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Effect of White Noise on Sleep in Patients Admitted to a Coronary Care

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ABSTRACT

Introduction: Sleep disorders are a common problem in patients in the critical care unit. The objective of the present study was to determine the effect of white noise on the quality of sleep in patients admitted to the CCU.

Methods: The present study was single-blind, quasi-experimental study. A total of 60 patients were selected using the purposive sampling method. Quality of sleep was measured with PSQI on the first day in admission, then after three nights of admission without any intervention for control group and for the experimental group quality of sleep measured by white noise with intensity of 50-60 dB then Quality of sleep was measured with PSQI. Data were analyzed by SPSS 13 software.

Results: The average total sleep time in the control group before the study reached from 7.08 (0.8) to 4.75 (0.66) hours after three nights of hospitalization, while in the experimental group, no significant changes were seen in the average sleep hours (6.69 ± 0.84 vs. 6.92 ± 0.89, P = 0.15).The average minutes of sleep in the control group before the study reached from 12.66 (7.51) to 25.83 (11.75) minutes after a three- night stay, while in the experimental group, no significant changes were observed in the average sleep duration (12.16 ± 7.50 vs. 11 ±6. 07, P = 0.16).

Conclusion: The use of white noise is recommended as a method for masking environmental noises, improving sleep, and maintaining sleep in the coronary care unit.

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Introduction

Sleep disorders in patients hospitalized in intensive care units are more common than those in other units.[1] They occur as a result of the inadequacy of sleep periods and stages.[2]

There is little knowledge about the quality of patients' sleep in CCU.[3] The sleep process is essential for patients' well-being and recovery[4] and acts as a modulator/moderator of cardiovascular function in both physiological and disease conditions.[5] Sleep consists of two general phases: rapid eye movement (REM) and non-REM sleep, and each phase is distinguished by physiological, psychological, and neurological functions.[6]

Sleep disorder in critical care patients is defined as inadequate sleep or inadequate sleep duration, which results in inconvenience and disorder in people's quality of life.[2] Increased sympathetic activity, and decreased cardiac parasympathetic activity, and subsequent tachycardia, cardiac arrhythmias, and hemodynamic instability are among the physiological complications of sleep disorder.[7]

Moreover, unfavorable quality of sleep as a stressful condition may aggravate ischemia and myocardial infarction.[8] The reason of interrupted sleep in the coronary care unit is multi factorial of which noise is one important factor.[3] Noise is defined as unwanted sounds that could have negative psychological and physiological effects.[9] Noises are an unavoidable part of our life, Noises may be made following environmental factors or

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human activities. The World Health Organization (WHO) and Environmental Protection Agency (EPA) suggest that the level of noise at night in hospitals will not be higher than 35-40 dB.[6,10] However, a study showed that the level of noise in CCU at night became higher than 80 dB.[11] A study performed by Xie et al., showed that noises comprised 17-57.6% of patients' awakening triggers in CCU, and among the noise sources were sounds of monitors, staff conversations, phone ringing, ventilation and heating systems, and other medical devices. The patients are most disturbed by staff conversations and alarms.[6]

Furthermore, Zakeri Moghaddam's et al.,[12] study performed in Iran showed that most of the patients admitted to the coronary care unit reported the staff conversations, patient conversations, telephone ringing, and alarms of monitors and devices as the environmental factors of sleep disorder. The noise intensity of staff conversations, monitors, and infusion pumps are 59-90 dB, 72-77 dB, and 73-78 dB, respectively.[13] Another study revealed that most of care delivery is performed at 8:00 pm, midnight, and 6:00 am, which showed noisy times in coronary care units.[14] It is necessary for nurses take measures in order to play a crucial role in diagnosing and eliminating factors contributing to sleep disorders and treat it.[15]

Numerous pharmacological and non-pharmacological methods are used to treat insomnia. The most common way of treating or coping with sleep problems is using drugs. Pharmacological methods are frequently used in the treatment of insomnia but they have many side effects. One of the complementary approaches of the medical treatment of sleep problems or the improvement of the sleep quality of patients hospitalized in the intensive care unit is using non-pharmaceutical methods. Varied non-pharmaceutical methods such as reducing environmental factors, [16] mental imagery, gradual and progressive relaxation, auditory masking, music therapy, and massage are used in the treatment of sleep disorders.[17]

Auditory masking is a phenomenon in which perception of a sound is reduced by another sound (sound masker).[18] White noise is used for noise masking. The white noise is a noise that makes hearing threshold level reaching its maximum rate, and this means in the presence of such sounds in the background of the environment, the more intense auditory stimuli are less capable of stimulating the cerebral cortex during sleep. The sounds that are used mostly in this regard include sounds like the sound of rain and the sound of ocean waves.[19] A study on students and infants revealed that white noise triggered sleeping and reduced night waking problems.[16,17] The objective of the present study was to determine the effect of white noise on the quality of sleep in older patients admitted to the CCU. The hypothesis was that masking the environmental noise and reducing sleep disorders by generating white noise can improve the quality of patients' sleep.

Materials and methods

The current study is a quasi-experimental intervention study. This article is extracted from a student thesis at Tehran University of Medical Sciences and has been approved by the ethics committee of the university.

The study population included the patients admitted to the coronary care unit of Shariati Hospital, Tehran, Iran in 2013. The sample size was estimated 62 patients (31 subjects in each of the control and experimental groups) with respect to the values reported in previous studies with a standard deviation of 3, accuracy level of 3, confidence level of 95%, test power of 0.8 and accounting for the possibility of attrition rate. The patients were included in the study using the purposive sampling method with the inclusion criteria as follows: minimum age of 30 years old; CCU stays, at least for three nights; awareness of time, place and people; having hemodynamic stability; capable of hearing; non- receiving of anesthetic medications, drugs and diuretic drugs during three- night stay in CCU.[20-22] To minimize the sleep disrupting factors, the

study was conducted in the same CCU for both groups. At the beginning of the study, the objectives of the study were explained to all candidate patients. The confidentiality of information obtained from them was also mentioned to them, and they were assured that they could opt out of the study at any stage of it without there being any impairment in their treatment, then, the amount of noise was measured for three nights in the coronary care unit from the change time of night shift in the morning (from 7 PM to 7 AM of the next day).

The quality and mean hours of precious sleep of the control group samples on the first day of hospitalization were measured and assessed by using the Pittsburgh Sleep Quality Index (PSQI) and the sleep log to evaluate the average sleep time. In the following, with the interval of three nights stay in the CCU without any action, the quality of sleep for three nights was measured again with the same instrument. After completing the control group sampling, the sampling of the experimental group was started, and similar to the control group, the quality and average time of the patients' previous sleep were initially measured on the first day. Then, the white noise was broadcasted for the patients with the intensity of 40-50 dB for one hour during three nights in the noisy hours of the ward, which were previously determined through measuring the sound intensity over the night (8 PM to 9 PM at night and 11 to 12 PM at night). After this period, the quality of sleep in patients was again measured with the same tool for three nights.

Data collection tool included three parts of demographic characteristics, Pittsburgh Sleep Quality Index (PSQI). The demographics and disease characteristic included age; gender; marital status; employment status; education; history of hospitalization; history of drug, alcohol, painkiller use or the use of drugs affecting sleep; history of midday sleep; and duration of midday sleep. The demographics form was prepared using previous studies. In order to make it as valid as possible, it was given to 10 faculty members in the School of Nursing and Midwifery with a conceptual expertise (teaching about sleep, having published books or articles on the subject, being an expert in psychiatric nursing, or intensive care), and an interdisciplinary methodological expertise. After studying and analyzing the faculty members' ideas, the necessary changes was made.

Pittsburgh Sleep Quality Index (PSQI) has nine questions in seven sections of subjective sleep quality, late sleeping, sleep sufficiency, sleep duration, and sleep disorders, use of sleep medications and defective performance during the day. Each section is rated from zero to three scores, indicating the normal situation, the mild, moderate or severe problems respectively. The minimum and maximum scores are zero and 21, respectively, and the higher score shows lower sleep quality. The sensitivity and specificity of this tool was respectively as 89.6% and 86.5%, and its reliability in test-retest was r= 0.85.[22] In Iran, reliability of the questionnaire was estimated at 0.77 with Cronbach's coefficient alpha.[23]

Given the normal distribution of sleep quality determined through the Kolmogorov - Smirnov test, descriptive statistical methods (mean, standard deviation, frequency) and statistical inference methods (Fisher's exact test, Chi - square, Pearson test, independent T and paired t-test) were used by SPSS ver.13 software to analyze the data.

Results

In this study, a total of 62 patients admitted to the CCU (control group: 31 patients, experimental group: 31 patients) were enrolled (one patient due to transfer to another ward in an interval less than three nights and one patient due to critical conditions was excluded from the study). The average age in the control and experimental groups were as 60.6 ± 11.53 and 58.87 ± 10.92 years, respectively. The cause for admissions of 24 patients in the control group and 25 patients in the intervention group was unstable angina. Other causes of hospitalization included DVT (6 patients) and with heart failure (5 patients). All patients

were hemodynamically in stable condition, and hearing ability and education of patients were approximately at the same levels.

The patients in both groups were similar in terms of demographic characteristics (age, gender, marital status, history of hospitalization, employment status, and admission cause) (Table 1).

No significant difference was found on the average score of PSQI sleep quality between the two groups before the study (P=0.941). However, the mean sleep quality score in both groups after the study showed significant differences (P<0.001).

Comparison of sleep quality for each group separately revealed that the average score of sleep quality in the control group reached from 5.20±1.8 to 11.23±2.3 (P<0.001). In the experimental group, significant changes were observed between the mean score of sleep quality before and after the study (5.17± 1.66 vs. 4.53 ±1.27, P = 0.008) (Table 2).

Table1. Baseline characteristics of study patients

Characteristics	Control (n=30) N (%)	Experimental(n=30) N (%)	P- value
Gender			1.00
Male	16 (53.3)	1 7(56.7)	
Female	14 (46. 7)	13 (43.3)	
Marital status			0.67
Single	4 (13.3)	2(6.7)	
Married	26 (86.7)	28 (93.3)	
Admission			1.00
Unstable Angina	24 (80)	25 (83. 3)	
Other causes	6 (20)	5 (16. 7)	
History of hospitalization			1.00
Yes	19 (63.3)	18 (60.0)	
No	11 (36.7)	12 (40.0)	
Employment			0.87
Unemployed	19 (63.3)	17 (56.7)	
Employed	11 (36. 7)	13 (43.3)	

Table 2. Quality of sleep in control and experimental group before and after intervention using Pittsburgh Sleep Quality Index

Group	Control Mean (SD)	Experimental Mean (SD)	Statistical indicator
Quality of sleep			
Before	5.20 (1.80)	5.17(1.66)	P= 0.94, df =58
After	11.23 (2.30)	4.53 (1.27)	P<0.001, df =58
Total	P<0.001, df =29	P=0.008, df =29	

Discussion

The results showed improved quality of patients' sleep in intervention group. This implies that with broadcasting white noise, the quality of sleep in patients can be improved.

According to the previous studies, the environmental noise is an important sleep disturbing factor,[23] especially in CCU.[9,24] In spite of many claims about the effectiveness of reducing noise in the critical care environment on improved sleep quality of patients; few studies have assessed the effect of such interventions.[10] The score of sleep quality of the control group after the study was increased significantly as compared with before the study (P<0.001),

it means that the quality of sleep was decreased, These results was in line with study by Schiza et al., on patients admitted to the CCU on the third day after admission, sleep problems of patients in this study were include: reduction of total sleep time and poor sleep quality.[3]

A study by Stanchina et al., showed that white noise in combination with the recorded noises improved the sleep quality of patients in ICU. Therefore, they concluded that white noise increases stimulation threshold of healthy people exposed to the noises recorded in ICU environment.[25] In another study, Williamson[19] showed that applying of white noise increased the score of sleep depth, getting back to sleep, and night sleep quality of patients who had undergone coronary artery bypass graft (CABG). Also, in a study on the effect of white noise, Aghaie found that the intervention group had lower levels of anxiety and restlessness compared with the control group.[26] The researchers believes that white noise improves patient's quality and quantity of sleep by reducing the effects of noise and inducing relaxation. However, since white noise is a natural sound, it seems that a natural sound like that of an ocean sounds leads to the individual's relaxation and this leads to the improvement of the patient's sleep quality.

Limitations of the study include the lack of isolated units for admitting each patient, inability to control all medications of patients due to their probable effect on sleep, the short time of examining sleep, and unequal causes of patients' admission. The researchers recommend future studies to select a larger sample size with encompassing all ages of patients admitted to the CCU and to examine the effect of continuous application of white noise during the night on patients. Furthermore, the relaxing or blocking effect of white noise may not be fully evident; this can be investigated in future studies.

Conclusion

Sleep disorders are more common among patients in intensive care units.

Environmental factors like noise is a common cause of sleep disorders. Based on the findings of this study, the use of white noise is recommended as a method for masking environmental noises, sleep induction, improving sleep, and maintaining sleep in the coronary care unit.

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Ethical issues

None to be declared.

Conflict of interest

The authors declare no conflict of interest in this study.

References

1. Weinhouse G L, SchwabRJ. Sleep in the critically ill patient. Sleep 2006; 29 (5):707-16.
2. Urden LD, Stacy K M, Lough ME. Critical care nursing: diagnosis and management. 6th ed. St. Louis: Mosby, 2010.
3. Schiza S, Simantirakis E, Bouloukaki I, Mermigkis C, Arfanakis D, Chrysostomakis S, et al. Sleep patterns in patients with acute coronary syndromes. Sleep Medicine 2010; 11 (2): 149-53. doi: 10.1016 / j. sleep. 2009.07.016
4. Elliott R, McKinley S, Cistulli P. The quality and duration of sleep in the intensive care setting: an integrative review. Int J Nurs Stud 2011; 48 (3): 384-400. doi:10.1016/j.ijnurstu. 2010. 11. 006.
5. Wolk R, Gami AS, Garcia-Touchard A, Somers VK. Sleep and cardiovascular disease. Current Problems in Cardiology

2005; 30 (12): 625-62. doi:10. 1016/j. cp car diol. 2005.07.002

6. Xie H, Kang J, Mills GH. Clinical review: the impact of noise on patients' sleep and the effectiveness of noise reduction strategies in intensive care units. Critical Care 2009; 13 (4): 208. doi: 10.1186/cc 7154.
7. Lautenbacher S, Kundermann B, Krieg J-C. Sleep deprivation and pain perception. Sleep Medicine Reviews 2006; 10 (9): 357-69. doi:10.1016/j. smrv.2005.08.001
8. Christine J, Laura I. Sleep deprivation among critical care patients. Crit Care Nurs 2010; 33 (5): 75-81. doi: 10.1097/ CNQ. 0b013e 3181c8e030.
9. Freedman NS, Kotzer N, Schwab RJ. Patient perception of sleep quality and etiology of sleep disruption in the intensive care unit. American Journal of Respiratory and Critical Care Medicine 1999; 159 (12): 1155-62. doi:10.1164/ajrccm.159.4.98061 4 1.
10. Pirrera S, De Valck E, Cluydts R. Nocturnal road traffic noise: a review on its assessment and consequences on sleep and health. Environment International 2010; 36 (7): 492-8. doi: 10.1016/ j.envint. 2010.03.007.
11. Chen NS, Lin KM, Kinshuk. Analysing users' satisfaction with e-learning using a negative critical incidents approach. Innovations in Education and Teaching International 2008; 45 (3): 115-26. doi :10. 1080/147 03290801950286.
12. Zakerimoghadam M, Shaba M, Kazem-nejad A, Ghadyani L. Comparison of effective factors on sleeping the nurses and hospitalized patients' viewpoints. Journal of Hayat 2006; 12 (2): 5-12. (Persian)
13. Lawson N, Thompson K, Saunders G, Saiz J, Richardson J, Brown D, et al. Sound intensity and noise evaluation in a critical care unit. Am J Crit Care 2010;19 (3): e88-98. doi: 10.4037/ajcc2010180.
14. Tamburri LM, DiBrienza R, Zozula R, Redeker NS. Nocturnal care interactions with patients in critical care units. Am J Crit Care 2004; 13 (9): 102-13.
15. Moghadarikoosha M, Cheraghi F, Fardmal J, Nagshtabrizi B, Falahimia G. The impact of nursing interventions on quality of sleep among patients in coronary care unit of Ekbatan Hospital in Hamadan City, Iran. Scientific Journal of Hamadan Nursing & Midwifery Faculty 2014; 22 (1): 60-9. (Persian)
16. Zeraati F, Seif Rabie MA, Araghchian M, Sabouri T. Assessment of quality of sleep and use of drugs with sedating properties in adult patients. Hospitalized in Hamadan Ekbatan Hospital. Scientific Journal of Hamadan University of Medical Sciences and Health Services 2010; 16 (4): 31-6. (Persian)
17. Abolhasani S. Investigation of the effect of sensory stimulations on sleep deprivation symptoms in patients hospitalized in coronary care unit. Koomesh 2006; 7 (1):71-6. (Persian).
18. Kawase T, Maki A, Kanno A, Nakasato N, Sato M, Kobayashi T. Contralateralwhite noise attenuates 40-Hz auditory steady-state fields but not N100m in auditory evoked fields. Neuro Image 2012; 59 (34): 1037-42 . doi:10. 1016/j.neuroimage.2011. 08. 108.
19. Williamson J. The effects of ocean sounds on sleep after coronary artery bypass graft surgery. Am J Crit Care 1992;1 (1): 91-7.
20. pencer J, Moran D, Lee A, Talbert D. White noise and sleep induction. Arch Dis Child 1990; 65 (8): 135-7. doi:10.1136/ adc.65.1.135.
21. Forquer L. The effect of continuous white noise on the sleep patterns, mood and cognitive performance of college student. 1st ed. Michigan: Central Michigan University. 2006.
22. Buysse DJ, Reynolds III CF, Monk TH, Berman SR, Kupfer DJ. The pittsburgh sleep quality index: a new instrument for psychiatric practice and research. Psychiatry Research 1989; 28 (2):193-213. doi: 10.1016/0165-1781(89)90047-4.

23. Rabat A, Bouyer J, Aran J, Courtiere A, Mayo W, Le Moal M. Deleterious effects of an environmental noise on sleep and contribution of its physical components in a rat model. Brain Research 2004; 1009 (1-2): 88-97. doi: 10. 1016/j. brain res. 2004.02.046.
24. Moghaddam JF, Nakhaee N, Sheibani V, Garrusi B, Amirkafi A. Reliability and validity of the persian version of the pittsburgh sleep quality index (PSQI-P). Sleep and Breathing 2012; 16 (1): 79-82. doi: 10.1007 /s11325 - 010-0478-5.
25. Stanchina ML, Abu-Hijleh M, Chaudhry BK, Carlisle CC, Millman RP. The influence of white noise on sleep in subjects exposed to ICU noise. Sleep Medicine 2005; 6 (5): 423-8. doi: 10.1016/j. sleep. 2004. 12.004.
26. Aghaie B, Rejeh N, Heravi-Karimooi M, Ebadi A, Moradian S T, Vaismoradi M, et al. Effect of nature-based sound therapy on agitation and anxiety in coronary artery bypass graft patients during the waning of mechanical ventilation: a randomized clinical trial. Int J Nurs Stud 2014; 51 (4): 526–38. doi:10.1016/j.ijnurstu. 2013. 08.003.