these associations.

REFERENCES

1. Materu SF, Sway GG, Mussa BS. Workplace concentrations of particulate matter and noise levels among stone quarry and soil brick-making workers in Tanzania. J Occup Environ Hyg. 2023;20(12):563–73.
2. Askari A, Poursadeqiyan M, Sahl Abadi AS, Mahdinasab L, Farhadi AR. Semi-quantitative risk assessment for workers exposed to occupational harmful agents in an oilfield in Iran. Work. 2023;76(1):147–57.
3. Kakavandi MG, Omidi A, Hashemian AH, Jabari M, Hamidi A, Bavandpur E, et al. An assessment of noise exposure and hearing health status among auto body workers in Kermanshah, Iran. J Educ Health Promot. 2021;10:290.
4. Askari A, Poursadeghiyan M, Alinia A, Sephvand A, Jafarzadeh E, Nasl-Saraji G, et al. Workplace risk factors assessment in North-Azadegan oil field based on harmful agents risk priority index (HARPI). Iran J Public Health. 2023;52(10):2157–68.
5. Biglari H, Saeidi M, Poursadeghiyan M, Sharafi H, Narooie MR, Alipour V, et al. A study on noise pollution in the city of Tehran, Iran. Int J Pharm Technol. 2016;8(3):17942–8.
6. Yazdanirad S, Khoshakhlagh AH, Al Sulaie S, Drake CL, Wickwire EM. The effects of occupational noise on sleep: a systematic review. Sleep Med Rev. 2023;72:101846.
7. Osei F, Effah E. Health effects caused by noise—the case of Africa: evidence in literature from the past 25 years. Asian J Adv Res Rep. 2022:19–27.
8. Masterson EA, Tak S, Themann CL, Wall DK, Groenewold MR, Deddens JA, et al. Prevalence of hearing loss in the United States by industry. Am J Ind Med. 2013;56(6):670–81.
9. Askari A, Sepahvand A, Davoodi M, Mokhtari F, Salehi-Sahlabadi A. Noise control measures prioritization and job groups identification exposed to hearing impairments to implement a hearing conservation program in the Azar oil field. Irtiqa Imini Pishgiri Masdumiyat. 2022;10(2):187–76.
10. Hahad O, Prochaska JH, Daiber A, Muenzel T. Environmental noise-induced effects on stress hormones, oxidative stress, and vascular dysfunction: key factors in the relationship between cerebrocardiovascular and psychological disorders. Oxid Med Cell Longev. 2019;2019:4623109.
11. Askari A, Abadi ASS, Alinia A, Pourjaafar M, Haghighi AH, Pirposhteh EA. Prioritizing and providing sound pollution control strategies at the CPF of North Azadegan

oilfield project. Sound Vib. 2021;55(4).

12. Themann CL, Masterson EA. Occupational noise exposure: a review of its effects, epidemiology, and impact with recommendations for reducing its burden. J Acoust Soc Am. 2019;146(5):3879–905.
13. Oosterveld W, Polman A, Schoonheyt J. Vestibular implications of noise-induced hearing loss. Br J Audiol. 1982;16(4):227–32.
14. Song Y, Pang W, Yan X, Luo Y, Rao Y, Qiu K, et al. Investigating the role of working patterns in tinnitus: results from a large UK population. Ear Hear. 2025;doi:10.1097.
15. Singh RV, Bhagat S, Sahni D, Aggarwal S, Kaur T. Noise-induced hearing loss among industrial workers in North India: a tale of various influencing factors. Indian J Otolaryngol Head Neck Surg. 2024:1–10.
16. Mehrotra A, Shukla SP, Shukla A, Manar MK, Singh S, Mehrotra M. A comprehensive review of auditory and non-auditory effects of noise on human health. Noise Health. 2024;26(121):59–69.
17. Thieren S, van Dommelen P, Benard M. Combining psychoeducation, sound exposure and counseling in hyperacusis therapy. J Hear Sci. 2024;14(3).
18. Askari A, Golmohammadi R, Alinia A, Honairi Haghighi A. Study the impact of acoustic barrier on noise reduction of generator building, case study: North Azadegan oil field. J Occup Hyg Eng. 2021;8(3):50–8.
19. Unger T, Borghi C, Charchar F, Khan NA, Poulter NR, Prabhakaran D, et al. 2020 International Society of Hypertension global hypertension practice guidelines. Hypertension. 2020;75(6):1334–57.
20. American National Standards Institute. Specifications for audiometers. New York: ANSI; 1989.