

Original Article

Alarm Fatigue and the Factors that Affect it in Intensive Care Unit Nurses: A Cross-Sectional Study

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Abstract

Purpose: The study was conducted to examine the level of alarm fatigue of intensive care nurses and the affecting factors.

Method: The study had a cross-sectional design and was conducted with nurses working in the intensive care units of a state university between January and March 2022, after the necessary permissions were obtained. The data of the study were collected with Questionnaire and Alarm Fatigue Scale. A minimum of 0 and a maximum of 36 points can be obtained from the Alarm Fatigue Scale. As the score obtained from the scale increases, so does the level of alarm fatigue. The data were evaluated with the Student *t*, One-Way ANOVA, Kruskal Wallis, and $p < 0.05$ was considered statistically significant.

Results: The level of alarm fatigue of intensive care nurses was found to be 24.18 ± 4.60 . It was also found that alarm fatigue was associated with age, marital status, working time in nursing and intensive care, and using technological devices ($p < 0.05$). A total of 62.0% of the intensive care nurses considered that the use of medical technology devices affected care and 61.2% had difficulties in using medical technological devices.

Conclusion and Suggestions: It was found that the level of alarm fatigue of the nurses was “moderate”, and the duration of work in the profession and the intensive care unit affected alarm fatigue. It was also determined that the nurses had difficulties in the use of technological devices in the intensive care unit. In this direction, it is recommended to evaluate the alarm fatigue level of intensive care nurses and to provide training to nurses on the use of technological devices in intensive care.

Keywords: Intensive Care, Nurse, Alarm Fatigue

Introduction

Intensive care units (ICU) are units where a high level of care and treatment is applied to individuals whose life is under threat (Sila & Aksoy, 2018). It is already known that intensive care nurses, who spend uninterrupted time with patients, have important roles in improving patient care outcomes in these specialized units (Sila & Aksoy, 2018; Avci et al, 2013; Karagozoglu et al, 2014). However, when ICU nurses perform their caregiver roles, they also carry the physical and psychological burden of taking care of critical patients, coping with situations that require high knowledge, ensuring patient safety, providing materials,

having these materials ready for use, and use technology-based products actively along with these responsibilities. In this respect, in today's world where using technology has become a necessity rather than a privilege, nurses must acquire sufficient knowledge, skills, and attitudes to adapt to the ever-changing and developing technology and to benefit from the opportunities offered by technology (Kekec & Tan, 2021; Yaman et al, 2017; Mason et al, 2014). As it is already known, intensive care nurses are expected to have a high level of experience in the use of technology because intensive care units are complex units where high technology is used frequently (Kekec & Tan, 2021; Yaman et al,

2017). However, monitoring patients with severe physical conditions in intensive care units with monitors, supporting life functions, applying special treatment methods, and having alarm systems of complex devices such as ventilators and infusion pumps cause intensive care nurses to experience several problems (Yaman et al, 2017; Mason et al, 2014; Oren & Dagci, 2021). The use of alarm systems, especially in the follow-up and care of patients in ICUs, provides the opportunity to receive information from the patient without interruption and to evaluate the patient from a wider perspective, but it also leads to the formation of alarm fatigue in nurses who care for these patients (Ergezen Dursun & Kol, 2018).

Alarm fatigue is defined as “the fatigue, sensory overload, boredom, reluctance to hear, and depersonalization in parallel with exhaustion after some time” occurring when the nurse is exposed to loud and different alarms for longer times (Ergezen Dursun & Kol, 2018; Cvach, 2012). This concept is discussed in the literature as a condition reducing the trust and intervention of the physician and nurse to the alarm, by analogy with the crying wolf effect (Ergezen Dursun & Kol, 2018). Also, as a result of alarm fatigue, nurses may use methods such as “muting the alarm”, “deactivating the alarm”, “adjusting the alarm threshold values to unsafe ranges for the patient”, and “adjusting the alarm volume to a level that cannot be heard” (Ergezen Dursun & Kol, 2018; Lewandowska et al, 2020). However, alarm fatigue also creates an unsafe environment for patients by causing important patient events to be overlooked in life-threatening conditions. In this regard, the present study aimed to contribute to the literature data by examining the alarm fatigue level of nurses who have important roles in patient care in intensive care units and the factors affecting alarm fatigue.

Method

The Place, Population, and Sample of the Study

The study was conducted in a descriptive and cross-sectional design with nurses working in the Intensive Care Units of a State University Health Practice and Research Hospital between January and March 2022. The

population of the study consisted of the intensive care nurses working in the intensive care units of the institution, and the sample consisted of 121 intensive care nurses, who were willing to participate in the study (among the 137 intensive care nurses who were actively working in the institution during the study period). In this way, 88.32% of the study population was reached.

Data Collection: A Questionnaire and the Alert Fatigue Scale, which were created by scanning the literature data, were used to collect the study data.

Questionnaire: It included questions on nurses’ socio-demographic, professional, and technology use (Kekec & Tan, 2021; Yaman et al, 2017; Oren & Dagci, 2021).

Alarm Fatigue Scale: The scale was developed by Torabizadeh et al. in 2017 (Torabizadeh et al, 2017). Its validity and reliability in Turkish were conducted by Kahraman and Baskale in 2018. The scale consists of 9 questions and the score range varies between 0-36. High scores show the effects of alarm fatigue on nurses’ performance (Kahraman & Baskale, 2020).

Questionnaire Form and Application Process of the Scale: The data of the study were collected with face-to-face interview method in the units where the nurses who agreed to participate in the study worked on the days and hours deemed appropriate by the institution where the study was conducted. The application of the forms took 10-15 minutes.

Ethical Aspect of the Study: The study was conducted in line with the “Helsinki Declaration” and permission was obtained from the Clinical Research Ethics Committee (2021/34-04) from the hospital administrators and intensive care nurses to collect the data.

Analysis of Data: Numbers, percentages, and mean values were used in the evaluation of the data on descriptive characteristics. The One-Sample Kolmogorov-Smirnov Test was used to evaluate the homogeneity of the data. The Student’s *t* Test was used in binary groups, the One-Way Analysis of Variance and Kruskal Wallis Tests were used for more than two groups, and Tukey Post-Hoc Tests were used to correlate the scale scores with the descriptive variables.

Results

The Relationship Between Some Characteristics of the Intensive Care Nurses and Alarm Fatigue:

It was found that 64.5% of the intensive care nurses were women, 64.5% were married, 64.5% had a bachelor's degree, 47.1% worked day and night, and 26.4% worked in the intensive care unit for 6-10 years. Statistically significant relationships were detected between the age, marital status, working time in the profession and the intensive care unit, working type variables, and alarm fatigue score average of the intensive care nurses ($p < 0.05$) (Table 1).

The Relationship between Intensive Care Nurses' Conditions Regarding Technology Use and Alarm Fatigue:

A total of 36.4% of

the nurses only used mobile phones as a technological device, 42.1% allocated 2-3 hours a day to the use of technological devices, 50.4% thought that the technological devices in the unit were suitable for use, and 62.0% used technological devices in intensive care units. It was found that 61.2% of them considered that the use of technology affected their care and 61.2% of them had difficulties in using technological devices in intensive care units. Statistically significant relationships were detected between the type of technological device that nurses used most, the time allocated to technological devices daily, and the difficulty in using the technological devices in the unit and the mean alarm fatigue score ($p < 0.05$) (Table 2).

Table 1. The Comparison of Some Characteristics of the Intensive Care Nurses and Alarm Fatigue

Characteristics	n %	X ± SD	p /Test value
Gender			
Female	78 64.5	23.44 ±4.61	0.568 t = 1.571
Male	43 35.5	23.95 ±4.68	
Age			
19-24	10 8.3	26.50 ±4.35	0.003 F=4.314
25-30	26 21.3	25.88 ±4.46	
31-36	36 29.8	23.02 ±5.11	
37-41	16 13.2	22.56 ±3.81	
42 and above	33 27.3	22.06 ±3.69	
Marital status			
Married	78 64.5	22.04 ±4.52	0.042 t = 1.216
Single	43 35.5	24.32 ±4.76	
Education level			
High school	20 16.5	23.20±4.86	0.522 kW = 2.250
Associate Degree	38 31.5	22.89±3.91	
Undergraduate	58 47.9	24.22±5.05	
Graduate	5 4.1	24.07±3.53	

Length of work in the profession (years)			
	43	35.5	25.51±4.92
0-5	45	37.2	22.42±4.02
6-10	33	27.3	22.31±4.30
11 years and above			
Way of Working			
Only night	38	31.4	25.07±4.75
Daytime only	26	21.5	23.13±3.29
Day and night	57	47.1	24.70±4.67
Working time in Intensive Care (years)			
	71	58.7	24.46±4.91
0-5	32	26.4	23.71±5.05
6-10	18	14.9	22.81±4.97
10 years and above			
The Intensive Care Unit Worked In			
Newborn	13	10.7	24.20±4.31
Internal medicine	15	12.4	23.07±3.34
Cardiovascular	17	14.0	23.52±4.36
Coronary	16	13.2	23.04±4.41
Brain surgeon	16	13.2	24.06±4.22
Anesthesia	14	11.6	25.21±3.22
General Surgery	18	14.9	23.22±4.66
Chest	12	9.9	23.08±3.71
Alarm Fatigue Score	121	100	24.18 ± 4.60

SD: Standard Deviation, t: Student's T test, F: ANOVA test KW: Kruskal Wallis Test
p: Statistical significance level

Table 2. The Comparison of Intensive Care Nurses Regarding Technology Use and Alarm Fatigue

CHARACTERISTICS	n %	X ± SD	p / Test value
The type of technological device used most in daily life			
Mobile phone	44 36.4	24.31±4.60	0.025 F=1.077
Mobile phone and computer	36 29.8	25.30±4.59	
Mobile phone and tablet	16 13.2	25.56±4.33	
Mobile phone and tablet mobile phone, tablet, computer	25 20.7	26.13±4.08	
Average daily usage of technological devices			
Less than 1 hour	26 21.5	21.46±4.19	0.033 KW=2.742
1-2 hours	14 11.6	23.98±4.39	
Between 2-3 hours	51 42.1	25.26±4.93	
3 hours and more	30 24.8		
Are the technological devices in the unit suitable for use?			
Yes	61 50.4	24.51±4.21	0.422 t = 3.040
No	60 49.6	24.68±5.18	
Do technological devices affect the care given?			
Yes	75 62.0	23.94±4.80	0.477 t = 4.059
No	46 38.0	23.10±4.30	
Do you have difficulty using technological devices in the unit?			
Yes	74 61.2	25.31±4.71	0.042 t=2.711
No	47 38.8	23.46±3.25	
Please indicate the reason for the difficulty you experience while using a technological device.			
Lack of training in technology	15 20.3	24.66 ± 4.60	0.235 kW=2.041
Insufficient training provided	26 35.1	23.23±5.04	
The language of the devices is in English	9 12.2	23.50±3.04	
Failure in technology use	15 20.3	21.22±3.70	
Not thinking that one will not use technological devices correctly	9 12.2	22.44±4.01	

Discussion

Alarm fatigue is a problem faced by all healthcare professionals, especially intensive care nurses who provide care for patients (Oren & Dagci, 2021; Cvach, 2012). Especially since nurses are the primarily responsible healthcare team in patient follow-up, they are at the forefront of experiencing alarm fatigue (Karagozoglu et al, 2014). Alarm fatigue affects patient safety, the health of patients and healthcare professionals, and the quality of care significantly. In the present study, the level of alarm fatigue of intensive care nurses and the factors affecting it was investigated.

Many medical technological devices have more than one alarm system for each patient in the intensive care units, where the treatment and care of patients who are struggling for life are provided (Ergezen Dursun & Kol, 2018; Cvach, 2012; Oren & Dagci, 2021). Among the current technologies used most frequently by nurses in intensive care units and that direct the care of intensive care patients, information technology systems, infusion systems with programmed barcodes, monitors, ventilators, and intravenous infusion pumps can be listed (Oren & Dagci, 2021; Mason et al, 2014; Torabizadeh et al, 2017). However, these alarm systems, which are integrated to notify health workers of negative changes in patient physiology and treatment process, may also pose a threat to intensive care nurses in the fields of healthcare and work performance in time (Oren & Dagci, 2021; Ergezen Dursun & Kol, 2018; Storm & Chen, 2021). In the present study, the alarm fatigue level of the intensive care nurses was found to be 24.18 ± 4.60 at a "moderate" level, and the intensive care nurses with the highest alarm fatigue were those who worked in the anesthesia intensive care unit (25.21 ± 3.22), the neonatal intensive care unit (24.20 ± 4.31) and the neurosurgery intensive care unit (24.06 ± 4.22). In the study of Storm and Chen, it was reported that most of the nurses experienced alarm fatigue (Storm & Chen, 2021). In a study conducted by Asadi et al. that examined the level of alarm fatigue of intensive care nurses during the COVID-19 period, it was reported that the level of alarm fatigue was quite high (Asadi et al, 2022). It was reported in the multicenter study of Carelli et al. that the level of alarm

fatigue of intensive care nurses was high and prolonged fatigue affected the lives of nurses in many aspects (Carelli et al, 2022). In this study, it was found that demographic characteristics of nurses such as age and marital status affected alarm fatigue and single intensive care nurses experienced statistically higher levels of alarm fatigue when compared to their married colleagues and nurses with a younger age than those with a higher mean age ($p < 0.05$). It was also determined that the working time and working style in the occupational-intensive care unit affected the level of alarm fatigue. However, there are also studies in the literature reporting that alarm fatigue decreases with increasing age and that single people have a higher alarm fatigue level (Storm & Chen, 2021; Asadi et al, 2022). This can be explained by the fact that young and single people spend more time with technological devices and are more sensitive to alarms that come from medical devices.

Rapidly developing science and technology in the 21st century seriously affected the future of individuals and societies along with the way they access, use, and produce information. Based on this aspect, technology has a priority place in both professional and individual fields of many people (Cansoy, 2018). The use of technology-based devices makes daily life easier, but also brings with it some problems (Kalaman et al, 2019). Although the majority (36.4%) of the nurses who participated in the study stated that they only used mobile phones, it was determined that the use of multiple technological devices was also common. It was also determined that the level of alarm fatigue increased statistically significantly with the increase in the number of technological devices used ($p < 0.05$). On the other hand, it was found that the level of alarm fatigue of nurses who had a daily technology usage time of three hours or more was higher than those with a daily use of technological devices between 0-1 hour ($p < 0.05$). In a study conducted by Terkes et al. that examined the attitudes of intensive care nurses towards using technology, it was reported that 97.8% of the nurses used smart mobile phones (Terkes et al, 2018). It was determined in another study that the level of anxiety and stress increased with the increase in the duration of technology-based social

media use of university students studying in the field of health sciences (Bilge et al,2020). In a study that was conducted with nursing department students, it was found that the prevalence of social media use increased the level of nomophobia, and this would negatively affect the quality of care by increasing distraction (Gutierrez-puertas et al, 2019). Eroglu and Kutlu reported in their study that the increased time that nurses allocated to the use of technology-based social media affected time management and productivity negatively (Eroglu&Kutlu, 2020). Social media and internet addiction issues are examined in the literature as a common problem with the use of technological devices by healthcare professionals. In this respect, it was reported that the increasing addiction rate brings different problems in the lives of users.

Nurses often use computer-based care processes in planning and implementing care, computers and different software systems in the electronic medical record system, and many devices in accessing information and communicating between teams (Konukbay et al, 2020). In the present study, the majority of intensive care nurses (62.0%) considered that technology-based medical devices affected nursing care, 61.2% had difficulty using technological devices, and the most common reasons for having difficulty using technological care-treatment devices were found to be factors such as insufficient level of training in the use of technological medical devices (35.1%), lack of training in the use of technological medical devices (20.3%), and feeling unsuccessful in using technological devices (20.3%). In the study of Yaman Aktas et al., it was reported that all of the intensive care nurses considered that technological devices affected care and the attitudes of the nurses towards the use of technological devices were positive (Yaman Aktas et al, 2017). In the study of Terkes et al., it was found that the majority of nurses considered that technology-based devices facilitated clinical functioning and had positive attitudes toward technology use (Terkes et al, 2018). In this study, the opinions of intensive care nurses about technological devices are similar to the literature.

Conclusion and Recommendations: It was found that the alarm fatigue of intensive care

nurses was moderate and alarm fatigue was associated with age, marital status, occupation, and working time in the intensive care unit. It was also found that the technological devices that nurses use in their daily life and the duration of use of technological devices affect alarm fatigue. The majority of intensive care nurses considered that the use of technology-based devices affected care, but they had difficulty using technological devices due to the lack of education and inadequacy. In this respect, it is recommended to evaluate the level of alarm fatigue of nurses, to raise awareness about the effects of technological devices on body, mind, and mental health, and to organize professional training programs on technological devices that are frequently used in intensive care units of institutions.

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