Original Article

Effects of Noise on Vital Signs and Anxiety Levels of Patients Hospitalized in the General Surgery Intensive Care Unit

Gungor Serap, MSc
Lecturer, Kahramanmaras Sutcu Imam University, Vocational School of Health Services, Department of First and Emergency Aid, Kahramanmaras, Turkey

Oztunc Gursel, PhD
Professor, University of Kyrenia, Faculty of Health Sciences, Nursing Department, Kyrenia, Cyprus

Correspondence Author: Gungor Serap, Lecturer, Kahramanmaras Sutcu Imam University, Vocational School of Health Services, Department of First and Emergency Aid, Kahramanmaras, Turkey e-mail: serap_32_06@hotmail.com

Abstract

Background: Noise is one of the important stressors in intensive care.
Aim: The purpose of this study is to identify the effects of noise on vital signs and anxiety levels of patients hospitalized in the General Surgery Intensive Care Unit (GSICU).
Methodology: This descriptive study was conducted with 77 patients selected via power analysis who were hospitalized in the GSICU of a Training and Research hospital and agreed to participate in the study. Data were collected through the "Socio-demographic Form", the "State and Trait Anxiety Inventory" the "VAS", the "Vital Signs and Sound Level Meter Forms".
Results: The results showed that the mean sound level in the GSICU was 56,18 dB. This value is higher than the value recommended for hospitals. The patients were reportedly disturbed mostly by the bed-side monitor sounds. No significant correlations were found between noise and trait/state anxiety, systolic /diastolic pressure, pulse, respiration, and body temperature ($p>0.05$).
Conclusion: It is recommended to make a periodical assessment of the effects of hospital noise on patients and workers within the framework of the Quality Health Service Standards.

Keywords: Noise, nurse, anxiety, vital signs, intensive care

Introduction

The control of exposure to environmental noise in the hospital is becoming a serious issue, particularly in areas where quiet is necessary (Qutub & El-Said, 2009). Intensive care units (ICUs) are noisy and busy environments, with patients being subjected to disturbances throughout the day and night (Plummer et al., 2019).Noise in ICUs has increased dramatically as a consequence of these changes, and the effect of noise on patients and staff has become an important issue (Konkani & Oakley, 2012).Sources of noise in the ICU include noise-generating beds, high-intensity alarms to signal medical emergencies, television sound, telephones ringing, carts rolling on the linoleum floors, a large number of alarm-generating monitoring equipment, use of mechanical ventilators and around-the-clock activities by staff members (Simons et al., 2018; White & Zomorodi, 2017).Studies have shown that noise has cardiovascular and physiological effects that can also affect mental health (Konkani & Oakley, 2012). The purpose of this study is to identify the impact of noise on patients in the general surgery intensive care unit (GSICU).

Background

Becoming ill and being hospitalized is a condition that causes anxiety and stress and is generally reported by patients as an unpleasant experience (Fredriksen & Ringsberg, 2006). Problems related to becoming ill and being hospitalized are seen more commonly in patients hospitalized in intensive care units. The patient's stress level is affected by the environmental features of the intensive care unit and the existing discomfort (Cochran & Ganong, 1989; Thomas, 2003; Zaybak & Cevik, 2015).

Factors such as medical devices used in intensive care units, invasive interventions, pain, immobility, limited visiting hours, being separated from family, constantly blinking lights or lights that are switched on all day, various disturbing smells, lack of attention paid to privacy, noise, too cold or too hot environment, and uncomfortable beds make ICUs stressful (Simons, Van den Boogaard & de Jager, 2019; Thomas, 2003; Zaybak & Cevik, 2015) and cause patients to see these units as a source of anxiety(Zaybak & Cevik, 2015).

Noise, one of the important stressors in intensive care units, is defined as all kinds of undesirable sounds that have negative effects on people and society (Cepel, 2017; Uzelli & Korhan Akin, 2014). Noise is also defined as a sound level that does not have a specific structure and could affect an individual physically or psychologically with the elements it has (Fredriksen & Ringsberg, 2006). The World Health Organization (WHO) recommends that the noise level in hospitals should remain around 40 dB (A) during the day and 35 dB (A) during the night (Berglund, Lindvall & Schwela, 1999). Apart from other noises, only the sound levels of the cardiac monitors in ICUs are known to reach 72-77 dB (Christensen, 2007). Studies on this issue show that hospital personnel and patients are exposed to a high level of noise (Kramer, Joshi & Heard, 2016; Lawson et al., 2010; Morrison et al., 2003). The main factors that cause a high level of noise in the intensive care unit are the activities of the personnel, background noise, acoustic monitor, and the treatment device alarm.[18] In addition, sources of noise could include the equipment used, hospital personnel, sound of opening and closing doors, and guests (Kramer, Joshi & Heard, 2016; Lawson et al., 2010; Morrison et al., 2003).

Psychological effects of noise on human health are listed as behavior disorders, anger, general discomfort, and feeling of boredom; the physical effects are temporary or permanent hearing damages, fatigue, sleep disorders, headaches, circulatory symptoms (increase in blood pressure, circulatory system disorders, accelerated respiration, acceleration in heartbeats, and sudden reflexes) (Terzi et al., 2019). The literature indicates the physiological effects of noise as respiration, oxygen saturation, heart rate, and changes in blood pressure (Kramer, Joshi & Heard, 2016; Lawson et al., 2010; Morrison et al., 2003).

Studies that investigated sources of noise and noise levels and the effects of noise on anxiety levels and vital signs are quite limited in number. Therefore, the data obtained from this study are believed to have positive contributions to nursing care and be a guide for preventing the damage that might be caused by noise in the process of patient care.

Methodology

Study Design: The purpose of this descriptive and cross-sectional study is to identify the effects of noise on vital signs and anxiety levels of patients hospitalized in the General Surgery Intensive Care Unit (GSICU).

Setting/ Sample: The target population of the study was all patients who were treated in the GSICU of a Training and Research Hospital. The sample of the study was composed of all patients who were treated in the GSICU between January 2017 and March 2017; agreed to participate in the study; were aged 18 and over; could speak and understand Turkish; did not have a hearing problem; were conscious and had place, person, and time orientation; used no medication that had a sedating effect or that affected heartbeat rate; did not have a chronic heart disease or hypertension; had no patient nearby who received emergency intervention; were not diagnosed with a psychiatric disease and did not use psychiatric medicine regularly; had a VAS score of 5 and below; and had been in the secondary intensive care unit for at least 24 hours.

The sample size of the study was identified using power analysis, which was 75. In the study process, the total number of 77 patients who met the research criteria were accessed, and the statistical analyses were performed with 77 patients.

The setting of the Study and its Features: The GSICU is located on the first floor of the area designed for intensive care at the University of Health Sciences. The GSICU is composed of 3 patient rooms with 6-bed capacity. The patient rooms are for two patients, and each room has two large windows, one overlooking the outside yard and one overlooking the inner yard. The patient's bed-side had an infusion pump device, a feeding pump, a bed-side patient monitor, a ventilator, a bed-side aspirator, a central oxygen system, and a mobile patient heating-cooling device. The unit also has a monitoring system measuring the patient's vital signs. The GSICU has a nurse station that had a wireless telephone.

The intensive care unit where the study was conducted had 9 nurses who worked in a shift system. While the day shift was between 8:00a.m and 4:00 p.m., the night shift was between 4:00 p.m. and 8:00 a.m. While there were 6 to 10 health workers in the day shift, there were 5 to 6 health workers in the night shift.

Measurements: Data were collected through the "Socio-demographic Form", the "State and Trait Anxiety Inventory" the "Visual Analogue Scale" and the "Vital Signs and Sound Level Meter Form" vital signs and noise level measurements. Patients' vital signs were identified using the bed-side monitors, and the environment noise level was recorded using the sound level meter. Prior to the study, three sound level meters with previously set calibrations were placed in each patient room, between the two patient beds, and in places at least 1 to 1,5 meters away from the important transition places causing sounds such as windows and doors. Three different devices were used to measure the sound levels more accurately so that the noise levels patients were exposed to could be measured from a closer distance and the device-related margin of error could be minimized. The questionnaires used in the study were administered to the patients by the researcher simultaneously with the measurements.

The Socio-Demographic Form: The Socio-demographic form prepared by the researcher in line with the literature was composed of 10 questions regarding included information about patients' demographic features (age, education level, marital status, profession) and disease-related information (presence of chronic disease, previous intensive care experience, the reason for currently being in the intensive care unit), and factors causing noise (Zaybak & Cevik, 2015; Gokce & Dundar, 2008; Terzi & Kaya, 2011; Demir & Oztunc, 2017; Freedman et al., 2001; Petterson, 2001).

State and Trait Anxiety Inventory (STAI-Form 1/ STAI-Form 2): State and Trait Anxiety Inventory is a Likert type scale that measures state and trait anxiety levels separately through 20 questions. While higher scores indicate high anxiety levels, lower scores show low anxiety levels. The total score to be obtained from both scales range from 20 (low anxiety) to 80 (high anxiety). The scale is responded on a 4-point scale ranging from "Never" to "Always". While direct statements indicate negative feelings, reverse statements indicate positive feelings.

Visual Analogue Scale: While one side of the 10cm-line shows that the patient has no pain, the other side of the line shows that the patient has a maximum level of pain. Patients determine their pain level by giving a number on this line. Hence, anxiety was investigated without ignoring the relationship between individuals' pain levels and anxiety.

Vital Signs and Sound Level Meter Form: The form was prepared to record the patients' vital signs and noise in the intensive care unit simultaneously.

Tools used in measuring Vital Signs: Measurement of patients' vital signs was performed using each patient's bed-side monitors in the unit; the calibrations of the devices are done regularly every year. Body temperature measurements were done using a tympanic thermometer in the unit; its calibration is done every six months.

Sound Level Meter: Sound levels were measured using three calibrated sound level meters (CEM, DT-8852 model, China) designed for the measurement of noise and all types of environmental sounds. Sound level meters are devices that measure sound value in each second and record it to a computer program throughout a period identified.

Data collection process: Before the study was started, the average sound level of the GSICU was recorded for one week, and these sound levels were compared to the sound levels during the measurements. The purpose was to decide whether the noise patients were exposed to was momentary or constant. No significant differences were found between the measurements done and the measurements performed throughout the study. Figure 1 shows the basic flow of the whole process of the research study (Figure 1).

Data Analysis: Statistical analysis of the data was performed in SPSS for Windows 22.0 package program. Descriptive statistics of the data utilized means, standard deviations, median, minimum values, frequencies, and ratio values. The distributions of the variables were analyzed with the Kolmogorov Smirnov test. Spearman correlation analysis was utilized for Correlation analysis; statistical significance was taken $p<0.05$ for all tests.

1st Meeting (9:00 a.m.)

- Written consent was received

-The Socio-demographic form was administered

-The State and Trait Anxiety Inventory was administered

-The noise level was recorded

-The patient's vital signs were taken using the monitor and digitalthermometer, and the data were recorded

2nd Meeting (3:00 p.m.)

-The noise level was recorded

-Patients' vital signs were taken using the monitor and digital thermometer, and the data were recorded
-The patient was administered the state Anxiety Scale

3rd Meeting (9:00 p.m.)

-The noise level was recorded

-Patients' vital signs were taken using the monitor and digitalthermometer, and the data were recorded
-The patient was administered the state Anxiety Scale

4th meeting (3:00 a.m.)

-The noise level was recorded

-Patients' vital signs were taken using the monitor and digitalthermometer, and the data were recorded

Figure 1. **Flowchart of the Study**

Ethical considerations: Prior to the study, ethics committee approval was taken from the institution where the study was conducted. The Helsinki declaration of Ethical Principles for Medical Research involving human subjects guided the study. Patients' verbal consent was received before the questionnaires were administered. The patients were informed that the study would have no effects on the treatment process. In addition, they were told that the data obtained would be stored only by the researcher and that confidentiality would be maintained.

Results

The average age of the patients was 54.8± 19.0. Of all the participating patients, 52 (67.5%) were males, and 25 (32.5%) were females (Table 1).Of all the patients, 18 (23.4%) had a diagnosed chronic disease, 83.1% were in the intensive care unit for post-operative follow-up, 41.6% were hospitalized before, and average hospitalization was 2.9± 2.7 days(Table 1).

At 9:00 a.m., the patients' trait anxiety scale mean score was 39.2± 9.5 and state anxiety scale mean score was 38.8± 11.0'; at 3:00 p.m., the state anxiety scale mean score was 36.8± 10.8; and at9:00 p.m., the state anxiety scale mean score was 37.5± 12.2. An analysis of the mean scores shows that the state anxiety scores measured at 9:00 a.m. were higher than the ones measured at 3:00 p.m. and 9:00 p.m. (Table 2).

The average sound levels in the GSICU between the dates the study was conducted were found 54.1±3.4 dB at 9:00 a.m., 53.9± 3.9 dB at 3:00 p.m., 53.6± 5.0 dB at 9:00 p.m., and 51.7± 4.5 dB at 3:00 a.m. (Table 3).

At 9:00 a.m., the average systolic blood pressure of the participating patients was 128.7±16.4 mmHg, diastolic blood pressure mean score was 74.2±10.2 mmHg, average pulse was 90.4±15.4/ minute, average respiration rate was 20.00±3.7/minute, and average body temperature was 36.3±0.2 º.At 3:00 p.m., average systolic blood pressure was 127.9±16.3 mmHg, average diastolic blood pressure was 73.3±10.9 mmHg, average pulse was 90.8±15.1/minute, average respiration rate was 20.00±3.7/minute, and average body temperature was 36.3±0.2º.At 9:00 p.m., average systolic blood pressure was 127.1±16.6 mmHg, average diastolic blood pressure was 73.5±11.0 mmHg, average pulse was 88.6±13.9/minute, average respiration rate was 19.5±3.7/minute, and average body temperature was 36.2±1.4 º. At 3:00 a.m., average systolic blood pressure was 125.0±16.3 mmHg, average diastolic blood pressure was 72.8±10.7 mmHg, average pulse was 87.2±14.3/minute, average respiration rate was 18.2±3.1/minute, and average body temperature was 36.3±0.2 º (Table 4).

Overall, no significant correlation was found between the noise level and trait anxiety, state anxiety, systolic pressure, diastolic pressure, pulse, respiration, and body temperature ($p > 0.05$) (Table 4).

The patients' state anxiety scale mean score at 3:00 p.m. was 36.8± 10.8. The mean score at 9:00 p.m. was 37.5± 12.2. A positive correlation was found between state and trait anxiety at 9:00 a.m. and state anxiety at3:00 p.m. and 9:00 p.m. (Table 4).

Table 1: Distribution of the Patients by the Socio-demographic Characteristics (N=77)

Socio-demographic Features	Summary Criterion*	
	n	%
Gender		
Male	52	67.5
Female	25	32.5
Age		
18-29	12	15.6
30-39	6	7.7
40-49	8	10.4
50-59	12	15.6
60-69	22	28.6
>70	17	22.1
Mean	54.8± 19.0	

Presence of chronic disease		
Yes	18	23.4
No	59	76.6
History of Hospitalization		
Yes	32	41.6
No	45	58.4
Reason for being in the GSICU		
Pre-operative Follow-up	5	6.5
Post-operative Follow-up	64	83.1
Other	8	10.4
Number of GSICU stay (day) Mean (Min- Max)	2.9±2.7 (2-19)	

Table 2. Distribution of the Patients' State and Trait Anxiety Levels by the Hours

	Min-Max	Median	Mean± S.d
STAI Trait Anxiety			
9:00 a.m.	23.0-64.0	38.0	39.2 ± 9.5
STAI State Anxiety			
9:00 a.m.	20.0-71.0	38.0	38.8 ± 11.0
3:00 p.m.	20.0-69.0	33.0	36.8 ± 10.8
9:00 p.m.	21.0-77.0	33.0	37.5 ± 12.2

Table 3: Distribution of the Average Sound Levels measured in the Intensive Care unit by the Hours

Noise Level(dB)	Min-Max	Median	Mean±s.d.
9:00 a.m.	45.4 - 62.1	54.3	54.1±3.4
3:00 p.m.	45.2 - 61.2	53.7	53.9±3.9
9:00 p.m.	43.6 - 76.3	52.4	53.6±5.0
3:00 a.m.	41.0 - 68.2	51.3	51.7±4.5

Table 4: Relationship between the Noise Score and State/Trait anxiety, systolic/diastolic blood pressure, pulse, respiration, body temperature

Time		State Anxiety	Trait Anxiety	Systolic Blood Pressure	Diastolic Blood Pressure	Pulse	Respiration	Body Temperature
9:00 a.m. noise level	r	0.069	0.115	-0.113	-0.109	0.216	0.018	0.090
	p	0.551	0.319	0.329	0.347	0.059	0.876	0.437
3:00 p.m. noise level	r		-0.059	0.010	-0.063	0.028	-0.025	-0.115
	p		0.610	0.929	0.585	0.808	0.828	0.321
9:00 p.m. noise level	r		0.051	-0.22	-0.079	0.022	0.043	0.260
	p		0.659	0.850	0.497	0.848	0.712	0.022
3:00 a.m. noise level	r			-0.129	-0.131	0.091	-0.065	0.081
	p			0.264	0.256	0.432	0.572	0.486
Average noise level	r	0.077	0.049	-0.100	-0.156	0.056	0.044	0.154
	p	0.508	0.669	0.389	0.175	0.628	0.706	0.182

Spearman correlation

Discussion

In 1859, Florence Nightingale stated that "unnecessary noise is the most cruel abuse of care which can be inflicted on either the sick or the well" (Hsu et al., 2012). By affecting patient and worker health and performance, noise in hospitals causes various negative results concerning stress and physical and physiological problems (Terzi & Kaya, 2011).Having the highest number of health personnel and the most advanced technological devices, ICUs contain various sources of noise (Lawson et al., 2010). The Noise Guidelines prepared by the WHO recommends that the noise level in hospitals should not exceed 40 dB during the day and 35 dB during the night (Christensen, 2007). Sound level measurements performed while measuring the patients' vital signs showed that average sound levels were 54.1±3.4 dB at 9:00 a.m., 53.9±3.9 dB at 3:00 p.m., 53.6±5.0 dB at 9:00 p.m. and 51.7±4.5 dB at 3:00 a.m.. These results indicate that the noise levels at 9:00 a.m., 3:00 p.m., 9:00 p.m., 3:00 a.m. are much beyond the levels that should be in a hospital environment.

A study on this issue conducted by Demir & Oztunc with the title of "Effect of Noise on Hospitalized Patient's Night Sleep and Vital Signs in ICU" measured sound level throughout one week and identified the average sound level as 52,04±5,75 dB (Demir & Oztunc, 2017). The sound level measured while measuring the patients' vital signs showed that the average sound level was 57,04±5,35 dB in the 4:00 p.m.-12:00p.m. shift. This value was 48,18±6,15 dB on the average in the 12:00 a.m. -8:00 a.m. shift. In the study that investigated the effect of noise on sleep quality, Fredman et al. measured sound levels as 59,1 dB during the day and 56,8 dB during the night, and 85,9 and 82,8 dB as peak levels (Freedman et al., 2001). Another study conducted by Petterson found that the sound level was 59.7 during the day, 59.2 in the afternoon, 53,2 during the night, and 57-65 dB on the average (Petterson, 2001). Luzzi et al. made an analysis of the noise pollution in the operating room and found the sound level during the day as 60 dB(A), and it was found to reach a value of maximum 90 dB(A) momentarily. This study found the maximum level as 94,8 dB throughout all the one-week sound measurements (Salandin, Arnold & Kornadt, 2011). Another study on noise in the intensive care unit conducted by Salandin et al. reported that the sound levels in ICUs were 44-95 dB in intensive care rooms for two patients, and between 36 and 104 dB in the intermediate intensive care unit. The maximum sound level in all shifts was 71-95 dB in ICUs with two beds and between 60 and 104 dB in intermediate intensive care units (Salandin, Arnold & Kornadt, 2011).

The major sources of noise in ICUs included personnel sounds, medical device alarm sounds, sounds during the care, telephone-ring sounds, treatment /dressing/ dinner trolley sounds (WHO, 2002). The factors that caused noise in the present study were found primarily the monitor sounds (32,5 %), which was followed by the sounds caused by the oxygen mask (24.7%), pump alarm (19.5%), working personnel (9.1%), ventilation (6.2%), other patients (2.6%), aspiration, telephone, repair, and patient relatives (3.8%). Kramer et al. assessed noise levels in the Pediatric ICU and measured the maximum sound levels as 78 dB (A) from monitor alarms, 74 dB (A) from infusion pump alarms, and 70 dB (A) from ventilator alarms (Kramer, Joshı & Heard, 2016). Lawson et al., in their study about sound loudness and intensity in intensive care units, found sound levels as 86,5 dB in monitor alarms, 86.0 dB in the ventilator alarm during patient aspiration, and 83.8 dB in the infusion pump device alarms; monitor alarms were ranked first among the loudest noise levels. This finding is in line with the findings of the present study in that the patients were mostly disturbed by the bed-side monitor sounds (Lawson et al., 2010). Kam et al. investigated noise pollution in ICUs and reported that conversation among the staff, which reached up to 90 dB was the primary cause of the noise (Kam PC & Kam AC, 1994).

The present study found that 9.1% of the patients were affected by the noise caused by the staff.
There are several negative effects of noise on human health; these effects might include vasoconstriction of blood vessels, an increase in the heart rate and blood pressure, and pupil dilation (Fikri, Sumer & Sabanci, 2015). When the study simultaneously measured the noise level and vital signs, no significant correlation was found between systolic pressure, diastolic pressure, pulse, respiration, and body temperature ($p > 0.05$). A significant ($p < 0.05$), weak, and positive correlation was found between the noise level and body temperature at 9:00 p.m., but these values were not considered significant. Demir and Oztunc, in their study entitled "Effect of Noise on Hospitalized Patient's Night Sleep and Vital Signs in ICU" measured vital signs and

sound level simultaneously; the correlations between maximum and minimum noise levels during the measurements of vital signs indicated a weak and positive correlation between the noise level and systolic blood pressure in both shifts (Demir & Oztunc, 2017). Systolic blood pressure increased in a parallel way with the increase in the sound level in the environment. This finding indicates that noise affected the individual's blood pressure.

In this study, the trait anxiety scale was administered once, at 9:00 a.m., and the state anxiety scale was administered three times at 9:00 a.m., 3:00 p.m. and 9:00 p.m. A positive correlation was found between the trait anxiety measured at 9:00 a.m. and state anxiety measured at 3:00 p.m. and 9:00 p.m. Contrary to what was expected, although the noise levels were very high, no significant relationship was found between noise and state and trait anxiety. Studies indicate that mainly physiological effects of noise were investigated, and the number of studies that investigated the psychological effects is quite limited (Akansel & Kaymakci, 2008). The most significant consequence of living in noisy places is feelings of nervousness, discomfort, and stress (Aydın ME, et al., 2005). By affecting the individual's mental health, noise causes behavior disorders, anger, anxiety, stress, depression, and delirium (Kacmaz, 2002; Malak Akgun & Akgun, 2017). Akan et al., in their study entitled "Noise Problem in Eastern Turkey: Psychiatric Signs of Noise Pollution and Effects on Quality of Life" reported that psychology and quality of life of public vehicle drivers were affected especially when they were exposed to high levels of noise, and noise pollution had negative effects on quality of life by causing serious psychological symptoms such as anxiety and depression (Akan, Yılmaz, Ozdemir & Korpinar, 2012). In the study conducted by Salandin et al. about noise in intensive care units, it was reported that when 70 dB is accepted as noise threshold value, it causes stress, physical effects, and waking from sleep in healthy individuals (Salandin, Arnold & Kornadt, 2011). Akansel and Kaymakci reported in their study entitled "Effects of ICU noise on patients: a study on coronary artery bypass graft surgery patients" that noise was an important cause of anxiety in patients (Akansel & Kaymakci, 2008).

Conclusions: This study that investigated the effects of noise levels in the GSICU on anxiety and vital signs found that

- the primary source of noise that disturbed patients was the bed-side monitors,
- the measurements taken throughout one week showed that the average sound level was 56,18 dB, which was above the value indicated for hospitals,
- Weak, positive correlations were found between the sound level measured and body temperature.

More descriptive and randomized controlled studies investigating the effects of noise levels at ICUs on patients are needed.

Acknowledgements: The authors would also like to thank all participants for their participation in this study.

References

Akan Z, Yilmaz A, Ozdemir O. & Korpinar MA. (2012). Noise pollution, psychiatric symptoms and quality of life: noise problem in the east region of Turkey. *Journal of Inonu University Medical Faculty*, *19*(2), 75-81.

Akansel N. & Kaymakci S. (2008). Effects of intensive care unit noise on patients: a study on coronary artery bypass graft surgery patients. *Journal of clinical nursing*, *17*(12), 1581-1590.

Aydin ME, Corumluoglu O, Sarı S. & Ozcan S. (2005). Traffic Noise Level Maps for the City of Konya Produced Using GPS Supported GIS Technologies. *Selcuk University, Journal of Engineering, Science and Technology*. 20 (2),7-18.

Berglund B, Lindvall T. & Schwela DH. (1999). Guidelines for Community Noise Geneva: World Health Organization.

Christensen M. (2007). Noise levels in a general intensive care unit: a descriptive study. *Nursing in critical care*, *12*(4), 188-197.

Cepel N. Noise pollution. Accessed September, 12, 2017. http://cevre.bartin.edu.tr/

Demir G. & Oztunc G. (2017). Effect of noise on hospitalized patient's night's sleep and vital signs in ıntensive care unit. *Turk J Intense Care.* 15 (3), 107-116.

Fikri E. & Sumer SK, Sabanci A. (2015). Noise level and its effects in textile factories. *Turkish Journal of Occupational Health and Safety*. 4 (15), 30-39.

Fredriksen SD. & Ringsberg KC. (2006). Living the situation stress-experiences among intensive care patients. *Intensive Crit Care Nurs*. 23, 124-131.

Freedman N, Gazendam J, Levan L, Pack A. & Schwab R. (2001). Abnormal sleep/wake cycles and the effect of environmental noise on sleep disruption in the intensive care unit. *American Journal of Respiratory and Critical Care Medicine*. 163 (2), 451-457.

Gokce T. & Dundar C. (2008).The frequency of exposing to violence and its effects on state and trait anxiety levels among the doctors and nurses working in Samsun psychiatry hospital. *Journal of Inonu University Medical Faculty*. 15 (1), 25-28.

Hsu T, Ryherd E, Waye KP. & Ackerman J. (2012). Noise pollution in hospitals: impact on patients. *JCOM*. 19 (7), 301-309.

Hunt KN. (2011) The NICU: Environmental effects of the Neonatal Intensive Care Unit on infants and caregivers. *Research Papers*, submitted in partial fulfillment of the requirements for the master of science˝, Graduate School Southern Illinois University, Carbondale, May 2011.

Kacmaz N. (2002). Psychological problems and nursing approaches of intensive care patients. *Journal of the Critical Care Nurses Society*. 6 (2), 75-81.

Kam PC, Kam AC. & Thompson JF. (1994). Noise pollution in the anaesthetic and intensive care enviroment. *Anesthesia.* 49 (11), 982-986.

Konkani A. & Oakley B. (2012). Noise in hospital intensive care units—a critical review of a critical topic. *Journal of Critical Care*. *27*(5), 522-e1.

Kramer B, Joshı P. & Heard C. (2016). Noise pollution levels in the pediatric intensive care Unit. *Journal of Critical Care*. 36, 111-115.

Lawson N, Thompson K, Saunders G, Saiz J, Richardson J, Brown D, Ince N, Caldwell M. & Pope, D. (2010) Sound intensity and noise evaluation in a critical care unit. *American Journal Of Critical Care*. 19 (6), 88-98.

Luzzia S, Falchib S, Becchib C. & Baldacchinic A. (2003). Sound Analysıs of noıse pollutıon ın operatıng rooms. 5th European Conference on Noise Control Euronoise.

Malak Akgun B. & Akgun M. (2017). Noise control in therapeutic environment. *Current Approachesto Psychiatry*. 9 (4), 431-441.

Morrison WE, Haas EC, Shaffner, DH, Garrett, ES. & Fackler, JC. (2003). Noise, stress, and annoyance in a pediatric intensive care unit. *Critical Care Medicine.* 31 (1), 113-119.

Petterson M. (2000). Reduced noise levels in ICU promote rest and healing. *Crit Care Nurse.* 20 (5), 104.

Plummer NR, Herbert A, Blundell JE, Howarth R, Baldwin J. & Laha S. (2019). Sound Ear noise warning devices cause a sustained reduction in ambient noise in adult critical care. *Journal of the Intensive Care Society*. *20*(2),106-110.

Qutub HO, & El-Said KF. (2009). Assessment of ambient noise levels in the intensive care unit of a university hospital. *Journal of family & community medicine*, *16*(2), 53–57.

Salandin A, Arnold J, & Kornadt O. (2011). Noise in an intensive care unit. *The Journal of the Acoustical Society of America*. 130 (6), 3754-3760.

Simons KS, Verweij E, Lemmens PM, Jelfs S, Park M, Spronk PE, Sonneveld JP, Feijen HM, van der Steen M, Kohlrausch AG,van den Boogaard M. & de Jager CP. (2018). Noise in the intensive care unit and its influence on sleep quality: a multicenter observational study in Dutch intensive care units. *Crit Care.* 22(1), 250. https://doi.org/10.1186/s13054-018-2182-y

Simons KS, van den Boogaard M. & de Jager CP. (2019). Impact of intensive care unit light and noise exposure on critically ill patients. *Neth J Crit Care*, *27*, 145-149.

Terzi B. & Kaya N. (2011). Nursing care of critically ill patients. *Turkish Journal of Intensive Care Medicine*. 1, 21-25.

Terzi B, Azızoglu F, Polat S, Kaya N. & Işsever H. (2019). The effects of noise levels on nurses in intensive care units. *Nursing in Critical Care*, *24*(5), 299-305.

Thomas La. (2003). Clinical management of stressors perceived by patients on mechanical ventilation. *AACN Advanced Clinical Care*. 14 (1), 73-81.

Uzelli D. & Korhan Akın E. (2014). Sensory input problems of intensive care patients and nursing approach. *Florence Nightingale Journal of Nursıng*. 22 (2), 120-128.

White BL. & Zomorodi M. (2017). Perceived and actual noise levels in critical care units. *Intensive and Critical Care Nursing*. *38*, 18-23.

World Health Organisation. Community Noise-Environmental Health Criteria Document-External Review Draft Geneva; WHO Publishing, 2002

Zaybak A. & Cevik K. (2015). Stressors in the intensive care unit: perceptions of patients and nurses. *Turkish Journal of Medical Surgical Intensive Care Medicine*. *6* (1), 4-9.