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Prevalence of noise induced hearing loss among vehicle drivers at Bandar Abbas freight terminal, south of Iran

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Abstract

Background: Traffic noise is one of the major sources of environmental pollution that can cause permanent or temporary loss of hearing in drivers. The purpose of this study was to estimate the prevalence of hearing loss among professional long-distance drivers in Bandar Abbas freight terminal.

Methods: One thousand long distance occupational drivers in Bandar Abbas freight terminal not certified by underlying medical conditions were selected for this study. The demographic background, experience, type and kind of vehicles were recorded in a check list. Audiometry test was done at 500, 1000, 2000, 3000, 4000, 6000, and 8000 Hz using Welton 1300 audiometer equipped with AD-19 supra-aural earphones. Statistical analysis was done using analysis of variance (ANOVA).

Results: The age, experience, vehicle kind and weight of drivers were 34.02 ± 13.19, 8.21 ± 7.84, and 8.73 ± 6.12 years and 68.30 ± 15.61 kg. Approximately 52% of drivers studied had a degree of hearing loss. The most common type of hearing loss was sensorineural with mild loss of 69% and 70.9% for the left and right ears, respectively.

Conclusion: Periodic medical examination with emphasis on the audiometry can be a way of diagnosing hearing loss in the drivers In addition to providing training courses for the drivers on hearing protection, the use of ear muffs equipment in the truck noise can also be considered as a solution.

Keywords: Hearing loss, Driver, Bandar Abbas freight terminal, Vehicle

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Introduction

Noise exposure at work can harm workers' health. The most well-known effect of noise at work is loss of hearing. Psychological, physiological and social effects such as feelings of disturbance, stress reactions and sleep disorders, some hormonal changes, increased blood pressure, increased risk of myocardial infarction and impairment of wellbeing and general quality of life can be caused by noise (1,2). There exist a close relationship between prolonged exposure to noise at high intensity, damage to the sensory hair cells of the inner ear and development of permanent hearing threshold shift in noise intelligibility (3,4). Noise from the work place environment can influence the development of cardiovascular diseases and hypertension in addition to hearing defect. High noise level is a causal factor for severe stress which has impacts on the health and daily life, for example through performance disorders, sleep disorders, and conversation interference (5). Sound damages the ear first at a frequency of about 4 kHz (A4 kHz notch) and one of the reasons for this is the acoustic resonance characteristics of the external ear. This hard-walled tube, closed at one end, amplifies acoustic energy in the upper frequencies by about 10 decibels. In addition, individual variation in the acoustic transfer characteristics of the tube is a factor in large variability in people's susceptibility to noise (6).

Nowadays, noise pollution is one of the major sources of environmental pollution caused by traffic. Excessive levels of noise are encountered due to traffic noise, and this situation can cause a permanent or temporary loss of hearing for the drivers. Professional drivers are the most susceptible to high noise levels for long duration (7-9). Injuries such as hearing loss caused by noise is called noise induced hearing loss (NIHL). This can be caused by several factors other than noise, but NIHL which is different in one important way can be reduced or prevented altogether (10). NIHL a type of HL is characterized by irreversible character and progressive evolution such as sensorineural hearing loss, almost always bilateral and symmetrical, not exceeding 40 dB (NA) at low frequencies and 75 dB (NA) at high frequencies, self-manifestation at 6000, 4000 and or 3000 Hz, extending up to frequencies of 8000, 2000, 1000, 500, 250 Hz, but preventable (11,12).

There is a great lack of good quality data describing the epidemiology of acquired driver's sensorineural hearing impairment worldwide.

Age, sex and some demographic characteristics are the factors influencing the prevalence of hearing loss (13,14). Previous studies have reported a significant correlation between the worker's knowledge of hearing protection in petrochemical industry and their experience (15). The use of other countries data to estimate the prevalence of NIHL is not recommended in this study. On the other hand, few studies were done on drivers hearing loss in Iran. According to the study of Janghorbani et al (16) on the prevalence and correlates of hearing loss of drivers in Isfahan, the prevalence of bilateral NIHL was 18.1%. In another study by Karimi et al (17) on NIHL risk in truck drivers, the results showed that hearing damage of professional drivers was expected to occur sooner at 4000 and 8000 Hz than lower frequencies. An assessment of noise exposure by job and dosimeter parameter in automobile press factories revealed that the levels exceeded 85 dBA, recommended by the US National Institute for Occupational Safety and Health (NIOSH) in all leaders and forklift drivers and in 83.3%, 97.4% and 91.7% of press operators, palette men and crane operators, respectively (18). A study in India had identified noise levels in bus and cabs at 89-106 dB. They observed that 89% of the bus drivers had abnormal audiograms that is impaired hearing (19).

Hearing loss usually develops over a period of several years. Since it is painless and gradual, it may not be noticed.

Bandar Abbas, the capital of Hormozgan province is considered as one of the most important Iranian ports on the Persian Gulf and the sea of Oman. This port is connected to other parts of Iran and the world through air, land and marine routes. More than a thousand trucks arrive and depart the Bandar Abbas freight terminal daily around the country. The drivers are within the age range of 21-65 years with different types of trucks and trailers; both old and new kinds of vehicles. There is an occupational health center in the terminal, where the center's facilities were used in the study. The purpose of this study was to estimate the prevalence of hearing loss among professional long-distance drivers in the Bandar Abbas freight terminal by examining the results of drivers audiograms collected through the audiometry tests.

Methods

This cross-sectional study was carried out from March 2013 through July 2014 in Bandar Abbas, south of Iran. One thousand long-distance occupational drivers arriving at Bandar Abbas freight terminal, that are not certified to have an underlying medical condition such as hearing loss, deafness, family history, high blood pressure, blood sugar etc were randomly selected for the study. A check list was used for recording the demographic background, experience and type of vehicles.

Hearing loss was detected and quantified by pure-tone audiometric testing (20). This consists of presenting sounds at different frequencies (Hz) at various intensities (dB) to each ear independently and recording the lowest intensity at which the sound was heard; that is, the threshold of hearing for that frequency in the tested ear. A higher threshold indicates poorer hearing.

The test was conducted in a sound treated booth, using an audiometer (model of Welton 1300, made in Denmark), equipped with AD-19 supra-aural earphones. The selected frequencies used for mid-frequency hearing loss were frequencies pure tone average of hearing levels at 500, 1000, 2000, and 3000 Hz. In order to evaluate hearing impairment, high frequency range of 3000, 4000, 6000, and 8000 Hz were used. The calculation of hearing was also carried out using 0 dB (HL) as reference (9). Guideline of the American Speech-Language-Hearing Association (ASHA) (21,22) was used as audiometric testing method. The index for hearing loss was a threshold at 0.5, 1, 2, 3, 4, 6, and 8 kHz for pure-tone average and greater than 25 dB of HL in the worse ear. The severity of classification of HL was as follows: (mild: between >25 to ≤40 dB), (moderate: between >40 to ≤60 dB) and greater than 60 dB of HL was classified as severe (23). Bilateral and unilateral HL were present when pure-tone audiometry respectively were 25 dB HL in both ears, and in one ear was equal to or below 25 dB HL and above 25 dB HL in the other ear, or when there was a value over 50 dB HL in at least one frequency. The data were stored in Microsoft Excel and descriptive statistics by mean, median, minimum and maximum values were used. For more statistical analysis, SPSS version 19 software was used; where the Pearson correlation coefficient was used to assess the correlation between the ages of the individuals surveyed and NIHL. In addition, the *t* test and analysis of variance (ANOVA) test with the level of significance at $P<0.05$ were used.

Results

General characteristics of studied drivers and vehicles are shown in Table 1.

Based on the results in Table 1, the average age of drivers and vehicle were 34.02± 13.19 years and 8.73±6.12 years respectively. It means the drivers and vehicles are almost young. The population involved in audiometry test is a sample of the related result shown in Figure 1.

After the audiometry test, the drivers were classified into 2 groups, namely drivers with 1) normal and 2) abnormal hearing. Their hearing situation was classified using the right and left ear. The results of this classification is shown in Figure 2.

After these classifications, drivers who were placed in the

Table 1. General characteristics of studied drivers and vehicles

Parameters	Mean	Standard deviation
Age (y)	34.02	13.19
Duration of work (y)	8.21	7.84
Vehicle old (y)	8.73	6.12
Weight (kg)	68.30	15.61

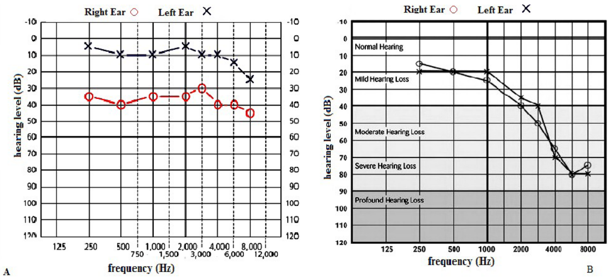

Figure 1. A sample of air-conduction thresholds audiometry result (A) a sample of audiogram classification (B) (24).

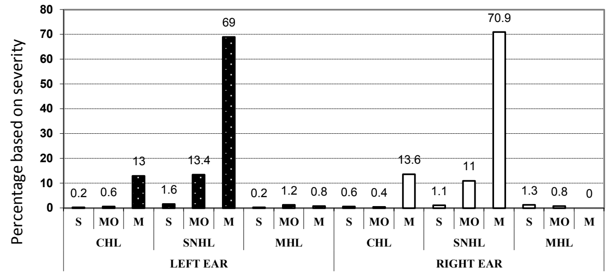

Figure 3. Abnormal hearing loss classification based on severity by left and right ear. Abbreviations: S, for Sevier; MO, for moderate; M, for mild.

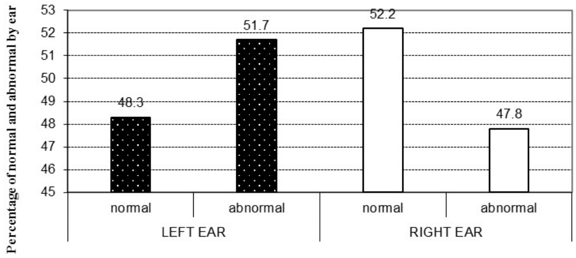

Figure 2. The drivers hearing situation classified by right and left ear.

abnormal hearing group were screened based on the severity of hearing loss by the type of hearing loss such as sensorineural hearing loss (SNHL), conductive hearing loss (CHL), and mixed hearing loss (MHL) as shown in Figure 3.

Based on the results from this study, the main type of hearing disorder was related to SNHL and mixed type had the minimum percent of HL in both ears.

In order to evaluate the effect of the related parameters, an analysis was done on data and the results (the mean and standard deviation for air-conduction thresholds of the drivers with HL are presented by ear, experience and age group in Tables 2 and 3.

According to the results from Tables 2 and 3, the mean of drivers' age with abnormal HL is more than the other group; normal HL means that a higher duration of driving significantly increased the risk of HL in both ears.

Discussion

According to the results of this study, approximately 52% of studied heavy vehicle drivers have some degree of hearing loss. The *t* test showed no statistically significant difference between the 2 averages of hearing loss in both ears ($P<0.03$). Since there was no significant difference in the rate of hearing loss for the left and right ear, one can conclude that the main source is released sound in the cabin of the truck and particularly road traffic does not interfere. The drivers with normal hearing have an average age of about 36.5 years old. However, the average age of drivers with hearing loss are about 42.5 years old. *T* test which was performed to test for statistically highly significant difference between these 2 traditions mean is shown. *T* test indicated significant differences between age and hearing loss in drivers with and without HL ($P=0.000$). Given the observed results (Table 2), the average experience of driving with and without hearing loss were 15.5 and 7.5 years respectively. It is likely that there is a relationship between experiences and hearing loss, therefore, it can be stated that road driving is a hard job and it is necessary that pension legal should be considered for this job.

Table 2. The Mean and standard deviation for air-conduction thresholds of drivers by ear, experience and age group

Right ear				Left ear			
Normal		Abnormal		Normal		Abnormal	
Mean age	SD	Mean age	SD	Mean age	SD	Mean age	SD
36.49	8.55	42.46	9.74	36.74	8.60	42.87	9.78
Experience mean	SD	Experience mean	SD	Experience mean	SD	Experience mean	SD
10.91	7.55	15.37	8.43	10.96	7.41	15.67	8.57

Table 3. Driver with hearing loss by ear, type of Hl and age

HL type	Left ear			Right ear		
Index	Average Age	Number	SD	Average Age	Number	SD
CHL	37.7	70	8.8	37.7	69	7.9
SNHL	43.3	426	9.7	43.5	392	9.9
MHL	45.1	11	10.9	45.8	10	10.3

Abbreviations: SNHL, sensorineural hearing loss; CHL, conductive hearing loss; MHL, mixed hearing loss.

More severe degrees of hearing loss are less in 11% of ears in 13.40 of the average hearing loss in the left ear and the percentage of high-grade, respectively, for 1.3 and 1.6%. One-way ANOVA was used to examine the relationship between age and driving record of the hearing loss, which was found to be between moderate to severe. This analysis revealed a highly significant relationship between the variables of age and hearing loss there. Thus, it can be stated that the risk of NIHL is high in vehicle drivers. The regulated standard for occupational exposure by NIOSH and OSHA to noise specifies a maximum exposure limit of 85 dB for a duration of 8 h/day. But in many cases, the duration of work in a day will be more than 8 h. Noise protection is not an easy matter for drivers; due to the sensitive nature of driving and the importance of visual and auditory senses, it may not be able to isolate the source and the recipient. Because drivers need to be in aural contact with the outside environment they on the other hand need to be protected from the health damaging consequences of noise. So the use of personal protective equipment (ear plug and ear muff) will not be a suitable solution too. Typically options for the drivers include audiometer test, reduction of drivers work time by implementation of regulations, and standardizing the amount of noise generated in the vehicles engines. The use of silencers between driver cabin and engine is also recommended. By abiding to the mentioned instructions, not only will professional drivers reduce the degree of hearing loss, there will also be a significant improvement in noise pollution.

Conclusion

A truck driver can encounter engine and road traffic noise during professional experience; hence the problem of NIHL has been reported in truck drivers. Among the 1000 vehicle drivers studied, approximately 52% have some degree of hearing loss. The rate of HL among studied drivers needs actions to be taken to reduce the problem. As vehicle noise cannot be totally eliminated, but can be reduced to some degrees, it is therefore necessary to take up intermediation to reduce the risk factors of noisy situations for the occupationally exposed truck drivers. Periodic medical examination with emphasis on the audiometry can be a way of diagnosis of hearing loss in the drivers. In addition providing training courses for drivers on the hearing protection and use of equipment in the truck noise reduction can be considered as a solution.

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Ethical Issues

It is hereby certified by the authors that all data collected during the study are as stated in this manuscript and no data from the study has been or may be published elsewhere separately.

Competing interests

The authors are committed to declare that they have no competing interests.

Authors' contributions

All authors contributed equally and were involved in study design, data collection, and article approval.

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