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Noise exposure in healthcare workers

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Abstract

The aim of this study is to evaluate the effect of noise in hospitals on healthcare workers, to develop recommendations for reducing noise in hospitals and to show why healthcare workers should be protected from noise exposure in hospitals. The study included a total of 80 healthcare workers from different units of the hospital who volunteered to participate. Two participants were excluded for sensorineural hearing loss and the results of 78 respondents were analyzed. Participants were evaluated using a questionnaire created by the researchers. Noise in different units of the hospital was measured during daytime working hours using the Sound Level Meter application with an iPhone 13[®] smartphone. Measurements yielded a mean noise level of 37.62 dBA (a minimum of 24.21 dBA to a maximum of 67.31 dBA). On occasions, noise levels in the hospital were as high as 74 dBA. Healthcare staff included in the study usually complained of moderate levels of noise and reported noise affected their performance. High levels of noise in hospitals negatively affect healthcare workers' performance. Healthcare workers' awareness about the impact of noise exposure in hospitals should be increased through in-service training programs. Improving noise levels in hospitals and implementing noise reduction interventions can help increase healthcare workers' performance and eliminate the negative impacts of noise exposure to the inner ear.

Keywords: Noise exposure, hospital, healthcare workers, noise-induced, work performance, acoustic stimulation

Introduction

Noise is uncomfortable sound that is part of everyday life, subjectively perceived as annoying and disruptive to performance [1-3]. It is a distinctive feature of the environment, including sounds from traffic, industry and neighbors [4]. Noise pollution is recognized as the fourth type of environmental pollution after air, water and solid waste pollution [5]. It affects the environment and humans alike. Noise exposure has been shown to lead to negative impacts, especially on human health. Negative effects of noise on human health include sleep disturbance, cardiovascular diseases, decreased cognitive performance, impaired memory, disruption of hormonal rhythm, and behavioral problems [6]. These effects are influenced by a number of factors, such as individual sensitivity to noise, ability to cope with noise as well as ability to control and regulate the source of sound and the environment [3].

Noise-induced hearing loss can occur with sudden exposure to intense sound or with prolonged exposure to loud noise [6]. Exposure to loud sounds and/or noise is one of the most common causes of hearing loss [7]. Research on understanding and preventing the effects of indoor noise on patients and staff is increasing [6].

Sound level meters and dosimeter devices are used to measure noise. A sound level meter is a device that measures the intensity of sound at a given moment. It is a device that measures the level of exposure to noise after a certain period of time by attaching a microphone to the clothing of the worker with a dosimeter [8]. It is known that smartphones can be used successfully to monitor and map noise pollution [9].

Pure-tone audiometry hearing thresholds are the gold standard for determining the effect of noise on hearing [10]. A pure tone audiometry test can measure hearing loss caused by noise, but

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the concept of being disturbed by noise varies depending on the meaning a person attaches to noise. In other words, the response to noise is subjective [11]. The subjective effects of noise also need to be evaluated.

Hospitals are noisy environments with sounds generated by medical devices, pagers, staff members, patients and their relatives [12-15]. Previous studies have found that noise levels in hospitals exceed the limits recommended by the World Health Organization (WHO) [16,17]. Adverse effects of noise should be assessed through noise mapping and monitoring [18]. Furthermore, identifying and eliminating the sources of noise in hospital units is critical for improving patients' health outcomes [17]. Noise pollution can be mapped and monitored using smartphone applications [9].

This study sought to evaluate the effect of hospital noise on healthcare workers, develop recommendations for reducing hospital noise and show why healthcare workers should be protected from noise.

Material and Methods

The study was carried out as a cross-sectional study type in Mustafa Kemal University Medical Faculty Hospital with healthcare professionals working at Mustafa Kemal University Medical Faculty Hospital. This study received ethics committee approval date 05.01.2023 and numbered 39 by Hatay Mustafa Kemal University Rectorate Non-Interventional Clinical Research Board. The study is a cross-sectional study. The data were analyzed by frequency and percentage using the SPSS 22 program.

The study involved healthcare workers from various units of the hospital (intensive care unit, operating room, wards, outpatient clinics, patient information & relations) who agreed to participate in the study. A total of 80 participants completed the questionnaire on hospital noise, but two participants were excluded for sensorineural hearing loss. Participants underwent a hearing screening test and otological examination. Two subjects with hearing loss worse than 20 dB at any of four frequencies (500 Hz, 1000 Hz, 2000 Hz and 4000 Hz) were excluded from the study. People without any ear disease or chronic disease were included in the study. Participants were recruited from those who had been working in the hospital for at least 12 months.

A questionnaire was created by the researchers in line with the literature [19]. This form, created by the researchers, Merkit M, Bulunuz M (2020), consists of 16 questions and includes questions about the socio-demographic and disease characteristics of the participants [19].

The first part of the questionnaire inquired about participants' occupation, length of service, unit in the hospital and duration of noise exposure in the unit; the second part inquired about the extent to which the participants were affected by hospital noise. Questionnaires were completed through face-to-face interviews with participants.

Noise in various units of the hospital was measured using the Sound Level Meter application with an iPhone 13® smartphone [20]. The application measures the loudness of sound in decibel A(dBA). Noise in each unit was measured three times over a period of forty-five minutes on the same day. Each measurement consisted of one-minute recordings. The first measurement was followed by a second measurement approximately twenty-two and a half minutes later and a third measurement approximately forty-five minutes after the first [21]. The three measurements were averaged and this level was taken as the level of hospital noise. Noise measurements were taken during daytime (working hours).

Questionnaires were applied by the researcher to the healthcare professionals working at Mustafa Kemal University Faculty of Medicine by face-to-face interview method. The application of the questionnaires took about 10 minutes. There were / no participants who wanted to leave the study or who did not want to fill in the questions in the questionnaire.

Results

Of the 78 participants included in the study, 39 (50%) were male and 39 (50%) were female. The mean age was 41 ± 8.54 years. Of the participants, 14 work for the intensive care unit (ICU), 10 for the operating room, 18 forwards, 24 for outpatient clinics, and 12 for patient information & relations. 14 participants were cleaning staff, 22 were nurses, 10 were security staff, 13 were medical secretaries, 13 were physicians, 4 were caregivers, and 2 were anesthetic technicians.

The length of service was one year for 5 participants, two to five years for 20 participants, six to ten years for 20 participants, 11 to 15 years for 20 participants and over 16 years for 13 participants. 44 (56.4%) of the participants reported they were exposed to constant and continuous noise in their unit while 34 (43.6%) reported intermittent noise.

Noise measurements taken at different times from various units of the hospital found an average level of 37.62 dBA, ranging from a minimum of 24.21 dBA to a maximum of 67.31 dBA. On occasions, noise levels in the hospital were as high as 74 dBA (Information) Figure 1 shows noise measurements taken at different units and average levels of noise. 84,6 % of the health workers included in the study complained about moderate levels of noise. The survey results are shown in Table 1.

When participants were inquired about the setting where they were most disturbed by noise, 17.9% (14) indicated home, 42.3% (33) hospital, 35.9% (28) traffic and 3.8% (3) everywhere. Results show most respondents are disturbed by noise in the hospital.

When participants were inquired about how frequently they were disturbed by loud noise; seven replied "never", eight replied "rarely", twenty-six replied "occasionally", twenty-nine replied "frequently" and eight replied "always".

When the participants were asked whether hospital noise could

be reduced, sixty eight (87%) of healthcare professionals thought that hospital noise could not be reduced. When the respondents were asked whether hospital noise affects their job performance, seventy four (95%) of healthcare professionals think that hospital noise affects their job performance. Survey results show that noise affects healthcare workers' performance. The questions inquiring the relationship between healthcare workers' performance and hospital noise are shown in Table 2.

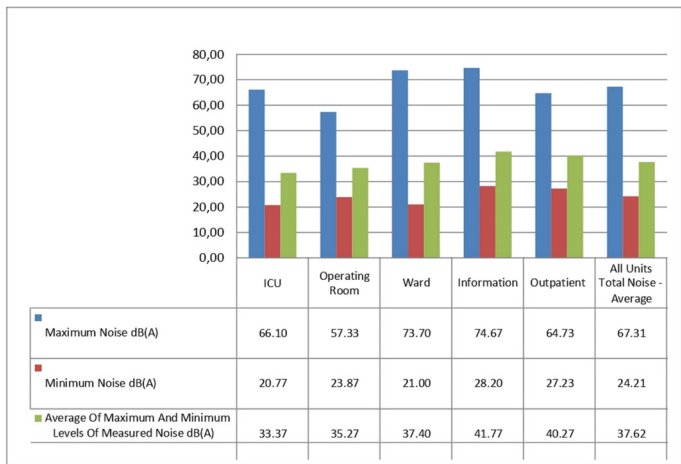


Figure 1. Shows noise measurements taken at different units and average levels of noise. The blue column shows the maximum noise level, the red column shows the average noise level, the green column shows the average noise level

Table 1. Healthcare workers' views on noise

Items	Options	n	%
How would you classify the level of noise at your home?	Very low	16	20.5
	Low	28	35.9
	Moderate	29	37.2
	High	4	5.1
	Very high	1	1.3
How would you classify the overall level of noise in the hospital?	Very low	2	2.6
	Low	7	9
	Moderate	36	46.2
	High	23	29.5
	Very high	10	12.8
How would you classify the level of noise in your unit?	Very low	0	0
	Low	11	14.1
	Moderate	39	50
	High	19	24.4
	Very high	9	11.5
How would you classify the level of noise during your rest time?	Very low	9	11.5
	Low	21	26.9
	Moderate	31	39.7
	High	14	17.9
	Very high	3	3.8

Table 2. Healthcare workers' opinions on the relationship between hospital noise and work performance

Items	Options	n	%
How likely do you believe that the level of noise in the hospital can be reduced?	Very Unlikely	17	21.8
	Unlikely	31	39.7
	Neutral	20	25.6
	Likely	7	9.0
	Very Likely	3	3.8
The effect of noise on work performance	Not related at all	2	2.6
	Unrelated	2	2.6
	Somehow related	20	25.6
	Related	33	42.3
	Directly related	21	26.9
Level of discomfort from noise in the hospital, building (loud conversations, shouting, screaming, etc.)	I do not hear these sound at all	1	1.3
	I hear these sounds but do not find them disturbing at all	11	14.1
	I hear these sounds but find them slightly disturbing	33	42.3
	I hear theses sounds and find them moderately disturbing	8	10.3
	I hear these sounds and find them disturbing	17	21.8
	I hear these sounds and find them highly disturbing	8	10.3

Discussion

In this study, we aimed to evaluate the effect of hospital interior noise on healthcare workers and draw attention to the importance of protecting healthcare professionals from noise.

The WHO has published guidelines on the maximum level of noise that should be present in hospitals; noise on wards should not exceed 30 dB equivalent continuous sound pressure level (LAeq), while noise in treatment rooms should be "as low as possible" [22].

The present study found that, the mean level of noise on wards was 37.4 dB(A) and the maximum level of noise was 73.7 dB(A). These measured levels of noise are above the levels recommended by the WHO.

Noise in intensive care units was found to reach levels that directly or indirectly affected health outcomes adversely for both patients and staff [23]. Reports assessing noise levels in intensive care units found that noise levels ranged from 50 to 65 dB (A), and at times reached 70 to 85 dB (A), with occasional peak noise levels exceeding 90 dB (A) [24,25].

The mean level of noise in the intensive care unit in this study exceeded 30 dB (A); it even reached a maximum of 66 dB (A), exceeding the levels recommended by the WHO.

A review of 76 studies showed that unwanted environmental noise in the hospital setting adversely affects patients' and staff members' health [26]. Noise also impairs nurses' health and professional quality of life. There is a significant relationship between noise and quality of life in healthcare workers exposed to high levels of noise [27]. A study with nurses showed that nurses are sensitive to noise in the workplace. In another study, 34% of the participants reported unbearably high levels of noise in the hospital and 46% reported high levels of noise in the units. The most disturbing types of noise were not those that were the loudest, but those that were repetitive (36.5%) and the sounds of people talking loudly [28]. There are repetitive sounds in intensive care units or operating rooms. Healthcare workers working in these units are constantly exposed to such noise, which has a negative impact on working performance. This study results clearly show that healthcare workers are affected by these unwanted sounds.

A study by Murthy et al. investigating the effect of noise on performance in hospitals analyzed the impact of noise in the operating room on mental activity and short-term memory. Their study found that noise in the operating room decreased mental performance and short-term memory in anesthesiology residents [29].

In this study, the level of noise in the operating room was on average 35.27 dB (A) and reached a maximum of 57.33 dB (A), exceeding the levels recommended by the WHO.

The WHO has suggested that LAeq levels should be no more than 35 dB in most units where patients are treated or observed, as patients have less ability to cope with stress [22]. A comprehensive review reported that environmental noise in hospitals affects patients' quality of sleep, can increase blood pressure and reduce immune responses, and can trigger a number of other negative side effects [2,30]. Reducing background noise levels improves speech intelligibility. Noise causes patients to have problems in learning, understanding and remembering new information in the hospital setting [29,31]. This study found that hospital noise disturbed healthcare staff and negatively affected their work performance; healthcare workers also reported that they found it unlikely that noise levels can be reduced.

Conclusion

The present study found that noise levels in hospitals are high and negatively affect the work performance of healthcare workers. In order to improve working conditions for healthcare staff and provide them with a healthy working environment, levels of noise in hospital should be periodically evaluated and sources of noise should be identified and reported. Incorporating sound-absorbing materials in the physical structure of hospitals and using noise warning signs can help reduce the level of hospital noise. In-service training programs should be organized to increase healthcare workers' awareness of the effects of noise exposure in hospital. Improving noise levels in hospitals and implementing noise reduction interventions can help improve healthcare workers' performance.

Limitations

The present investigation has some limitations. The number of individuals participating in the research is limited. More participants are needed to confirm our findings. Another limitation is that it is a single-center study.

Conflict of Interests

The authors declare that there is no conflict of interest in the study.

Financial Disclosure

The authors declare that they have received no financial support for the study.

Ethical Approval

Before starting the study, informed consent from the patients, approval from the ethics committee and necessary permissions from Mustafa Kemal University Hospital where the study was conducted were obtained. This study received ethics committee approval date 05.01.2023 and numbered 39 by Hatay Mustafa Kemal University Rectorate Non-Interventional Clinical Research Board.

References

1. Muzet A. Environmental noise, sleep and health. *Sleep Med Rev.* 2007;11:135-42.
2. Pope D. Decibel levels and noise generators on four medical/surgical nursing units. *J Clin Nurs.* 2010;19:2463-70.
3. Kam P, Kam A, Thompson J. Noise pollution in the anaesthetic and intensive care environment. *Anaesthesia.* 1994;49:982-6.
4. Stansfeld SA, Matheson MP. Noise pollution: non-auditory effects on health. *Br Med Bull.* 2003;68:243-57.
5. Jia XQ, Li SY, Miu HJ, et al. Carbon nanomaterials: a new sustainable solution to reduce the emerging environmental pollution of turbomachinery noise and vibration. *Front Chem.* 2020;8:683.
6. Basner M, Babisch W, Davis A, et al. Auditory and non-auditory effects of noise on health. *Lancet.* 2014;383:1325-32.
7. Liberman MC, Kujawa SG. Cochlear synaptopathy in acquired sensorineural hearing loss: Manifestations and mechanisms. *Hear Res.* 2017;349:138-47.
8. TO PDLC, TRAFFICKING CL. United States Department of Labor. 2011. <https://2009-2017.state.gov/j/tip/rls/tiprpt/2011> access date 13.12.2022.
9. Zipf L, Primack RB, Rothendler M. Citizen scientists and university students monitor noise pollution in cities and protected areas with smartphones. *PLoS One.* 2020;15:e0236785.
10. Dobie RA, Wojcik NC. Age correction in monitoring audiometry: method to update OSHA age-correction tables to include older workers. *BMJ Open.* 2015;5:e007561.
11. Kroesen M, Molin EJ, van Wee B. Measuring subjective response to aircraft noise: The effects of survey context. *J Acoust Soc Am.* 2013;133:238-46.
12. Wilson C, Whiteman K, Stephens K, et al. Improving the patient's experience with a multimodal quiet-at-night initiative. *J Nurs Care Qual.* 2017;32:134-40.
13. Kristensen MS, Edworthy J, Özcan Vieira E, Denham S. Alarm fatigue in the perception of medical soundscapes. *Proceedings of EuroNoise 2015; 10th European Congress and Exposition on Noise Control Engineering, May 31- June 3 2015. Maastricht, The Netherlands.*
14. Oleksy AJ, Schlesinger JJ. What's all that noise—Improving the hospital soundscape. *J Clin Monit Comput.* 2019;33:557-62.

15. Stafford A, Haverland A, Bridges E. Noise in the ICU. *Am J Nurs*. 2014;114:57-63.
16. Loupa G, Katikaridis A, Karali D, Rapsomanikis S. Mapping the noise in a Greek general hospital. *Sci Total Environ*. 2019;646:923-9.
17. Sasso L, Bagnasco A, Aleo G, et al. Editorial: Noise on hospital wards—what have we learned?. *J Clin Nurs*. 2016;25:891-3.
18. Wada T, Sano H, Nishio S-y, et al. Differences between acoustic trauma and other types of acute noise-induced hearing loss in terms of treatment and hearing prognosis. *Acta Otolaryngol*. 2017;137:S48-52.
19. Merkit M, Bulunuz M. Evaluation of noise awareness education applications in school. *Akdeniz Eğitim Araştırmaları Dergisi*. 2020;14:378-95.
20. Akdemir ÜÖ, Akdemir A. Smart phone applications in noise level measurements. *ÇÜ Müh Mim Fak Dergisi*. 2019;34:71-8.
21. Shahnaz N, Brown S. How accurate are these smartphone sound measurement apps. *Canadian Audiologist*. 2020;7.
22. Berglund B, Lindvall T, Schwela DH, Organization WH. Guidelines for community noise. 1999. <https://docs.wind-watch.org/WHO-Communitynoise.pdf>. access date 08.12.2022.
23. Delaney L, Litton E, Van Haren F. The effectiveness of noise interventions in the ICU. *Curr Opin Anaesthesiol*. 2019;32:144-9.
24. Litton E, Elliott R, Thompson K, et al. Using clinically accessible tools to measure sound levels and sleep disruption in the ICU: a prospective multicenter observational study. *Crit Care Med*. 2017;45:966-71.
25. Delaney LJ, Currie MJ, Huang HC, et al. The nocturnal acoustical intensity of the intensive care environment: an observational study. *J Intensive Care*. 2017;5:41.
26. Wallis R, Harris E, Lee H, et al. Environmental noise levels in hospital settings: a rapid review of measurement techniques and implementation in hospital settings. *Noise Health*. 2019;21:200-16.
27. McCullagh M, Xu J, Dickson VV. Noise exposure and quality of life among nurses. *Workplace Health Saf*. 2022;70:207-19.
28. Marqués Sánchez del P, Calle Pardo AP, Sánchez DC, et al. Nurses' perception of noise levels in hospitals in Spain. *J Nurs Adm*. 2008;38:220-2.
29. Murthy V, Malhotra S, Bala I, Raghunathan M. Detrimental effects of noise on anaesthetists. *Can J Anaesth*. 1995;42:608-11.
30. Bevan R, Grantham-Hill S, Bowen R, et al. Sleep quality and noise: comparisons between hospital and home settings. *Arch Dis Child*. 2019;104:147-51.
31. Pope DS, Gallun FJ, Kampel S. Effect of hospital noise on patients' ability to hear, understand, and recall speech. *Res Nurs Health*. 2013;36:228-41.