PERCEIVED STRESS AND ALARM FATIGUE AMONG NURSES DEALING WITH CRITICALLY ILL PATIENTS: A CROSS SECTIONAL STUDY

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Abstract

Nurses are exposed to many clinical monitoring alarms in managing critically ill patients, gradually leading to emotional exhaustion and burnout. This situation is called alarm fatigue, where nurses tend to do inappropriate actions to silence the alarms or adjust them outside the appropriate limits. Thus, this study aims to explore stress and alarm fatigue among staff nurses dealing with critically ill patients. A cross-sectional study was conducted among 114 nurses dealing with critically ill patients (ICU/CCU/HDU/NICU, and A&E) in a private hospital in Kuala Lumpur. Using purposive sampling, participants who met inclusion and exclusion criteria were asked to fill up a questionnaire consisting of sociodemographic data, a nursing stress scale, and an alarm fatigue questionnaire. After 30 minutes, the questionnaire was collected. Most nurses dealing with critically ill patients reported a low level of stress (65.8%) and alarm fatigue (69.3%). Based on study findings, subscale workload was identified as the primary source of stress (Mean = 2.516, SD = 0.484). Meanwhile, education level and working shift are the only sociodemographic characteristics associated with stress and alarm fatigue ($p < 0.05$). However, no significant correlation was seen between stress and alarm fatigue, and this revealed a weak correlation between these two variables ($r = 0.078$, $p = 0.411$). Stress and alarm fatigue was found statistically not significant towards each other. Future studies should explore different risk factors associated with alarm fatigue among nurses dealing with critically ill patients.

Keywords: Stress, Alarm Fatigue, Clinical Alarm, ICU

Introduction

Increasing ICU admissions before the pandemic in Malaysia has led to a worrying current state. The Malaysian Registry of Intensive Care (MRIC) report in 2017 revealed that from 40660 entries to the ICU, 6.1% of the patients (2464 patients) were case readmissions, with the average ICU stay being 4.9 days. The MRIC report found that ICU admissions have increased to 38,196 compared to 37,759 in 2016, with a median bed occupancy rate of 89.2%. Working in such a high-intensity area with a high equity level could expose nurses to the risk of physical and emotional exhaustion that leads to stress and burnout symptoms. A study found that nurses who spent most of their hours working in specialization areas were exposed to many mental health issues and a high level of burnout (1). Perceived stress among nurses handling critical ills often occurs when the demands of the working environment overpower the capacities of workers to cope with them (2, 3).

A sentinel event was described as an unexpected occurrence that resulted in death or psychological injury to a patient and required immediate response and investigations (4). A previous study identified that nurses are exposed repeatedly to an average of 771 patient monitor alarms per patient per day (5). A high alarm burden may gradually contribute to alarm desensitization among healthcare staff and potentially cause unintended adverse

consequences. Overexposure to alarms causes nurses to decrease concentration, makes nurses careless, commit more mistakes, and be less sensitive to alarms (6). Nurses tend to do inappropriate actions to silence some alarms on a busy day, such as turning down the volume, turning the alarm off, or adjusting them outside the appropriate limits. This situation is called alarm fatigue and is very dangerous as it threatens the patient's safety.

Intensive care, also referred to as critical care, is an interdisciplinary specialty that focuses on the comprehensive treatment and management of patients who are experiencing or are at risk of acute, life-threatening organ dysfunction (7). Within the context of adult critical care units, the Intensive Care Unit (ICU), High Dependency Unit (HDU), and Critical Care Unit (CCU) are key components. However, the specific focus of this study is solely on nurses employed in the ICU. In Malaysia, literature on perceived stress and alarm fatigue among nurses handling critically ill patients is limited. Previous researchers concentrated on teamwork, benefit, and reward as factors linked with job stress among nurses in Malaysian healthcare facilities. Critical care nurses claimed to feel more stressed than ward nurses and agreed that better pay would help elevate their overall satisfaction (8). Therefore, exploring perceived stress and alarm fatigue among local healthcare providers in the critical care unit is necessary to reflect on the problems arising in our setting. Adopting standardized alarm safety policies is a long process, as the National Patient Safety Goals in the United States took nearly two years before implementation, with multiple phases involved (9). Thus, this study aims to explore the level of stress and alarm fatigue among staff nurses dealing with critically ill patients.

Materials and Methods

Study design and population

This study used a descriptive quantitative design of a cross-sectional study. The target population was registered nurses who worked in the ICU/CCU, HDU, NICU, and A&E Department of Gleneagles Hospital Kuala Lumpur.

Samples

The sampling method used in this study was purposive sampling. Data from the Human Resource department of Gleneagles Hospital Kuala Lumpur estimated that 160 nursing staff worked in these units. Thus, using the Raosoft software of the sample size calculator, the sample size for this study was 114 participants. In determining specific characteristics of the studied population, inclusion and exclusion criteria were developed accordingly. The inclusion criteria set for this study were nurses who provide nursing care to critical ills. The participants must have at least three months of working experience and understand English. Meanwhile, exclusion criteria included junior nurses in the orientation phase and were tagged with the Nurse Clinician and nurses on confinement period or study leaves.

Instruments

The self-administered questionnaire was used in this study. The questionnaire consists of three parts which are part A, B, and C.

Part A sociodemographic data

Part A investigates the participants' sociodemographic data and consists of five items; age, gender, level of education, years of working experience, and working shift.

Part B (Nursing Stress Scale, NSS)

This questionnaire was adapted from the original version of the Nursing Stress Scale developed by Gray-Toft and Anderson in 1981 and consisted of 34 items (10). It was distributed into seven potentially stressful situations, including death and dying (six items), conflict with physicians (six items), inadequate preparation (four items), lack of staff support (three items), conflict with other nurses (six items), workload (five items), and uncertainty concerning treatment (four items). A four-point Likert Scale was used to indicate the frequency of work stressors experienced by nurses from never (1), occasionally (2), frequently (3), and very often (4). The results were calculated from total scores ranging from 34 to 136. A higher score indicates a higher frequency of work stressors experienced by the participants. In this study, participants who scored more than 85 were described as having a high-stress level. Meanwhile, those who scored less than 85 were categorized as having a low stress level. The Cronbach's alpha result for the NSS questionnaire is 0.897.

Part C (Alarm Fatigue Questionnaire)

This questionnaire was adapted from the original version of the Alarm Fatigue Questionnaire by Torabizadeh et al. in 2017 (11). The questionnaire consists of 13 items that use a five-point Likert Scale ranging from always (4), usually (3), sometimes (2), rarely (1), and never (0), with questions number 1 and 9 reversely scored.

A total score was between 8 (minimum) and 44 (maximum). Higher scores indicate a more significant impact of alarm fatigue on nurses' performance. In this study, participants who scored more than 27 were described as experiencing a high level of alarm fatigue. Meanwhile, those who scored 26 or less were categorized as having a low level of alarm fatigue. The Cronbach's Alpha for Alarm Fatigue Questionnaire is 0.623. Cronbach's Alpha is considered reliable, as a study by Ahmad et al. (12) highlighted that internal reliability is achieved when Cronbach's alpha value is 0.6 or above.

Data collection

The data was collected after approval from the UiTM Research Ethics Committee [REC/08/2020(MR/217)] and Gleneagles Hospital Kuala Lumpur. After permission from the Director of Nursing of Gleneagles, the researcher identified the intended participants and presented an explanation of the research background and data collection

flow. Participants who agreed to participate were asked to sign the consent form before data collection. The researcher then handed off a self-administered questionnaire that was prepared in the English language. Lastly, participants were allocated 30 minutes to complete the questionnaire before returning their responses for data analysis.

Statistical analysis

Descriptive analysis (frequency and percentage) was performed on all variables in the study (sociodemographic characteristics, stress level, and level of alarm fatigue). The relationship between variables was measured using an independent sample t-Test, One-Way ANOVA test, and Pearson Correlation Test. All data were analyzed using statistical software SPSS version 26, with statistical significance defined by p-value < 0.05.

Results

Demographic characteristics of respondents

Demographic characteristics of respondents

Of 114 participants, 67 (58.8%) were less than 30 years old, and only 3 participants (2.6%) were 51 years and above. Most were female nurses, n = 106 (93%), while only 8 (7%) were male. More nurses in critical care areas were qualified with diplomas or certificates; n = 63 (55.3%), and the remaining 51 had bachelor's degrees; n = 51 (44.7%).

Table 1: Demographic characteristics of respondents (N = 114)

Variables	Frequency (n)	Percentage (%)
Age		
<30	67	58.8
30-39	40	35.1
40-49	4	3.5
>50	3	2.6
Gender		
Male	8	7.0
Female	106	93.0
Educational Level		
Certificate / Diploma	63	55.3
Bachelor's degree	51	44.7
Working Experience		
< 1 year	6	5.3
1-4 years	49	43.0
5-10 years	29	25.4
>10 years	30	26.3
Working shift		
Days	15	13.2
Nights	2	1.8
Rotated	97	85.1

The Stress Level among Nurses Dealing with Critically Ill Patients

Table 2 shows the stress level among nurses dealing with critically ill patients. Out of 114 participants, 75 nurses (65.8%) demonstrated a low-stress level, while the remaining 39 (34.2%) showed a high-stress level.

Table 2: Level of stress among nurses dealing with critically ill patients (N =114)

Variables	Frequency (n)	Percentage (%)
Low level of stress (score <85)	**75**	**65.8**
High level of stress (score >85)	**39**	**34.2**

Table 3 shows the mean score among all seven stress subscales to identify which stressors affect nurses the most. The workload was described as the leading cause of stress among nurses, with a mean of 2.516, while the lack of support from management was a minor stress source, with a mean of 2.067.

Table 3: Mean score of nursing stressors subscales (N =114)

Variable	Minimum	Maximum	Mean	SD
Death and Dying	1.170	3.300	2.208	0.473
Conflict with Physician	1.170	3.500	2.208	0.485
Inadequate Preparation	1.000	3.750	2.338	0.612
Lack of Support	1.000	4.000	2.067	0.634
Conflict with Other Nurses	1.000	4.000	2.323	0.588
Workload	1.400	3.600	2.516	0.484
Uncertainty Concerning Treatment	1.000	3.500	2.200	0.594

Level of Alarm Fatigue among Nurses Dealing with Critically Ill Patients

Table 4 shows the level of alarm fatigue among nurses dealing with critically ill patients. Most nurses, n = 79 (69.3%), have demonstrated a low level of alarm fatigue, and only a minority, n = 35 (30.7%), showed a high level of alarm fatigue.

Table 4: Level of alarm fatigue among nurses dealing with critically ill patients (N =114)

Variables	Frequency (n)	Percentage (%)
Low level of alarm fatigue (score <26)	79	69.3
High level of alarm fatigue (score >27)	35	30.7

Relationship between sociodemographic characteristic with stress and alarm fatigue

Table 5 shows the relationship between sociodemographic characteristics with stress. Only two sociodemographic variables were significantly different to stress with a p-value < 0.05. The variables were level of education (p = 0.037) and working shift (p = 0.002). Post hoc analysis was then conducted for the variable 'working shift'. The result showed that nurses who worked during the days and rotated shifts perceived stress significantly higher than those on the night shifts.

Table 6 shows the relationship between sociodemographic characteristics with alarm fatigue. Only one sociodemographic variable, educational level, showed a significant relationship with alarm fatigue, with a p-value of 0.026.

Table 5: Relationship between sociodemographic characteristic with stress (N =114)

Demographic (n)	Mean (SD)	Mean diff (95% CI)	F-stat (df1, df2)	*p*-value
Gender				
Male (8)	74.630 (8.895)	-2.941 (-13.668, 7.786)	-0.543 (112)	0.588[a]
Female (106)	77.570 (15.076)			
Educational Level				
Certificate/ Diploma (63)	74.780 (14.882)	-5.771 (-11.183, -0.360)	-2.113 (112)	0.037[a]
Bachelor's degree (51)	80.550 (14.010)			
Age				
< 30 (67)	77.850 (14.413)		0.424 (3;110)	0.736[b]
30-39 (40)	76.700 (15.492)			
40-49 (4)	81.500 (14.434)			
> 50 (3)	69.970 (15.948)			
Working experience				
<1 year (6)	69.500 (18.652)		1.525 (3;110)	0.212[b]
1-4 years (49)	79.490 (14.569)			
5-10 years (29)	78.790 (11.571)			
>10 years (30)	74.070 (16.432)			
Working shift				
Days (15)	65.600 (13.399)		6.780 (2;111)	0.002[b**]
Night (2)	67.500 (6.364)			
Rotated (97)	79.380 (14.166)			

[a] Independent Sample T-Test

[b] One-Way ANOVA Test

** Post hoc analysis: Nurses who worked on days and rotated shifts perceived stress at a significantly higher level compared to other working shift

Table 6: Relationship between sociodemographic characteristics with alarm fatigue (N = 114)

Demographic (n)	Mean (SD)	Mean diff (95% CI)	F-stat (df1, df2)	*p*-value
Gender				
Male (8)	24.130 (3.182)	-0.667 (-3.511, 2.176)	-0.465 (112)	0.643[a]
Female (106)	24.790 (3.959)			
Educational Level				
Certificate/ Diploma (63)	25.480 (4.028)	1.633 (0.203, 3.063)	2.263 (112)	0.026[a]
Bachelor's degree (51)	23.840 (3.574)			
Age				
< 30 (67)	24.990 (3.570)		0.338 (3;110)	0.798[b]
30-39 (40)	24.250 (4.343)			
40-49 (4)	25.250 (3.403)			
> 50 (3)	25.330 (6.807)			
Working experience				
<1 year (6)	27.830 (1.835)		1.671 (3;110)	0.177[b]
1-4 years (49)	24.880 (3.626)			
5-10 years (29)	24.660 (3.716)			
>10 years (30)	24.000 (4.586)			
Working shift				
Days (15)	23.000 (4.971)		2.037 (2;111)	0.135[b]
Night (2)	23.000 (4.234)			
Rotated (97)	25.050 (3.672)			

[a] Independent Sample T-Test

[b] One-Way ANOVA

Relationship between stress and alarm fatigue

Table 7 shows the relationship between stress and alarm fatigue. No significant correlation is seen between stress and alarm fatigue (p-value < 0.05). The result shows that the amount of change in the alarm fatigue is minimally determined by the stress, revealing a weak correlation between these two variables (r = 0.078, p = 0.411).

Table 7: Correlation between stress and alarm fatigue (N = 114)

	Alarm Fatigue	
	Pearson coefficient, *r*	***p*-value**
Stress	0.078*	0.411

*Pearson Correlation

Discussion

The stress level among nurses dealing with critically ill patients

Among the 114 participants, 75 (65.79%) nurses demonstrated low stress in dealing with critically ill patients. This finding could be due to the study's location chosen by the researcher. Nurses who work in private hospitals are relatively prepared for the job stress they will face, developing better-coping mechanisms (13). Private hospitals highly emphasize job performance among nurses. External motivation ranging from benefits, awards, pay, compensation, and honors offered by the private hospital, encourage nurses to provide better service to the hospital's customers. Hence, rewarding salaries from the private healthcare sector does help nurses to cope better with stress. Moreover, patient overcrowding is hardly seen in

private healthcare institutions. Patients who walked-in private hospitals are mostly self-pay, funded by their health insurance or employer-provided health insurance (14). Therefore, the census was stable with low equity cases, explaining the low-stress level among respondents.

The level of alarm fatigue among nurses dealing with critically ill patients

In this study, most participants were found to have a low level of alarm fatigue (69.3%). Out of 114 participants, only a minority (30.7%) experienced high alarm fatigue. This finding is surprising to the researcher as it contradicts the trend of alarm fatigue worldwide. However, the low alarm fatigue reported could be attributed to the advancement in alarm customization software installed in the acute care setting. In the study setting, nurses may customize the alarms' priority and readjust them based on urgency. For example, the alarm panel owned three color-coded labels: green, yellow, and red, corresponding to low, medium, and high levels of urgency. At the beginning of duty, nurses need to reset the monitor's default setting according to the patient's reference value to reduce unnecessary false alarms. Unnecessary alarms disturbed nurses' workflow, created anxiety for the patient, and impacted their sleep quality (15). Moreover, great teamwork is one of the major contributors to low levels of alarm fatigue in Gleneagles Hospital Kuala Lumpur. In an acute setting providing care to the critically ill, each team member must be considerate to mutual work, cooperate for interdisciplinary acquaintance, and enable communication to prevent incidents (16).

Relationship between sociodemographic characteristics with stress and alarm fatigue

Moreover, only two factors have been statistically significant in examining the relationship between sociodemographic characteristics and stress. These factors are level of education and working shift. Undeniably, the higher level of education one gets, the more one is involved in critical thinking. The application of critical thinking in daily nursing routine is essential as it contributes to better problem solving, decision-making, and promoting professional accountability (17). In Malaysia, the minimum nurse requirement is to possess a Diploma in Nursing. However, many healthcare institutions have started to promote education enhancement as an added value for their healthcare workers. Besides being beneficial in-patient outcomes, nurses with higher education are associated with excellent time management and coping with stressful situations (18).

On the other hand, working in shifts was a significant sociodemographic characteristic related to stress. Working in rotating shifts requires nurses to face and adjust to a desynchronization between their everyday routine and the external environment over a long period. A previous study showed that rotating shift nurses experienced lower job satisfaction and were strongly associated with increased job stress (19). Frequent disruption of circadian rhythm contributes to adverse physical and psychological health effects and negatively affects nurses' work performance.

In identifying the relationship between sociodemographic characteristics and alarm fatigue, it is concluded that educational level was the only significant variable in determining alarm fatigue. Many works of literature reported the influence of education in creating awareness of alarm fatigue (6). They emphasize educating staff on how monitors, sensors, and alarms function in treating critical ills (20). Continuous organizational effort in educating staff is essential as it significantly improves nurses' response rate toward the notice. An extensive education program on alarm safety promotes professional responsibility, thus nurturing confidence among nurses in taking care of critical ills (21).

Relationship between stress and alarm fatigue

This study shows no significant relationship between stress and alarm fatigue among nurses dealing with critically ill patients. An unnecessary workload due to high alarms during the working shift might lead to mental stress and indirectly contribute to alarm fatigue (22). However, rejecting stress factors in alarm fatigue opens a new dimension for future researchers to widen this study topic. Stress is not a primary reason for alarm fatigue occurrence, as alarm fatigue often occurs based on an individual's evaluation of the urgency of alarms, comparing patient's clinical and physiological data, and piling up of workload (23). Besides, proper training in managing the equipment is required to help nurses become familiarized with and gain confidence while working in the acute care setting. Although nurses were trained to be professional in dealing with any situation, some nurses might have developed a therapeutic nurse-patient relationship, much closer than it was supposed to (24). The nurse's total time and effort on patients they were assigned to significantly determine the therapeutic nurse-patient relationship, determining their stress tolerance.

While the study may not show a significant relationship between stress levels and fatigue, it remains imperative to address these issues within a hospital environment. Nurses commonly experience elevated levels of stress and fatigue due to the demanding nature of their work, which can have detrimental effects on their well-being and the quality of patient care. Consequently, it is crucial to implement strategies that effectively reduce and manage stress among nurses. One such strategy is the development of stress management programs, which can offer nurses techniques and resources to cope with stress. These programs may include stress reduction workshops, mindfulness training, relaxation exercises, and counselling services. Additionally, it is important to prioritize the provision of regular breaks and sufficient rest periods for nurses during their shifts to allow for rejuvenation. Encouraging a healthy work-life balance through proper scheduling and limiting overtime hours is also essential.

This research has a few limitations. This study topic is still very new in this country, and the data were obtained during Malaysia's peak of the COVID-19 pandemic. Due to many clinical restrictions, the data presented were taken from only one private healthcare institution in Kuala Lumpur. Future researchers should broaden the study to multiple settings, especially among public healthcare institutions.

Conclusion

In conclusion, this study found no significant relationship between stress and alarm fatigue among staff nurses dealing with critically ill patients. The rejection of stress factors in alarm fatigue opens a new dimension for future researchers to widen this study topic. Existing literature had focused more on the technical parts of alarm devices, yet only a few highlighted human factors relating to alarm fatigue. Thus, exploring different study designs, or conducting a qualitative study, may give a deeper insight into nurses' perceptions of alarm fatigue. The strength of this study is that it provides the baseline needed to compare alarm fatigue occurrence during the outbreak of COVID-19. Data collection for this study was performed during the early period of an epidemic when patients showed mild symptoms and did not present with many complications. Hence, only minimal monitoring equipment was required throughout their stays in these units. This situation explained the researcher's finding of a low level of alarm fatigue among nurses handling critically ill patients.

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Competing interests

The authors declare that they have no competing interests.

Ethical clearance

Ethical approval from The Research Ethics Committee (REC) of University Technology MARA (UiTM) was obtained on 26 August 2020, and the reference number was (REC/08/2020(MR/217) and approval from Gleneagles Hospital Kuala Lumpur was obtained on 30 September 2020. The consent form was given, and if the respondent agreed to participate, the respondent could continue to answer the questionnaires.

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