ORIGINAL ARTICLE ASIAN JOURNAL OF MEDICAL SCIENCES

The noise profile and hearing impact of commercial fiberglass reinforced plastic speed boats in Port Blair, Andaman and Nicobar Islands

Jonathan Lalchawilena[1], Lalhmingmawii[2]

[1]Audiologist and Speech Therapist, [2]Assistant Professor, Department of Otorhinolaryngology, Zoram Medical College, Falkawn, Mizoram, India

Submission: 16-03-2022 Revision: 28-03-2023 Publication: 01-05-2023

ABSTRACT

Background: Hearing impairment may result from tourism-related vehicle engine noise in Port Blair, Andaman, and Nicobar Islands. **Aims and Objectives:** Measure noise levels and test commercial fiberglass-reinforced plastic (FRP) speedboat operators for hearing loss. **Materials and Methods:** Hearing loss and noise impacts were checked in a total of 145 male crew members and workers exposed to commercial FRP-speedboat outboard engine noise. 18–50-year-olds with 1–20 years of experience participated. To detect hearing loss, noise-induced hearing loss (NIHL) risk indicators that could appear as a 4 kHz noise notch and the existence of high-frequency sloping hearing loss were detected using pure tone audiometry. The level of noise exposure was measured in conjunction with a questionnaire to assess an individual's general knowledge of the effects of noise and hearing loss. **Results:** A 4 kHz noise notch, some high-frequency slope hearing loss, and an overall hearing loss rate of 42.1% were found in 145 participants. Out of these, 15.9% had the most common bilateral notch. Bilateral high-frequency sloping was 10.3%, Unilateral high-frequency sloping was 4.9%, and unilateral 4 kHz notch was 11.0%. According to the questionnaire, research participants are shockingly unaware of noise-induced hearing loss. The FRP Speedboat outboard engine's measured noise level ranged from 79.7 to 89.4 dB (A). **Conclusion:** The FRP Speedboat crews were at risk of hearing loss, specifically NIHL with continuous noise exposure. High frequency sloping hearing loss, mild to moderate hearing loss, and a substantial 4 kHz noise notch are found in noise-exposed employees. Awareness is needed to prevent irreversible hearing loss.

Key words: Noise-induced hearing loss; Fiber-reinforced plastic; Speedboat, Noise notch; High frequency sloping hearing loss

Access this article online

Website: http://nepjol.info/index.php/AJMS

DOI: 10.3126/ajms.v14i5.53276

E-ISSN: 2091-0576

P-ISSN: 2467-9100

INTRODUCTION

Unwanted sound is a common term for noise. People today participate in a variety of daily activities and are exposed to a wide range of noise, including engine, industrial, traffic, economic, and recreational noise. Individuals may experience hearing loss, annoyance, and other negative effects from noise. When exposed to sounds of different intensities and durations, a person may experience noise-induced hearing loss (NIHL).[1,2] At any age or sex, NIHL can occur. Approximately 12% or more of the world's population was predicted to be at risk for NIHL.[3] NIHL is a well-known occupational illness and a significant environmental health issue worldwide.[4,5] Early-stage NIHL may only result in a temporary threshold shift at few frequencies that may be reversible, whereas continued noise exposure is likely to result in a permanent threshold shift or permanent hearing loss, which may affect both ears or any ears.[6,7] The maximum hearing loss brought on by noise is typically 40 dB in the low-frequency range and up to about

Address for Correspondence:
Dr. Lalhmingmawii, Assistant Professor, Department of Otorhinolaryngology, Zoram Medical College, Falkawn, Mizoram, India.
Mobile: +91-8837409678. **E-mail:** mamee.vaivenga@gmail.com

75 dB in the high-frequency range.[8] Asymmetrical noise-induced hearing loss has previously been documented, but NIHL is always sensorineural and almost always bilateral and symmetrical.[8,9] People exposed to sounds of <75 dB are unlikely to develop NIHL, but those exposed to sounds of 85 dB or higher over time are more likely to do so.[1] Pure-tone audiometry (PTA) is widely regarded as the gold standard test for diagnosing NIHL.

The Andaman and Nicobar Islands, also known as "the Andamans," are a cluster of 572 magnificent islands in the southeast corner of India's Bay of Bengal. Port Blair, in particular, has witnessed a growth in tourism-related activities and international tourists. Commercial passenger speedboats, especially fiberglass-reinforced plastic (FRP) speedboats, are a common means of transportation utilized to travel to numerous islands and sites, generating a significant amount of noise. Numerous crew members were often exposed to varied levels and durations of outboard motor noise, which elevated their chance of developing hearing loss. This paper examines the fundamental noise profile and the potential impacts of noise exposure on personnel.

Aims and objectives

Many individuals in Port Blair, Andaman, and Nicobar Islands, were subjected to vehicle engine noise as a result of tourism-related activities, which may be damaging to healthy hearing. This study aims to assess noise levels and conduct hearing tests to assess the risk of hearing loss faced by personnel whose work involves operating commercial FRP (fiber-reinforced plastic) speedboats.

MATERIALS AND METHODS

All 145 members of the FRP Speedboat crew and personnel who went to a referral hospital for their annual checkups also had their hearing tested. All men were regularly subjected to the roar of the commercial FRP-outboard speedboat's motor throughout their shifts. Their ages ranged from 18 to 50 (mean age = 30.4), and their years of experience varied from 1 to 20 (mean = 6). Everyone has had an audiological examination in a soundproofed room to check for hearing loss and the effects of noise. No one mentioned having their hearing tested before. An otoscopic examination of the ear was performed prior to audiometry in order to rule out the presence of any conductive pathology. The tympanic membrane of the patient was not damaged. Table 1 displays the study crew's basic demographic data, including their participation in the FRP Speedboat. This study used a hearing test (PTA), a noise awareness questionnaire, and a noise intensity measurement to investigate the risks, prevalence, and awareness of NIHL.

Table 1: Basic information of FRP speedboat crew in the study

Measures	Age years (n=143)	Service years n=143
Mean	30.38	6.38
Median	29.00	4.00
Mode	21.00	1.00
Std. D	8.06	6.01
Range	32.00	19.00
Min	18.00	1.00
Max	50.00	20.00

FRP: Fiberglass-reinforced plastic

PTA

PTA was performed for both air conduction and bone conduction at 0.25, 0.5, 1, 2, and 4 kHz using a calibrated ALPS AD 2000 (India) audiometer to estimate thresholds. Reports from audiograms were recorded and examined. The audiometry process took each participant between 10 and 15 min, and hearing levels were categorized in accordance with the World Health Organization classification of hearing loss. A noise notch (4 kHz notch) and high-frequency hearing loss, which may be indicative of early or early signs of NIHL or hearing disorders, were specifically looked for during the PTA test in order to identify any hearing impairment. People with high-frequency hearing loss and such a noise notch were thought to be at risk of hearing loss or damage. Different operational definitions and notch identification criteria have been used in the past. The notch has been used frequently in the past and up to this day to report NIHL prevalence. Similar to the criteria used by Mahboubi et al., the following criteria were used in this study: (a) 4 kHz threshold >25 decibel hearing level (dBHL); (b) 4 kHz threshold >10 dB compared to the 2 kHz threshold; and (c) 4 kHz threshold >10 dB compared to the 8 kHz threshold.[10] The results of the SPSS version 26 analysis of the data collected are displayed in the figures. If variable's P=0.05, it is deemed statistically significant.

Noise awareness questionnaire

The general awareness of an individual regarding the effects of noise and hearing loss was evaluated using a short noise awareness questionnaire (Appendix 1). This included some pertinent inquiries regarding ear and hearing issues, awareness of the effects of noise, inquiries regarding the use of hearing protection, and individual assessments of one's own hearing capacity. The questionnaire took each participant between 5 and 10 min to finish.

Noise measurement

At the exposure site, the noise level was measured using sound-level meter (SLM). The intensity-level measurement was conducted using a Mextech Digital SLM SL4012. According to the user manual, the equipment's calibration

was examined. First, a general assessment of the analyzer band performances was made by measuring some well-known wide-band noise. For measurements taken outside, a windscreen was provided for the microphone. Noise measurements were made at a location where the master and crew (who are typically exposed to FRP speedboat outboard motor and engine noise) typically work. This was done twice: Once at a distance of about one meter (position 1) from the boat's outboard motor or engine and once at a distance of about three and a half meters (position 2) from the noise of the motor or engine. During readings, the SLM was held in the hand at the level of the crew's or master's ears. Seven noise intensity measurements for P1 and seven for P2 were totaled, and each recording lasted for roughly 20 s. The SLM was used to measure noise levels using A-frequency weighting and a quick response time. Figure 1 shows the noise measurement protocol.Despite the low risk involved in this study, it was conducted ethically by obtaining written and verbal consent from all subjects' personnel before the administration of the questionnaire.

RESULTS

In the context of PTA, questionnaire response, and noise intensity level measurement, the data were analyzed along with descriptive statistics, percentages, and proportions of the study subjects.

Pure tone audiogram

To determine the hearing profile, including the presence of hearing loss, the noise notch (4 kHz dip) that indicates risks of NIHL, and the presence of high frequency sloping and hearing loss (HFSHL) as a result of noise exposure, PTA results and findings were recorded and presented in this study. Figure 2 displays the distribution of the NIHL risk indicators. PTA reveals normal hearing in 57.93% (n=84) of the 145 candidates, but an overall rate of 42.1% (n=61) reveals abnormal audiograms (Figure 2).

Hearing impairment

The prevalence of B/L mild sensorineural hearing loss (SNHL) was found to be 4.14% (n=6), as measured by PTA. Similarly, unilateral hearing loss was identified in 4.14% (n=6), with 0.69% (n=1) and 3.5% (n=5) of unilateral hearing loss affecting the right and left ears, respectively. Taking an average of 500 Hz, 1 kHz, and 2 kHz, the impairment was mild for most participants.

Noise notch

According to the audiometry, 8.3% of the sample (n=12) had a bilateral mild (notch mild [NMi]) notch at 4 kHz (30–40 dB and 7.6% (n=11) had a bilateral moderate (notch moderate [NMo]) notch at 4 kHz (>41 dB). Only

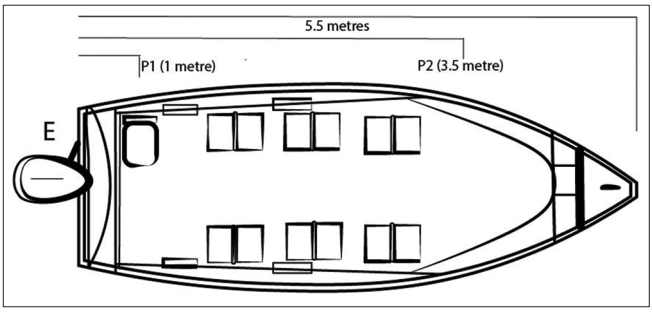

Figure 1: Top view of the fiberglass-reinforced plastic-speedboat and the distances between the outboard engine (E) and the two receivers P1 and P2 (insert about here)

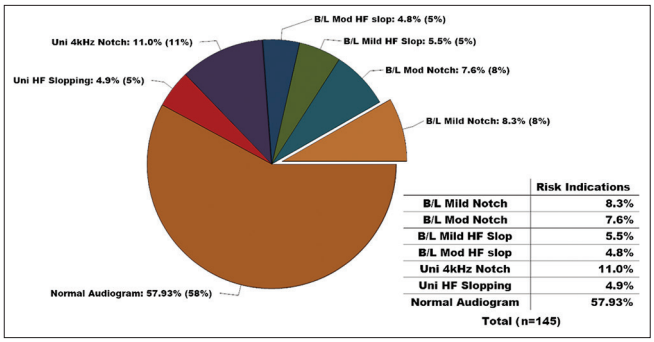

Figure 2: Distribution of (hearing damage) risks for noise-induced hearing loss

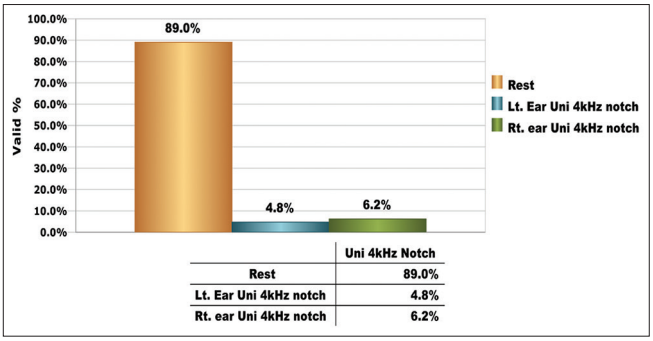

Figure 3: Distribution of unilateral 4 kHz notch

6.2% (n=9) of the cases have a 4 kHz notch in the right ear, and only 4.8% (n=7) of the cases have a 4 kHz notch in the left ear (Figure 3).

High-frequency hearing loss

According to audiometry, 5.5% (n=8) had mild sloping SNHL and 4.8% (n=7) had moderate sloping SNHL. In addition, 4.8% (n=7) of patients had unilateral HF sloping loss (Figure 4).

The term "normal hearing" in this study refers to hearing threshold levels that are better than or equal to 25 dBHL across test frequencies (i.e., 0.25, 0.5, 1, 2, 4, 6, and 8 kHz). The degree of high-frequency sloping loss and audiometric noise notch were also assessed using the following criteria:

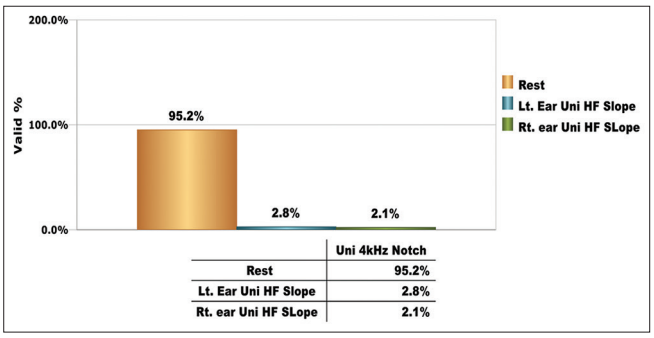

Figure 4: Distribution of unilateral high frequency (HF) sloping loss

- NMi: (a). 4 kHz threshold >25 dBHL, (b). 4 kHz (noise notch) >10 dB compared to 2 kHz with a maximum threshold notch up to 40 dBHL, (c). 4 kHz notch at least 10 dB poorer compared to 8 kHz threshold level NMo: Similar to NMi, but the 4 kHz notch threshold lies between 41 and 55 dBHL (moderate hearing level in dB). Notch severe (NS) or Profound (NP): Similar to NMi and NMo, the threshold level of the 4 kHz notch lies between 71 and 90 dBHL (severe hearing level) for NS and 90 dBHL (profound hearing level) and above for NP. Sloping loss (SL): Maximum threshold levels of 3, 4, and 6 kHz are at least 5 dB poorer than the pure-tone average of thresholds at 0.5, 1, and 2 kHz, and the threshold level at 8 kHz is at least 5 dB poorer than the maximum threshold levels at 3, 4, and 6 kHz.

Subjects underwent statistical analysis to examine the effects of age and experience, or the relationship between the two, on noise exposure risks for hearing loss as detected by PTA. Each set of audiometry data was subjected to a Pearson Chi-square test. It is found that age and bilateral moderate notching are significantly correlated (P=0.021). Similar to this, there was a statistically significant correlation between years of experience or service and the bilateral moderate notch (P=0.002).

The questionnaire

According to a noise awareness questionnaire, among the 145 candidates, awareness of noise and its effects was limited or non-existent, none of them had ever used hearing protective devices, and all of them reported normal hearing sensitivity.

The noise measurement

The intensity level of a single outboard engine or outboard motor of the FRP Speedboat during noise measurement range from 79.7 dB to 89.4 dB (A). The noise intensity level during idle and during load was essentially similar. The mean sound level recorded for positions 1 and 2 was 86.7 and 81.5 dB (A), respectively. The noise level recorded with mean in dB (A) is indicated in Table 2.

Table 2: Noise level recorded (dB [A])

Position 1		Position 2	
Min	Max	Min	Max
81.5	89.4	79.7	86.7

DISCUSSION

This study demonstrated that exposure to the engine noise of an FRP-outboard Speedboat has a significant impact on hearing. First, it was observed that the majority of workers performing such repetitive jobs produce a large quantity of 4 kHz notch, which indicates the prevalence of NIHL and its associated risk. Numerous studies and comprehensive data support the notion that the 4 kHz notch is a characteristic of NIHL.[1,11-15] The prevalence of the 4 kHz notch was determined to be 26.9% in this investigation. Bilateral notch (BN) showed a higher prevalence (15.86%, n=23), with 8.3% (n=12) of cases being mild and 7.6% (n=11) of cases being moderate. Bhatt and Guthrie reported that those with a history of noise exposure had the highest prevalence of BN among their study group (16.6%).[12] These results and past research indicate that BN is an NIHL phenotype and that it is even possible to investigate the genetic connection.[16] Furthermore, 16.2% (n=16) of the participants in this study have a unilateral 4 kHz notch, with 6.2% (n=9) having the notch in the right ear and 4.8% (n=7) having the notch in the left ear. In our study, the prevalence of unilateral notches was lower than that of BNs, but Lie et al. and Wilson and McArdle both reported that unilateral notches were more common than BNs.[17,18] This suggested that there could be more than one cause of audiometric notches, with noise being just one of them. NIHL is a complicated disorder influenced by both inherited and environmental factors. According to some surveys, age, gender, and noise exposure, all have a significant impact on audiometric notches.[19,20] Our findings revealed a substantial relationship between age and experience and the bilateral moderate 4 kHz notch. This revealed that NIHL is a symptom or feature of the 4 kHz notch, namely, the bilateral notch (NMo). The 4 kHz notch, according to this and prior studies, is a critical component of NIHL and can be used to predict NIHL risks.

Second, it was noted that some of the personnel also shows hearing loss at frequencies over 2 kHz due to the high-frequency slope. 10.34% of the participants (n=15) in the current study had HFSHL, where 5.5% (n=8) had B/L

mild sloping SNHL and 4.8% (n=7) had B/L moderate sloping SNHL. About half (4.9%) of the 10.34% display unilateral sloping (Figure 4). In our study, the average age of the participants was 30 and the maximum age was 50; therefore, presbycusis or age-related hearing loss (ARHL) was not anticipated. Therefore, the audiometric configuration showing HFSHL in this person appears to be a result of prolonged exposure to environmental variables like noise.[21,22] HFSHL may also be a sign that long-term noise exposure can result in hearing loss that affects all high-frequency frequencies beyond 2 kHz.[5,23,24] One can also assume that some personnel with symmetrical HFSHL must have developed sensory presbycusis which usually occurs in middle age populations. According to Arvin et al., HFSHL can occur significantly sooner than 50 years.[19] Age and noise interaction have been shown in the literature to exacerbate presbycusis.[25] An animal model study also supported the hypothesis that early noise exposure accelerates ARHL.[26,27] While assumptions can be made, the exact cause of HFSHL cannot be ascertained and not in the scope of this study. Although it is challenging to pinpoint the exact reason for early HFSHL in the noise-exposed group, its existence should not be disregarded as it may be a sign of NIHL overlaid by the early onset of ARHL. The findings of the current study suggest that HFSHL can occur in persons who are exposed to noise, but the numbers were minimal.

The risks of hearing loss due to noise exposure were quite common; as a result, over 42.07% of the employees examined in our study had abnormal audiograms. Mild hearing loss was the most commonly reported NIHL,[20] which is consistent with our findings. In contrast to the findings of this study, Bhatt and Guthrie reported that 55.6% of their study sample had a 4–6 kHz notch in at least one ear.[12] The discrepancy between the current study's 4 kHz notch and Bhatt and Guthrie 4–6 kHz notch, as well as the higher noise exposure intensity, could account for the higher percentage found.

Surprisingly, the staff who was being researched showed little awareness of noise and its impacts. Most people said that a speedboat's outboard engine noise wasn't excessive. No one has stated a need for or understanding of the use of a hearing protective device. It was the first hearing test, according to all study participants. This demonstrated the subjects' profound ignorance. There is some crucial information about hearing loss risk factors missing from the questionnaire, including exposure to noise during leisure activities, smoking, high blood pressure, and diabetes.

The basis of all contemporary hearing conservation programs is the quantitative measuring of noise, which is carried out using SLM and noise dosimeters. Zytoon reported noise readings aboard small- and medium-sized fishing vessels at an average level between 84.7 and 94.3.[28] The noise level in the study ranged from 79.7 dB (A) to 89.4 dB. (B). The mean noise level for P1 at the two locations was 86.7 dB (A), while for P2 it was 81.5 dB (A). This showed that at least 81.5 dB to 86.7 dB of outboard engine noise was heard by the crew and the master (A). In addition, some people might be more vulnerable. This is enough to cause NIHL over time. The hazards associated with NIHL are basically non-existent at 80 dB (A), minimal at 85 dB (A), and significant at 90 dB (A).[29] Consequently, 85 dB and higher sound levels have been regarded by many as dangerous in workplace contexts. According to studies, prolonged exposure to moderately loud noise between the decibels of 75 and 78 can cause cochlear hearing loss.[16,30,31] In Europe, all new automobiles must comply with Europe-wide noise standards, which have decreased from 82 decibels (dB (A)) in 1978 to 72 dB (A) in 2016.[32] The maximum outboard engine noise produced by the FRP Speedboat was 89 dB(A), which is likewise louder than the limit allowed for regular automobiles and motorcycles. This showed that prolonged or continuous exposure to the noise of an outboard engine may impact a person's hearing sensitivity and that workers who were not exposed enough were at risk of developing NIHL in the future. Surprisingly, because the highest noise level recorded was below 90 dB (A), regular use of even an ordinary earplug with a noise reduction rate (NRR) of 20 to 25 dB can be a successful NIHL preventive measure for these personnel.

Taken together, the results and discussion show that the motor and outboard engine noise of an FRP speedboat can be loud enough to produce NIHL. The majority of workers who participate in these activities on a regular basis are at risk of hearing loss; hence, a hearing conservation program should be put in place. It is especially important to have a dedicated organization in developing countries like India that works to increase public awareness of workplace safety issues, implement effective measures to reduce the occurrence of workplace accidents, educate and motivate workers to avoid injuries, and reduce the hazards they face on the job.

Limitations of the study

This study has potential limitations. The causes of high-frequency hearing loss in speed boat personnel require more investigation, according to the study. Investigating audiometric patterns that might point to a link between NIHL and age-related hearing loss is also essential. The validity of the research on the major effects of outboard motor noise can be strengthened by adding more standard noise measurements and analyzing noise exposure time.

CONCLUSION

Most of the study participants reported normal hearing sensitivity (25 dBHL). With the exception of 4 kHz and above, the majority of patients' hearing thresholds fell within normal ranges. The presence of the 4 kHz notch, which is typically associated with NIHL, and the sloping audiogram (high frequency at 4 kHz and 8 kHz), which was also observed, put personnel who routinely came into contact with the FRP-outboard Speedboat's engine or motor at risk for developing NIHL. Even a typical earplug with an NRR of 20 to 25 dB can be used regularly as an NIHL preventive precaution, though, as the outboard engine's maximum noise level was measured to be around 90 dB (A). However, regular audiometry may help in the avoidance of subsequent issues by early diagnosis of a noise notch and high-frequency loss. Utilizing hearing protection devices and being aware of the impacts of noise is essential. To properly characterize noise exposure under various working situations, it was suggested that more quantitative and higher-quality noise data be included. A professional hearing conservation program must be able to alter the consequences of NIHL because it is preventable and its effects are predictable.

ACKNOWLEDGMENTS

The authors thanked and gave acknowledgment to the Department of Otorhinolaryngology at G.B. Pant Hospital in Port Blair, from which the data were examined and collected.

REFERENCES

1. Ali A, Garandawa HI, Nwawolo CC and Somefun OO. Noise-induced hearing loss at cement company, Nigeria. Online J Med Med Sci. 2012;1(3):49-54.
2. Nandi SS and Dhatrak SV. Occupational noise-induced hearing loss in India. Indian J Occup Environ Med. 2008;12(2):53-56.
   https://doi.org/10.4103/0019-5278.43260
3. Alberti PW, Symons F and Hyde ML. Occupational hearing loss. The significance of asymmetrical hearing thresholds. Acta Otolaryngol. 1979;87(3-4):255-263.
   https://doi.org/10.3109/00016487909126417
4. Holborow C. Deafness as a world problem. Adv Otorhinolaryngol. 1983;29:174-182.
   https://doi.org/10.1159/000407490
5. Noise and hearing loss. NIH Consens Statement Online. 1990;8(1):1-24.
6. Elias SO and Ijaduola GT. Noise induced hearing loss in laundry workers in Lagos. Niger Med Pract. 2003;44(1):3-6.
   https://doi.org/10.4314/nmp.v44i1.28673
7. Tenaj MK. Noise induced hearing loss. Indian J Otol. 2014;20:151-154.
   https://doi.org/10.4103/0971-7749.146928
8. Le TN, Straatman LV, Lea J and Westerberg B. Current insights in noise-induced hearing loss: A literature review of the underlying mechanism, pathophysiology, asymmetry, and management options. J Otolaryngol. 2017;46(1):41.
   https://doi.org/10.1186/s40463-017-0219-x
9. Mirza R, Kirchner DB, Dobie RA, Crawford J and ACOEM Task Force on Occupational Hearing Loss. Occupational noise-induced hearing loss. J Occup Environ Med. 2018;60(9):e498-e501.
   https://doi.org/10.1097/JOM.0000000000001423
10. Mahboubi H, Zardouz S, Oliaei S, Pan D, Bazargan M and Djalilian HR. Noise-induced hearing threshold shift among US adults and implications for noise-induced hearing loss: National Health and Nutrition Examination Surveys. Eur Arch Otorhinolaryngol. 2013;270(2):461-467.
    https://doi.org/10.1007/s00405-012-1979-6
11. Barrs DM, Althoff LK, Krueger WW and Olsson JE. Work-related, noise-induced hearing loss: Evaluation including evoked potential audiometry. Otolaryngol Head Neck Surg. 1994;110(2):177-184.
    https://doi.org/10.1177/019459989411000207
12. Bhatt IS and Guthrie O. Analysis of audiometric notch as a noise-induced hearing loss phenotype in US youth: Data from the National Health and Nutrition Examination Survey, 2005-2010. Int J Audiol. 2017;56(6):392-399.
    https://doi.org/10.1080/14992027.2017.1278799
13. Kirchner DB, Evenson E, Dobie RA, Rabinowitz P, Crawford J, Kopke R, et al. Occupational noise-induced hearing loss: ACOEM Task Force on Occupational Hearing Loss. J Occup Environ Med. 2012;54(1):106-108.
    https://doi.org/10.1097/JOM.0b013e318242677d
14. Kowalski TJ, Pawelczyk M, Rajkowska E, Dudarewicz A and Sliwinska-Kowalska M. Genetic variants of CDH23 associated with noise-induced hearing loss. Otol Neurotol. 2014;35(2):358-365.
    https://doi.org/10.1097/MAO.0b013e3182a00332
15. McBride DI and Williams S. Audiometric notch as a sign of noise induced hearing loss. Occup Environ Med. 2001;58(1):46-51.
    https://doi.org/10.1136/oem.58.1.46
16. Prince MM, Stayner LT, Smith RJ and Gilbert SJ. A re-examination of risk estimates from the NIOSH Occupational Noise and Hearing Survey (ONHS). J Acoust Soc Am. 1997;101(2):950-963.
    https://doi.org/10.1121/1.418053
17. Lie A, Skogstad M, Johnsen TS, Engdahl B and Tambs K. Hearing status among Norwegian train drivers and train conductors. Occup Med. 2013;63(8):544-548.
    https://doi.org/10.1093/occmed/kqt114
18. Wilson RH and McArdle R. Characteristics of the audiometric 4,000 Hz notch (744,553 veterans) and the 3,000, 4,000, and 6,000 Hz notches (539,932 veterans). J Rehabil Res Dev. 2013;50(1):111-132.
    https://doi.org/10.1682/jrrd.2011.11.0225
19. Arvin B, Prepageran N and Raman R. "High frequency presbycusis"-is there an earlier onset? Indian J Otolaryngol Head Neck Surg. 2013;65(Suppl 3):480-484.
    https://doi.org/10.1007/s12070-011-0356-x
20. Singh PK, Kumar N, Kumar D, Shrivastava N and Kumar A. A retrospective study of noise induced hearing loss in a tertiary care hospital of Jharkhand-an alarming but ignorant truth. Int J Otorhinolaryngol Head Neck Surg. 2017;3:340-342.
    https://doi.org/10.18203/issn.2454-5929.ijohns20171190
21. Katz J, Chasin M, English KM, Hood LJ and Tillery KL. Handbook

of Clinical Audiology. 7th ed. 2015. pp. 634-635.

22. Lee KY. Pathophysiology of age-related hearing loss (peripheral and central). Korean J Audiol. 2013;17(2):45-49.
https://doi.org/10.7874/kja.2013.17.2.45
23. Le TN, Straatman LV, Lea J and Westerberg B. Current insights in noise-induced hearing loss: A literature review of the underlying mechanism, pathophysiology, asymmetry, and management options. J Otolaryngol Head Neck Surg. 2017;46(1):41.
https://doi.org/10.1186/s40463-017-0219-x
24. Newby HA. Audiology. 4th ed. Englewood Cliffs, NJ: Prentice Hall; 1979. p. 322-325.
25. Gates GA, Schmid P, Kujawa SG, Nam B and D'Agostino R. Longitudinal threshold changes in older men with audiometric notches. Hear Res. 2000;141(1-2):220-228.
https://doi.org/10.1016/s0378-5955(99)00223-3
26. Alvarado JC, Fuentes-Santamaría V, Gabaldón-Ull MC and Juiz JM. Age-related hearing loss is accelerated by repeated short-duration loud sound stimulation. Front Neurosci. 2019;13:77.
https://doi.org/10.3389/fnins.2019.00077
27. Kujawa SG and Liberman MC. Long-term sound conditioning enhances cochlear sensitivity. J Neurophysiol. 1999;82(2):863-873.
https://doi.org/10.1152/jn.1999.82.2.863
28. Zytoon MA. Occupational noise exposure of fishermen aboard small and medium-scale fishing vessels. Int J Indust Ergon. 2013;43:487-494.
https://doi.org/10.1016/j.ergon.2012.08.001
29. Lutman ME. What is the risk of noise-induced hearing loss at 80, 85, 90 dB(A) and above? Occup Med. 2000;50(4):274-275.
https://doi.org/10.1093/occmed/50.4.274
30. Melnick W. Human temporary threshold shift (TTS) and damage risk. J Acoust Soc Am. 1991;90(1):147-154.
https://doi.org/10.1121/1.401308
31. EPA. Information on Levels of Environmental Noise Requisite to Protect Public Health and Welfare with an Adequate Margin of Safety. EPA Report 550/9-74-004. United States: Environmental Protection Agency; 1974.
32. Cars & Noise. Vehicle Certification Agency 2022. Available from: https://www.vehicle-certification-agency.gov.uk/fuel-consumption-co2/fuel-consumption-guide/cars-and-noise/#topic-title [Last accessed on 2023 Mar 31].

Authors' Contributions:
JL - Was the principal investigator and was responsible for data collecting, participant hearing evaluation, and drafting the major manuscript; **L -** Evaluated and analyzed the hearing assessment data, as well as proofread and edited the written materials

Work attributed to:
Zoram Medical College, Falkawn, Mizoram, India.

Orcid ID:
Jonathan Lalchawilena - https://orcid.org/0000-0002-8573-3451
Lalhmingmawi - https://orcid.org/0009-0008-7166-0571

Source of Support: Nil, **Conflicts of Interest:** None declared.

APPENDIX - 1

RISK, AWARENESS AND PREVENTION OF HEARING LOS NIHL NOISE EXPOSURE QUESTIONAIRE

Instruction: *Please fill out the following questionnaire as completely and accurately as you can. All information, which you provide will be confidential and be used only for intended study.*			
Name:	XXXXXXXXXXXX	Age/Sex	
Address:		Work site:	
Education		Phone:	
	Have you ever faced, read, heard or seen anything which is related to hearing loss problems? (if no go to next question)	_____ a. Yes	_____ b. No
	Have you ever experienced or ever been affected by any type of hearing Problems, such as: ____ a. Ear pain (Ex. due noise exposure) ____ b. Temporary Hearing Loss/Noise Sensitivity ____ c. Already use/used hearing aids ____ d. Tinnitus or Ringing in Ear (is a condition in which there is a sense of sound within the ear without the existence of any external sound) ____ e. Any other problems that are not listed: _____ ____ f. None of the a above		Remarks
	Are you exposed to loud noise at your current work or job? If yes, please describe the source(s) of that noise and the amount of time you are exposed each day: _____		□ No □ Yes
	Do noise levels in your work area prevent conversation with co-workers in a normal voice level when at work?		□ No □ Yes
	Do you regularly engage in noisy hobbies such as use of motorcycles, power tools, firearms, or loud music? □ No □Yes. If yes, please describe: _____ _____		□ No □ Yes
	Do you have your hearing tested before? If yes, please describe where and when: _____		□ No □ Yes
	Do you currently use hearing protection? If yes, which: □ plugs □ muffs □ other. Any problems with hearing protectors?		□ No □ Yes
	Do you currently use tobacco products? - Kind: Amount per day: - Have you developed any other medical problems during the past year? □ No □Yes If yes, please explain: _____ _____ _____ - Do you have any other questions or concerns about your hearing or the use of hearing protectors?		□ No □Yes
	Do you have any idea, from where can you get an earplug (Hearing protection devise)?		□ No □Yes
	In a typical week, how much time do you spend on hearing music? __ a. 1–5 h __ b. 6–10 h __ c. 11–15 h __ d. 16–20 h		
	To hear music what do you use Mostly? __ a. Mainly Headset __ b. Mainly from Loudspeakers or TV __ c. Both (Almost equivalent)		
	Before reading the previous Have you ever known that loud music and noise could damage the hearing system?		□ No □Yes
Consent Statement: *I agree to take part in the study specified above and I understand that my participation is voluntary only.*			□ No □Yes