

Evaluation of noise pollution in Shiraz hospitals

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Original Article

Abstract

Introduction: High sound, is an occupational and environmental hazard common. Hospitals as medical and health care setting are affected by noise sources. Therefore, the aim of this study is to investigate the noise pollution in Shiraz hospitals.

Methods: A cross-sectional study in different parts and the area around the 8 educational and non-educational hospitals in Shiraz was performed. For all hospitals Indices Leq (inside and outside), I_{max} , I_{min} , and SIL were measured in the morning, afternoon and night by Sound level meter TES 1358. Data was analyzed by SPSS 16 and Test ANOVA and t-test and Measurement Repetitive were performed.

Results: Average measured parameters Leq (inside and outside), I_{max} , I_{min} , and SIL in all hospitals and in different shifts was more than limits of the country. The average leq inside and outside were between 53 to 60 and 65 to 85 dB, respectively in teaching hospitals and 49 to 58 and 48 to 71 dB in non-teaching hospitals were variable. Average all parameters in teaching hospitals was more than for non-teaching hospitals.

Conclusion: In all sites and times of day and night, even at night shifts, the noise pollution is a serious problem in all hospitals. Thus, engineering control and management measures are recommended to improve the environment of medical and choice of appropriate equipment.

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Introduction:

Sound is considered as one of the most important communicating ways of human with his surrounding environment. Sound waves are transmitted in environment unconsciously and can be bothering for human that are called noise pollution (1,2). Exposure to noise can put various mental and physiological effects such as high

blood pressure, performance reduction, sleep disturbance, discomfort, and stress, tinnitus, hearing loss induced by noise and temporary and permanent hearing threshold shift (3,4).

Hospitals are influenced by various noise pollutions such as made noises by systems, people, etc. according to suggestion of National Institute for Occupational Safety and Health, pressure equivalent in hospitals shouldn't exceed 40 dB (A)

during day and 35 dB (A) at nights (5). In addition, World Health Organization (WHO) announced allowable noise in hospitals 35 dB (A) at nights, in patients' rooms 30 dB (A), and in sectors 40 dB (A) (6).

According to Iran national standard, allowable noise inside the hospital during the day from 7 am to 10 pm and from 10 pm to 7 am is 45 dB (A) to 35 dB (A), respectively and in the hospital campus during the day from 7 am to 10 pm and during night from 10 pm to 7 am in the morning are 55 dB (A) and 45 dB (A) respectively (7).

Jung et al. in a study, that investigated noise pollution and its effect on the medical staff and patients, concluded that the noise level during the day in hospitals is between 52.6 dB (A) to 64.6 dB (A) that is higher than Taiwan standard (50 dB) (8).

In a study conducted to measure and evaluate noise levels in the environment of hospital, researchers found that the average noise level pressure is 60 dB that is far beyond the Society of Conservation Biology of America that suggests 45dB and 35 dB for day and night, respectively (9). Morrison et al. in a study, that examined the effects of noise, stress and annoyance in their intensive care unit, reported average noise level 61dB and 59 dB for day and night, respectively (10).

The results of Golmohamadi study on the sound check and the effects of its persecutors in Hamedan hospitals showed that the average equivalent sound pressure level inside and outside hospitals are 55.8 dB (A) and 56.2 dB (A), respectively and 57 dB (A) and 54 dB (A) inside educational hospitals, respectively. According to state standard sound limit with regard to inside and outside of hospitals, the noise level in these hospitals was higher than the permissible limit (11).

Mahdi Poursadeghi et al. by results from conducted studies at two hospitals of Imam Reza (pbuh) and Ghaem in Mashhad city showed that noise pollution is higher than allowable limit in most places in the hospital. Sound pressure level in both hospital emergency rooms and the library are more than allowable level (12).

There is agreement among researchers on noise pollution in hospital environment and according to importance of Shiraz hospital as medical and educational center that still no study

has been conducted on noise pollution in this case study.

Therefore, the present research investigates noise pollutions in 8 educational and non-educational hospitals of Shiraz city by considering all important indices of pollution such as maximum equivalent, equivalent sound pressure level, and minimum equivalent, and speed interference level.

Methods:

This study was conducted cross-sectional in 4 educational hospitals and 4 non-educational hospitals (Namazi, Shahid Faghihi, Khalili, Hafez, Shahr, Dena, Shafa, and Kosar) in Shiraz. The reasons of selecting this hospitals are their importune, location, and number of clients.

In order to investigate noise pollution completely according to similar studies and pre-test, the hospitals with more noise solutions were selected. Indexes of maximum level, minimum level and frequency analysis at three frequencies of 1000, 2000 and 4000 Hz were measured to calculate speed interference level in determined stations based on regular station arranging method. According to various sectors area inside hospitals, 410 stations in various sectors and 32 stations in hospital campus in 4 main directions (north, south, west, and east), totally 442 stations were measured in Saturday and Monday in 3 shifts of morning, afternoon, and night for 3 consequent months in slow mode using Tes1358 audiometer machine. In order to be sure of measurement by audiometer, it was calibrated after measuring calibrator. Sound measurement height was considered in various parts according to hearing height (1.5 m above ground level) and hospitalization rooms (1 meter from the ground).

SPSS 16 was used to analyze data. One-way analysis of variance, t-test, and repeated measurements for statistical comparisons with 0.05 significance level were used.

Results:

Tables (1) and (2) show equivalent average level exposure inside and outside, interfering with the conversation, the highest, and lowest recorded in

three morning, afternoon, and night shifts in educational and non-educational hospitals.

Table 1. Average of measured parameters in 3 shifts in educational hospitals

Hospital	Measured parameters / shift	Namazi	Shahid Faghihi	Hafez	Khalili	Significance level*
Equivalent sound pressure level inside (Mean±SD)	Morning	3.6±60.68	4.8±59.8	3.1±58.26	6.5±60.4	0.83
	Afternoon	3.3±60.65	4.7±59.1	3.4±57.8	3.9±57.3	0.56
	Night	5.1±55.83	5.07±56.8	4.6±55.06	4.1±53.64	0.72
Speech Interference level (Mean±SD)	Morning	4.40±60.27	5.26±60.18	1.5±59.67	4.54±56.7	0.48
	Afternoon	4.1±60.01	4.51±58.1	4.75±56.81	5.25±56.77	6.10
	Night	5.9±56.44	4.40±56.07	4.6±56.65	3.6±50.45	0.12
The maximum recorded noise (Mean±SD)	Morning	10.79±71.12	6.75±67.14	9.77±71.48	5.5±65.66	0.59
	Afternoon	7.34±69.45	5.9±65.03	8.98±68.46	4.19±64.14	0.5
	Night	7.27±63.69	6.07±62.43	3.61±64.94	5.78±61.92	82.0
The minimum recorded noise (Mean±SD)	Morning	5.54±52.12	5.07±51.54	5.28±47.12	5.36±46.58	0.21
	Afternoon	3.7±52	7.9±51.41	4.77±47.14	5.68±47.45	0.39
	Night	5.81±49.5	5.32±48.2	5.92±44.62	33.33±46.58	0.46
Equivalent sound pressure level in campus (Mean±SD)	Morning	17.07±70.25	19.97±84.87	22.58±81.5	21.15±71.22	0.51
	Afternoon	18.68±76.2	17.82±85	23.82±82.98	21.07±70.85	0.63
	Night	14.16±65.07	21.21±69.15	21.4±67.5	13.9±67.4	0.98

* One-way ANOVA with a significance level of 0.05

Table 2. The average of various measured parameters in 3 shifts of morning, afternoon, and night in non-educational hospitals

Hospital	Measured parameters / shift	Dena	Kosar	Shafa	Shahr	Significance level*
Equivalent sound pressure level inside (Mean±SD)	Morning	4.05 ± 58.46	3.1 ± 57	1.2 ± 05/55	2.86 ± 53.4	0.12
	Afternoon	5.4 ± 58.74	3.1 ± 57.6	1.1 ± 54.5	7.05 ± 54.8	0.47
	Night	5.1 ± 56.22	3.9 ± 55.3	1.34 ± 49.97	1.1 ± 49.8	0.26
Speech Interference level (Mean±SD)	Morning	2.43 ± 57	1.86 ± 57.72	2.38 ± 55.1	2.4 ± 56.02	0.58
	Afternoon	5.33 ± 57.98	3.8 ± 55.87	3.45 ± 55.93	5.5 ± 54.51	0.72
	Night	1.73 ± 54.86	4 ± 55.83	2.14 ± 49.71	3.45 ± 49.31	0.09
The maximum recorded noise (Mean±SD)	Morning	7.37 ± 67.42	2.72 ± 67.48	1.83 ± 62.45	3.48 ± 62.4	0.19
	Afternoon	5.69 ± 66.82	6.07 ± 64.68	2.96 ± 62.57	3.54 ± 61.65	0.42
	Night	7.17 ± 63.54	5.78 ± 62.54	3.01 ± 56.45	1.09 ± 56.47	0.10
The minimum recorded noise (Mean±SD)	Morning	4.54 ± 50.68	5.14 ± 48.08	1.08 ± 42.47	2.17 ± 42.77	0.05
	Afternoon	3.14 ± 52.36	5.33 ± 48.5	3.25 ± 40.7	1.02 ± 41.65	0.07
	Night	5.38 ± 45.02	6.75 ± 44.5	1.62 ± 41.42	0.66 ± 38.17	0.16
Equivalent sound pressure level in campus (Mean±SD)	Morning	12.66 ± 58.5	12.49 ± 61.85	11.13 ± 58	21.57 ± 71.27	0.55
	Afternoon	6.93 ± 58.5	13.14 ± 60.27	64/12 ± 65/58	20.13 ± 69.22	0.63
	Night	11.92 ± 60.12	10.46 ± 48.67	6.85 ± 58.62	17.9 ± 69.22	0.14

* One-way analysis of variance with 0.05 significance level

Table 3. Comparison among measured parameters in morning, afternoon, and night shifts

Parameters	The significance level*				
	Hospital	Equirvalent sound pressure level inside	Speech interference level	The maximum recorded noise	The minimum recorded noise
Namazi	0.09	0.32	0.32	6.10	0.52
Shahid Faghihi	0.49	0.27	0.38	0.53	0.25
Hafez	0.31	0.39	0.44	0.69	0.51
Khalili	0.14	0.07	0.53	0.95	0.94
Dena	0.67	0.38	0.34	0.054	0.96
Kosar	0.46	0.6	0.33	0.5	0.21
Shafa	* 0.004	* 0.02	* 0.01	0.53	0.99
Shahr	0.3	0.13	* 0.03	* 0.003	0.98

Table 4. Comparing educational and non-educational hospitals

Mesured parameter	Hospital type		Significance level
	Educational	Non-educational	
Equivalent sound pressure level inside (Mean±SD)	4.68±58.06	4.42±55.41	* 0.0018
Speech interference level (Mean±SD)	7.26±66.11	5.56±63.12	* 0.013
The maximum recorded noise (Mean±SD)	5.61±49.02	5.61±45.01	* 0.0001
The minimum recorded noise (Mean±SD)	4.46±57.35	3.35±50.96	* 0.0001
Equivalent sound pressure level in campus (Mean±SD)	74.33±19.42	61.08±13.15	* 0.0001

* Student t-test with 0.05 significance level

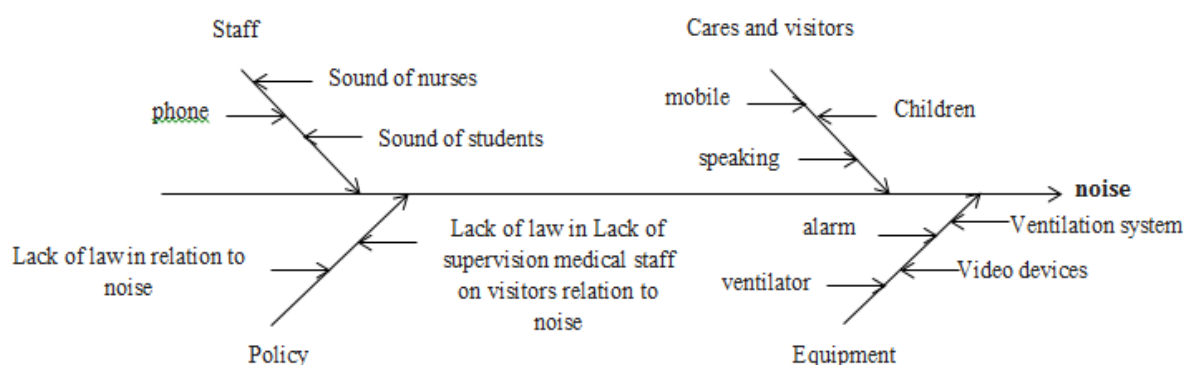


Diagram 1. Fishbone diagram as noise maker factor in hospital

Most of equivalent sound pressure level inside educational hospitals and non-educational hospital were related to Namazi hospital in the morning shift and to Dena hospital in afternoon shift. In addition, the average speech interference level in educational hospitals is related to Namazi hospital in morning shift and in non-educational hospitals is related to Dena hospital in afternoon shift. The average of the minimum and maximum recorded noise in educational hospitals was related to Namazi hospital in morning shift and Hafez hospital in night shift. The average of minimum and maximum recorded noise in non-educational hospitals was related to Kosar hospital in morning shift and Shafa hospital in night shift. The average maximum equivalent sound pressure level in hospital and its campus in both educational and non-educational hospitals are related to Shahid Faghihi hospital and Shahr hospital in afternoon shift. Obtained results from one-way analysis of variance test showed that there isn't significant difference statistically in all measured parameters for both educational and non-educational hospitals.

Table (3) shows significance level of comparing inside and outside parameters of equivalent sound pressure level, speech interference level, minimum and maximum recorded noise in 3 morning, afternoon, and night shifts for various hospitals. Although the most measuring parameters were for morning shift, but this difference wasn't significant except in parameters equivalent sound pressure level and speech interference level and the highest noise level recorded in Shafa hospital and minimum and maximum noise level recorded in Shahr hospital,

Table (4) shows results of comparing various measurements in educational and non-educational hospitals. Averages of all measured parameters are significantly more in educational hospitals than non-educational hospitals.

Conclusion:

The study shows that the average of all measurements in all hospitals (educational and non-educational) parameters exceeds allowable level.

Mackenzie and et al showed in their study that the intensive care unit have higher noise pollution because of having medical equipment (13) Botha et

al in their research reported 58.7 dB noise inside hospital (14). In another study conducted by Elora et al in 2011 to evaluate noise pollution in their hospital environments, their results showed that sound levels in the NICU, hospitalization sector, and laundry are 63.6 dB, 62.8 dB, and 82.5 dB, respectively that exceed international values recommended for hospital environments (15).

Comparison between educational and non-educational hospitals in our study showed that an average of all measured parameters in educational hospitals is higher than non-educational hospitals. The higher noise level in these hospitals can be for reasons such as large area, a variety of therapeutic areas, the presence of students, and therefore the large reference of clients than non-educational hospitals. In this study, the average equivalent sound pressure level in the enclosure space around hospitals is higher than allowable level in Iran in all hospitals. Although, there was no statistically significant difference between different hospitals, but in some hospitals noise is higher than other hospitals for location and geographical location, traffic and noise of vehicles. In study of Sobtha and et al, noise level in Slovakia in hospitals campus was 71.3 dB which reported reason was traffic noise (14) that corresponds with the result of the present research.

Generally, findings of this study show that noise pollution in eight hospitals of Iran does not comply with EPA standards. According to obtained results and seriousness of such obstacles and significant difference among the obtained values and standard value, importance of hospitals in societies, harmful effect of noise on mental and physical health of clients to hospitals to get medical facilities, employees especially nurses who work in long hours necessitate actions to control and modify principally such as attention to construction location, considering constructions standards, modification the audio system and reduce the alarm, control and prevent the transmission of sound by using sound absorbers in ceilings, walls and double-glazed windows, use it to purchase hospital equipment and for compliance with standards, rules and regulations established management control of visitors and companions of patients, staff and family members to speak softly and not using cell phones, radio and TV can reduce

noise pollution. In addition, periodic measurements and purification sound pressure level, and identification noise maker factors in hospitals can control this pollution.

Unfortunately, just environmental noise pollution was investigated for problems such as non-accessing to technical facilities to measure sound pressure level. Testing dosimetry for nurses who work long hours in hospitals in facing with noise pollution seems necessary and essential. Studies in other hospitals in Shiraz city and investigating their noise pollution should be noticed.

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