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Sleep quality, but not quantity, is associated with self-perceived minor error rates among emergency department nurses

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ABSTRACT

Introduction: The emergency department (ED) is demanding and high risk. The impact of sleep quantity has been hypothesized to impact patient care. This study investigated the hypothesis that fatigue and impaired mentation, due to sleep disturbance and shortened overall sleeping hours, would lead to increased nursing errors.
Methods: This is a prospective observational study of 30 ED nurses using self-administered survey and sleep architecture measured by wrist actigraphy as predictors of self-reported error rates. An actigraphy device was worn prior to working a 12-hour shift and nurses completed the Pittsburgh Sleep Quality Index (PSQI). Error rates were reported on a visual analog scale at the end of a 12-hour shift.
Results: The PSQI responses indicated that 73.3% of subjects had poor sleep quality. Lower sleep quality measured by actigraphy (hours asleep/hours in bed) was associated with higher self-perceived minor errors. Sleep quantity (total hours slept) was not associated with minor, moderate, nor severe errors.
Discussion: Our study found that ED nurses' sleep quality, immediately prior to a working 12-hour shift, is more predictive of error than sleep quantity. These results present evidence that a "good night's sleep" prior to working a nursing shift in the ED is beneficial for reducing minor errors.

1. Introduction

Emergency departments (EDs) are 24-hour facilities known for overcrowding, long waits, and elevated patient and family anxiety (Bernstein et al., 2009). In an environment that requires detailed and specific patient care measures, sleep deprivation and fatigue can affect quality of care delivered by an ED nurse (RN), which can negatively impact patient safety (Dorrian et al., 2006). Because of the ongoing nursing shortage, nurses are working longer shifts and extra days to meet patient demand and provide necessary shift coverage (Griffiths et al., 2014). The impact of this necessity has led to increased stress, fatigue, and sleep disruption (Barker and Nussbaum, 2011; Rogers et al., 2004).

Sleep deprivation and disruption may be associated with fatigue that leads to errors which could negatively affect patient recovery or lead to adverse outcomes or eventual death (Johnson et al., 2014). This study was conducted to determine if sleep quality (uninterrupted sleep) or sleep quantity (number of hours of sleep), prior to working a 12-hour shift in an ED, affects the perceived error rate of RNs in a critical care setting. Our hypothesis was that fatigue and impaired mentation, due to sleep disturbance and shortened overall sleeping hours, would lead to increased nursing errors.

2. Background

According to the American Hospital Association, annual ED visits in the United States have increased to 127.2 million in 2010 (US Census Bureau, 2011). The ED is unique in that it is a complex area known for treating acutely ill patients with a wide array of illnesses and injuries, many of which are a mystery upon arrival. The ED is fast-paced and demanding. RNs are frequently asked to organize complex care for patients in life-threatening situations. Interruptions, disruptions, and overcrowding can contribute to a decrease in cognitive functioning for nurses (Epstein et al., 2012; Practices, 2011; Rivera-Rodriguez and Karsh, 2010). Thus, the ED is an environment ripe for preventable error (Brennan et al., 1991; Epstein et al., 2012; Gawande et al., 1999; Lecoanet et al., 2013).

Fatigue combined with critical situations may increase the risk of error (Griffiths et al., 2014). A 2014 study of critical care nurses in the United States reported that sleep loss (inadequate sleep) and disrupted sleep negatively impacted nursing decision-making and

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was associated with an increase in adverse patient outcomes (Scott et al., 2014). This study concluded that nurses who were either fatigued or sleep-deprived increased risk for both the nurse and the patient. (Scott et al., 2014). Although there have been studies that describe medical errors within inpatient and clinical settings, there is a lack of literature that studies the effect of sleep quality and fatigue on medical errors among ED nurses (Dean et al., 2006; Scott et al., 2006, 2014). This study examined the impact of sleep on self-perceived medical errors of ED nurses.

2.1. Design

This study was a prospective, observational, self-administered survey coupled with a biophysical measure. The study measured the quality and quantity of sleep using the Pittsburgh Sleep Quality Index (PSQI) and wrist actigraphy (FitBit). The FitBit was worn prior to working a 12-hour shift. After their 12-hour shift, RNs completed a survey to score self-perceived minor, moderate, and severe error rates (Table 1).

2.2. Setting

The study was conducted at a 460 bed university hospital, with a 40 bed emergency department. This hospital is a Joint Commission Advanced Comprehensive Stroke Center and certified chest pain center, located in Dallas County, which has an estimated population of 2,518,638 (US Census Bureau, 2015). Daily attendance ranges between 98 and 140 patients per day, with an average of 3224 patients per month and an annual attendance estimate of 40,000 patients for 2015. Patients were leveled 1–5, with level 5 being the highest level of critical care and level 1 being the lowest level of care. Patient levels for 2014 included: Level 5 (13,330), Level 4 (6581), Level 3 (4199), Level 2 (9040), and Level 1 (1358).

Approval was obtained from the Institutional Review Board. Thirty RNs were recruited who met the inclusion criteria of being assigned to work full-time in the ED and having completed orientation.

2.3. Data collection

The study duration was six months. Because nurse experience and education are linked to patient outcomes, each consented nurse completed a Nurse Experience Form to document their work experience (Aiken et al., 2003). To measure the quality and quantity of sleep, each nurse wore a small wrist actigraphy device once, for a period of approximately 15 hours, prior to his or her next scheduled nursing shift (Fig. 1). Actigraphy devices record movement during sleep, and assess sleep patterns while in the subject's normal sleep setting (Martin and Hakim, 2011). The actigraphy device (FitBit) worn by the participants recorded the total number of hours slept, the number of times during a sleep cycle that the subject awoke (total wake after sleep onset [WASO] minutes), and the number of times during a sleep cycle that the subject was restless. The FitBit device has been shown to be both reliable and valid for collecting movement during sleep (Montgomery-Downs et al., 2012).

At the beginning of the 12-hour shift, immediately following wearing of the device, the nurse completed a PSQI form that was then submitted, along with the actigraph, to a locked box. After their 12-hour shift, the nurse was asked to complete a medical error Self-Assessment Survey, which indicated the amount of self-perceived minor, moderate, and severe medical errors during the shift. The survey was also placed in a locked box.

1. The number of **minor** medical errors I made today was:

   0 — 100
   None — Excessive

2. The number of **moderate** medical errors I made today was:

   0 — 100
   None — Excessive

3. The number of **severe** medical errors I made today was:

   0 — 100
   None — Excessive

Fig. 1. The Visual Analogue Scale (VAS) used for self-assessment. *Note that each VAS was precisely 100 mm in length when distributed to participants.

3. Measures

3.1. Nursing experience

Nursing experience and education are linked to patient outcomes and was measured with the Nurse Experience Form in this study (Aiken et al., 2003; Olson et al., 2008). The number of full-time equivalent (FTE) experience years of employment in nursing was calculated by multiplying the number of years worked as a registered nurse by the FTE employment status of each year and expressed as RN-FTE. Experience in emergency critical care was computed in the same manner, but included only those years when the nurse worked in an emergency critical care unit. Nursing degree and certification status data were also collected. Nurses participating in the study were assigned a unique identification number and no personal identifiers were associated with any paper work other than the consent.

3.2. Pittsburgh Sleep Quality Index

The Pittsburgh Sleep Quality Index is a 19 item self-report scale that measures quality of sleep (Buysse et al., 1989). Seven mechanisms are utilized to evaluate sleep behavior and measure the quality of sleep. Sensitivity and specificity are high (89.6% and 86.5%, respectively), and the survey can be completed within five minutes. Previous reliability tests have shown an adequate reliability coefficient ($\alpha = 0.83$) (Buysse et al., 1989).

3.3. Actigraphy

The FitBit is a noninvasive sensory unit that is worn on the wrist and quantifies sleep, steps, active minutes, and stationary minutes. The benefit of actigraphy is that it can be worn in the subject's natural environment and is both reliable and valid in measuring

Table 1
Examples of error types.

Error level	Definition	Example 1	Example 2
Minor	Does not reach the patient	Choosing the wrong patient in the Pyxis, realizing it, then choosing the right patient.	Documenting in the wrong chart, realizing it, then documenting in the correct patient's chart.
Moderate	Reaches patient, but does not cause harm	Entering the patient's room and realizing you have forgotten the proper supplies, having to leave the room and then return.	Telling the patient you will bring them a glass of water, forgetting, and having to be reminded by the patient a second time.
Major	Reaches patient and causes harm	The patient was given the wrong medication.	A medication was delivered to a patient via the wrong route.