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Noise Pollution in Kerman-Iran

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Key Words: Noise pollution, urban traffic, noise level, Kerman

ABSTRACT

Noise is defined as unwanted or objectionable sound. Human susceptibility to noise varies in terms of intensity, altitude, timbre of sound, personal sensibility, age, and history of ear disorder. Noise pollution which is the result of heterogeneous and uncontrolled developments of cities is one the serious problems in large cities of Iran. Although noise pollution in Kerman (located in southeast of Iran) is not as serious as that of large cities in Iran, it can be considered as one of the elements which have changed Kerman's life pattern. In this study, conducted in 1999, in order to assess noise pollution level in Kerman, 13 stations were selected and the levels of L_{max}, L_{AV}, L_{99}, L_{90}, L_{50}, L_{10} were measured daily for 156 days. Results, in all stations, indicated that sound level in Kerman exceeds national standard level and WHO guidelines. Therefore, it is essential to take some actions in order to control Kerman noise pollution with some undesirable impacts.

INTRODUCTION

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During the recent decades, different factors such as population increase, urbanization, and rapid industrial development have greatly influenced the environment and had harmful impact on human life, particularly in urban districts. Today, one of the most important calamities in urban life is unwanted, meaningless, and unmusical sound, which is technically called noise pollution (6).

Robert Koch (1910) stated that in future, harsh noise is the most danegrous enemy which threatens mankind health (5). It is obvious that today, noise polltuion has turned into a complex social problem in mega cities. Accordingly, it has deleterious effects on nearly all citizens. To decrease noise pollution in urban areas, we should first recognize noise soures, envovled elements, damaging effects, and noise pollution threshold. Accordingly, in this study, the noise levels in Kerman were measured and anyalyzed. Kerman is a city located in southeast of Iran. It had a population about 500.000 in 1999. The main objective of this study was to measure noise levels in different parts of the city and compare the results with national and international standards.

Noise Standards and Threshold

The vehicle noise standards are actually a compromise between what is technically possible in noise reduction and what is commercially practicable. It is important to realise that they do not necessarily represent what is an acceptable level of noise, as far as the public is concerned (11).

If it could be shown that traffic noise gave rise to physiological problems that could be correlated with the noise level, this would provide a sound criterion for the establishment of standards. Although such effects exist, however, their significance is as yet very uncertain, and at the present time there is no justification for supposing that exposure under normal conditions to the noise from road traffic is in any way harmful to hearing, even for protracted durations of exposure, nor that it has any other direct adverse physiological effect. Indirect physiological effects, such as stress syndormes, may exist, but it is impossible as yet to draw a conclusion in the

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concluded from research that noise results in increasing sympatiocotonic reaction in human body such as dilation of the pupils, and it is known that temporary threshold shift in acuity of hearing varies considerably with the indivictual and the length and intensity of exposure to noise (4). Exposure need not be severe, a 12h drive in a car produces a detectable loss in acuity for many people, although exposure to external traffic noise levels probably would not. It has been suggested that a possible effect of traffic noise might be the hastening of age induced hearing loss (11).

Interference with speech or sleep are two possible consequences that lie somewhere between the physiology and the psychology. Noise interference with speech is usually a masking process. As a result of background noise, a person may hear only a few or perhaps none of the speech sounds necessary for satisfactory intelligibility. Also, noise of a certain level many mask some speech sounds and not others, depending on the talking level, on the particular sound, and on the relative frequency distribution of the sound and of the noise (11).

A sound level of 48 dB(A) allows conversation in a normal voice at a distance of 4 m (9). A maximum indoor level of 40 to 5 dB (A) is quoted if television and radio are to be understood comfortably (1).

Social surveys show that interference with sleep is frequently cited as a major reason for annoyance with neighbourhood noise, and sleep interfrence can exist even without a person being conciously awakened. Noise can disrupt sleeping electro-encephalogram (EEG) rhythm without awakening the subject, who does not report inferior sleep on waking (3).

At the present time, standards are necessarily set by consideration of the levels to which people are exposed and their subjective reaction to them. Such standards change frequently, but a report by OECD in 1973 gave the following national examples (11).

1. In France the recommended day-time noise standard is that the average noise level, L50, should not exceed 40-45 dB(A) in living areas, administrative offices and schools. This level may be increased by 5 dB(A) in administrative and commercial buildings. Generally, a 45 dB(A) level inside a builing is taken to correspond to a 60 dB(A) level at the facade. For residential building construction there are three types of area classified as follows:

- Pleasant areas with L_{50} levels of less than 60 dB(A);
- Areas with L_{50} levels of between 60 dB(A) and 70 dB(A) where special steps with regard to insulation have to be taken;
- Areas with L_{50} levels of over 70 dB(A) where housing construction should not be permitted.

2. Japanese regulations specify maximum outdoor L_{50} levels for different types of residential zones (11). A day-time L_{50} level of 50 dB(A) is specified for zones used for dwellings only. The corresponding night level is 40 dB(A). However, for areas facing two lane roads the maximum permissible day-time L_{50} is increased to 55 dB(A) while for the areas facing wider roads 60 dB(A) is permitted. A maximum day-time level of 60 dB(A) is specified for zones containing commercial and industrial uses as well as a considerable number of dwelling.

This level can be increased to 65 dB(A) for areas facing roads. These standards, which were specified by Japanese Government ... ıde a time limit of five years for their

... f Scandinavian building authorities has ... (A) as the permissible average 24 h inside ... (11). This level is taken to be equivalent to ... he buildings which are assumed to have closed double glazed windows.

4. The US Fedral Highway Administration in April, 1972 published interim noise standards and procedures which relate L10design noise levels to land use (3, 8).

To be eligible for Federal aid participation, all applicable highway projects shall include noise abatement measures unless exception have been approved. The prescribed exterior limits are as follows:

- 60 dB(A) for parks and open spaces where quietness is of primary importance.
- 70 dB(A) for residential areas, hotels, motels, schools churches, libraries, hosptials, recreation areas, playgrounds, active sports areas and parks-additionally the interior design noise level in the buildings mentioned in this category must not exceed 55 dB(A);
- 75 dB(A) for developed areas not included in the foregoing categories.

Thus, the recommended maximum day-time levels of L_{10} for the outside of residences vary from 56 dB(A) to 70 dB(A). For countries L_{50} as the noise measure, recommended standards are at about the 60 dB (A) level.

5. Table 1 shows outdoor noise standrad in Iran (2).

Table 1. **Outdoor noise standard in Iran(7)**

Area	**Day-time**	**Night-time**
Residential areas	50dB	30dB
Residential & commercial areas	60dB	50dB
Commercial areas	65dB	55dB
Residential & industrial areas	70dB	60dB
Industrial areas	75dB	65dB

6. Table 2 briefly demonstrates world Health Organization (WHO) guidelines regarding noise. These guidelines are very handy when we intend to improve sound quality (by considering determined noise level) in different environment. To measure outdoor and indoor noise level, measurement should be done respectively 50 cm under a window and 120 cm far from a wall. For ear disorder cases, measurement should be done at ear level. When one is exposed to noise, average sound pressure level will be demonesated within a certain period e.g. 24 hours. It is technically called equivalent continous sound pressure level or leq and also its unit for measurement is decibles (dB) (12).

In general, noise criteria and standards are established based on its several impacts. Different categories are used to explain noise level according to determined standard levels and criteria. One of these categories consider time precentage of noise which exceeds determined noise level in certain time (10).

Table 3 shows statistical distribution of different noise level (L_1, L_{10}, L_{50} and L_{90}). L_1 means noise level exceeded for 1 percent of time and L_{10}, L_{50} and L_{90} mean noise level exceeded for 10, 50, and 90 percent of time, respectively. They are all measured in dB(A).

MATERIALS AND METHODS

To study noise pollution in Kerman (1999), 13 stations were set up. The stations were selected based on scientific methods and the expansion of the city. To measure L_{max}, L_{AV}, L_{99}, L_{90}, L_{50}, and L_{10} noise levels, a digital phonemeter (auto analyzer) was utilized. Moreover, the duration and days of sampling were both considered according to interanational standards. The time for determination of noise level was 30 minutes in an hour and it was done all through the day. It was tried to carry out the study in both working days and days off. For this reason, measurement was done on 1st, 7th, 14th, and 21st day of each month. Measurement, in each station, was performed for 12 days (each day a period of 24 h) within a year. Since only one phonemeter was available, the research took for 156 days. The means of values (noise levels) in 13 stations in Kerman (1999) are demonstrated in Table 4.

RESULTS AND DISCUSSION

Table 4 shows measurement of noise levels (L_{max}, L_{Av}, L_{99}, L_{90}, L_{50}, and L_{10}) in 13 stations in Kerman (1999).

According to collected data from different stations in Kerman, it can be claimed that noise level in most districts is above standard level. It is also obvious that people are suffering from noise pollution. Therefore, it seems essential that some measures should be taken in this regard.

However, to clarify and demonstrate the issue more in detail, results from different stations will be analyzed in the following part. The minimum noise level [83.9 dB(A)] was recorded in stations four and five, and the maximum noise level [94.5 dB(A)] was registered in site seven. It is noteworthy that the other stations also show almost the same level. The statistics are indicating that noise level is very high in Kerman. Most countries as well as Iran consider L_{10} as an indicator to measure noise level. It is 70 dB(A) for outdoors. But collected noise levels are highly above 70 dB(A) and even higher than Iran standard noise levels. Moreover, there is a significant difference between L_{10} noise level in Kerman and permissible level 70 dB(A) ($p<0.0001$). Figure 14 shows means of noise levels in Kerman. It is based on the results which obtained from 13 sites in Kerman.

According to recent surveys, the following items are the main causes and sources of noise in Kerman (8).

1. Vehicle traffic (esp motor cycles), heavy traffic in narrow streets, old vehicles;
2. Construction industry;
3. Rough and uneven streets (cause: using inappropriate asphalt in covering road surfaces);
4. Inside city industries, or industries next to the city;
5. Driving regulations breaking (by some drivers);
6. Concentration of urban traffic on few main routes;
7. Insufficiency in number and capacity of parking lots;
8. Traffic jam in traffic circle and intersections;
9. Commercial activities and shopping.

The researcher recommonds the following solutions for some mentioned problems:

1. Expanding parks and roadside planning in order to creat an insulation between noise sources and buildings;
2. Widening streets, intersections, and roads;
3. Expanding beltways;
4. Preventing old vehicles traffic;
5. Stopping drivers whose vechicles produce nuisance sound;
6. Restricting misuse of warning sound such as horns;
7. Transferring bus terminal to the outskirts of the city;
8. Establishing new factories far from residential areas and installing their noisy machines indoors;
9. Restricting expansion of residential areas around the airport;
10. Transfering disturbing workshops, factories, works, and mills to an industrial estate;
11. Walling around construction areas, preventing working at night, and using machines; Which are not very noisy.

Figures 1 to 13 indicates general condition of noise levels in the stations.

Table 2. **Brief guidelines of WHO regarding noise**

Environment	Critical impacts	L_{eq} based on dB (A)	Time	L_{max} based on dB (A)	Equipment installment to determine L_{max}
In bed (night time)	Sleep disturbance and annoyance	30	8	--	--
House area (day time)	Room annoyance, speech interference	55 50	16	--	--
House surrounding (night time)	Sleep disturbance when the windows are open	45	8	--	--
Classroom	Speech interference, problems in transfaring informations, annoyance	35	8	--	--
School yard	Annoyance	35	--	--	--
Patient room (hospital)	Sleep disturbance, conversation interference	30	8	45	Fast
Staff room (hospitsal)	Sleep disturbance, conversation interference	30	8	45	Fast
Conceret, outside of concent, discotheque, headphone	Hearing deficiency	100	4	--	--
Fire work, toy noise	--	--	--	140	Very fast

Table 3. **Statistical distribution of different outdoor noise levels based on 5 dB(A)**

5 dB (A) interval	Percent of total time	Noise level
61-65	1	L_1
56-60	10	L_{10}
51-55	50	L_{50}
46-50	90	L_{90}
41-45	100	

Table 4. **The means of noise levels in 13 stations in Kerman (1999)**

Station Number	L_{max}	L_{eq}	L_{AV}	L_{99}	L_{90}	L_{50}	L_{10}
1	89.6	73.4	72.7	62.9	66.2	72.1	76.2
2	84.3	72	70.6	61.2	66	67.6	73
3	87.9	74.6	74	65.4	69.4	72.7	77.5
4	83.9	69.5	68.6	60.9	63	62.1	74.4
5	83.9	71.7	70.2	62.2	64.9	68.5	74
6	91.9	81.5	80.8	72.4	76.1	79.7	83.7
7	94.5	81.5	82.3	72.4	75.6	79.8	86.1
8	91.1	82	82.6	71.9	74.4	77.5	87.1
9	90.5	80.6	80.6	73	75.4	77.1	82
10	94.3	80	78.5	65	67.4	73.7	84.1
11	94	76.7	78.4	65.4	68.3	72	78.1
12	93.4	77.4	78.4	66.4	67.1	72.8	79.5
13	92.8	81	77	63.5	67.5	75.6	79.4

Fig. 1. **Noise level in station 1 (1999)**

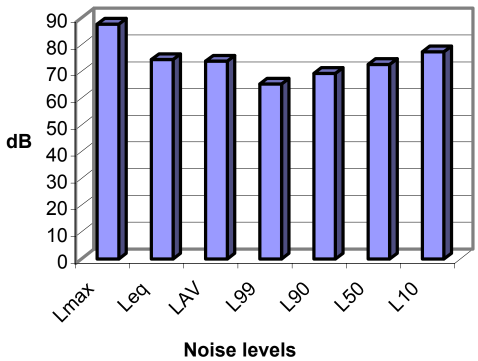


Fig. 2. **Noise level in station 2 (1999)**

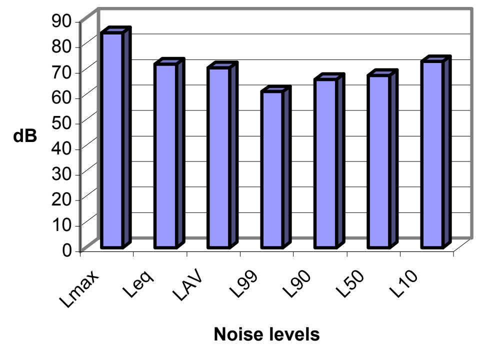


Fig. 3. **Noise level in station 3 (1999)**

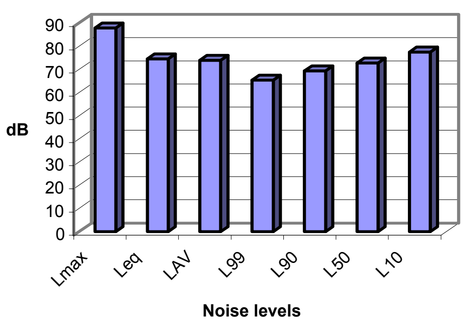


Fig. 4. **Noise level in station 4 (1999)**

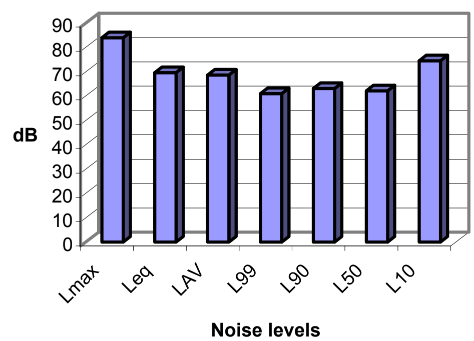


Fig. 5. **Noise level in station 5 (1999)**

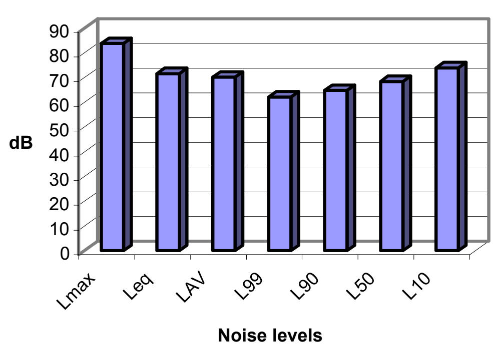


Fig. 6. **Noise level in station 6 (1999)**

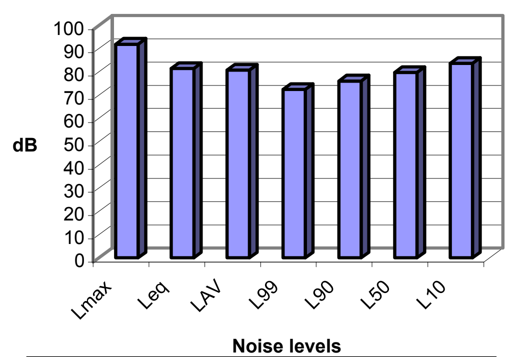


Fig. 7. **Noise level in station 7 (1999)**

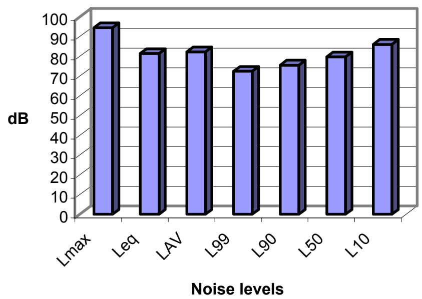


Fig. 8. **Noise level in station 8**

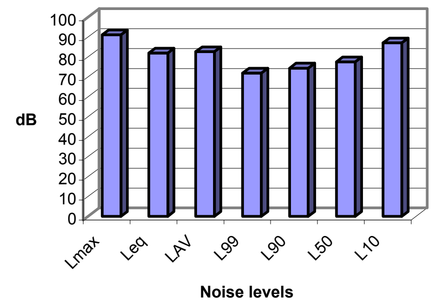


Fig. 9. **Noise level in station 9 (1999)**

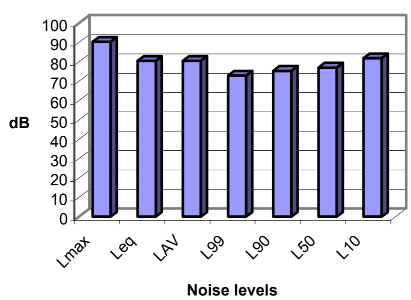


Fig. 10. **Noise level in station 10(1999)**

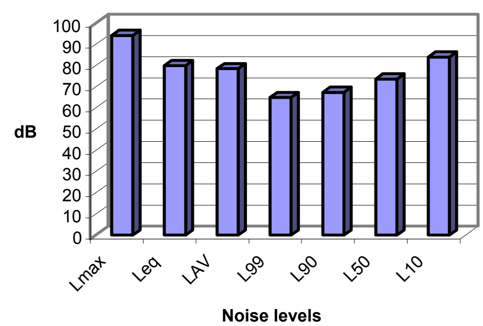


Fig. 11. **Noise level in station 11 (1999)**

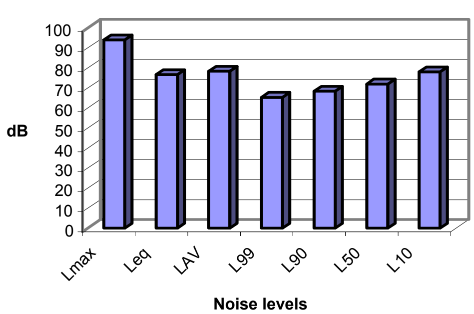


Fig. 12. **Noise level in station 12 (1999)**

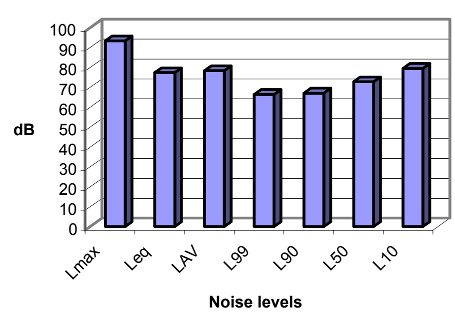


Fig. 13. **Noise level in station 13 (1999)**

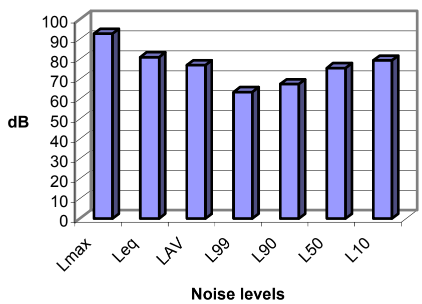
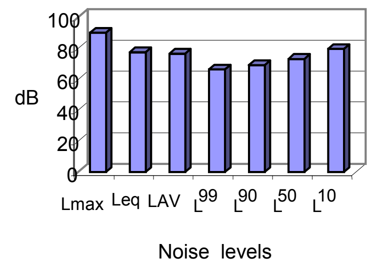


Fig. 14**. Means of noise levels in 13 stations, Kerman (1999)**



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