Identification of Different Types of Sleep Quality Measurement Tools in Critically Ill Patients : Systematic Review

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Abstract

Objective: This systematic review is to find out what sleep quality measurement tool is most appropriate for critical patients in the ICU so that this paper can provide information to nurses regarding the needs of critical patients in fulfilling sleep while the patient is in the ICU.

Method: March 2023 database search through PubMed/MEDLINE, ProQuest, Scopus, Sage Journals, Taylor France Online, and ScienceDirect, with the keywords Sleep DAN quality AND instrument OR questioner AND Critical ill OR ICU OR intensive care unit with inclusion criteria: primary sources 2018-2023; full text, English, the number of respondents is at least 10 people

Results: The review consisted of 11 articles that met the criteria, out of 11 articles a total of 965 respondents, males amounted to 60.9%, and females amounted to 39.1%, with an average age of 60.5 years in the age range of ≥18-85 years, at least treated in the ICU for 24-72 hours, almost most of the GCS respondents ≥ 13, the most measuring instruments used RSCQ.

Conclusion: The fulfillment of the needs of patientsin critical patients is very disrupted. There are many methods for assessing critical patient sleep in the ICU but according to the authors, the RCSQ is the most reliable measuring tool.

Keywords: Sleep quality, ICU, critically ill patients, RCSQ, sleep assessment, sleep measurement tool, intensive care, nursing, sleep disruption

INTRODUCTION

Sleep is a basic human need that affects the immune system, maintains homeostasis, and improves some cognitive functions, adjustment of physiological functions through hormonal secretion and anabolic stimulation (Chen et al., 2019). Sleep is essential for the well-being of critical patients because while sleeping, the body and mind are restored. Metabolic waste is cleansed, peak growth hormone secretion helps the body to heal from possible physical damage, and cortisol secretion increases (Ritmala-Castren et al., 2022). Sleep deprivation is a major problem for critical patients and can have negative effects on the patient's physiological and psychological function, including changes in immune function, hormonal imbalances, and cognitive impairment (Alsulami et al., 2019; Rood et al., 2019). Sleep disorders are generally associated with immune system dysfunction, decreased resistance to infections, altered nitrogen balance, impaired wound healing, neurological and cardiopulmonary side effects. The prevalence of sleep disorders in critically ill patients ranges from 22-61% (Biazim et al., 2020) (Chen et al., 2019). In the ICU, approximately 50% of sleep duration occurs during the day, which indicates a circadian rhythm disorder (Edmiston et al., 2023b; Munro et al., 2021), 90% of patients admitted to the ICU with long-term ventilator use have sleep disturbances (Munro et al., 2021).

Optimisation of rest in critical patients can prevent delirium (Chen et al., 2019). Sleep deprivation in critical patients during ICU treatment has negative effects on patients (Alsulami et al., 2019; Munro et al., 2021), and can cause delirium (Munro et al., 2021). Patient YThose admitted to the ICU experienced decreased physical and cognitive function, mood instability, emotional distress, and increased symptoms due to poor sleep quality (Edmiston et al., 2023a; Munro et al., 2021). In critically ill patients, pain, anxiety, effects of treatment, environment, as well as medical and healthcare interventions, and patients' medical diagnoses, can affect the quantity and quality of sleep (Biazim et al., 2020; Edmiston et al., 2023b; LocihovÃi et al., 2020; Munro et al., 2021). Changes that occur in the ICU sleep cycle in patients can persist after the patient is

discharged from the hospital and become a predisposition to post-discharge functional decline (LocihovÃi et al., 2020; Varella et al., 2021). The presence of abnormal sleep patterns in critically ill patients is associated with higher mortality and affects the patient's clinical outcomes (LocihovÃi et al., 2020). Nurses must control and evaluate the sleep quality of critical patients in the ICU to minimize these effects.
Several studies have shown the effect of sleep on health, longevity, and quality of life (Varella et al., 2021). Components of critical patient sleep quality in the ICU include prolonged sleep latency, decreased sleep habit efficiency, and too little time in the restorative stage of sleep (Edmiston et al., 2023b; Varella et al., 2021). Changes in sleep patterns are characterized by increased fragmentation, frequent awakenings, and shorter sleep in patients. To reduce the problem of sleep deprivation, the first step is to have the right measuring tools to quantitatively measure sleep quality in critically ill patients (LocihovÃi et al., 2020) (Rood et al., 2019). Detection Early sleep disorders in ICU patients can help reduce the morbidity of sleep disorders in critically ill patients (Varella et al., 2021). In some countries, proper sleep quality measures to identify sleep-related problems in the ICU are lacking. Sleep in ICU patients was assessed with a variety of objective and subjective tools. Assessing sleep quality in critical patients in the ICU is complicated, so nurses need measuring tools to evaluate it objectively (Chen et al., 2019). Nurses and medical teams must consider the right measuring tools in evaluating the quality of a patient's sleep during their stay in the ICU. Any nurse intervention to address sleep disorders and prevent sleep deprivation requires reliable and valid sleep measurements. With reliable sleep evaluation methods, patients' sleep can be monitored and problems can be identified and addressed (Ritmala-Castren et al., 2022). Systematic review This is the author's reason to find out what sleep quality measurement tool is most suitable for critical patients in the ICU so that this paper can provide information to nurses and other medical teams regarding the needs of critical patients in fulfilling sleep while the patient is in the ICU. The author believes that systematic review this will inform the development of future strategies to improve the quality of sleep of patients in the ICU.

METHOD

Protocol and registration

This systematic review follows the Preferred Reporting Items for Systematic Review and Meta-analysis (PRISMA).

Search Strategy

A systematic database search was conducted in March 2023. We conducted searches on PubMed/MEDLINE, ProQuest, Scopus, Sage Journals, Taylor France Online, and ScienceDirect, and the neonatal and pediatric populations were excluded from the search. Keywords used: Sleep DAN quality DAN instrument OR questioner AND Critical ill OR ICU OR intensive care unit. The inclusion criteria are: (1) primary sources published from 2018 to 2023; (2) full text, (3) written in English, (4) the number of respondents was at least 10 people, and (5) the ICU sleep was measured using at least one method. The author evaluates the title and abstract of all articles that meet the inclusion criteria and identifies articles that have full text. After the full text screening, studies that were not conducted in intensive care were removed.

Data Extraction and Critical Assessment

An electronic database search initially identified 1,233 studies (PUBMED: 448 articles, SCOPUS : 256 articles, PROQUEST : 48 articles, SCIENCE DIRECT : 32 articles, SAGE JOURNALS : 331 articles, and TAYLOR FRANCIS ONLINE : 118 ARTICLES). Duplicates, titles and abstracts were removed by looking at a sample of at least 10 patients from 1,233 articles examined, resulting in 34 selected articles to be read in their entirety by reading abstracts. It was evaluated that there were 13 articles that had to be issued because the research place was not in the ICU and could not be downloaded in full text. Identified from 21 articles for re-screening , it turned out that there were 10 articles that had to be reissued because fourstudies were not in the ICU and/or the sample was not ICU patients or not a history of treatment in the ICU (n=3), qualitative method research (n=2), pediatric samples or neonates (n=3), and was a literature review (n=2). There are 11 articles that have met the inclusion requirements in the writing of this article for analysis.

RESULT

Search outcomes

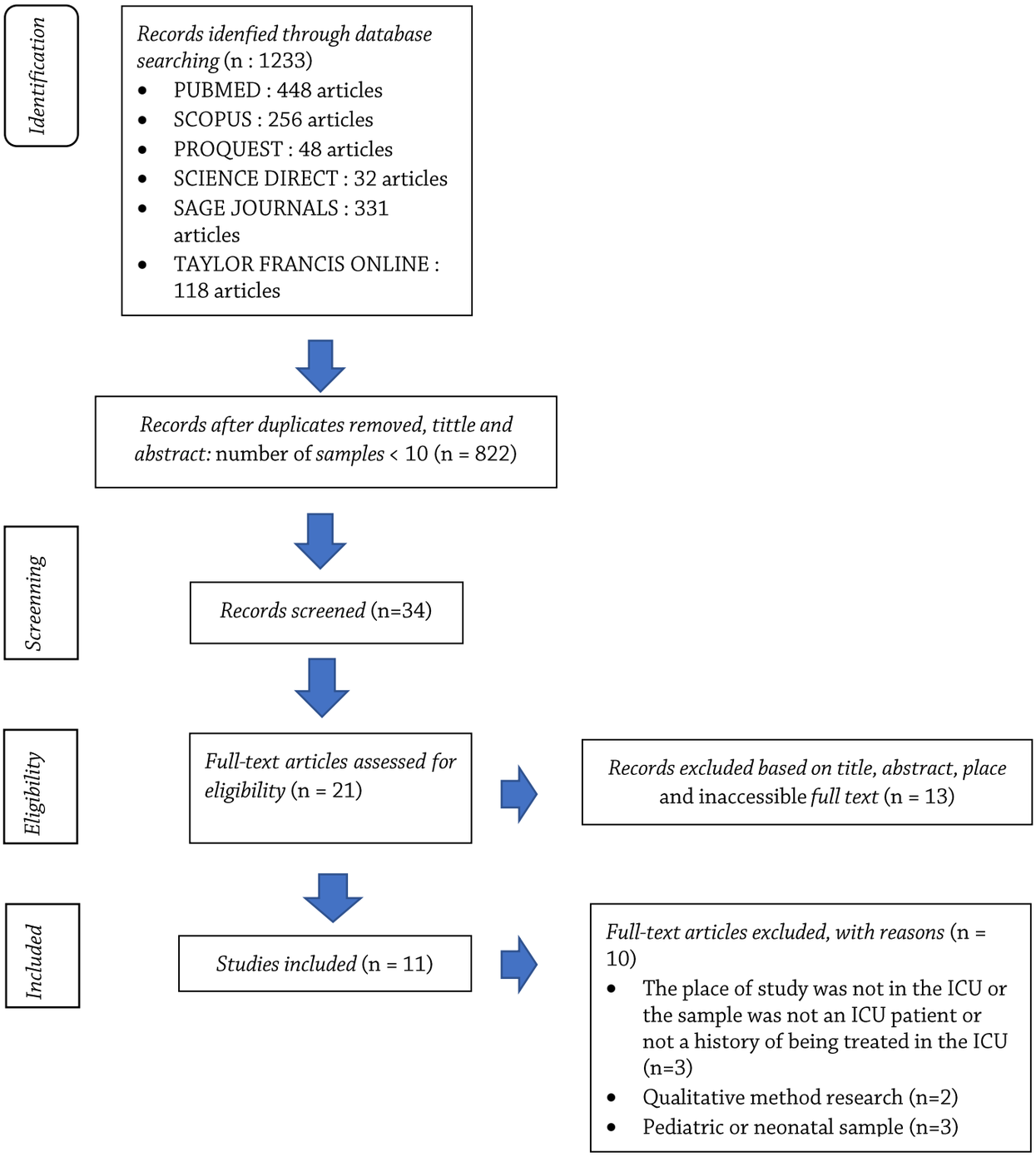

Fig.1 PRISMA flow diagram of search outcom

Table 1 Charactigraphyeristics of Included Studies and Main Findings

NO	Title, Author (Year), Place	Sample size/ Participant Charactigraphyeristic	Method	Instruments	Intervention	Result
1	Development and daily use of a numeric rating score to assess sleep quality in ICU patients, Paul Rood, Tim Frenzel, Rutger Verhage, Monique Bonn, Hans van der Hoeven, Peter Pickkers, Mark van den Boogaard, 2019, Netherlands.p	Stage 1 Sample: 119 male patients Age : mean (SD) 65 (±16) APACHE II score, median [IQR] Not collected. Stage 2 Sample : 998 male patients Age : mean 63 (±14) APACHE II score, median 15 [12–19]	Cross-sectional for 2 days of measurement every 08.00-noon.	Richards-Champbell Sleep Questionnaire (RCSQ) and numeric rating score sleep	• This study was carried out in two prospective stages, the first stage was to measure the perception of patients' sleep quality using the Richards Campbell Sleep Questionnaire (RCSQ) • The second stage evaluates the use of numeric rating score sleep for patients who are able to communicate for those whose quality measurement results are poor, so for 2 consecutive days measurements are carried out using numeric rating score sleep carried out every morning from 08.00 to noon.	• In the first phase 468 patients admitted to the ICU, 194 patients (119 males (61%), aged 65 ± 16 years) were able to rate sleep quality, Median 8 [IQR 6–13] • Patients are visited after an average length of stay in the ICU of 4 days [IQR 2-9] days. The median score of the numeric rating scale (NRS) is 6 [IQR 4-8], 103 (53%) feel that they are getting enough sleep. The average RCSQ is 6 [IQR 4–7]. • Causes of sleep disturbances resulting from RCSQ multifactigraphyorial: Pain (23%), noise (19%) and light (11%) • The mean difference (±SD) found between RCSQ and NRS Sleep with Bland-Altman analysis was 0.25 (±1.21, 95% CI) • NRS-Sleep was significantly correlated with an RCSQ score of R of 0.88 (p b .01). • The second phase of 998 (62%) were male, the average age was 63 ± 14 years. The median [IQR] length of stay in the ICU is 1 [0-2] days. • Patients get enough sleep (71%). Median NRS-Sleep 6 [IQR 5–7].

						Multifactorial sleep problems: depth of sleep (94%), sleep quality (88%), number of awakenings (76%), return to sleep (74%) and fall asleep (61%).
2	The Richards-Campbell Sleep Questionnaire and Sleep in the Intensive Care Unit Questionnaire: translation to Portuguese and cross-cultural adaptation for use in Brazil, Samia Khalil Biazim, Daniela Almeida Souza, Hipólito Carraro Junior, Kathy Richards, Silvia Valderrama, 2020, Brazil.	• The sample amounted to 50 respondents, with 27 respondents being female with an average age of 47.7 years. • Inclusion criteria: patients aged 18 years or older, treated in the ICU HC/UFPR for at least 72 hours • Exclusion criteria: patients with delirium with the Confusion Assessment Method for Intensive Care Unit measure; have a GCS score of <3, do not understand Portuguese, write, or assess answers.	The study evaluated the RSCQ and SICUQ instruments to Portuguese with Brazilian cross-cultural adaptation.	Richards-Campbell Sleep Questionnaire (RSCQ) and Sleep in the Intensive Care Unit Questionnaire (SICUQ)	• The original RCSQ was adapted to add a sixth item, i.e., perceived nighttime noise • SICUQ is used to assess sleep quality in critical patients, as well as to determine the factors that affect sleep in the ICU; environment and routine care of patients. • The RCSQ and SICUQ questionnaires are given quickly (delivery time, 2-3 minutes and 4-5 minutes, respectively).	• A total of 27 patients (54%) were female. • The average age of respondents was 47.7 ± 17.5 years • 1 repondent (2%) used mechanical ventilation, 2 respondents (4%) with tracheostomy, and 2 respondents (4%) used sedation at the time of data collection but met the inclusion criteria: Assessed by the Richmond Agitation-Sedation Scale and the Confusion Assessment Method for Intensive Care Unit showed the demographics and clinical characteristics of the study participants. • Scor RSCQ interobserver reliability was excellent (ICC = 0.84; 95% CI: 0.71-0.90; p < 0.001). • Scor SICUQ interobserver reliability is good for SICUQ domains 1-5 (ICC=0.75; 95% CI 0.55-0.86; p<0.001) and excellent for SICUQ domains 6-7 (ICC=0.86; 95% CI 0.76-0.92; p<0.001).
3	Psychometric evaluation of the Freedman	• Sample of 129 patients, mean age is 60.61±13.88 years,	The research method uses psychometrics	Modified Freedman Questionnaire	• The Spanish modified Freedman questionnaire by Gómez Sanz by	• The results of the KMO sampling adequacy test were

	questionnaire to assess sleep in critical patients. M.D. Bernat Adell, E. Bisbal Andrés, L. Galarza Barrachina, G. Cebrián Graullera, G. Pages Aznar, A. Melgarejo Urendez, M.A. Morán Marmaneub, A. Monfort Lázaro, M.D. Ferrandiz Selles, 2020, Spain.	range (25-85); 62% are male. • The reason for admission to the ICU, 46.5% was for medical reasons, 23.3% were postoperative, 18.6% were coronary diseases, and 11.6% were traumatic. • Inclusion criteria: Critically ill patients admitted to the ICU with the age of > 18 years, patients communicating Spanish. • Exclusion criteria: Patients undergoing neuromuscular blockade, patients with hearing or speech impairment, patients with a history of dementia, patients with substance abuse, patients with a Glasgow coma scale of <12, patients with out-of-range RASS values (+1 and –1).	to test the validity of the content and internal consistency based on the Cronbach alpha coefficient .		measuring 18 items using a Likert scale of 1-10. • Data was collected from 08.00 to 10.00. • The questionnaire is given at an interval of 1 hour between interviewer A and interviewer B. • Data was collected when patients were admitted to the ICU, while being treated in the ICU, and when discharged from the ICU. • Statistical analysis: descriptive, qualitative analysis. • The validity of the content is explored through expert consensus. • The reliability of the questionnaire was assessed by analyzing the internal consistency through the Cronbach alpha coefficient , and the stability was assessed through retests using the level of compatibility between observers with the interclass correlation index (ICC). • The validity of the construct to explore the dimensions of the questionnaire was assessed through factor	0.751 and the Bartlett test was a significant value (P< 0.001). • The validity of the varimax rotation method construct shows a correlation between the analyzed variables and the 4 factors taken (sleep quality, drowsiness, sleep disturbances due to environmental causes, and sleep disturbances caused by human factors). • The internal consistency of the questionnaire was assessed using the Cronbach coefficient which showed a P value of 0.933. • The stability of the instrument is assessed using ICC test --- retest; The coefficients obtained excellent correlation across all the analyzed items.

					analysis using the varimax orthogonal rotation method, the cut-off value of ≥0.4 and determined 4 factors: sleep quality, drowsiness, sleep disturbances due to environmental causes, and sleep disturbances due to human factors.	
4	Prospective repeated assessment of self-reported sleep quality and sleep disruptive factigraphyors in the intensive care unit: acceptability of daily assessment of sleep quality, Ghaida Alsulami, Ann Marie Rice, & Lisa Kidd, 2019, Saudi Arabia	• The sample amounted to 120 patients with: 72 males, 48 females • Inclusion criteria: adult patients (≥18 years) admitted to the ICU for 24 hours of conscious and communicative ≥, with Glasgow Coma Scale 13. • Exclusion Criteria: Patients who are anesthetized or agitated with the Richmond Agitation and Sedation Scale of 14, patients with a history of sleep disorders, patients with cognitive dysfunction, and patients who do not speak Arabic.	Prop	Richards-Campbell Sleep Questionnaire (RSCQ-A) and Sleep in Intensive Care Questionnaire (SICQ)	Arabic version of RCSQ measurement (RCSQ-A) and Sleep in Intensive Care Questionnaire (SICQ) every morning at 07:00-12:00 while the patient is admitted to the ICU room.	• The APACHE II score of participants within 24 hours in the ICU ranged from 10-24 with an average of 15±782.606. More than half of the participants had an APACHE II score between 10-16 n=71 (59.2%); Meanwhile, 49 participants (40.8%) had higher scores between 17-24. • The average ICU LOS is 9.35 days ± 3.15. Patients who had an APACHE II score between 10-16 were admitted to the ICU for 4-12 days. Patients with scores between 17-24 were admitted to the ICU for 6-21 days. • The patient's sleep quality was poor on average, with an RCSQ-A<50 score. The average Sleep Efficiency Index is 60.3%. • Patients rated noise as the most intrusive extrinsic factor with a score of 7.48±1.57, followed by clinical intervention 5.95±1.57; The noise with the highest value was speaking 6.80 ± 1.25, while the intrinsic disturbance factor

						with the highest value was fear with a value of 3.64 ± 2.01.
5	Sleep Quality in the Advanced Heart Failure ICU, Elizabeth A. Edmiston, Heather K. Hardin and Mary A. Dolansky, 2023, France.	• The sample size was 22 people, dominated by men, with an average age of almost 62 years. All respondents have a bachelor's degree. • Inclusion Criteria: Patients > 18 years of age who are admitted to AHFICU, have a diagnosis of heart failure (identified in the patient's medical record), and have a prior HF diagnosis of at least 3 months. • Exclusion Criteria: Not understanding English, using a mechanical ventilator or unconscious, having a history of neurodegenerative diseases such as dementia or other diseases specific to cognitive impairment, unable to complete the Mini-Cog screening test.	Cross-sectional	Pittsburgh Sleep Quality Index (PSQI)	• Measurements of respondents' sleep quality were assessed before entering the ICU, while being treated in the ICU, and after being treated in the ICU. • The first data collection ; Participants were asked to remember the quality of their sleep within 7 days prior to registration. • Second data collection; Data were collected at the bedside in the participant's private room or by phone (participant preference), and the participant was questioned about the quality of their sleep during the hospitalization. • Third data collection; They were collected by phone 1 week after discharge, and participants were asked about the quality of their sleep since being discharged from the hospital.	• More than half of the participants had severe HF symptoms and were unable to perform any physical activity. • Most study participants had a diagnosis of heart failure for several years and were hospitalized at least once in the last 6 months. The average length of stay is more than 8 days from admission to discharge from the ICU. • The severity of comorbid conditions among participants showed a high risk of death at 1 year (mean Charlson Comorbidity Index>5). • More than half of the participants had a diagnosis of obstructive sleep apnea and were prescribed CPAP, but more than half of those prescribed CPAP did not use it regularly. • All participants reported taking at least two medications at home before being admitted to the hospital, with a range of up to 20 medications at home. • Of the study participants who completed all three interviews (N=22), 96% reported sleep deprivation: 96% during hospitalization, and 86% after discharge. • The average sleep quality score increased before admission to

						the ICU, while being treated in the ICU and decreased after discharge • Significant differences in global sleep quality were identified between three time points (F[1, 21]=4.82; P<0.05 with the mean significance of the difference in sleep quality before, and after admission to the ICU, and the difference during the ICU and after discharge. • There was no significant difference in sleep quality on admission and discharge in HF patients, in the seven components of sleep significant differences were found between time points in subjective sleep quality, sleep duration and sleep habit efficiency with a tendency to differ in sleep latency • There were no differences in sleep disorders, sleep medication use or daytime dysfunction over time in the study.
6	Richards-Campbell sleep questionnaire: psychometric properties of Chinese critically ill patients, Li-xia Chen, Dai-hong Ji, Feng Zhang, Jian-hua Li, Li Cui, Chun-jie Bai, Heng Liu and Yan Liang, 2018, China.	• Sample 86 patients are male, and 64 are female. • There are 44 patients in the MICU, 52 in the SICU and 54 in the EICU. • Inclusion Criteria: Patients aged 18 years or older who have been treated for	Descriptive comparative studies	Richards-Campbell Sleep Questionnaire (RSCQ-C)	• Data were collected every morning (07.00-08.00) on weekdays by two researchers who had experience working in the ICU. • The 44 night shift nurses were instructed to perform nurse-based RCSQ-C completion for their patients	• The median age of 150 patients was 64.74 years [SD=16.15 (minimum 20 to maximum 93)]. • RCSQ scores were not significant with age, sex, and ICU type separately (P=0.270, 0.745 and 0.858, respectively). • Cronbach's α internal coefficient of RCSQ-C is 0.923.

		72 hours in the ICU, have a minimum of junior high school education, and agree to participate in the study. • Exclusion Criteria: Using sedatives within 24 hours, screening results for delirium [tested using the Confusion Assessment Method for the ICU]			approximately 60 minutes before the end of their 12-hour shift at 8 a.m. • Neither nurses nor patients know each other.	• The corrected item-total correlation is approximately 0.767–0.834 (P<0.01) • The content validity index (CVI) value for each item was 0.60-1.00, and the average CVI for all items was 0.84, indicating that the CVI of the RCSQ-C was good. • The validity of the RCSQ-C construct was 0.866 (sleep depth), 0.776 (sleep latency), 0.504 (awakening) and 0.856 (sleep quality), while the correlation between the total scores was 0.771. Except for going back to sleep, all correlation coefficients were significant at the level of 0.01. • Validity of discrimination 49.34±24.64. All RCSQ-C components in subjects with the highest quartile were higher compared to the lowest quartile (P<0.001).
7	Sleep and Actigraphyivity Patterns are Altered during Early Critical Illness in Mechanically Ventilated Adults, Cindy L. Munro, Zhan Liang, Maya N. Elías, Ming Ji, Xusheng Chen, Karel Calero, 2022, United States.	• A total of 31 patients out of 34 registered who have completed (91.1%). • A total of 13 (41.9%) were male, the median age was 59.6 ± 17.3 years. • The average severity of the APACHE III is 74.5 ± 25.5. • Inclusion criteria: adult patients with the use of mechanical	Randomized controlled trial	Actigraphyigraphy	Data collection was carried out 2 times, namely during the day (06:00 – 21:59) and at night (22:00 – 05:59).	• The average (SD) at night during the 5-day ICU period was 83.1% ± 16.1% • The average DAR during the 5-day ICU period was 66.5 ± 19.2%. The percentage of days where the average DAR > 80% was only 17.5% (80% > DAR occurred in 14 days out of a total of 80 recorded observation days in all subjects). • The majority of activities fall below 1000 activities in the count/hour for each 24-hour

		ventilation (age ≥ 18 years); intubated for 48 hours in the ICU; family members give consent, family members speak English or Spanish and are willing to record audio of written messages. • Exclusion criteria: Dementia, psychiatric history, auditory hallucinations, or severely deaf), inability to speak English or Spanish.				period, while the higher number of activities (e.g., > 1000 counts/hour) occurs between 11:00 AM–12:00 PM, 5:00 PM–6:00 PM, and 9:00 PM–10:00 PM.
8	Cross-cultural adaptation of the Richards-Campbell Sleep Questionnaire for intensive care unit inpatients in Brazil: internal consistency, test-retest reliability, and measurement error, Natalia Cunha Varella, Renato Santos Almeida, Leandro Alberto Calazans Nogueira, Arthur Sa Ferreira, 2021, Brazil.	• The sample amounted to 113 respondents • Inclusion criteria: 18 years old in ICU, GCS=15, hemodynamic stable. • Physiotherapist inclusion criteria: have worked in the ICU for> 2 years, fluent in Portuguese-Brazilian.	The research method used psychometry to test the validity of the content and internal consistency based on the Cronbach alpha coefficient with a sample number of 78.	Richards-Champbell Sleep Questionnaire (RCSQ)	• First, to assess the initial version of the translated questionnaire, a sample of 30 participants from the population of interest was recommended. • For the evaluation of the psychometric questionnaire (internal consistency), a sample of 78 participants was required to test H0: Cronbach's α = 0.50 vs. H1 : α = 0.70 with a type-I error of 5% (two-sided) and a strength of 80%. • Finally, for the test-retest reliability analysis, a sample of 45 participants was needed to test the intraclass correlation	• Stage 1 (content validity) registers 30 participants; • Phase 2 (internal consistency) enrolled 83 participants (47 males [56.6%], 60.4 ± 14.2 years), of which 53 participants (31 males [58.5%], 59.0 ± 14.9 years) agreed to participate in phase 3 (reliability). • For phase 2 participants, the length of stay on the day of filling out the questionnaire was 2.7 ± 3.8 days with a total length of stay in the ICU of 3.3 ± 4.4 days. • The ICU mobility scale (IMS) was 6.1 ± 3.8 points and the APACHE II score was 10.5 ± 5.4. The most common comorbidity is hypertension (n = 46, 55.4%), which corresponds to the most

					coefficient (ICC) H0: ICC = 0.50 vs. H1 : ICC = 0.75 with a type-I error of 5% (double-sided) and 80% power. • The participants were taken data in the morning (07:0011) by one of two trained physiotherapists.	common cause of hospitalization is cardiovascular surgery (n = 38 [45.8%). All but 1 (n = 82, 98.8%) participants were given analgesic treatment the night before the evaluation, 30 (36.1%) were treated with anxiolytics, and 12 (14.5%) received sedatives. • The results of the internal consistency of RCSQ-PT Br. The total average score of RCSQ-PT-Br was 46.9 ± 26.7 in the range of 3.4-98.8. The total score of RCSQ-PT-Br shows good internal consistency (Cronbach's α = 0.850 95% CI = [0.789-0.897]). Internal consistency remained good after removing each scale item (Cronbach's α in the range of 0.798-0.856). • Content validity analysis (n = 83). sleep latency of scale items (ICC2.1= 0.764), number of awakenings (ICC2.1= 0.821), and return to sleep (ICC2.1= 0.767). Reliability capabilities were acceptable for single measurements of sleep depth (ICC2.1= 0.632) and sleep quality (ICC2.1= 0.747). 3.5. SEM measurement error varies from 14 (number of awakenings) to 21 mm (depth of sleep) between scale items; Similarly, the MD varies from 38

						to 58 mm for items of the same scale.
9	Investigating the construct and concurrent validity of the Richards-Campbell Sleep Questionnaire with intensive care unit patients and home sleepers, Marita Ritmala-Castren, Anna Axelin, Kathy C. Richards, Marion L. Mitchell, Tero Vahlberg, Helena Leino-Kilpi, 2022, Finland.	• The median age of the 114 participating ICU patients was 59 years old (SD = 14, range = 25-87), and 37% were 31 women. • Inclusion criteria: Adult patients are over 18 years old and able to answer the survey independently.	Cross-sectional	Richards-Champbell Sleep Questionnaire (RCSQ)	• Researchers evaluated night's sleep using RCSQ for 7 nights in the patient's home. • The results were compared to a one-night RCSQ sleep evaluation of conscious, non-intubated, oriented adult patients with no neurological or surgical trauma and no diagnosed sleep disorders. • The participants were asked to rate the quality of their sleep the night before using the RCSQ domain for a week. • The participants also assessed how fresh they were when they woke up, which was also measured on a visual analogue scale of 0-100 mm. Data collection in the morning after at least a full night in the ICU.	• The average sleep index was 54 mm (SD = 28.8 mm). From the RCSQ sleep domain, ICU patients rated falling asleep at night as the highest (mean = 63, SD = 32.3 mm) and the lowest sleep depth (mean = 44, SD = 33.6 mm). • A total of 114 patients are sleeping at home. The average age of participants who slept at home was 48 years (SD = 15.4, range = 18-80 years), with 61% of women • In total, there were 798 nights of sleep reported through the survey. • The average range of participants' responses to each question in seven nights was 41 mm (SD = 23.2 mm) of a possible 100 mm. • Comparing the evaluation of sleep at home with the sleep evaluation of ICU patients, participants who slept at home reported their sleep significantly better in all domains than the oriented, non-intubated adult participants. The percentage of awake time is estimated to be highest of all sleep domains by people sleeping at home, while ICU patients are estimated to be the highest asleep. The variation

						between the different sleep domains was much smaller in the evaluation of people sleeping at home (65-78 mm) than in the evaluation of ICU patients (44-63 mm). Patients were significantly older (mean = 59 years, SD = 14.1, range = 25-87 years) than people who slept at home (mean = 48 years, SD = 15.4, range = 18-80 years) ($p<0.05$)
10	Sleep quality assessment in intensive care: actigraphyigraphy vs. Richards-Campbell sleep questionnaire, Hana Locihová, Karel Axmann, Katarína Žiaková, Dagmar Šerková, Simona Černochová, 2020,	• The sample consisted of 20 patients living in the ICU. • Inclusion criteria: GCS score: 15; orientation to the place, time and person, be treated in the ICU for at least 24 hours, be at least 18 years old, and be willing to be a respondent. Exclusion Criteria: Undergoing treatment for sleep disorders, neurocognitive dysfunction, structural brain damage, being admitted to the ICU for exacerbation of the condition, delirium, sedative administration within	Single-center prospective observational.	RCSQ and ACTIGRAPHY	• The questionnaire was filled out once during ICU treatment, on the morning of the second day (between 7 a.m. and 9 a.m.) after the previous night's sleep monitoring with ACTIGRAPHY. • On average, the questionnaire takes 2-5 minutes to complete. • Patients with visual impairments or other disorders fill out questionnaires assisted by trained nurses. • Actigraphyigraph is used in the dominant wrist. • The main focus of night sleep is from 9 pm to 5 am. Noise measurements are taken during the night shift (6 p.m.).	• The sample consisted of nine men (45%) and 11 women (55%). • The median age was 65.7 years (range 18-79 years; SD 14.5), height 166 cm (SD 10.1), body weight 80.4 kg (16.7) and body mass index (BMI) 29.2 (SD 6.0). • The average total RCSQ was 47.6 (SD 24.4). • Sleep well (RCSQ≥50) in nine patients (45%) and poor sleep (RCSQ <50) in 11 patients (55%). Among the items, the highest (53.6 DbA) and lowest (34.1 DbA) noise levels were recorded at 5 a.m. and 01:00, respectively. ACTIGRAPHY gives the following results: in all cases, the standard sleep time is 480 minutes (8 hours, from 9 p.m. to 5 a.m.). Total sleep time (TST) was 415.6 minutes. • Sleep quality in patients with higher BB is subjectively considered to be lower in sleep

		the previous 24 hours and the patient refusing to be a respondent.				quality values (83.5±14.1kg vs. 66.6±20.4kg; P=0.005), individual height (172±7.45cm vs. 159±8.98cm; P=0.005) and those with a high BMI (33.4±8.49kg/m2 vs. 26.1±3.53kg/m2; P<0.001), no statistically significant factigraphyor was found in the age characteristics (P<0.01) while from the gender characteristics it was found that male patients had worse sleep quality than female sex. • Based on the differences in individual ACTIGRAPHY parameters between groups with different subjective sleep quality (bad vs good), no statistically significant differences were found: sleep efficiency (86.4±10.34 vs. 86.8±8.69%; P=0.82); TST (415±49.6 vs. 416±41.7 minutes; P=0.82); WASO (65.2±49.6 vs. 63.6±41.7 minutes; P=0.82); Resurrection (19.1±9.83 vs. 14.7±7.04; P=0.94); average length of awakening (3.22±0.876 vs. 3.97±1.64 minutes; P=0.13) and SFI (41.7±17 vs. 38.9±16.1; P=0.59). • On the RCSQ and ACTIGRAPHY parameter variables, the dependencies were studied using Spearman correlations. None of the selected variables showed a statistically significant

						dependence: return to sleep vs. WASO (r=0.0716; P=0.7549); resurrection vs. resurrection (r=0.1097; P=0.6324) and sleep quality vs SFI (r=0.0452; P=0.8439). • The results showed a low level of agreement between subjective sleep quality assessments using questionnaires and objective ACTIGRAPHY measurements.
11	Reliability of the Korean version of the Richards Campbell Sleep Questionnaer, Kyoung Kim, Ju-Hee Park, Jaeyoung Cho, Sang-Min Lee, Jinwoo Lee, 2020, Korea.	• The number of samples of 52 patients Thirty patients (57.7%) were male, and the average age of the patients was 62.8 ± 15.9 years. • The ≥19-year-old patient has been admitted to MICU for more than 24 hours. • Inclusion Criteria: Patients are able to communicate, have a Richmond Agitation and Sedation Score (RASS) from –2 to +2. • Exclusion Criteria: Patients with acute neurological or psychic disorders of atrial and delirium diseases.	cross-sectional	Richards-Champbell Sleep Questionnaire (RCSQ)	Data collection using the K-RCSQ instrument during the day: 9 am and 5 pm.	• The reasons for admission to the ICU were respiratory failure (49.2%), heart failure (15.4%), kidney failure (13.8%), and sepsis (10.8%). • The average score (APA CHE) II was 17.5 ± 7.3, and the Sequential Organ Failure Assessment (SOFA) score was 7.3 ± 4.3. • At the time of the RCSQ assessment, three patients (5.7%) were under mild sedation, one patient had been given propofol (72 mg/kg/day), and two patients were anesthetized with dexmedetomidine (16.8 µg/kg/day and 4.8 µg/kg/day, respectively), eight patients (15.4%) had been given opiates for pain control, one patient had received a fentanyl patch (75 µg/hour), and seven others have been given en remifentanil (average, 57.6 µg/kg/day).

						• Most patients (80.8%) were conscious and calm at enrollment, with a RASS score of 0. The average length of stay in the ICU is 4 days (range, 1-21 days). At the time of discharge from the ICU, 43 patients (82.7%) were unable to do ADL. • The average score of all five K-RCSQ items was 41.9 ± 28.9 (range, 0–100). Only eight patients (15%) showed very good sleep (> score of 75), while 16 patients (31%) had a K RCSQ score of less than 26, which indicates very poor sleep • The overall internal consistency of all five items of K-RC SQ is 0.96. Of the K-RCSQ subscales, the primary "sleep depth" had the highest average K-RCSQ score, and the "back to sleep" domain had the lowest K-RCSQ score. The average score of the perceived noise assessment was 40.7 ± 28.1 (range, 0–90). There was a significant linear correlation between the noise score and the mean K-RCSQ score (r = -0.37, P <0.001). Noise perception scores were significantly lower in the good sleep group (K-RCSQ score > 50) than in the poor sleep group (K RCSQ score ≤ 50) (28.75 ± 26.35 vs 48.28 ± 26.99, P = 0.014)

Search outcomes

A systematic search was conducted using databases including PubMed, Scopus, ProQuest, ScienceDirect, SAGE Journals, and Taylor & Francis Online. The search strategy used a combination of keywords: sleep AND quality AND instrument OR questionnaire AND critically ill OR ICU OR intensive care unit. This yielded a total of 1,233 articles. After removing duplicates, screening titles and abstracts, and applying an inclusion criterion of a minimum sample size of 10 patients, the number of relevant articles was narrowed down to 34. Further evaluation based on full-text availability, study location, sample size, and research methodology resulted in the exclusion of 10 articles, leaving 11 studies eligible for review. These 11 articles involved a total of 965 respondents, with 60.9% male and 39.1% female participants, and a mean age of 60.5 years. Only studies published between 2018 and 2023 were included. One article was published in 2018 (Li-xia Chen), two in 2019 (Paul Rood and Ghaida Alsulami), four in 2020 (Samia Khalil Biazim, MD Bernat Adell, Hana Locihova, and Kyoung Kim), one in 2021 (Natalia Cunha Varella), one in 2022 (Cindy L. Munro), and one in 2023 (Elizabeth A. Edmiston). These studies formed the basis for this literature review on sleep quality assessment in critically ill patients.

Sample of Study

The sample in this writing is mostly adults with the youngest ≥ 18 years old and the oldest are 85 years old, with a minimum of being admitted to the ICU for 24-72 hours, patients are able to communicate, some use intubated respondents for at least 24 hours in this writing, but almost most of the respondents are with GCS ≥ 13, the average patient is admitted to the ICU for medical reasons, postoperative, coronary heart disease, and traumatic.

Evidence from the use of sleep quality measuring devices in critical patients in the ICU

Polysomnography (PSG)

Sleep assessment in the ICU can be checked using objective tools such as polysomnography (PSG) (Alsulami et al., 2019; Biazim et al., 2020). PSG is considered a standard sleep measurement tool (Alsulami et al., 2019; Biazim et al., 2020; LocihovÃi et al., 2020; Munro et al., 2021; Rood et al., 2019; Varella et al., 2021). However, this measuring tool is included in the unit cost ICU which will overwhelm patients and consequently is rarely used in daily clinical practice (Biazim et al., 2020; LocihovÃi et al., 2020; Rood et al., 2019; Varella et al., 2021). Polysomnography can also Provides information about the stages and cycles of sleep (Biazim et al., 2020). PThe use of PSG is difficult to implement in critically ill people because its use requires electroencephalography monitoring, movement of all limbs, eye movements, video monitoring, and the presence of a certified sleep technician (Munro et al., 2021). Quality measuring instruments polysomnography and actigraphyigraphy is also not available in all ICUs, and requires experts to perform interpretation (Alsulami et al., 2019; Biazim et al., 2020; Chen et al., 2019). otherwise the results are unreliable (Varella et al., 2021) , EThe lectrobe must be continuously attached to the patient to collect sleep quality data (Alsulami et al., 2019).

Richards-Champbell Sleep Questionnaire (RCSQ)

Society of Critical Care Medicine recommends that patient sleep should be continuously assessed using a valid assessment tool such as a questionnaire Richards-Champbell Sleep Questionnaire (RCSQ) . RCSQ is an instrument to assess sleep in ICU patients. It consists of five questions: the depth of sleep, falling asleep, the number of awakenings, the time of awakening, and the overall quality of sleep (Alsulami et al., 2019) (Biazim et al., 2020; Chen et al., 2019; Ritmala-Castren et al., 2022; Rood et al., 2019; Varella et al., 2021). However, to fill out the RCSQ, patients must be awake and have the concentration and cognitive ability to process five questions using a visual analogue scale of 0-100 mm (Chen et al., 2019; LocihovÃi et al., 2020; Ritmala-Castren et al., 2022; Rood et al., 2019). The total sleep score of the RCSQ is obtained by summing the individual scores on five sleep items and dividing them by five.

Participants who belonged to the lowest quartile (scores 1–25) were considered to have very poor sleep, and those who belonged to the highest quartile (scores 76–100) were considered to have very poor sleep (Chen et al., 2019), or The score ranges from 0 (worst sleep) to 100 (best sleep) (LocihovÃi et al., 2020; Ritmala-Castren et al., 2022; Varella et al., 2021), most ICU patients are unable to carry out RCSQ, their clinical eligibility in the ICU is limited (Rood et al., 2019).

Pittsburgh Sleep Quality Index (PSQI)

Definition of sleep quality based on Pittsburgh Sleep Quality Index (Buysse Charles F Reynolds Ill et al., n.d.) which includes subjective sleep quality, sleep latency, sleep duration, sleep efficiency, sleep disorders, sleep medication use, and daytime function. The PSQI had 25 question items, with four items measuring the amount of sleep and 21 items measuring seven components of sleep quality (subjective sleep quality, sleep latency, sleep duration, sleep habit efficiency, sleep disorders, sleep medication use, and daytime dysfunction) using a four-point Likert scale. The total score ranged from 0 - 21, with a total score of > 5 indicating poor sleep quality. Each of the seven components has a score range from 0-3, with a score of 0 indicating no difficulty and a score of 3 indicating severe difficulty. PSQI internal consistency reliability test in the study (Edmiston et al., 2023) (Edmiston et al., 2023b) in the population of advanced heart failure patients treated in the ICU, the reliability was good (R=0.75).

Numeric Rating Score Sleep and Freedman Questionnaire (RASS; Richmond Agitation Sedation Scale)

NRS is a simple and efficient way of measuring pain, but it can also be used to assess a patient's sleep experience in the ICU (Rood et al., 2019). The Freedman Questionnaire (RASS) is a questionnaire to assess patients' sleep with 4 factors: Secondary sleep disorders due to health workers and diagnostic tests, sleep quality, daytime sleepiness, and sleep disturbances due to environmental factors (light and noise) (Chen et al., 2019).

Wrist Actigraphyigraphy

Actigraphyigraphy is a small, lightweight, wrist-based rest/activity monitoring device. Actigraphyigraphy It contains an accelerometer capable of sensing any movement with an acceleration of at least 0.01 g to measure long-term gross motor activity and integrate the degree and intensity of movement. The motion is then converted into an electrical signal, which is digitally integrated to obtain an activity count. Actigraphyigraphy incorporates a built-in algorithm to translate the number of 15-second time period activities, known as " epochs ". This simple method is based on monitoring motor activity in sleep patients. The number of movements is recorded asynchronously at pre-set intervals (15, 30 or 60 seconds). The data is stored in the actigraphyigraph memory and analyzed after the monitoring is complete. Recordings can be assessed visually or automatically with software using a variety of algorithms. Choosing the right algorithm is essential for the sensitivity and specificity of the method. The chosen algorithm must be calibrated for a specific population of subjects/patients (LocihovÃi et al., 2020). Actuarial angiography is a feasible, reliable, and relatively inexpensive alternative method for assessing sleep and activity of patients in the ICU (Munro et al., 2021). Wrist activation is used to estimate nighttime sleep and daytime activity. Actigraphyigraphy widely used for patient activity and sleep measurement. 18–20 Spectrum Actigraphyiwatch is the latest version of the available device. Actigraphyigraphy placed on the wrist of each patient (dominant wrist is preferred, if not obstructed by vascular access line or restrain, etc.) within 48 hours of ICU admission, and continue to be recorded for up to five consecutive days (120 hours), or until ICU discharge (Munro et al., 2021). The main benefit of ACTIGRAPHY is that it is simple to use and low cost, but it has limited data reliability. The actigraphyigraph method is not used alone; but is a supporting instrument (e.g. in the subjective assessment of the effects of a clinical intervention).

Table 2 Distribution of Critical Patients in the Use of Sleep Quality Measuring Instruments in the ICU Room

	1	2	3	4	5	6	7	8	9	10	11
Respondents	194	50	129	120	22	150	31	83	114	20	52
Male (%)	61.3	46	62.01	60	86.36	42.67	41.93	43.37	63	45	57.69
Female (%)	38.7	54	37.99	40	13.64	57.33	58.07	56.63	37	55	42.31
Age (mean±SD)	65 ±16	47.7±17.5	60.61±13.88	59.7±9.44	60.42±11.94	64±16.15	59.6±17.3	60.5±14.1	59.6±14.1	65.7±14.5	62.8±15.9
Case Type (%)											
Surgery	38.6	86	23.26	49.17	100	34.67	48.39	62.65	UD	UD	UD
Internal Medicine	51.03		63.56	50.83		52	48.39	37.35			
Neurology	7.21	14					3.22				
Trauma			13.18			13.33					
Mechanical Ventilation (%)	47.94	2	72.09	35.83	59.09	100	100	UD	27.19	UD	5.77
Therapy (%)											
Sedation	29.38	4	44.18	100	UD	UD	UD	14.5	UD	UD	5.77
Analgetics								98.8			
Sleeping pills	28.86		43.41	46.67					25		
Research Instruments											
NRSa	✓										
RCSQb	✓	✓		✓		✓		✓	✓	✓	✓
SICUQc		✓									
RASSd			✓	✓							
SPQIe					✓						
Actigraphyographyf							✓			✓	
Sleep Quality (mean±SD)	6a* 6b*	37.9b** 6.2 ± 2c1 3.2±1.7c2	3.62 ± 0.51d	34.41±5.6b	11.64±3.89e	44.76±19.96b	6.9±1.3f1 86.8±15.4f2	45.7±27.1b	50±35.3b	47.6±24.4b 415.6±43.9f1 86.6±9.2f2 64.5±43.9f3 3.6±1.4f4 40.4±15.8f5	42.4±28.3b

a.NRS= Numeric rating score; b.RCSQ= Richards Campbell Sleep Questionnaire; c.SICUQ= Sleep In the Intensve Care Unit Questionnaire; d.RASS= Richmond Agitation Sedation Scale; e.SPQI= Sleep Quality Index; SD= Standard Deviation; UD (undescribed)= undescribed; *median **mean [c1]domain1-5 on SICUQ [c2]domain6-7 on SICUQ, [f1]Nighttime Total Sleep Time (TST), [f2]Sleep Efficiency, [f3](SE) Wake After Sleep Onset, [f4]Average awakennig length, [f5]Sleep Fragmentation Index

DISCUSSION

Based on the analysis of some of these articles, according to the author, the method of measuring sleep quality in critical patients is in the form of measuring sleep quality tools objectively and subjectively, the author found that most critical patients experience sleep disorders (Pulak & Jensen, 2016), worse sleep disorders were found in patients undergoing treatment in the ICU compared to patients who were at home (Alsulami et al., 2019), and some of these sleep disorders are carried away until the patient undergoes treatment after returning from the ICU (Varella et al., 2021). The authors also found that sedation, mechanical ventilation, and the reason the patient was admitted to the ICU (surgical, medical or trauma) had an effect on sleep characteristics assessed by PSG, RCSQ, and actuarial sleep quality measures. The author found that Environmental factors can cause changes and disturbances in the patient's sleep, this is based on the article (Bernat Adell et al., 2020) stated that noise is the most annoying factor. In intubated patients, the quality of sleep was much worse than in patients after extubation. The results of the study said that, although patients' nighttime sleep hours were relatively high (6.6 ± 1.3 hours), their sleep was substantially disrupted during the first 5 days of ICU admission, with activity attacks occurring at night. The results suggest that interventions that can improve sleep quality (e.g., day/night orientation, daytime activities, early morning mobility, noise reduction, group care activities, and decreased nighttime sleep fragmentation) are needed during the initial stay in the ICU. In the fifth article, it was found that individuals with advanced heart failure who were treated in the ICU had poor sleep quality while being treated in the ICU. Respondents also reported significantly better sleep quality after the patient was discharged compared to before admission and while being treated in the ICU. Patients in this study may be prone to poor sleep due to the severity of symptoms before hospitalization, diuretic use, and poor sleep hygiene. Meanwhile, the seventh article says that poor resting activity cycles are found in patients who are fitted with mechanical ventilators during the initial period of being admitted to the ICU. Munro et al., (2021)

In the second article, it was found that the cross-cultural and Portuguese-speaking RCSQ and SICUQ seemed to have good interobserver reliability, in the fourth article it was also said that ICU patients who completed daily reports related to sleep quality using RCSQ during their stay in the ICU got valid results, in the fifth article it was found that the psychometric properties of RCSQ are a valid and reliable tool for measuring the subjective sleep quality of ICU patients. Similar to the eighth article, it is mentioned that the RCSQ is a valid and reliable instrument for evaluating the sleep of patients admitted to the ICU in Brazil. Likewise, the ninth article states that the RCSQ accurately measures sleep quality in conscious patients both in the ICU and at home. This study is the first study to positively evaluate the validity of its construct through a known group technique using home sleepers and ICU patients and simultaneously validity using a single item score of feeling fit which shows a strong correlation with RCSQ, thus adding dimension to the sleep study. RCSQ can be used for sleep evaluation in the ICU to improve well-being and recovery. while the eleventh article also says the same thing that critical patients sleep quality is very difficult to assess, but says that the RCSQ is a suitable and well-validated instrument for subjective assessment of sleep quality. However, its use in the ICU is difficult and limited (as is the case with other questionnaires). On the other hand, actigraphy is a method that is technically simple and available, albeit with low reliability. Thus, the main potential of actigraphy is that it can function as a supporting instrument to complement other sleep quality assessment methods. For example, it can be used to evaluate the effectiveness of sleep promotion interventions in the ICU. Using the RCSQ for sleep evaluation in critically ill inpatients can help track sleep optimization strategies and reduction of comorbidities that are diverted to low-quality and/or sleep-deprived in this population.

PSG is an objective measure of sleep quality, which has a Gold Standard, but it has a high cost so that it will burden patients who in the end are very rarely used in daily clinical practice. Another advantage of PSG is that this measuring tool can provide information about the stages and cycles of sleep, but it has disadvantages, namely that its use requires electroencephalography monitoring and the presence of a certified sleep technician, besides that its existence is not always available in all ICUs, and when using it requires an expert to interpret, if it is not included an expert interpretation of the quality of sleep is not reliable, Likewise, electrodes should be continuously attached to the patient during sleep quality data collection. Currently, actigraphy has been identified as a reliable alternative to replace PSG in patients in the ICU. The results of the third study showed that the Freedman questionnaire modified by Gómez Sanz showed good psychometric characteristics, and could be a reliable tool for evaluating sleep quality in ICU patients with RASS between −1 and +1, as well as environmental and human factors that can interfere with sleep. While thefirst article states that the use of NRS-Sleep in daily practice is a feasible method to evaluate and monitor perceived sleep and can be used to evaluate in interventions to improve sleep quality.

Some questionnaire measurement tool studies report that the development of the tool is based on the exploration of relevant literature and expertise within the team. There are 9 studies that report reliability and validity tests in this paper. Only four used the target population for testing the tool. This shows us that questionnaires as a research data collection method are poorly understood in the critical care community. A well-designed measuring tool can produce satisfactory results, a measuring tool in the form of a questionnaire is the most widely used data collection method and but in filling it out there are still many things that go wrong. Some adhere to rigorous assessments for content, criteria, and construct validity that include testing for consistency, generalization, and usability.

CONCLUSION

This paper is the first literature review that can provide a detailed overview of various types of sleep quality measuring instruments commonly used in critical patients in the ICU. This paper aims to look at the properties, feasibility, and quality of the instruments used to evaluate sleep in critically ill patients admitted to the ICU. The fulfillment of sleep needsin critical patients is very disrupted and can be seen from the short duration of sleep, easy to wake up, and difficult to fall asleep again. There are many methods for assessing critical patient sleep in the ICU, but according to the authors, RCSQ is the most reliable measure in subjectively assessing sleep in critically ill patients as a substitute for polysomnography as an objective measure of sleep quality. RCSQ is also a questionnaire measurement tool that is advancedand specific so it is very suitable for use in critically ill patients. However, its use and application still have to look at the patient's condition, because some patients cannot use it such as: Patients who are anesthetized or agitated with the Richmond Agitation and Sedation Scale 14, patients with a history of sleep disorders, and patients with cognitive dysfunction. The authors recommend that further research with larger sample sizes be conducted in the future to measure the various dimensions of sleep, and provide additional evidence on the instrument's reliability, validity, feasibility, and reliability. The author also supports the testing of new technologies that are able to improve their feasibility and accuracy.

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