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Noise pollution and sleep disturbance among Neyshabur Hospital staff, Iran (2015)

Somayeh Rahimi Moghadam[1], Mohamad Naser Laiegh Tizabi[2], Narges Khanjani[3], Mojtaba Emkani[4], Vahid Taghavi Manesh[5], Ali Akbar Mohammadi[6,*] Mohammad Bagher Delkhosh[1], Hossein Najafi [7]

1- Instructor, Department of Occupational Health Engineering, Neyshabur University of Medical Sciences, Neyshabur, Iran.
2- MSc of Occupational Health Engineering, Department of Occupational Health Engineering, Neyshabur University of Medical Sciences, Neyshabur, Iran.
3- Associate Prof., Environmental Health Engineering Research Center, Kerman University of Medical Sciences, Kerman, Iran.
4- MSc in Occupational Health Engineering, Department of Occupational Health Engineering, Faculty of Health, Gonabad University of Medical Sciences, Gonabad, Iran.
5- Students Research Committee, Neyshabur University of Medical Sciences, Neyshabur, Iran.
6- Instructor, Department of Environmental Health Engineering, Neyshabur University of Medical Sciences, Neyshabur. Iran.
7- Instructor, Department of Environmental Health Engineering, Torbat Heydariyeh University of Medical Sciences, Torbat Heydariyeh, Iran.

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*** Corresponding authors:**
Ali Akbar Mohammadi,
E-mail:
mohammadi.eng73@gmail.com

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Abstract

Background: Noise pollution is the third most dangerous risk factor for human health after air and water pollution. The aim of this study was to evaluate the effect of noise pollution on sleep disturbance among Neyshabur governmental teaching hospital staff, Iran, in 2015.
Materials and Methods: This cross-sectional study was conducted in winter 2015. The sample size was 261 people from 2 hospitals in Neyshabur. The instruments for data collection were a CELL440 sound meter and the Pittsburgh Sleep Quality Index (PSQI) questionnaire. Data were analyzed using SPSS software.
Results: The mean sound level in the 22-Bahman and Hakim hospitals was 35.10 ± 8.79 dB and 44.60 ± 10.02 dB, respectively. 87% of the participants had poor sleep quality and 30% had to use sleeping pills to get to sleep. In 94.6%, poor nocturnal sleep caused poor performance during the day. 69.3% of participants reported that it took more than 30 minutes for them to get to sleep. Work history and exposure to noise had an inverse association with sleep quality. For each unit increase in noise, the score of sleep quality decreased significantly by 0.6.
Conclusions: Sleep quality can affect the performance of hospital personnel and can cause human errors in prescribing and injecting medications and other therapeutic interventions. It consequently has adverse effects on the patients. Therefore, necessary measures should be taken for reducing and controlling the noise, informing the personnel, changing shiftwork patterns, and allowing people to choose shift work voluntarily.

Keywords: Noise Pollution, Sleep Disorders, Hospitals, Iran

Introduction

Noise pollution is the third most dangerous factor for human health after air and water pollution. Noise and its effects on human health and the environment is now an important research topic (1, 2). The results

have indicated that 600 million workers are exposed to occupational noise. The effects of exposure to loud noise at workplaces and other locations have been well documented. Epidemiologic studies have shown that high noise levels can damage the auditory system, reduce sensory and neural hearing, directly impact speech communication, and have adverse effects on other organs including the nervous, cardiovascular, endocrine, and blood systems (3-5). Another response of the human body to noise is the secretion of adrenaline and noradrenaline that causes changes in the heart rate and blood pressure, and consequently results in misbehavior, violence, and lack of concentration.

Sleep disturbance is another probable adverse effect of occupational noise (6-8). Sleep is one of the most basic human needs and has a significant impact on quality of life, and physical and mental health (9). Sleep causes reduced consciousness and interaction with the environment. Sleep quality affects the immune system and human health (10). Poor sleep quality is a stressor that causes the secretion of epinephrine and norepinephrine hormones that increase the heart rate, respiratory rate, blood pressure, and need for oxygen in the myocardial system and reduce renal blood flow, which exacerbates myocardial infarction (11). According to studies, 30-45% of people in the world suffer from insomnia, and 15-42% suffer from sleep disorders. Women have more sleep disturbances than men (12). The mortality rate for people who sleep more than 8:30 hours or less than 3:30 hours a day is 15% higher than those who sleep 7 hours a day (13). Sleep disorders can cause a variety of occupational problems, such as mistakes in calculating and prescribing medication, lack of proper decision making, job quitting, job dissatisfaction and non-occupational problems such as driving accidents, using hypnotic drugs and physical injuries (14).

Several factors affect the quality of sleep, among which noise is one of the most important ones. Noise is considered as an inclusive problem in most countries. The healthcare sector is one of the most important areas in human societies and has a direct relationship with human well-being and maintaining the health of the community, in which happy personnel and requires healthy and happy personnel (15). Hospitals may also be affected by noise pollution that can lead to a negative impact on the health and comfort of patients and personnel. The sources of noise pollution in hospitals are either internal sources, such as air conditioning systems, treatment equipment and the activity of the personnel, or external sources, such as urban traffic that is inevitable and rising (4). The noise pollution, in addition to other adverse effects, may also cause sleep disorders among the hospital personnel. Inappropriate sleeping, shift work, lack of appropriate equipment, encountering urgent and unpredictable situations, and noise pollution may have a number of negative effects on job performance, mental and physical health, social life, tolerance of occupational stress, and the increased probability of excessive use of different medications (16-21). In a study conducted for overnight shift workers such as hospital staff, more than 50% had sleep disorders (22).

According to the safety standards of Iran, the allowed volume of sound inside and the space around the hospital from 7 am to 10 pm should be 55 and 45 dB, respectively. Moreover, the allowable noise rate during the night from 10 pm to 7 am should be 45 dB and 35 dB, respectively (4).

In this study, in addition to measuring noise levels, the quality of sleep has been evaluated and compared among different occupational groups. Most of the previous studies have been about the hospital noise in big cities including Tehran, Mashhad, and Hamadan, Iran, and in busy hospitals. The noise levels measured in these hospitals

were above the standard levels (23,24,4). This study was conducted in a small city and in a hospital with fewer patients and staff in order to evaluate noise levels in less busy hospitals. Therefore, the aim of this study was to evaluate the effect of noise pollution on sleep disturbance among different occupational groups of Neyshabur governmental teaching hospital, Iran, in 2015.

Materials and Methods

This cross-sectional study was conducted in the winter of 2015 with the permission of officials in two governmental hospitals affiliated to Neyshabur University of Medical Sciences, Iran. In order to measure noise exposure in the hospital environment, hospital wards were divided into sections and sound measurements were done in the interior wards with a sound level meter (CELL440, UK). Measurements were done by a trained expert in each station. The sound level meter was set at slow response speed and A-weighted network. Measurements were done in both hospitals. The sound dosimeter was calibrated each time, before use. The sound measurement was performed on all days of the week, even on holidays, in the morning and afternoon shifts.

Noise measurement was performed in different wards of the hospital such as the emergency department, neonates, dialysis, men's surgery, woman's surgery because of the sensitivity of the medical procedures in these sections. According to previous studies, the probability of noise pollution was higher in these wards. After doing an initial investigation and visiting the aforementioned wards, the sketch of each ward was drawn and then the wards were gridded into two by two squares. Then, the dosimeter was placed in the middle of the randomly selected grids and noise measurements were performed.

Measuring noise was done according to the International Organization for Standardization (ISO) 9612 standard (25). According to this standard, the dosimeter was placed in the middle of each selected square and at the height of the operator's ear, which was 1.50 ± 0.75 meters and the microphone was faced toward the source of the noise. In each square, measurements were done three times and each time for 10 minutes. Logarithmically averaged values were reported as total noise levels at each station.

All workers of two active teaching hospitals affiliated to Neyshabur University of Medical Sciences (Hakim and 22-Bahman hospitals) were invited to participate in the study and eventually, 261 people participated. 109 people from Hakim hospital and 152 people from the 22-Bahman hospital from different wards and four different occupational groups of physicians, nurses, midwives and cleaning services participated in this study. The objectives of the study and the methods were explained to the participants and all consented to participate in the study.

Demographic information was collected by a demographic questionnaire. In order to gather information about sleep quality, the Pittsburgh Sleep Quality Index (PSQI) questionnaire was completed by the individuals. The excluding criteria were having serious physical and mental illness, chronic pain and chronic diseases that affect sleep; and not being able to complete the questionnaires.

PSQI questionnaire used in this study, examines the quality of sleep in the past 4 weeks. This questionnaire has 18 questions, and 7 components, which are individual mental definitions of sleep quality, latency in sleep, sleep duration, sleep efficacy (the proportion of useful sleep duration from the total time spent in bed), sleep disturbances (defined as night waking), use of sleep medications, and daytime function. Sleep quality in this questionnaire has a score between 0 and

21. The higher scores of the questionnaire reflect the better the quality of sleep. A score of 0 to 6 shows good sleep quality and a score higher than 6 shows bad sleep quality (26). Farrahi et al. also studied the psychometric properties of this questionnaire in Persian, and reported 100% sensitivity, 93% specificity, and a Cronbach's alpha of 89% (27).

Data were analyzed using SPSS software (version 20, IBM Corporation, Armonk, NY, USA) and the analysis of variance (ANOVA) and chi-square statistical tests. Data normality was checked by the Kolmogorov-Smirnov test, and because the data were distributed normal parametric tests were used. $P < 0.05$ was considered significant.

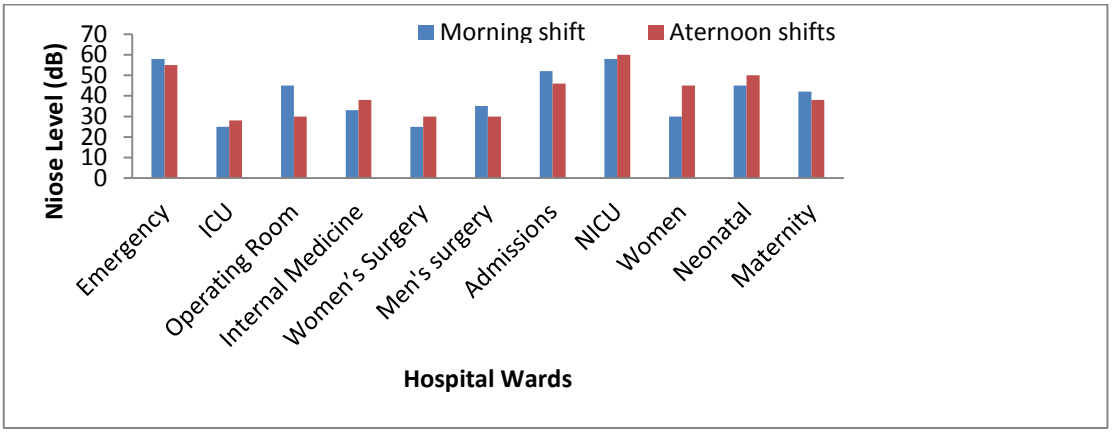

Figure 1: The average noise level in the morning and afternoon shifts, in both working days and holidays, in the Hakim hospital, Neyshabur, Iran
ICU: Intensive Care Units; NICU: Neonatal Intensive Care Unit

Results

The average noise level in different wards of the 22-Bahman hospital was 35.1 dB and the average noise level at the Hakim hospital was 44.6 dB. The results showed that in the morning and afternoon shifts, when various sections of the hospital were monitored, the highest level of sound reported was 65 dB which had been measured in the admissions section, emergency and neonatal departments. The lowest level of noise was measured in the intensive care units (ICU) section which was 15 dB (Figures 1 and 2).

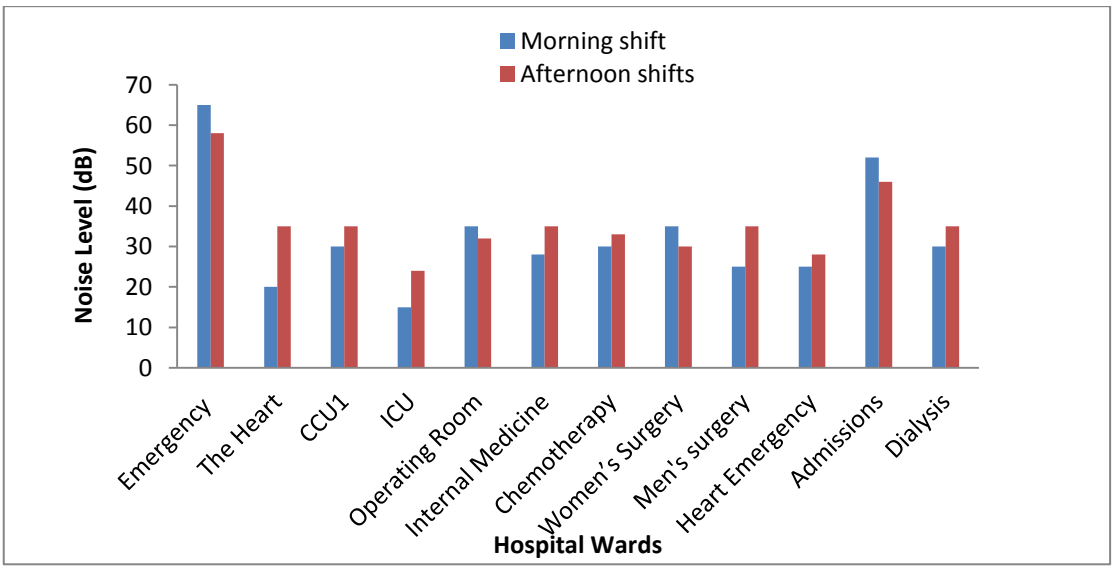

Figure 2: The average noise level in the morning and afternoon shifts in 22-Bahman Hospital, Neyshabur, Iran. CCU1: Coronary Care Unit; ICU: Intensive Care Units

The participants included 261 personnel of two hospitals affiliated to Neyshabur University of Medical Sciences, including 22 doctors (8.4%), 155 nurses (59.4%), 36 nurse aides (13.8%) and 48 cleaning staff (18.4%). 137 of the participants were women (47.5%), and 23.4 percent were single. The demographic variables are classified according to the type of job in table 1.

Table 1: Summary of the demographic variables of participants

Variable	Job			
	Cleaning staff	Nurse aide	Nurse	Doctor
	(Mean ± SD)*			
Age (year)	43.01 ± 8.13	46.56 ± 10.11	38.60 ± 7.22	45.07 ± 8.02
Height (cm)	166.00 ± 5.62	158.85 ± 9.33	166.56 ± 9.09	170.07 ± 11.64
Weight (kg)	70.92 ± 13.14	65.14 ± 7.925	66.09 ± 12.70	72.00 ± 10.70
BMI ** (kg/m^2)	26.48 ± 4.18	26.07 ± 4.79	23.82 ± 4.52	24.86 ± 3.32
Work experience (year)	12.07 ± 5.18	13.00 ± 3.82	6.63 ± 4.65	8.28 ± 5.12

***** Data are shown as mean ± standard deviation
**** BMI:** Body Mass Index

The results of this study showed that it took about 25 ± 10 minutes for the participants to go to sleep and their average wake-up time was around 7:30 in the morning, and they slept about 6.6 ± 1.1 hours. Initially, one question about sleep quality (their own opinion about their own sleep quality) was asked and in response to that 14.6% of the subjects reported poor sleep quality, 39.5% relatively poor sleep quality, 36.4% relatively good sleep quality and 9.6% good sleep quality.

Then, participants completed the PSQI questionnaire for sleep quality. According to that, 34 subjects (13%) had good sleep quality and 227 subjects (87%) had poor sleep quality.

The average total sleep quality score of the staff members in the two hospitals was 8.39 ± 1.67. The higher score in this index indicates a more severe sleep quality disorder. The sleep quality of the subjects and their relationship with some of their demographic characteristics are presented in table 2.

Table 2: Demographic characteristics and sleep quality status

Variable		Sleep quality	
		Poor	Good
		Frequency (%) *	
Job	Doctor	18 (81.80)	4 (18.20)
	Nurse	137(88.40)	18 (11.60)
	Nurse aids	29(80.60)	7(19.40)
	Services	42(87.0)	6(10.40)
BMI ** (kg/m^2)[28]	< 19	11(84.60)	2(15.40)
	19-22	27(84.40)	5(15.60)
	22-25	29(96.70)	1(3.30)
	> 25	40(76.90)	12(23.10)
Job satisfaction	Yes	(31.60)	(68.04)
	No	(76.60)	(22.40)
Marital status	Married	158(78.90)	42(21.10)
	Single	33(54.45)	28(45.55)
Sex	Man	107(86.30)	17(13.70)
	Woman	120(87.60)	17(12.40)

***** Data are shown as mean ± standard deviation
**** BMI:** Body Mass Index

Table 3: Frequency of sleep-related problems in the last month

Sleep problem	Not happened	Less than once a week	Once or twice a week	Three times or more per week
	Frequency (%) *			
Takes more than 30 minutes to go to sleep	59(22.6)	125(47.9)	58(22.2)	18(6.9)
Waking up in the middle of the night or early in the morning	43(16.5)	151(57.9)	57(21.8)	10(3.8)
Forced to get up and go to the bathroom	107(41.0)	117(44.8)	35(13.4)	2(0.8)
Inability to breathe easily	129(49.4)	97(37.2)	32(12.3)	3(1.1)
Coughing or snoring loudly	77(29.5)	120(46.0)	48(18.4)	16(6.1)
Feeling cold	30(11.5)	115(44.1)	93(35.6)	23(8.8)
Feeling hot	69(26.4)	117(44.8)	63(24.1)	12(4.6)
Nightmares	142(54.4)	98(37.5)	18(6.9)	3(1.1)
Having pain	88(33.7)	134(51.3)	38(14.6)	1(0.4)
Other factors	190(72.8)	60(23.0)	11(4.2)	0(0.0)

* Data are shown as number (%)

Table 4: The results of the Pittsburgh sleep quality index (PSQI) questionnaire sleep quality questionnaire in each item

	PSQI * components	Frequency (%)
Mental sleep quality	Very good	38 (14.6)
	Fairly good	103 (39.5)
	Fairly bad	95 (36.4)
	Very bad	25 (9.6)
Latency in sleep	Less than 15 minutes	1 (0.4)
	16-30 minutes	79 (30.3)
	31-60 minutes	148 (56.7)
	More than 60 minutes	33 (12.6)
Sleep duration	More than 7 hours	37 (14.2)
	7-6 hours	204 (78.2)
	5-6 hours	15 (5.7)
	Less than 5 hours	5 (1.9)
Sleep efficiency	More than 85%	187 (71.6)
	75 to 84%	54 (20.7)
	65-74%	14 (5.4)
	Less than 65%	6 (2.3)
Sleep disturbances	None	0 (0)
	1 to 9	55 (21.1)
	10 to 18	198 (75.9)
	19 to 27	8 (3.1)
Use of sleep medications	No use	174 (66.7)
	Once a week	75 (28.7)
	Once or twice a week	12 (4.6)
	Three times or more than three times a week	0 (0)
Inappropriate performance throughout the day	Never	14 (5.4)
	Once or twice a week, very little	105 (40.2)
	Once or twice a week, some	104 (39.8)
	Three or more times a week, serious	38 (14.6)

* **PSQI:** Pittsburgh Sleep Quality Index

According to the data, a high percentage of doctors, nurses, healthcare providers and service providers suffered from low sleep quality. There was no statistically significant difference between different job groups (P = 0.49). Some sleep-related problems among the participants are reported in table 3.

According to the results shown in table 4, 33.3% of people used sleep medication. In 94.6%, an overnight sleep deprivation caused inappropriate daily functioning and 69.3% of the subjects reported it took more than 30 minutes for them to go to sleep.

75.2% of the staff of the 22-Bahman hospital and 89.9% of the staff of the Hakim hospital suffered from poor sleep quality, but the difference was not significant (P = 0.27).

The results of linear regression showed that there was an inverse relationship between work experience (β = -0.31) and sound exposure (β = -0.57) with sleep quality and this relationship was significant for voice exposure (P = 0.02), but not for work experience (P = 0.13). After adjusting for variables such as age, work experience, body mass index (BMI), marital status and type of job, noise exposure was still significant and for each unit increase in noise, sleep quality score decreased by 0.3 (Table 5).

Table 5: Variables predicting sleep quality among the hospital staff participating in this study

Variable	Single variable		Multivariate	
	β	P*	β	P**
Age (year)	0.14	0.05	0.30	0.04
Work experience (year)	-0.31	0.13	-0.38	0.34
BMI	0.43	0.13	0.71	0.51
Marital status	6.02	0.03	2.60	0.54
Sex	3.82	0.75	4.53	0.59
Job type	0.56	0.05	0.44	0.05
Shift work	0.43	0.03	0.21	0.04
Exposure to sound (dB)	-0.57	0.02	-0.30	0.049

* Single regression test
** Multivariate regression test

Discussion

The results of this study showed that the average noise levels in the different wards of the 22-Bahman and Hakim hospitals were 35.1 dB and 44.6 dB, respectively. The average of the total sleep score in the two hospitals was 8.39 ± 1.67 and 87% of the subjects had poor sleep quality. Our results showed that for each one dB increase in noise, the score of sleep quality decreased by 0.3 scores.

This study also showed that the noise levels in both morning and afternoon shifts in the emergency department and admissions of the 22-Bahman hospital, and in the emergency department, operating rooms, admissions, and the labor and neonates wards of the Hakim hospital was higher than the standard of the World Health Organization (WHO) which is 35-40 dB in the morning and 30-40 dB in the afternoon and night (29).

Fasih-Ramandi and Nadri evaluated the background noise in the ICU of a governmental hospital of Tehran. The average equivalent sound levels (Leq) during the morning, afternoon, and evening shifts were reported to be 62.5, 60.5, and 59.0 dBA, respectively (23). Another study from Hamadan reported an average noise level of 54-57 dB in hospitals (4).

In our study, the highest average noise level was 65 dB which was in the admissions, emergency and neonatal wards, while the lowest level was in the ICU which was 15 dB. The results of our study are different from the results of Fasih-Ramandi and Nadri study. The reason for this difference might be related to the difference in a number of patients admitted to these hospitals. Fasih-Ramandi and Nadri study was conducted in a big and populous city, the number of visitors and patients was higher, the hospital was busier, traffic surrounding the hospital was heavier, and they had more staff working during the day. However, our study was done in a small city with fewer patients and visitors.

The results of this study are consistent with the study of Asgharnia et al., conducted in Babol hospitals, Iran, which showed that in all hospitals the emergency department was the noisiest ward (30). Also, a study was done by Hashemi et al. in Behbahan hospitals, showing that the specialized wards, emergency department and general clinics of the Shahidzadeh hospital had the highest mean noise level during morning hours (31).

In another study, Buemi et al. also reported that in a hospital in Italy, during the daytime, the maximum sound level at the ICU, the hemodialysis room, and the corridor was 76.8, 67.0, and 66.8 dBA, respectively (32). Ann et al. measured and evaluated the noise levels in Francis hospital and reported that the average noise level was 60 dBA, and almost 60% of patients believed their sleep had been disturbed by the noise from staff, equipment and other patients (33). In Morrison et al. study, the average sound levels measured in a major hospital of the USA was between 52.6 and 64.6 dB during daytime (34). The results of our study and other studies have showen that noise levels are higher than the standard threshold in some hospital wards such as admissions and the emergency department.

The findings of this study showed that the average total score of sleep quality in the two hospitals was 8.39 ± 1.67. In this study, 87% of the subjects had poor sleep quality.

Roodbandi et al. evaluated the quality of sleep among nurses in Kerman and reported that according to the sleep quality index, 91.2% (n = 145) of the hospital nurses and 79.6% (n = 133) of the university employees had poor sleep quality (35). Salehi et al. (16) and Bozorg sohrabi (36) also showed that 62.5% of nurses working in Tehran Imam Khomeini Hospital and 84% of nurses working in the ICU of hospitals in Mazandaran province had low sleep quality. The results of these studies are consistent with the present study, and all indicate poor quality of sleep among the majority of personnel working in hospitals.

The poor sleep quality seen in our study and other similar studies is probably related to the environmental and working conditions. Many studies have mentioned constant confrontation with seriously ill patients, high environmental noise, high responsibilities, shift work (37, 38) and mental stressors as main factors related to poor sleep quality among nurses.

In the present study, among the dimensions of sleep quality, the most frequent problems were feeling cold or hot, delay in falling asleep and waking up in the middle of the night or early in the morning. In the studies done by Salehi et al. on nurses working at the Tehran Imam Khomeini Hospital (16) and Bozorg sohrabi et al. done on ICU nurses in Mazandaran (36), delay in falling asleep was also one of the most common problems of sleep quality, which is consistent with this study.

The results of this study show that 94.6% of the subjects had a problem in doing their daily work, because of poor nocturnal sleep, which is similar to Salehi et al. study (16), showing that approximately 65% of people complained of sleepiness during the day. Studies have shown a clear association

between sleep quality and drowsiness during the day (35).

In this study, there was no significant relationship between marital status, job type and BMI with sleep quality. The results of a recent epidemiological study in Japan showed that the prevalence of sleep problems in women is significantly higher than in men, and sleep time in men is considerably longer than women (39). In the present study, there was no significant association between sex and quality of sleep, but there was a significant association between age and sleep quality.

There was a significant association between work experience and quality of sleep in Bozorg sohrabi et al. study (36), but a significant association was not observed in the present study.

A study conducted in Kerman showed that sex, age, education, marital status and the number of children were not effective on sleep, but shift work and the average daily working hours were significantly effective on sleep quality (35).

In this study, the quality of sleep was not significantly different in the two hospitals under study, but the mean sound level in both hospitals was higher than the permissible limit.

The significant association between noise and the quality of sleep in this study is in line with the results of Saremi et al. study which was about the association between traffic noise and the quality and quantity of sleep among 250 police officers in Tehran (40). In both studies, with increasing the mean sound level the quality of sleep decreases and the feeling of tiredness increases. In this study, we found that even after adjusting for other factors, noise affects the quality of sleep.

Basner et al. studied the effect of city traffic, trains and airplane noise in laboratory conditions on 72 healthy man subjects and stated that noise disturbs the structure and the continuity of human sleep (41). A similar result was reported by Kazemi et al. among the patients of a teaching hospital in Rafsanjan (42), with the difference that noise, and moans of other patients, movement of hospital equipment, and the noise of beds and mattresses and ventilation systems were among the main sources of noise in that research.

Sleep quality can greatly affect the function of hospital staff and cause human errors in diagnosis, administration, and injection of drugs and other healthcare issues which can have adverse consequences for the patients. Therefore, it is important to investigate and find out the factors affecting sleep quality. Further studies are needed to identify other environmental factors affecting the quality of sleep among hospital staff.

The results of many local and international studies have reported that noise inside some hospitals was more than standard. The source of this noise may be visitors or patient's family members, medical and nursing staff, rolling of trolley wheels, children playing, doors opening or closing, patients moaning or crying, renovation of hospitals, and people's footsteps (43). Bayo et al. found that most of the noise in one major hospital in Spain was from sources located primarily inside the hospital (44).

In this study most of the noise in noisy wards was generated by patients and visitors, hospital employees, commuting vehicles and ambulances, devices and instruments falling on the ground, conversation between medical staff and patients, televisions, mobile phones, elevators, doors opening and closing, the ventilating systems, respirators, and monitors.

One of the shortcomings of this study was not analyzing noise frequencies and not evaluating the effect of noise on patients resting inside the hospital. We suggest that future researchers plan studies for identifying the source of noise, the noise frequencies involved and better ways for controlling the noise.

Conclusion

The results of this study showed that the average noise level in the hospital was higher than the permissible threshold. Most employees had poor sleep quality, which may be the result of noise pollution. Therefore, in order to improve working conditions and have a more efficient manpower, interventions should be implemented.

Hospitals have a limitation in using noise absorbing material because of infection control concerns and medical practice issues. Therefore the best practical initiative is building hospitals according to proper architecture principles and with construction materials that absorb noise or keep it confined. Making more single rooms for both patients and personnel, and acoustically isolating the family member's waiting rooms, emergency departments, nursing stations or other noisy sections can also be helpful. The Second important intervention is emphasizing the culture of quiet, for example speaking quietly, wearing soft-soled shoes, and avoiding non-urgent interventions and noisy activities.

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Conflict of Interest: None declared

References

1. Jafari N, Bina B, Mortezaie S, Ebrahimi A, Abdolahnezhad A. Assessment of environmental noise pollution in Feiz hospital wards and its adjacent area. Health System Reaserch 2012; 8(3):377-84
2. Wiese CH, Wang LM. LV-11-C031: Measured levels of hospital noise before, during, and after renovation of a hospital wing, and a survey of resulting patient perception. ASHRAE Trans 2011; 117(Pt 1):256-63.
3. Vinodhkumaradithyaa A, Srinivasan M, Ananthalakshmi I, Kumar DP, Rajasekhar RVJ, Daniel T, et al. Noise levels in a tertiary care hospital. Noise Health 2008; 10(38):11-3.
4. Golmohammadi R, Aliabadi M. Noise pollution and its irritating effects in hospitals of Hamadan, Iran. Journal of Health System Research 2012; 7(6):958-64.
5. Rahimi Moghadam S, Khanjani N. Evaluation of hearing loss and changes in blood pressure of welders in a 4 year period. International Journal of Occupational Hygiene 2015; 5(4):172-6.
6. Busch-Vishniac IJ, West JE, Barnhill C, Hunter T, Orellana D, Chivukula R. Noise levels in Johns Hopkins Hospital. J Acoust Soc Am 2005; 118(6):3629-45.
7. Cordova AC, Logishetty K, Fauerbach J, Price LA, Gibson BR, Milner SM. Noise levels in a burn intensive care unit. Burns 2013; 39(1):44-8.
8. Ghotbi MR, Khanjani N, Barkhordari A, Rahimi Moghadam S, Mozaffari A, Gozashti MH. Changes in urinary catecholamines in response to noise exposure in workers at Sarcheshmeh Copper Complex, Kerman, Iran. Environ Monit Assess 2013; 185(11):8809-14.
9. Bagheri H, Shahabi Z, Ebrahimi H, Alaeenejad F. The association between quality of sleep and health-related quality of life in nurses. Journal of Hayat 2007; 12(4):13-20.
10. Bryant PA, Trinder J, Curtis N. Sick and tired: does sleep have a vital role in the immune system? Nat Rev Immunol 2004; 4(6):457-67.
11. Zolfaghari M, Farokhnezhad Afshar P, Asadi Noghabi AA, Ajri Khameslou M. Modification of environmental factors on quality of sleep among patients admitted to CCU. Journal of Hayat 2013; 18(4):61-8.
12. Kumar VM. Sleep and sleep disorders. Indian J Chest Dis Allied Sci 2008; 50(1):129-35.
13. Ansari H, Noroozi M, Rezaei F, Barkhordar N. Assessment of sleep pattern among hospitals' nurses of Zahedan University of Medical Sciences in 2011. Journal of Rafsanjan University of Medical Sciences 2015; 13(11):1021-32.
14. Isah EC, Iyamu OA, Imoudu GO. Health effects of night shift duty on nurses in a university teaching hospital in Benin City, Nigeria. Niger J Clin Pract 2008; 11(2):144-8.

15. Soleymany M, Masoodi R, Sadeghi T, Bahrami N, Ghorbani M, Hasanpoor A. General health and its association with sleep quality in two groups of nurses with and without shift working in educational centers of Iran University of Medical Sciences (IUMS). Journal of Shahrekord University of Medical Sciences 2008; 10(3):70-5
16. Salehi K, Alhani F, Sadegh-Niat Kh, Mahmoudifar Y, Rouhi N. Quality of sleep and related factors among Imam Khomeini hospital staff nurses. Iran Journal of Nursing 2010; 23(63):18-25.
17. Soleimany M, Nasiri Ziba F, Kermani A, Hosseini F. Comparison of sleep quality in two groups of nurses with and without rotation work shift hours. Iran Journal of Nursing 2007; 20(49):29-38.
18. Hashemi Nejad N, Rahimi Moghadam S, Mohammadian M, Amiri F. Survey of relationship between mental health and job stress among midwives who were working in hospitals of Kerman, Iran, 2011. The Iranian Journal of Obstetrics, Gynecology and Infertility 2013; 16(64):1-9.
19. Mohammadian M, Hashemi Nejad N, Rahimi Moghadam S, Amiri F. The survey of musculoskeletal disorders of midwives and its relationship with job stress. Journal of Fundamentals of Mental Health 2013; 15(59):171-83.
20. Rahimi Moghadam S, Emkani M, Mohamadyan M, Moosazadeh M, Khanjani N, Layegh MN, et al. Musculoskeletal disorders and its relation with job stress in midwives. International Journal of Occupational Hygiene 2017; 9(1):38-45.
21. Rahimi Moghadam S, Moosazadeh M, Mohammadyan M, Emkani M, Khanjani N, Layegh Tizabi MN. Psychological health and its relation with occupational stress in midwives. International Journal of Occupational Hygiene 2016; 8(4):217-22.
22. Hojati H, Jalalmanesh S, Fesharaki M. Sleeplessness effect on the general health of hospitals nightshift nurses in Gorgan, Iran. Journal of Gorgan University of Medical Sciences 2009; 11(3):70-5.
23. Fasih-Ramandi F, Nadri H. Background noise in Iranian hospital intensive care units. Noise Control Eng J 2017; 65(1):14-21.
24. Zonouzi F, Ranjbarian M, Afjeie SA. Evaluation of noise in neonatal intensive care unit in Mofid Children's Hospital. Medical Science Journal of Islamic Azad University Tehran Medical Branch 2006; 16(3):129-34.
25. International Organization for Standardization. 13.140 Noise with respect to human beings ISO 9612:2009- Acoustics-Determination of occupational noise exposure -- Engineering Method. 2nd ed. Geneva, Switzerland: International Organization for Standardization; 2009 April. 43 p. Available from: https://www.iso.org/standard/41718.html
26. Buysse DJ, Reynolds ChF, Monk TH, Berman SR, Kupfer DJ. The Pittsburgh sleep quality index: a new instrument for psychiatric practice and research. Psychiatry Res 1989; 28(2):193-213.
27. Farrahi J, Nakhaee N, Sheibani V, Garrusi B, Amirkafi A. Psychometric properties of the Persian version of the Pittsburgh Sleep Quality Index addendum for PTSD (PSQI-A). Sleep Breath 2009; 13(3):259-62.
28. World Health Organization. Global Database on Body Mass Index. an interactive surveillance tool for monitoring nutrition transition. Geneva, Switzerland: World Health Organization; 2006. Available from: http://apps.who.int/bmi/index.jsp?introPage=intro.html
29. Berglund B, Lindvall T, Schwela DH. Guidelines for community noise. Geneva, Switzerland: World Health Organization; 1999.
30. Asgharnia HA, Tirgar A, Amouei A, Fallah SH, Khafri S, Mohammadi AA, et al. Noise pollution in the teaching hospitals of Babol (Iran) in 2012. Journal of Babol University of Medical Sciences 2014; 16(4):64-9.
31. Hashemi Z, Bakhshi Y, Salami M, Omrani N. Hashemi, Z. Relationship between sensitivity and annoyance with noise parameters (PNC, SIL) in hospitals of Behbahan. Occupational Medicine Quarterly Journal 2016; 8(2):12-23.
32. Buemi M, Allegra A, Grasso F, Mondio G. Noise pollution in an intensive care unit for nephrology and dialysis. Nephrology Dialysis Transplantation 1995; 10(12):2235-9.
33. Hale DR. Noise in the hospital: a quality improvement approach. J Nurs Adm 1996; 26(3):4.
34. Morrison WE, Haas EC, Shaffner DH, Garrett ES, Fackler JC. Noise, stress, and annoyance in a pediatric intensive care unit. Crit Care Med 2003; 31(1):113-9.
35. Jafari Roodbandi AS, Feyzi V, Khanjani N, Rahimi Moghadam S, Shafiezadeh Bafghi M, Moghadasi M, et al. Sleep quality and sleepiness: a comparison between nurses with and without shift work, and university employees. International Journal of Occupational Hygiene 2016; 8(4):230-6.

36. Bozorg Sohrabi F, Soleymani A, Habibi M, Emami Zeydi A, Nejad Gorji H, Hasanzade Kiab F. Sleep quality and its related factors in nurses, work in open heart intensive care units in Mazandaran providence: a cross - sectional study. Journal of Health Breeze 2014; 2(1):18-23.
37. Anjazab B, Farnia F. Survey relationship between job stress with behavioral and mental responses of midwives working in public hospitals of Yazd in 1999. Journal of Shahid Sadoughi Universityof Medical Sciences 2002; 10(3):32-8.
38. Mollart L, Skinner VM, Newing C, Foureur M. Factors that may influence midwives work-related stress and burnout. Women Birth 2013; 26(1):26-32.
39. Asai T, Kaneita Y, Uchiyama M, Takemura Sh, Asai S, Yokoyama E, et al. Epidemiological study of the relationship between sleep disturbances and somatic and psychological complaints among the Japanese general population. Sleep and Biological Rhythms 2006; 4(1):55-62.
40. Saremi M, Khani Jazani R, Rezapour T, Kavousi A, Shirzad H. Effects of traffic noise exposure on police officers' sleep: Questionnaire Survey. Journal of Police Medicine 2013; 2(3):193-200.
41. Basner M, Müller U, Elmenhorst EM. Single and combined effects of air, road, and rail traffic noise on sleep and recuperation. Sleep 2011; 34(1):11-23.
42. Kazemi M, Rafiee G, Ansari A. Factors relevant to sleeping disturbances in hospitalized medical-surgical patients of Ail Ebne Abitaleb teaching hospital of Rafsanjan. Journal of Rafsanjan University of Medical Sciences 2005; 4(4):270-5.
43. Juang DF, Lee CH, Yang T, Chang MC. Noise pollution and its effects on medical care workers and patients in hospitals. Int J Environ Sci Technol 2010; 7(4):705-16.
44. Bayo MV, García AM, García A. Noise levels in an urban hospital and workers' subjective responses. Arch Environ Health 1995; 50(3):247-51.