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Original

The Relationship between the Environmental Noise Intensity, Feeling and Annoyance with the Shiftwork in the Emergency Department

Farhanaz Khajeh Nasiri [1], ZahraSadat Mousavi Fard [2*]

1 Department of Social Medicine, Faculty of Medicine, Tehran University of Medical Sciences, Tehran, Iran• 2 Department of Occupational Health Engineering, Faculty of Medical Sciences, Tarbiat Modares University, Tehran, Iran• Corresponding Author: ZahraSadat Mousavi Fard, Email: mossavizahra@modares.ac.ir

ABSTRACT

Background: Noise pollution is a serious issue in hospitals, especially in emergency departments where high noise levels from emergency patients and treatments can negatively affect medical personnel and patients. This study aimed to measure noise levels during day and night shifts in three major hospitals affiliated with Tehran University of Medical Sciences (Imam Khomeini, Shariati, and Sina hospitals) and investigate the level of annoyance experienced by medical staff. **Methods:** In this cross-sectional studyTES-1351B sound level meter was used to measure sound pressure levels and the measurement stations were determined according to ISO 9612 standard. A general questionnaire was used to determine demographic characteristics. Also, by a valid self-reporting questionnaire, the feeling about environmental noise intensity and noise annoyance was measured. Statistical analysis was done by SPSS software using ANOVA and t-test. **Results:** The average sound pressure level in the emergency departments of the studied hospitals was 67.940±7.70 dB. Significant differences were found between morning and evening shift noise levels. (p-value=0.001). The highest average sound pressure level occurred during the evening shift with an average of 72.382±4.35 db. Also, there was a significant difference between the feeling about environmental noise intensity and noise annoyance in Imam Khomeini and Sinai hospitals respectively, (p-value=0.037) (p-value=0.011). **Conclusion:** The study concludes that noise pollution in the emergency departments of these hospitals needs attention. Implementing administrative and technical-engineering measures to reduce noise pollution is essential to enhance the well-being of medical staff and patients and ensure a more satisfactory healthcare environment.

Keywords: Noise; Annoyance; Emergency department; Shift Work Schedule

Introduction

Noise is an undesirable sound without harmony and rhythm. Noise pollution is defined as a level of environmental noise that causes annoyance and disturbance.[1] The perception of noise may be affected by individual sensitivities.[2] The results of studies showed that the level of noise pollution in hospitals, even with improvements technology in hospital equipment is increasing and is a threatening factor for the health of patients and employees.[3-6] Hospitals are noisy environments due to the sound of employees' conversations, the movement of visitors, the sound of

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device alarms, and the ringing of telephones.[5] In this environment, sound is one of hazard factor that effects on the well-being employees. Increasing noise slows down the productivity of professionals and increases the occurrence of medical errors.[7-9] In the results of past studies, it has been reported that the increase in the feeling of stress and exhaustion caused by work place noise.[10] A study by Blomkvist and colleagues examined the effects of noise levels on a group of coronary intensive care nurses over a period of several months. The results of the study showed that in the group that was exposed to a lower noise level compared to the group that was exposed to a higher noise level, there was an improvement in the quality of patient care, and better interactions with patients.[11] Several studies of environmental noise measurements in hospitals conducted worldwide have reported noise levels exceeding the value recommended for a healthy environment.[12,13] The United States Environmental Protection Agency (USEPA) recommends day and night noise levels below Leq 45 and 35 dB (A), respectively.[14] the sound of more than 40 decibels leads to stress, excessive fatigue, and impaired communication skills.[7] Also, a positive relationship between loud noise and dysfunction of health care workers in the operating room (inefficient communication, reduced speech understanding, poor performance of complex tasks, poor cognitive performance and concentration, stress, fatigue and anxiety) has also been reported.[15,16] Nursing staff generally agree that exposure to excessive noise may lead to psychological phenomena. A number of studies have investigated the relationship between noise and mental health.[17] A large study in Brazil that interviewed more than 60,000 people found that occupational noise was associated with a higher risk of major depressive disorder in women.[17]In this way, noise in the hospital environment can cause harmful effects to hospital staff, such as fatigue, irritability, auditory symptoms and functional interference, which can create risks of work errors.[18] Hospital emergency room is one of the most important and busy parts of hospitals. The existence of noise pollution in these parts where emergency patients or medical procedures, especially the special care department, has destructive effects.[19] Many researchers have studied the effects of noise on patients have reviewed,[20] but relatively few studies are available for staff in the hospital emergency department. Therefore, the purpose of this study is to measure the amount of noise produced during two shifts, day and evening, in the emergency department of three major hospitals of Tehran University of Medical Sciences (Imam Khomeini, Shariati and Sina hospitals) and also to investigate the level of annoyance caused by noise in the medical staff of this unit.

Methods

This cross-sectional (descriptive-analytical) study was conducted in the summer of 1401 in the emergency department of three hospitals of Tehran University of Medical Sciences (Imam Khomeini, Sina and Shariati). Sound pressure level was measured using TES-1351B sound level meter made by TES company at both maximum (Lmax) and minimum (Lmin) levels, with A-weighted network. The common unit of sound measurement is the decibel (dB), which is a measure of the energy in noise relative to the minimum amount of average energy that humans can detect. In this research, the sound measurement was measured in A-weighting (dBA) to better simulate the human ear's perception of loudness, which is well used for a wide range of average noise levels. The sound measurement station in the emergency room was determined according to ISO 9612. In this measurement, an acoustic calibrator was used to calibrate the sound meter.

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Figure 1. The level of the feeling about environmental noise intensity at work environment.[22,23]

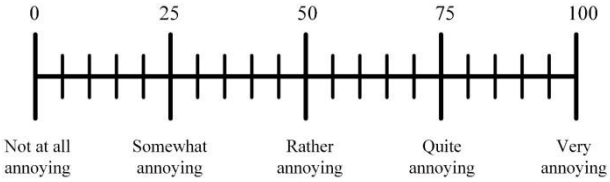

Figure 2. Measure of work environment noise annoyance.[24]

The device was installed on a stand at a height of 1.5 meters from the ground and at a distance of 1 meter from the walls, and to eliminate the effect of air flow and wind, sponge protection was used on the surface of the microphone. Sound parameters were measured from 8 to 10 o'clock during the day shift and from 20 to 22 o'clock during the evening shift with 3 repetitions at each station. Also, a demographic information questionnaire and a self-report questionnaire were distributed to assess noise annoyance. The validity and reliability of this questionnaire was checked by Farhang and his colleagues in 2013 and its Cronbach's alpha coefficient was reported as 0.81.[21]

This questionnaire consists of three sub-tests.

In the first sub-test, which examined the feeling about environmental noise intensity. The subjects were asked to assign a score from 0 to 10 to the intensity of the sound in their surroundings (according to Figure 1).

In the second sub-test, the personnel were asked to give a score from 0 to 100 to the degree of annoying noise in their work environment (according to Figure 2).

And in the third subtest (**never-rarely, sometimes and often-always)**, the personnel were asked to express their feelings about the noise in the workplace (based on the questionnaire Emotions associated with sound exposure).[24]

This research was approved by the Ethics Committee of the University of Medical Sciences with the code IR.TUMS.MEDICINE.REC.1401.158.

Results

In this cross-sectional (descriptive-analytical) study to investigate noise annoyance in the emergency department of academic hospitals, 64 personnel working in the hospitals of Tehran University of Medical Sciences were investigated. Using the Kolmogorov-Smirnov test, the normality of the data was checked and then normal data tests were used. Gender distribution in the research population of emergency medical staff was 50% male and 50% female. The status of the job category included 62% of doctors, 28% of nurses, and 10% of nurse assistants. The mean and standard deviation of age in the research population were 30.84 ± 5.60 and 48.4% were married. 54.7% of the work shift was in the evening and 45.3% in the morning, according to this issue, the survey was done in the same work shift of the workers (evening and morning).

The results of measuring the level of noise exposure in the studied hospitals are presented in Table 1. Based on the results, the average noise level in all hospitals is higher than the permissible limits (45 dB during the day and 35 dB at evening).[14]

There was no significant difference between the average environmental sound level in the studied hospitals.

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Table 1. Level of environmental noise in the emergency department of studied hospitals

Hospital	Mean (standard deviation) (dB)	P-value*
Imam Khomeini	۶۸/۵۸ (۰/۶۷)	۰/۲۷
Shariati	(1.74)٦٨,٧٥	
Sina	٦٥,٩ (١/٠١)	

*ANOVA, P-value<0.05

Table 2. The results of feeling about environmental noise intensityamong the studied hospitals

People's feelings		Hospitals		
		Shariati	Sina	Imam Khomeini
Feeling exhausted	never-rarely	%75	%54.54	%59.09
	sometimes	%0	%0	%4.54
	often-always	%25	%45.45	%36.36
Lethargy and sleepiness	never-rarely	%100	%100	%72.72
	sometimes	%0	%0	%22.27
	often-always	%0	%0	%4.54
Dizziness	never-rarely	%100	%90.90	%90.90
	sometimes	%0	%9.09	%4.54
	often-always	%0	%0	%4.54
Reduced concentration power	never-rarely	%100	%81.81	%68.18
	sometimes	%0	%9.09	%4.54
	often-always	%0	%9.09	%27.27
Headache	never-rarely	%40	%50	%54.54
	sometimes	%0	%9.09	%0
	often-always	%60	%40.09	%45.45
Sadness	never-rarely	%100	%86.36	%31.8
	sometimes	%0	%13.6	%45.45
	often-always	%0	%0	%22.72

Table 3. Mean intensity of noise in different shifts

Shift	Mean (standard deviation) (dB)	*P-value
Morning	61.47(7.97)	0.001
Evening	72.38(4.35)	

T-TEST, PV<0.05

Based on the results, the overall average sound pressure level in the studied hospitals was 67.940±7.70 dB. In Table 2, the percentage of personnel's feelings about workplace noise is presented. Based on these results, feeling exhausted and headache were the most common complaints.

In Table 3, the results related to the overall average sound pressure level in two shifts (morning and evening) are presented separately. there was a significant difference between average sound pressure level in morning with evening shift. The highest average sound pressure level is related to the evening shift. Also, there was a significant difference between mean score of feeling about environmental noise intensity and annoyance of noise in the emergency environment of hospitals.

The average score of feeling about environmental noise intensity (scale that was showed as Figure1) and noise annoyance (scale that was showed as Figure2) is presented in Table 4. Based on the results, there was a significant difference between the average score of feeling about environmental noise intensity and noise annoyance among three studied hospitals. And according to the POST HOC test, there was a significant difference between the feeling (p value=0.031) and noise annoyance (p value =0.008). between Imam Khomeini and Sinai Hospitals.

There was no difference between feeling about environmental noise intensity and noise annoyance in both groups of men and women(Figure 3).

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Table 4. The Mean score of feeling about environmental noise intensity and annoyance of noise in the emergency environment of hospitals

Emotions and complaints	Hospital	Mean (standard deviation) score	p-value*
Feeling about environmental noise intensity	Imam Khomeini Sina Shariati	7.50(2.52) 5.59(2.175) 6.25(2.59)	0.03
Noise annoyance	Imam Khomeini Sina Shariati	59.09(31.38) 34.09 (18.68) 46.25(28.41)	0.01

ANOVA, PV<0.05

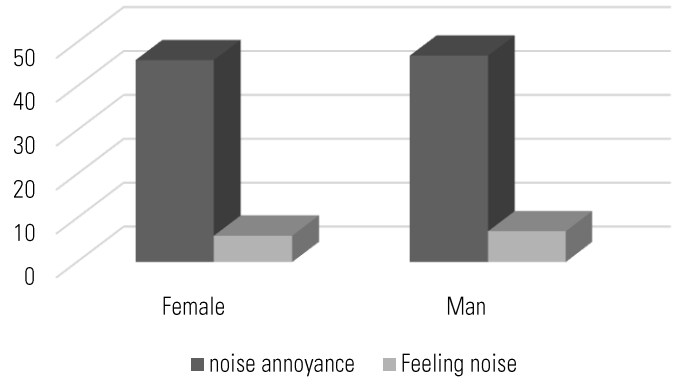

Figure 3. The mean score of noise annoyance and feeling of its intensity in women and men

Table 5. The level of intensity and annoyance of noise in the emergency room of hospitals according to the staff's work shift

	Shift	Number of persons	Mean (standard deviation) score	*p-value
Noise Annoyance	The Evening The morning	35 29	42.14 (4.44) 51.72(5.53)	0.17
Feeling about environmental noise intensity	The Evening The morning	35 29	6.40(0.38) 6.52(0.53)	0.85

*T-TEST, PV<0.05

There was no significant difference between the noise annoyance and the feeling of its intensity between The Evening and the morning shift personnel (Table 5).

Discussion

Noise pollution in different parts of hospitals, as the most common source of environmental stress, has psychological and physiological destructive effects on medical personnel, so this study was conducted with the aim of determining the amount of noise in the work environment and the annoyance caused by it in three hospitals of Tehran University of Medical Sciences in the summer of 2022. The average sound pressure level in all three investigated hospitals was higher than the permissible limits. And there was no significant difference between the average sound pressure levels in the three investigated hospitals. In the study of Nowrozi et al.[25]], the average sound pressure level in the emergency department of the hospital on working days was reported to be 67.85 decibels and was higher than the WHO(World Health Organization) standards. Also, in the study of Ivazadeh et al., among the investigated departments in the hospital, the highest Ambient noise related to the emergency department (69.65 dB) was reported.[26] In the study of Short et al.[27]], the average noise in the emergency room was

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reported between 55.8-64 dB, which is beyond the recommended limit. The results of the present study were consistent with the results of previous studies. Based on the results of the present study, the overall noise level in all studied hospitals was significantly higher in the evening shift than in the morning shift. Short et al.'s study reported that the average sound level of hospitals was the highest in the evening shift, which was even 90 decibels in some places momentarily,[27] the results of this study were consistent with the results of the present study.

There was a significant difference in the feeling about environmental noise intensity in the three studied hospitals. In this way, in Imam Khomeini Hospital, the personnel with an average score of 7.50 experience environmental noise more than in Sinai Hospital with an average score of 5.59. Also, there was a significant difference in the score of noise annoyance among the personnel among the studied hospitals. The score of noise annoyance in Imam Khomeini Hospital (59.09) was more than Sinai Hospital (34.09) and among the complaints, headache complaint with 45.45% and feeling tired with 36.36% were the most frequent.In three investigated hospitals, the level of sound intensity was higher than the standard, and in all three hospitals, more than 25% of the investigated population reported feeling tired. In the study of Passes et al.[28]], it was also found that the more the perception of noise in the environment, the more complaints such as discomfort, bad mood, fatigue, effect on efficiency, headache, stress, irritability, nervousness, change in Productivity and eye pressure will be higher, which is consistent with the results of this study.

In the study of Gong et al.[29], it shows a significant correlation between high noise nuisance and public health. Also, according to a study by Amoatey et al.[30], 72.5% of the medical staff complained about the noise level of the hospital environment. and 70% of them reported noise as the main factor of distraction during work. According to the study of Amoatey et al.[30], only 49.3% of the cause of noise pollution in the emergency room is related to human noise, telephone ringing with 42% and the operation of medical equipment with 40.6%, can affect the noise pollution in the hospital environment, which should be To be considered in controlling the sound of the hospital environment.

Conclusion

According to the results of the sound pressure level in the emergency room of Imam Khomeini, Sina and Shariati hospitals, it was more than the permissible limit in most places. Also, it caused more annoyance in evening shift. Therefore, it is necessary to plan and adopt administrative and technical-engineering measures to reduce the amount of noise pollution to the permissible limits of the standard.

Among the suggestions that can be given include:

- A medical equipment engineer should be appointed for periodic inspection of hospital equipment. Noisy equipment and beds should be repaired and rubber pads and shields should be used to reduce noise caused by vibration.
- By using different methods such as using plastic trays and bowls as well as using softer paper or cloth for packing medical devices and equipment, the sound level can be significantly reduced.
- At the construction stage, materials for insulating the surfaces against sound should be used.
- In order to improve and improve the mental health status of emergency medical staff, it is possible to suggest the use of proper nutrition, sports facilities and proper rest in the hospital.
- Education through the national media to the public, as well as special education to the hospital staff about the adverse effects of noise on human health and installing educational posters in the hospital environment, in order to observe silence and reduce noise, can be suggested as one of the important factors in reducing noise.

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Conflict of interests

The authors declare that there is not any conflict of interests regarding the publication of this manuscript.

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Authors Contribution

Research design: M and KH.

Data collection: M.

Data analysis: KH.

Writing and editing the article: KH and M.

References

1. Khademi G, Imani B. Noise pollution in intensive care units: a systematic review article. Reviews in Clinical Medicine. 2015;2(2):58-64.DOI: 10.17463/RCM.2015.02.002
2. Al-Tarawneh OM, D'emeh WM, Yacoub MI. An assessment of nurses' knowledge regarding noise in intensive care units in Jordan. International Journal of Africa Nursing Sciences. 2020;12:100183. DOI:10.1016/j.ijans.2019.100183
3. Horsten S, Reinke L, Absalom A, Tulleken J. Systematic review of the effects of intensive-care-unit noise on sleep of healthy subjects and the critically ill. British journal of anaesthesia. 2018;120(3):443-52. DOI: 10.1016/j.bja.2017.09.006
4. de Lima Andrade E, da Cunha e Silva DC, de Lima EA, de Oliveira RA, Zannin PHT, Martins ACG. Environmental noise in hospitals: a systematic review. Environmental Science and Pollution Research. 2021;28(16):19629-42. DOI:10.1007/s11356-021-13211-2
5. Abbasi M. Increasing Hospital Noise Levels: a Worldwide Challenge. Archives of Occupational Health. 2022;6(1):1148-9. DOI: 10.18502/aoh.v6i1.8662
6. Busch-Vishniac I, Ryherd E. Hospital soundscapes: characterization, impacts, and interventions. Acoust Today 15: 11. 2019. DOI: 10.1121/AT.2019.15.3.11
7. Khademi G, Roudi M, Farhat AS, Shahabian M. Noise pollution in intensive care units and emergency wards. Iranian journal of otorhinolaryngology. 2011;23(65):141.
8. Farhangi P, Khajehnasiri F. The Prevalence of Depression, Anxiety, and Stress Among Medical Residents: A Cross-Sectional Study in Iran. Acta Medica Iranica. 2020 Nov 19:452-5. DOI:10.18502/acta.v58i9.4767
9. Loupa G. Influence of noise on patient recovery. Current Pollution Reports. 2020;6(1):1- DOI:10.1007/s40726-019-00134-3
10. Joseph A, Ulrich R. Sound control for improved outcomes in healthcare settings. Concord, CA: The Center for Health Design; 2007. Google Scholar. 2010.
11. Cole J, Blomkvist V, Ulrich RS. Impact of acoustics on staff and patients in CCU. Hospital Development. 2005;36:19-22.
12. Zannin PHT, Ferraz F. Assessment of indoor and outdoor noise pollution at a university hospital based on acoustic measurements and noise mapping. Open Journal of Acoustics. 2016;6(4):71-85. DOI:10.4236/oja.2016.64006.
13. Montes-González D, Barrigón-Morillas JM, Gómez Escobar V, Vílchez-Gómez R, Rey-Gozalo G, Atanasio-Moraga P, et al. Environmental noise around hospital areas: A case study. Environments. 2019;6(4):41. DOI:10.3390/environments6040041
14. Abatement USOoN. Information on levels of environmental noise requisite to protect public health and welfare with an adequate margin of safety: US Government Printing Office; 1974.
15. McNeer RR, Bennett CL, Dudaryk R. Intraoperative noise increases perceived task load and fatigue in anesthesiology residents: a simulation-based study. Anesthesia & Analgesia. 2016;122(2):512-25. . DOI: 10.1213/ANE.0000000000001067
16. Keller S, Tschan F, Beldi G, Kurmann A, Candinas D, Semmer NK. Noise peaks influence communication in the operating room. An observational study. Ergonomics. 2016;59(12):1541-52. DOI: 10.1080/00140139.2016.1159736
17. McCullagh M, Xu J, Dickson VV, Tan A, Lusk S. Noise Exposure and Quality of Life Among Nurses. Workplace Health & Safety. 2022;70(4):207-19. DOI:10.1177/21650799211044365
18. Daraiseh NM, Hoying CL, Vidonish WP, Lin L, Wagner M. Noise exposure on pediatric inpatient units. The Journal of Nursing Administration. 2016;46(9):468-76. DOI:10.1097/ nna. 0000000000000377
19. Rabiyan M, Gharib M. Noise pollution in the oprating rooms and intensive care units. 2004.
20. Helton MC, Gordon SH, Nunnery SL. The correlation between sleep deprivation and the intensive care unit syndrome. Heart & lung: the journal of critical care. 1980;9(3):464-8.
21. Prüss-Üstün A, Wolf J, Corvalán C, Bos R, Neira M. Preventing disease through healthy environments: a global assessment of the burden of disease from environmental risks: World Health Organization; 2016.
22. Babisch W, Houthuijs D, Pershagen G, Cadum E, Katsouyanni K, Velonakis M, et al. Annoyance due to aircraft noise has increased over the years—Results of the HYENA study. Environment international. 2009;35(8):1169-76. DOI: 10.1016/ j.envint.2009.07. 012
23. ISO I. TS 15666 acoustics—assessment of noise annoyance by means of social and socio-acoustic surveys. Geneva: International Organization for Standardization. 2003.
24. Pawlaczyk-łuszczyńska M, Dudarewicz A, Waszkowska M, Szymczak W, Kameduła M, Śliwińska-Kowalska M. Does low frequency noise at modarate levels influence human mental performance? Journal of low frequency noise, vibration and active control. 2005;24(1):25-42. DOI: 10.1260/0263092054037711

[Downloaded from aoh.ssu.ac.ir on 2025-12-09]

[DOI: 10.18502/aoh.v7i1.14290]

25. Norouzi E, Dehghan SF, Baiyatian M, Zarei A, Ghahramani E, Mahmodi A, et al. Investigation of Noise Pollution in One of the Hospitals Covered in Kurdistan University of Medical Sciences. Journal of Environmental Treatment Techniques. 2022;10(4):290-4. DOI:10.47277/JETT/10(4)294
26. Eivazzadeh M, Gholampour A, Jafarabadi MA, Moradi G. The association between noise annoyance and general health among Iranian nurses at Tabriz Pediatric Hospital. Journal of Occupational Health and Epidemiology. 2019;8(4):190-8. . DOI:10.29252/johe.8.4.190
27. Short AE, Short KT, Holdgate A, Ahern N, Morris J. Noise levels in an Australian emergency department. Australasian Emergency Nursing Journal. 2011;14(1):26-31. DOI:10. 1016/j.aenj.2010.10.005
28. Passos PS, Fiorini AC. Perception and effects of noise in employees of a university hospital. Research, Society and Development. 2022;11(2). DOI:10.33448/rsd-v11i2.25998
29. Gong X, Fenech B, Blackmore C, Chen Y, Rodgers G, Gulliver J, et al. Association between Noise annoyance and mental health outcomes: a systematic review and meta-analysis. International Journal of Environmental Research and Public Health. 2022;19(5):2696. DOI: 10.3390/ijerph19052696
30. Amoatey P, Al-Harthy I, Al-Mushaifari MA, Al-Jabri K, Al-Mamun A. Spatiotemporal Assessment Of The Effect of Indoor Noise On Annoyance, Health And Comfort In Hospital Wards And Intensive Care Unit. 2021. DOI: 10.21203/rs.3.rs-602718/v1

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