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Survey of Noise-Induced Hearing Loss and Health in Professional Drivers

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Background: Noise from traffic is a major source of environmental pollution in different countries.
Objectives: This study aimed to investigate the effect of noise on professional drivers' health and hearing loss in Tehran, Iran.
Materials and Methods: This cross-sectional descriptive and analytic study was performed on 1901 professional drivers referred to one of the authorized occupational health clinics in Tehran, Iran, in 2011. Basic demographic data including height, weight and age were recorded. Moreover, body mass index (BMI), cholesterol, triglycerides and audiometry tests were performed.
Results: The results of BMI showed that the 44.7% of professional drivers were overweight, 16.7 % moderately obese and 4.2% were severely obese. Cholesterol of drivers, 27.3% was border line high risk and 13.3% high-risk. Triglycerides of drivers, 19.5% were border line high risk and 25.8% high-risk. The mean age of the drivers, cholesterol, triglycerides and BMI were 41.56 ± 10.57, 193.12 ± 42.63, 176.21 ± 118.21 and 26.89 ± 4.29, respectively. The rates of hearing loss in high audiometric frequencies were more than at low audiometric frequencies. Hearing loss in older drivers was more and this was due to the long exposure to noise pollution.
Conclusions: Due to the long exposure to the loud noise during the day, hearing loss in drivers is significant. The left ear displays greater loss than the right ear. Therefore, strategies to prevent hearing loss in drivers could include education, lifestyle changes and compliance issues related to hearing health, use of personal protective equipment, conducting periodic examinations and early treatment .

Keywords: Noise; Noise-Induced; Hearing Loss

1. Background

One of the most important tasks of architects, builders, urban planners, industrial hygiene engineers, acoustic engineers, equipment manufacturers, and public health personnel is to ensure that noise are kept to an acceptable level in the general environment, in the workplace, and inside dwellings. Noise is of special concern in occupational health where hearing loss has been documented (1). Today, noise is one of the occupational and environmental hazards that affect health and safety of workers in transportation, manufacturing, construction, agriculture and various industrial activities (2).

Transportation systems, including roads, railways, and air traffic have caused environmental noise pollution (3-5). In recent years, road traffic has a significant role in causing environmental noise, which can have adverse effects on communities (5, 6). Traffic noise has a psychosocial and physiological effects on exposed people (7, 8).The professional drivers are susceptible to high noise levels for long time and duration (2).

Noise caused by traffic is a major source of environmental pollution in different countries. Several reports on hearing loss in noisy environments exist. These studies show that effective noise is as an occupational hazard for professional drivers (9-12). Also, several studies were done on the negative health effects of noise on professional drivers that can be mentioned as follows:

Merchant et al. (2000) evaluated hearing loss in rickshaw drivers of Karachi. They used a Smith Hearing Screening (SHS) questionnaire. He observed loss of hearing and tinnitus among rickshaw drivers (13). Ali and Tamura (2003) survey road traffic noise in Cairo (Egypt) at 21 sites. They observed a relationship between road traffic noise levels and the percentage of highly annoyed respondents (9). Mukherjee et al. (2003) assessed equivalent noise exposure to drivers of state buses in Kolkata, India. They observed exposure to noise depended on number of trips per day and exceeded the recommended threshold (10).

Majumder et al. (2009) evaluated an excess risk of hearing impairment of professional drivers in Kolkata city in India. They were concluded that the occupational hazards of professional driving significantly increased hearing threshold levels of drivers as compared to office workers (2). Occupation is a major determinant of health (14).

2. Objectives

Therefore, this study aimed to examine the effect of noise on health and loss of hearing among professional drivers in Tehran, Iran.

3. Materials and Methods

This cross-sectional descriptive and analytic study was performed on 1901 professional drivers referred to one of the authorized occupational health clinics in Tehran, Iran, in 2011. Sampling was carried out through census and all the drivers who received the health card were referred to the center and participated in the study. The audiometric tests were conducted in the occupational health clinic of a teaching hospital. In this study, audiometric testing was conducted at the National Institute for Occupational Safety and Health (NIOSH) frequencies (0.5, 1, 2, 3, 4, 6 and 8 kHz). The audiometric testing consisted of air conduction and pure tone of left and right ears at recommended frequencies. A portable audiometer (clinical audiometer model KA88, made in Turkey, Ritmton Co.), at the calibrated sound pressure level, inside a soundproof audiometric booth was used. The test was started from 0 dB (A) for all tested frequencies. As the intensity was increased or decreased, each subject was asked to press a switch. The lowest sound intensity level that could be heard by the subject for each frequency was reported as hearing threshold level for that frequency. Threshold of 25-dB (A) and above was considered abnormal. The written informed consent was obtained from the participants.

Basic demographic data including height, weight and age were recorded. Body Mass Index (BMI), cholesterol, triglycerides testing and audiometry tests were performed. Then, the forms were completed by the medical practitioner who was in charge of data collection. The collected data were analyzed using different descriptive (frequencies and descriptive statistics) and analytic methods (correlation and ANOVA) with SPSS software version 18.

4. Results

The results of the present study showed that 21% (n = 400) of the professional drivers aged less than 30 years, 25.5% (n = 484) between 31 - 40 years, 30.4% (n = 577) between 41 - 50 years, 21% (n = 400) between 51 - 60 years and 2.1% (n = 40) were older than 60 years. Table 1 shows BMI, cholesterol and triglycerides grouping and the number and percentage of each category. The results of BMI showed that 44.7% of the professional drivers were overweight, 16.7 % moderately obese and 4.2% were severely obese. Cholesterol of drivers, 27.3 % is border-line high risk and 13.3% high-risk. Triglycerides of drivers, 19.5% are border-line high risk and 25.8% high-risk. The correlations between age with cholesterol, triglycerides and BMI were significant at the 0.01 level and were equal to 0.114, 0.048 and 0.067, respectively. The correlations between cholesterol, triglycerides with BMI were significant at the 0.01 level and were equal to 0.167, 0.236, respectively.

Characteristics of drivers with and without bilateral hearing loss are shown in Table 2. The hearing loss of professional driver for right ear and left ear in the audiometric frequencies are shown in Tables 3 and 4, respectively. The results showed that the rates of hearing loss were increased with increasing audiometric frequencies. In the 4000 Hz frequency, hearing loss was changed considerably compared to lower frequencies. Mean of hearing threshold in different age groups are shown in Table 5.

Table 1. Grouping Of Body Mass Index, Cholesterol, Triglycerides and Percentage of Each Category

Category	Values	Number	Percent
BMI, Kg/m^2			
Under Weight	≤ 18.5	19	1
Normal (Healthy Weight)	18.51 - 24.99	634	33.3
Overweight	25 - 29.99	850	44.7
Moderately Obese	30 - 34.99	318	16.7
Cholesterol, mg/dl			
Low Risk	< 200	1129	59.4
Border Line High Risk	200 - 239	519	27.3
High Risk	> 240	253	13.3
Triglycerides, mg/dl			
Normal	< 150	992	52.2
Border Line High	150 - 199	371	19.5
High	200 - 499	490	25.8
Very High	> 500	48	2.5

Table 2. Characteristics of Drivers With and Without Bilateral Hearing Loss [a]

Variables	With Bilateral Hearing Loss Mean (SD)	Without Bilateral Hearing Loss Mean (SD)	P Value
Age, y	44.45 (0.71)	41.26 (0.26)	0.002
FBS, mmol/L	6.03 (0.083)	5.8 (0.03)	0.67
Cholesterol, mmol/L	5.05 (0.07)	4.98 (0.025)	0.7
TG, mmol/L	2.02 (0.09)	1.98 (0.03)	0.88
BMI, kg/m^2	26.67 (0.27)	26.91 (0.1)	0.03
Systolic blood pressure, mmhg	121.03 (1.1)	120.87 (0.34)	0.38
Diastolic blood pressure, mmHg	78.83 (0.5)	78.99 (0.18)	0.37

[a] Abbreviations: BMI, body mass index; FBS, fast blood sugar; TG, triglyceride.

Table 3. Hearing Loss of Professional Driver for Right Ear in the Audiometric Frequencies[a]

Hearing Loss, dB	0 - 20	20 - 40	40 - 60	60 - 80	> 80
Frequency, Hz	**Normal**	**Mild**	**Moderate**	**Severe**	**Profound Hearing Loss**
F 250[b]	1743 (91.7)	137 (7.2)	14 (0.7)	6 (0.3)	1 (0.1)
F 500	1741 (91.6)	141 (7.4)	11 (0.6)	8 (0.7)	-
F 1000	1697 (89.3)	180 (9.5)	20 (1.1)	3 (0.2)	1 (0.1)
F 2000	1621 (85.3)	224 (11.8)	46 (2.4)	8 (0.4)	2 (0.1)
F 3000	1458 (76.7)	310 (16.3)	97 (5.1)	27(1.4)	9 (0.5)
F 4000	1114 (58.6)	513 (27)	188 (9.9)	67 (3.5)	19 (1)
F 6000	1209 (63.6)	429 (22.6)	167 (8.8)	72 (3.8)	24 (1.3)
F 8000	1146 (60.3)	441 (23.2)	183 (9.6)	108 (5.7)	23 (1.2)

[a] Data are presented as No. (%).
[b] Frequency.

Table 4. Hearing Loss of Professional Driver for Left Ear in the Audiometric Frequencies [a]

Hearing Loss, dB	0 - 20	20 - 40	40 - 60	60 - 80	> 80
Frequency, Hz	**Normal**	**Mild**	**Moderate**	**Severe**	**Profound Hearing Loss**
F250[b]	1726 (90.8)	148 (7.8)	21 (1.1)	4 (0.2)	2 (0.1)
F500	1720 (90.5)	158 (8.3)	11 (0.6)	9 (0.5)	3 (0.2)
F1000	1641 (86.3)	220 (11.6)	28 (1.5)	8 (0.4)	4 (0.2)
F2000	1534 (80.7)	280 (14.8)	67 (3.5)	10 (0.5)	10 (0.5)
F3000	1325 (69.7)	386 (20.3)	135(7.1)	40 (2.1)	15 (0.8)
F4000	957 (50.3)	593 (31.2)	242 (12.7)	82 (4.3)	27 (1.4)
F6000	1047 (54.9)	512 (26.9)	226 (11.9)	88 (4.6)	32 (1.7)
F8000	1032 (54.3)	516 (27.1)	225 (11.8)	99 (5.2)	29 (1.5)

[a] Data are presented as No. (%).
[b] Frequency.

Table 5. Mean of Hearing Threshold in Different Frequencies in Different Age Groups

Age Group, y	250 Hz	500 Hz	1 kHz	2 kHz	3 kHz	4 kHz	6 kHz	8 kHz
Right Ear								
20 - 29	8.86	7.60	5.88	5.69	7.04	9.13	9.32	9.4
30 - 39	9.87	8.89	7.73	7.24	10.20	13.82	13.39	13.98
40 - 49	10.05	9.63	8.99	9.26	13.91	20.47	18.99	19.96
50 - 59	11.73	11.03	11.30	13.21	19.47	26.68	26.98	29.01
≥ 60	14.66	14.92	15.68	18.31	25.76	35.42	36.44	39.07
Left Ear								
20 - 29	8.58	7.74	6.03	5.73	8.44	10.91	10.45	9.87
30 - 39	10.49	9.92	9.19	8.53	11.99	16.70	16.59	15.89
40 - 49	9.92	9.65	9.64	10.78	16.66	24.07	22.80	22.96
50 - 59	11.72	10.93	11.14	15.02	22.42	29.91	30.07	30.73
≥ 60	13.90	15.34	16.36	23.31	31.78	40.42	43.64	42.88

5. Discussion

The results showed that there was a positive correlation between age, with cholesterol, triglycerides and BMI with high reliability. In other words, these parameters were increased with increasing age. This positive correlation in most cases had a significant difference ($P < 0.01$). These results are consistent with other studies (14, 15). The majority of drivers are overweight according to BMI. It would be risky for the health of drivers.

No significant correlations were observed between the all parameters mentioned in the Table 2 (FBS, BMI, systolic blood pressure and diastolic blood pressure, cholesterol and triglycerides) except the age with hearing loss ($P > 0.05$). However, the prevalence of increased blood pressure was increased with increasing age, that this results has been reported in other studies (16). The mean values of systolic blood pressure and diastolic blood pressure and FBS had a normal range.

Results showed that the rate of hearing loss in high frequency was more than at low frequency. From 3000 and 4000 Hz onwards, a significant difference in the frequency of hearing loss can be seen ($P < 0.05$). Also, according to the results of this study, there was a significant correlation between age and hearing loss. Hearing loss in older drivers are more and this is due to the long exposure with noise pollution. Thus, protection, treatment and periodic checkups are required for long-term driving. These results are consistent with other studies (9-12). As Table 5 shows in both ears, the mean of hearing loss in high frequency (4 - 8 kHz) was more than the low frequency. However, hearing loss in professional drivers in left ear was more than the right ear. The rate of hearing loss was increased in high frequency but this increasing in low age range (20 - 29 and 30 - 39) in the 8000 Hz was decreased. These results are consistent with other studies (17).

The pattern of noise-induced hearing loss and age-related hearing loss are different in audiogram. Presbycusis is usually seen after the age of 60 and may show a different pattern on audiogram, leading to a down sloping curve without a notch on audiogram. Also, distinction of presbycusis from noise-induced hearing loss may be difficult in the setting of combined occupational noise exposure and older age (18). Although the results showed that increasing of age increases the hearing loss, to better assess we need for screening and assessment of various factors including the underlying factors.

The traffic noise cannot be totally eliminated, but a lot could be done to reduce and control it. Hard actions may be taken by the administration against unnecessary use of automobile horns in cities. Some items may also be taken by automobile industry to reduce the noise level emission of vehicles, which will need introduction of improved automobile technology like masking of engine noise, sound proofing of vehicles and etc. (2).

The results showed that the driver's lifestyle, BMI, cholesterol and triglycerides are increased. Fast food and restaurant food use among driving is more common that could be the reason for increasing BMI, cholesterol and triglycerides. Therefore, in this section, in order to protect the driver health, education seems essential. Due to exposure with the noise during the day, drivers' hearing loss is significant. Hearing loss in the left ear is greater than the right ear. Therefore, strategies to prevent hearing loss in drivers could include education, lifestyle changes and compliance issues related to hearing health, conducting periodic examinations and early treatment. In addition, an effective hearing conservation program (including specific requirements for monitoring noise exposure, audiometric testing, audiogram evaluation, hearing protection for employees with a standard threshold shift, training and education, and record keeping) must be made.

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Authors' Contributions

Nazanin Izadi and Maryam Saraie: design, performance and analysis of the study and Mahdi Sadeghi: manuscript preparation.

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