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Original

Association between Socioeconomic Factors and Hearing Loss in Working Population

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Abstract

Background: This study aimed to investigate the association between demographic, social, and economic factors of employees and hearing loss. **Methods:** In this cross-sectional study, the required data were extracted from the periodic medical examination of 987 workers in an automotive industry. Kruskal-Wallis and Mann-Whitney tests were used to study the associations. The data were analyzed in the SPSS software. **Results:** In this study, most of the subjects were in the age group of 30-49 years and also had less than 10 years of working experience. In terms of education level, most of them had a diploma. The relationship between work experience and hearing loss indicated profound hearing loss among a workers with 10 to 20 years of work experience. According to age, the subjects over the age of 55 years had the highest prevalence of hearing loss (p = 0.04). **Conclusion**: Age and work experience, education, income, and type of job are among the factors that could predict the at risk population for hearing loss.

Key words: Hearing loss; Socioeconomic status; Automotive industry; Occupational health

Introduction

Noise-induced hearing loss is a sensory neurological disorder that progresses slowly as a result of exposure to continuous or intermittent noise and is one of the major problems in industrialized countries.

The most common causes of hearing loss include age-related factors and exposure to excessive noise, respectively.[2] The burden of the diseases ensued from exposure to work-related noise is 7% in western countries, 21% in developing countries and 16% on average across the globe.[3] The World Health Organization (WHO) estimates that 466 million people suffer from disabling hearing loss, 16% of whom are due to occupational exposure to noise.[3] Moreover, 24% of the hearing loss in the American adult population is attributed to the noise in the workplace.[4] Noise-induced hearing loss (NIHL) reduces one's ability to communicate and discern the ambient noise which can increase the risk of injury and decrease productivity. [5] People with NIHL generally suffer from non-auditory consequences, such as cognitive disorders, sleep disturbance and cardiovascular distress.[6] In 2008, according to the data from the National Institute for Occupational Safety and Health (NIOSH), 12.2% of work-related

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accidents were related to NIHL that is estimated to have economic consequences of about 242.4 million dollars annually.[7] Every year 30 million people are exposed to hazardous noise in the USA, more than 21000 cases of hearing loss were recorded by the US Department of Labor in 2009.[7] Recently, various efforts have been made to assess the extent of noise exposure problems in Iranian industries.[8] However, a review of scientific studies in the field of hearing loss indicated that most of these studies were conducted on patients and infants who did not have hearing loss due to exposure to workplace noise.[9-17] Also, studies in the field of workplace noise have focused more on the relationship of noise pollution with occupational and personal factors, as well as noise assessment and control. [18-27] A study conducted in Poland in 2019 found that the number of occupational diseases is increasing after 10-14 years of exposure to noise. Most cases have been reported after the exposure period of 20 years or more.[28] Zephania Abraham et al. stated that demographic factors are one of the factors affecting occupational hearing loss. They showed that the overall prevalence of NIHL was higher among textile workers, as well as among men, older workers, and those with long-term exposure.[29] Abbasi et al. reviewed the protective effects of vitamins/antioxidants on occupational NIHL. They reported that diet can affect hearing loss; since vitamin B12, folic acid, and N-acetylcysteine (NAC) have a significant protective effect on preventing NIHL.[30]

A study by Susan et al. reported that people with low education (undergraduate) were 3.2 times more likely to develop hearing loss. They stated that even after examining education and important demographic factors, hearing loss is associated with economic problems, including low income.[31] Given that the above factors can affect the prevalence of hearing loss. Moreover, according to the head of the ear health department (2018), Iran ranks the third in the world in terms of hearing loss. However, the prevalence of hearing loss arising from exposure to workplace noise in the country has not been accurately estimated[32]. This study aimed to investigate the contribution of demographic, social, and economic factors of employees in the level of their hearing loss. In this study, the employees of Seveh, Iran automotive industry were chosen as the research community.

Methods

The present study was performed by retrospective cohort method. In this study, 987 periodic medical examination files were investigated and the required information were extracted. Occupational health assessment form for recording examination results includes 5 pages and 9 sections, such as personal details, work history, occupational hazards assessment, personal history, family and medicine, medical examinations and clinical tests, referral results, and final physician recommendation. The inclusion criterion included having more than two years of work experience and the exclusion criteria was incomplete information contained in the medical health assessment file. In this study, hearing loss was the dependent variable and the recorded audiometry results from employees' occupational health assessment forms were divided into sex groups and the required information were extracted. Normal hearing loss ranged from 0 to 25 dB , mild hearing loss from 26 to 40 dB, moderate hearing loss from 41 to 55 dB, moderately severe hearing loss from 56 to 70 dB, severe hearing loss ranged from 71 to 90 Db, and hearing loss above 90 dB was considered profound hearing loss. [33]Audiometry test at frequencies of 500-8000 Hz were performed by occupational medicine service companies according to the NIOSH instructions.[34] In this study, hearing impairment was used in accordance with the definition of noise-induced hearing loss by NIOSH.[35] Independent variables included age, marital status, income, education, type of job, and work experience. The age factor was divided into

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three groups, including under 30 years, 31 to 49 years, and above 50 years. Marital status was divided into two groups of single and married, and educational level into three groups, including junior high school, diploma, and academic degree. Years of work experience was divided into three groups of under 10 years, 10 to 20 years, and above 20 years, type of job into 7 groups, and income level was classified into 3 groups. To study the relationship between potential factors and hearing loss, Kruskal-Wallis and Mann-Whitney tests were used. The data were analyzed in SPSS software, version 23.

Results

According to studies conducted on the 987 employees' periodic medical examinations, prevalence of NIHL and its relationship with various factors were analyzed. Table1 shows different jobs that exist in this industry; 58.2% of the participants were working in the production unit and the lowest number of them was in the service force subgroup (2.3%).

The demographic characteristics of the study population are given in Table2. Regarding the age variable, most of the participants (74.6%) were in the subgroup of 30-49 years and below 1% were in the subgroup of over 50 years. Data related to work experience of the subjects indicated that, while 88.5% of them had under 10 years of work experience, 1.1% had more than 20 years of work experience. Among the subjects 83.7% were married and 16.3% were single. Regarding the education variable, it was determined that only 15.5% of the study population were graduated from junior high school, while both high school diploma and academic subgroups had almost the same percentage. According to the survey conducted on individuals' income, it was determined that 19.9% of the study population earned less than 40 million Iranian Rials and most participants earned 40-70 million Rials (Iranian currency) (58.2%).

Figure 1 reveals hearing status of the staff's both left and right ear separately. The results revealed that more than half of the study population had normal hearing status in both ears. In this study, severe hearing loss accounted for a low percentage for both ears; however, according to the results, the status of the right ear of all subjects was better than the left ear.

Figure 2 depicts hearing status of both ears among the surveyed staff. As the pie chart presents in, out of 987 individuals, 66% of the subjects had a hearing threshold up to 25 dB for both ears (normal state range). However, 27.8% of the subjects had mild hearing loss for both ears.

Table 1. Frequency distribution of people working in different units of the car factory

Job	Frequency	(%)
production	575	58.2
Administrative department	115	11.6
Security	102	10.4
Technician	67	6.8
Ware house keeper	65	6.6
Transportation	41	4.2
Service sector	22	2.3

Table 2. Frequency distribution of demographic characteristics of the population under study

Variable	Grouping	Frequency	%
Age category	< 30 years	241	24.5
	30-49 years	738	74.6
	> 50 years	8	0.9
Work experience	< 10 years	875	88.5
	10-20 years	101	10.4
	> 20 years	11	1.1
Marital status	Single	160	16.3
	Married	827	83.7
Education	Junior High School And Below	151	15.5
	Diploma	424	42.9
	Academic	410	41.5
Income	<40 million Rials	196	19.9
	40-70 million Rials	574	58.2
	>70 million Rials	217	22

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Table 3 represents the frequency of different conditions of employees' hearing status based on demographic characteristics as well as their relationship with each other. Kruskal-Wallis test did not show a significant relationship between education and hearing status (P>0.05). Regarding marital status, the prevalence of moderate and profound hearing loss was higher in single groups compared to married groups and Mann-Whitney test show significant results (p=0.035).

The relationship between income and hearing loss indicated that, the highest percentage of people with normal hearing was in the high-income group. Based on the results of Kruskal-Wallis test, no significant relationship (P =0.119) was observed between the prevalence of profound hearing loss in people and an income of 40 to 70 million Rials . Another important factor in this study was age and work experience that according to the results, the most severe hearing loss was among groups of people who had 10- 20 years of work experience. Regarding the age, individuals over 55 hadd the highest prevalence of hearing loss according to this study (P<0.05). Regarding the age, individuals over 55 had the lowest prevalence of normal hearing according to this study (P <0.05). Finally the relationship between job and hearing status was analyzed and it was found that the highest prevalence rate of hearing loss was related to production unit (p<0.05).

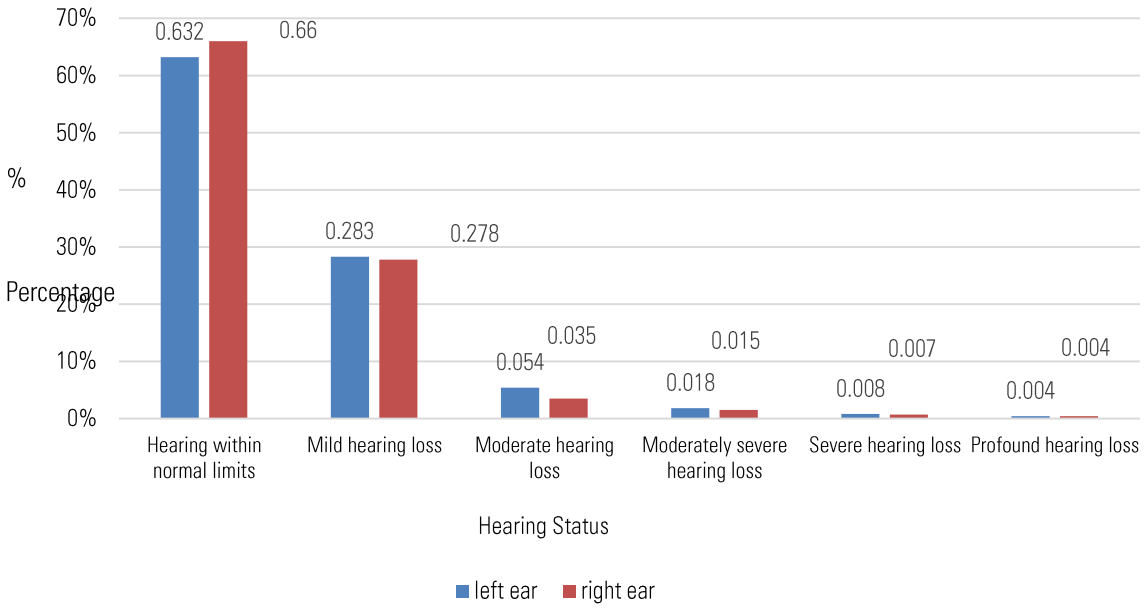

Figure1- Hearing status of the surveyed staff separately left and right ear

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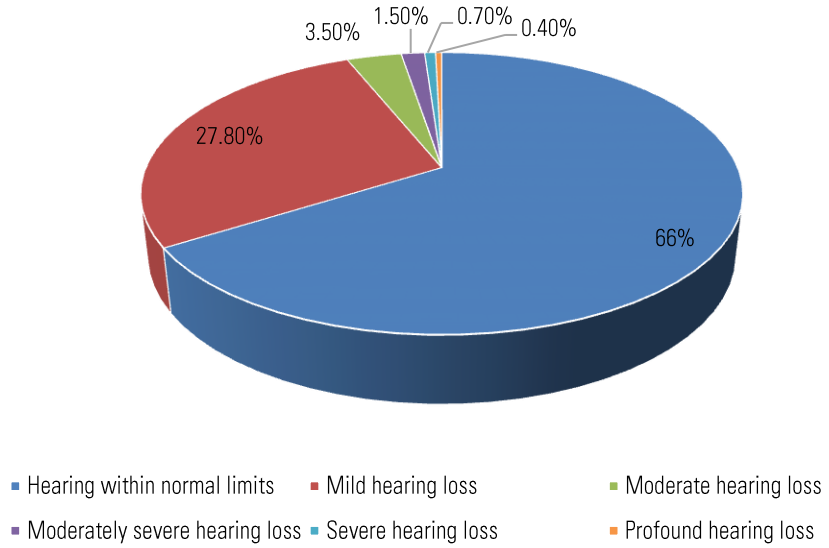

Figure 2. Hearing status of employees' both ears

Discussion

According to the results presented on the frequency of employees' hearing loss, it was found that more than half of the people had normal hearing, and showed a very small percentage of hearing loss. A study conducted in Sari on the hearing status of soft drink workers mentioned that the left ear was more sensitive to sound than the right ear.[36] In fact, various studies have shown that the highest percentage of hearing loss was related to the left ear[37,38] which was consistent with the results of the present study. Several factors seem to be involved in achieving such result, including that the left ear is more sensitive to sound compared to the right ear and the way workers are positioned in the workplace can cause the left ear to be exposed to higher levels of noise. Also another non-occupational injuries can cause severe hearing loss in the left ear, such as accidents, bullying, and fighting by which the left ear might get hit. In this study, the correlation of work experience and job type with the prevalence of hearing loss was studied and according to the results individuals with 10-20 years of work experience had the highest prevalence of hearing loss. A study which investigated the relationship between hearing loss and work experience also showed that the prevalence of occupational hearing loss based on work experience in people with 5 to 10 years of work experience, 11 to 15 years, 16 to 20 years, and above 20 years was 38.5%, 55.6%, 66.7%, and 70%, respectively.[29] In addition, the participants who worked in the administrative department had the highest percentage of normal hearing and individuals working in the production line had the highest prevalence rate of hearing loss.

Since the production department personnel are present at the production line for long time periods and due to the fact that there are machines and devices with high sound power level in most production lines of different industries, this group of people experienced the highest rate of hearing loss. Moreover, people who work in the administrative department had the highest percentage of normal hearing due to the least exposure to harmful noise in the workplace. A study conducted in the US to identify occupations exposed to excessive noise showed that, production unit (55%), construction and extraction (54%), installation and maintenance (54%), transportation and handling of materials (44%), and security services (36%) had the most exposure to noise, respectively.[39]

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Table 3. Frequency of employees' hearing status based on demographic characteristics and their relationship with each other

Demographic characteristic		HEARING STATUS												P Value
		Hearing within normal limits		Mild hearing loss		Moderate hearing loss		Moderately severe hearing loss		Severe hearing loss		Profound hearing loss		
		Frequency (%)	Prevalence %	Frequency (%)	Prevalence%	Frequency (%)	Prevalence%	Frequency (%)	Prevalence %	Frequency (%)	Prevalence %	Frequency (%)	Prevalence %	
Education	Junior High School	102(15.9)	67.5	43(15.6)	27.9	4(11.4)	2.6	3(20)	1.9	0(0)	0	0(0)	0	
	Diploma	272(42.3)	65	125(45.3)	29.3	15(42.9)	3.5	6(40)	1.4	2(28.6)	0.5	1(25)	0.2	
	Academic	274(41.8)	66.5	107(39.1)	26.2	16(45.7)	3.9	6(40)	1.5	5(71.4)	1.2	3(75)	0.7	0.838
Marital status	single	96(14.7)	59.3	50(18.1)	30.9	11(31.4)	6.8	3(20)	1.9	2(28.6)	1.2	4(10)0	0.5	
	married	559(85.3)	67.3	226(81.9)	27.2	24(68.6)	2.9	12(80)	1.4	5(71.4)	0.6	0(0)	0	0.035
Income	Less than 40million Rials	116(17.7)	58.9	71(25.7)	36	7(20)	3.6	1(6.7)	0.5	2(28.6)	1	0(0)	0	
	40-70million Rials	388(59.2)	67.2	152(55.1)	26.3	19(54.3)	3.3	9(60)	1.6	5(71.4)	0.9	4(100)	0.7	0.119
	Above 70million Rials	151(23.1)	69.3	53(19.2)	24.3	9(25.7)	4.1	5(33.3)	2.3	0(0)	0	0(0)	0	
Work experience	Under 10 years	578(88.5)	66.1	245(89.5)	28.1	32(91.4)	3.6	10(66.7)	1.1	7(100)	0.8	2(50)	0.2	
	10-20 years	67(10.2)	65	28(10.5)	28.2	3(8.6)	2.9	2(13.3)	1.9	0(0)	0	2(50)	1.9	
	Above 20 years	8(1.3)	72.7	0(0)	0	0(0)	0	3(20)	27.3	0(0)	0	0(0)	0	0.04
Age	Under 30 years	152(23.2)	62.6	69(25)	28.4	15(42.9)	6.2	3(20)	1.2	3(42.9)	1.2	1(25)	0.4	
	30-49 years	496(75.7)	67	207(75)	28	20(57.1)	2.7	10(66.7)	1.4	4(57.1)	0.5	0(0)	0	
	Above 50	2(7)	1.1	0(0)	0	0(0)	0	2(13.3)	22.2	0(0)	0	3(75)	0.4	0.038
Type of job	Warehouse keeper	26(4)	40	34(12.3)	52.3	3(8.6)	4.6	0(0)	0	2(28.6)	3.1	0(0)	0	
	Production	386(59.2)	67.2	150(55.1)	26.3	19(54.3)	3.3	9(60)	1.6	5(71.4)	0.9	4(100)	0.7	
	Transportation	30(4.6)	71.4	11(4)	26.2	1(2.9)	2.4	0(0)	0	0(0)	0	0(0)	0	
	Service sector	18(2.7)	78.3	5(1.8)	21.7	0(0)	0	0(0)	0	0(0)	0	0(0)	0	0.001
	Technician	42(6.4)	62.7	21(7.6)	31.3	3(8.6)	4.5	1(6.7)	1.5	0(0)	0	0(0)	0	
	Security	61(9.8)	62.1	28(10.1)	27.2	7(20)	6.8	4(26.7)	3.9	0(0)	0	0(0)	0	
	Administrative department	87(13.3)	75.7	25(9.1)	21.7	2(5.7)	1.7	1(6.7)	0.9	0(0)	0	0(0)	0	

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The prevalence of hearing loss in different groups based on demographic parameters was also studied and it was found that the highest percentage of individuals with normal hearing status had academic education. Therefore, people with higher education are employed in administrative positions and are not exposed to production line excessive sound level; whereas individuals with lower education are employed in production line. Regarding the income factor in this study, it was determined that the people with higher income have better hearing status. It confirms the previous findings that people with higher levels of education and managerial positions have higher incomes and due to the fact that they do not have much exposure to high sound power level existing in production line, this group has normal hearing status. By studying the age range of individuals, it was found that the most hearing loss is in the age group of more than 50 years, which is similar to the study conducted in Sweden, indicating that hearing loss in the age group of 35 to 39 years was 50% and in the age group of 55 to 59 years was 90%.According to a study conducted by operating engineers in the USA, hearing loss among workers in age group of 40 and workers in age group of 50-60 was 75% and 100%, respectively.[40] Given the highest rate of hearing loss is among individuals with more than 10 years of work experience, it is quite evident that, there is a positive correlation between age and hearing loss. According to previous studies, age and excessive noise may be two separate reasons for hearing loss or both of these factors can synergistically lead to hearing loss.[29] In fact, aging and the influence of physiological factors on the one hand and the rise of work experience and presence in work environment on the other hand, raises the percentage of hearing loss rate. This finding suggests that, the longer the duration of exposure to excessive noise, the higher the prevalence of hearing loss.

The present study was conducted only in one of the industrial cities of the country, and in order to generalize it to a larger community, the results of periodic examinations of several cities can be studied.

Conclusion

According to the findings of this study, factors, such as age and work experience, education, income, and type of job can affect hearing-induced hearing loss, so that by increasing age and work experience, the rate of hearing loss also intensifies. In addition, by increasing education and income levels, which are directly related to the type of job, the individuals' normal hearing status increases. However, in general, the impact of demographic factors on hearing loss is small. Therefore, the effect of other factors on hearing loss can be examined in future studies such as sound pressure level in the workplace, the availability of personal protective equipment and etc.

Conflict of interest

The authors declare that there is no conflict of interest.

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Authors Contribution

Research design: M.F, M.Z, A.B

Data collection: M.F, M.Z

Data analysis: A.B

Writing and editing articles: A.B, SH.Z

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