RESEARCH ARTICLE

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Evaluation of Noise Pollution in Small Workshops in Qom, Iran; and Its Situation Compared to National Noise Standards

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Background & Aims of the Study: Noise is one of the most important environmental pollutants. It is a global health problem, especially among industrial workers. Since there was little information about noise levels in small workshops in Qom city, this study aimed to noise evaluation in small workshops and compares it with national standards.

Materials and Methods: This was a cross-sectional study. Initially jobs and workshops that were causing noise pollution were identified. Then, noise was measured with a calibrated sound dosimeter, model CASELLA CEL-320, in A-network, in 108 working places. The results were compared with national noise standards.

Results: The total numbers of workers in the workshops were 317 people, and inside the workshops 76.3% of the workers and 66.7% of the workshops were exposed to noise over the standard threshold. Outside the workshops, in 89% noise pollution was higher than the standard city values. Only 11% of noise pollution in the city workshops had a 1 or less than 1 dB difference with the standard noise threshold.

Conclusion: Small workshops cause a significant amount of noise pollution in Qom city. This can affect the workers' and the public's health. Noise control procedures such as controlling the source and direction of noise distribution, as well as setting up workshops in the right location, and far from residential areas are necessary.

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Background

Population growth along with industrial and technological development in megacities has increased problems for urban dwellers and one of these problems is environmental pollution (1). One of the main environmental problems that have been less studied in Iran is noise pollution (2), which is now a global health problem, especially for industrial workers (3). Although the industrial revolution caused increased growth in production in the world, but it has also made noise an inevitable exposure for humans (4).

Noise pollution is an important and common health hazard in most industries, and if necessary preventive measures are not implemented it can lead to physiologic, mental, economic and social problems among the exposed employees. Noise above the stranded

threshold leads to hearing loss, nuisance in conversation, distraction and not noticing danger signs; and therefore adversely affects workers safety and performance. It is also causes stress and unwanted physiological responses and decreased comfort among workers during work time. Although evaluating and controlling noise in big industrial environments has been considered by researchers, but in small scale industries due to various reasons, noise evaluation has been taken less seriously (5,6).

Small workshops create jobs for urban populations, have a close link with other parts of the society and are important in urban development. However, the presence of these industries and workshops especially in residential areas can increase pollution and exposure to health hazards, such as noise, waste, particulate matter, bad orders, vibration, wastewater, soot and air pollution. These industries might also cause traffic and nuisance (7,8).

It has been estimated that in developing countries, 45 to 95% of the workforce work in small scale industries (9). Small scale industries according to the definition of the Iran Statistics Centre are industries in which the number of employees is not more than 9 people. Statistics reported by the Iran Statistics Centre in 1987 shows that from 339234 industrial workshops inside the country a number of 327715 which is about 96.5 % of the active workshops, are small workshops with 1 to 50 employees and these workshops make 64.5% of industrial occupations (10). Also according to statistics reported by the Iran Industrial Organization from 89991 industrial licenses granted by the end of 2011, 80289 cases, which are 89.2%, were granted to workshops with less than 50 employees (11). The occupation rate in Qom province in 2006 was 94.2% which means the industrial and services sector in this province has a good situation and respectively 42.6 and 49.2% of all occupations were in this sector (12). Noise pollution from industrial activity in Qom city, along with noise from traffic is among the problems of people residing close to industries, workshops and roads.

Noise pollution is one of the most prevalent occupational hazardous risk factors; and can have adverse effects on different organs such as the hearing and cardiovascular system. It also has negative effects on mental health and work efficiency among workers.

Aims of the study:

In this study we tried to estimate the level of noise pollution in small workshops of Qom city and compare it with occupational standards and then suggest ways for controlling noise pollution.

Materials & Methods

This was a cross-sectional descriptive study conducted in May, June and July of 2015 in order to measure noise pollution in the small workshops of Qom City which had less than 10 employees. Initially a list of all private occupations was inquired from the Guild Hall of Qom City. Occupations with workshops which were causing noise pollution were identified, and then 108 workshops, and from each workshop three cases were randomly selected. The total number of workers in the selected workshops was 317 people. Measuring noise was done for 30 minutes inside the workshops; and also 30 minutes in a one meter distance outside the workshop at the peak of their occupational activity in daytime and at two times, one in midday (10:30-13:30) and one in afternoon (16:30-19:30) hours. Because noise intensity is on a logarithmic scale, in order to estimate the average of noise levels in three workshops, equation number 1 was used. Also this formula was used to estimate the average of noise levels in three spots which were in the commuting areas of the workers and in workshops with pounding noises. This equation is used for multi-levels in different frequencies and different sources for one level, and calculates the overall sound level. Due to the logarithmic nature of sound pressure levels,

it is not possible to directly do summation, subtraction or averaging on these numbers. After voice measurements, in order to compare the results with the threshold, the average of time levels (SPLTWA) was calculated for an 8-hour shift, by using equation 2.

In calculating the average of time levels, first the level of each exposure and the corresponding exposure time is measured, then the equivalent exposure levels of the worker was calculated for a period of time according to the equation. After calculating the equivalent level of occupational exposure, the results were compared with the standard of the professional occupational health committee of Iran, which is 85 dB for a working shift (8 hours). As the area understudy was generally among the residential industrial areas, in this study we compared the sound pressure levels outside the workshops with the standard for these areas which is 70 decibels (13).

$$LP\ (dc) = 10Log\ [\frac{1}{n}.\sum_{i=1}^{n} 10^{\frac{LPi}{10}}] \qquad \text{Eq. (1)}$$

Where LP is the average source sound intensity, N is the number of measuring points and LPi is the sound pressure level in each measuring point.

$$Leq\ (db.) = 10Log\ [\frac{1}{T}.\sum_{i=1}^{n} ti10^{\frac{LPi}{10}}] \qquad \text{Eq. (2)}$$

Where Leq is sound level equilibrium in decibels, ti is the duration of exposure in hours, T is the reference time of 8 hours and LPi is the sound pressure level of exposure in decibels.

Noise measuring

Noise measuring was done by local measurements in order to estimate workers exposure and by using a sound dosimeter, model 320-CEL made in England by CASELLA with a CEL-282 caliber and through these steps.

1. The dosimeter was calibrated through the method advised by the company and the A-network was used for measuring general sound levels. The device was calibrated after each measurement in a quiet environment.
2. Sound measurement was done according to the guidelines of the Occupational Health Technical Committee of Iran.
3. The speed of the device was chosen as slow according to standard recommendations.
4. The duration of measuring sound was 30 minutes inside the workshop and 30 minutes in a 1meter distance outside the workshop.
5. The variables measured by the device including: LAS, LASmn, LCPK, LAE and LCPK were recorded.

Results

Table 1 shows the average number of employees in each workshop, the average measured sound pressure levels (LAEQ) inside the workshops and 1 meter outside the workshops, the time average of the levels (SPLTWA) and the average working hours of the workers in a day. The levels measured inside the workshops are the sound level which workers are exposed to during working hours. The main source of noise production in these workshops was the sharpening machine, hammer, trunk mold, wind pump, injector engine speed testing machine, firesaw, cupboard cutting machines, three-functioning saws, milling machines, motorcycle testing and tuning, knitting machines and hosiery making machines, sewing machines, whipping machines (in carpet washing), offset machine (in printing shop), printing services machines, milling and peaking, grinding, and cutting machines and confectionary mixer machines. The noise recorded 1 meter away of the workshops, was from the activities of neighboring workshops and commuting vehicles, as well as the noise from the workshop machines.

Table 1) Noise from machinery and workshop activities (LAEQ) in different occupations

Occupational group	activity	Number of units	Average number of employees	Average working hours per day	Leq (30min) inside the workshop	SPL_{TWA}	LEQ (30 min) in a 1 m distance outside the workshop
Aluminium makers	Aluminium door and window frame	3	2.33	8	98.4	98.4	79.4
Car dealers	Car dealer representative branches and mechanics	3	11	9	96.2	96.7	85.7
Shirts and trico	Shirt maker	3	1	7	74.4	73.8	69
Blacksmiths and cutters	Lathing	3	2.66	10	92.2	93.1	81.1
	Car Blacksmithing	3	2	8	87.9	87.9	78.5
	Cylinder making	3	2.66	7	89.4	88.8	85
	Welding water pump pieces	3	1.33	7	77.3	76.7	73.2
Car oil change	Changing car oil and air	3	3	10	94.1	95	81.1
	Carwashing	3	5	10	86.6	87.7	76.1
Rag making	Rug washing	3	6	12	88.2	89.9	69.7
Printing and binding	Printing	3	4	11	81.5	82.8	73.3
	Binding	3	2	10	87.9	88.8	73.8
	Printing services	3	2	10	76.5	77.4	69.8
Taylors	Taylors	3	1.66	9	74.4	74.9	69
Blacksmiths and window frame makers	Welding	3	1.33	8	77.3	77.3	73.2
	Iron doors and windows	3	3	10	102.8	103.8	93.3
Carpenter	Wood cutting	3	3.33	9	102.5	103	75.1
	Wardrobe building	3	2	11	84	85.4	74.1
	Furniture making	3	2.33	11	82.4	83.8	76.3
	Carpentry	3	2	8	93.1	93.1	80.5
Bicycle and motor cycle	Motor cycle repairing	3	1	4	89.1	86	81
Tile making	Stone cutting	3	2.33	9	82.8	83.3	68.9
Stone cutters	Stone cutting services	3	3	11	93.4	94.8	86.7
Flattening	Car ironing	3	2	7	101	100.4	76.2
Carpets and decorations	Making blinds and curtains	3	2.33	11	90.9	92.3	74.8
Metal-workers	Canal making,	3	2	7	93.1	92.5	92.9
	Making cooler valves	3	3	19	85.9	86.8	76.1
Locks, hinges and hardware	Key making	3	1	6	81.6	80.3	74.3
Confectioners	Honey and Sesame Sohan	3	4.33	11	80.7	82.1	75.2
Metal product producers	Kitchen cupborard makers	3	2	10	96.2	97.1	88.5
Knitter	Knitting with computer devices,	3	3	9	87.8	88.3	74.5
	Sock making with computer devices	3	3	8	76.4	76.4	71.6
Construction material and equipment	Iron selling and Blacksmithing	3	2.33	10	88.4	89.4	80
Mechanics	Injector pump	3	2	8	88.3	88.3	69.7
	licensed mechanic	3	6.66	9	93.6	94.1	76.4
Tile makers	Tile making	3	3	10	80.6	81.6	76
Total	-	108	317	-	-	-	-

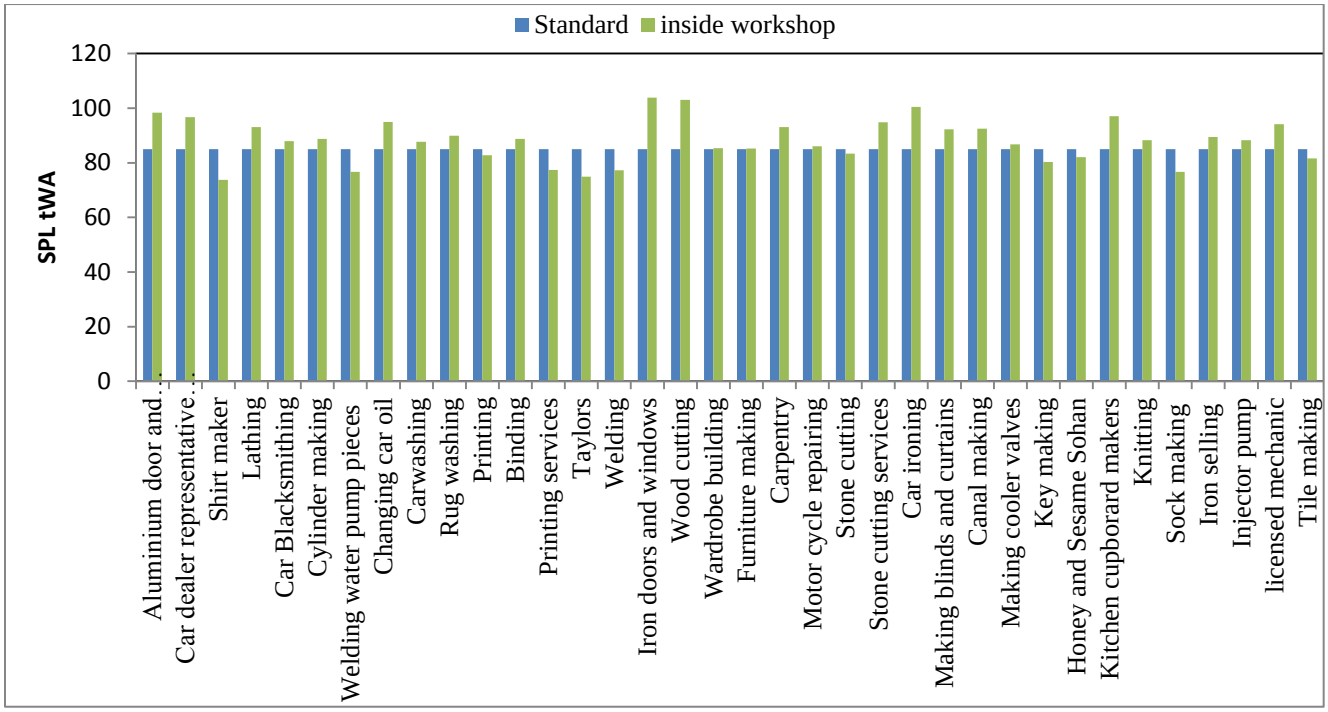

Figure.1) Comparing the noise inside the Workshops with National standards

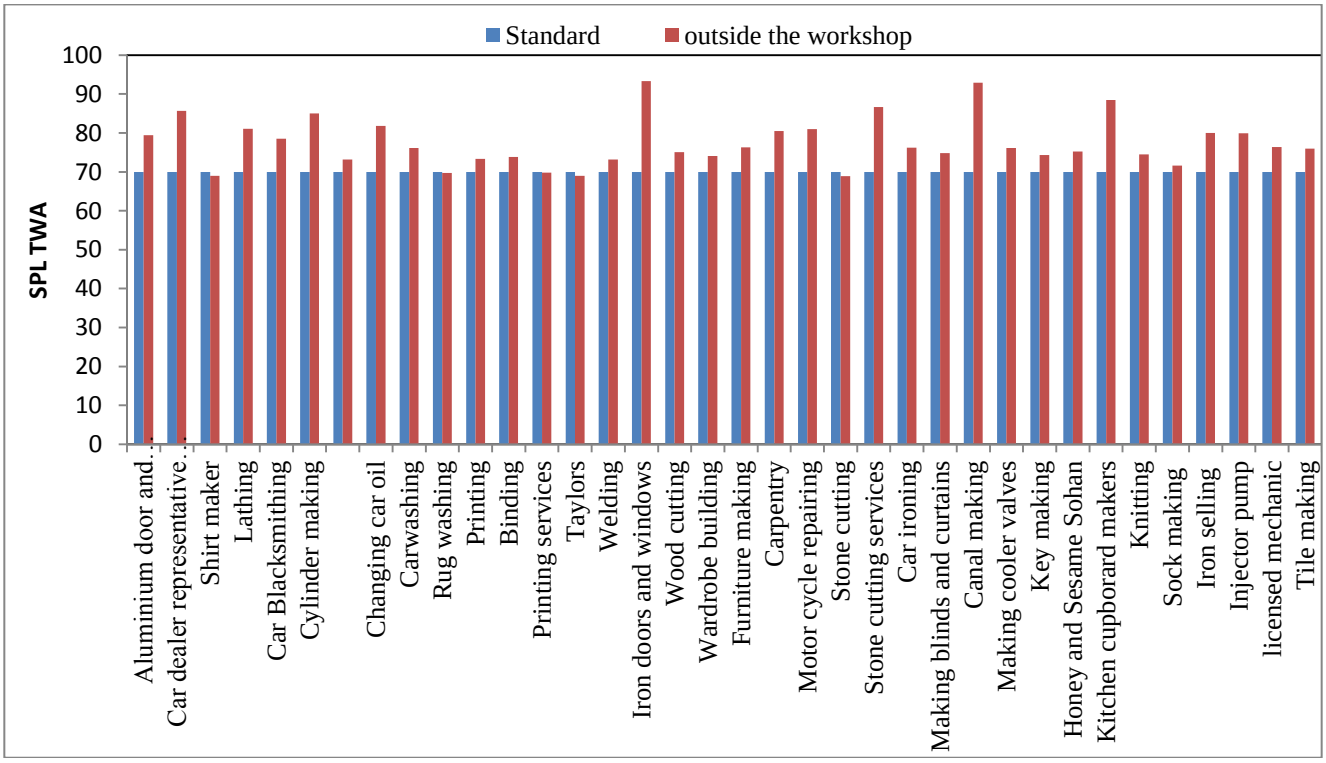

Figure 2) Comparing sound levels outside the workshops with national standard thresholds

According to the results in Fig.1 and comparing it with national standards, all occupations related to the car industry produced more than 85 decibels noise and according to the time average levels in table 1 and the recommendations of the national occupational

health technical committee, in the aluminum door and window frame industry and the iron door and window frame industry, the situation is similar to workers in the automobile industry and workers in these groups are probably more prone to the adverse effects of high noises. Our results show that 76.34% of the workers in 66.67% of the workshops received noise levels over the standard threshold.

Results in Fig. 2 show that except a few workshops, other measurements done in a 1 meter distance from workshops were all above the national threshold for industrial residential areas. This threshold is 70 decibels and the workshops with lower than standard threshold were just a few decibels lower than the threshold. According to the results in fig. 2, in 89% of the measurements, noise pollution outside the workshop was above standard limits and in only 11%, it was in the standard range.

Discussion

In this study, the average daily sound levels in most small workshops in Qom city was over the standard threshold. Also the sound level of more than 66.7% of the workshops, inside the workshop and 89% of the workshops in a 1 meter distance away from the workshop was higher than the permissible national standard.

In other studies conducted in Iran, sounds levels in the majority of small urban workshops was above standard thresholds as well. Rashidi et al (14) reported that in the towns of Ilam Province, blacksmiths were producing the highest level of noise pollution in their workshops with sound levels over 103.8 decibels; and then iron door and window frame makers with a sound level of 102.8 decibels has the second highest level of noise measured. In Rashidi's study noise pollution in the printing industry was 79.6 decibels. In our study the noise level was 81.54 dB in printing workshops, 87.9 dB in binding workshops and 76.5 decibels in printing services. In another study done by Hokm Ali et al (15) in small workshops of Birjand City, the level of noise pollution in stone carving workshops was 94.5 decibels. In our study the level of noise pollution in stone carving workshops was 93.4 decibels. Also in a study done by Taheri et al noise levels in carpentry workshops were 92.8 dB, which is similar to the current study in which the levels in carpentry workshops were 93.1 dB, in furniture making 82.4 dB, in cupboard making 84 dB and in wood cutting 102.5 dB. The sound level at the car body repair workshop was equal to 100.4 dB. This value was similar to the sound measured in Qazvin city body repair workshops, which had an average workers daily exposure to noise of 98.3 ± 3.4 dB in network A, and was in a range of 90-140 dB (17). Also, in Taheri et al's study about the noise level of carpentry workshops in Sabzevar, noise exposure was 92.8 dB and the minimum and maximum were 72 and 115.3 dB respectively (18). Noise exposure in the present study was 103 for wood cutters, 85.4 for closet makers, 83.8 for furniture makers and 93.1 dB for carpenters. These results are in the range of noise pollution that the carpentry workshops of Sabzevar city had. In this current study the area was dominantly residential-industrial, and the sound levels outside the workshops was compared with the standards for these areas; and except in 11% of the workshops, the noise levels outside the workshops was above the standard levels for residential-industrial areas (70 dB).

High noise levels above the threshold have also been reported from other cities in Iran. In a study (19) about evaluating noise pollution in Qazvin city, noise levels in the city commuting areas was between 69.9 to 72.8 dB. In the study done by Naddafi et al (20) the maximum noise pollution in different parts of Zanjan during day and night was respectively 72 and 77.7 dB, in the A network and above the standard threshold. In the residential-industrial areas of Tabriz city, the amount of noise pollution in the studied areas was between 69.67 and 70.77 dB (21), which is higher than the standard noise

level for these areas. Other studies about noise pollution in cities has shown that in most city regions the noise levels are higher than national standards and factors such as industries and traffic are among the main reasons for noise pollution (22,23).

Other studies conducted outside Iran, such as a study done by Henrique et al (24) in the city of Curitiba in Brazil showed that in 93.3% of the measurements, the levels of noise pollution was more than 65 dB and in 40.3% noise pollution was more than 75 dB. Also in another study done by Yilmaz and Ozer (25) in 126 points in the city of Erzurum in Turkey, in 96 measuring points, noise levels were higher than standard. Darson et al (26) evaluated noise pollution in Ghoonieh, Turkey; and noise measurements were done in 366 points of the city and the average noise pollution of the city was above 65 dB; and the main sources of noise production were traffic and industries.

Conclusion

Most small workshops in cities produce significant noise pollution which is higher than the recommended national standards. Due to the hazardous effects of noise on workers and people residing in these areas, we suggest that the basics of occupational safety should be taught to workers, protective equipment should be supplied to them, their working hours should decrease and their rest should increase, appropriate industrial equipment should be chosen for the production processes, equipment should be taken care of and serviced regularly, equipment should be left in the appropriate location and should have sound insulators or should been closed in confined insulating spaces. In cities, workshops should be established in proper locations and regulations should prevent founding workshops in residential areas. A program for organizing industries and businesses, based on the experience of other Iranian and world cities (27, 28) can be efficient in controlling noise pollution in Qom city.

Footnotes

Conflict of Interest:

The authors declared no conflict of interest.

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