



## Noise Pollution in Zahedan and Residents' Knowledge About Noise Pollution

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### ABSTRACT

**Context:** Noise is considered one of the most pervasive and harmful agents in crowded cities. The aim of this study was to determine the exposure rate to noise pollution of residents on the main streets of Zahedan city in southeastern Iran and the knowledge and attitudes of these residents concerning noise.

**Evidence Acquisition:** Noise was measured for three consecutive weeks in the October-November areas of the city in 31 test locations, using a CEL-440 Classic sound level meter and analyzer during the noisiest hours of the day (07:00 to 22:00).

Using a validated questionnaire, data were collected from 400 subjects to estimate their knowledges and attitudes about noise pollution.

**Results:** The average noise level in the main city streets during the day was  $75 \pm 2.96$  dB. The mean age of participants was  $31.9 \pm 11$  years. Approximately 82.3% of the subjects tested reported that street noise pollution was too high, and 48% suggested that the best way to decrease city noise pollution was to enhance people's knowledge of the problem. Furthermore, 65.8% of the subjects stated that street noise is a cause of stress. There was a significant association between noise levels and subjects' sleepiness ( $P < 0.05$ ). In addition, noise pollution in Zahedan city streets was found to be higher than standard levels.

**Conclusions:** It was concluded that appropriate traffic management and a health promotion program are essential for increasing the residents' understanding about how to improve the current noise pollution situation.

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### ► Implication for health policy/practice/research/medical education:

The study discusses noise pollution of residents and their knowledge and attitudes concerning noise. Reading this article is recommended to the specialists in the field of occupational and environmental health, health policy makers as well as general population.

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## 1. Context

Currently, noise pollution requires special attention in crowded and industrial cities. One of the factors that creates this kind of pollution is urban and suburban transportation. It has been predicted that the burden

of noise pollution will increase considerably if current trends of increased crowding and greater numbers of automobiles in cities continue without proper management. Often, the physiological and psychological effects in humans of continuous noise appear gradually over a long period of time, although there are no such complications for those who are not subject to the effects of noise (1). The human body's reactions to loud noises are similar to reactions to imminent risks. Some of these characteristic reactions are the secretion of adrenaline hormone and changes in heart rate and blood pressure

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(2, 3). Other effects of noise include feelings of annoyance (4), headaches, irritability, fatigue, aggressive behavior, stress, insomnia (5), and digestive problems (6). Noise control is regarded as an important health issue that would increase the quality of life of city residents (Table 1).

**Table 1.** Descriptive and Questionnaire Results of Zahedan Residents' Knowledge About Street Noise

|   | Variables                      |                     |
|---|--------------------------------|---------------------|
|   | Responses/Groups               | Frequency, No. (%)  |
| Noise reduction procedure               | Knowledge increase             | 192 (48)            |
|   | Traffic reduction              | 183 (45.8)          |
|   | Others                         | 25 (6.2)            |
| Duration of noise exposure of residents | < 5 year                       | 168 (42)            |
|   | 5-15 year                      | 111 (27.8)          |
|   | > 15 year                      | 121 (30.2)          |
| Average knowledge                       | Male                           | 259 (3.55 out of 6) |
|   | Female                         | 140 (3.45 out of 6) |
| Hours of noise                          | 7-9                            | 47 (11.7)           |
|   | 11-14                          | 146 (36.5)          |
|   | 15-17                          | 36 (9)              |
|   | 17-19                          | 171 (42.8)          |
| Noise sources                           | Motorcycle                     | 186 (46.5)          |
|   | Car                            | 88 (22)             |
|   | Bus                            | 52 (13)             |
|   | Loud speakers                  | 38 (9.5)            |
|   | All                            | 36 (9)              |
| Noise level                             | Very high                      | 109 (27.2)          |
|   | High                           | 220 (55)            |
|   | Pays no attention to the noise | 71 (17.8)           |
| Who is responsible for noise reduction? | Traffic department             | 134 (33.4)          |
|   | Everyone                       | 145 (36.3)          |
|   | Don't know                     | 39 (9.8)            |
|   | Others <sup>a</sup>            | 92 (20.5)           |

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Bus, automobile, metro, light rail, and other transportation systems are significant sources of city noise (7). In addition, the effects of noise and hearing loss caused by noise are global problems, especially in industrial communities (6, 8, 9). Approximately 20-30 million Americans believe that they are exposed to high noise levels, and it is estimated that approximately 10 million people have hearing loss caused by noise. Furthermore, it is believed that more than 200 million people worldwide are subject to the effects of noise (10, 11). A study in California demonstrated that noise was increasing at the rate of 6.7 dB/A due to street traffic. There is also evidence that living next to high-traffic streets increases the risk of discomfort by 40 percent (12). This paper discusses the exposure level of residents to noise pollution in the main streets of Zahedan city, as well as their knowledge of and attitudes about noise pollution.

## 2. Evidence Acquisition

This cross-sectional study was carried out in Zahedan southeastern of Iran to estimate the level of noise pollution in the main city streets and to determine the knowledge and attitudes of the residents about this issue. Data were collected as follows:

### 2.1. Noise Pollution

When seeking to measure noise levels, the highest traffic load on the main streets was found to occur between the hours of 07:00 and 22:00. Next, 31 test locations were selected from the streets with the highest levels of traffic (Figure 1). Noise was measured using a CEL-440 Classic sound level meter with analyzer, after calibrating the device with a 1 KHz Cel calibrator at 114 dB and situating the meter at a height of 150 cm above the ground. Equivalent noise (Leq) was measured in 5-minute segments, measuring maximum (Lmax), minimum (Lmin), peak (Lpk), and L90 levels at 1-hour intervals. The tests were performed for 3 consecutive weeks between the hours of 07:00 to 22:00, in all 31 test locations in the October-November area of the city, in weighted networks of A and fast mode.



**Figure 1.** Most Crowded Streets With the Highest Level of Traffic in Zahedan

### 2.2. Residents' Knowledge of Noise Pollution

A 29-item questionnaire was prepared, which included items on the demographic characteristics of the test subjects, location-related variables, and knowledge of noise pollution. The validity and reliability of the questionnaire was determined by Cronbach's alpha (0.72) as well as by opinions of experts in this field. The questionnaires were completed by trained interviewers with 400 randomly selected residents of the main streets of the city. Finally, descriptive statistics including frequency, percentage, and mean  $\pm$  SD were used to analyze the data using SPSS (version 13).

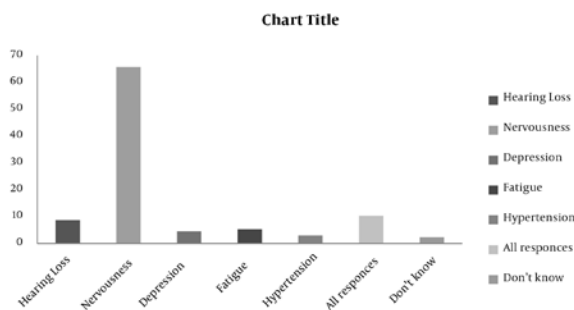
## 3. Results

In this study, approximately 65% of the participants

**Table 2.** Attitudes of People About the Effects of Noise on Behavior, Peace, Decision Making, and Sleep of Main Street Residents of Zahedan City in 1388

|                 | The Rate of Noise Effects in Percent and Frequency |           |            |            |            |
|-----------------|--|-----------|------------|------------|------------|
|                 | No effect  | Low       | Fair       | High       | Very High  |
| Behavior        | 5.4 (22)   | 13.8 (55) | 35.8 (143) | 26.2 (105) | 18.8 (75)  |
| Comfort         | 3.2 (37)   | 9.3 (37)  | 21 (84)    | 29.5 (118) | 37 (148)   |
| Decision making | 10.2 (41)  | 21.5 (86) | 30 (120)   | 23.3 (93)  | 15 (60)    |
| Asleep          | 4.3 (17)   | 11 (44)   | 18.7 (75)  | 29.5 (118) | 36.5 (146) |

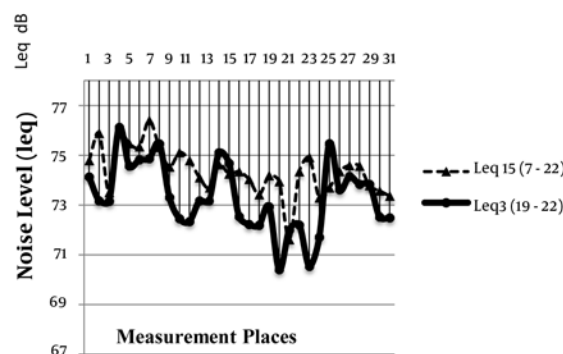
were male, and the mean age was  $31.9 \pm 11.40$  years. Approximately 62% of subjects reported that street noise was painful, and 229 (57.3%) believed that noise is evident in their homes. The noisiest times of the day were identified by interviewees as 11:00–14:00 and 17:00–19:00, and they blamed motorcycles as the main source of noise pollution. They held people responsible for noise reduction in the city. They also mentioned that high and very high levels of noise had a negative effect on comfort (66.5%), sleep (66%), behavior (45%), and daily decisions (38.3%) (Table 2). Figure 2 shows the subjects' viewpoints concerning the frequency of complications caused by noise. According to their responses, nervousness is the main complication of noise. We found no evidence of differences in participants' knowledge based on gender or distance from noise pollution.



**Figure 2.** Relative Frequency of Complications Caused by Noise Reported by Subjects in Zahedan

### 3.1. Results of Noise Evaluation

The main city streets experienced the highest traffic load between the hours of 12:00–14:00 and 17:00–19:00, when on average 719 and 678 vehicles passed by per hour, respectively. Over an entire day, the main city streets experienced an average equivalent noise level (Leq) of  $75 \pm 2.96$  dB, with peak sound levels of  $110 \pm 4.2$  dB, maximum sound pressure levels of  $93 \pm 7.2$  dB, minimum sound pressure levels of  $64.35 \pm 6.1$  dB, and L90 equivalent to  $69.4 \pm 2.4$  dB (that is, the sound levels were higher than this value during 90% of the measurement times). Figure 3 shows the average equivalent noise level (Leq) over 15-hour (07:00–22:00) and 3-hour (19:00–22:00) periods in the 31 test locations in the main city streets of Zahedan.



**Figure 3.** Average Equivalent Noise Level (Leq) Over 15 Hours (7:00–22:00) and 3 Hours (19:00–22:00) in the Main Streets of Zahedan City in 2008

### 4. Conclusions

Results of the study showed that the highest traffic load on the city's streets was between the hours of 07:00–9:00 and 11:00–14:00, when an average of 678 and 719 vehicles passed that route each hour, respectively. The average equivalent sound pressure levels in the city's main streets per day was  $75 \pm 2.96$  dB, the average peak sound level was  $110 \pm 4.2$  dB, and the average maximum sound level was  $93 \pm 7.2$  dB. As the chart in Figure 3 shows, equivalent sound levels in all of the measured test locations were higher than the standard limit (the standard sound level set by the US Environmental Protection Agency of 55 dB) during all of the measured 15 hours. According to the environmental expert council, these studies show a consistent trend towards increased cardiovascular risk if the daytime noise level exceeds 65 dB (A). Traffic noise is the most important source of environmental stress 4. In research conducted in Kashan (Iran), the equivalent sound pressure level in high traffic points of the city was 81.7 dB, and the average level was 79.7 dB 15. In research conducted in Sanandaj (Iran), the equivalent level at some hours of the day was 85 dB 16. In our research, according to the table, the minimum equivalent sound level was 72.6 dB, and the maximum average equivalent sound pressure level was 76.9 dB. Based on global guidelines, the standard sound limit is 55 dB LAeq (22:00–8:00). This limit is 55 dB in Great Britain, 55–57 dB in Spain, and 60 dB in Switzerland (13). According to the results of this study, sound pressure levels in all of the 15 hours and in an average of the 15 tested hours was higher than the standard limits. The findings

of this study shows that the Zahedan traffic load, especially on its main streets, is high and that the noise pollution rate due to traffic load and a lack of attention of drivers to noise pollution is greater than the standard level (LAeq 22:00–08:00). The results of one study showed that high and very high levels of noise have a negative effect on feelings of tranquility (66.5%) and sleep (66%). One study on the effects of long-term exposure to road traffic noise on sleep quality, assessed using questionnaires and actimetry, showed that sleep quality improved after the reduction of noise levels 5. According to the Environmental Expert Council of Germany, severe annoyance that persists over a prolonged period of time is to be regarded as causing distress 4. Studies conducted in some cities of Iran (14, 15) on noise in high traffic points of the city show that state, city and According to Zahedan residents, people should pay attention to the noise pollution of cities, and special strategies should be developed to reduce noise pollution. Based on the results of this study and due to increasing trends of traffic load and city population as well as noise pollution studies in other countries, there is an increasing need for proper consideration from traffic police, municipalities, television stations, universities, and other related organizations to this form of pollution. By increasing knowledge and awareness among residents of the effects of noise pollution, a preventive solution may be achieved that decreases noise pollution in short-term, mid-term, and long-term periods. According to the results of sound measurements and the survey questionnaire, noise pollution in Zahedan streets is higher than the standard level. Due to the increasing trends of city population and traffic loads on streets, there is a need for traffic management, increased knowledge, community participation and comprehensive planning in order to improve the current state of noise pollution.

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### Authors' Contribution

The overall implementation of this study including design, data management and analysis, and manuscript

preparation were the results of joint efforts by multiple individuals who are listed as co-authors of this paper. All authors have made extensive contribution into the review and finalization of this manuscript.

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