Scientific Research Publishing

International Journal of Otolaryngology and Head & Neck Surgery, 2025, 14(3), 111-119
https://www.scirp.org/journal/ijohns
ISSN Online: 2168-5460
ISSN Print: 2168-5452

Determinants of Noise-Induced Hearing Loss among Drivers in Bisha, Saudi Arabia

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How to cite this paper: Alqarni, N.A.M., Alqarny, M., Aldrehan, L.Z.A., Alshahrani, M.T.A., Alshahrani, S.A., Alshahrani, M.S.S., Alshehri, M.A.A., Alelyani, R.H., Aldosari, N.K.A., Alaklabi, S.M.A., Alshahrani, S.D.M., Altalee, H.S.M., Alshahrani, L.A., Alhalafi, A.H. and Elnahriry, T.A. (2025) Determinants of Noise-Induced Hearing Loss among Drivers in Bisha, Saudi Arabia. *International Journal of Otolaryngology and Head & Neck Surgery*, **14**, 111-119.
https://doi.org/10.4236/ijohns.2025.143013

Received: March 10, 2025
Accepted: May 11, 2025
Published: May 14, 2025

Abstract

Introduction: Noise exposure is a preventable cause of hearing loss, with traffic being a primary source of loud sounds that can lead to noise-induced hearing loss. Research indicates that hearing loss is notably prevalent among drivers. **Objective:** This study aimed to estimate the prevalence of noise-induced hearing loss and its associated factors among drivers in Bisha City, Saudi Arabia. **Materials and Methods:** A cross-sectional study was conducted in Bisha City, Saudi Arabia, involving adult car drivers aged 18 years and older. The study used an online link with a validated questionnaire to measure noise-induced hearing loss among drivers. The questionnaire was distributed via social media using the author's professional networks, friends, and family, allowing any viewer in Bisha City to respond voluntarily from November 2024 to January 1, 2025. **Results:** Of the 387 participants, 213 (55%) were male and 174 (45%) were female, with a mean age of 29.6 years. A total of 30 drivers (7.7%) were found to have NIHL. The noise level inside the car was statistically significant (P = 0.001) in relation to hearing loss. **Conclusion:** Noise-induced hearing loss was observed among car drivers, regardless of the car's production year or driving duration. Drivers exposed to noise in their cars could potentially impair their hearing. We recommend implementing measures such as improving road quality, adding noise cancellation features to cars, and screening drivers' hearing abilities to ensure their safety.

Keywords

Noise Induced Hearing Loss, Drivers, Car, Hearing Loss, Saudi Arabia

1. Introduction

Noise-Induced Hearing Loss (NIHL) arises from prolonged exposure to elevated sound levels. Continuous exposure to excessive noise can lead to NIHL [1]. The World Health Organization (WHO) estimates that approximately 466 million individuals worldwide have a disabling hearing impairment [2]. Millions globally suffer from noise-induced hearing loss, which is one of the most common disabilities [3]. The incidence of NIHL is consistently higher among males than females and varies across racial groups, with sensitivity decreasing as pigmentation increases [4]. Noise exposure is a preventable cause of hearing loss [5], and traffic is a significant contributor to high sound levels, which can lead to NIHL [6]. General transportation systems, such as railways, roads, and air traffic, significantly contribute to environmental noise pollution [7]. The prevalence of hearing loss is high among drivers [8] due to prolonged exposure to loud sounds [9]. Drivers of heavy vehicles, such as buses and trucks, are more exposed to Noise-Induced Hearing Loss (NIHL) [10] [11]. Bisha, in the southwestern region of Saudi Arabia, serves as a critical connection between the central and southern regions through its main roads, where traffic volume and vehicle speeds are high. The high traffic density, especially from heavy vehicles like trucks and buses, contributes to significant noise pollution. Prolonged exposure to such noise can lead to NIHL, posing a public health concern in the area. Addressing NIHL in Bisha is crucial for safeguarding the health of its population, particularly since the condition is preventable. However, to our knowledge, no previous study has explored the distribution of NIHL among drivers in Bisha. This study aimed to estimate the prevalence of NIHL and its associated factors among drivers in Bisha.

2. Method

This cross-sectional study was conducted in Bisha, Saudi Arabia, from November 2024 to January 1, 2025, among drivers in Bisha City. Using an electronic sample size calculator, we determined that the minimum required sample size was 384 participants, based on a 5% margin of error and a 95% confidence interval.

The questionnaire was distributed online through social media, utilizing the author's professional networks, friends, and family, allowing any viewer in Bisha City to respond voluntarily.

We included adult participants aged 18 and older with valid driver's licenses. We excluded individuals without valid licenses, those who refused to participate, and anyone with a prior diagnosis of hearing problems or medical conditions predisposing them to hearing loss, such as chronic suppurative otitis media or otitis

media with effusion. Additionally, individuals with a family history of hearing loss or comorbidities like hypertension, diabetes mellitus, or hypothyroidism were excluded from the study.

Data collection included the type of car and engine energy used, noise level inside the car, the car's production year, duration of driving, listening habits to the car audio system, use of headphones, and demographic details. All drivers completed a validated self-reported 10-item questionnaire, adapted from the work of Manar MK *et al.* [12], which assessed noise-induced hearing loss among drivers. Each question was scored with 1 point, and a total score of 8 or more was considered indicative of NIHL.

The collected data were coded, entered, and analyzed using the Statistical Package for the Social Sciences (SPSS) version 23. The chi-square test and multiple logistic regression were applied to determine the statistical significance of associations, with p-values of 0.05 or less considered statistically significant.

3. Results

A total of 387 car drivers participated in the study: 213 (55%) were male and 174 (45%) were female. Among all participants, 30 drivers (7.7%) were found to have noise-induced hearing loss. The mean age of drivers was 29.6 years, and the age group most affected by NIHL was 18 - 30 years, with 21 (8.3%) drivers affected.

The female drivers were more affected by NIHL than male drivers, 18 (10.3%) compared to 12 (5.6%), respectively. Regarding nationality, there were 378 (97.7%) Saudi drivers, with 29 (7.7%) having NIHL, while there were only 9 (2.3%) non-Saudi drivers, with 1 (11%) having NIHL. Concerning marital status, single drivers had the highest frequency of NIHL at 23 (5.9%), compared to married drivers at 6 (1.5%) and divorced drivers at 1 (0.25%).

NIHL was found to have a high occurrence among drivers with a Bachelor's degree, 22 (8.4%), and students, who had a higher prevalence compared to employees, 16 (4%) and 11 (3%), respectively.

Table 1 presents the sociodemographic data of the study population and its association with NIHL, with none of these factors showing significant associations ($P > 0.05$).

In terms of car type by size, 203 participants (52.5%) drove small cars, 141 (36.4%) medium cars, and 43 (11.1%) large cars. Only 1 participant (0.25%) drove an electric car, and 6 participants (1.55%) drove hybrid cars. Gasoline-powered cars were the most common, with 368 participants (95.1%) using them, while only 12 (3.1%) used diesel-powered cars. Regarding production years, most participants' cars (294 or 76%) were produced between 2015 and 2025. Cars produced between 2005 and 2014 accounted for 82 vehicles (21.2%), while only 11 cars (2.8%) were from 1995 to 2004, with the mean production year being 2017.3. None of these car-related factors were significantly associated with NIHL ($P > 0.05$), as shown in Table 2.

Table 1. Sociodemographic data and its association with NIHL.

Sociodemographic	Category	Frequency N = 387 (%)	NIHL N (%)	Chi-square test (N 387)	P-value
Age	18 - 30 years old	253 (65.4)	21 (8.3)	1.83	0.607
	31 - 40 years old	65 (16.8)	6 (9.2)		
	41 - 50 years old	58 (15)	2 (3.4)		
	More than 50 years old	11 (2.8)	1 (9.1)		
Sex	Male	213 (55)	12 (5.6)	2.97	0.085
	Female	174 (45)	18 (10.3)		
Nationality	Saudi	378 (97.7)	29 (7.7)	0.145	0.703
	Non-Saudi	9 (2.3)	1 (11.1)		
Marital status	Married	152 (39.3)	6 (3.9)	5.81	0.121
	Single	224 (57.9)	23 (10.3)		
	Divorced	7 (1.8)	1 (14.3)		
	Widow	4 (1)	0 (0)		
Educational level	Postgraduate studies	22 (5.7)	2 (9.1)	3.04	0.385
	Bachelor	262 (67.7)	22 (8.4)		
	Diploma	33 (8.5)	0 (0)		
	High school or less	70 (18.1)	6 (8.6)		
Job status	Employee	179 (46.3)	11 (6.1)	3.31	0.346
	Unemployed/Retired	50 (12.9)	3 (6.0)		
	Student	150 (38.8)	16 (10.7)		
	Freelance	8 (2.1)	0 (0)		
Place of residence	Urban	355 (91.7)	28 (7.9)	0.110	0.740
	Rural	32 (8.3)	2 (6.2)		

Table 2. Car details, driving practices, and their association with NIHL.

Variables	Category	Normal N (%)	NIHL N (%)	Chi-square test (N 387)	P-value
Type of car based on body size and engine size.	Small car	191 (94.1)	12 (5.9)	2.64	0.267
	Medium car	126 (89.4)	15 (10.6)		
	Big car	40 (93.0)	3 (7.0)		
Type of energy	Electric	1 (100)	0 (0)	1.679	0.642
	Hybrid	6 (100)			
	Diesel	12 (100)			
	Gasoline	338 (91.8)	30 (8.2)		
Noise level inside the car	High	19 (79.2)	5 (20.8)	14.39	0.001*
	Medium	164 (89.1)	20 (10.9)		
	Low	174 (97.2)	5 (2.8)		
Driving hours	0 - 5 h	290 (92.1)	25 (7.9)	0.956	0.620
	6 - 10 h	56 (91.8)	5 (8.2)		
	11 - 15 h	11 (100)	0 (0)		

Continued

Year of production	1995-2004	11 (100)	0 (0)	2.269	0.322
	2005-2014	73 (89.0)	9 (11.0)		
	2015-2025	273 (92.9)	21 (7.1)		
Listen to the car's audio system.	Yes, in a low voice	71 (95.9)	3 (4.1)	3.916	0.271
	Yes, in a medium voice	164 (90.1)	18 (9.9)		
	Yes, listen out loud	57 (90.5)	6 (9.5)		
	NO	65 (95.6)	3 (4.4)		
Using headphones	Yes	119 (95.2)	6 (4.8)	2.250	0.134
	No	238 (90.8)	24 (9.2)		

*Statistically significant.

The noise levels heard by drivers inside the car were found to be statistically significant in our study (P = 0.001) (Table 2). Among the cars, 24 (6.2%) had high noise levels, 184 (47.5%) had moderate noise levels, and 179 (46.3%) had low noise levels. The mean driving time per day was 3.8 hours. Most drivers, 315 (81.4%), reported driving for 0 - 5 hours per day, while 61 (15.8%) drove for 6 - 10 hours, and only 11 drivers (2.8%) drove for 11 - 15 hours per day. Regarding audio system use, 74 (19.1%) drivers listened at a low volume, 182 (47%) at a medium volume, and 63 (16.3%) at a high volume, while 68 (17.6%) did not listen to the audio system at all. Additionally, 262 (67.7%) drivers did not use headphones while driving.

Table 3. Questionnaire items and population responses.

Questionnaire items	Yes N (%)	No N (%)
Do you have problems hearing over telephone/mobile phones?	51 (13.2)	336 (86.8)
Do you have trouble following conversations when two or more people are talking at the same time?	125 (32.3)	262 (67.7)
Do people complain that you watch TV at a high volume?	140 (36.2)	247 (63.8)
Do you have to strain to understand conversations?	80 (20.7)	307 (79.3)
Do you have trouble hearing in noisy environments?	210 (54.3)	177 (45.7)
Do you often ask people to repeat themselves?	155 (40.1)	232 (59.9)
Do many people seem to mumble or not speak clearly?	104 (26.9)	283 (73.1)
Do you misunderstand what others say and respond inappropriately?	79 (20.4)	308 (79.6)
Do you have trouble understanding the speech of women and children?	56 (14.5)	331 (85.5)
Do people get annoyed because you misunderstand them?	58 (15.0)	329 (85.0)

Table 3 shows the responses from the 10-item questionnaire. The item "Do you

have trouble hearing in a noisy background?" received the highest number of "yes" responses at 210 (54.3%), while the item "Do you have a problem hearing over telephone/mobile phones?" received the fewest affirmative responses, with 51 (13.2%).

Table 4 highlights several significant associations. Drivers who heard high noise levels inside their cars were significantly more likely to develop NIHL (OR = 2.377, 95% CI: 0.988 - 4.350, P = 0.008).

Table 4. Logistic regression analysis for risk factors associated with NIHL.

Variables	Estimate (β)	Odds Ratio (OR)	95% confidence intervals (CI) Lower-upper	p-value
Sex	0.659	0.517	0.242 - 1.106	0.089
Age	0.014	0.986	0.948 - 1.025	0.469
Nationality	0.408	0.665	0.080 - 5.500	0.705
How many hours do you drive each day?	0.014	1.014	0.881 - 1.166	0.849
Noise level inside the car	1.335	2.377	0.988 - 4.350	0.008
What is your car's year of production?	0.018	0.982	0.920 - 1.048	0.582

4. Discussion

The World Health Organization (WHO) reported that in 2018, approximately 466 million people worldwide were affected by disabling hearing loss, with South Asia being the highest contributor at 27%. WHO also projects that the number of individuals with disabling hearing loss will rise to 630 million by 2030 and 900 million by 2050 [13]. Millions worldwide have suffered from noise-induced hearing loss, one of the most common disabilities [3]. In our study, 7.7% of car drivers were found to have noise-induced hearing loss (NIHL), which aligns with findings that drivers have a higher prevalence of hearing loss compared to the general population [8]. This could be explained by the car environment, where prolonged exposure to elevated noise levels contributes to NIHL. The noise level inside the car in our study was statistically significant (P = 0.001), indicating that the louder the car environment, the higher the prevalence of NIHL among drivers [9].

Previous studies suggest that drivers of heavy vehicles, such as buses and trucks, are more susceptible to NIHL due to increased exposure to loud environments [10] [11]. However, our study did not find a significant association between the duration of driving and NIHL. Despite this, it is well established that drivers, particularly in professional settings, are exposed to loud noises for prolonged periods, leading to higher rates of hearing impairment compared to the general population. Prevalence rates of NIHL among professional drivers range from 4.5% to 46%, depending on the type and intensity of driving [14].

In our study, the mean driving time per day was 3.8 hours; however, no association was found between driving hours and NIHL. This contrasts with findings from other studies on professional drivers, where long-term exposure to noisy environments over several years has been linked to hearing loss [15]. The lack of association between driving hours and NIHL may stem from non-linear exposure thresholds, where prolonged exposure doesn't directly correlate with NIHL risk. Additionally, inaccuracies in self-reported driving hours could obscure true relationships.

Themann C *et al.* found that NIHL is more common among males [4], but our study did not find a significant gender difference. We observed that female drivers had a slightly higher prevalence of NIHL compared to males, despite previous studies involving primarily male participants [8] [15] [16]. This suggests that female drivers are not immune to the risk. Female drivers may exhibit higher NIHL prevalence due to factors like increased headphone usage and greater occupational noise exposure. Understanding these confounding factors is essential to fully comprehend the gender differences in NIHL, as they can influence auditory health beyond driving conditions. Further research could illuminate these relationships.

Factors such as the year of car manufacture and the location of the engine influence the noise levels experienced by drivers [11]. However, in our study, neither the car's production year nor the type of engine (gasoline or diesel) was significantly associated with NIHL. This indicates that other factors, such as road conditions and driving practices, might play a larger role in noise exposure.

To mitigate the impact of NIHL on drivers, general measures such as improving road surface quality are recommended [16]. Periodic audiometric tests can help detect hearing loss early, aiding in the prevention of further deterioration. Recognizing existing hearing loss is crucial for educational and legal purposes [17]. Regular screening of drivers' hearing abilities and training on noise prevention could help reduce the long-term effects of NIHL on their quality of life and professional careers [16] [18].

5. Limitations

This study focused primarily on drivers rather than the general population. Assessing NIHL among the general population is needed to compare its prevalence with that among drivers. Using validated tools, such as questionnaires, helps assess prevalence; however, self-reported data can be subjective and prone to recall bias. The absence of objective measures, such as pure-tone audiometry, might impact on the study's findings. We suggest incorporating clinical assessments in future research to measure actual NIHL numbers.

6. Conclusion

Noise-induced hearing loss has been observed in car drivers, regardless of the car's production year or the duration of driving. Drivers are exposed to noise inside their vehicles, which may negatively affect their hearing over time. To mitigate this risk,

it is essential to improve road quality and implement noise reduction features in cars. Furthermore, routine hearing screenings for drivers are recommended to safeguard their health and ensure road safety.

Consent to Participate

Informed consent was obtained from all participants.

Ethical Approval

Ethical approval was obtained from King Abdullah Hospital in Bisha City, Saudi Arabia via reference number E-CTS REF No. BIS-24-00020, dated: 23-10-2024.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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