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Original

Investigation of Noise Pollution Distribution in Different Parts of Yazd Textile Factories

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Abstract

Background: Chronic occupational exposure to noise is an unavoidable reality in the country's textile industry and even other countries. The aim of this study was to compare the sound pressure level in different parts of the textile industry in Yazd and in different parts of the textile industry. **Methods:** This cross-sectional study was performed on 930 textile workers in Yazd. A questionnaire was used to obtain demographic information and how to use protective equipment. Then, to obtain the sound pressure level of each unit and device and to use the measurement principles, a calibrated sound level meter was used. Then the results were analyzed using SPSS Ver.29 software. **Results:** The participants in this study were 714 males and 216 females with a mean age of 35.27 and 33.63 years, respectively. Seven hundred fifty-six participants (81.29%) were exposed to sound pressure levels higher than 85 dB. Among the participants, only 18.39% of the people used a protective phone permanently. Except for factory E, with an average sound pressure level of 77.78 dB, the rest of the factories had an average sound pressure level higher than the occupational exposure limit. The sound measurement results of different devices show that the sound pressure levels above 90 dB are related to the parts of Dolatab, Ring, Kinetting (knitting), Chanel, Autoconer, Dolakni, Open End, MultiLakni, Tabandegi, Texture, and Poy. **Conclusion:** Based on the results of the present study, noise above 90 dB is considered as one of the main risk factors in most parts of the textile industry (spinning and weaving), which in the absence of engineering, managerial or individual controls on it causes hearing loss in becoming employees of this industry.

Keywords: Noise exposure; Sound pressure level; Textile industry; Hearing loss

Introduction

Given the population growth in today's society, the need for industry and technology to meet the needs of this population is inevitable. With the mechanization of industrial methods, although human beings achieve mass production in a shorter time, they have also created risks. Facing excessive noise is one of the biggest and most common occupational hazards, especially in industrial environments. In general, no industry can be found safe from noise pollution.[1, 2] According to the Centers for Disease Control and Prevention, 4 million workers work daily in areas with noise pollution.[3] The World Health Organization also estimates that 7% of the world is exposed to dangerous noise in the workplace.[4, 5] According to the Ministry of Health's Occupational Health Center, about two million workers are exposed to noise above the permissible level.[6] The

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World Health Organization estimates that noise will cause 3% of deaths and 10 to 15% of world diseases in 2020.[7]

Noise exposure is a major problem in most work environments, including common and irreversible hazards in the textile industry. The intensity and frequency of sound, the duration of exposure to sound, and the presence of some diseases are among the factors that cause temporary and permanent hearing loss in such people;[8] As much as 16% of adult hearing loss worldwide is due to occupational noise.[9] Studies show that 82% of cases of hearing-induced hearing loss occur in workers in industries and factories.[2, 3] According to NIOSH, the biggest risk factor for noise-induced hearing loss is long-term exposure without hearing protection to noise above 85 dB. The relationship between hearing loss and increased sound level increases exponentially.[1] Noise has received much attention in recent years due to its increasing health risks. The most obvious effects of sound are increased stress,[10] temporary and permanent hearing loss, headache, dizziness, lack of concentration, increased blood pressure, and changes in heart rate.[11] Recent studies have also reported a significant association between exposure to occupational noise and coronary heart disease, and symptoms of obesity.[12, 13]

After the wood industry, NIOSH and OSHA make the textile industry one of the industries with a high level of noise pollution that many workers face; Introduces. Studies also report a high prevalence of hearing impairment due to exposure to high levels of noise in the spinning, weaving, and textile occupations of 57%, which is very high compared to other occupations.[1, 14] Studies conducted in the textile industry have been limited and without comparison with each other in the field of noise pollution and the rate of hearing loss at all frequencies, especially at the frequency of 4 kHz.[15] Due to the use of relatively old machines and high speeds in these machines to increase production and more efficiency and due to the prevailing frequency of most textile machines, which are 3, 4, and 6 kHz, hearing loss in these frequencies is more frequent.[16] Here, an attempt has been made to measure the sound pressure level of textile machines in the textile industry of Yazd and compare them with each other.

Methods

Participants

This study was a descriptive observation among nine textile companies in Yazd city and was conducted as a census on a total of 930 people working in this industry. The condition for entering the study was to be employed in the textile industry and to have at least three months of work experience in this industry. Occupational groups in these industries include spinning, weaving, office, warehouse, packaging, technical and electrical.

Data gathering tools

A researcher-made questionnaire collected demographic information. Also, in this study, how to use a protective phone was asked and recorded by workers in three cases: always, sometimes, and never. The sound was measured by location and type of device. Based on this, the studied factories were named from A to I. Also, based on the sound pressure level classification, the factories were divided from values less than 85dBA to 102dBA.5.5.

Sound measurement was used using a sound leveling device model TES135120 made in Taiwan, set on network A and FAST speed. Before measurement, the calibrator was calibrated to eliminate measurement error using the B&K Calibrator Model 4230. Due to the continuity and non-change of sound at different working times due to the superficial sound sources in this industry and the worker's distance to the sound source, the reduction of sound pressure level is very small (17).

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Table 1. Material abundance in 9 factories understudy

factory	Gender - Number (%)		Total number (percentage of total study participants)
	men	women	
A	122(81.33)	28(18.67)	A
B	48(60)	32(40)	B
C	67(100)	0(0)	C
D	141(74.21)	49(25.79)	D
E	40(80.33)	8(16.67)	E
F	38(55.07)	31(44.93)	F
G	46(83.64)	9(16.36)	G
H	98(100)	0	H
I	114(65.90)	59(34.10)	I
total	714(76.77)	216(23.23)	total

Due to the constant sound pressure level during working hours for each job, by measuring the sound pressure level of each machine, the amount of worker exposure will be obtained.[17] In the following, for a number of occupations such as mechanics, electricians, production engineers, and laboratory workers exposed to different levels of sound pressure at different times, their exposure rate was calculated and recorded using the level equivalent of eight hours leq.

Formula (1):

$$Leq = 10\log(\frac{1}{\mathrm{T}}\sum_{n=1}^{n}\left(\mathrm{Ti}\times 10^{\frac{lpi}{10}}\right)\mathrm{dB}$$

In this formula:

Leq: Equivalent exposure level in decibels

Ti: i's exposure time in hours

T: Reference time (usually 8 hours)

Lpi: The sound pressure level of the i exposure in decibels

Data analysis

Data analysis was performed using SPSS software Ver.21. Descriptive statistics such as mean and frequency were used to report and compare the information.

Results

The statistical population of the studied workers included 930 people, of which 714 (76.77%) were men and 216 (23.23%) were women. Table 1 shows the frequency of gender in the nine factories under study.

The analysis of the results shows that the average age of men is 35.27 years and the average age of women is 33.63 years. The average BMI was 25.38 kg / cm2 for men and 25.42 kg for women, which were approximately equal numbers, indicating that individuals were on the verge of obesity. In this study, it was found that 174 people (18.71%) with a sound below 85 dB, and 756 people (81.29%) with a sound of 85 dB and above. The analysis of the results based on the number of people exposed to different levels of sound pressure is shown in Table 2. According to this table, in company A, the highest sound pressure level is 94.2 dB, and 131 people, equivalent to 87.33% of people, are exposed to noise above 85 dB. In Company B, the maximum sound pressure level is 94.4 dB. Sixty-seven people, equivalent to 83.75% of people, are exposed to sounds higher than 85 dB. In Company C, the maximum sound pressure level is 102.5 dB, and 53 people, equivalent to 79.09% of people, are exposed to noise above 85 dB. The maximum sound pressure level in the Company is 0.93 dB.

One hundred forty-two people, equivalent to 74.73% of people, are exposed to noise above 85 dB. At Company E, the maximum sound pressure level is 91.2 dB. Twenty people, equivalent to 41.66% of people, are exposed to sound above 85 dB. In company F, the maximum sound pressure level is 0.95 dB. Fifty-eight people, equivalent to 84.04% of people, are exposed to sound above 85 dB. At G, the maximum sound pressure level is 96.2 dB. Thirty-nine people, equivalent to 70.89% of people, are exposed to noise above 85 dB. In company H, the maximum sound pressure level is 0.99 dB. Eighty-eight people, equivalent to 89.78% of people, are exposed to noise above 85 dB. In Company I, the maximum sound pressure level is 4/101 decibels. One hundred fifty-eight people, equivalent to 91.33% of people, are exposed to noise above 85 dB.

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Table 2. Number of people exposed to different levels of sound pressure level by factory

Factory(n)	sound pressure level(dbA)					
	< 84/9		< 84/9		< 84/9	
A(150)	19	A(150)	19	A(150)	19	A(150)
B(80)	13	B(80)	13	B(80)	13	B(80)
C(67)	14	C(67)	14	C(67)	14	C(67)
D(190)	48	D(190)	48	D(190)	48	D(190)
E(48)	28	E(48)	28	E(48)	28	E(48)
F(69)	11	F(69)	11	F(69)	11	F(69)
G(55)	16	G(55)	16	G(55)	16	G(55)
H(98)	10	H(98)	10	H(98)	10	H(98)
I(173)	15	I(173)	15	I(173)	15	I(173)
Total(930)	174	Total(930)	174	Total(930)	174	Total(930)

Table 3. How to use a protective phone in the participants by factory

Use the ear pllug	Number of people (%) by factory									Number
	A	B		A	B		A	B		A
always	25 (16.67)	2 (2.50)	always	25 (16.67)	2 (2.50)	always	25 (16.67)	2 (2.50)	always	25 (16.67)
sometimes	80 (53.33)	25 (31.25)	sometimes	80 (53.33)	25 (31.25)	sometimes	80 (53.33)	25 (31.25)	sometimes	80 (53.33)
never	45 (30)	53 (66.25)	never	45 (30)	53 (66.25)	never	45 (30)	53 (66.25)	never	45 (30)
total	150	80	total	150	80	total	150	80	total	150

The table below also lists the average overall sound pressure level. According to the results, in company E, the average sound pressure level is less than the allowable limit (77.78). As reported in the table, the maximum number of people is exposed to sound pressure levels below 95 dB.

The status of using a three-level hearing protection phone was never, sometimes, and always checked. The results of surveying the use of protective earplugs showed that 121 men (17%) and 50 women (23%) use protective earphones regularly. How to use personal protective equipment (protective phone) by the factory is listed in Table 3. The results show that the participants in Company I had the highest percentage of use of protective earplugs (62.4%). On the other hand, Company C is one of the companies where workers used less and more protective earplugs (i.e., only 5.97% of the employed people) regularly. The lowest usage of the protective phone belongs to company D with a frequency of about 1%. In total, it was found that 171 people, equivalent to 18.39% of the total population, have used a protective phone permanently, and 445 people, equivalent to 47.85% of people, have never used a protective phone.

The results of separating sound generating devices and units based on sound pressure level by factories show that the highest sound pressure level in Company A is related to the Dolatab machine with a sound pressure level of 94.2 dB, in company B is related to ring machine with the sound pressure level of 94.4 dB, in company C for the ring machine with a sound pressure level of 102.5 dB, in company D for the spinning machine poy with a sound pressure level of 93 dB, in company E for the knitting machine with a sound pressure level of 91.2 dB, in Company F is related to the ring device with 95 dB sound pressure level, in company G is related to Chanel device with 96.2 dB sound pressure level, in company H is related to Dolatab device with 99 dB sound pressure level. Company I is related to the Dolatab device, with a sound pressure level of 101.4 dB. Accordingly, rim and Dolatab devices have the highest sound pressure level (100 to 102.5 dB). In the following stages, Chanel devices (95-99.9 dB), then Duplex, Counting, Texture, Pouy and Radiance devices (90 -94.9 dB),

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then Autoconner, Finisher, Gillbox, Heat Set, Orion, Passage, Cheleh Keshi, and Winder (85- 89.9 dB) and then Carding, Shoulder, Ding and Kovinich (80-84.9 dB) are respectively.

Discussion

In this study, the amount of noise pollution in nine textile industries in Yazd was investigated. The study population was 930 employees of the Yazd textile industry. Of these, 714 were men with a mean age of 35.27 years, and 216 were women with a mean age of 33.63. Based on the results of sound measurement in the textile industry, 174 people (18.71%) were exposed to sound pressure levels below 85 dBA, and 756 people (81.29%) were exposed to sound pressure levels above 85 dBA and were more than the occupational limit. The results showed that the sound pressure level in textile companies in most machines and units is higher than the Iranian standard (85 dB). Thus, the average sound pressure level in the studied factories except for one case (factory E) was reported to be higher than the allowable limit, which is consistent with the results of the study of Polar et al.[18] and the study of Mehrparvar et al.[14] Based on the results of surveying the use of protective earphones among individuals, it was found that only 171 people (18.39%) use protective earphones regularly and continuously. Four hundred forty-five people (47.85%) also do not use a headset. Other people sometimes use hearing protection. The results of Mehrparvar et al.'s study show that only 84 (21%) of the studied workers used protective earphones. Of these, 30 used their protective earphones correctly and 54 incorrectly;[14] Which indicates the very low prevalence of hearing protection use among workers, which is consistent with the present study results. Also, the results of two studies by Morvati et al.

Show that the level of use of protective earphones in spinning and weaving workers in Yazd city is 42.5%,[19] and out of the total number of studied workers who were exposed to noise above the permissible level, only 1/1 24% of them always used a headset[20] which is more than the amount obtained in the present study. According to the results of the present study, despite the clear need to use protective earphones, the level of use of this equipment is very low. Among the main reasons are the low level of hearing protection devices, workers' discomfort while using the protective earphone, inadequate training in the correct use of the earpiece, lack of awareness of the effects of exposure to unauthorized noise, and lack of sufficient motivation .[14] The sound measurement results of different devices show that the sound pressure levels above 90 db are related to the parts of Dolatab, Ring, Kinetting (knitting), Chanel, Autoconer, Dulakni, Open and Multi-Lakani, Radiance, Texture, and Poy, which are necessary in addition to using Protective earphone, other necessary measures should be taken to reduce the sound pressure level in these units.

In addition to temporary and permanent hearing loss, noise causes headaches, dizziness, lack of concentration and balance, increased blood pressure, changes in heart rate, and increased stress.[11] Loss of concentration and balance of workers due to hearing loss[21] Due to the shape and nature of spinning and weaving machines, which are mostly composed of small units with high rotation, the potential dangers with high intensities of the accident to workers in this necessary industry Take the necessary measures to prevent possible accidents. Also, considering that long-term exposure to sound levels above 90 decibels and increased work experience[22] will lead to the secretion of vasoconstrictors and increase blood pressure and its subsequent consequences on human health,[23] appropriate engineering and management controls. Necessary to be done in sound control in this industry. The NIOSH Association also presented a report in which it was determined that the textile industry is one of the industries that have high noise pollution, as it was mentioned in the

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same report that the noise level in the textile industry is higher than 90 dB. Noise pollution in these industries is mostly due to the high speed of devices, gears, and car engines, which further research in this field can provide a suitable control way to reduce noise in sound generating sources. The difference in sound pressure level values in the present study is due to differences in the date of manufacture of the machinery used, the emission environment, the technology used in it, and how the parts are maintained and serviced.

Finally, provide and apply control solutions such as noise reduction at the source (including repair, timely replacement of parts, lubrication), use of sound-absorbing panels on the walls and ceiling, periodic and pre-employment inspections to identify individuals, use of protective earmuff with Appropriate NRR is recommended.

Conclusion

According to the results of this study, it can be concluded that workers in the textile industry do not have good working health. Due to the high level of sound pressure in most parts (above 90 dB) and the effect of sound on hearing loss of workers in these parts, and the inherent dangers of spinning machines, it is necessary to control the effects of sound and possible accidents in this industry. Management and engineering or a combination of two methods and training people are necessary to reduce workers' noise exposure.

Conflict of interests

Authors declare no conflicts of interests.

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