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Evaluating the effects of noise on the general health status of hospital employees

Abstract

One of the most significant sources of workplace pollution that lowers people's quality of life is noise. Particularly in settings like hospitals, where the nature of the work necessitates the presence of tranquillity, these impacts are particularly apparent. This study aims to evaluate how noise impacts hospital staff members' general health. Seventy-five 75 hospital employees took part in the study. Hospital departments' sound levels were measured using a calibrated cel-231 sound meter. Saliva samples were taken in the morning and the evening to assess the levels of cortisol in two fasting and non-fasting stages. The data were analyzed using descriptive statistical tests, paired and independent t-tests, and analysis of variance. The study's findings revealed that the mean and standard deviation of the sound pressure levels at Ahvaz's Abuzar and Amir al-Momenin (AS) hospitals are 75.3 decibels and 76.9 decibels, respectively. It was discovered that there is a substantial difference in the amounts of cortisol released in the staff of the two hospitals concerning the impact of the hospital environment on cortisol (p=0.00). The mean sound pressure level in workplaces was shown to have an impact on workers' salivary cortisol concentration levels, according to the study's findings.

Keywords: *Cortisol, garbage disposal unit, hunger, blood oxygen concentration, hospital, sound effect*

mehdi nouri[1] , Behead fouladi dehaghi[2*] , kambiz ahmadi angali[3],

1. Department of occupational health, school of public health, Ahvaz jundishapur university of medical sciences, Ahvaz, Iran

2. Environmental technologies research center. Ahvaz jundishapur university of medical sciences. Ahvaz.Iran

3. Department of biostatistical, school of public health, Ahvaz jundishapur university of medical sciences, Ahvaz, Iran

**Correspondence author: bdehaghi@gmail.com*

Introduction

A peaceful, tranquil, and quiet atmosphere is necessary for the hospital since it is one of the most significant and essential centers of public services and because of the nature of the activities and services offered there. The requirements of the patients and the staff's obligations at work are relevant to this problem. Noise in hospital settings can disrupt staff conversations with patients and each other, disrupt concentration and decrease staff accuracy, cause nervous and mental disorders, raise blood pressure, heart rate, and breathing rates, disturb patients' sleep, and lengthen patients' stays in the hospital (1-2). In his study, Florence Nightingale said that excessive noise makes patients' conditions worse and has a detrimental impact on both patients and staff (2). Noise pollution is particularly effective in influencing newborns' physical development, their capacity to learn and focus while working, and their long-term protection, in addition to causing hearing loss and stress in people (4). The transitory loss will become a permanent loss if exposure to sound is repeated and become permanent. This loss is frequently irreversible and is not due to auditory system exhaustion but rather to the death of the ciliated cells in the Corti organ. Temporary hearing loss may also occur in those who have this disorder. One of the effects of sound on the hearing system is sound complexity. Exposure to relatively high amounts of sound pressure, such as the sound of explosions, is the only factor that can produce this disease. Traumatic sound levels describe it. When you come across this external sound, your hearing organ. Damage is caused by mechanical means, such as ripping off the eardrum or injury or damage to the tissues tying various bone fragments to the hearing organ. These exposure's severe effects necessitate prompt medical intervention. Such difficulties can also result from mechanical ear strikes. Other organs, including the brain tissue, are not harmed in the presence of extremely big sound pressure waves. Some victims of one or more explosions experience brain damage and sporadic attacks. Hearing loss is the most significant harm brought on by sound. The most frequent reason for hearing loss in persons over the age of 50 is this issue. There are two types of hearing loss brought on by sound: temporary and permanent. When a person is unintentionally or non-occupationally exposed to noises louder than 65 dB, a transient shift in hearing threshold or temporary hearing loss can result. The rise in the hearing threshold that results from this adjustment might range from a few to tens of dB. A heavy sensation and ringing in the ears are present in this syndrome (5).

Hospitals frequently experience harmful situations due to noise. In hospitals, mechanical devices, ventilation systems, patient and client talks, and clients who need medical services, as well as workers, produce the sound. Noise harms how well medical care is provided to patients and customers, as well as how well medical care department staff (including nurses, physicians, assistant nurses, etc.) accomplish their jobs (6-7). The World Health Organization recommends that hospitals have noise levels of 35 to 40 decibels during the day and 30 to 40 decibels at night (8). Research by Erdoan Gultkin and his associates on the degree of noise pollution at hospital polyclinics in Istanbul, Turkey, revealed that these locations have sound levels over the WHO-recommended limit (9). Auditory and non-auditory consequences of sound on health in Germany was the title of a 2014 research by Mathias Basner, Wolfgang Babich, and Adrian Davis that evaluated survey

responses and measured noise in various workplace settings. The effect of auditory noise on human health is being studied, including poor patient care in medical and daycare centers. In addition, professional calls, social calls that cause hearing loss, and the non-hearing effects of sound on health such as effect on the cardiovascular system and increase in blood pressure, sleep disorders, confusion lacks of proper implementation of medical care have been investigated. They concluded that noise could negatively impact human health in both auditory and non-auditory ways (10). Adi Padma Kumar, D Bassin, and other researchers performed a study in 2013 in India to determine the noise levels in two teaching hospitals' ICU (special care) units. The results show that the average background noise in hospitals should not be more than 35 decibels, which is the minimum established by the World Health Organization. The level of noise in both critical care units of hospitals is more than this requirement. Finally, they advise that different programs, including staff training and alteration of the design of the ECU sections, should be taken into consideration during construction. The largest quantity of noise throughout the night should also be less than 40 dB (11). Omer Nekati Devologlu and several colleagues did research at the hospital polyclinics of Istanbul, Turkey, for a paper by Erdoan Goltkin (2013) titled "Noise Pollution." The findings demonstrated that Polyclinic No. 3's maximum average sound level did not statistically differ considerably from those of other facilities. Finally, yet importantly, all metrics exceeded the benchmark set by the World Health Organization (9). Generally, exposure to loud noise at work can have negative impacts, such as elevated blood pressure, poor job performance, sleep issues, anxiety and tension, and lastly, diminished hearing in people (12-13). Cortisol performs some functions in the body, including lowering immunological responses, decreasing inflammation, affecting metabolism, and raising blood sugar levels. When there is stress, inflammation, or a drop in blood glucocorticoid levels, this hormone is secreted. Corticotropin-releasing hormone, which is released from the brain and stimulates the pituitary gland to secrete more adrenocorticotropin hormone, controls its production. This hormone increases the release of cortisol. The body naturally produces this hormone, with morning levels being the greatest and evening levels being the lowest. Cortisol, often known as the stress hormone, is generated in large quantities by the body in reaction to stress and is in charge of various physiological changes linked to stress. Cortisol deficiency results in general symptoms such as weight loss, muscular weakness, exhaustion, low blood pressure, and abdominal discomfort. Sometimes a stressor combined with a production decline might result in an adrenal crisis that needs rapid medical intervention. Excessive cortisol levels can result in osteoporosis, high blood sugar, obesity, fragile skin, purple veins on the belly, and high blood pressure. Women may experience irregular menstrual cycles and a rise in facial hair, while kids may experience slow development and small height (14). In the present study, the impacts of noise on the overall health status of hospital staff members were assessed following the aforementioned contents.

Materials and methods

In 2014, a field survey and laboratory investigation were done for this fundamental and semi-experimental study. There were two phases to this scientific investigation. The first stage involved a preliminary visit to various departments and locations inside a few chosen academic and non-academic hospitals, measuring the sound pressure level there, as well as determining the corresponding degree of sound exposure and sound effect index for each hospital location. At the beginning of the work shift (before noise exposure) and after the work shift (after noise exposure), the employees who were chosen for the research had their blood pressure, heart rates, percentages of blood oxygen content, and saliva samples taken (after noise exposure). The 28-question Goldberg and William questionnaire was then used to assess the research participants' overall health state to identify any further impacts of noise on them (such as headaches, tension, excitement, sleep issues, etc.). Employees of Abuzar and Amirul Munin hospitals in Ahvaz made up the statistical population of the study. Seventy-five of them (46 from Amirul Mominin hospital and 29 from Abuzar hospital) were included in the study based on the Cochran formula and had given their agreement to participate. The research volunteers were not allowed to have hearing issues, headaches, head surgery, mental shock (within the past six months), heart, vascular, or diabetic issues, or to have less than one year of hospital job experience. In addition, individuals had the option of leaving the study at any time during its course. To determine the current sound pressure level, the sources of sound production, and the corresponding level of sound exposure and sound effect index among the staff of various departments of chosen hospitals, sound measurements were made in various locations across the study areas. For the aforementioned measurement, the stationing approach was employed. This approach divides the workshop (referring to the ward or unit of the hospital) into grid sections of the same size, and the center of each home was assessed by a station using a CEL-231 sound meter. The more houses there are, the more desired it is to have a better outcome (15). They average the various sound levels that the person is exposed to during the work shift to assess their exposure to noise as well as other harmful elements in the workplace. To do this, the worker's equivalent exposure level over a given time—the time equation of balances—is first computed using the level of each exposure time and the exposure time associated with that level. This equation looks like this (15):

$$\overline{LP} = 10 \text{ Log}\left[\frac{1}{n} \times \sum_{i=1}^{n} 10^{\frac{LP_i}{10}} \right] \quad (1)$$

The number of persons exposed to noise in the aforementioned study must be taken into account to establish the negative effects of noise on humans. This index's value is generated using the link between the data weighting factor and the number of persons at risk of noise, and the amount of damage caused by sound, as computed for the population under study and then compared to the standard table (16).

NII= SLWP/P total (2)

where P is the total number of individuals exposed, and W is the extent of sound damage as determined by the sound intensity.

Diagnostic kits with the brand name Cobas produced in France are used to examine and extract cortisol from the saliva samples of research participants. Blood pressure, heart rate, and oxygen saturation of subjects were measured using the Echomax A sphygmomanometer model HB2000, following the guidelines of (17) (18). A typical 28-question questionnaire was used to assess the general health state of the research participants. In 1972, Goldberg developed the GHQ General Health Questionnaire, which soon gained popularity as the most used instrument for assessing non-psychiatric patients. The GHQ general health questionnaire was developed in many versions over the ensuing years, including the 60-item, 30-item, 28-item, and 12-item versions. Of these versions, the 28-item version contains more questions and has better psychometric features, as a result, it is used more frequently than the other version. Goldberg and Hillier developed the 28-item version of this questionnaire in 1989; it comprises 28 items and 4 subscales (19). There are 28 items in the General Health Questionnaire (GHQ), and each one is graded from 0 to 3. Finally, the person's overall score will range from 0 to 84. A person's mental health is inversely correlated with their score; the greater the score, the worse their mental health is. This questionnaire's subscales include:

Physical symptoms subscale: questions 1-7

Anxiety and insomnia subscale: questions 8-14

Social functioning disorder subscale: questions 15-21

Depressive symptoms subscale: questions 22-28

After getting the scores, the person can be placed in four classes:

Without symptoms or the minimum level: score 0-6 in the subscales and score 0-22 in the total score.

Mild symptoms score 7-11 in the subscales and score 23- 40 in the total score.

Mean symptoms: score 12-16 in the subscales and score 41-60 in the total score.

Severe or pathological symptoms: score 17-21 in the sub-scales and score 61-84 in the total score.

Severe or pathological symptoms: score 17-21 in the sub-scales and score 61-84 in the total score (19).

The information collected from this study was analyzed using central tendency indexes like mean. The gender of the patients under study and their overall health were compared using the Chi-square test.

The level (p=0.00) to (p=0.36) was used for significance in the statistical tests carried out for this study, and (p=0.67) was used for non-significance.

Findings

75 individuals, with an average age of 32, participated in the experiment as a whole (Table 1)

Table 1. The demographic features of the participants

Gender	Frequency	Percentage	Valid frequency	Cumulative percentage
female	53	70.7	7.70	7.70
Male	22	29.3	3.29	100
Total	75	100.0	100	

				Hospital of service
3.61	3.61	61.3	46	Amirul Momineen
100	7.38	38.7	29	Abouzar
	100	100	75	Total

Table 2 displays data on people's blood pressure, heart rates, and oxygen saturation levels.

Table 2. The descriptive statistics of blood pressure, heart rate, and blood oxygen percentage of people

Descriptive statistics					
Variable type	Number	Minimum	Maximum	Mean	SD
Maximum blood pressure mmHg	75	110	145	49.124	750.7
Minimum blood pressure (minimum) mmHg	75	70	90	57.79	110.5
heart rate (number)	75	69	127	43.86	530.11
Blood oxygen percentage	75	95	99	33.97	920
Valid number	75				

The sound levels in various departments of the hospitals under study were measured in the subsequent section, and the equivalent level of sound exposure and the sound effect index for each department of the hospitals were independently determined (Table 3).

Table 3. The descriptive statistics of sound pressure level, equivalent exposure level, and sound effect index in different departments of Amirul Mominin (AS) and Abuzar Ahvaz non-teaching hospitals

Variable type	Number	Minimum	Maximum	Mean	SD
Amirul Momenin Hospital					
Sound pressure level	24	8.67	3.95	75.231	6.0642
Equivalent exposure balance	24	67.2	92.7	74.746	6.0682
Sound effect index	24	54	31.2	42.6	5.4529
Valid numbers	24				
Abouzar Hospital					
Sound pressure level	14	9.66	86.8	76.907	5.5849
Equivalent exposure balance	14	3.66	86.2	76.607	5.5849
Sound effect index	14	0.54	31.2	1807.1	
Validated numbers	14				

Using a reliable 28-question public health questionnaire, the results of various impacts of noise on the study subjects—such as headache, sleep difficulties, tension, excitement, and confusion—are displayed in figure 1.

Results of survey analys

Frequency

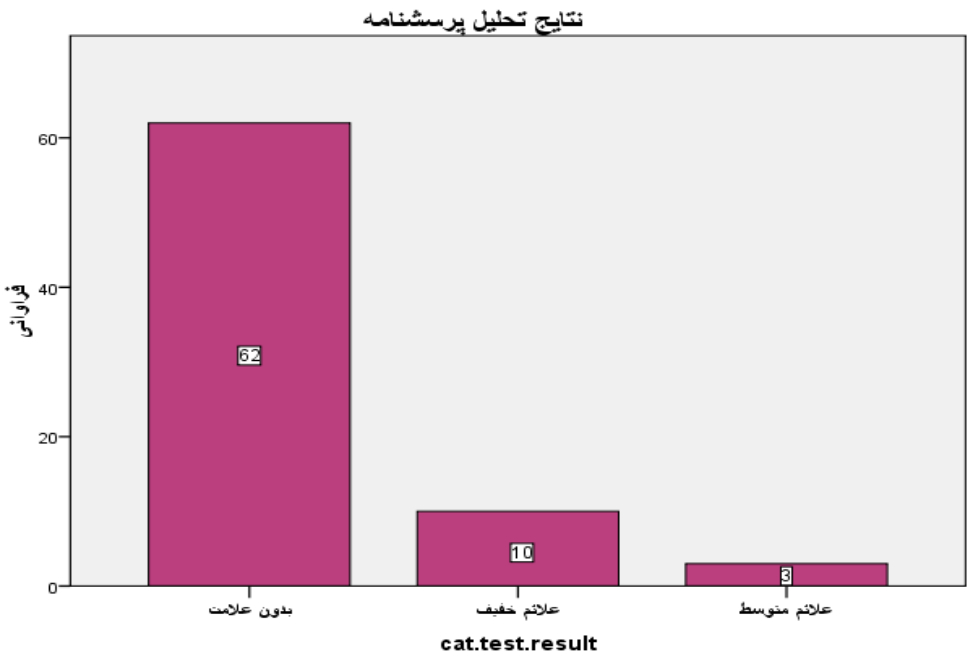

Figure 1. Frequency percentage of symptoms related to the general health of employees

Table 4. The relationship between gender and its effect on the general health of the studied people

	Analysis of test results			
Total	No symptom	Mild symptoms	Average symptoms	Gender
53	43	7	3	Female
70.7%	57.3%	9.3%	4%	Total
22	19	3	0	Male
29.3%	25.3%	4%	0%	Total
75	62	10	3	Total sum
100%	82.7%	13.3%	4%	

Table 5. The significant relationship between the amounts of cortisol secreted at the beginning and end of the shift

Shift								
At the beginning of the shift	Mean	SD	Standard deviation error	Confidence factor of 95%		T-test	Degree of freedom	Significance
				Maximum	Minimum			
	0.83107	124743	0.14404	0.54406	111807	5.770	74	0.00
Shift								
Shift ending	Mean	SD	Standard deviation error	Confidence factor of 95%		T-test	Degree of freedom	Significance
				Maximum	Minimum			
	0.44853	0.95154	0.10987	0.22690	0.66746	4.082	74	0.000

Table 6. The summary of the results of 4 tests performed in the states of cortisol concentration before and after exposure to noise

	The mean in full state	The mean in the state of hunger	95%confidence interval of the difference	p- paired test

Cortisol concentration before noise exposure	0.34	0.26	0.05-0.11	0.00
Cortisol concentration after noise exposure	0.33	0021	0.15-0.09	0.00

Discussion

This study aims to investigate how noise affects hospital staff members' overall health. In this study, noise measurements were made in various areas and departments of the 24 and 14 departments, respectively, of the Amirul Momineen (AS) and Abuzar hospitals in Ahvaz to compute the equivalent sound level (Leq), sound effect index (Nii), and sound pressure level (LP). It was discovered that due to the high volume of clients, numerous conversations between clients and employees, restlessness, and cries of the injured and patients, units such as the engine house facility and the waste disposal system, in which industrial devices and equipment are used, as well as other units such as the emergency room and children's departments. The sound pressure level and sound effect index are greater in this area of the hospital (owing to pain), as are the sounds produced by the ventilation and air exchange systems, hospital loudspeakers, and the hospital's audio system. The emergency room had the greatest sound pressure level according to research by Karmi et al. titled "Sound Pollution in Golestan Ahvaz and Fatemeh Zahra (S) Bushehr Hospitals," with discussions, ventilation systems, and the usage of different medical devices being the main reasons. It is congruent with our findings in this regard (40). The findings of another study by Pour Sadeghi et al., which was undertaken to examine noise pollution in two particular Mashhad hospitals, are in agreement with those of our study (20). The employees of the two hospitals mentioned above who were exposed to noise had their blood pressure (minimum and maximum), heart rate, and percentage of blood oxygen concentration measured. It was found that noise can alter the amounts of the factors mentioned, and 75 people were chosen to continue the study. Generally, the cardiovascular and respiratory systems are directly impacted by noise. Salami Elsonkafi's study in Nigeria had the heading (contact with noise as the main factor in increasing the blood pressure of employees of a sock weaving industry). It has been demonstrated that noise exposure alters both systole (the greatest pressure) and diastole (the lowest pressure) blood pressure (21). Additionally, Shahid Mohammad and colleagues' study (Effect of sound levels in the hospital environment on patients and clients of Faisalabad Hospital in Pakistan) found that exposure to noise at various times has a direct impact on subjects' blood pressure (systole and diastole), heart rate, and percentage of blood oxygen concentration (22), which was compared with the findings in this study. It demonstrates how well the outcomes of the two investigations agreed. As a result, exposure to sound is recognized as a powerful factor in raising blood pressure, heart rate, and the percentage of blood that is oxygenated. The respondents in the other half of the research were assessed using Goldberg's 28-question general health questionnaire to examine various detrimental consequences of noise, such as headache, sleep disruption, tension and excitement, depression, etc. Only 62 of the 75 participants who answered the questionnaire showed any symptoms, while 10 had minor ones and 3 had moderate ones. The findings showed that two of the individuals with moderate symptoms were working in the emergency rooms and facilities, which are the areas of the hospitals under study with the most sound impacts. Additionally, the results of this questionnaire's research showed that the gender of the study respondents had no bearing on their general state of health. In other words, the gender difference in the research subjects' response to noise is not statistically significant (p=0.39). In a research titled "Investigation of the influence of wind turbine noise on the general health of wind farm workers," Abbasi et al. found that all indicators of general health, except for sadness, are significantly correlated with sound equivalent level (23). From the standpoint that two of the patients in our research with mild symptoms work in facilities and emergency rooms, which had the loudest noise levels in other sections of the hospital. The findings of a study by Zamanian et al. entitled "Effects of exposure to noise in the work environment on the general health of steel industry employees"(24) show a direct and meaningful relationship between contact with noise and some employees' general health status in the aforementioned industry, which is consistent with the findings of our study.

Conclusion

The results show that the direct impact of noise on employees was demonstrated by raising the sound pressure level in various hospitals under study, both in terms of public health and in terms of the sound effect index on the employees chosen for the study. Additionally, the kind of hospital where workers are employed has a sizable impact on cortisol release and naturally the rise in stress, which may be decreased by taking environmental care and controls into account. Based on the studies conducted, it is possible to conclude that exposure to noise, particularly in areas with more intense noise pollution, can cause stress in workers. This stress is caused by the effect of noise due to increased cortisol secretion, which can be reduced by implementing management and engineering controls. Extensive study has been done on the subject due to the significance of limiting the negative effects of noise on

employees in industries and other professional settings, particularly in minimizing the emergence of stress induced by the influence of noise. The researcher in this study evaluated the following recommendations to reduce the negative impacts of noise on workers:

• Regularly assessing the level of noise in every area of the hospital and recording the findings

• Monitoring employee general health as well as evaluating the physical and mental health state, including yearly audiometry for those at risk.

• Using enclosures, sound insulation, and other techniques to lessen the effects of noise in the workplace...

• Implementing training initiatives to help hospital staff members manage their stress at work

• Providing suitable personal protection tools, such as shielded phones, to lessen the negative impacts of noise on individuals.

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Conflict of interest

None.

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Ethics statement

None

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