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Poor Sleep Quality in Critically Ill Patients

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Abstract

Aims: This study aimed to evaluate the sleep quality of critically ill patients in Indonesia. Additional aims are to compare sleep quality among patients using both the Richards-Campbell Sleep Questionnaire (RCSQ) and smartwatch-based data.

Methods: A descriptive cross-sectional study was conducted involving adult critically ill patients in three hospitals in Indonesia. A total of 437 patients completed the RCSQ, with 26 of these individuals additionally utilizing a smartwatch to objectively assess sleep quality. A frequency distribution was employed to analyze all samples exhibiting poor quality, alongside the Mann-Whitney test to compare RCSQ and smartwatch scores.

Results: Among 437 participants, 217 patients (49.7%) were classified as having poor sleep quality based on a mean (±SD) RCSQ score of 59.26±24.8, below a cut-off point of 63.4**.** Mean (±SD) scores across RCSQ domains were as follows: the sleep depth (60.87±27.97), sleep latency (56.68±27.99), awakening (56.99±27.10), sleep continuity (59.30±28.28), and sleep quality (59.30±28.28). The measurement results from smartwatch data indicated an overall sleep quality score of 72.42±9.72. No significant difference was observed between the total score of RCSQ and smartwatch sleep quality (p=0.297).

Conclusion: Critically ill patients demonstrated generally poor sleep quality, with sleep latency and awakening being the most affected domains

Keywords: critical illness, ICU, sleep quality

Introduction

Sleep is a substantial physiological need frequently reported as a concern by critically ill patients (Shih et al., 2023). A previous systematic review reported that >60% of critically ill patients experience poor sleep quality (Shih et al., 2023), and a previous study in Indonesia reported that most critically ill patients (46.4%) have a sleep duration of less than four hours (Setiyarini et al., 2025). Reported sleep issues include circadian rhythm disturbances (Telias & Wilcox, 2019), insufficient sleep duration, and poor sleep quality (Naik et al., 2018). Approximately half of the sleep of critically ill patients occurs during the daytime, with a greater proportion of the light to moderate phase (N1 and N2) in the Non-Rapid Eye Movement (NREM) stages within the total sleep time. They have reduced sleep duration, diminished slow-wave sleep (SWS), rapid eye movement (REM), and frequent awakenings (Wilcox et al., 2018). These sleep quality problems represent disturbances in the sleep depth, sleep onset and latency, awakening, and sleep continuity (Naik et al., 2018). Poor sleep quality significantly affects critically ill patients, potentially resulting in an increased occurrence of delirium (Young et al., 2021), decreased quality of life and survival, increased risk of mortality (Young et al., 2021), and substantial consequences for patients undergoing prolonged ICU care (Miranda-Ackerman et al., 2020). Consequently, it is essential to consistently evaluate sleep quality (LocihovÃi et al., 2020).

Assessing sleep quality is essential for understanding patients' subjective experiences. Instruments such as the Richards-Campbell Sleep Questionnaire (RCSQ) offer direct feedback from patients (Richards et al., 2020). Furthermore, evaluating sleep quality aids in identifying and quantifying the influence of environmental factors, which are prevalent disruptors in critical care areas (Mohamed et al., 2020). Sleep assessments can identify disruptions in the circadian rhythm, which can substantially impact recovery and overall health (Parthasarathy & Tobin, 2012). Sleep quality assessment is beneficial for identifying patients with sleep disturbances, determining interventions, and evaluating the effectiveness of those interventions (Aitken et al., 2017; Alsulami et al., 2019). In addition to using the RCSQ, sleep quality can be assessed using objective measurements, such as smartwatches, to enhance patient comfort and minimize data loss (Gaiduk et al., 2023). Smartwatches are wearable and noninvasive devices, making them appropriate for the continuous monitoring of critically ill patients without inducing discomfort (Bilge et al., 2024). Moreover, smartwatches have demonstrated feasibility for application in the critical care area, delivering reliable data without considerable disruption to patient care (Zhang et al., 2024).

This research employs the definition critical area, including High Care Unit (HCU) and Intensive Care Units (ICU), is designated for the monitoring and management of patients with severe illnesses, the support of vital organs, and the deployment of specialized personnel to preserve the lives of individuals with life-threatening conditions (Kayambankadzanja, et al., 2022). This study differentiates between HCU and ICU based on the type of room, specifically surgical, cardiac, and medical or internal medicine rooms. The distinctions between ICU and HCU types are determined by the patients' diagnoses, complexity of their conditions, and interventions that have consequences for patients' sleep quality (Showler et al., 2023).

Numerous studies have examined the sleep quality of critically ill patients in Indonesia. However, few studies have used dual measurement tools to assess the objectivity of the findings, which may substitute subjective measuring techniques with objective assessments utilizing a smartwatch. The main objective of this study was to describe the sleep quality of critically ill patients in Indonesia. The additional objectives were to compare the sleep quality in each critical care area and compare the differences in sleep quality using the RCSQ instrument and a smartwatch to offer a comprehensive understanding of the sleep quality of critical patients from multiple perspectives.

Methods

Study design

A descriptive cross-sectional study was conducted from October 2023 to April 2024 at three hospitals in Central Java and the Special Region of Yogyakarta Province, Indonesia. We collected data from nine critical care units, consisting of two general ICUs from two hospitals, a medical HCU, two general HCUs from two hospitals, a cardiac HCU, a surgical HCU, two cardiac ICUs from two hospitals, and a cardiac surgery ICU.

Participants

To describe sleep quality, we used consecutive sampling to enroll 437 critically ill patients who agreed to complete the RCSQ without withdrawing from the study. To compare sleep quality assessment between the two tools, 26 patients consented to use both the RCSQ and a smartwatch. Four patients withdrew, and the remaining participants declined to use the smartwatch because of discomfort while sleeping. The inclusion criteria for selecting the study participants were as follows: 1) adult patients (age >18 years) treated in a critical care unit for >24 h; 2) Richmond Agitation Sedation Scale score of −1, 0, or 1; and 3) excellent cognitive status and awareness (GCS score of 14–15). The exclusion criteria were as follows: 1) patients with cranial injury, visual impairment, stroke, dementia, or organic brain disorders, and 2) patients who were incapable of effective communication. The dropout criteria included critically ill patients who, at the time of data collection: 1) experienced emergency conditions; 2) required an increased dose of sedation; or 3) died. Data was collected for one night.

Instrument

The sleep quality was measured using the RCSQ instrument as subjective data. Richards et al. (2000) developed the RCSQ instrument, which comprises five questions, including the domains of sleep depth, sleep latency, awakenings, sleep continuity, and overall sleep quality. The RCSQ measurement using a visual analog score (VAS) ranges from 0-100 with a cut-off point of RCSQ >63.4 indicating good quality of sleep, while 0-63.3 indicates poor sleep. The instrument was tested and adapted to Indonesian culture using cross-cultural adaptation with forward and backward translation phases. The final Indonesian version of the RCSQ underwent forward translation by two language centers independently for each forward and backward translation. Face and content validity were assessed by six experts. The instrument was pilot-tested and psychometric testing was conducted. There was no substantial change in the final Indonesian version compared to the original English version of the RCSQ. The final Indonesian version of the RCSQ had face validity (97.2%), content validity (I-CVI and S-CVI=1.000), construct validity (r=0.372-0.867), and internal consistency reliability (α=0.864). All Interclass Correlation Coefficients (ICC), which measure agreement between researchers and four assistants, showed reasonably high internal reliability. We collected the RCSQ data once, approximately five minutes after the patient woke up, and the patient self-reported it.

To compare sleep quality assessment tools, we conducted a sleep quality assessment using the RCSQ and the Huawei Band 8 smartwatch (Huawei Device Co., Ltd.; China). This device is equipped with TruSleep™ technology to monitor sleep by combining motion data from an Accelerometer (ACC) and heart rate signals from Photoplethysmography (PPG) (Mei et al., 2024). These sensors accurately identify sleep depth, duration, and stage. This will result in total sleep quality scores that range from 0 to 100. In addition, this device has a feature to record day or night sleep and record sleep for days, weeks, months, and years. This device automatically records data on the researcher's smartphone for analysis. The smartwatch was applied before bedtime at 9:00 p.m. and immediately removed after the patient woke up. The ICC for the smartwatch data was not applicable because the measurements were automated by the device.

Statistical analysis

We conducted a frequency distribution analysis of the RCSQ data to assess the patients' overall sleep quality, each domain, and the room area. However, the RCSQ data were not normally distributed. Therefore, we used the Kruskal-Wallis test to evaluate the differences in sleep quality across different critical care areas and the Mann-Whitney test to compare the differences between the RCSQ and smartwatch scores. Significance was considered if the $p \leq 0.05$, with 95% confidence interval values.

Ethical statement

This study was approved by the UGM FK-KMK Ethics Committee (No. KE/FK/1088/EC/2023), research permission from each hospital, and informed consent from the study participants.

Results

Demographic characteristic

In total, 437 critically ill patients completed the RCSQ instrument (Table 1), and 26 of them used a smartwatch. The mean age of the participants was M=52.96, SD=15.49 years. The majority were male (66.4%) and were admitted to the Intensive Cardiac Care Unit (ICCU) (41.0%). Most patients were not intubated (98.9%) and did not receive sedatives (69.1%).

Patients' sleep quality (RCSQ)

The mean score of sleep quality of the overall participants was M=59.26, SD=24.83, which was categorized as poor, and 217 patients (49.7%) had poor sleep quality. Most sleep quality domains were poor, with the lowest score being sleep latency (Table 2).

Patients' sleep quality in different areas

The patients in the ICCU and general HCU had the highest scores, indicating good sleep quality. The cardiac HCU participants followed these groups, with their scores approaching the threshold for good sleep quality. Contrarily, the participants in the surgical and medical HCUs, general ICUs, and cardiac surgery ICU obtained poor sleep quality scores across all domains (Table 2). There are significant differences in median RCSQ scores across critical care areas for all sleep domains (p<0.05) (Table 3).

Table 1. Demographic characteristics of the study participants (n=437)

Demographic Characteristics	n	(%)	Mean±SD
Age (years)			52.96±15.49
Gender			
Male	290	66.40	
Female	147	33.60	
Areas			
General HCU	52	11.90	
Cardiac HCU	31	7.10	
Surgical HCU	82	18.80	
Medical HCU	21	4.80	
General ICU	14	3.20	
ICCU	179	41.00	
Cardiac surgery ICU	58	13.30	
Primary Diagnosis			
Acute Coronary Syndrome	146	33.40	
Other cardiovascular disorders	64	14.60	
Trauma	47	10.80	
Neoplasm	31	7.10	
Respiratory disorders	29	6.60	
Sepsis and infection	23	5.30	
Endocrine disorders	19	4.30	
Nephrology disorders	10	2.30	
Neurology disorders	9	2.10	
Obstetrics	1	0.20	
Postoperative cardiac surgery	58	13.30	
Use of Sedative Opioid			
Non-sedative opioid	302	69.10	
Sedatives and/or opioids	135	30.90	
Intubation Status			
Non-intubated	432	98.90	
Intubated with GCS score of 14-15	5	01.10	

Table 2. Participants' sleep quality scores

Variable	n	RCSQ Score (Mean±SD)	Poor RCSQ n (%)	Good RCSQ n (%)
Domain				
Sleep depth	437	60.87 ± 27.97	203 (46.50)	234 (53.50)
Sleep latency	437	56.68 ± 27.99	230 (52.60)	207 (47.40)
Awakening	437	56.99 ± 27.10	223 (51.00)	214 (49.00)
Sleep continuity	437	59.30 ± 28.28	211 (48.30)	226 (51.70)
Sleep quality	437	61.91 ± 29.61	187 (42.80)	250 (57.20)
RCSQ total score	437	59.26 ± 24.83	217 (49.70)	220 (50.30)
Critical area				
General HCU	52	68.15 ± 28.25	25 (48.10)	27 (51.90)
Cardiac HCU	31	61.22 ± 24.01	13 (41.90)	18 (58.10)
Surgical HCU	82	46.78 ± 21.93	46 (56.10)	36 (43.90)
Medical HCU	21	45.60 ± 22.67	9 (42.90)	12 (57.10)
General ICU	14	43.19 ± 27.11	13 (92.90)	1 (7.10)
ICCU	179	66.90 ± 23.75	93 (52.00)	86 (48.00)
Cardiac Surgery ICU	58	53.12 ± 16.76	18 (31.00)	40 (69.00)

RCSQ: Richard Campbell Sleep Questionnaire: score range of RCSQ 0-100; Cut-off point RCSQ >63.4 (good sleep quality)

The measurement of sleep quality using the Huawei Band 8 Smartwatch indicates no significant difference in terms of sleep quality scores as compared to the RCSQ scores. The mean score difference was 1.14 points, and both methods placed sleep quality within the same category (Table 4).

Table 3. The difference in sleep quality in each domain based on the critical care areas

RCSQ Domains	RCSQ Score							p value
	General HCU	Cardiac HCU	Surgical HCU	Medical HCU	General ICU	ICCU	Cardiac Surgery ICU	
	(Median ±IQR)	(Median ±IQR)	(Median ±IQR)	(Median ±IQR)	(Median ±IQR)	(Median ±IQR)	(Median ±IQR)	
Sleep depth	80.44± 8.50	73.00± 35.60	44.00± 47.50	41.00± 34.25	53.60± 68.93	75.00± 44.00	54.00± 25.25	0.001
Sleep latency	78.70± 64.40	71.50± 43.00	35.75± 43.10	43.00± 33.00	41.60± 40.30	69.00± 40.50	54.00± 31.00	0.001
Awakening	66.85± 41.33	69.00± 37.40	43.50± 48.00	40.00± 47.75	38.05± 38.35	69.00± 43.00	45.50± 33.00	0.001
Sleep continuity	83.85± 50.08	73.00± 38.10	39.00± 33.25	42.00± 30.00	55.00± 53.40	70.00± 47.60	55.50± 30.25	0.001
Sleep quality	88.40± 51.90	77.00± 39.80	44.50± 42.75	37.00± 38.00	53.55± 42.20	80.00± 36.70	55.50± 33.00	0.001
Total RCSQ	80.50± 35.43	62.20± 25.50	44.90± 36.28	43.00± 28.95	48.70± 36.68	66.60± 30.70	53.70± 26.15	0.001

RCSQ: Richard Campbell Sleep Questionnaire; HCU: general high care unit; ICU: intensive care unit; ICCU: intensive cardiac care unit; Score range of RCSQ 0–100; cut-off RCSQ score >63.4 (good quality of sleep); IQR: Interquartile Range

Table 4. The difference in sleep quality measurements using the RCSQ tool and a smartwatch (n=26)

Tool	Sleep Quality Score (Median±IQR)	p value
RCSQ	80.00 ± 36.70	0.297[a]
Smartwatch	72.42 ± 9.72	

[a]*Mann–Whitney*

Discussion

The present research shows that the average RCSQ score of critically ill patients (49.7%) falls into the poor category. These findings support previous research results showing that >40% of critically ill patients experience poor sleep quality Naik et al., 2018). A previous systematic review demonstrated that 66% of critically ill patients have sleep quality disturbances (Shih et al., 2023). The mean RCSQ score of 59.20±24.83 is similar to the score obtained by Richards et al. (2000) instrument validation study, which reported a score of 60.00±27.00 in 70 male ICU patients. This result may be due to the fact that the patients in the study did not use ventilators. In contrast, the previous study by Naik et al. (2018) reported a lower mean score of 51.60±13.50, possibly because the patients in their study were in a more critical condition and required more procedures and treatments, which are major risk factors affecting sleep quality. However, despite the contrary findings, both studies were dominated by older age samples.

The RCSQ measured all of the participants' domains, all of which fell into the poor category. A similar result was found in (Naik et al., 2018) that the RCSQ group categorized all domains as poor (63.4). There are several things that can lead to inadequate overall sleep quality unfavorable environmental conditions that change brain chemistry and make it take longer to fall asleep and wake up and sleep fragmentation that breaks up the sleep cycle (Honarmand et al., 2020; Showler et al., 2023; Telias & Wilcox, 2019).

The RCSQ mean scores of all participants showed the lowest values in the sleep and awakening domains. Studies found that high-care activities and non-conducive environmental conditions after nighttime sleeping hours can cause a decrease in sleep latency and awakenings (Telias & Wilcox, 2019). Sleep latency can also be influenced by homeostasis changes and circadian rhythm disturbances which often occur in ICU patients (Showler et al., 2023; Telias & Wilcox, 2019). Moreover, physiological changes can also disrupt the NREM and REM phases, leading to changes in sleep cycles and increased awakenings (Showler et al., 2023; Telias & Wilcox, 2019).

Based on the different critical care areas, the lowest RCSQ score was in the general ICU rooms. This may occur because ICU necessitate life support equipment that includes additional alarms, reflecting the stringent monitoring of patients' conditions due to their severity (Chen & Nates, 2019). Meanwhile, HCU are designed for patients needing more intensive monitoring and care than what a general ward provides, yet not requiring the complete resources of an ICU (Ohbe et al., 2023). Furthermore, ICU patients have more severe physiological conditions than patients in HCU. Critically ill patients often experience disrupted circadian rhythms and loss of normal melatonin secretion (Honarmand et al., 2020; Lachmann et al., 2021). Severe illness triggers inflammatory responses that can alter the sleep–wake cycle (Baxter et al., 2020). While treatments such as vasopressor infusions further reduce restorative REM and slow-wave sleep (Weinhouse et al., 2022). These physiological disturbances, combined with the ICU's intensive monitoring environment, likely explain why ICU patients had poorer sleep quality compared to those in HCUs.

Among the seven critical care areas, the mean total RCSQ score was poor in the cardiac surgical room, surgical and medical HCUs, and general ICU. Most of the participants in the cardiac surgical room were postoperative patients, who primarily complained of pain and had more than five invasive medical devices installed. Postoperative patients with various invasive devices often report discomfort and poor sleep quality (Lin et al., 2022). The surgical and medical HCUs, as well as general ICUs, have high maintenance activity at night, resulting in high-intensity lighting and noise. These environmental conditions, including exposure to high-intensity light and noise, can contribute to poor sleep quality in these spaces (Honarmand et al., 2020). Noise and lighting are associated with melatonin secretion and Reticular Activating System (RAS), which could lead to circadian rhythm and sleep cycle disruptions (Simons et al., 2019; Yam et al., 2018).

Participants in the cardiac ICU and general HCU had excellent sleep quality scores, while those in the cardiac HCU had ratings that were close to the cut-off point for good sleep quality. Many patients in the cardiac ICU and HCU received Alprazolam, anti-angiogenic, and analgesic therapies. Alprazolam, a benzodiazepine, effectively treats insomnia by enhancing sleep efficiency and reducing awakening (Wang et al., 2019). However, its long-term use can increase stage 2 NREM sleep time, reduce stage 3 and 4 NREM sleep time, and decrease REM sleep time throughout the night (de Mendonca et al. 2023). Additionally, the majority of cardiac patients receive ACE inhibitors, which have a 0.38-fold lower risk of causing insomnia as compared to calcium channel blockers (Aditya et al., 2019).

This research indicated no significant difference in the sleep quality scores between patients using the smartwatch tool and those using the RCSQ tool. Except for the sleep duration domain, which the RCSQ instrument cannot assess, the sleep quality assessment domains in both tools are similar. Smartwatches have objective measurement capabilities for monitoring health conditions, including sleep quality (Li et al., 2024). Specifically, smartwatches have advantages in measuring sleep duration, the number of awakenings, and sleep cycles (Li et al., 2024). Although the RCSQ has limitations in assessing sleep amount and depth compared to the smartwatch, some patients in this study reported uncomfortable to wear during sleep. When patients wear a smartwatch, several dimensions of comfort must be considered for its use in clinical settings, including appearance, pressure, harm, attachment, and movement (Li et al., 2024).

Limitations

The present study's strength includes its comprehensive coverage of various critical care areas and its ability to enroll patients with a diverse range of diseases in Indonesia. However, a limitation of this study is the small smartwatch sample size. Therefore, we need to conduct the study in a larger sample size. Moreover, only five participants were on ventilators, indicating that the critically ill patients studied did not have very severe conditions.

Contribution to global nursing practice

This study's results offer an overview of the sleep quality of critically ill patients in Indonesia. This study offers an overview of the various types of critical care areas that situations can influence patient sleep quality. Nurses must develop targeted interventions to enhance patient sleep quality in ICU, according to the specific type of ICU present.

Conclusion

Patients in the critical care area generally had poor sleep quality, with sleep latency and awakening being the worst domains. Most participants in the general ICUs, surgical and medical HCUs, and cardiac surgery ICU had poor sleep quality, whereas those in the ICCU and general HCU had good sleep quality. The differences in sleep quality across the different room areas may be due to variations in care activities, environmental conditions, and patients' disease severity. This study's results indicate that the RCSQ and smartwatch sleep quality measurements were complementary, offering a more comprehensive assessment. RCSQ and smartwatches can be used to assess sleep quality in critically ill patients, but larger-scale research is necessary to assess the acceptability of smartwatch use among these patients.

Author Contribution

SS has prepared study conception and design, methodology, drafting of the manuscript, critical revision manuscript and final approval of the version; DS has prepared study conception and design, data analysis, drafting of the manuscript; ST has prepared conception and design, data analysis; IFW, ES, HY, YC, G, HA they have compiled study conception and design, data analysis and interpretation of data and HRM has criticized for important intellectual content and revision manuscript.

Conflict of interest

Authors state no conflict of interest.

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