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The impact of bed occupancy rate and patient dependency on nurse fatigue in intensive care units

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Abstract

Background: Intensive Care Unit (ICU) nurses are frequently exposed to high workloads resulting from elevated Bed Occupancy Rates (BOR) and the intensive care needs of patients with total dependency. These conditions increase the risk of physical and mental fatigue, which may compromise the quality of nursing care and patient safety.
Purpose: To examine the association between BOR and patient dependency level with nurse fatigue in the ICU.
Method: A quantitative approach, specially focusing on analytical survey and cross-sectional method. The study took place from April 2024 in Kanjeng Raden Mas Tumenggung Wongsonegoro Regional Hospital, Semarang. The independent variable was bed occupancy rate and patient dependency; dependent variable is nurse fatigue. Using total sampling, 81 respondents were selected with a split group of 29 ICU nurses to collect patients' dependency level test, who met specific inclusion and exclusion criteria. The analysis proceeded with a univariate test to determine the frequency distribution of respondent's characteristics, followed by bivariate analysis using Kendall Tau correlation.
Results: Statistical analysis confirmed a significant correlation between BOR and nurse fatigue ($p = 0.043$), as well as between patient dependency and nurse fatigue ($p = 0.048$).
Conclusion: The BOR and patient dependency rate were both key factors influencing fatigue among ICU nurses. These findings underscore the critical need for workload regulation informed by operational indicators to protect nurses' well-being and to uphold the quality of care in intensive settings.

Keywords: Bed Occupancy Rate; Intensive Care Unit; Nurse Fatigue; Patient Dependency.

INTRODUCTION

The Intensive Care Unit (ICU) is a specialized healthcare service unit designed to provide intensive care and close monitoring for critically ill patients. This unit operates within a complex and dynamic system due to the necessity of handling patients with multiple organ dysfunctions who require immediate and intensive interventions. In this context, ICU nurses play a crucial role as they are responsible for delivering round-the-clock patient care. Beyond technical duties, ICU nurses are also expected to offer

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emotional support to patients and their families while collaborating closely with other healthcare professionals. These demands create significant physical and psychological burdens, increasing the risk of fatigue (Suwarni, Akbar, & Suhartono, 2020). Nurse fatigue in the ICU has become a major concern in nursing practice as it directly impacts patient safety and the well-being of the nurses themselves (Akbar, 2019). Numerous studies have indicated that ICU nurses are more vulnerable to fatigue compared to nurses in other departments, primarily due to the intensity and complexity of their work. For instance, a study conducted in 17 hospitals in Sao Luis, Brazil revealed that 39.2% of ICU nurses experienced fatigue based on Grunfeld's criteria (Alvarez, Thomaz, Lamy, Nina, Pereira, & Garcia, 2020).

Although the literature acknowledges fatigue as a significant issue in ICU nursing, there remains a gap in understanding the specific factors that contribute to it. One of the underexplored areas is the role of Bed Occupancy Rate (BOR) and the level of patient dependency. BOR serves as an operational indicator in hospitals, reflecting the percentage of occupied beds over a given period. Patient dependency level indicates the extent to which patients require assistance with basic daily activities, which in ICU settings typically necessitates total care (Siyoto, & Tule, 2019). Combined effects of BOR and patient dependency level on ICU nurse fatigue remain scarce and inconsistent. This signals a research gap regarding operational and contextual determinants of nurse fatigue in intensive care environments (Al-Masaeed, O'Brien, Rasdi, & Alqudah, 2021).

The limited and inconsistent findings on the combined effects of bed occupancy rate (BOR) and patient dependency level on ICU nurse fatigue highlight the need for deeper investigation into how these operational factors interact to influence nurses' physical and psychological well-being. High BOR may increase the pace and intensity of care, while high patient dependency requires complex, time-consuming interventions both of which cumulatively contribute to fatigue. Variations in staffing ratios, institutional support systems, and nurse resilience may mediate these effects, suggesting that contextual factors within ICU settings play a critical role. Understanding these dynamics is essential for developing targeted interventions to optimize nurse performance and safeguard patient safety (MacPhee, Dahinten, & Havaei, 2017).

RESEARCH METHODS

A quantitative approach, specially focusing on analytical survey and cross-sectional method. The study took place from April 2024 in Kanjeng Raden Mas Tumenggung Wongsonegoro Regional Hospital, Semarang. The independent variable was bed occupancy rate and patient dependency; dependent variable is nurse fatigue. Using total sampling, 81 respondents were selected with a split group of 29 icu nurses to collect patients' dependency level test, who met specific inclusion and exclusion criteria.

The inclusion criteria required nurses actively working in the ICU, having an ICU training certificate, working in shifts, and willing to participate in the study. Exclusion criteria included nurses serving as head nurses, managers, or supervisors, as well as those on leave.

Data obtained from questionnaire and formula. BOR is calculated by the formula: (Number of days of patient care / (Number of beds × number of days in the period)) × 100%. The ideal BOR score is in the range of 60%-85%. With a BOR score < 60%, it indicates low efficiency (many beds are not being used). When >85%, it indicates a potential overload that could affect the quality of care, including workload and nurse fatigue.

Patient dependency using Barthel index. Measurements were made by scoring 10 key activity items, namely: eating, moving (transferring), personal care, using the toilet, bathing, walking on a flat floor, going up and down stairs, dressing, pooping, and urinating. The total Barthel Index score ranges from 0 to 100, with interpretations: 0-20 (total dependence), 21-60 (heavy dependence), 61-90 (moderate dependence), 91-99 (light dependence), and 100 (full independence).

The Industrial Fatigue Research Committee (IFRC) questionnaire includes 30 statement items divided into three main aspects, namely physical fatigue such

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as body fatigue and muscle aches, mental fatigue such as difficulty concentrating and forgetfulness, and emotional fatigue such as mood swings and anxiousness. Each item was rated using a 5-point Likert scale, namely never, rarely, sometimes, often, and very often. The interpretation of these scores is generally divided into three categories, with 30-59 indicating poor fatigue, 60-89 moderate fatigue, and 90-150 high fatigue.

The analysis proceeded with a univariate test to determine the frequency distribution of respondent's characteristics, followed by bivariate analysis using Kendall Tau correlation. This research has obtained permission from Health Research Ethics Committee Kanjeng Raden Mas Tumenggung Wongsonegoro Regional Hospital with number. B/2522/070/III/2023.

RESEARCH RESULTS

Table 1. Characteristics of Respondents (N=81)

Variable	Results
Age (Mean±SD)(Range)(Year)	(34.19±5.772) (25-45)
Gender (n/%)	
Male	25/30.9
Female	56/69.1
Number of years employment (n/%)	
≤ 10 years	49/60.5
> 10 years	32/39.5
Education (n/%)	
Diploma	60/74.1
Bachelor (D4/S1/Ners)	21/25.9
ICU Certification (n/%)	
Yes	81/100.0
No	0/0.0
BOR (%/level)	
ICU I	87.5/ High
ICU II	91.7/High
ICU III	71.42/ Ideal
Patients Dependency Level (n/%)	
High care (21-60)	3/20.7
Total care (0-20)	26/79.3
Nurses Fatigue Level (n/%)	
Moderate	35/43.2
High	46/56.8

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Tabel 1. characteristics of respondent with a mean age and standard deviation (34.19±5.772) ranging from 25-45 years. Most of the respondents were female, 56 (69.1%), 49 (60.5%) had less than 10 years of employment, and 60 (74.1%) had completed a diploma. All respondents had ICU training certification (100%). The highest Bed Occupancy Rate (BOR) was found in ICU II with a value of 91.7%. The highest level of patient dependence was in the total care category as many as 26 patients (79.3%), while most of the nurse fatigue was in the high category, which was 46 people (56.8%).

Table 2. Kendall Tau's Correlation

Variables	Nurse Fatigue Level	
	τ	p-value
BOR	0.500	0.043*
Patient Dependency Level	0.323	0.048*

The relationships among variables were analyzed using the Kendall Tau correlation test. A statistically significant positive correlation was found between bed occupancy rate (BOR) and nurse fatigue (p = 0.043), indicating that higher BOR was associated with greater levels of nurse fatigue. This finding supports the assumption that increased bed occupancy results in a heavier workload and higher physical and mental stress among nurses. Significant positive relationship was observed between patient dependency levels and nurse fatigue (p = 0.048). Although the correlation between patient dependency and fatigue was weaker than that between BOR and fatigue, the positive direction remained consistent. This suggests that patients requiring total care contributed to an increased frequency and intensity of nursing interventions, which in turn led to higher nurse fatigue.

DISCUSSION

The findings of this study indicate a significant relationship between BOR and nurse fatigue in the ICU, as well as between patient dependency levels and nurse fatigue. These results affirm that operational factors, such as bed occupancy and the degree of care patients require, play a crucial role in shaping nurses' workloads and directly affect their physical and mental conditions (Cho, & Steege, 2021).

High BOR values reflect the large number of patients that nurses must serve simultaneously. Two of the three ICU units studied had BOR values exceeding 85%, categorized as high according to the Indonesian Ministry of Health standards. A high occupancy rate requires nurses to care for more patients per shift, thereby increasing the workload and contributing to physical and psychological fatigue (Pratiwi, & Dody, 2017). Elevated BOR is associated with spikes in nurse workload that can trigger chronic fatigue and stress. The increased number of patients also leads to higher complexity in nursing interventions, further aggravating the risk of fatigue (Fundora, Liu, Calamaro, & Mahle, 2021).

This situation is further compounded when patients present with high levels of dependency, requiring total care and continuous monitoring. Nurses must frequently perform time- and energy-intensive interventions such as repositioning, personal hygiene, suctioning, and medication administration, often within tight timeframes. The physical and psychological demands on nurses escalate, leading to cumulative fatigue that can impair concentration, reduce work performance, and increase the likelihood of errors. Prolonged exposure to such conditions without adequate rest and staffing support may contribute to burnout, decreased job satisfaction, and a higher turnover rate among ICU nurses (Brzozowski, Cho, Knudsen, & Steege, 2021).

A large patient volume within a given timeframe not only raises the quantity of tasks but also affects nurses' concentration and precision in delivering care.

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The risk of medical errors and burnout escalates when healthcare professionals work under pressure without adequate rest periods. Therefore, BOR must be integrated into workload management systems to minimize excessive fatigue and support optimal nurse performance (Heryyanto, 2022).

High BOR that is not matched by effective workload management can lead to the accumulation of physical and mental fatigue in nurses, which ultimately impacts the quality of nursing services. Continuous fatigue not only reduces responsiveness and accuracy of clinical actions, but also increases the risk of absenteeism, decreased motivation, and turn-over rates of nursing staff. Important for hospital management to use BOR as an early indicator in developing policies for task distribution, scheduling work shifts, and providing adequate rest periods. These strategies will help create a more balanced work environment, support nurses' well-being, and maintain patient safety in the intensive care unit (Bi, Yin, Li, Gao, Zhang, Zhong, & Li, 2020).

Patient dependency levels also demonstrated a significant correlation with ICU nurse fatigue. Most patients in this study were classified as having total dependency (79.3%), indicating that they required full assistance for basic daily activities. This increased both the quantity and intensity of nursing interventions (Benzo, Farag, Whitaker, Xiao, & Carr, 2022).

The high proportion of totally dependent patients placed a substantial physical and psychological burden on nurses, as they were required to perform comprehensive care tasks such as hygiene, mobilization, feeding, and continuous monitoring. This continuous demand for high-intensity care reduces the opportunity for rest during shifts and contributes to cumulative fatigue over time. Total patient dependency often necessitates collaborative efforts and increases the likelihood of overtime or skipped breaks, which can impair nurse well-being and performance (Chayati, Putranti, & Firmawati, 2018).

Patients in the total care category require complex support, including continuous monitoring of vital signs, intravenous therapy administration, ventilator monitoring, and full assistance with hygiene and mobility. An increased number of such patients correlates with elevated demands on nurses' time, energy, and attention to detail. Nursing workload is shaped not only by patient volume but also by the quality and complexity of care needs (Jang, Kim, Kim, Kim, Choi, Kim, & Jung, 2021).

The proportion of total care patients increases, nurses are compelled to perform more frequent and time-intensive interventions, which can lead to cumulative physical and mental fatigue. This elevated workload may compromise the ability of nurses to maintain optimal performance, potentially affecting patient safety and care quality. Sustained exposure to high-intensity care demands without adequate staffing or rest can contribute to burnout, reduced job satisfaction, and a decline in overall well-being among nurses. Essential for ICU management to consider not only the number of patients but also their level of dependency when planning staffing and workload distribution (Cho, Sagherian, Scott, & Steege, 2022).

Nurse fatigue in the ICU has broader implications beyond individual well-being; it also affects care quality and patient safety. Prolonged fatigue can reduce nurses' focus, accuracy, and clinical decision-making capabilities, which in turn heightens the risk of adverse events. For this reason, hospital administrators must factor in BOR and patient dependency levels when planning fair and humane working conditions for ICU nurses (Zhang, Dai, Jiao, & Lee, 2023).

Important for hospital management to design supportive workload balance policies, such as setting the number of nursing staff in proportion to bed occupancy and patient dependency rates. This approach not only prevents excessive fatigue in nurses but also contributes to improved quality of care and patient safety. Regular evaluation of nurses' fatigue levels as well as training in stress management and work capacity building need to be an essential part of the ICU's human resource management system. The quality of nursing care can be optimally maintained in a challenging work environment (Min, Hong, Son, & Lee, 2021).

Mitigation strategies may include proportional shift rotation, increasing nurse staffing during peak hours, and providing training in time management and stress

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coping strategies. Organizational support and effective time management have been shown to significantly reduce nurse fatigue. Work experience contributes to improving efficiency and mental resilience among ICU nurses (Parpucu, Kucuk, & Ayademir, 2024). Nurses with more work experience tend to develop stronger coping mechanisms and clinical judgment, allowing them to manage complex patient care with greater confidence and less emotional exhaustion. Interventions focusing on organizational support, time management skills, and continuous professional development are essential strategies in reducing fatigue and maintaining nurse well-being in intensive care settings (Farid, Purdy, & Neumann, 2020).

CONCLUSION

The study highlights that both bed occupancy rate (BOR) and patient dependency levels significantly affect nurse fatigue in intensive care units. High BOR and many totally dependent patients increase workload, leading to physical and mental exhaustion. These findings emphasize the importance of integrating operational indicators into nursing workforce planning to maintain balanced workloads and care quality.

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