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The Association between Alarm Fatigue, and Burnout among Nurses in Critical Care Units

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ABSTRACT

Objective(s): To examine the association between alarm fatigue and burnout among nurses working in adult critical care units.

Methods: A descriptive-correlational study design was used targeting 377 nurses practicing in critical care units within 13 hospitals in Iraq. Data gathering extended for the period from January 6th, 2024 to March 7th 2024, by investigating sociodemographic, professional characteristics of nurses, and alarm fatigue questionnaire, and the Burnout Assessment Tool.

Results: Overall, 240 out of 377 nurses in critical care units showed a moderate degree of alarm fatigue, with a percentage of 63.7%. Of equal importance, the majority of nurses suffered from high levels of burnout, with a mean score of 2.53. The Pearson correlation (r =.441 at p = 0.01) also showed a positive association between alarm fatigue and burnout among nurses in critical care units.

Conclusion: This study illuminated the statistically significant positive correlations between nurse's alarm fatigue and each dimension of burnout (exhaustion, mental distance, cognitive impairment, emotional impairment, psychological complaints, psychosomatic complaints, secondary symptoms, and overall burnout).

Recommendations: The provision of training sessions on stress management, building resilience strategies, and coping techniques provide nurses with the necessary tools to more effectively navigate the challenges of their profession. Furthermore, it is crucial to replicate this study in critical care units in other governorates of Iraq to compare and improve the generalization of the findings.

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العلاقة بين الاعياء الناتج عن الإنذار، والإرهاق الوظيفي بين الملاكات التمريضية في وحدات الرعاية الحرجة

المستخلص

الاهداف: لفحص العلاقة بين الاعياء الناتج عن الإنذار و الإرهاق الوظيفي بين الملاكات التمريضية العاملة في وحدات الرعاية الحرجة للبالغين.

المنهجية: تم استخدام تصميم الدراسة الوصفية الارتباطية مستهدفا 377 ممرص(ه) من العاملين في وحدات الرعاية الحرجة في 13 مستشفى في العراق. امتد جمع البيانات للمدة من 6 كانون الثاني 2024 إلى 7 اذار 2024 بتقصي الخصائص الاجتماعية والديموغرافية والمهنية للملاكات التمريضية ، واستبيان إعياء الإنذار، وأداة تقييم الإرهاق الوظيفي .

النتائج: بشكل عام، أظهر 240 من أصل 377 ممرضًا في وحدات الرعاية الحرجة درجة معتدلة من إعياء الإنذار، بنسبة مئوية قدرها 63.7%. وعلى نفس القدر من الاهمية, فأن غالبية الملاكات التمريضية عانين من مستويات عالية من الإرهاق الوظيفي ، بمتوسط درجة قدرها 2.53. كما أظهر ارتباط بيرسون (r =.441 at p = 0.01) وجود علاقة إيجابية بين الاعياء الناتج عن الإنذار والإرهاق بين الملاكات التمريضية في وحدات الرعاية الحرجة.

الاستنتاجات: سلطت هذه الدراسة الضوء على الارتباطات الإيجابية ذات الدلالة الإحصائية المعنوية بين الاعياء الناتج عن الإنذار الملاكات التمريضية وكل بعد من ابعاد الإرهاق الوظيفي (البعد العقلي، والضعف الإدراكي، والضعف العاطفي، والشكاوى النفسية، والشكاوى النفسية الجسدية، والأعراض الثانوية، والإرهاق العام).

التوصيات: إن توفير الدورات التدريبية حول إدارة التوتر، وبناء استراتيجيات المرونة، وتقنيات التكيف يوفر للممرضات الأدوات اللازمة للتغلب على تحديات مهنتهم بشكل أكثر فعالية. علاوة على ذلك، من المهم تكرار هذه الدراسة في وحدات الرعاية الحرجة في محافظات العراق الأخرى لمقارنة وتحسين تعميم النتائج.

الكلمات المفتاحية: إعياء الإنذار، الإرهاق، الملاكات التمريضية، وحدات الرعاية الحرجة.

Introduction

The continuous development in health care industry and technology today have enabled hospitals to utilize a wide-array of instruments and machines that have the potential to improve daily clinical practice [(1)]. These instruments and machines may be present in all healthcare settings, but particularly prevalent in critical care and other intense medical environments in which patients are continuously exposed to monitoring using devices that are capable of warning health care providers via specialized alarm systems [(2,3)].

In 1983, there were fewer than six different types of medical alarms used for patient monitoring; however, two decades later, the quantity had escalated to over forty kinds [(4)]. In intensive care units, clinical alarms from monitoring devices are one of the greatest essential techniques to alert health care providers for immediate or possible dangers jeopardizing the lives and well-being of patients' [(5)].

Monitoring technology within the ICU setting is the exclusive responsibility of the in-charge nurses [(6)]. A critical care nurse is an individual who administers immediate care to patients who are critically ill or injured [(7)]. In a critical care setting, critical care nurses execute many vital roles, such as nurse practitioners, staff nurses, case managers, clinical nurse specialists, and nurse researchers [(8)]. Nurses working in critical care remain the main providers of health care and are in charge of providing efficient direct care to patients, monitoring them 24 hours a day [(9)]. However, nurses are constantly faced with double burdens when practicing their complex and multi-faceted roles [(10)].

Execution of these multifaceted responsibilities may expose them to various occupational hazards, including infections acquired in hospitals environment, physical violent, intervertebral disc herniation,

compassion with fatigue, anxiety, depression, stress, moral distress, sleep disturbance, illness risk, and alarm fatigue and burnout [11,12,13,14,15,16,17,18,19,20]. ICU nurses are subjected to numerous alarms throughout their shifts [21]. Most alarms are false alarms that do not indicate a worsening of patient's conditions [22,23]. Nevertheless, it is both professional and ethical obligation that nurses should not ignore any alarm [24]. In 2014, the Emergency Care Research Institute (ECRI) indicted that life-saving equipment technology which produce frequent alarms made clinical work more challenging for all health care professionals in particularly nurses [25].

The ECRI registered the alarm threat at the top of the list of ten health technology hazards to be established [26]. Simultaneously, repeated alarms may result in healthcare personnel either not intervening or delaying their response to alarm signals. In some cases, they might delay or disregard the alarm information altogether. This phenomenon is known as alarm fatigue [27]. Alarm fatigue, is an insensitive state caused by excessive alarm exposure, which could lead nurses to switch off or muffler alarms, as a large number of non-actionable alarms causes nurses to diminish their response time and decrease confidence with alarms [28].

The literature had recognized five distinct reasons for alarm fatigue: features of systemic monitoring (like ringtones, minimal accuracy, pitch), patient features (like aging, examination, psychological state, mechanical ventilation, ventricular arrhythmias ,wide QRS or low amplitude.), job-associated elements (including job load, work experiences, many duties), and organizational features (like unit environment , workflow, planning, as well as protection policy), lastly, twofold factors workload and organizational aspects being possible to modify[29].

Carelli et al., [30] were the first researchers who documented alarm fatigue spread within the hospital setting in Europe as well as dissecting the relationship among special alarm fatigue demeanors and professional mal-practice. According to studies, an approximate 80–99% of alarms occurrence are incorrectly triggered, due to mixture of individual, institutional, as well as technological reasons [31,32]. Petersen and Costanzo [33] have estimated that about 88% of nurses concurred that nuisance alarms happen with unacceptable frequency, while 96% reported that alarms interfere with providing care to patients. Researchers in the Netherlands estimated that a 24-hour median noise level in the ICUs was 55.4 ± 5.7 decibels [34]. The National Ministry of Environment recommended that the noise level in hospitals is to be maintained below the level of 40 dBA at night and below 50 dBA during the day [35].

Likewise, nursing staff who encounter a higher level of alarm fatigue are closely at risk of suffering from burnout, which could affect the quality of healthcare they provide as well as threaten their patient's security [36]. Burnout is a mental state resulting in the exhaustion in both physical and psychological power that is caused by prolonged unsolved job related stress as well as ineffectual coping mechanism [37].

Burnout is widespread in many healthcare professions; however, it is most prevalent in nursing, due to the fact that routine responsibilities frequently demands engage into strong personal interactions with patients [38]. Nurses, as a community, are susceptible to burnout due to numerous reasons, including a demanding working atmosphere [39]. Recurrent exposure to aggressive actions [40]. The absence of autonomy [41]. In addition to an enormous workload [42]. Further investigation has shown that critical care unit nurses may be more susceptible to burnout when the staffing ratio is inadequate, of $\geq$ 1:2 [43]. As an illustration, there is a correlation between high levels of

burnout among nurses and inadequate staffing ratios [44]. Employment in stressful environments could lead to burnout [45,46]. However, such claim need to be empirically examined. Therefore, this study is basically designed to fill that highlighted gap.

As a direct result, nurses may experience a wide-range of symptoms, including severe headaches, sleeplessness, fatigue, irritability, digestive disorders, irritation, burnout, an absence of energy, breathing problems and an abnormal fluctuation in body weight [47,48,49]. Furthermore, nurses exhibiting burnout symptoms continue to exhibit both physical and mental manifestations such as tension, tiredness, depression, and overall job dissatisfaction [50]. Extensive documentation exists regarding the negative effect of burnout on interpersonal relationships and home life; additionally, burnout has been associated with an increased susceptibility to physical illnesses, including cardiovascular illnesses, an elevated level of blood pressure, and sleep difficulties [51,52,53].

The present study undertaking is especially needed in such an intensive field like critical care nursing. This study, is the first of its kind in Iraq that examines association between alarm fatigue and burnout among critical care unit nurses, using a newly developed burnout assessment tool. The significance of presenting the study at the current time is justified considering the increased number of patients requiring treatment in the critical care setting over the past years, mainly the elderly and patients with acute and chronic life-threatening diseases [54,55], has resulted in too many devices producing alarms and contributing to alarm fatigue in nurses [56].

The expected results of conducting this study will be important for national health care policymakers in the nurses' recruitment process. Thus, this study aimed to answer the following research question: Is there an association between alarm fatigue and burnout among nurses in critical care units?

Methods

Study design

A descriptive correlational design was used for the study. Descriptive correlation studies are used to offer static descriptions of situations and determine whether a relationship exists between variables without manipulation or control of the variables.

Study Setting

The study was conducted at 13 Teaching Hospitals across the Republic of Iraq.

Sample and Sampling

A non-probability purposive sampling method was used. The study sample targeted staff nurses who worked in critical care units (respiratory and cardiac care units).

Data Collection

Data gathering started from January 4th, 2024 to March 7th 2024. The participants' answered the questionnaire independently. Each self-report questionnaire filled out took nearly 15 to 20 minutes. The minimum size of the sample was calculated according to the Raosoft® sample size calculator, whereas the confidence level was 0.95 and the margin error was 0.05. A total of 377 was the recommended minimum sample size.

Female and male nurses were both participants in the study, with a response rate of 89%. Inclusion Criteria: nurses who were practicing direct clinical nursing in critical care units, both morning, evening, and night shifts, were included. Staff nurses who consented to participate in the study. Newly appointed nurses are nurses who have recently graduated from nursing school and are new to the profession with less than one year of experience. It is hypothesized that the newly appointed nurses are more susceptible to alarm fatigue and burnout. That is why they were added to the study. All nurses who refused to participate in the study, nurses who did not complete the questionnaire, and nurses

who do not perform direct clinical tasks and are content with administrative work were excluded.

Study Instruments

The research questionnaire involves four sections: section one, sociodemographic characteristics of nurses, and is detailed in Table 1. Section two consisted of the professional characteristics of nurses, as detailed in table 2. Section three involved the Arabic version of the Nurses Alarm Fatigue Questionnaire, which was used to assess alarm fatigue of nurses [57]. The 13 items in the above-mentioned questionnaire are self-reported items. The assessment and measurement of the questionnaire are conducted using a five-level Likert rating scale, beginning from 1 to 5, where 1 represents (never), 2 represents (rarely), 3 represents (occasionally), 4 represents (usually), and 5 represents (always). With the exception of items 1 and 9, which have a reverse score. For instance, when participants choose “never” for items 1 or 9, it is scored as 4, demonstrating the excessive effect of alarm fatigue. Conversely, choosing “always” for items 1 and 9 results in a score of 0, demonstrating that the responding nurse is acting correctly. Nurses Alarm Fatigue questionnaire scores range between 8 (minimum) and 44 (maximum), with greater scores indicating a greater impact of alarm fatigue on nurses' performance.

Section four involves the Burnout Assessment Tool (BAT). Schaufeli et al., [58] were the researchers who developed the English version of the BAT. The BAT includes 33 items, which involve the Burnout Assessment Tool Core Symptoms (BAT-C) and Burnout Assessment Tool Secondary Symptoms (BAT-S). The BAT-C evaluates four core dimensions. The first dimension of the core symptom of the burnout assessment tool is exhaustion; the second dimension is mental distance; the third dimension is emotional impairment; the fourth dimension is cognitive impairment; and it contains 23 items. While the BAT-S evaluates the two secondary dimensions, the first dimension of the burnout assessment tool secondary symptom is psychological distress, and the second dimension is psychosomatic complaints, which consist of 10 items.

Both are rated using a Likert scale consisting of five points, ranging from 1 to 5. With 1 demonstrating (never), 2 demonstrating (rarely), 3 demonstrating (sometimes), 4 demonstrating (often), and 5 demonstrating (always). Authorization was acquired from the corresponding author to evaluate the burnout tool psychometric properties when translated into Arabic. The English version of the burnout tool was obtained. A back-to-back approach was used to translate the English version. Initially, certified bilingual specialists in both fields of professional nursing and English-Arabic languages undertook the translation of the burnout tool from English into Arabic. The process is then reversed by having other certified bilingual experts in both fields of professional nursing and English-Arabic translate it back from its Arabic form into English version. Finally, a revised and agreed upon version was produced.

Due to the use of Arabic versions of the alarm fatigue questionnaire, permissions obtained from the corresponding author to use the Arabic version, validity and reliability were not retested. Nevertheless, burnout tool validity and reliability were tested when translated into Arabic version. For the Content Validity Index (CVI), the Arabic versions of the burnout tool were presented to an expert panel of ten faculty members to rate the level of relevance of the items. The CVI of the burnout tool is 0.97, which indicates an excellent content validity level for the Arabic version of the burnout tool, indicating that the tested tool is capable to measure what it is intended to measure [59]. Reliability was assessed in a pilot study with 38 nurses, and

the researchers in the pilot study sampling found that nurses had a clear understanding of each item of the burnout tool. Likewise, the researcher was not questioned on any items during the pilot study to clarify any item with Cronbach's alpha (0.91). Then reliability was tested with 377 nurses, achieving a Cronbach's alpha of 0.926.

Data Analysis

The data were analyzed using version 24 of the IBM Statistical Package for the Social Sciences (SPSS). Descriptive statistics and inferential methods were used. In order to analyze the sociodemographic data, professional characteristics, nurses alarm fatigue level, and burnout level, descriptive statistics were applied. The association between alarm fatigue and burnout among nurses in critical care units was determined using Pearson correlation.

Ethical Consideration

The ethical committee in Iraq at the University of Baghdad College of Nursing approved the study, and ethical approval was gained from the University of Baghdad College of Nursing Committee of Scientific Research (CSR) number 2, on November 22nd, 2023. On December 17th, 2023, an official agreement was obtained from the Ministry of Planning (Central Statistical Organization). The researchers undertake to keep participant identifying details private and to use the collected data without producing any actual or possible damage to the study participant. The study tool was designed to protect the participant's right to privacy. After obtaining the official agreement from hospitals, participants were offered the right to participate freely in the research by signing an informed consent agreement and being said them that their involvement was voluntary with the assurance that the data would be kept strictly confidential and used for scientific study only. The researchers have effectively finished the Human Research Protection Foundation Training of the Office of Human Research Protection (OHRP) with 5 lessons and 5 certificates on 9/1/2024.

Results

Table 1. Participants' Socio-demographic Characteristics (N = 377)

Variable	Frequency	Percent
Age (Years): Mean (SD): 29.14 ± 7.34		
21-28	240	63.7
29-36	88	23.3
37-44	26	6.9
45-52	15	4.0
53-60	8	2.1
Sex		
Male	159	42.2
Female	218	57.8
Marital Status		
Single	173	45.9
Married	198	52.5
Divorced	4	1.1
Widow/Widower	2	0.5
Educational Qualification		
Nursing high school	59	15.6
Associate degree in Nursing	153	40.6

Bachelor's degree in Nursing	156	41.4
Postgraduate diploma in Nursing	3	0.8
Master's degree in Nursing	6	1.6
Residency		
Rural	32	8.5
Urban	345	91.5

SD= Standard Deviation

According to the data presented in Table 1, with a mean age of 29.14 ± 7.34, the preponderance of participants was aged between 21-28-years (*n = 240*; 63.7%). This is followed by individuals between the ages of 29-36-years (*n = 88*; 23.3%), 37 to 44-years (*n = 26*; 6.9%), 45 to 52-years (*n = 15*; 4.0%), and 53 to 60-years (*n = 8*; 2.1%). In terms of participants' sex, more than half were females (*n = 218*; 57.8%) compared to males (*n = 159*; 42.2%).

Regarding marital status, more than half reported being married (*n = 198*; 52.5%), followed by singles (*n = 173*; 45.9%), divorced (*n = 4*; 1.1%), and Widow/Widower (*n = 2*; 0.5%).

In terms of educational qualification, more than two-fifths hold bachelor's degrees (*n = 156*; 41.4%). This is followed by individuals with an associate degree (*n = 153*; 40.6%), nursing high school graduates (*n = 59*; 15.6%), master's degree owners (*n = 6*; 1.6%), then postgraduate diploma owners (*n = 3*; 0.8%). Concerning residency, a significant majority of respondents reported that they have lived in urban areas (*n = 345*; 91.5%) in contrast to individuals who have resided in rural regions (*n = 32*; 8.5%).

Table 2. Participants' Professional Characteristics (N = 377)

Variable	**Frequency**	**Percent**
Current workplace		
Cardiac Care Unit for male Patients	13	3.4
Cardiac Care Unit for female Patients	6	1.6
Cardiac Care Unit for male and female Patients	114	30.2
Intensive Care Unit for male Patients	4	1.1
Intensive Care Unit for female Patients	6	1.6
Intensive Care Unit for male and female Patient	234	62.1
Work Shift		
Morning shift	185	49.1
Evening shift (2:30 p.m. – 8:30 a.m.)	183	48.5
Night shift (8:30 p.m. – 8:30 a.m.)	9	2.4
Nurse-to-Bed Ratio		
3:1	49	13.0
2:1	62	16.4
1:1	111	29.4
1:2	49	13.0
1:3	49	13.0
1:4 or more	57	15.1
Participation in electronic monitoring devices training programs		
Yes	195	51.7
No	182	48.3
Participation in Mechanical Ventilator Training		
Yes	182	48.3
No	195	51.7

Receiving Psychological Counseling		
Yes	88	23.3
No	289	76.7
Having a second job		
Yes	113	30.0
No	264	70.0
Years of working: Mean (SD): 6.168 ± 6.74		
Years of experience in the current unit: Mean (SD): 4.01 ± 4.5		
The mean time span of daily work hours in direct clinical nursing is 11.81 ± 5.90 (SD)		

SD= Standard Deviation; **MS**= Mean of Scores

As shown in Table 2, in terms of the current unit where nurses are employed, most nurses work in the intensive care unit for male and female patients (*n = 234*; 62.1%). Following this are nurses who work in the cardiac care unit for both male and female patients (*n = 114*; 30.2%), those who work in the cardiac care unit for male patients (*n = 13*; 3.4%), those who work in each of the cardiac care units for female patients and the intensive care unit for female patients (*n = 6*; 1.6%) for each of them, and those who work in the intensive care unit for male patients (*n = 4*; 1.1%).

Regarding work shift, less than half work in morning shift (*n = 185*; 49.1%), followed by those who work in evening shift (2:30 p.m. – 8:30 a.m.) (*n = 183*; 48.5%), and those who work in night shift (8:30 p.m. – 8:30 a.m.) (*n = 9*; 2.4%). With respect to nurse-to-bed ratio, such a ratio is 1:1 for less than a third (*n = 111*; 29.4%), followed by 2:1 (*n = 62*; 16.4%), 1: 4 or more (*n = 57*; 15.1%), and 1:2 and 1:4 (*n = 49*; 13.0%) for each of them.

As per participation in training programs, more than half reported that they participated in such programs (*n = 195*; 51.7%) compared to those who did not participate (*n = 182*; 48.3%). Concerning participation in mechanical ventilator training, more than half reported that they did not participate in such a training (*n = 195*; 51.7%) compared to those who participated in it (*n = 182*; 48.3%). Regarding receiving psychological counseling, most reported that they did not receive such a counseling (*n = 289*; 76.7%) compared to those who reported that they received it (*n = 88*; 23.3%). With respect to having a second job, most reported that they do not have it (*n = 264*; 70.0%). The mean of years of working is 6.168 ± 6.74, the mean of years of experience in the current unit is 4.01 ± 4.5, and the mean of time span is 11.81 ± 5.90.

Table 3. Nurse Alarm Fatigue Level

Nurse Alarm Fatigue Level	Frequency	Percent
Low	91	24.1
Moderate	240	63.7
High	46	12.2

Nurses Alarm Fatigue questionnaire scores range based on8-20= low, 20-32= Moderate, 32-44= High.

As shown in Table 3, the study results display that most nurses experience moderate level of alarm fatigue (*n = 240*; 63.7%), followed by those who experience low level (*n = 91*; 24.1%), and those who experience high level (*n = 46*; 12.2%).

Table 4. Levels of Burnout (N = 377)

Sub-Scales	Mean	SD	Asses*
Exhaustion			
At work, I feel mentally exhausted.	2.52	1.17	Medium
Everything I do at work requires a great deal of effort.	3.87	1.17	Very High
After a day at work, I find it hard to recover my energy.	3.48	1.27	High
At work, I feel physically exhausted.	3.45	1.23	High
When I get up in the morning, I lack the energy to start a new day at work.	3.14	1.36	High
I want to be active at work, but somehow, I am unable to manage.	2.55	1.31	Medium
When I exert myself at work, I quickly get tired.	2.36	1.23	Medium
At the end of my working day, I feel mentally exhausted and drained.	3.18	1.34	High
Overall Assessment	**3.07**	**0.90**	**High**
Mental Distance			
I struggle to find any enthusiasm for my work.	3.47	1.42	High
At work, I do not think much about what I am doing and I function on autopilot.	2.47	1.39	High
I feel a strong aversion towards my job.	1.92	1.22	Medium
I feel indifferent about my job.	1.39	0.86	Medium
I'm cynical about what my work means to others.	1.66	1.16	Medium
Overall Assessment	**2.18**	**0.78**	**Medium**
Cognitive impairment			
At work, I have trouble staying focused.	2.00	1.09	Medium
At work I struggle to think clearly.	2.06	1.09	Medium
I'm forgetful and distracted at work.	1.87	1.11	Medium
When I'm working, I have trouble concentrating.	1.84	1.04	Medium
I make mistakes in my work because I have my mind on other things.	1.49	0.87	Low
Overall Assessment	**1.85**	**0.84**	**Medium**
Emotional impairment			
At work, I feel unable to control my emotions.	2.03	1.17	Medium
I do not recognize myself in the way I react emotionally at work.	2.02	1.07	Medium
During my work I become irritable when things don't go my way.	2.55	1.31	High

I get upset or sad at work without knowing why.	2.19	1.17	Medium
At work I may overreact unintentionally.	2.05	1.15	Medium
Overall Assessment	**2.17**	**0.86**	**Medium**
Psychological distress			
I have trouble falling or staying asleep.	2.89	1.47	High
I tend to worry.	2.49	1.31	Medium
I feel tense and stressed.	2.49	1.37	Medium
I feel anxious and/or suffer from panic attacks.	2.06	1.27	Medium
Noise and crowds disturb me.	3.63	1.36	Very High
Overall Assessment	**2.71**	**1.04**	**Medium**
Psychosomatic complaints			
I suffer from palpitations or chest pain.	2.15	1.23	Medium
I suffer from stomach and/or intestinal complaints.	2.45	1.34	Medium
I suffer from headaches.	3.23	1.29	High
I suffer from muscle pain, for example in the neck, shoulder or back.	3.53	1.31	Very High
I often get sick.	3.00	1.14	High
Overall Assessment	**2.87**	**0.93**	**High**
Burnout			
Overall Assessment	**2.53**	**0.67**	**High**

SD= Standard Deviation; **MS**= Mean of Scores; Scoring based on Statistical norms for Flemish employees (BAT-23).

According to the findings presented in Table 4, nurses experience a high level of exhaustion at mean score equal to (3.07), with medium level of mental distance at mean score equal to (2.18), medium level of cognitive impairment at mean score equal to (1.85), medium level of emotional impairment at mean score equal to (2.17), medium level of psychological distress at mean score equal to (2.71), high level of psychosomatic complaints at mean score equal to (2.87), and overall assessment of the burnout from the nurses is high, at mean score equal to (2.53).

Table 5. Burnout Assessment Tool Scoring.

	Total core	**Exhaustion**	**Mental distance**	**Emotional impairment**	**Cognitive impairment**	**Secondary symptoms**
Low	**1.00 – 1.60**	**1.00 – 1.75**	**1.00 – 1.20**	**1.00 – 1.20**	**1.00 – 1.80**	**1.00 – 1.70**
Average	**1.61 – 2.40**	**1.76 – 2.70**	**1.21 – 2.40**	**1.21 – 2.19**	**1.81 – 2.59**	**1.71 – 2.75**
High	**2.41– 3.29**	**2.71 – 3.74**	**2.41 – 3.59**	**2.20 – 3.19**	**2.60 –3.39**	**2.76 – 3.50**
Very high	**3.30 – 5.00**	**3.75 – 5.00**	**3.60 – 5.00**	**3.20 – 5.00**	**3.40 – 5.00**	**3.51– 5.00**

Table 5 present the total scoring for measuring burnout, categorized into “Total core, Exhaustion, Mental distance, Emotional impairment, Cognitive impairment, and Secondary symptoms.” Each category is scored on a scale from 1.00 to 5.00 and is classified into four levels: “Low, Average, High, and Very high.” The table provides detailed numerical ranges for each level

within every category, permitting for the interpretation of an individual's burnout severity across these different aspects.

Table 6. Correlation between Nurse Alarm Fatigue, and Burnout.

1. Nurses' alarm fatigue	-.080	-.065	-.096
2. Exhaustion	.458**		
3. Mental Distance	368**		
4. Cognitive impairment	.342**		
5. Emotional Impairment	.376**		
6. Psychological complaint	.292**		
7. Psychosomatic complaints	.237**		
8. Secondary Symptoms	.307**		
9. Burnout	.441**		

**. Correlation is significant at the 0.01 level (2-tailed). Spearman rho correlation

Based on the findings presented in Table 6, the research indicates that there are statistically significant positive correlations between nurse alarm fatigue and each of exhaustion, mental distance, cognitive impairment, emotional impairment, psychological complaint, psychosomatic complaints, secondary symptoms, and overall burnout (r =.458 at p = 0.01; r =.368 at p = 0.01; r =.342 at p = 0.01; r =.376 at p = 0.01; r =.292 at p = 0.01; r =.237 at p = 0.01; r =.307 at p = 0.01; r =.441 at p = 0.01), respectively.

Discussion

The ICU environment is widely recognized as a source of tension, not only for patients and family members but also for health care staff [(60)]. Therefore, the central point of this research is to investigate the association between alarm fatigue and burnout among nurses in critical care units. This study is the first descriptive correlational design to identify the association between alarm fatigue and burnout among nurses in critical care units in Iraq. The main results of this study shows that association between alarm fatigue and burnout among critical care nurses was authenticated. Of equal importance, positive correlations among nurse alarm fatigue and each of exhaustion, mental distance, cognitive impairment, emotional impairment, psychological complaints, psychosomatic complaints, secondary symptoms, and overall burnout were empirically authenticated, as presented in Table 6. As presented in Table 3, the level of alarm fatigue in this study was moderate among nurses in critical care units. These results agree with the descriptive analytical study, which aimed to identify the incidence of alarm fatigue and related factors among 308 nurses in intensive care units within 11 hospitals, and they found in their study that the majority of the sample (63.3%) had a medium level of alarm fatigue [(61)]. These results were not surprising to the researchers due to the fact that nurses in critical care units are on the front lines of patient care and are routinely responsible for monitoring multiple patients [(62)]. At the same time, they are bombarded with various alarms throughout their shift, many of which may be false alarms or non-critical alarms. Nurses spend an extensive amount of time investigating and responding to these false alarms, which may contribute to alarm fatigue in nurses [(63)].

Equally important, as presented in Table 4, the mean score of the overall burnout is (2.53) indicating a high level of burnout among nurses with a high level of exhaustion. This result was confirmed by a study that aimed to examine the association among burnout and professional quality of life among 109 nurses in the ICU during the COVID-19 epidemic, and they found in their study that the average score of exhaustion (3.13), which was higher than disengagement

(2.43); however, both results demonstrated a high level of burnout among nurses [64]. These results were not surprising to the researcher due to the fact that nurses in critical care units provide care for patients with life-threatening conditions during their shift; thus, they become easily exhausted and tired as a result of heavy workloads and long work hours, making it difficult for them to start a new workday with energy and vigor, ultimately contributing to burnout among them [65].

No less important, the current study revealed that nurses exhibited a medium level of mental distance, as illustrated in Table 4. These findings contradict the study, which aimed to investigate burnout and assess the role of occupation demand resources and work abilities on burnout levels among 204 emergency nurses in South Africa, and they found in their study that the mean score for mental distance was (2.74) which indicates a high level of mental distance among emergency nurses [66]. Both results highlighted that nurses who first commence practicing in critical care units are excited and motivated; nonetheless, when the workplace environment fails to provide adequate support for the nurse's effort and realities, their expectations begin to diverge, frustration and disappointment may increase, and job dissatisfaction can rise, resulting in reduced production, a decline in self-assurance and a loss of enthusiasm, and a greater likelihood of developing mental distance and burnout [67].

Of equal importance, the current study has also shown that the mean score of cognitive impairment is (1.85) indicating a moderate level, as illustrated in Table 4. This comes in a disagreement with the study, which aims to investigate the relationship among destructive leadership, employment requirements, resources, and burnout among 2115 nurses in Finland, and they found in their study that the mean score for cognitive impairment was (2.60), which indicates a high level of cognitive impairment among Finnish nurses [68]. These findings were not surprising to the researcher because nurses routinely work in a highly stressful environment with a high workload, long work hours, and may experience the need to make rapid decisions under pressure on a regular basis touching life-death aspect. All these factors contribute to impaired cognitive function, leading to difficulties in concentration, memory problems, impaired judgement, and an increased the likelihood of making mistakes, which negatively and directly affects patient care [69].

Equivalently significant, the current study displayed that there is a medium level of emotional impairment among nurses, as presented in table 4. The same result was confirmed by a cross-sectional-analytical study, which aimed to investigate the impact of burnout on the quality of life among 83 nurses in an emergency unit. They found in their study that emotional impairment was (55.4%) which indicates a medium level of emotional impairment among nurses [70]. This result highlighted the fact that nurses working in critical care units are continuously exposed to traumatic incidents, patient suffering, high pressure situations, providing care for critically-ill patients, supporting patients and their families, and dealing with death-and-life situations. This may lead nurses to an exaggerated level of empathy feeling for patients and their families, resulting in feelings of helplessness and sadness. Over time, emotional impairment can occur, making nurses more vulnerable to burnout [71].

Equally substantial, the present study noted that there is an average level of psychological distress among nurses, as presented in table 4. These results agree with the study, which aimed to examine the relationship among sensory treatment forms, perceived stress, and job-related burnout as a stress-related state in working people, and they found in their study that the mean score of psychological distress was (2.1), which

indicates an average level of psychological distress [72]. The results were surprising to the researchers. The level of psychological distress was moderate, and we had high expectations that psychological distress would be at a high level because nurses dealing with critically ill patients, witnessing suffering, and facing patient deaths can take a significant emotional toll on nurses. They may experience feelings of sadness and helplessness compounded by the strain of working a long, often evening shift that disrupts their sleep pattern, contributing to psychological distress [73].

Equally meaningful, as presented in Table 4, the mean score of the psychosomatic complaints was (2.87), indicating a high level of psychosomatic complaints among nurses. These results disagree with the study, which aimed to offer a refined version of the burnout assessment tool and assess the validity and reliability of the tool among 255 nurses, and they found in their study that the mean score of psychosomatic complaints was (2.48) which indicates a medium level of psychosomatic complaints among nurses [74]. This result highlighted the fact that working in critical care units exposes nurses to a high level of tension. This tension triggers the natural body response of fight or flight, leading to the release of hormones like cortisol and adrenaline. Over time, this hormone may dysregulate, leading to physical symptoms like chest pain and palpitation [75]. Tension of work also can affect the digestive system, leading to intestinal complaints such as nausea and indigestion [76]. Long working hours standing on their feet can cause muscle tension and pain, especially in the neck, shoulder, and back, leading to musculoskeletal disorders [77]. Also, working in healthcare settings, particularly critical care units, increases exposure to pathogens, further contributing to frequent illnesses [78].

On par in significance, table 6 shows statistically significant positive correlations between nurse alarm fatigue and each of the following: exhaustion, mental distance, cognitive impairment, emotional impairment, psychological complaints, psychosomatic complaints, secondary symptoms, and overall burnout. These results agree with the study, which aimed to examine the association between alarm fatigue and burnout among 236 nurses in critical care units and found in their study a significant association between alarm fatigue and burnout among critical care nurses [79]. An additional cross-sectional study supported the current study findings, which aimed to examine the degree of alarm fatigue, its related factors, and its association with burnout among 364 critical care nurses. They discovered in their study that alarm fatigue was positively correlated with burnout [80]. This means that nurses are more likely to develop alarm fatigue as an outcome of their high-pressure profession and excessive effort in responding to alarms. These alarms, often excessive and potentially false, can cause fatigue, disrupt sleep, and instill a sense of inefficacy due to the excessive effort required to respond to a non-critical alarm. This, in turn, can contribute to feelings of frustration, helplessness, stress, and ultimately, burnout [81].

Nursing Implications

It is crucial to enhance the role of nursing leaders in diagnosing and addressing burnout among nurses by providing education on burnout phenomena and effective coping strategies. Additionally, regarding alarm fatigue, the Ministry of Health should develop a body of knowledge to address this widespread phenomenon in order to rescue nurses who are at risk of alarm fatigue by participating in training programs covering awareness of alarm fatigue, coping mechanisms, alarm management, and relaxation techniques, all designed to reduce the alarm fatigue among nurses.

Conclusion

This study found positive correlations between alarm fatigue and each of the following: exhaustion, mental distance, cognitive impairment, emotional impairment, psychological complaints, psychosomatic complaints, secondary symptoms, and overall burnout. The result of the study emphasizes the importance of health, especially nurses' health in critical units, since this is the first national study with critical care nurses that found there is an association between alarm fatigue and burnout. Solutions must come through health system-level. Examples of such solutions include but not limited to: implementation of the Ministry of Health's health insurance system, increasing nurses' wages in proportion to their efforts, all of which may be helpful in effectively managing alarm fatigue. In addition, activating technology solutions such as smart alarms, artificial intelligence applications, and predictive analytics will streamline alarm notifications and reduce the overall number of alarms that nurses are exposed to. In addition, implementing a psychological counseling system within the hospital to deal with alarm fatigue and stress.

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Conflict of interest

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Authors contributions

Sahar Yaqoob and Sadeq AL-Fayyadh conceptualized the study and designed the initial manuscript. Sahar Yaqoob collected, analyzed, and interpreted the data. Sadeq AL-Fayyadh reviewed and revised the manuscript and made contributions to content and design. Sadeq AL-Fayyadh supervised the study. All authors read and approved the final manuscript for publication.

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