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TITLE: Sleep assessment by patients and nurses in the intensive care: an exploratory descriptive study

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Abstract

Background: Sleep disruption is common in intensive care unit (ICU) patients, with reports indicating reduced quality and quantity of sleep in many patients. There is growing evidence that sleep in this setting may be improved.

Aim: To describe ICU patients' self-report assessment of sleep, examine the relationship between patients' self-reported sleep and their reported sleep by the bedside nurse, and describe the strategies suggested by patients to promote sleep.

Methods: An exploratory descriptive study was undertaken with communicative adult patients consecutively recruited in 2014–2015. Patients reported sleep using the Richards-Campbell Sleep Questionnaire (score range 0–100 mm; higher score indicates better sleep quality), with nursing assessment of sleep documented across a five level ordinal variable. Patients were asked daily to describe strategies that helped or hindered their sleep. Ethical approval for the study was gained. Descriptive statistical analysis was performed [median (interquartile range)]; relationships were tested using Spearman's rank correlation and differences assessed using the Kruskal-Wallis test; $p < 0.05$ was considered significant.

Results: Participants (n=151) were recruited [age: 60 (46–71) years; ICU length of stay 4 (2–9) days] with 356 self-reports of sleep. Median perceived sleep quality was 46 (26–65) mm. A moderate relationship existed between patients' self-assessment and nurses' assessment of sleep (Spearman's rank correlation coefficient 0.39–0.50; $p < 0.001$). Strategies identified by patients to improve sleep included adequate pain relief and sedative medication, a peaceful and comfortable environment and physical interventions, e.g. clustering care, ear plugs.

Conclusion: Patients reported on their sleep a median of 2 (1–3) days during their ICU stay, suggesting that routine use of self-report was feasible. These reports revealed low sleep quality. Patients reported multiple facilitators and barriers for sleep, with environmental and patient comfort factors being most common. Interventions that target these factors to improve patient sleep should be implemented.

Keywords

Critical illness, intensive care, Richards-Campbell Sleep Questionnaire, sleep disorders

Introduction

Sleep disruption is common in the intensive care unit (ICU) population, with reports indicating reduced quality and quantity of sleep in a majority of patients.[1, 2] Intensive care patients receive as little as two hours of sleep over a 24 hour period, with little demonstrated change over three decades of investigation.[3-5] The quality of the sleep is also compromised, with some results suggesting that intensive care patients do not experience normal sleep.[1, 6]

Sleep is considered to be physically and psychologically restorative and essential for healing and recovery from illness. During critical illness sleep is vital, potentially promoting immune function and thus reducing preventable healthcare-associated infection.[7]

There are many potential causes for sleep disruption during critical illness. These include alterations in circadian rhythm, elevation of the stress response, management strategies such as medications, care activities, technology interaction (e.g. patient-ventilator synchrony) and environmental factors such as noise and light.[8] Difficulty sleeping due to noise and the invasiveness of therapeutic interventions has been reported as one of the most important physical stressors for ICU patients by patients, relatives and healthcare professionals.[9]

There is evidence that nurses are not able to accurately assess patient sleep, when compared to patients' own assessment of their sleep, with nurses consistently over-rating the amount and quality of patient sleep.[10, 11] Sleep assessment in a number of studies has been undertaken using polysomnography, although routine use of this method during patient care is rarely feasible or affordable. The recognition of poor quality and quantity of sleep during critical illness has been strengthened by the development of patient self-assessment sleep tools. The most commonly used sleep assessment instrument in ICU described in literature is the Richards-Campbell Sleep Questionnaire (RCSQ).[11-16] The RCSQ is a five item visual analogue scale (VAS) that contains assessment items relating to sleep depth, falling asleep, number of awakenings, percent of time awake and overall quality of sleep that are rated on a 100 mm scale. There is initial evidence of the utility of the RCSQ in the ICU, although reports of its use have predominantly been limited to a single (usually

the last) night of the patients' ICU stay. Only one study (conducted in the USA) has reported RCSQ use on multiple ICU days.[13]

Sleep assessment instruments enhance the ability of health professionals to recognise and respond to poor sleep, but their use is not widespread in the clinical environment. However healthcare professionals need to recognise and respond to reports of poor sleep quality and quantity in order to provide appropriate interventions to support sleep. Many factors, including potentially modifiable factors, that may affect the patient's ability to sleep have been identified. Incorporation of these factors into quality improvement interventions has led to mixed results regarding improvement of ICU patients' sleep.[14, 17-20] These inconsistencies may be due to methodological differences such as setting and context, as well as frequency and method of sleep assessment.

The primary aims of this study were to:

1. Describe ICU patients' self-report assessment of sleep throughout their ICU stay;
2. Determine the feasibility of ICU patients self-reporting sleep assessment on multiple days during their ICU stay;
3. Describe the interventions and environments suggested by ICU patients to promote sleep;

These three primary aims were designed to inform future development of an intervention to improve patient sleep if a need was identified. Additionally, a sub-study was undertaken to:

4. Describe current documentation of ICU patients' sleep by nurses;
5. Examine the relationship between nurses' assessment of sleep and patients' self-reported sleep.

Methods

Setting and design

An exploratory descriptive study was undertaken at the Princess Alexandra Hospital (PAH) and the Royal North Shore Hospital (RNSH) Intensive Care Units (ICUs). Both ICUs are Level 1 tertiary-

referral ICUs in Brisbane (PAH) and Sydney (RNSH), Australia. The ICUs each provide care for critically ill adult surgical and medical patients; more than 2000 patients are admitted to PAH annually while more than 3000 patients are admitted to RNSH annually. To be eligible for enrolment participants were: 1) adult patients (≥18 years); 2) treated in ICU for greater than 24 hours; and 3) able to interact and respond to English commands (including language, hearing and vision). Patients were excluded from study enrolment if: 1) they had a known or suspected pre-existing sleep disorder; 2) there was high suspicion or diagnosis of dementia; 3) there was high suspicion or confirmed excessive intake of alcohol or other substance abuse and 4) were a prisoner. Patients who met the criteria were consecutively recruited between March and July 2014 (PAH and RNSH) and September 2014 and February 2015 (PAH only).

Researchers at both sites collected data relating to ICU patients self-reported sleep and strategies for improvement in sleep. Two ICUs were included because each unit has noteworthy differences in physical layout, with the PAH containing a mix of open bed spaces and single rooms while the RNSH contains only single rooms. Only the PAH was the site for the sub-study which examined documentation of patient sleep by ICU nurses and the relationship between patient reported sleep quality and nursing documentation of patients' sleep. As the study aims were descriptive (that is designed to inform the development of future interventional studies), a sample of 150 participants (with at least 50 participants per study site) was the target.

Data collection and measurement

Ethics approval was obtained from the Metro South, Northern Sydney Health, Griffith University and University of Technology Sydney Human Research Ethics Committees. Patients provided agreement to report sleep while they were in ICU and were then approached towards the end of their ICU admission or following discharge to the ward to provide informed consent. At this time of seeking patients' consent Research Nurses performed an unstructured assessment of orientation to time, place and person to determine that they were sufficiently aware and lucid to provide consent.

Outcome Measures:

A range of assessments were obtained from each of the participating patients as follows:

- Patient self-report assessment of sleep: Richards-Campbell Sleep Questionnaire (RCSQ):

The RCSQ, developed by Richards et al,[16] is a 5 item VAS; patients are asked to place a mark on a 100mm line to indicate their perception of sleep depth, latency (time to fall asleep), awakenings, time awake and quality of sleep. The RCSQ has undergone some validity and reliability testing in the critical care environment.[16, 21] The total score for the RCSQ was calculated by dividing by five the sum total of all five VAS lines, where each line was measured in millimetres (from the low end of the scale to the mark) i.e. calculating an average of the five characteristics. The RCSQ was printed on an A4 sheet of paper with descriptors for each sleep characteristic printed at either end of a 100mm line. The Research Nurses collected the participants' RCSQ between 0700 and 1200 each day, or soon after they awoke in the morning.

- ICU patients report of strategies or interventions which promote or deter sleep:

After the daily RCSQ completion, Research Nurses asked participants: "What strategies or interventions helped you get to sleep last night?" and "What activities woke you or kept you awake last night?". Answers to these questions were communicated verbally, written or through actions.

- Nursing documented assessment of sleep:

Nursing documented assessment of sleep was described via audits of the PAH ICU Clinical Information System (CIS). Nurses documented sleep quality according to the locally developed categories 'no sleep', 'minimal sleep', 'moderate sleep', 'majority sleep' and 'slept all night'.

Other measures:

The clinical and demographic information was collected through a combination of daily and post-discharge chart audit and unit records and included: sleep interventions provided to the participant (pharmacologic and non-pharmacologic); age; gender; severity of critical illness (using Acute

Physiology & Chronic Health Evaluation (APACHE) II and III scores[22, 23]); diagnostic group; mode and length of mechanical ventilation; ICU length of stay and hospital length of stay.

Data analysis

Quantitative data were entered and analysed using STATA 12.[24] Data were cleaned by checking for completeness and range of values for variables. Descriptive statistics with frequency, percent, mean, median, standard deviation, interquartile ranges, and minimum/maximum values have been used to summarise variables. Total sleep quality was the mean of the five sleep RCSQ items on each assessment. Further, the RCSQ score was converted into an estimation of the sleep efficiency index (SEI) as outlined by Li.[14] Relationships between study variables (e.g. sleep quality and nurse documentation of patients' sleep) were tested using Spearman's rank correlation coefficients for continuous data and Kruskal-Wallis H test for group differences. An alpha level of $p<0.05$ was considered statistically significance.

Inductive content analysis was used to summarise the data obtained in response to questions regarding strategies or interventions to promote or deter sleep. Data were analysed by members of the team in each of the study sites, before being combined to form categories of strategies that might be incorporated into subsequent sleep improvement interventions.

Results

Participants

During the study period 1900 patients were screened, 1510 were ineligible, with 174 enrolled. Twenty three participants were not included in the final analysis as they withdrew, were deceased, lost to follow-up or other reasons (Figure 1). Study participants were approximately 60 years old, remained in ICU for 4 days, in hospital for 2 – 3 weeks and were able to provide a self-report of their sleep quality for approximately one-third of their ICU stay (Table 1).

Within the primary study involving participants from both study sites, 151 participants reported their sleep using the RCSQ a total of 356 times. Participants provided data from one to 18 days, with a

median of 1 day (IQR: 1–3 days) of sleep reports per participant and 50% of participants were able to report on their sleep on 2 or more days. These reports represented a median of 33% (IQR 20% - 46%) of the ICU stay for participants. From the day participants were first able to report on their sleep they were able to report a median of 100% (IQR 57% - 100%) of the remaining ICU days. For the data drawn from the single site sub-study at the PAH, 101 participants reported sleep a total of 237 times.

Participants' self-report assessment of sleep

Average sleep quality during ICU admission was described as poor by the participant cohort with median scores for each of the elements of sleep depth, latency, awakenings, time spent awake and overall sleep quality being below 50 mm (Figure 2). Furthermore median SEI within the cohort was 65% (Table 2), where a SEI greater than 85% has been proposed as indicating good quality sleep.[16]

Participants' reported strategies which promote and deter sleep

Participants were able to identify the strategies that they considered assisted sleep and the deterrents that interrupted their sleep (Table 3). Common strategies to assist sleep formed four categories including pharmacological, environmental, patient care and psychosocial. Categories of strategies that were considered deterrents to sleep generally represented the opposite of the facilitators and included patient care and clinical condition, environmental, psychosocial and interventions and devices.

Nurses' documentation of ICU patients' sleep

In relation to the 101 participants from the PAH, nurses documented observations of sleep quantity 285 times (maximum of one observation per day; see Table 4). The majority of observations indicated that nurses' documented patients had experienced 'moderate' sleep (n=109; 38%) or 'slept majority of night' (n=80; 28%).

Limiting the data set to those occasions when both the nurse and the patient participant provided assessment of patient sleep for the preceding night resulted in 199 pairs of nurse-patient data (PAH site only). Results indicated a moderate association between nurses' documentation of the quantity of sleep and each of the individual elements of participants' report of sleep quality on the RCSQ

(Spearman's rank correlation coefficient =0.39 – 0.50; p<0.001). Despite moderate correlations, wide variation in participants' report of sleep quality across each of the nurse reported categories existed and these differences were statistically significant (Kruskal-Wallis; p<0.001) (Figure 3). This analysis was repeated using only the first day that each patient reported sleep and a nurse also documented sleep, resulting in 87 pairs of nurse-patient observations. Results remained consistent with above data (Spearman's rank correlation coefficient for Questions 1 – 5: 0.37 – 0.42; p<0.001).

Discussion

The primary aims of this study were to investigate the quality of patients' self-reported sleep on multiple occasions during their time in ICU, the feasibility of, and how frequently they were able to report on their sleep and to describe factors reported by patients to promote or deter sleep. These aims were designed to inform future interventional work to improve patient sleep. In addition we examined the relationship between patients' self-reports and associated nurses' assessments of their patients' sleep.

Sleep quality: Participants' self-reports of sleep on the five items of the RCSQ were, on average, less than 50 out of 100 mm. The mean overall score of the RCSQ was similar at 46 mm. These results are similar to other recently reported findings in the study population of ICU patients [13-15, 25, 26] and some earlier studies,[11, 27] although slightly lower than some. The SEI derived from the RCSQ is not often reported, but at 65% this was lower than that reported in critically ill, non-ventilated, medical, cardiac patients in the original validation of the instrument,[16] but slightly higher (65% vs 61%) than that of the control group in a sample of patients similar to the current study.[17]

Frequency of participants reporting on their sleep: In this study 50% of participants reported on their night time sleep on two or more occasions, up to a maximum of 18 nights. Most studies include self-reported sleep by intensive care patients on only one occasion. A notable exception was the study of Kamdar et al[10] in which 33 patients in a medical ICU for 137 days completed 121 self-reports, a rate of 88% of available days and an average of 3.7 reports per patient. Thus our finding that ICU patients are able to respond to questions about their overnight sleep on multiple occasions supplements other

recent findings. The study of this larger mixed ICU cohort suggests that it is feasible for clinical staff to ask patients to self-assess their sleep regularly using a brief structured instrument such as the RCSQ.

Factors facilitating and deterring sleep: Factors that participants reported as deterring or interrupting sleep were similar to those reported previously, namely pain and discomfort, patient care activities, noise from staff and equipment, and non-circadian light levels.[6, 28-30] Factors that participants reported facilitating or promoting sleep frequently focused on the reverse aspect of the above activities, such as reduced perceived noise and light levels, clustering of care activities and medications, including analgesics, hypnotics and sedatives. Studies of these and other potential strategies to improve quantity and quality of sleep in ICU patients' have been reported, with some testing either single interventions, a combination of two or more, or more complex guidelines or bundles of interventions (including solely non-pharmacological or combined non-pharmacological and pharmacological). A number of these interventions have been reported to improve sleep, but many have not. For example, Jones and Dawson[31] and Le Guen and colleagues[32] found that patients who used the interventions of eye masks and earplugs reported better perception of sleep than those who received standard care. Patients who used earplugs alone have also reported experiencing better sleep compared to a control group.[33] 'Sedating' music was found in a randomised controlled trial[34] to improve patient-reported quality of sleep and some objective measures of sleep. Similarly, a study that combined eye masks and sleep-inducing music via earphones resulted in some improvement in patient-reported sleep quality.[32] In a study of a modified care routine with multiple components (e.g. clustering of care and strict adherence to night-time light reduction) it was found that patients in the group who received the intervention reported better sleep compared to the prior standard care group,[14] similar results were found in another study with a larger sample size.[17] However in another well designed quality improvement project, a multifaceted sleep promoting intervention did not improve patients' self-reported sleep quality.[13] The multifaceted and mutifactorial nature of sleep disruption in this population, and the influence of context and setting, are the probable reasons that account for the variation in research findings.

Nurses' documentation of sleep quantity: Nurses recorded that almost four in 10 patients had a moderate amount of sleep and slightly more than a quarter slept for the majority of the night with a further quarter having minimal sleep; few were recorded as having no sleep or sleeping all night. There was a moderate significant correlation between patients' self-report of sleep on the RCSQ and recorded observations of sleep, but when compared the two were statistically significantly different. The latter finding is consistent with most studies where nurses' recorded observations of patients' sleep in ICU have been assessed against objective measurement of sleep and/or patients' self-reports. Most report that nurses overestimate sleep quality.[10, 35-37].There have been reports of nurses using the same instrument as the patients (RCSQ) showing reasonable agreement,[11, 27] although this pattern has not been consistent.[10] Some small studies which suggested systematic assessment by nurses using frequent behavioural observations appeared promising,[38, 39] but observations were required every 5 min and every 15 min respectively, which is arguably not feasible in a busy ICU environment and likely to result in many missing data points.

Limitations

This study was conducted across two large tertiary ICUs in different cities of Australia, with each unit containing a mix of medical, surgical and trauma patients. Although the sample enrolled in this study was diverse, the restriction to tertiary ICUs likely limits the generalisability of the results. Due to the study process of collecting sleep data in ICU subsequent to patients' initial verbal agreement with informed consent obtained towards the end of their ICU stay or after discharge to the ward, some eligible patients were not able to be included because they were discharged before an investigator could approach. Despite this, the sample size included in the study is relatively large and was representative of the study population.

Subjective measurements of sleep were collected in this study through patient self-report rather than objective measures, which would be obtained if polysomnography (PSG) was used. However PSG is costly and challenging as continuous monitoring is required to ensure adequate signal quality. Both actigraphy and bispectral index monitoring (instruments that also obtain objective measurements) do

not provide reliable data in ICU patients.[36] Further, sleep quality is highly subjective and this is demonstrated when many people still report unrestorative sleep despite a PSG reading that is 'normal'. Therefore it is the patient's experience of their sleep that is the clinically meaningful outcome, making their self-report of sleep arguably the most appropriate sleep assessment to perform.[40]

Implications for practice and research

The feasibility of clinical staff routinely recording ICU patients' self reports of their sleep quality on multiple occasions has been demonstrated in this study. These assessments can occur when patients are sufficiently alert, but not necessarily verbal, to respond to a brief instrument. This could be supplemented by routine early documentation in the care plan of pre-hospital sleep habits and patterns as one-fifth or more of ICU patients have reported - sleeping problems.[13, 15, 41] The need for routine interventions to improve the sleep of patients in intensive care is reinforced by the findings of this study. Some relatively simple interventions to reduce night time exposure to sound and light have been shown to be effective in mostly small studies, as described above. Interventions such as ear plugs and eye shades should be offered, but used only in those patients who wish to use them and are able to remove them at any time. Attempts to improve ICU patients' sleep with more complex, multifaceted interventions have shown mixed results. Consideration of factors that are specific to each intensive care setting is essential, as factors such as geographical layout, severity of illness of patients and staffing patterns are likely to influence the effectiveness of interventions. Interventions to improve sleep, both simple and complex, is an area of research that is fertile for critical care investigators.

The clinical meaning of the SEI is not well understood, and has not been widely examined. The formula used to calculate the SEI is based on the initial RCSQ validation work undertaken by Richards and colleagues in a cohort of male ICU patients[16] and was first reported by Li and colleagues.[14] Further examination of the psychometric properties and clinical meaning of the SEI in various critical care populations is required.

Conclusions

Intensive care patients' self-reported sleep quality was low, less than 50/100 mm, and with a low sleep efficiency index based on these data. The common factors patients reported that facilitated sleep included reduced noise and light levels; clustering care activities and medications, including analgesics, hypnotics and sedatives; while the common factors deterring sleep were pain and discomfort, patient care activities, noise from staff and equipment, and high levels of night-time light. There was some association between nurses' assessment of patients' sleep and patient self-reports, but nurses' assessments were higher than those of patients' reports. The patients' ability to self-report on their sleep on a simple instrument was encouraging and could be routinely implemented.

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Table 1: Characteristics of study participants and participants' sleep assessments

	Princess Alexandra Hospital n = 101	Royal North Shore Hospital n=50	Combined n=151
Male, n (%)	60 (59)	38 (76)	98 (65)
Admission Diagnosis, n (%)			
Medical sepsis	15 (15)	2 (4)	17 (11)
Medical other	17 (17)	17 (34)	34 (23)
Medical respiratory	4 (4)	4 (8)	8 (5)
Surgical elective	17 (17)	6 (12)	23 (15)
Surgical cardiac	7 (7)	11 (22)	18 (12)
Surgical emergency	9 (9)	3 (6)	12 (8)
Trauma	28 (28)	6 (12)	34 (23)
Other	4 (4)	1 (2)	5 (5)
	Median [IQR] (min, max)		
Age	56 [42–69] (18,85)	65 [53–75] (18,88)	60 [46–71] (18,88)
ICU LOS (days)	4.0 [2.6–8.7] (1,70)	3.6 [2.0–7.9] (1,105)	3.9 [2.3–8.7] (1,105)
Hospital LOS (days)	19.5 [11.7–33.9] (3,335)	12.6 [7.4–29.9] (1,105)‡	17.7 [9.6–32.7] (1,335)
APACHE II	16 [12–22] (3,38)	10.5 [8–16] (2,30)	15 [10–20] (2,38)
APACHE III	53 [39–75] (16,141)	35 [26–53] (8,96)	46 [34–64] (8,141)
No. of assessments per participant	2 [1–3] (1,14)	1 [1–3] (1,18)	1 [1–3] (1,18)
% of participants' total ICU stay (days) with sleep assessment	30 [20–50] (7,100)	33 [20–38] (6,75)	33 [20–45] (6,100)

‡ Two patients had their hospital discharge date censored.

ICU= Intensive care unit; IQR= Interquartile range; LOS= Length of stay

Table 2 Participants reported sleep quality using the Richards-Campbell Sleep Questionnaire across both study sites (PAH: n = 101, 237 observations; RNSH: n = 50, 119 observations)

Richards- Campbell Items	PAH (n=237*) Median [IQR]	RNSH (n=119*) Median [IQR]	Combined (n=356) Median [IQR]
Sleep depth	43 [13–65]	45 [20–62]#	44 [16–64]#
Falling asleep (latency)	45 [20–70]#	45 [23–70]	45 [22–70]#
Awakenings	46 [23–73]	47 [24–71]	47 [24–72]
Returning to sleep	49 [20–73]#	46 [21–73]	48 [20–73]#
Overall sleep quality	48 [11–72]	45 [17–74]	48 [16–72]
Overall RCSQ Score^	46 [24–66]#	46 28–63]#	46 [26–65]#
SEI‡	65 [56–73]#	65 [58–72]#	65 [57–72]#

*Patients contributed multiple sleep observations (maximum of one observation per day)
Missing response(s) on item
^ Overall RCSQ = Average (mean) of 5 items (Q1-Q5). Higher score – greater perceived sleep quality
‡ Sleep Efficiency Index (SEI) = 46.88 + [0.39*Overall RCSQ]; SEI>85% indicates good sleep quality [16]

Table 3: Participant reported strategies to facilitate or deter sleep

| Categories	Strategies
Facilitators of sleep	
Pharmacological	Pain relief, antiemetic, 'usual' medications for pre-existing mental health conditions, sleeping medications
Environmental	Reduced noise, reduced light, closing doors and blinds, low level music, ear plugs, eye masks
Patient care	Clustering of care, promoting comfort through repositioning, wash / shower before sleep, optimising temperature
Psychosocial	Family visits, prayer, reassurance from nurses, feeling safe, familiarity
Deterrents to sleep	
Patient care and clinical condition	Pain, physical discomfort, coughing, nausea and/or vomiting, diarrhoea, hunger, thirst, feeling hot / cold, incontinence, dry mouth, difficulty communicating
Environmental	Light, noise from ICU equipment, noise from staff, noise from adjacent bed spaces, staff handover
Psychosocial	Frustration, anxiety, fear, vivid dreams, worry, unfamiliar environment, mind racing
Interventions and devices	Observations, repositioning, sheet changes, physiotherapy, radiology, artificial airway, feeding tubes, urinary catheters, suctioning

Table 4: Nurses' documentation of patient sleep quality (PAH site only; n=101; 285 observations)

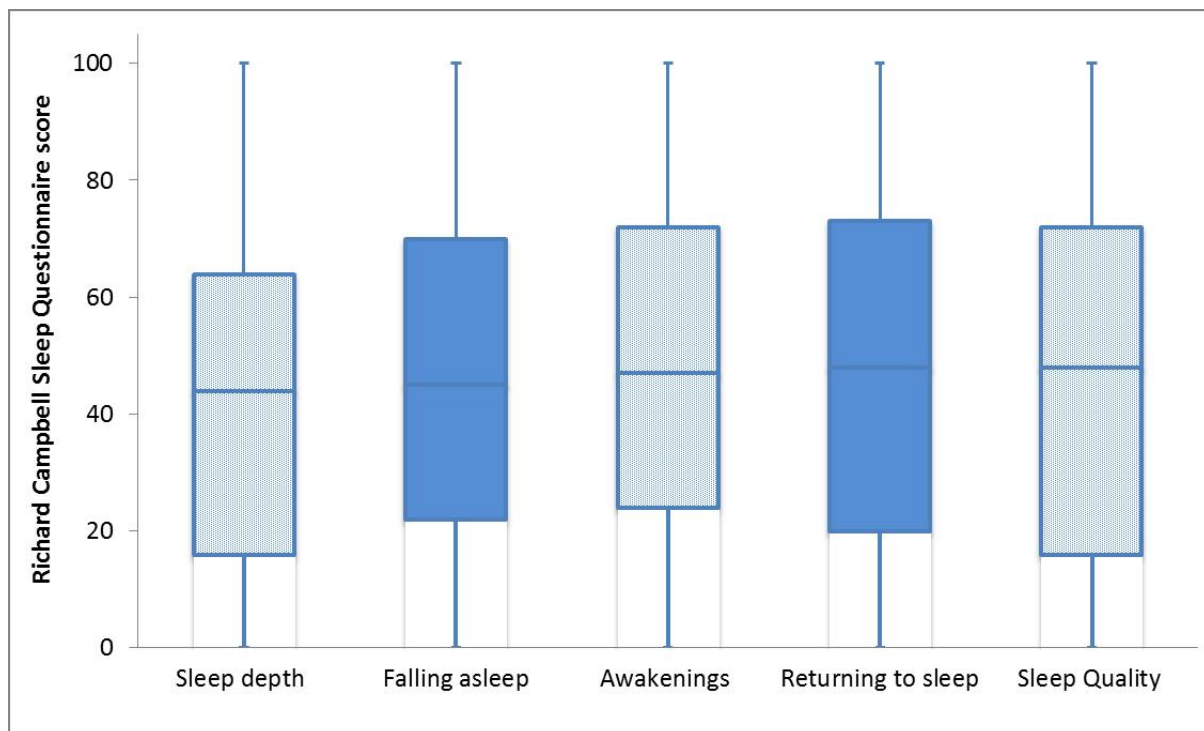|	N (%)
No sleep	19 (7)
Minimal sleep	75 (26)
Moderate sleep	109 (38)
Sleep majority of night	80 (28)
Slept all night	2 (1)

*Nurses can contribute multiple sleep observations (maximum of one observation per day)
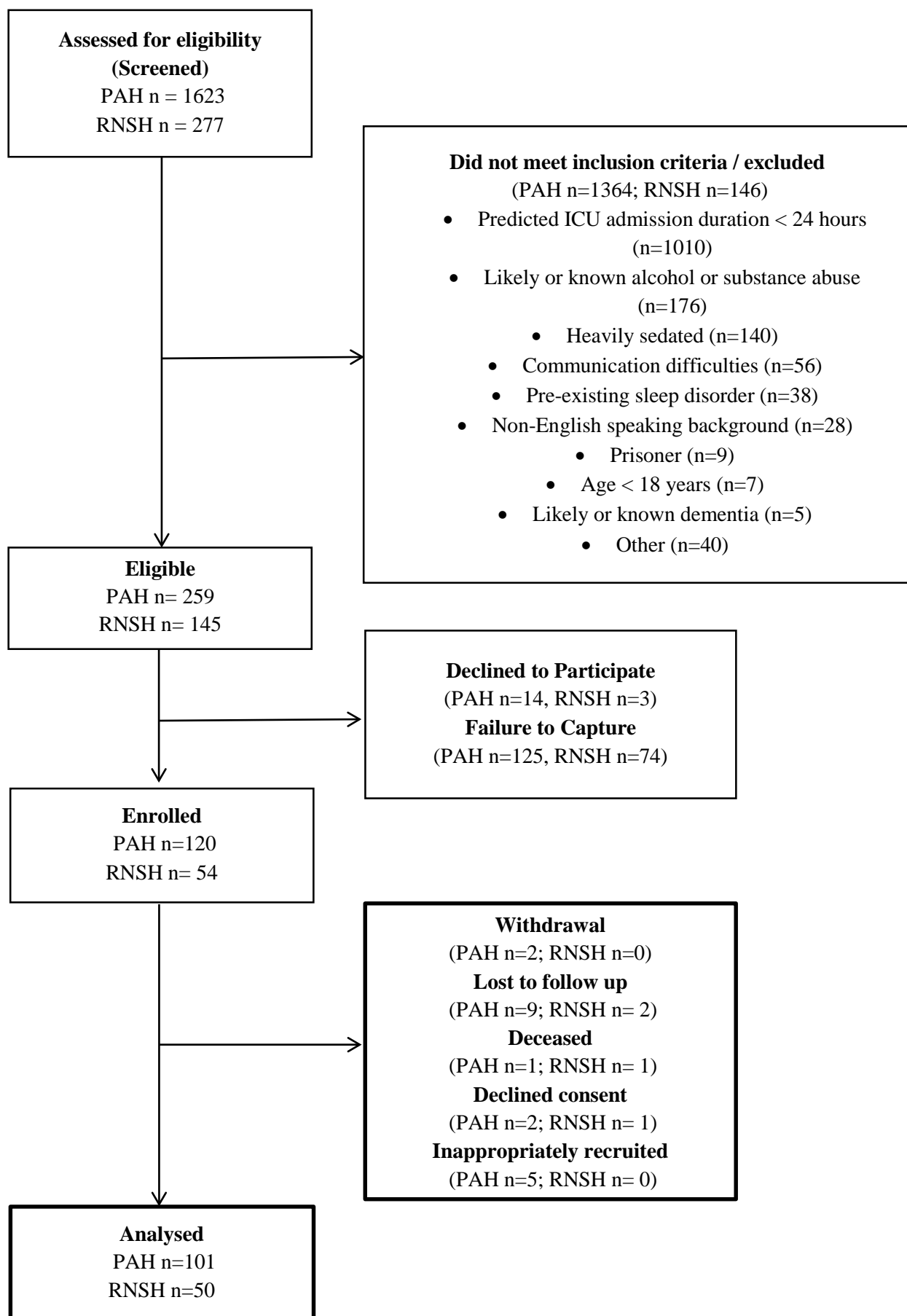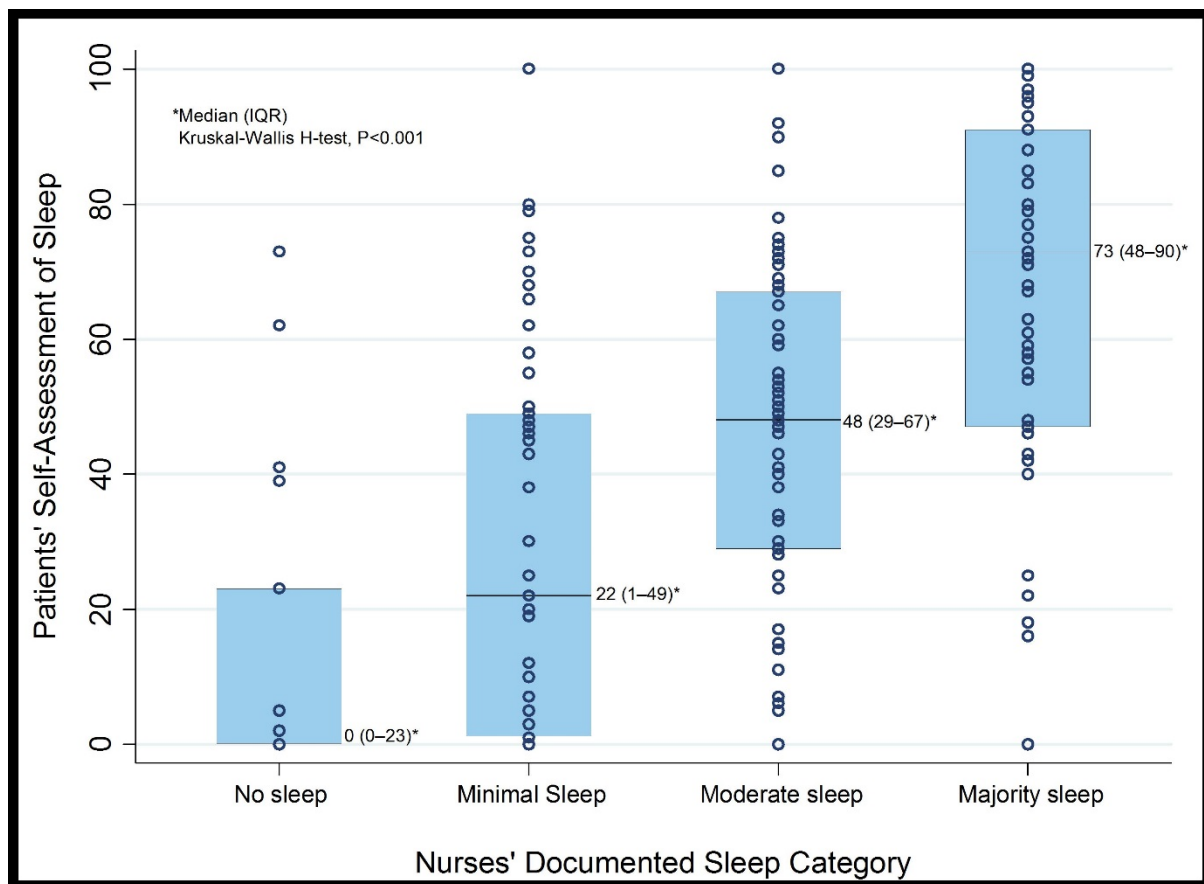
Figure 1: Participant flow diagram

Figure 2: Patient participants' reported sleep quality using the Richards-Campbell Sleep Questionnaire score (n=151; 355-356 observations) (Patients contributed multiple sleep observations – maximum of one observation per day)

Figure 3: Scatter plot of participants' overall sleep assessment (Richards-Campbell Sleep Questionnaire) and nurses' documentation of sleep quality (n= 199 paired data points, PAH only)

Figure 3