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Sleep Quality and Work Performance of Shift Work – Nurses in the Critical Care Units in Kingdom of Bahrain

A Thesis Submitted in Partial Fulfilment of the Requirements for the Master of Science Degree in Adult Health Nursing

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Abstract

Background: Although poor sleep quality may decrease nurses' performance, the association between the two has not yet been evaluated in Bahrain. Sufficient sleep quality empowers a well-balanced immunity, supports work performance, and work safety. This need is particularly important in the population of nurses who encounter a different shift pattern. The risks associated with poor sleep quality includes cognitive problems, mood alterations, increased depression, increased irritability, reduced work performance, reduced motivation, increased safety risks, and physiological changes.

Aim: To determine the baseline level of sleep quality and work performance of shift work nurses in intensive care units, and to examine the correlation between sleep quality and work performance at a government hospital in the Kingdom of Bahrain

Methodology: The Pittsburgh Sleep Quality Index (PSQI) and Nurse Work Function Questionnaire (NWFQ) were used in a cross-sectional survey by simple random sample of 200 nurses working in five intensive care units in one government hospital in Bahrain (NWFQ). For data analysis, descriptive statistics, t tests, ANOVA, Pearson's correlation, and stepwise regression were used.

Results: There was a high prevalence of poor sleep quality (89%) with a mean (SD) of 13.6 (± 4.9), It was statistically significant with nurse performance level. The Nurse work functioning questionnaire had an overall mean (SD) of 56.3 (± 22.5). Sleep quality is comprised of seven components: sleep latency ($P = 0.758$), subjective sleep quality ($P = 0.530$), daytime dysfunction ($P = 0.112$), sleep disturbances ($P = 0.833$), habitual sleep efficiency ($P = 0.792$), sleep duration ($P = 0.801$), and use of sleeping medication ($P = 0.840$) were found to be statistically significant predictors of nurse work performance, Along with shift work ($P < 0.0001$), Female nurses ($P = 0.010$) and having a children ($P = 0.043$), nurses' educational level ($P < 0.0001$), and nurses' designation ($P < 0.0001$).

Conclusion: The study results suggested that poor sleep quality may lead to lower nurse performance and very persistently poor sleep quality among shiftwork critical care nurse nurses . There was a statistically significant difference between critical care nurses who did one shift and those who did two shifts, and nurses who worked three shifts had even lower sleep quality. In addition, critical care nurses' performance was impaired more significantly with more shifts worked.

Practice Implication: little is currently known regarding the relationship between sleep quality and work performance in Bahraini nursing literature; this study intended to fill the gap. Worksite training and education services are needed to detect, prevent, manage, and follow up with nurses who have poor sleep quality to maintain nurses' well-being and health, this increased quality of nursing work performance.

Keywords: Sleep Quality, Work Performance, Critical Care Nursing, Shift Work Schedule

Publications

Shift Changes' Effects on Sleep Quality and Work Performance among Nurses Working in Bahrain's Intensive Care Units

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Sleep Quality and Work Performance Among Shift Work Critical Care Nurses: A Cross-Sectional Study

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Dedication

In the name of Allah, the merciful, the Beneficent, and prayer, and peace upon be upon our Prophet, Muhammad, his family, and the best of God creatures. This study is dedicated to:

- *My great parents Mr. Ateya Mohammad Al-Aradi and Mrs. Madina Salman At-Tooq, whose guides me through the dark valley with a light of hope and support and never cease to give in countless ways,*
- *My beloved brothers and sister; Mr. Mohammed Ateya Al-Aradi, Mr. Ali Ateya Al-Aradi, Mr. Hussain Ateya Al-Aradi, Mr. Ebrahim Ateya Al-Aradi, and Ms. Zahra Ateya Al-Aradi, whose stands by me when things look dark*
- *My beloved sister-in-law Mrs. Eman Ali and nieces Noor and Jood Mohammed Ateya Al-Aradi, never stop loving you*
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LIST OF ABBREVIATIONS

BMI	: Body Mass Index
DM	: Diabetes Mellitus
FLD	Flexible Line of Defense
ICN	: International Council of Nurses
ICU	: Intensive Care Unit
LOR	: Line of Resistance
MOH	Ministry of Health
NHRA	: National Health Regulatory Authority
NLD	Normal Line of Defense
NSM	: Neuman System Model
NWFQ	: Nurse Work Functioning Questionnaire
OSA	: Obstructive Sleep Apnea
PSQI	: Pittsburgh Sleep Quality Index
RNs	: Registered Nurses
SJL	: Social Jetleg
SMC	: Salmaniya Medical Complex
SPSS	Statistical Package for Social Sciences
SWSD	: Shift Work Sleep Disorder
UK	: United Kingdome
US	: United States

Chapter I
Introduction

INTRODUCTION

Sleep quality is a crucial phenomenon that has recently come to the forefront of issues addressed by healthy people and healthcare providers that is associated with high societal cost and occupation hazards (Al-Omran et al., 2019). Since the fundamental of well-being and optimal health is getting sufficient sleep (Berhanu et al., 2018). Sufficient sleep quality empowers a well-balanced immunity, supports work performance, and work safety (Stimpfel et al., 2020). This need is particularly important in the population of nurses who encounter a different shift pattern, including the evening and night duties, over twenty-four hours per day, patient care needs, against sleep – wake cycle and person's circadian pacemaker (Booker et al., 2018;Giorgi et al., 2017).

Humans, and especially nurses, need sleep to function optimally; however, sleep disorders, such as insomnia, can have harmful physiological and psychological effects. The risks associated with poor sleep quality include cognitive problems, mood alterations, increased depression, increased irritability, reduced work performance, reduced motivation, increased safety risks, and physiological changes (Kbatony et al., 2020; McDowall et al., 2017). Several studies have shown that insufficient sleep is an important cause of medical errors in the healthcare environment (Habiburrahman et al., 2021; Giorgi et al., 2017).

Sleep assessment tools are available for use to evaluate nurses sleep quality, but, as yet, no research that has been focused on sampling the sleep quality, sleep problems, in relation to nurse's work performance in Bahrain. Various factors can contribute to good sleep quality, such as education level, socio-economic status, and the personal views of the nurses, including

nurse's knowledge and practice (Ross et al., 2017). This study utilizes a survey to evaluate the sleep quality and work performance of shift-work critical care nurses in intensive care units in Salmaniya Medical Complex (SMC) in Bahrain.

Modern era demands that nurses work on a 24-hour basis which means that nurses must work for eight or twelve hours shifts, especially from public and organizational contexts, which often affects preference over the basic physiological principles governing the sleep-wake cycle (Zeng et al., 2019); result in low level of work performance and poor sleep quality (Alfonsi et al., 2021; Alshahrani et al., 2017; Di Muzio et al., 2020; Park et al., 2018). The sleep-wake cycle consists of eight hours of nocturnal sleep and sixteen hours of daylight wakefulness in individuals, which is controlled by two internal influences: sleep homeostasis, and circadian rhythms (Burton & Walker, 2020). Together these two internal influences determine most aspects of sleep quality and related variables like sleepiness and awakens; most important they explain how the timing and depth of sleep are related (Chang & Yang, 2020). Mrosovsky (1990) coined the term "rheostasis" to unite the two .

The circadian rhythm is human's 24-hour geophysical cycle or human's biological clock (Burton & Walker, 2020). Accordingly, circadian rhythms system enabled humans to anticipate daily changes in the surround environment and mostly preparing the body to sleep (Chang & Yang, 2020). Over the last decade, there has been a significant growth in the total of people sleeping less than six hours in a 24-hour cycle resulting in epidemic of insufficient sleep (Chaput et al., 2018). As evidence of this point, several studies examined the sleep quality of nurses on shift duty found that nurses sleep less than six hours per day when working consecutive shifts

more than ever in the critical care setting and has recognized that poor sleep quality is a common problem among nurses (Sun et al., 2019).

Maintaining and endorsing a high sleep quality sleep for critical care nurses in a high technology and stressful healthcare environment remains a universal goal for health economy because sleep is one of the major experiences, which can minimize nurses' health condition and influence work performance quality (Tsai et al, 2019).

Burton et al., (2020) described sleep as the duration of "inactivity and restoration of mental and physical functions". Moreover, Kline, (2013)described sleep quality as "One's satisfaction of the sleep experience, integrating aspects of sleep initiation, sleep maintenance, sleep quantity, and refreshment upon awakening".. The importance of attending to sleep quality was highlighted by the Gerace & Rigney (2020) and Mahmood et al. (2014)who reported that sleep is considered the "reference guide of psychological health" to monitor among healthcare providers..

Sleep is an essential physiological and psychological function for humans and a basic need of human beings. Various studies related to sleep quality direct that adults require seven to ten hours of sleep duration recommendations in a 24-hour period (Stimpfel et al., 2019; Chaput et al., 2018). Especially for nurses, working different shift duties in ways that directly influences their lifestyles, health, sleep quality, and indirectly their job performance (Choi & Joo, 2018). Shift work, and mostly night shift, is documented as a source of stress for nurses (Axelsson et al., 2018).

Shift work is recognized to be a workplace hazard that can result in inadequate rest, tiredness, and daytime sleepiness, culminating in medical errors and accidents (Tiwari et al.,

2021). In a study by Christian et al. (2019), it was found that about 57% to 83.2% of nurses had an increased risk of sleep deprivation and poor sleep quality due to job related factors;20% - 30% of shift workers experienced shift work sleep disorder (SWSD); 27% of nurses used sleep medications; 18.5% had a moderate-to-severe risk for obstructive sleep apnea (OSA); and 4.5% of nurses experienced excessive daytime sleepiness.

Many studies had investigated the prevalence of poor sleep quality among nurses in different countries whereby the rates of poor sleep quality were highest in Iran 83.2% (Jafari et al., 2015) and lowest in Nigeria 43.2% (Fadeyi et al., 2018). However, to the researcher's best knowledge, there is no studies has investigated sleep quality among nurses in the kingdom of Bahrain.

Problem Statement

Sleep quality emerged as a concern for healthcare providers working shift duty. They cited difficulties getting to sleep and staying asleep as the main reasons for their sleep deprivation (Ganesan et al., 2019). The importance of investigating nurses sleep quality to develop a responsible work plan has long been recognized by many health industries. However, numerous hospitals are still overwhelmed by shortage of registered nurses (RNs), increasing demand for nurses, increasing health care needs, and increasing overtime (Gosselin et al., 2015), forgetting nursing workload for those who stay in the profession which can often cause various health issues and can be traced to lack of sleep, shift work, and sleep disorders (Izadi, 2018).

Poor sleep quality often accompanies nurses as they are on continuous stressful shift work. Therefore, when a clear picture of nurses' sleep quality is not properly identified during work scheduling, it subsequent adversely affects nurses' health and their work performance level.

Presenting countless mechanisms of the relationship between sleep quality, nursing performance, and patient safety (Park et al., 2018). Todays, a good sleep, a must have, for all nurses for optimum well-being, performance, and safety at work.

In instant, there is a the lack of studies investigating the sleep quality and its association with nurses' work performance in Bahrain and a need for a better understanding of nurses' sleep quality in a structured approach in identifying and viewing their work performance to ensure a high-quality patient care which is central to a healthy work environment.

Research Significance

The significance of investigating sleep quality among critical care nurses is that it provides a critical look at the impact of sleep on personal, nursing-patient care, and workplace communication. Reviewing the current studies on this topic will clarify the prevalence, quality, and patterns of sleep quality among critical care nurses and how the results will improve the health and well-being of shift work nurses hence work performance of nurses.

There is enough evidence to suggest that poor sleep quality can have adverse effects on nurses' health and patient safety. Adverse effects on nurses' health include; increased risk of developing cardio-metabolic stress such as risk of Diabetes Mellitus (DM) (increased by 1.09 % to1.40 %); risk of weight gain and heart disease (increased by1.23%); risk of stroke (increased by 1.05%); risk of cancer (increased by1.01% to 1.32%); and increased risk of altered levels of appetite regulating hormones (leptin, corticol, and throtropin) among subjects sleeping less than 7 hours in connection with shift work (Kecklund & Axelsson, 2016; Hughe, 2008). Moreover,

the risk of psychosocial stress, cognitive impairments, and altered immune functioning are increased by shift work and sleep loss (Kecklund & Axelsson, 2016; Hughes, 2015).

Additionally, many adverse effects of poor sleep quality on nurses' performance are indicated by research as well. Poor sleep quality can decrease nurses' psychomotor activities and decision making (Johnson et al., 2010), variability in attention and working memory (Kaliyaperumal et al., 2017), ineffective communication and coping skills (Mahmood et al., 2014), increased medical patient safety errors by 3.4%, and increased work-related injury and accidents by 1.09% to 1.40% (Hughe, 2008).

However, high sleep quality can affect significantly upon nurses' health and work performance including improved physical and mental health, necessary energy to overcome the daily activities, thus increased overall quality of life (Kang et al., 2020), and on nurses' performance; increased professional satisfaction, decreased work absenteeism, increased work productivity, decreased nurse turnover to other jobs, and increased professional growth (Park et al., 2018).

Overall, sleep disorders such as: insomnia can result in physiological and psychological complications (Judd, 2017). The significance of sleep quality to nursing is strongly related to increased quality of nursing care thus increased patient safety, ability to live a normal life, and function appropriately through adequate sleep control. The nurse's fundamental responsibilities are to restore health and to alleviate suffering. This study utilizes a survey to evaluate the sleep quality and work performance among critical care nurses in intensive care units to provides the baseline data (ground) for attention of researchers and mangers to provide satisfactory work

conditions with minimum complications of sleep among critical care nurses and integrate sleep hygiene practice among nursing students to prepare them for shift work duty.

Research Questions

Having investigated the sleep quality and work performance among shift work critical care nurses, the following questions are proposed:

1. What is the prevalence of poor sleep quality among shift-work critical care nurses?
2. What is the quality and patterns of sleep in shift – work critical care nurses?
3. Is there any relationship between sleep quality and job performance in shift – work critical care nurses?
4. Is there any association between shift – work critical care nurses background factors and there sleep quality and job performance?

Research Objectives

- Identify the prevalence of poor sleep quality among shift-work critical care nurses.
- Measure the quality and patterns of sleep among shift – work critical care nurses.
- Examine the relationship between sleep quality and job performance in shift - work critical care nurses.
- Examine the association between demographic and clinical-related factors ,and sleep quality and job performance of shift – work critical care nurses.

Definition of Terms

The conceptual and operational definitions for this study are as follows:

- Critical care nurse: "A specialist nurse holds a current license as a generalist nurse and has successfully completed an education programmer that meets the prescribed standard for specialist nursing practice. The specialist nurse is authorized to function within a defined scope of practice in a specified field of nursing." (Schober et al., 2020). Operational definition is registered nurses who care for critically ill patients in intensive care units at SMC hospital in Bahrain.
- Shift work: 24 hours rotated work schedules system (day shifts only/ 2-shifts system/ 3-shifts system) (Choi & Joo, 2018). Operational**:** work shift was defined as more than one work shift per week during last month.
- Sleep Quality: Kline (2003) described sleep quality as "one's satisfaction of the sleep experience, integrating aspects of sleep initiation, sleep maintenance, sleep quantity, and refreshment upon awakening". In other word, sleep is subjective which person self-report of sleep quality. Operational by utilizing the Pittsburgh Sleep Quality Index (PSQI).
- Job performance: Degree of how nursing care is organized and operated in terms of efficiency and effectiveness over a standard period (Harmanci et al., 2018). Operationalized by utilizing Nurses Work Functioning Questionnaire (NWFQ).

Chapter II

Literature Review

LITERATURE REVIEW

The present chapter intentions to review and analyze the research published between 2015 and 2021 relative to the relationship between work performance and sleep quality in shift work critical care nurses conducted worldwide. The first section of this chapter presents an executive summary of the previous studies of sleep and relevant concepts on the subject of sleep quality, work performance, and shift-work critical care nurses. The next section examines the current state of knowledge and possible gaps, followed by the researcher benefited, intention and reasons of the undertaken research from the previous studies, and subsequently by the theoretical framework of the study. Finally, this chapter concludes with a description of the role of advanced practice nurse regarding sleep quality and work performance of shiftwork critical care nurses.

Executive Summary of the Studies

This literature review consists of one main parts with subtopics which are relevant. It Sleep Quality among Shift work Critical Care Nurses and consists of three points: (1) Prevalence of Poor Sleep Quality, (2) Antecedents of Poor Sleep Quality including: Shift work and Sleep Quality, Neurophysiological Factors: Chronotype, Demographic factors: Older Age and Female Gender, Occupational Stress, Chronic Symptoms, and Family Burden, and (3) Consequences of Poor sleep Quality on: Employee Health: Physical Health, Psychological Health, Social Health, and Safety, Job Satisfaction, and Work performance in relation to Nursing Care and Patient Safety, and Work relationship (Figure 2).

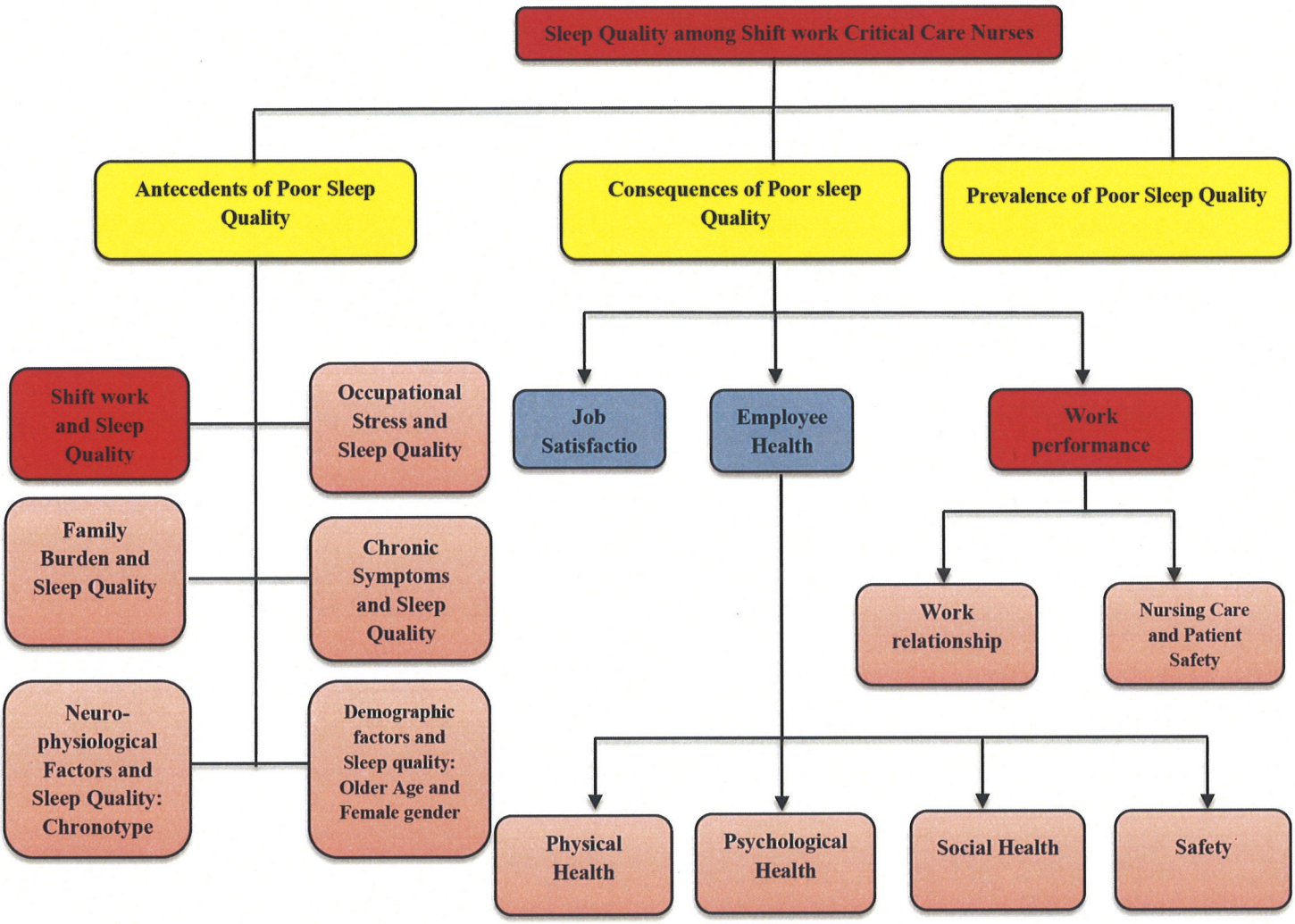


Fig. (2) Literature Review Topics Selection Process

Sleep is vital to life and one of the basic psychological needs according to Maslow's Hierarchy of Needs (Booker et al, 2019; Ojile, 2017). The term 'Sleep' origin recorded in the 5th century and described in 450 Before Christ (B.C) by Greek physician, 2450 years ago, Alcmaeon hypothesized that sleep is a state of unconsciousness due to the decreased of blood circulation to the brain (Alligood, 2021). However, now the concept sleep is rarely related to low blood circulation (Burton & Walker, 2020). Later more studies done on this subject and in 1967, Allan Rechtschaffen and Anthony Kales published the first guideline explaining sleep stages according to brain wave patterns resulting in four non-REM stages of sleep which still used till today (Kales et al, 1967). Although, sleep was previously regarded as an inactive, or passive, state in which the human body and brain "turned off" to rest and recover from the person's awakening daily life activities (Kales et al, 1967; Burton & Walker, 2020). Now, sleep is encompassed of both quantity and quality (National sleep foundation, 2020).

In fact, Allan Rechtschaffen and Anthony Kales (1967) greatly improved the understanding of the complexity of the sleep experience, and the potential complication of sleep absence or sleep loss (Burton & Walker, 2020). The National Sleep Foundation, the American Academy of Sleep Medicine, and the Sleep Research Society recommended that sleep duration per night for adults aged 18 to 64 is 7 to 9 hours for optimal health (Chaput et al, 2018). Yet, many studies suggest that average sleep quantity have decreased from 9 hours in 1910 to as barely 4 to 6 hours on working days in 2018 (Kline, 2020; National Sleep Foundation, 2020; Langenberg et al, 2016). This indicates that individuals are obtaining insufficient sleep on working day, then trying to "catch up "on off days (Kim et al, 2019; Chaput et al, 2018).

Even though sleep quantity is important but by itself is inadequate to measure sleep; it is important to also analyse sleep quality and its relationship with health and work performance (National Sleep Foundation, 2020). Research indicated to view the sleep as a complete, the need to look at the perspective involving a physical stimulation, psychological stimulation, emotional stimulation, cognitive evaluation, culture, and environment factors that clarity the person sleep quality status (Olawale et al, 2017).

2.1 Sleep Quality

High sleep quality is important in regaining control over quality of health and life (National Sleep Foundation, 2020). Generally, it is possible to obtain an adequate sleep quantity per night, yet not feel rested due to poor sleep quality or interruptions while sleep (Books et al., 2018 & Akbari & Hajian, 2015). Therefore, both quantity and quality of sleep must be considered. Consequently, a systematic review identified several measurements that compose sleep quality consist of sleep latency, awakenings, wake after sleep onset, and sleep efficiency (Jotheeswari et al, 2020). Sleep latency is the amount of time it takes to transition from wake to sleep; awakenings are the number of times per night that a person is awake for more than five minutes; wake after sleep onset is the amount of time spent awake after sleep has begun but before final awakening; and sleep efficiency is the ratio of total sleep duration to time in bed (Jotheeswari et al, 2020 & Buysse et al., 1989). In order to achieve deep sleep and REM sleep, the sleep latency must be less than or equal to 30 minutes, the waking up period must not exceed one time during the night, the onset of the waking period should not exceed 20 minutes, the sleep efficiency must be greater than or equal to 85% (Kline, 2020). Getting quality sleep will have profound effects on a person's physical condition as well as cognitive functioning that will allow them to recover from stress and

fatigue (Khatony et al., 2020). Hence the words "fatigue" and "sleepiness" are often coexisted as a consequence of poor sleep quality and/ or sleep deprivation (Kecklund & Axelsson, 2016). It is therefore important for individuals to measure their sleep quality, for optimal well-being and job satisfaction.

The systematic review's measurement of sleep quality is consistent with the PSQI, the instrument that most use to assess subjective sleep quality (Park et al, 2018). The Pittsburgh Sleep Quality Index is a valid and reliable tool, that measured sleep quality by seven components: (1) overall self-rated sleep quality by the participant as very good, fairly good, fairly bad, or very bad, (2) sleep latency; measured by the quantity of minutes it takes to fall asleep each night combined with how frequent one cannot fall asleep within 30 minutes, (3) sleep duration; measured by total hours of actual sleep per night, (4) habitual sleep efficiency; is the ratio of quantity of hours slept to the quantity of hours spent in bed, (5) sleep disturbances; include waking up during the night, getting up to use the bathroom, coughing or snoring, feeling too hot or cold, having bad dreams, experiencing pain, and having difficulty breathing comfortably, (6) use of sleeping medications; measured by how often they are used, and (7) daytime dysfunction; measured by trouble staying awake while driving, eating, or engaging in social activity and difficulty maintaining enthusiasm to complete daily tasks (Buysse et al,1989). For the purposes of this study, sleep quality will be measured according to the PSQI definition that discovers more components of sleep quality, including sleep disturbances, the use of sleeping medications and daytime dysfunction.

2.2 Sleep Quality among Shift work Critical Care Nurses

The International Council of Nurses (ICN) classifies nursing as an integral part of the health care system (ICN, 2021). Nursing is a profession that deals with challenging activities with

high levels of accountability (Khaton et al, 2020). According to the National Health Regulatory Authority (NHRA) there are a total of 11,744 registered nurses in the Kingdom of Bahrain who all contribute to provide service for both in-patient and out-patient (NHRA, 2021).

The critical care unit is one of the specialized areas in the hospital that have the capacity to deal with patients who have life threatening diseases (ICN, 2021). Critical care nurses are specifically trained nurses that provide 24-hour monitoring, patient care, and specialized treatments (ICN, 2021). Therefore, their sleep quality is vital to provide high efficiency and highest patient care outcomes (Giorgi et al, 2017 & Barton, 2009). It has been revealed in a study by Burghi et al, in 2013, that sleep quality among 129 Intensive Care Units (ICU) workers, most especially in nurses, is compromised (Burghi et al., 2013). Findings indicated that the global prevalence of inadequate sleep quality in ICUs was 67.4% including 82% of nurses and 45% of doctors, as well as 13.3% of the ICU staff used sleep medicine and sleep duration shorter than six hours independently linked to sleep disorders (Burghi et al., 2013).

With respect to sleep duration, Ganesan et al., in 2018, found a significant deficit of the amount of sleep obtained between different shift types among ICU workers n= 48, 33.9 ± 9.8 years indicated that between consecutive night shifts, healthcare workers slept an average of 6.5 ± 1.8 hours which impaired alertness and performance particularly at night shifts (Ganesan et al., 2018)

In today's work environment being a critical care professional is not an easy task. In the critical care unit, nurses can be confronted with a variety of situations that can affect their sleep and work (Tarhan et al, 2018). A study done by Serkan et al., in 2018, compare the sleep quality of critical care nurse with the nurses who work in policlinics and other services n = 44, discovered that ICU nurses are noticeably more sleep-deprived (PSQI score = 12) than floor nurses (PSQI

score = 9) practically for nurses who doing night shift was linked to greater cases of insomnia (PSQI score: 15) compared to those who worked day shift (PSQI score: 10) (P value < 0.01) (Serkan et al., 2018).

The following review of the literature begins with prevalence of poor sleep quality, then identifies the antecedents of sleep quality, and concludes with the consequences associated with poor sleep quality among shift works critical care nurses.

Prevalence of Poor Sleep Quality among Nurses

Sleep difficulties among nurses, including insufficient sleep, disturbed sleep pattern, thus poor sleep quality, are widely prevalent (Bazrafshan et al., 2019). The literature reports a significant number of nurses had compromised sleep quality (Jotheeswari et al., 2020; Bazrafshan et al., 2019; Berhanu et al., 2018; Olawale et al., 2017; Dong et al., 2017; Ghalichi et al., 2013), particularly shift work nurses had a high degree of sleep deficiency (Marques et al., 2020; Kang et al., 2020; Elhami et al, 2020; Dall'Ora & Dahlgren 2020; Alshahrani et al, 2019; Axelsson et al, 2018; Joseph et al., 2018; McDowall et al., 2017; Akbari & Hajian, 2015), and the night nurses had especially lower sleep quality comparing to another shift (Huang et al., 2021; Di Muzio et al., 2020; Chae & Choi., 2020; Kim et al., 2019; Baker, 2019; Booker et al., 2018; Ichiba et al., 2018, Orpella et al., 2016; Langenberg et al., 2016; Burghi et al., 2013; Johnson et al., 2010).

Studies found the prevalence of poor sleep was: 43.1% to 86% among healthcare workers in Iran (Kbatony et al., 2020; Bazrafshan et al., 2019; Akbari et al., 2016; Ghalichi et al., 2013), 79.8% among night duty nurses in Korea (Park et al., 2018), 78% among shift work nurse in United Kingdom (UK) (McDowall et al., 2017), 69% of shift working nurses in India (Kaliyaperumal et al., 2017), 65.4% in Ethiopia (Berhanu et al., 2018), 30.8% to 56% in shifts work nurses in 2017

and 2018 in United States (US) (National Sleep Foundation, 2020), 54.8%, to 83% in nurses in China (Deng et al., 2020; Sun et al., 2019; Dong et al., 2017), 57% in nurses in Taiwan (Shao et al., 2010), 48.6% to 59.8% in nurses in Saudi Arabia (Al-Omran et al., 2019, Olawale et al., 2017; Alshahrani et al, 2017), and 43.2% to 58.3% in nurses in Nigeria (Fadeyi et al., 2018; Kolo et al., 2017).

Sleep duration is one of the elements of sleep quality, and therefore, is an important aspect to note. A study conducted by Muzio et al. (2019) revealed that 92% of nurses who work on day-evening regular shifts achieve four hours of restorative sleep a night while for night workers, only 6.3% manage to sleep for at least four hours which is lower than the recommended sleep duration of 7 to 9 hours. It was highlighted that sleep quality and quantity is significantly lower for those working in rotating shift works (Di Muzio et. al., 2019; Ganesan et al., 2018; Serkan et al., 2018). Additionally, one of the most common complaints among shift work nurses is falling asleep when working nights (Huang et al, 2021). Almost 35.5% of the nurses working shift work reported falling asleep during the night shift at least once a week, and only 20.7% of nurses working only day-evening shifts (Huang et al, 2021 & Hughes, 2015). Another survey found that nearly one-fifth of nurse working shifts, mostly night duty, reported struggling to stay awake during their shift (Habiburrahman et al., 2021).

In fact, it was estimated that up to 85% of shift work nurses suffer from poor sleep quality (National Sleep Foundation, 2020), and, consequently, up to 61.0% suffer from sleep deprivation (Zeng et al., 2019). According to Shockey & Wheaton (2017) study, healthcare practitioners represent two of the five occupational groups with the highest prevalence of poor sleep quality and short sleep duration (Shockey & Wheaton, 2017). The extent to which shiftwork nurse are

influenced by sleep deprivation is alarming; during working years that eventually can lead to errors and unsafe patient care (Vanttola et al., 2019; Weaver et al., 2016). Therefore, it is critical to address poor sleep quality in nursing as they are at high risk of sleep deprivation and making errors that affect patient care and safety (Wastwell et al., 2021).

Antecedents

According to Walker & Avant (1995) antecedents are the events or incidents that occur before the existing concept. It is important to understand the antecedent that associated with sleep quality to help researcher understand the unique preceding factors that can contribute to poor sleep quality among shift work critical care nurses. Insignificant research has been finalized on factors contributing to sleep quality specific to critical care nurses; much more literature is related to nursing in general. Shift work, neurophysiological factors: chronotype, demographic factors: older age and female gender, occupational stress, chronic symptoms, and family burden act as antecedents relate to the concept of poor sleep quality (Zhang et al, 2016). These six antecedents are interrelated and described below.

- Shift work and Sleep Quality

Nursing is a stressful and physically demanding professional; add to it impaired sleep quality due to consecutive shift work (Christian et al., 2019). Literature review described shift work as a heavy burden, work hazards, and the most common reason for the poor sleep quality of nurses; for the psychological, physical, spirit, and work performance complications that followed it (Dall'Ora, & Dahlgren, 2020). In addition to increased rates of sleep pathologic that divided into six main categories: (1) insomnia (difficulty initiating or maintaining sleep); (2) sleep-related respiratory disorders (such as obstructive sleep apnea); (3) hypersomnia of central origin (such as

narcolepsy); (4) circadian rhythm disorders (such as jet lag); (5) parasomnias (such as sleep-walking); and (6) sleep-related movement disorders (such as restless legs syndrome) (Alfonsi et al., 2021; Baker, 2019; Books et al., 2017; Chanchlani, 2017; Wickwire et al., 2017). Much more recent research by Haile et al. (2019) revealed that shift work sleep disorders affect around a quarter (25,6%) of nurses who work shifts (Haile et al., 2019).

Shift work produces chronic and increased fatigue by reducing both sleep quantity and quality (Ichiba et al., 2018). In a study done in Saudi Arabia by Al-Omran et al., in 2019 investigated sleep disorders and insomnia among night shift healthcare workers showed that shift work nurses had problems falling (76%) and staying asleep (72.2%) than none shift healthcare workers. In Korean, Chae & Choi (2020) conducted a study amongst 127 intensive care unit nurses aimed to compared two-shift duty (n = 48 nurses) with the three-shift duty (79 nurses) sleep quality, showing that the two-shift group had lower sleep latency and higher sleep quality then three-shift group (Chae & Choi, 2020).

In particular, nurses working non-shift work had better sleep quality than those working shift works (Chang & Peng et al., 2021), and the sleep quantity of shift work nurses was less than non- shift work nurses (Huang et al., 2021). According to Niu et al. (2017), nurses who worked shifts had decreased sleep efficiency and used more sleep medicine (to Niu et al., 2017). Another study done by Demir & Arslan (2011) concluded that rotating shifts work nurses have high sleep latency especially after the night shift, they struggle to properly cycle into the deeper sleep stages (Demir & Arslan, 2011). The trigger was not simply noises or various disturbance during the daytime. A system of irregular rotating shift works can disturb nurses' circadian rhythm and motive sleep deprivation (Niu et al. 2017). Therefore, the sleep debt (sleep loss) can only be

restored during their nonworking days (Chang & Peng, 2021). It is probably due to this, that more than two days off after night shifts are needed, to improve nurses' quality of sleep and their mental health (Sun et al, 2018).

Additionally, shift-working nurses appeared to have poorer work performance than non-shift workers (Cheng et al, 2017), sleep loss significantly affected decision making, initiative, integration of information, high-attention tasks, planning and plan execution, and vigilance (Stimpfel et al, 2020). Apart from the effects of current shift work, varies literature review proved that even those who had previously done shift work were substantially more likely to have poor sleep quality than those who had never done shift work (Zhang et al., 2016).

Overall, health institutions require shift times to cover the 24-hour day cycle and to provide holistic nursing quality care (Marques et al., 2020). Nurses who fail to establish a good circadian rhythm and sleep cycle due to frequent change in shifts usually have disturbed sleep patterns and are unable to get quality, uninterrupted sleep (McDowall et al, 2018). It has been established that night shift works against the normal circadian rhythm (Reiter et al, 2019). This requires the nurses to be active when their body rhythms are preparing for inactivity and sleep, and sleep when their body rhythms are preparing them to be active and awake (Wickwire et al., 2017).

- Neurophysiological Factors and Sleep Quality: Chronotype

The human being very in sleep experience due to the different individual characteristics and neurophysiological factors such as morning type and evening type (Mollazadeh et al, 2021). These characteristics are mediated by person chronotype, that's associated with chronobiology that investigates the rhythmic factors in biological incidents, shows a person's circadian phases, which display when physical activity, hormone degrees, body temperature, cognitive capacity, and eating

and sleep cycles are active throughout the day (Reiter et al, 2019). Each individual has distinctive chronotypes in terms of biological and behavioral rhythms, which includes sleep - wake cycle, body temperature, and cortisol and melatonin launch (Mollazadeh et al, 2021). Chronotype classifies individuals as morning type or evening type based totally on their physiological and genetic traits (Reiter et al, 2019). Chronotype is therefore known to associate with a person's profile of mood states consist of tension or anxiety, anger or hostility, vigor or activity, fatigue or inertia, depression or dejection, confusion or bewilderment, and sleep hygiene behavior; while some people select to sleep and wake up early, others favor to sleep and wake up past due (Mollazadeh et al, 2021). Morning type individuals sleep and awaken early, feeling active without consumption of a stimulant such as caffeine (Mollazadeh et al, 2021).

On the other hand, Evening type individuals sleep late at night and have problem in waking up within the morning; they become stimulated at the highest degree within the afternoon, and therefore show higher performance all through the afternoon and nighttime hours (Mollazadeh et al, 2021). In results reported by Mollazadeh et al. in (2021) there was a statistically significant correlation between the shift to the morning chronotype, and decrease sleep quality among nurses (Mollazadeh et al., 2021). In addition, a study by Reiter et al. (2019) have established that nurses with a morning type had better sleep quality between morning shifts (Reiter et al, 2019), while evening type was associated with irregular sleep and frequent awake during their sleep, leading to insufficient sleep duration and poor sleep quality (Reiter et al, 2019).

Therefore, we included shift type, age, gender, marital status, education backgrounds, body mass index (BMI) and years of experience, as background variables in this study and investigated

whether sleep quality and work performance score of critical care nurses vary with these background variables.

- Demographic factors and Sleep quality: Older Age and Female Gender

Demographic characteristics and person-level variables also affect sleep quality above all age and gender (Wickwire et al, 2017). Numerous studies have presented that age and gender differences are associated with disturbed sleep – wake cycle, and poor sleep quality (Wickwire et al, 2017; Dong et al., 2017). The complaints about sleep problems increased with female gender (Chang et al, 2020 & Shao et al, 2010). A study done by Tsou (2022) discovered that the prevalence of poor sleep quality in women (61.7%) was significantly higher than that in males (52.7%). Similar, Chang & Yang, in 2020 indicated that female shift-working nurses had poor sleep quality (PSQI scores 7.05 ± 3.07) that also influence their body mass index (Chang & Yang, 2020). Also similar was a study finding done by Shao et al. (2016) that the majority of female shift workers (57%) reported global sleep-quality scores more than or equal to 5, indicating inadequate sleep (Shao et al., 2016).

Another study done by Lajoie et al. (2015) concluded that female who work in a rotating shift pattern have lower sleep quality, according to self-reported indications of the validated PSQI, and a higher prevalence of metabolic syndrome than female who wok none shift duty. Furthermore, a study by Langenberg et al. (2016) indicated that female nurses had poorer sleep quality in all shift types (Langenberg et al. 2016).

Older age and aging are associated with a decrease in sleep quality as well as a progressive shortening of the deep sleep time (Chaput et al, 2018). Van Nguyen and Liu (2022) both found that as nurses get older, like everyone else, would suffer from sleep deprivation and poor sleep

quality so that they will be easier to feel sleepiness and fatigue (Van Nguyen & Liu, 2022). However, Theses finding were rejected by Chang and Peng (2021), who found the nurses under the age of 40 years old working rotating shifts had lower sleep quality than nurses over 40 years old working rotating shifts.

- Occupational Stress and Sleep Quality

Previous studies suggest that occupational stress may be a factor that directly correlates with the poorer sleep quality of nurses (Choi & Kim, 2021; Deng et al 2020, Li et al; 2019; Xiong et al, 2019). In a survey study done by Vahedian et al. (2019) in 21 767 ICU nurses discovered that male gender, lower levels of peer collaboration, working with a unit supervisor, nurse-patient ratios, and working in a surgical ICU were all linked to higher stress levels (Vahedian et al., 2019). Another study by Segon et al. (2022) found stress significantly associated with poor sleep quality (Segon et al., 2022).

There are many potential explanations for the link between poor sleep quality and nursing stress, including heavy job responsibility and high-risk exposure such as needle stick or other sharp object injuries, with constant encounters with disease, trauma, and even death (Vahedian et al, 2017). Due to the uncertainty and particularity of nursing; preventing and controlling occupational injuries are main concerns during their care (Verma et al, 2018). Along with the expectations of nursing, the profession, and public can result in unhealthy behaviors and lifestyles, including sleep loss, remaining standing for long periods of time, lack of exercise, and excessive occupational pressure (Abeer et al., 2018).

A chronic state of occupational stress can lead to mental tiredness, exhaustion and altered mood including anxiety, depression, and other psychological problems that have adverse effect on

sleep pattern and contribute to poor sleep quality (Wolf et al, 2017). This place shift works critical care nurses at a high risk of physical and mental diseases. Furthermore, chronic fatigue due to sufficient sleep contributes to bad concentration, which causes much more medical errors and easier harming patients at work (Tiwari et al., 2021).

- Chronic Symptoms and Sleep Quality

Chronic symptoms such as gastrointestinal problems and joint, back or muscle pain are predictors of the severe insufficient sleep that occurs among nurses (Chang & Peng, 2021). Chang and Peng conducted a meta-analysis study on a total of 18 199 nurses in 2021, of which 12 786 were in the rotating and irregular shift group and 5413 were in the fixed day shift group. The result indicated that rotating and irregular shift nurses are more prone than fixed day shift nurses to develop back pain associated with work-related musculoskeletal disorders (Chang & Peng, 2021).

Neck, shoulder, back pain and muscle aches are the most common complaint among critical care nurse, due to nursing care for instance patient shifting, extended standing, patient changing and positional (Ganesan et al., 2018; Gosselin et al., 2015). Krishnan et al. (2021) investigated the prevalence and risk factors of work-related musculoskeletal disorders; the findings revealed that 97.3% of nurses reported having work-related pain in the previous 12 months including: Lower back (86.7%), ankles (86.7%), neck (86.0%), shoulders (85.0%), lower legs (84.7%), and upper back (84.3%) were the most painful body parts (Krishnan et al. 2021).

- Family Burden and Sleep Quality

Sleep disturbance among shift works was greater in nurses who had three or more family members than those who had no family members to care for (Lee & Troxel, 2019). The presence

of children at home plays a crucial role in reduction of sleep quality (Lee & Troxel, 2019). A study done by Harris et al. (2022) among nurses with and without children; the results suggest that nurses with children are more likely to have a stronger connection between poor sleep and increased stressor frequency and severity (Harris et al. 2022). Having supportive family interactions is connected with higher sleep quality, whereas sleep problems are most severe when family relationships are very strained and provide insufficient support. (Ailshire & Burgard, 2012).

Consequences:

Consequences are the events or incidents that happen as result of the occurrence of the concept (Walker & Avant 1995). The consequences of poor sleep quality are related to nurses' reaction including behavioral and emotional problems and the nurse's own interpretation of the meaning of sleep quality. Sleep is difficult to assess and poorly managed because it is a subjective experience, especially among nursing population; is a daily challenge due to shiftwork and nursing itself a demanding profession (Tsai et al., 2019). In fact, nursing working shiftwork rarely obtains optimal sleep quantity and quality. A study done by Chaput et al. (2018) shows that shift workers obtain 1 to 4 hours less sleep than non-shift workers. Many nurses complain of sleep loss (sleep debt) that cumulative, resulting in significant healthy and work performance concerns (Choi & Kim, 2021). A study by David et al. in 1997 revealed that cumulative nocturnal sleep debt was analogous to cumulative daytime sleepiness in that they were dynamic and escalating (David et al. 1997).

The consequences of poor sleep quality can negatively affect nurses' health, quality of work performance, safety, and thus patient care. Therefore, the researcher has identified three main

points to be discussed. It includes the impact of shift work critical care nurses' sleep quality in: (1) employee health, (2) job satisfaction, and (3) work performance.

- Employee Health

Health and safety are paramount within health care provider. The nurse, whose mission is to provide direct care towards the prevention of relief of disease and suffering at all times (Chae & Choi, 2020; Burghi et al 2013). It is therefore essential that nurses maintain physical, mental, and emotional well-being to ensure that the nursing care offered is not compromised by personal ill-health or malpractice (Di Muzio et al, 2019). It has been known for years that poor sleep quality can cause health complications in relation to physical, psychological, social, and safety well-being, that divided in short-term disturbances entities of "jet-lag" and "shift-lag" and long-term complication (Pillai & Drake, 2017).

- **Physical Health**

When researching the physiology alteration and changes related to sleep quality, a growing body of evidence that poor sleep quality is lined to: (1) alter the metabolism and regulation of appetite act as contributing factors for increasing obesity (Chang & Yang, 2020; Park et al, 2018; Zhang et al , 2020), (2) alter glucose tolerance have been shown to significantly increased risk of developing diabetes and insulin insensitivity in shift works population (Khosravipour et al, 2021), (3) alteration of hormones regulation and metabolism such as growth hormone, melatonin, cortisol, leptin, and ghrelin levels are highly correlated with cardiovascular disease, hypertension, and angina (Burch et al, 2018; Khosravipour et al, 2021; Shen et al 2016; Lajoie et al 2015) (4) alter lipid metabolism that increased the risk of high cholesterol, thyroid disease, kidney disease, and liver disease (Li et al 2019; Chung et al 2013), (5) increased possibility of exposure to light

pollution (light at night) is a contributing factor that increased release of melatonin, thus increased risk of breast and prostate cancer (Rosa et al, 2019), and (6) decreasing immune function leading to increased rates of infection and other adverse effects on health (Lee & Rhie 2021; David et al 1997).

A study conducted by Shiffer et al. in 2018 showed that the risk of developing cardiovascular abnormalities, cancer, metabolic disorders, and psychological disorders, were associated with rotational shift work (Shiffer et al., 2018). Another study by Wicker (2016) showed that sleep deprivation has been associated with hypertension, heart disease, obesity, and diabetes. In fact, prolonged sleep restriction with disruption of circadian rhythm has caused the slowing of metabolic rate and increased the postprandial plasma glucose levels (Li et al 2019). This predisposes the person to developing obesity and diabetes (Zhang et al., 2020: Wicker, 2016).

Overall, shift workers have a 50% to 73% higher risk of obesity (Sun et al, 2017; Gangwisch et al, 2005), a 20% higher risk for diabetic (Strohmaier et al, 2018; Gan et al, 2015), a 23% higher risk for heart attacks (Strohmaier et al, 2018), a 13% higher risk for cancer (Schernhammer et al, 2013), a 5% higher risk for strokes (Strohmaier et al, 2018), and a 24% higher risk for entirely cardiometabolic diseases combined (Strohmaier et al, 2018).

- **Psychological Health**

There is a very large-scale, strong body of evidence showing that poor sleep quality has adverse consequences on cognition, mental and mood state of a person (Cheng et al, 2017). Critical care nurses may experience multiple stressors, not the least of which is the difficulty and cost of caring for a critically ill patient (Chae & Choi, 2020; Jakimowicz et al, 2018). In a survey of the literature, nurse distress has been addressed in studies of nurses caring for critically ill patients

who present with cardiac arrest or sepsis (Chae & Choi, 2020; Jakimowicz et al, 2018; Jarden et al, 2018; Vahedian-Azimi, et al 2017; Burghi et al 2013; Nesbitt & Goode, 2014). These studies suggest that nurses are overwhelmed with the demands of a patient's illness and are consequently at risk for developing a high level of emotional distress. In these studies, nurses' sleep quality and level of stress were positively correlated. Additionally, a separate study by Deng et al, 2019 showed that nurses who report more positive perceptions of their job as being stressful are more likely to have poor sleep, as determined by the PSQI. It appears that nurses' perception of their workload and the demands placed on them are the primary factors that affect their level of sleep and stress (Sun et al, 2019).

Research conducted by Tarhan et al., in 2018, have pointed out that nurses working shifts have higher incidences of psychological problems comparing to non-shift duty. It was also suggested that the deterioration in sleep quality have led to increasing anxiety, depression, fatigue, and sleepiness (Tarhan et al, 2018). There is a significant correlation between fatigue and perceived quality of sleep: the shift work nurse's perception of fatigue was higher with poorer sleep quality than that of non- shift nurse's (Kbatony et al, 2020; Sun et al, 2019; Millere et al., 2018).

The current literature shows that shift work nurse has an alteration in psychophysical homeostasis resulting from poor sleep quality are risk factors for stress, depression, mood fluctuations, and insomnia (Rosa et al, 2019).

- **Social Health**

Sleep quality is critical for daily functioning and social relationships (Zhang et al, 2019), while poor sleep quality put strains on personal relationships, such as marriage and family life,

daily life activities, and social functions (Zhang et al, 2019 and Sun et al, 2018). Sleeping during the day disrupts the person's social health and relationships: that phenomena is found and well-documented in literature review entities social jetlag (SJL) (Kang et al, 2020; Thomas et al, 2019).

Social jetlag is a measure of the discrepancy between one's chronotype and social activities periods during the day (Kang et al, 2020). When researching the social alteration related to poor sleep quality, sleepiness during family gathering and limits attendance at social functions and visiting family are among a multitude of adverse effects (Chae & Choi, 2020; Thomas et al, 2019).

Given the fact that many shift workers may be exposed to circadian disruption thus increasing an individual's risk of sleepiness during social activities (Kang, J., Noh, W., & Lee, Y., 2020). Consequently, shift workers should be trained on strategies to minimize social jetlag in sequence and resulting sleep disorder (Thomas et al, 2019).

- **Safety**

The intensive care setting presents unique challenges and requires additional skills. In critically ill and injured patients, nurses are confronted with situations that threaten their safety and that make them feel overwhelmed (Gosselin et al., 2015). Nurses must be able to manage their own emotions and that of their patients. In addition, nurses must be prepared to deal with the complex and unpredictable nature of the intensive and emergency care environment (Jarden et al., 2020). The intensive care environment is characterized by a high degree of unpredictability, and nurses are frequently required to make decisions that may affect the outcome of their patient's care (Jarden et al., 2018). Nurses who feel unprepared to deal effectively with these challenges are at risk of developing burnout. This can become a self-fulfilling prophesy in situations where, as nurses, their emotional and physical needs are not met. The physical environment of the ICU is

also characterized by high levels of noise, light, movement, and shiftwork. Nurses 'ability to cope with these work and environmental factors is limited (Jarden et al., 2020). The stress of the environment is compounded by the nurses' feelings of guilt and the sense of being responsible for the success or failure of their critically ill patients, and the stress of the nursing work is doing shift duties, resulting in sleep debt, hance poor sleep quality (Vanttola et al, 2019).

Sleep debt is the leading cause of drowsy driving and sleep-related vehicle crashes that frequently is cited as a primary or secondary trigger of industrial and motor vehicle accidents (Lee et al, 2016). Drowsy drivers have slower reaction times, reduced vigilance, and information processing deficits, which make it difficult to detect hazards and respond quickly and appropriately (Lee et al, 2016). Lee et al. (2016) indicated that night shift workers are short sleepers, their total sleep time less than 6 hours, and were mostly associated with very high rates of drowsy driving and motor vehicle accidents when driving home after work (Lee et al, 2016).

Weaver et al., in 2018, conducted research pointing out that the occupational safety of healthcare professionals not only involved the workplace setting but also the commute to and from the workplace. They have identified that the commute represents a potential safety hazard. They have studied that workers who had sleep disturbances are nearly five times more likely to fall asleep while driving after work. Also, they are most likely to commit safety violations, uncontrolled anger, and miss work.

Tarhan et al. (2018) emphasized the evidence that sleep quality interferes with staff safety such as sharp-stick injuries and violent actions; documenting higher injury rate among nurses working shift duty, over time, and extended shifts (Tarhan et al, 2018).

- Job Satisfaction

Job satisfaction is a reliable predictor and key to employee retention (Jakimowicz et al, 2018). The satisfaction of nurses is influenced by their shift status (fixed one-shift duty, two-shift duty, and three-shift duty) and their personal characteristics. Nurses with a fixed one shift duty are more highly satisfied with nursing job than nurses with a three-shift duty (Choi & Joo, 2018)

In a study done by Choi & Joo (2018), they concluded that nurses who work in rotating and night shifts had effects on their sleep quality, thus resulted in less job satisfaction and increased the probabilities of burnout and intention to leave the job. As sleep quality increased so did job satisfaction (Jakimowicz et al, 2018). Non- shift nurses have the highest sleep quality and highest job satisfaction scores (Choi & Joo, 2018). On the other hand, shift works nurse have the highest burnout and job dissatisfaction scores (Choi & Joo, 2018).

In general, nurses working extended hours and consecutive shifts duty can lead to sleep deprivation, job dissatisfaction, and burnout (Jakimowicz et al, 2018).

- Work performance

Work performance related to productivity, efficiency, task execution speed and supervision, can be affected by sleep quality precipitated by an irregular shift schedule (Giorgie et al., 2017). Its included:

- **Nursing Care and Patient Safety**

Critical care nurses may experience multiple stressors, not the least of which is the difficulty and cost of caring for a critically ill patient (Chae et al, 2020). In a survey of the literature, nurse distress has only been addressed in studies of nurses caring for critically ill patients who

present with life-threating diseases such as cardiac arrest and sepsis (Chae et al, 2020, Jakimowicz et al, 2018, Jarden et al, 2018, Jarden et al, 2020, and Vahedian et al, 2017) . These studies suggest that nurses are overwhelmed with the demands of a patient's illness and are consequently at risk for developing a high level of emotional and physical distress. In these studies, nurses' sleep quality and level of stress were positively correlated. However, a separate study showed that nurses who report more positive perceptions of their job as being stressful are more likely to have poor sleep, as determined by the PSQI (Park et al, 2019). It appears that nurses' perception of their workload and the demands placed on them are the primary factors that affect their level of sleep, work performance, and patient safety (Tiwari et al, 2021).

Madlabana et al (2020) identified that nurses with good sleep quality have greatly willingness and ability to provide quality health care services and directly affect the success of health care interventions. While sleep-deprived nurse has been cited as a reason for unscheduled absenteeism during their work performance (Abeer et al, 2018, Almadani et al, 2020).

Work performance is also influenced by the nurses' overall health and mood. Complications such as reduced communication skills, irritability, bad mood, and breakdown of emotional coping skills may arise from poor quality of sleep (Khaton, et.al. 2020). Poor sleep quality may lead to decreased productivity of nurses (Park, et. Al, 2018). A short duration of sleep is statistically significantly associated with lower ratings of quality of nursing care and patient safety (Stimpfel et al, 2020).

Disrupted sleep and wake rhythm of shift nurses is greatly associated with a decline in cognitive efficiency (Di Muzio et al, 2020). Shift work nurses have impaired ability to quickly and correctly perform mental calculations compared to those who work in fixed shifts (Molzof et al.,

2019). Shortened sleep quantity and poor sleep quality has been shown to decrease cognitive capabilities like attention span, concentration, and reaction time (Shiffer et al, 2018).

Moreover, Sleep debt and circadian misalignment related impaired alertness and performance are more predominant on nights compared to day shifts (Ganesan et al, 2019). Exposure to bright light increases the alertness of a person (Ganesan et al, 2018). Nurses working in shifts have lesser exposure to light thus their alertness is reduced, this subsequently results in decreased work performance and increased chances for medical errors (Simons & Boeijen, 2018). Altered circadian rhythms is also associated with the nurse's ability to precisely do basic and advanced attentional performance tasks (Behrens et al., 2019).

Shift workers had poorer sleep quality and performed significantly poorer on cognitive flexibility, shifting, response inhibition, and working memory (Khormizi et al, 2018). Memory lapses increase and problem-solving abilities decline (Khormizi et al, 2018). Disturbances in executive functions of the brain can increase risks of accidents at work and the number of nursing errors (Stimpfel et al, 2020). More than half of the nurses who worked in shifts described being sleep deprived and making more patient care errors (Elhami et al, 2020).

Actually, it was highlighted that sleep quality is significantly lower for those working in rotating shifts correlates with medication errors (Westwell et al, 2021 & Xiong et al, 2021). Univariate analysis has been made and observed that medication errors occur more frequently during occasional night shifts (Di Muzio et al, 2019). Medication errors related to fatigue rise proportionally to the number of shifts and hours worked per month (Di Muzio et al, 2019).

Xiong et al. (2021) showed that there is a correlation between poor sleep quality among shift work nurses and patient safety; shift work nurses have reported an error or near miss nursing

care obtained significantly poor sleep quality than non-shift nurses who did not report an error or near miss care (Xiong et al, 2021). Without adequate sleep quality, nurses have more trouble concentrating, learning, and communicating (Kecklund & Axelsson, 2016).

Poor sleep quality and night work associated with work-related accidents; a study by Harris et al (2019) revealed a positive association between work-related accidents, near-accidents, and dozing off at work. The study established a positive fundamental relationship between poor sleep quality and night work causing harm to nurse themselves, to patients, to others healthcare providers, and to medical equipment. By involuntary dozing off at work and dozing off while driving to and from work.

Generally, evidence showed that poor sleep quality caused many mental incidents which led to a decline in attention, efficiency, and easy fatigability in the workplace (Judd, 2017). Such incidents have exposed patients to health risks. Hence poor sleep quality directly led to decreased work performance of nurses (Park et al, 2018).

- **Work relationship**

Poor sleep quality negatively influences working relationships. Sleep deprived nurses may be moody, irritable, and much less tolerant of co-employees' differing opinions, making them greater vulnerable to reactionary outbursts, burnout syndrome, and other relationship-destroying behaviors (Books et al, 2020).

Work relationship issues have an effect on the whole organization (Books et al, 2020). They contribute to inefficiency and task dissatisfaction. Without a doubt, sleep deprivation causes critical problems in each personal lifestyles and the workplace (Books et al, 2020). The findings

of a study by Van Veen et al. (2021) demonstrate that poor sleep quality is consistently associated with increased aggression. Ensuring that the nurses are motivated, provided with adequate rests, trained, rewarded, and promoted appropriately contributes to high quality nursing performance (Choi & Kim, 2021).

2.2 Current State of Knowledge and Possible Gaps

Reviews of literature highlighted the need for continuous assessment, review, and education of nurses on sleep quality (Elhami et al., 2020 & Chou et al., 2015). Although there have been numerous studies on shiftwork and its effects on nurses' sleep, little is known about the quality and quantity of sleep and its correlation with work performance for this specialty practice group of critical care nurses specifically in Bahrain. In addition to that, review of the literature showed that: nurses were aware of their insomnia but were not seeking help to treat it, and there was no documentation of it (Dall'Ora & Dahlgren, 2020; Chung et al., 2013). Most studies on nurses' sleep quality have been conducted in western nations, few have been done in eastern nations, and to the researcher's best knowledge no studies have been done on nurses' sleep quality and work performance in shift work critical care nurses in Bahrain. To further worsen this problem, most healthcare providers, including critical care nurses, usually receive little or no formal education about sleep quality or the need of sleep-in maintaining well-being and performance either during or after their training (Dall'Ora & Dahlgren, 2020). Thus, there is an urgent need to focus on critical care nurses' health and wellbeing which affects the quality of patient care and health outcomes.

This confirms that a large gap still exists between nursing research, education, and practice. However, this literature review offers potential assessment scales, educational and practice

strategies to influence intensive care nurses' decisions to adopt and carry-on evidence-based sleep hygiene practices. Given the complexity of sleep and the different patho-physiological mechanisms responsible for it, the nurse can turn around the situation by using and applying modifiable behaviors of sleep hygiene measure. Full collaboration among healthcare providers, team members, and the presence of an active and supportive nursing management are needed to achieve the full benefits of quality sleep management for nurses.

Benefit, Intention and Reasons of the Undertaken Research

Upon admission at the intensive care unit, nurses are typically the first healthcare providers whom patients encounter. Throughout the patient's stay, critical care nurses play an important role in patients' hospitalization and management, nurses must be highly informed and alert to ensure their effective practice in the intensive care setting. The important role of sleep quality among critical care nurses in intensive care units is the focus of this paper, to offer recommendations to improve sleep for shift working nurses and identify tools and strategies to improve sleep quality.

The purpose of this study is to review the evidence-based research and measure the sleep quality among critical care nurses working shift work, most specifically how sleep quality relates to nurse's work performance using the (PSQI) and the (NWFQ). The aim is to illuminate the problem, if one exists, and to offer guidelines to improve sleep health for shift working nurses by identify tools and strategies to improve sleep quality. Sustaining high-quality sleep among nurses is an objective of health economy because it is one of the key life cycle experiences that can significantly compromise the nurse healthiness, quality of nursing care, and negatively affect job performance (Tsai et al., 2019).

The Theoretical Framework of the Study

Due to the stressors contributing to the area of nursing, shiftwork has been identified as a critical characteristic for those working in this profession. Nurses must deal with shiftwork that can lead to poor sleep quality hence effect work performance in their workforce. The Neuman Systems Model (NSM) directs on varieties of stressors that may produce harm to an individual's health and well-being; shiftwork is one of nurse's stressors. The purpose of this section is to present and utilized the NSM as a conceptual framework and guide for exploring sleep quality and work performance of shift work – nurses in the critical care units.

The Neuman Systems Model is a comprehensive, system-based, and holistic view of the person and concentrates on how the person can cope and adapt to different internal and external stressors through primary, secondary, and tertiary prevention intervention to maintain normal wellbeing stability (Neuman, 1996). Interventions are aimed at retaining, attaining, and maintaining person system wellness through primary prevention involves identifying and reducing potential or actual risk factors, secondary prevention involves the appropriate prioritization of interventions and the reduction of the noxious effects of an invading stressor, and in tertiary prevention, adjusting processes for reconstitution and maintenance factors take place (Alligood, 2021).

The Neuman Systems Model confirming that person as whole is an open system (core) which interrelated and interdependent because of internal and external environmental stressful situations, which leads to organic responses with associated physiological, psychological, sociocultural, and even surround environmental effects (Alligood, 2021). The human being, environment, health, wellness, illness, basic structure and energy resources, person variables, flexible line of defense, normal line of defense, and lines of resistance are the major concepts of the Neuman Systems Model (Neuman, 1996).

The Neuman Systems Model identifies the core (client system), which is surrounded by concentric rings whose purpose is to protect the system from stressor invasion (Neuman, 1996). The core variables include the physiological, psychological, sociocultural, developmental, and spiritual (Alligood, 2021). Concentric rings around the core provide different levels of defense. The normal line of defense (NLD) is a health standard or normal wellness level that can be used to measure changes in stability or wellness which depicted as the center of three concentric rings (Alligood, 2021). The NLD is the accumulation of various coping mechanisms over time that maintain system stability or wellness, with expansion indicating increased wellness and contraction indicating decreased wellness or illness (Alligood, 2021). The flexible line of defense (FLD) is the outermost ring that protects and keeps the NLD healthy. This ring is described as "accordion-like" in that it provides more protection when expanded, but less protection when it is draped (Alligood, 2021). The third concentric ring is lines of resistance (LOR), which are closest to the basic system structure and are in charge of stabilizing and returning the system to wellness after exposure to an environmental stressor, either internal representing intrapersonal stressors or external representing interpersonal and extra-personal stressors (Alligood, 2021).

The use of the model of Neuman systems provides the framework for understanding the idea of adversity by explaining the relationship between sleep quality and work performance, the effects of shiftwork, and the nurse's contact with his or her surround environment and nursing workforce. In this study, the NSM compares the existing shift working factors that can influence the degree of sleep quality thus nurse work performance among critical care nurses. The Neuman Systems model considers the immediate surroundings, the need to assess the environment, and the effects of increasing or decreasing stressors. This consideration can lead to identifying the stressful factors that contribute to nurse poor sleep quality and determining how to address them

appropriately. The Neuman Systems Model focuses on preventing potential health problems in the first place. This recognizes the importance of preventing potential complications from nurse poor sleep quality. However, previous research has identified a need for secondary intervention to strengthening lines of resistance includes strategies to improve sleep quality that have already occurred in nursing because of shift work stress (Ros et al., 2017). Furthermore, tertiary prevention can be used to sustain any gains in nurses' health or system stability gained because of the study, such as nurses' increased awareness of shift work stress.

Primary prevention involves recognizing an actual risk factor associated with an environmental stressor. With shift – work critical care nurses, shiftwork would be an external environment stressor and extra-personal, sociocultural stressor to the client system (critical care nurses). The stressor's influence on the client's normal line of defense and lines of resistance is measured as sleep quality and work performance. Figure (1) for study variables using Neuman Systems model.

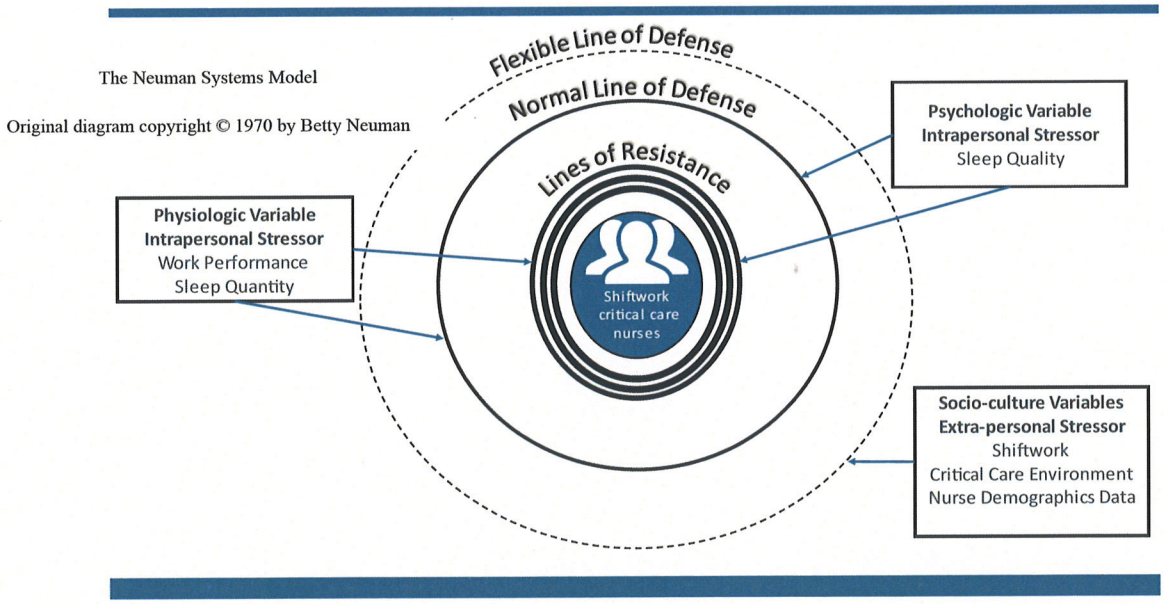


Fig. (1) Study Variables using Neuman Systems Model

2.4 The Role and Core Competence of Advanced Practice Nurse

The worldwide development of advanced practice nursing roles has been influenced by increasing demands and costs of healthcare (McDonnell et al, 2015). Also, one perspective on nursing is no longer viewed as simply a practical occupation but as a profession that values higher education as a means to build competent practitioners at all levels (Woo et al., 2017). APN is an individual opportunity for learning and self-growth and enables wider social and institutional change by bridging theory and practice through critical reflection and action, which reflects changing attitudes towards nursing work and increase the patient quality of care (ICN, 2020).

According to the International Council of Nursing (2020), APN are defined as: "A registered nurse who has acquired the expert knowledge base, complex decision-making skills and clinical competencies for expanded practice, the characteristics of which are shaped by the context and/or country in which s/he is credentialed to practice". The APN scope of practice, role, and core competence provides educational level in greater detail and underlines the accountability and obligation that comes with providing advanced, high-quality, ethical care to the public (Woo et al., 2017). The most applicable core competencies apply to this study includes:

Ethical Decision-Making Core Competency

This guides the professional in self-regulation, outlines the major ethical considerations of the professional and reminds nurses of the special responsibility they assume when caring for the sick (Grace & Uveges, 2022). Therefore, nurses should maintain high sleep quality for physical,

mental, and emotional well-being to ensure that the nursing care offered is not compromised by personal ill-health or malpractice in relation to poor sleep quality (ICN, 2020).

Evidenced Based Practice Core Competency

As a research consumer using nursing evidenced based practice, we should investigate nursing problems to improve nursing care and to refine and expand nursing knowledge. Poor sleep quality is identified as one of nursing problems (Grace & Uveges, 2022). Moreover, the knowledge obtained from this study can help to develop specific programs that could enhance nurses' sleep quality.

Guiding and Coaching core Competency

This study will provide baseline information for further revising the nursing curriculum in kingdom of Bahrain. The Results of this study will set an example during teaching and learning of the nursing staffs and students and will facilitate a compressive in-services education program to increase sleep hygiene practice.

Teamwork and Collaboration core Competency

This study will stimulate nurses to know their sleep quality so that they can then collaborate for optimal solution to increase their sleep quality through teamwork. Also, the information obtained in this study can be used as guidelines for nursing and integrated for future collaborations with interprofessional team to decrease the effect of poor sleep quality in nursing.

Leadership Core Competency

The result of this study could be used for future nursing planning and policy making at the local level of nursing management and informatics in kingdom of Bahrain.

In this study, the researcher was influenced by her thoughts, emotions, and responsibilities as a caregiver, educator, counselor, and researcher, and leading the change which is conduct certain themes of APN and clarify a nurse's activity (ICN, 2020).

Summary

Based on the literature review above, studies on the effect of poor sleep quality and shift work systems on health problems and work performance are clearly discussed among nurses. However, local studies on the similar subject are still uncommon as it is discussed significantly in other countries. This chapter critically examines the literature and describes factors of the existing body of literature review that has indicated influence sleep quality and work performance among shift work critical nurses. The subsequent section discusses the studies that has investigated the prevalence of poor sleep quality in nursing, the antecedents, and consequences of poor sleep quality among nurses. In conclusion, this literature review supports the assumption of shift work reduces sleep quality and causes increased health complications which affect nurses' work performance.

Chapter III

Materials and Methods

MATERIALS AND METHODS

This chapter presents details of the research methodology that was used in this study to collect and analyze data. It explains research design, sample and setting of the study, research tool for data collection, sampling methods, data collection procedure, and ethical consideration. It is hoped that the chosen methodology will generate useful information through the collection and analysis of data on sleep quality and job performance of staff nurses in intensive care unit.

Research Design

A quantitative, descriptive, cross-sectional survey research design was used to explore the sleep quality and work performance of intensive care nurses.

Rationale for the Research Design

The quantitative research was considered to be ideal since little was previously know about nurses' sleep quality and work performance in shift work critical care nurses in Bahrain and was driven by the research problem. According to Beins (2017), a quantitative approach is ideally suited to situations in which little preceding research has been conducted and hence not much is known. Also, the researcher was interested in obtaining a baseline in the level of sleep quality of participating intensive care nurses, therefore it was decided that a cross-sectional survey research design was the most relevant and appropriate for this study. Cross-sectional studies are undertaken to examine, describe, and collect data at one fixed point in time (Polit & Beck, 2021). And survey research is a type of non-experimental empirical research design used extensively in social sciences research, to describe, compare, or explain knowledge, attitudes,

and behavior (Beins, 2017). In this study, the surveys will conduct for the purpose of description; to obtain information on the current status of a specific phenomenon, to quantify attitudes, events, attributes, opinions, or behaviors in a given population, and to establish associations and trends between different variables (Polit & Beck, 2021).

Therefore, a quantitative, descriptive, cross-sectional survey research design will enable the researcher to collect numerical data and perform quantitative analysis using statistical procedures at one point in time, in order to determine the level of sleep quality and it is effects on job performance among critical care nurses at one government hospital in kingdom of Bahrain. Many published studies that have investigated this phenomenon have incorporated a similar descriptive cross-sectional research design. This was also considered as a valid rationale for choosing this research design, so that research result findings from this current study could be compared to these other similar international research studies.

The survey data will be obtained by means of a self-administered questionnaire. It is one of the most common data collection methods in descriptive research, which facilitates the generation of information from which hypotheses can be formulated as well as an insight into and an understanding of the phenomena and situation (Polit & Beck, 2021).

The advantages of using a questionnaire as a means of obtaining data include low cost, confidentiality can be maintained, anonymity can be assured, a large amount of data can be obtained, large geographic coverage and avoidance of interviewer bias (Polit & Beck, 2021). However, a disadvantage of self-administered questionnaires is a low response rate (Polit & Beck, 2021). The smaller the rate of return, the less reliability can be placed on the findings

generated, and the higher the response rate, the more comprehensive the results of the survey will be (Polit & Beck, 2021).

Strategies for Managing Response Rate

To ensure a satisfactory response rate, significant efforts were made in recruiting. Additional measures to help assure a satisfactory response rate included presentation and format, believability, pre-notice, and appeals, as indicated in the literature (Polit & Beck, 2021). To increase response rate and reducing non-response of data collection in this study; the researcher integrated methods included but not limited to, advance warning of the study by means of a poster display in each ward, information leaflets at ward level, send information leaflets to staff nurse via e-mail, assurance of both anonymity and confidentiality of respondents, ensuring that the surveys were professionally designed with a pleasant appearance and a covering letter/ information letter provided, and consent letter to each potential respondent informing them of the study. Moreover, if there is no response via e-mail, the researcher will visit each ward on several occasions to explain the study and answer any questions put forward by potential respondents.

Settings

The study carried out at one of government hospital is Salmaniya Medical Complex in kingdom of Bahrain in five intensive care units including: main intensive adult care unit, burn intensive care unit, cardiac critical unit, pediatric intensive care unit, and neonate intensive care unit. The government hospital is situated in the capital city, and it chose because it is the main public hospital in the country (Ministry of Health - Kingdom of Bahrain, 2022). And being a

national hospital, it is assumed that it has the largest number of nurses that care for critically ill adult patients with different conditions such as neurological, cardiac, medical, surgical, traumatic, and burns. The intensive care nurses have contact with a variety of critically ill adult patients.

Population

The populations that employed in this study are nurses working at one of government hospital in kingdom of Bahrain about 400 nurses. Register Nurses who care for critically ill patients at one of government hospital in kingdom of Bahrain comprised the target population. Nurses caring for critically ill patients during the study period and meeting the eligibility criteria comprised the study population. These included nurses working in the identified intensive care units included in the study.

Sample

A single proportion sample size estimate was determined by statistical analysis software (Statistical Package for the Social Sciences (SPSS) version 28.0). It has been determined to use a standard deviation of (.5); the margin of error or confidence interval is determined to be +/- .05; with a 95% confidence level. The sample size was based on available data. Therefore, this estimates my sample size to be 200 respondents needed, around 50% of total population. The sample size has been determined according to the following formula:

$$n = \frac{N}{1 + N \times e^2}$$

Where $N = 400$ is the population of critical care nurse in SMC, and e denotes the allowed probability of committing an error in selecting a sample from the population. Therefore, the sample size is

$$n = \frac{400}{1 + 400 \times 0.05^2} = 200$$

Inclusion & Exclusion Criteria

A simple random sampling technique used after selection of the sample based on the following inclusion criteria:

- Registered Nurses
- Nurse who working in intensive care units including main intensive adult care unit, burn intensive care unit, cardiac critical unit, pediatric intensive care unit, and neonate intensive care unit.
- Nurses who had worked at the above specified units for at least one year.

Exclusion criteria

- Nurses who have medical diagnosis of sleep disorder.
- Nurses who refuse to give informed consent.

Sampling Technique

In this research, probability samples are selected based on the characteristics of the target population and the requirements of the survey (Polit & Beck, 2021). One type of probability sampling is referred to as 'a simple random sampling' used for this study. A simple random sample consists of a sample which involves random selection of subjects through computerized mathematically calculated, therefore each subject has an equal chance of being chosen as a representative sample (Beins, 2017). The researcher believes is best probability sampling

techniques that help obtaining information where each element of the population has an equal and independent chance of being chosen (Polit & Beck, 2021). The population for this inquiry was a sample of all nurses working in the identified intensive care units included in the study.

Measurement Tools

The research questionnaire contained three parts, which aimed to elicit the level of sleep quality among shift working nurses in intensive care units in Bahrain along with job performance and sample characteristics form.

Tool One: Sample Characteristics Form

The form was developed and written by the researcher in consultation with two academic supervisors. This attaché to the front of the other tools. The validity of the sample characteristics form done by consultation with an academic supervisor. Since demographic characteristics represent relatively simple constructs, the face validity establishing is more straightforward (Polit & Beck, 2021). It is includes subjective self – report to obtain data of the respondents regarding five parts: Demographic variable includes: age, gender, level of education, marital status, number of children, Anthropometrics includes: weight, height, BMI, Lifestyle variables includes: amount of exercises, caffeine intake (Tea), smoking, Work – relate variables includes years of experience, area of practice, position, shifts pattern (fixed duty or two shifts duty morning/ evening or three shifts duty morning/evening/night), and Health - relate variables includes: pregnancy, diabetic, hypertension, hearts disease, and other.

Tool Two: The Pittsburgh Sleep Quality Index (PSQI)

Authors of the PSQI are Buysse, D. J., Reynolds, C. F., Monk, T. H., Berman, S. R., & Kupfer, D. J. developed in 1989, which was adapted in this study to investigated participants sleep quality. It includes subjective self – rated items to elevate sleep quality and has been commonly used in sleep literature (Buysse et al., 1989; Kang & Lee, 2020). The PSOI comprise eighteen items across seven factors of sleep quality which include: Subjective sleep quality (one item), Sleep latency (four items), Sleep duration (one item), Sleep efficiency (four items), Sleep disturbance (one item), Daytime dysfunction (one item), and Use of sleeping medications (four items) (Buysse et al., 1989). The total of all factors provides the measure for overall sleep quality (Buysse et al., 1989). Scores range from 0 (good sleep) – 21 (poor sleep), and > 5 indicate poor sleep quality (Buysse et al., 1989). Its validity was checked based on subjects in three groups: good sleepers, poor sleepers, and disordered sleepers (Buysse et al., 1989). The internal consistence (Cronbach's α) was 0.83 for total score, test – retest reliability correlation coefficient was 0.85 for total score and 0.65 to 0.84 for each domain, and convergent construct validity has been shown with other subjective sleep measures including the insomnia severity index (Pearson r = 0.80) (Buysse et al., 1989; Morin et al., 2011).

Tool Three: The Nurses Work Functioning Questionnaire (NWFQ)

Authors of the NWFQ are Gärtner, F. R., Nieuwenhuijsen, K., Dijk, F. J., & Sluiter, J. K. developed in 2011, which was adapted in this study to investigated participants work performance. It includes subjective self – rated items to elevate impairments in work functioning due to common mental disorders in health care workers during previous 4 weeks, and the worker chooses a response on a Likert scale of between 5 and 7 categories (Gartner et al., 2011). The NWFQ enclose a 50-item self-report questionnaire consisting of seven subscales: cognitive

aspects of task execution (11 items), impaired decision making (3 items), causing incidents at work (8 items), avoidance behavior (8 items), conflicts and irritations with colleagues (7 items), impaired contact with patients and their family (8 items), and lack of energy and motivation (5 items) (Gartner et al., 2011). The total of all factors provides the measure for overall job performance with standard sum score ranges from (1 to 100) to calculate final total score (Gartner et al., 2011). Scores range from 'totally disagree' to 'totally agree' with it. Relation (e.g. 'almost never' to 'almost always') and total frequencies (e.g. 'not once' to 'more than once a day'), and an additional option to record that the statement 'does not apply to my job are also included (Gartner et al., 2011). Overall reliability and convergent validity were satisfactory for six of the subscales except one subscale (impaired decision making) lacked reproducibility and validity and required additional work before use (Gartner et al., 2011). Therefore, in this study, researcher used the NWFQ that included all subscales except impaired decision-making scale.

Reliability of Research Measurement Instruments in this Study

The reliability of these scales was assessed with Cronbach's Alpha measure of internal consistency. To consider a scale with satisfactory reliability, DeVellis R. 2003 criteria were used and 0.7 was considered as the minimum.

The Pittsburg Sleep Quality Index (PSQI)

The PSQI scales showed excellent reliability according to the Cronbach's alpha measure of internal consistency which measured 0.921. All scale's components showed very high affinity to the scale reflected by moderate to high item-total correlation that ranged from 0.71 to 0.98. The following table (1) feature more details:

Table (1) The Reliability of The Pittsburg Sleep Quality Index (PSQI)

Scale	No. components	Cronbach's Alpha	Interpretation
Pittsburg Sleep Quality index	7	0.921	High

The Nurses Work Functioning Questionnaire (NWFQ)

The NWFQ subscales showed high reliability according to the Cronbach's alpha measure of internal consistency except for the avoidance behavior subscale which recorded acceptable reliability. Their reliability index ranged from as low as 0.777 for the avoidance subscale to as high as 0.933 for the cognitive aspect. All subscales' items showed very high affinity to their respective scale reflected by moderate to high item-total correlation that ranged from 0.43 to 0.91. The table (2) feature more details:

Table (2) Reliability of The Nurses Work Functioning Questionnaire (NWFQ)

NWFQ subscale	No. of items	Cronbach's Alpha	Interpretation
Cognitive aspects of task execution...	11	0.933	Excellent
Causing incidents at work	8	0.924	Excellent
Avoidance behavior	8	0.777	Acceptable
Conflicts and irritations with colleagues	7	0.902	Excellent
Impaired contact with patients and their family	8	0.917	Excellent
Lack of energy and motivation	5	0.896	Excellent

Data collection procedures

The researcher contacted with all of the Clinical Nurse Supervise on each of the five units where the study conducted and informed regarding the date and time of the study to encourage staff participate and efficient data collection procedures. Then, the PSQI tool, and the NWFQ tool, along with Sample Characteristics Form, a covering letter/information consent form, disturbed online via electrically link to each eligible nurse working on the intensive care units. Those who are participating in the study read the information provided about the study, signed the informed consent form, and completed the questionnaire (Fig.4).

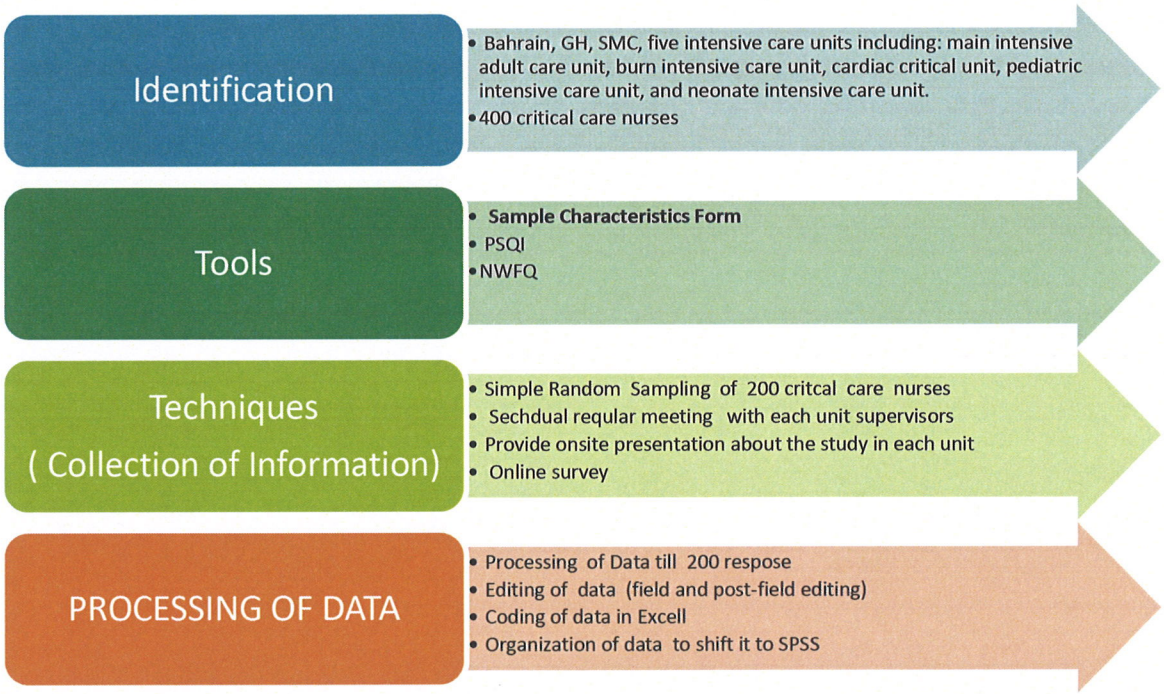


Fig. (4) Schematic Diagram of Data Collection Procedure

During the data collection period, the researcher decided to give an online presentation of the research study to all of the Clinical Nurse Supervise and to prospective respondents to

each of the five units. Also, the researcher called the Clinical Nurse Supervise of each unit every 2-3 days to encourage their nurses to participate and returned surveys. This gave the researcher an excellent opportunity to provide a comprehensive outline of the whole proposed study inquiry and to elaborate on the requirements of potential nurses if they consented to participate in the study. Also, the nurses informing that the survey is voluntary and then asked to complete the survey.

Ethical considerations

This study uses human subjects; therefore, a formal ethical approval is obtained from the Institutional Review Board (IRB) No. 3/2020-21 dt. October 1,2020, Ministry of Health (MOH) No. AURS/ 358/ 2020, and Secondary Health Care Research Sub Committee (SHCRC). There is no risk to study participants during this research study. Informed consent obtained from study participants. No form of personal identification was incorporated into the survey; therefore, confidentiality and anonymity of the respondents was guaranteed.

Data Analysis

In this study, inferential and descriptive statistic used to analyze participant responses. Descriptive data analyses were carried out in the Statistical Package for the Social Sciences version 28.0 (SPSS V.28) in which the demographic, work-related, and the core scales (PSQI & NWFQ) findings were explored and summarized (IBM Corp, 2021) according to study objectives (Table 3).

In order to summarize the demographic characteristics of the sample, we used basic descriptive statistics: frequency, percentage, mean, and standard deviation (IBM Corp, 2021).

Categorical variables like gender, age groups, etc. were summarized using frequency and percentage distribution for each category. Likewise, was the descriptive analysis of the two scales where the frequencies and the percentages of correct and incorrect response categories were obtained.

For the continuous variables of sleep quality and nurse work function were summarized by calculating the measures of central tendency (mean and median) and dispersion (minimum, maximum, and standard deviation, etc.). To assess the normality of their distribution, the two scales scores were examined with the Kolmogorov-Smirnov normality test and their kurtosis and skewness were examined as well. The scales reliabilities were assessed with Cronbach's Alpha measure of internal consistency . To consider a scale with satisfactory reliability, DeVellis R. 2003 criteria were used and 0.7 was considered as the minimum.

The spearman correlation test was employed to assess the direction, the magnitude, and the statistical significance of the (Univariate) relationships among the scales. This test was selected instead of Pearson correlation test because the data did not meet the normality assumption of the conventional Pearson test. Simple linear regression was used to evaluate the predictive value of the participants' reported sleep quality on their work performance.

The association between the participants' demographic characteristics and the scales were examined with the Mann-Whitney test (the non-parametric alternative to the T-test) and the Kruskal-Wallis test (the non-parametric alternative to the ANOVA) to reveal any significant differences among the demographic groups based on their self-reported on the PSQI and NWFQ scales. Moreover, independent sample t-test and one-way ANOVA used to mean comparison of

PSQI and NWFQ with demographic characteristics of the critical care nurse participants. For all of these tests, an Alpha of 0.05 was set as a cut-off point of the statistical significance.

Table (3) Data Analysis in relation to Research Objectives

Research objectives	Data collection tool	Data analysis
Identify the prevalence of poor sleep quality among critical care nurses.	PSQI	**Descriptive statistics**: frequency, percentage, mean, and standard deviation
Measure the quality and patterns of sleep among shift – work critical care nurses.	PSQI Sample Characteristics Form	**Central tendency** (mean and median) **Dispersion** (minimum, maximum, and standard deviation, ect.) **Frequencies and percentages** of correct and incorrect response
Investigate any possible relationship between sleep quality and job performance in shift - work critical care nurses.	PSQI NWFQ	The spearman correlation test Simple linear regression

Identify background factors that might affect sleep quality and job performance of shift – work critical care nurses.	Sample Characteristics Form PSQI NWFQ	Mann-Whitney test Independent T-test Kruskal-Wallis test One-way ANOVA Chi Square test

Analysis of the data takes place after returning all the online surveys. For data entry and data documentation structures and analysis of quantitative data; data entry done by using Excel Microsoft. The researcher used Excel to enter data in a controlled manner, validate and checked data for quality and completeness, coding the variables responses, clean data, and export SPSS V.28 for analysis, which prevent and educe any error during the inputting of data. The original soft copies of the returned surveys were kept away in a secure file within a locked password. All the data was managed on the researcher's laptop. The security and protection of the data was maintained by means of a username and password in the researcher laptop.

Chapter IV

Results

RESULTS

The results of the current study will be presented in five parts as follows:

Part I:	Characteristics of Survey Participants (Critical Care Nurses)
Part II:	Scores of Pittsburgh Sleep Quality Index Questionnaire
Part III:	Scores of Nurses Work Functioning Questionnaire
Part IV:	Correlations between PSQI and NWFQ
Part V:	Correlations between Sociodemographic Characteristics and Total Scores of PSQI and NWFQ
Part VI	Correlations between Sleep Quality (Good Sleeper Vs Bad Sleeper) and Sociodemographic Characteristics and Total Scores of NWFQ (N= 200 Critical Care Nurses)

Part I: Characteristics of Survey Participants (N= 200 Critical Care Nurses)

Personal Demographics

Table 4 illustrates that nearly three quarters were females (n=145, 72.5%) with those age 31 and more formed the vast majority (n=159, 79.5%) with mean (SD) of 38.23±8.224 years old. Married participants are the largely represented group (n=157, 78.5%) in the sample with those having children had a similar proportion (n=142, 71%). The sample is dominated with the bachelor's degree holders (n=162, 81%).

Table 4: Personal Demographic Characteristics of the Critical Care Nurses (n=200)

Variable	Categories	No.	%
Gender			
	Male	55	27.5
	Female	145	72.5
Age (Years)			
	21-30	41	20.5
	31-40	74	37.
	41-50	73	36.5
	51-65	12	6.0
Mean±SD		**38.23±8.22**	
Marital status			
	Single	40	20.0
	Married	157	78.5
	Divorced	3	1.5
Having children			
	Yes	58	29.0
	No	142	71.0
Education level			
	Diploma	31	15.5
	Bachelor	162	81.0
	Master	7	3.5

Professional Demographics

Table 5 shows that study nurses came from five critical areas with more than three quarters (n=154, 77%) of them came from two areas only (ICU and NICU). The sample is dominated by the registered nurses (n=188, 94%) who worked for 6 years and more (n=148, 74%) with mean experience of 8.92±4.654 years, and usually doing three work shifts (n=164, 82%).

Table 5: Professional Demographic Characteristics of the Critical Care Nurses (n=200)

Variable	Categories	No.	%
Area of practice			
	BICU	10	5.0
	CCU	27	13.5
	ICU	80	40.0
	NICU	74	37.0
	PICU	9	4.5
Length of clinical experience (Years)			
	1	5	2.5
	2-5	47	23.5
	6-10	87	43.5
	11-15	44	22.0
	>15	17	8.5
Mean±SD		**8.92 ± 4.654**	
Designation			
	RN	188	94.0
	Supervisor	9	4.5
	Head Nurse	3	1.5
Work Shifts Schedules			
	One Shift	22	11.0
	Two Shifts	14	7.0
	Three Shifts	164	82.0

BICU: Burn Intensive Care Unit, CCU: Critical Care Unit, ICU: Intensive Care Unit, NICU, Neonatal Intensive Care Unit, PICU: Pediatric Intensive Care Unit, One Shifts: Morning, Two Shifts: Morning and Evening, Three Shifts: Morning, Evening, and Night.

Habits and Psychosocial Characteristics

Table 6 reveals that nearly 80% of the participants do not perform any physical exercise but also a similar proportion do not smoke (n=163, 81.5%). Regarding their caffeine consumption, fairly half of them consume caffeine beverages. Almost two thirds of the sample enjoy some sort of family support (n=119, 59.5%) and the vast majority stated that they have occupational stress (n=198, 99%).

Table 6: Habits and Psychosocial Characteristics of the Critical Care Nurses (n=200)

Variable	Categories	No.	%
Performing exercise			
	No	159	79.5
	Yes	41	20.5
Smoking			
	No	163	81.5
	Yes	37	18.5
Caffeine consumption			
	No	99	49.5
	Yes	101	50.5
Family support			
	No	81	40.5
	Yes	119	59.5
Occupational stress			
	No	2	1.0
	Yes	198	99.0

Anthropometrics Measurements

Table 7 reveals that on n average the critical care nurses weigh 79.3±18.6 Kg with mean height of 163.1±8.8 cm. their mean BMI is 29.4±5.9 Kg/cm^2 which deemed them as overweight on average.

Table 7: Anthropometrics Measurements of the Critical Care Nurses (n=200)

Variable	Mean	Median	St. Dev.	Min	Max	Range
Weight	79.3	80	18.6	44	170	126
Height	163.1	161	8.8	145	187	42
BMI	29.4	29	5.9	18.5	59.5	40.9

Health Conditions Prevalence

Table 8 illuminates nurses' health conditions prevalence who working in intensive care units. The reported prevalence of DM was 14.5% whereas the HTN was twice as high at 28.5%. Only 9% of the participants claimed to have heart diseases with a bit higher proportion having some hereditary diseases (13%). Less than one tenth of the participant are currently pregnant (8%) and the other health conditions were mentioned was hypothyroidism (3.5%).

Table 8: Health Conditions Prevalence of The Critical Care Nurses (n=200)

Health conditions	No. (%)
Diabetes mellitus (DM)	29(14.5)
Hypertension (HTN)	57(28.5)
Heart diseases	18(9)
Hereditary diseases	26(13)
Pregnancy	16(8)
Other conditions: Hypothyroidism	7(3.5)

Part II: Scores of Pittsburgh Sleep Quality Index Questionnaire (N= 200 Critical Care Nurses)

PSQI: Total Scores

Table 9 illustrates the mean total score and the mean score of each sub-component achieved by critical care nurses on the 19- items PSQI tool. The seven component scores are then added together to get a total PSQI score with a range of 0 to 21. The findings were calculated according to the Buysse et al. (1989) guidelines. Out of 21 points, the nurses scored with mean (SD) of 13.6 (± 4.9) on average on this scale which again confirms that they suffer poor sleep quality (poor sleep = >5 points). Each sleep quality component's mean (SD) was as follows: a sleep latency of 2.4 (± 0.9); a subjective sleep quality of 2.6 (± 0.8); a daytime dysfunction of 2.3 (± 0.9); sleep disturbances of 2.3 (± 0.9); a habitual sleep efficiency of 0.3 (± 0.5); a sleep duration of 2.1 (± 0.7); and use of sleeping medication of 1.8 (± 0.9).

Table 9: Mean Scores of The Sub-Components of PSQI Among Critical Care Nurses (n=200)

Component	Question	Responses	No.(%)	Mean ±SD
Subjective Sleep Quality				
	Q9: During the past month, how would you rate your sleep quality overall?			
		Very good (0)	12 6	
		Fairly good (1)	10 5	2.6 ±0.8
		Fairly bad (2)	27 13.5	
		Very bad (3)	151 75.5	
Sleep Latency				

	Q2: How long (in minutes) has it taken you to fall asleep each night?			
		=<15 minutes (0)	21	10.5
		16-30 minutes (1)	11	5.5
		31-60 minutes (2)	44	22.0
		>60 minutes (3)	124	62.0
	Q5a: Cannot get to sleep within 30 minutes			2.4 ±0.9
		Not during the past month (0)	22	11
		Less than once a week (1)	11	5.5
		Once or twice a week (2)	3	1.5
		Three or more times week (3)	164	82
Sleep Duration				
	Q4: How many hours of actual sleep do you get at night?			
		>7 hours (0)	7	3.5
		6-7 hours (1)	19	9.5
		5-6 hours (2)	115	57.5
		<5 hours (3)	59	29.5
				2.1 ±0.7
Habitual Sleep Efficiency				
	Q1: When have you usually gone to bed?			
		Mean±SD		**10.1±3.6**
	Q3: When have you usually gotten up in the morning?			

	4 hours	28	14	
	5 hours	172	86	
Q4: How many hours of actual sleep do you get at night?				
	>7 hours (0)	7	3.5	
	6-7 hours (1)	19	9.5	
	5-6 hours (2)	115	57.5	
	<5 hours (3)	59	29.5	
(Q3 – Q1)/Q4 * 100				
	>85% (0)	155	77.5	
	75-84% (1)	40	20	
	65-74% (2)	3	1.5	0.3 ±0.5
	<65% (3)	2	1	
Sleep Disturbance				
Q5b: Wake up in the middle of the night or early morning				
	Not during the past month (0)	21	10.5	
	Less than once a week (1)	5	2.5	
	Once or twice a week (2)	10	5.0	
	Three or more times week (3)	164	82.0	
Q5c: Have to get up to use the bathroom				
	Not during the past month (0)	26	13.0	
	Less than once a week (1)	22	11.0	
	Once or twice a week (2)	110	55.0	
	Three or more times week (3)	42	21.0	

Q5d: Cannot breathe comfortably			
	Not during the past month (0)	51	25.5
	Less than once a week (1)	35	17.5
	Once or twice a week (2)	45	22.5
	Three or more times week (3)	69	34.5
Q5e: Cough or snore loudly			
	Not during the past month (0)	39	19.5
	Less than once a week (1)	36	18.0
	Once or twice a week (2)	64	32.0
	Three or more times week (3)	61	30.5
Q5f: Feel too cold			
	Not during the past month (0)	23	11.5
	Less than once a week (1)	30	15.0
	Once or twice a week (2)	78	39.0
	Three or more times week (3)	69	34.5
Q5g: Feel too hot			
	Not during the past month (0)	21	10.5
	Less than once a week (1)	26	13.0
	Once or twice a week (2)	79	39.5
	Three or more times week (3)	74	37.0
Q5h: Have bad dreams			
	Not during the past month (0)	21	10.5
	Less than once a week (1)	20	10.0

	Once or twice a week (2)	81	40.5	
	Three or more times week (3)	78	39.0	
Q5i: Have pain				
	Not during the past month (0)	21	10.5	
	Less than once a week (1)	13	6.5	
	Once or twice a week (2)	2	1.0	
	Three or more times week (3)	164	82.0	
	Not during the past month (0)	21	10.5	
Q5j: Other reason(s), please describe, including how often you have had trouble sleeping because of this reason(s):				
	Not during the past month (0)	200	100	
	Less than once a week (1)	0	0	
	Once or twice a week (2)	0	0	
	Three or more times week (3)	0	0	
∑ Q5b ~ Q5j				
	0 (0)	21	10.5	
	1 -9 (1)	5	2.5	2.2 ±0.9
	10 – 18 (2)	76	38	
	19 – 27 (3)	98	49	
Use of Sleeping Medication				
Q6: During the past month, how often have you taken medicine to help you sleep (prescribed or "over the counter")?				
	Not during the past month (0)	37	18.5	1.8 ±0.9

	Less than once a week (1)	9	4.5	
	Once or twice a week (2)	117	58.5	
	Three or more times week (3)	37	18.5	
Daytime Dysfunction				
Q7: During the past month, how often have you had trouble staying awake while driving, eating meals, or engaging in social activity?				
	Not during the past month (0)	21	10.5	
	Less than once a week (1)	15	7.5	
	Once or twice a week (2)	78	39.0	
	Three or more times week (3)	86	43.0	
Q8: During the past month, how much of a problem has it been for you to keep up enthusiasm to get things done?				
	Not during the past month (0)	21	10.5	
	Less than once a week (1)	9	4.5	
	Once or twice a week (2)	87	43.5	
	Three or more times week (3)	83	41.5	
Q7 + Q8	0(0)	2	1	
	1-2 (1)	0	0	2.3 ±0.9
	3-4 (2)	81	40.5	
	5-6 (3)	98	49	
Global Sleep Quality				**13.6±4.9**

PSQI: Pittsburgh Sleep Quality Index

PSQI: Sleep Quality Score

Table 10 reveals that the majority of nurses (n=178, 89%) reported poor sleep quality, described it as at least being fairly bed (n=27, 13.5%) to as worse as very bad (n=151, 75.5%). while just 22 nurses (11 %) were good sleepers with a PSQI-P score of ≤5.

Table 10: PSQI Sleep quality score of the critical care nurse participants (n=200)

	Very good	Fairly good	Fairly bad	Very bad
	0	1	2	3
Subjective sleep quality	12 (6.0%)	10 (5.0%)	27 (13.5%)	151 (75.5%)
	Good Sleeper		Bad Sleeper	
	22 (11%)		178 (89%)	

Measures Sleep Quality Score Range= 0 - 21; ≤ 5 = normal sleep quality, 6-21 disordered sleep (Buysse et al., 1989)

PSQI: Scores for Individual Components

Table 11 demonstrates that the majority of critical care nurses have sleep problems disturbances (n= 171, 75.5%). The vast majority of the participants usually go to bed at 12 MN and after (n=164, 82%) with two thirds of them require more than half an hour to fall asleep (n=124, 63%). Those who wake up at 5am are the largely represented group (n=172, 86%) with a similar proportion with participant who have sleep from 2 to 5 hours only in a typical day (n=172, 85.5%).

Nearly three quarters of the participants reported to have one or more trouble during sleep ranging from one a week to three and more a week (71%). Around 87% of the participants reported that they wake up in the middle of the night or early morning at least once in a week and 83.5% of them cannot get to sleep within 30 minutes in the last month.

Table 11: Individual Components PSQI Score of the Critical Care Nurse S (n=200)

Component	Normal	Mild dysfunction	Moderate dysfunction	Severe dysfunction	p-value
Subjective sleep quality	Very good 12(6.0%)	Fairly good 10(5.0%)	Fairly bad 27(13.5%)	Very bad 171(75.5%)	**<0.0001**
Sleep latency	=<15 minutes 21(10.5%)	16-30 minutes 11(5.5%)	31-60 minutes 44(22.0%)	>60 minutes 124(62.0%)	**<0.0001**
Sleep duration	>7 hours 7(3.5%)	6-7 hours 19(9.5%)	5-6 hours 115(57.5%)	<5 hours 59(29.5%)	**<0.0001**
Habitual sleep efficiency	>85% 155(77.5%)	75-84% 40(20.0%)	65-74% 3(1.5%)	<65% 2(1.0%)	**<0.0001**
Sleep disturbances	Not during the past month 21(10.5%)	Less then once a week 5(2.5%)	Once or twice a week 76(38.0%)	Three or more times a week 98(49.0%)	**<0.0001**
Medicine to sleep	Not during the past month 37(18.5%)	Less than once a week 9(4.5%)	Once or twice a week 117(58.5%)	Three or more times a week 37(18.5%)	**<0.0001**
Daytime dysfunction	Not during the past month 21(10.5%)	Not during the past week 0(0%)	Once or twice a week 81(40.5%)	Three or more times a week 98(49.0%)	**<0.0001**

PSQI: Correlation among the Components

Table 12 shows the 7 PSQI components were found to be weakly to strongly correlated by positive and statistically significant relationships according to the Spearman correlation test. The weakest correlation detected between the daytime dysfunction and the habitual sleep efficiency (r=+0.186, 0.008). On the other hand, the strongest correlation was between the habitual sleep efficiency and sleep duration (r=+0.701, p<0.001).

Table 12: Correlation among the PSQI Components of the Critical Care Nurses (n=200)

PSQI component		Subjective sleep quality	Sleep Latency	Sleep duration	Habitual sleep efficiency	Sleep disturbances	Medicine to sleep
Sleep Latency	Spearman r	0.666	--				
	p-value	<0.001	.				
Sleep duration	Spearman r	0.496	0.555	--			
	p-value	<0.001	<0.001	.			
Habitual sleep efficiency	Spearman r	0.207	0.285	0.701	--		
	p-value	0.003	<0.001	<0.001	.		
Sleep disturbances	Spearman r	0.620	0.499	0.400	0.200	--	
	p-value	<0.001	<0.001	<0.001	0.005	.	
Medicine to sleep	Spearman r	0.680	0.633	0.499	0.287	0.652	--
	p-value	<0.001	<0.001	<0.001	<0.001	<0.001	.
Daytime dysfunction	Spearman r	0.543	0.468	0.393	0.186	0.580	0.572
	p-value	<0.001	<0.001	<0.001	0.008	<0.001	<0.001

Part III: Scores of Nurses Work Functioning Questionnaire (N= 200 Critical Care Nurses)

NWFQ: Total and Sub- Total Scores

Table 13 indicates the mean total score and the mean score of each sub-component achieved by critical care nurses on the 50- items NWFQ tool. The findings were calculated out of 100 points according to the Gärtner et al. (2011) guidelines. The nurse work functioning questionnaire had an overall mean (SD) of 56.3 (± 22.5) indicate moderate level of impaired work functioning. Each NWFQ subscale's mean (SD) was as follows: cognitive aspects of task execution 68.1 (± 23), causing incidents at work 42 (± 19.1), avoidance behavior 51.6 (± 24.4), conflicts and irritations with colleagues 62.2 (± 28.9), impaired contact with patients and their family 51.3 (± 20.8), and lack of energy and motivation 62.3 (± 28.6).

Table 13: Total and Sub- Total Scores of NWFQ of the Critical Care Nurses (n=200)

Scale	Mean	Std. Deviation	Min - Max	Kurtosis	Skewness
Nurses work function	56.3	22.6	0.0-92.7	0.3	-0.6
Cognitive aspects of task execution	68.1	23	0-100	0.722	-1.004
Causing incidents at work	42	19.1	0-77	0.158	-0.488
Avoidance behavior	51.6	24.4	0-100	-0.533	0.477
Conflicts and irritations with colleagues	62.2	28.9	0-100	0.326	-0.395
Impaired contact with patients and their family	51.3	20.8	0-91.7	-0.196	-0.757
Lack of energy and motivation	62.3	28.6	0-100	0.140	-0.861

NWFQ Sub- Scale (1): Cognitive Aspects of Task Execution

Table 14 signifies the cognitive aspects of task execution among critical care nurse was found to be at a moderate level as nearly 67.9% of their responses fell into the left segment of the scale (4, 5, and 6) which indicates they are facing difficulty to great difficulty in this aspect. The findings are further supported when this aspect score was calculated according to the authors' guidelines. Out of 100 points, the participants scored 68.1 points on average on this subscale which again confirms that they suffer moderate level of impaired work functioning in this aspect.

Table 14: Sub- Total Scores of NWFQ (1): Cognitive Aspects of Task Execution of the Critical Care Nurses (n=200)

	No difficulty						Great difficulty	
	0	1	2	3	4	5	6	Mean ± SD
Statement	*n(%)*	*n(%)*	*n(%)*	*n(%)*	*n(%)*	*n(%)*	*n(%)*	
NWFQ1:	Keeping sufficient overview of your tasks							
	2 (1.0)	11 (5.5)	10 (5.0)	28 (14.0)	48 (24.0)	51 (25.5)	50 (25.0)	4.31± 1.471
NWFQ2	Not forgetting something one day.							
	5 (2.5)	12 (6.0)	10 (5.0)	20 (10.0)	33 (16.5)	43 (21.5)	77 (38.5)	4.51± 1.659
NWFQ3	Working efficiently							
	3 (1.5)	13 (6.5)	12 (6.0)	15 (7.5)	31 (15.5)	41 (20.5)	85 (42.5)	4.60± 1.641
NWFQ4	Carrying out your work activities in general							
	7 (3.5)	9 (4.5)	13 (6.5)	21 (10.5)	33 (16.5)	35 (17.5)	82 (41.0)	4.49± 1.710
NWFQ5	Carrying out your work independently.							
	3 (1.5)	17 (8.5)	12 (6.0)	25 (12.5)	43 (21.5)	35 (17.5)	65 (32.5)	4.26± 1.670
NWFQ6	Staying alert in your work							
	2 (1.0)	13 (6.5)	18 (9.0)	16 (8.0)	36 (18.0)	54 (27.0)	61 (30.5)	4.39± 1.594
NWFQ7	Working accurately							
	17 (8.5)	47 (23.5)	32 (16.0)	27 (13.5)	29 (14.5)	8 (4.0)	40 (20.0)	2.94± 1.997
NWFQ8	Preventing incidents in your work.							

	2 (1.0)	18 (9.0)	12 (6.0)	8 (4.0)	45 (22.5)	50 (25.0)	65 (32.5)	4.43± 1.6
NWFQ9	Working carefully.							
	15 (7.5)	52 (26.0)	35 (17.5)	28 (14.0)	26 (13.0)	2 (1.0)	42 (21.0)	2.86± 1.9
NWFQ15	I make mistakes more often than before.							
	Totally disagree	**Disagree**	**Disagree a little**	**not agree/ not disagree**	**Agree a little**	**Agree**	**Totally agree**	
	22 (11.0)	20 (10.0)	7 (3.5)	8 (4.0)	34 (17.0)	7 (3.5)	102 (51.0)	4.20± 2.2
NWFQ16	has the feeling to have lost control over the work?							
	(Almost) never	**Once in a while**	**Some-times**	**Regularly**	**Often**	**Very often**	**(Almost) always**	
	22 (11.0)	13 (6.5)	4 (2.0)	19 (9.5)	23 (11.5)	71 (35.5)	48 (24.0)	4.06± 1.9
Overall	**4.5%**	**10.2%**	**7.5%**	**9.8%**	**17.3%**	**18%**	**32.6%**	**68.1± 2**

NWFQ Sub- Scale (2): Causing Incidents at Work

Table 15 implies that causing incidents at work among critical care nurse was found to be at a low level as nearly 77.8% of their responses fell into the right segment of the scale which indicates the occurrence of incidents at work doesn't happen so frequently (mostly between once a month and once per week). The findings are further supported when this aspect score was calculated according to the authors' guidelines. Out of 100 points, the participants scored 42 points on average on this subscale, which again confirms that they suffer from a low level of impaired work functioning in this aspect.

Table 15: Sub- Total Scores of NWFQ (2): Causing Incidents at Work of the Critical Care Nurses (n=200)

	Once a month	1 x per month	2 - 3 x per month	on average 1 x per week	on average 2 - 3 x per week	on average 1 x per day	on average more than 1 x per day	Mean ± SD
	0	1	2	3	4	5	6	
Statement	*n(%)*	*n(%)*	*n(%)*	*n(%)*	*n(%)*	*n(%)*	*n(%)*	
NWFQ14	Error-free administering/handing medication							
	2 (1.0)	17 (8.5)	14 (7.0)	16 (8.0)	49 (24.5%)	39 (19.5)	63 (31.5)	4.31± 1.630
NWFQ26	Almost caused incidents in your work?							
	28 (14.0)	41 (20.5)	65 (32.5)	28 (14.0)	0 (0.0)	38 (19.0)	0 (0.0)	2.22± 1.605
NWFQ27	Almost made a mistake in the administration/handing of medicines?							
	21 (10.5)	40 (20.0)	103 (51.5)	4 (2.0)	18 (9.0)	14 (7.0)	0 (0.0)	2.00± 1.280
NWFQ28	Underestimated the seriousness of a situation?							
	21 (10.5)	34 (17.0)	36 (18.0)	37 (18.5)	25 (12.5)	47 (23.5)	0 (0.0)	2.76± 1.681
NWFQ29	Initiating infusion.							
	21 (10.5)	33 (16.5)	20 (10.0)	126 (63.0)	0 (0.0)	0 (0.0)	0 (0.0)	2.25± 1.075
NWFQ30	Assessing which (nursing) care a patient need.							
	21 (10.5)	46 (23.0)	80 (40.0)	37 (18.5)	0 (0.0)	16 (8.0)	0 (0.0)	1.98± 1.250
NWFQ31	Performing and reporting actions (e.g., in the nursing plan or treatment plan).							
	22 (11.0)	22 (11.0)	33 (16.5)	98 (49.0)	1 (0.5)	24 (12.0)	0 (0.0)	2.53± 1.367
NWFQ32	Performing and reporting actions (e.g., in the nursing plan or treatment plan).							
	22 (11.0)	38 (19.0)	75 (37.5)	45 (22.5)	0 (0.0)	20 (10.0)	0 (0.0)	2.11± 1.323
Overall	**9.9%**	**16.9%**	**26.6%**	**24.4%**	**5.8%**	**12.4%**	**3.9%**	**42 ± 19.1**

NWFQ Sub- Scale (3): Avoidance Behavior

Table 16entails that critical care nurses reported low level of avoidance behaviour as nearly 46.6% of their responses fell into the left segment of the scale which indicates the avoidance behaviour at work doesn't happen so frequently. The findings are further supported when this aspect score was calculated according to the authors' guidelines. Out of 100 points, the participants scored 51.6 points on average on this subscale which again confirms that they suffer low level of avoidance behaviour.

Table 16: Sub- Total Scores of NWFQ (3): Avoidance Behavior of the Critical Care Nurses (n=200)

	Almost never	Sometimes	Regularly	Often	Almost always	Mean ± SD
	0	1	2	3	4	
Statement	*n(%)*	*n(%)*	*n(%)*	*n(%)*	*n(%)*	
NWFQ36	Leaving for a moment so you can be alone.					
	21 (10.5)	54 (27.0)	6 (3.0)	16 (8.0)	103 (51.5)	2.63 ± 1.564
NWFQ37	Avoiding conversations with your colleagues.					
	21 (10.5)	37 (18.5)	23 (11.5)	55 (27.5)	64 (32.0)	2.52± 1.378
NWFQ38	Avoiding common areas.					
	27 (13.5)	48 (24.0)	22 (11.0)	45 (22.5)	58 (29.0)	2.30± 1.445
NWFQ39	Avoiding working together with your colleagues.					
	51 (25.5)	58 (29.0)	25 (12.5)	12 (6.0)	54 (27.0)	1.80± 1.556
	Disagree	**Disagree a little**	**Not agree not disagree**	**Agree a little**	**Agree**	
	0	1	2	3	4	
	n(%)	*n(%)*	*n(%)*	*n(%)*	*n(%)*	
NWFQ40	Making decisions I leave to my colleagues.					
	118 (59.0)	43 (21.5)	4 (2.0)	15 (7.5)	20 (10.0)	0.88± 1.343
NWFQ41	I often only do what is absolutely necessary.					
	67 (33.5)	23 (11.5)	17 (8.5)	21 (10.5)	72 (36.0)	2.04± 1.736
NWFQ42	Meetings and evaluations I avoid as much as possible.					
	57 (28.5)	14 (7.0)	12 (6.0)	31 (15.5)	86 (43.0)	2.38± 1.720
NWFQ43	I prefer to do only routine jobs.					
	71 (35.5)	19 (9.5)	19 (9.5)	23 (11.5)	68 (34.0)	1.99± 1.733
Overall	**27.1%**	**18.5%**	**8%**	**13.8%**	**32.8%**	**51.6 ± 24.4**

NWFQ Sub- Scale (4): Conflicts and Irritations with Colleagues

Table 17 implies that critical care nurses reported moderate level of conflicts and irritations with colleagues as more than 61.6% of their responses fell into the left segment of the scale which indicates the occurrence of conflicts and irritation with colleagues at work happen frequently (mostly between often and almost always). The findings above are further supported when this aspect score was calculated according to the authors' guidelines. Out of 100 points, the participants scored 62.2 points on average on this subscale which again confirms that they suffer from a moderate level of impaired work functioning in this aspect.

Table 17: Sub- Total Scores of NWFQ (4): Conflicts and Irritations with Colleagues of the Critical Care Nurses (n=200)

	Almost never	Sometimes	Regularly	Often	Almost always	Mean ± SD
	0	1	2	3	4	
Statement	*n(%)*	*n(%)*	*n(%)*	*n(%)*	*n(%)*	
NWFQ33	Friction between you and someone from your team.					
	23 (11.5%)	35 (17.5%)	22 (11.0%)	21 (10.5%)	99 (49.5%)	2.69± 1.502
NWFQ34	Being irritated during work					
	21 (10.5)	14 (7.0)	8 (4.0)	19 (9.5)	138 (69.0)	3.20± 1.388
NWFQ35	Tensions between you and your colleagues.					
	21 (10.5)	19 (9.5)	57 (28.5)	69 (34.5)	34 (17.0)	2.38± 1.184
	Disagree	**Disagree a little**	**Not agree not disagree**	**Agree a little**	**Agree**	
	0	1	2	3	4	
	n(%)	*n(%)*	*n(%)*	*n(%)*	*n(%)*	
NWFQ44	I am often astonished at how easy it is for others to upset me.					
	90 (45.0)	23 (11.5)	10 (5.0)	29 (14.5)	48 (24.0)	1.61± 1.698
NWFQ45	I often react irritated towards colleagues/ managers.					
	52 (26.0)	12 (6.0)	8 (4.0)	80 (40.0)	48 (24.0)	2.30± 1.543
NWFQ46	I often get angry about matters at work.					
	46 (23.0)	9 (4.5)	8 (4.0)	68 (34.0)	69 (34.5)	2.52± 1.556
NWFQ47	I often have conflicts with my manager.					
	43 (21.5)	11 (5.5)	7 (3.5)	36 (18.0)	103 (51.5)	2.72± 1.626
Overall	**21.1%**	**8.8%**	**8.6%**	**23%**	**38.5%**	**62.6 ± 28.9**

NWFQ Sub- Scale (5): Impaired Contact with Patients and their Family

Table 18 indicates that critical care nurses reported moderate level of impaired contact with patients and their family as nearly 63.4% of their responses fell into the segments of the scale which indicates they are facing sometimes difficulty to great difficulty in this aspect. The findings above are further supported when this aspect score was calculated according to the authors' guidelines. Out of 100 points, the participants scored 51.3 points on average on this subscale which again confirms that they suffer moderate level in this aspect.

Table 18: Sub- Total Scores of NWFQ (5): Impaired Contact with Patients and their Family of the Critical Care Nurses (n=200)

	No difficulty						Great difficulty	Mean ± SD
	0	1	2	3	4	5	6	
tatement	*n(%)*	*n(%)*	*n(%)*	*n(%)*	*n(%)*	*n(%)*	*n(%)*	
NWFQ10	Contact with patients and their family.							
	2 (1.0)	15 (7.5)	17 (8.5)	54 (27.0)	46 (23.0)	16 (8.0)	50 (25.0)	3.88± 1.588
NWFQ11	Showing sufficient empathy towards patients and their family							
	2 (1.0)	14 (7.0)	18 (9.0)	34 (17.0)	53 (26.5)	32 (16.0)	47 (23.5)	4.03± 1.559
NWFQ12	Taking time for your patients.							
	7 (3.5)	12 (6.0)	20 (10.0)	46 (23.0)	46 (23.0)	41 (20.5)	28 (14.0)	3.74± 1.561
NWFQ13	Competently handling aggressive patients or family members.							
	2 (1.0)	17 (8.5)	14 (7.0)	6 (3.0)	23 (11.5)	37 (18.5)	101 (50.5)	4.73± 1.709
	Almost never	**Once in a while**	**Sometimes**	**Regularly**	**Often**	**Very often**	**Almost always**	
	0	**1**	**2**	**3**	**4**	**5**	**6**	
	n(%)	*n(%)*	*n(%)*	*n(%)*	*n(%)*	*n(%)*	*n(%)*	
NWFQ22	I do not succeed in listening well to my patients.							
	23 (11.5)	55 (27.5)	63 (31.5)	12 (6.0)	9 (4.5)	18 (9.0)	20 (10.0)	2.32±1.817
NWFQ23	I notice myself that I treat patients too roughly.							
	45 (22.5)	39 (19.5)	83 (41.5)	6 (3.0)	3 (1.5)	2 (1.0)	22 (11.0)	1.89±1.743
NWFQ24	The tone of voice I use with my patients, or their family is not too friendly.							
	23 (11.5)	37 (18.5)	66 (33.0)	64 (32.0)	0 (0.0)	10 (5.0)	0 (0.0)	2.06±1.191
NWFQ25	I am curt towards patients or their family.							
	23 (11.5)	35 (17.5)	95 (47.5)	28 (14.0)	0 (0.0)	19 (9.5)	0 (0.0)	2.02±1.280
Overall	**7.9%**	**14%**	**23.5%**	**23.5%**	**11.3%**	**10.9%**	**16.8%**	**51.3 ± 20.8**

NWFQ Sub- Scale (6): Lack of Energy and Motivation

Table 19 reveals that critical care nurses have a moderate level of lack of energy and motivation as nearly 71% of their responses fell into the left segments of the scale which indicates they are at least feeling lack of energy on regular basis. The findings are further supported when this aspect score was calculated according to the authors' guidelines. Out of 100 points, the participants scored 51.3 points on average on this subscale which again confirms that they suffer moderate level of impaired work functioning in this aspect.

Table 19: Sub- Total Scores of NWFQ (6): Lack of Energy and Motivation of the Critical Care Nurses (n=200)

	Almost never	**Once in a while**	**Sometimes**	**Regularly**	**Often**	**Very often**	**Almost always**	**Mean ± SD**
	0	**1**	**2**	**3**	**4**	**5**	**6**	
Statement	*n(%)*	*n(%)*	*n(%)*	*n(%)*	*n(%)*	*n(%)*	*n(%)*	
NWFQ17	does not look forward to a working day/ shift?							
	22 (11.0)	14 (7.0)	18 (9.0)	21 (10.5)	1 (0.5)	44 (22.0)	80 (40.0)	4.09± 2.166
NWFQ18	starts the working day/ shift already moaning and groaning?							
	25 (12.5)	16 (8.0)	28 (14.0)	47 (23.5)	21 (10.5)	22 (11.0)	41 (20.5)	3.26± 1.981
NWFQ19	works without any enthusiasm?							
	26 (13.0)	29 (14.5)	29 (14.5)	17 (8.5)	35 (17.5)	26 (13.0)	38 (19.0)	3.18± 2.071
NWFQ20	I have great difficulty in getting through a working day.							
	21 (10.5)	19 (9.5)	8 (4.0)	22 (11.0)	21 (10.5)	65 (32.5)	44 (22.0)	3.87± 2.003
NWFQ21	I have the need for an extra day off to be able to get through the working week well.							
	21 (10.5)	9 (4.5)	5 (2.5)	21 (10.5)	17 (8.5)	51 (25.5)	76 (38.0)	4.30± 1.998
Overall	**11.5%**	**8.7%**	**8.8%**	**12.8%**	**9.5%**	**20.8%**	**27.9%**	**62.3 ± 28.6**

Part IV: Correlations between PSQI and NWFQ (N= 200 Critical Care Nurses)

Pearson Correlation: Total NWFQ correlate with PSQI

Table 20 reveals the Pearson correlation significant (2-tailed) between the "total score of NWFQ" and the seven components that comprise "sleep quality" include: "subjective sleep quality", "sleep latency", "sleep duration", "habitual sleep efficiency", "sleep disturbances", "use of sleeping medication", and "daytime dysfunction", along with "global sleep quality", and the six sub-scales of NWFQ: "cognitive aspects of task execution", "causing incidents at work", "avoidance behavior", "conflicts and irritations with colleagues", "impaired contact with patients and their family", and "lack of energy and motivation". The result showed a very strong positive correlation coefficient between sleep quality and NWFQ ($r = +0.840$). moreover, the relationship was significant ($p<.0001$). This demonstrates that each indicator is independent of the others. Indeed, each sub- component of sleep quality had significant positive correlations ($p<0.0001$) with NWFQ.

Table 20: NWFQ total and sub- total scores of the critical care nurse participants (n=200)

		NWFQ	Subjective sleep quality	Sleep latency	Sleep duration	Habitual sleep efficiency	Sleep disturbances	Use of sleeping medication	Daytime dysfunction	Globa sleep qualit
NWFQ	Pearson Correlation									
	Sig. (2-tailed)									
	N									
Subjective sleep quality	Pearson Correlation	0.758**								
	Sig. (2-tailed)	<0.001								
	N	200								
Sleep latency	Pearson Correlation	0.797**	0.845**							
	Sig. (2-tailed)	<0.001	<0.001							
	N	200	200							
Sleep duration	Pearson Correlation	0.530**	0.673**	0.700**						
	Sig. (2-tailed)	<0.001	<0.001	<0.001						
	N	200	200	200						
Habitual sleep efficiency	Pearson Correlation	0.112	0.197**	0.254**	0.568**					
	Sig. (2-tailed)	0.114	0.005	<0.001	<0.001					
	N	200	200	200	200					
Sleep disturbances	Pearson Correlation	0.833**	0.813**	0.778**	0.601**	0.209**				
	Sig. (2-tailed)	<0.001	<0.001	<0.001	<0.001	0.003				
	N	200	200	200	200	200				
Use of sleeping medication	Pearson Correlation	0.792**	0.759**	0.781**	0.612**	0.265**	0.754**			
	Sig. (2-tailed)	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001			
	N	200	200	200	200	200	200			
Daytime dysfunction	Pearson Correlation	0.801**	0.793**	0.747**	0.610**	0.211**	0.815**	0.663**		
	Sig. (2-tailed)	<0.001	<0.001	<0.001	<0.001	0.003	<0.001	<0.001		
	N	200	200	200	200	200	200	200		
Global sleep quality	Pearson Correlation	0.840**	0.909**	0.913**	0.810**	0.406**	0.894**	0.866**	0.867**	
	Sig. (2-tailed)	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	
	N	200	200	200	200	200	200	200	200	

Spearman Correlation: Sleep Quality Correlate with Total NWFQ

Figure 5 shows that there is a strong correlation between the participants' sleep quality and the level of their work function ($r=+0.680$, $p<.0001$) as per Spearman correlation test. As the sleep quality increases, this associates with an increase in the level of work function.

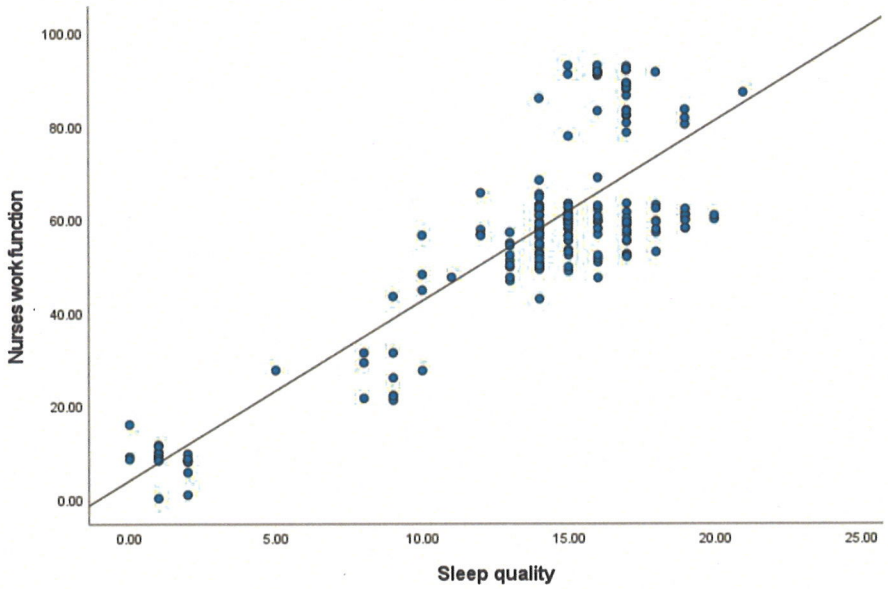


Fig.5 Spearman Correlation between the total NWFQ and PSQI of the critical care nurse participants (n=200)

Spearman Correlation: Sleep Quality Correlate with Each Subscale NWFQ

1: Sleep Quality and Cognitive Aspects of Task Execution and General Incidents

Figure 5 reveals a very strong positive and statistically significant relationship between the participants sleep quality and their reported level of impairment in cognitive aspect of task execution ($r= +0.86$, $r^2= 0.74$, $p<0.0001$). This finding indicates that as poor sleep quality increases, the level of impairment in the cognitive aspect of task execution increase.

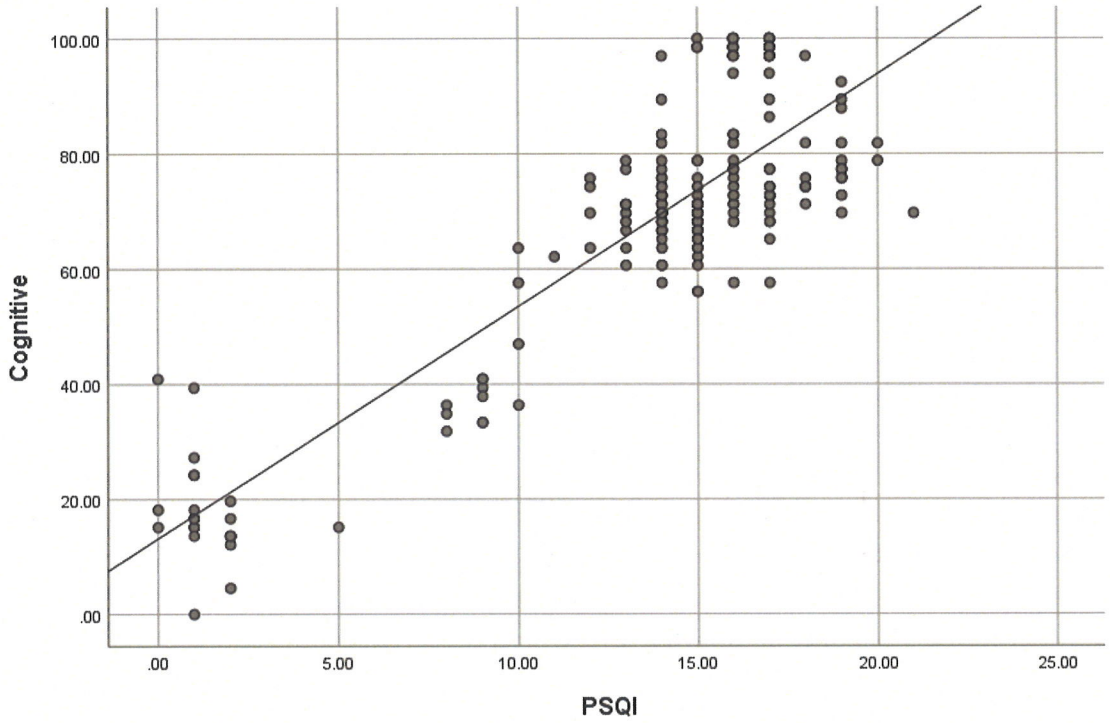


Fig. 5 Spearman Correlation between sleep quality and cognitive aspects of task execution and general incidents of the critical care nurse participants (n=200)

2: Sleep quality and Causing Incidents at Work

Figure 6 reveals a very strong positive and statistically significant relationship between the participants sleep quality and their reported frequency of incidents at their work ($r= +0.81$, $r^2= 0.65$, $p<0.0001$). This finding indicates that as poor sleep quality increases, the frequency of incidents at work increases.

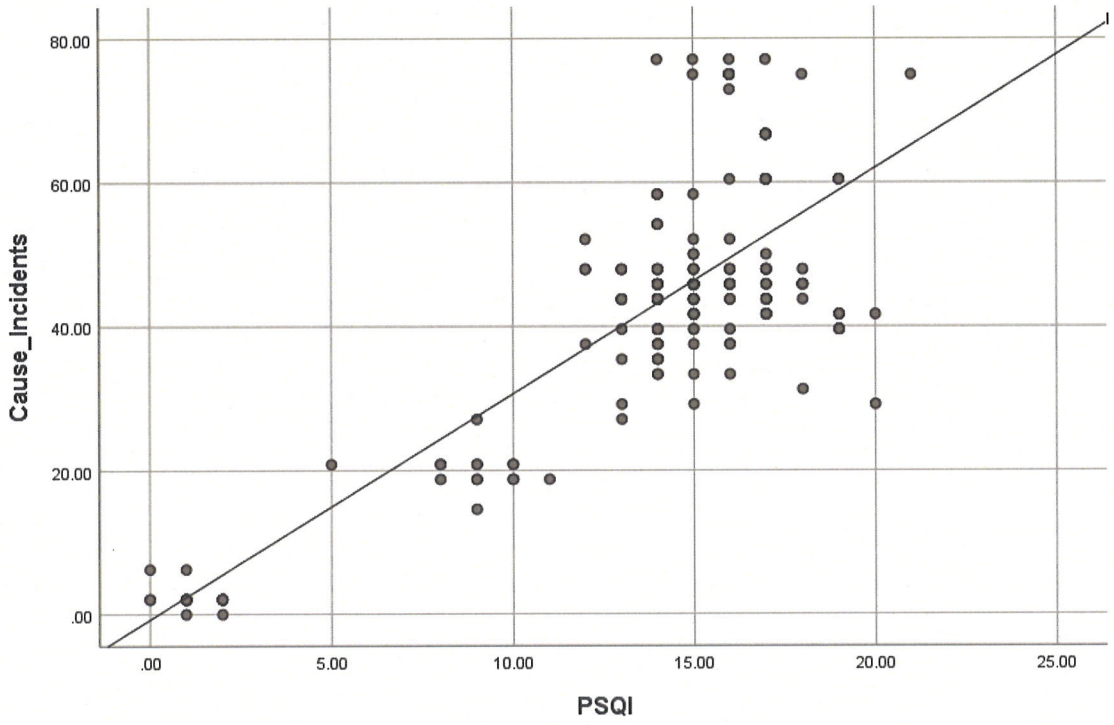


Fig. 6 Spearman Correlation between sleep quality and causing incidents at work of the critical care nurse participants (n=200)

3: Sleep Quality and Avoidance Behavior at Work

Figure 7 reveals a very strong positive and statistically significant relationship between the participants sleep quality and their reported frequency of incidents at their work ($r= +0.56$, $r^2= 0.31$, $p<0.0001$). This finding indicates that as poor sleep quality increases, the frequency of avoidance behavior at work increases.

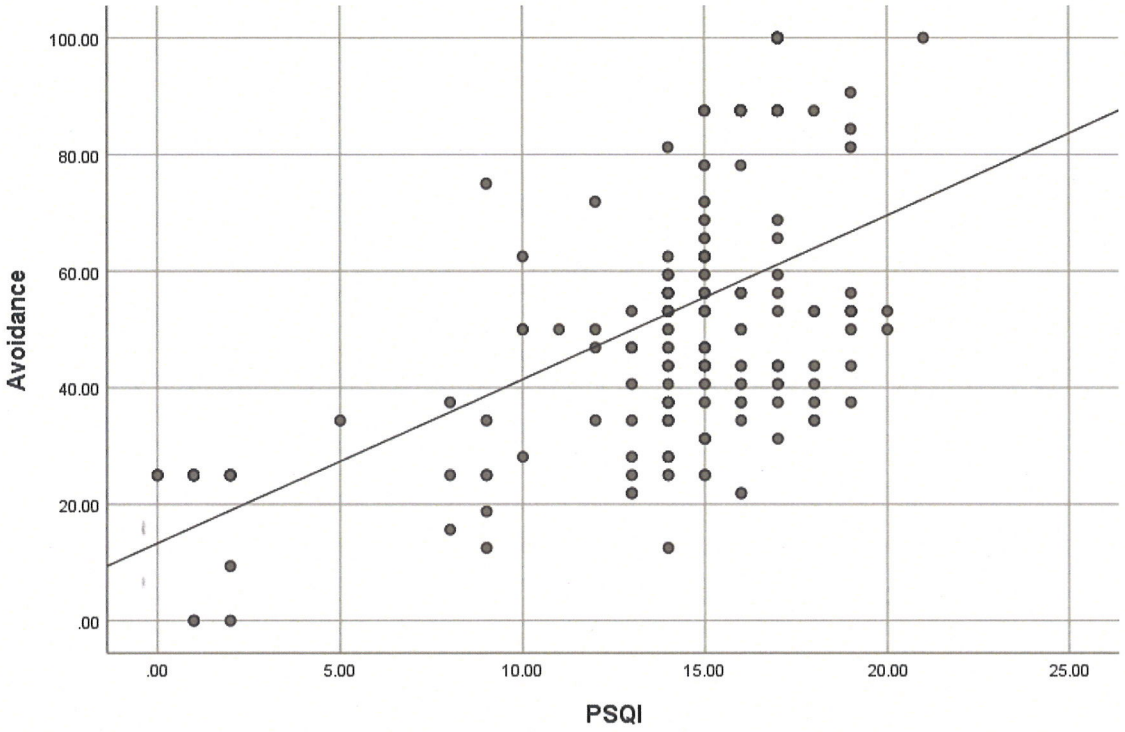


Fig. 7 Spearman Correlation between sleep quality and avoidance behavior at work of the critical care nurse participants (n=200)

4: Sleep quality and Impaired Contact with Patients and their Family

Figure 8 reveals a very strong positive and statistically significant relationship between the participants sleep quality and their reported Impaired contact with patients and their family at their work ($r= +0.76$, $r^2= 0.58$, $p<0.0001$). This finding indicates that as the poor sleep quality increases, the Impaired contact with patients and their family at their work increases.

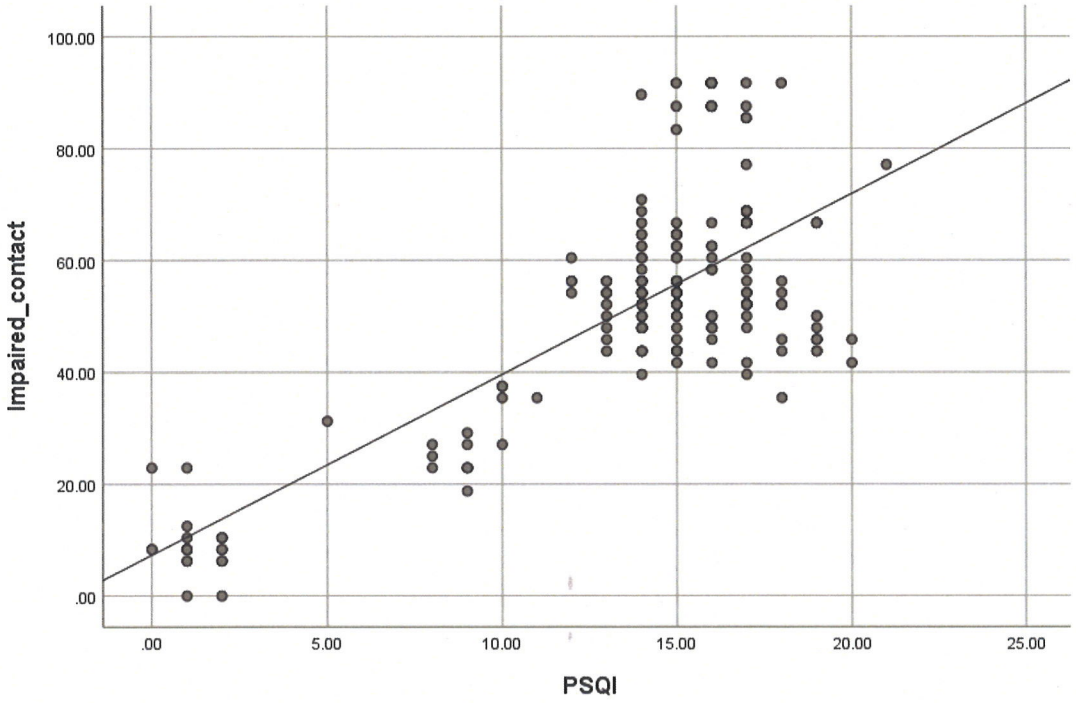


Fig. 8 Spearman Correlation between sleep quality and impaired contact with patients and their family of the critical care nurse participants (n=200)

5: Sleep Quality and Conflicts and Irritations with Colleagues

Figure 9 reveals a very strong positive and statistically significant relationship between the participants sleep quality and frequency of conflicts and irritations with colleagues at their work ($r= +0.76$, $r^2= 0.81$, $p<0.0001$). This finding indicates that as poor sleep quality increases, the frequency of conflicts and irritations with colleagues at their work increases.

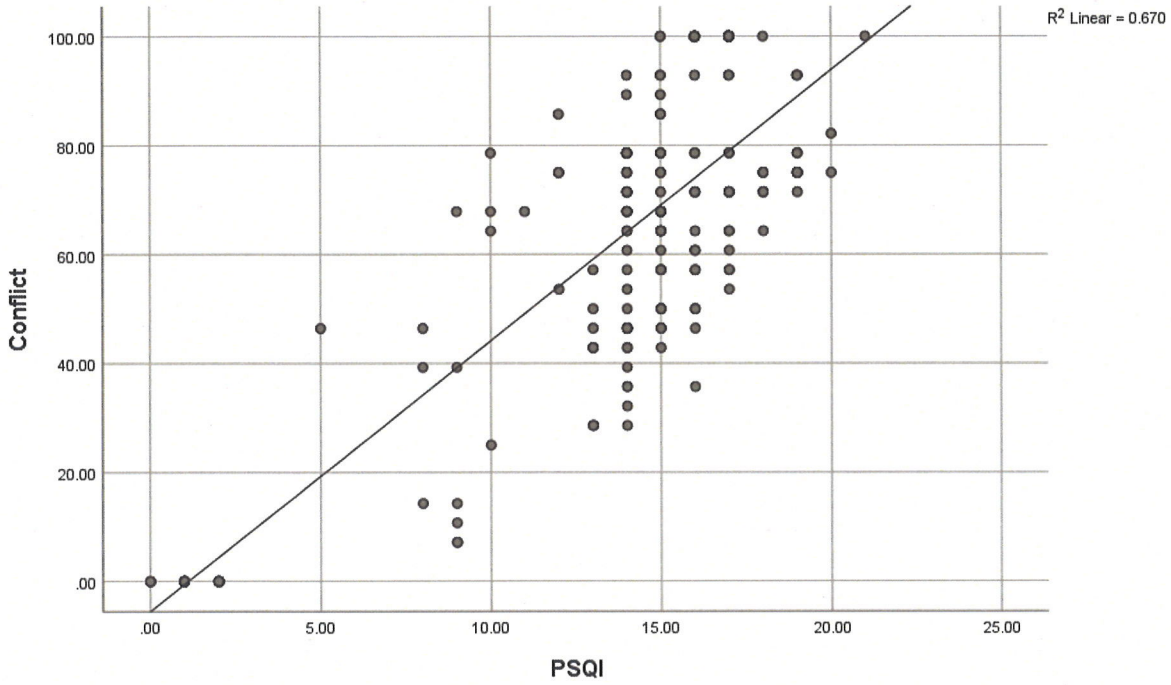


Fig. 9 Spearman Correlation between sleep quality and conflicts and irritations with colleagues of the critical care nurse participants (n=200)

6: Sleep Quality and Lack of Energy

Figure 10 reveals a very strong positive and statistically significant relationship between the participants sleep quality and frequency of conflicts and irritations with colleagues at their work ($r= +0.84$, $r^2= 0.71$, $p<0.0001$). This finding indicates that as poor sleep quality increases, the frequency lack of energy increases.

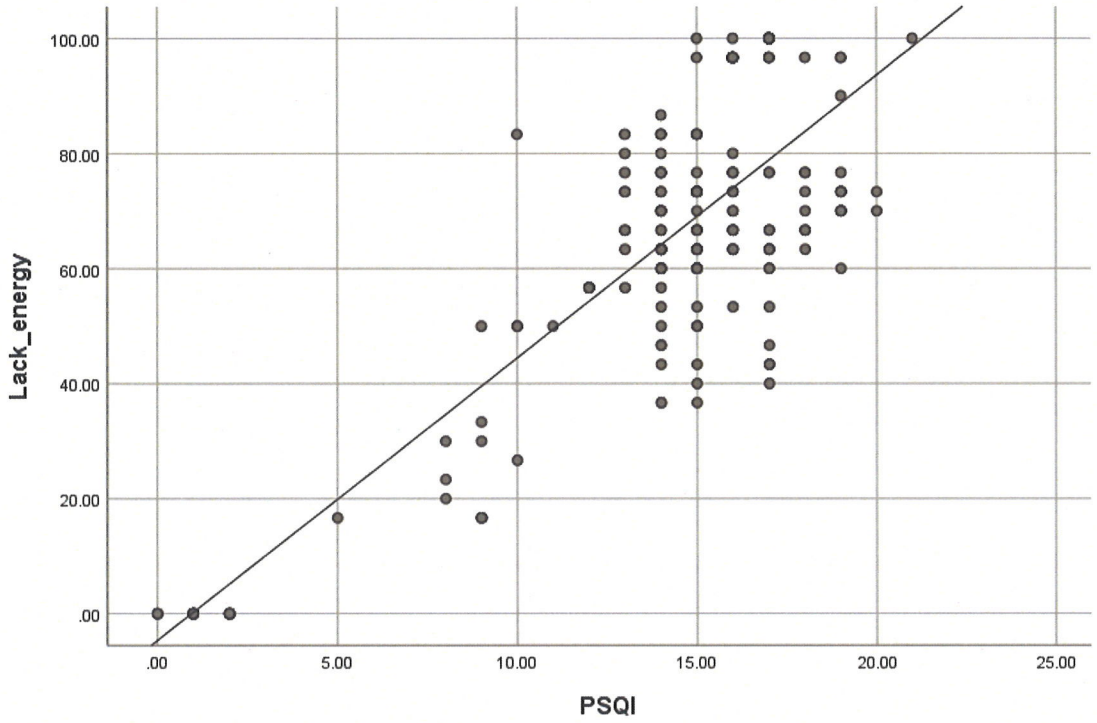


Fig. 10 Spearman Correlation between sleep quality and lack of energy of the critical care nurse participants (n=200)

Simple Linear Regression: Sleep Quality and NWFQ

Table 21shows simple linear regression analysis which revealed a highly significant regression model (F= 474.6, df=1, $p<0.0001$). Sleep quality exerts a very large effect on the nurse's work performance as reflected by a very high R^2= 70%. The regression equation indicates a 1-point increase in poor sleep quality is associated with a 0.84-point increase in impairment of nurses' work.

The relationship is further modeled using the simple linear regression between sleep quality and each sub- scale of NWFQ shows:

1: Simple Linear Regression: Sleep Quality and Cognitive Aspects of Task

Sleep quality exerts a very large effect on the cognitive aspect of nurses work as reflected by a very high R^2=74.4%. The regression equation indicates a 1-point increase in poor sleep quality is associated with 0.86-point increase in impairment of the cognitive aspect of nurses' work which revealed a highly significant regression model (F=577.4, df=1, p<0.0001).

2: Simple Linear Regression: Sleep Quality and Causing Incidents at Work

Sleep quality exerts a very large effect on the incidents frequency as reflected by a very high R2=65.4%. the regression equation indicates the 1-point increase in the poor sleep quality is associated with 0.81-point increase frequency in incidents at work which revealed a highly significant regression model (F=377.4, df=1, p<0.0001).

3: Simple Linear Regression: Sleep Quality and Avoidance Behavior

Sleep quality exerts a very large effect on the frequency of the avoidance behaviors reflected by a very high R2=31.7%. the regression equation indicates the 1-point increase in the poor sleep quality is associated with 0.56-point increase frequency avoidance behavior at work which revealed a highly significant regression model (F=93.4, df=1, p<0.0001).

4: Simple Linear Regression: Sleep Quality and Conflicts and Irritations with Colleagues

Sleep quality exerts a very large effect on the frequency of conflicts and irritations with colleagues reflected by a very high R2=66.8%. The regression equation indicates 1 point

increase in the poor sleep quality is associated with 0.81-point frequency of conflicts and irritations with colleagues which revealed a highly significant regression model (F=401.7, df=1, p<0.0001).

5: Simple Linear Regression: Sleep Quality and Impaired Contact with Patients and their Family

Sleep quality exerts a very large effect on the Impaired contact with patients and their family reflected by a very high R^2=58.2%. the regression equation indicates 1 point increase in the poor sleep quality is associated with 0.76 point increase Impaired contact with patients and their family which revealed a highly significant regression model (F=277.9, df=1, p<0.0001).

6: Simple Linear Regression: Sleep Quality and Lack of Energy and Motivation

Sleep quality exerts a very large effect on the frequency lack of energy and motivation reflected by a very high R2=71.3%. The regression equation indicates 1 point increase in the poor sleep quality is associated with 0.84 point the frequency lack of energy and motivation which revealed a highly significant regression model (F=401.7, df=1, p<0.0001).

Table 21: Simple Linear Regression of sleep Quality and NWFQ of the critical care nurse participants (n=200)

Dependent Variable	Independent Variable	Regression Results					
		R	R^2	F	B	t	P
Sleep quality	NWFQ	+0.680	0.70	474.6	0.84	21.8	p<.0001
	Cognitive aspects of task execution	+0.86	0.74	577.4	0.86	24.0	p<.0001
	Causing incidents at work	+0.81	0.65	377.4	0.81	19.4	p<.0001
	Avoidance behavior,	+0.56	0.32	93.4	0.57	9.7	p<.0001
	Conflicts and irritations with colleagues	+0.76	0.81	401.7	0.82	20.0	p<.0001
	Impaired contact with patients and their family	+0.76	0.58	277.9	0.77	16.7	p<.0001
	Lack of energy and motivation	+0.84	0.71	495.8	0.85	22.3	p<.0001

Part V: Correlations between Sociodemographic Characteristics and Total Scores of PSQI and NWFQ (N= 200 Critical Care Nurses)

Table 22 illustrates Independent Sample T-Test and One-Way ANOVA analysis of PSQI and NWFQ and sociodemographic characteristics (personal and professional). The analysis showed that the results of:

The socio-demographic variables diminishing sleep quality are gender, marital status, education level, length of clinical experience, designation, and shift work. PSQI scores, and gender were statistically significant (P = 0.034^). The female nurses reported significantly poor sleep quality than male nurses (14.0 ± 4.2 vs 12.4 ± 6.2, respectively). Married nurses also reported poor sleep quality compared to single and separate/divorced nurses (14.1 ± 4.4 vs 11.7 ± 6.2 and 12.6 ± 4.0, p = 0.020, respectively). Master holders reported significantly better sleep quality than those with diploma and bachelor's degrees (8.4 ± 6.4 vs. 12.6 ± 4.2 and 14.0 ± 4.8, p<0.0005).

The nurses who worked for more than 10 years reported poor sleep quality than those with ≤ 5 and 6 to 10 years' experience (15.4 ± 3.2 vs 14.2 ± 4.3 and 12.0 ± 5.7, p <0.0001, respectively). Both nursing supervisors and head nurses reported significantly better sleep quality than the registered nurses (2.7 ± 3.5 and 4.3 ± 4.9 vs 14.3 ± 4.1, p <0.0001, respectively). Interestingly, the more type of shift the nurses work, the worse is the reported sleep quality. Nurses who work only one shift reported normal sleep quality of 1.4±1 whereas those who work two shift had significantly poorer sleep quality measured 9.2 ± 0.9 (p<0.0001). Furthermore,

participants who work three shifts had reported even worse sleep quality with a statistically significant difference than the two mentioned groups (15.7 ± 1.8, $p<0.0001$).

Additionally, only four of the nurses' socio-demographic characteristics were found to be associated with NWFQ are education level, area of practice, designation, and shift work. Surprisingly, the nurses' educational level was associated with all the NWFQ aspects with those have master's degrees reported significantly lower work impairment in all of these aspects compared to the Bachelors' and diplomas' holders (26.7 ± 20.4 vs 58.8 ± 22.6 and 49.7 ± 16.1, $p <0.0001$, respectively). ICU and PICU nurses reported the highest impaired work function in NWFQ with statistically significant differences when compared to the other three units. Registered nurses significantly higher work impairment across NWFQ when compared with the supervisors and the head nurses (58.9 ± 20.2 vs 11.6 ± 10.7 and 24.8 ± 27.2, $p <0.0001$, respectively). Remarkably, the more variety of shifts the participants work, the higher the impaired work functions they suffer from it. Nurses who doing three shift schedule reported significant differences when compared to two and one shift schedule (64.6 ± 14.0 vs 33.6 ± 11.9 and 9.2 ± 5.2, $p <0.0001$, respectively).

Table 22: Mean Comparison Of PSQI and NWFQ with Demographic Characteristics of the Critical Care Nurses (n=200)

Characteristics	PSQI		NWFQ	
	Mean ± SD	p-value	Mean ± SD	p-value
Age Group (Years)				
21-30	13.1 ± 5.1	0.347~	57.8 ± 25.7	0.766~
31-40	13.0 ± 5.4		57.7 ± 26.0	
41-50	14.4 ± 4.4		54.3 ± 17.0	
51-65	13.6 ± 2.7		53.8 ± 17.7	
Gender				
Male	12.4 ± 6.2	0.034^	52.8 ± 27.8	0.181^
Female	14.0 ± 4.2		57.6 ± 20.1	
Marital Status				
Single	11.7 ± 6.2	0.020~*	51.6 ± 30.7	0.344~
Married	14.1 ± 4.4		57.4 ± 19.9	
Divorced/Separated	12.6 ± 4.0		55.7 ± 24.6	
Having Children				
Without	13.9 ± 4.6	0.817^	51.9 ± 18.0	0.134^
With	14.1 ± 4.3		58.0 ± 20.31	
Education Level				
Diploma	12.6 ± 4.2	0.005~*	49.7 ± 16.1	<0.001~*
Bachelor	14.0 ± 4.8		58.8 ± 22.6	
Master	8.4 ± 6.4		26.7 ± 20.4	
Area Of Practice				
Burns unit	12.9 ± 6.5	0.655~	47.9 ± 20.8	0.012~*
CCU	12.7 ± 4.7		49.3 ± 16.4	
ICU	13.8 ± 4.9		62.8 ± 27.2	
NICU	13.6 ± 5.0		52.6 ± 18.2	
PICU	15.4 ± 2.6		57.6 ± 11.2	
Length Of Clinical Experience (Years)				
≤ 5	14.2 ± 4.3	<0.001~*	60.1 ± 20.0	0.356~
6 to 10	12.0 ± 5.7		54.5 ± 28.8	
> 10	15.4 ± 3.2		55.5 ± 11.7	
Designation				
RN	14.3 ± 4.1	<0.001~*	58.9 ± 20.2	<0.001~*
Supervisor	2.7 ± 3.5		11.6 ± 10.7	
Head Nurse	4.3 ± 4.9		24.8 ± 27.2	
Work shift				
One Shift	1.3 ± 1.0	< 0.001	9.2 ± 5.1	<0.001
Two Shifts	9.2 ± 0.8		33.5 ± 11.8	
Three Shifts	15.6 ± 1.8		64.5 ± 13.6	

- CCU: Critical Care Unit, ICU: Intensive Care Unit, NICU, Neonatal Intensive Care Unit, PICU: Pediatric Intensive Care Unit, RN: Registered Nurses, PSQI: Pittsburgh Sleep Quality Index, NWFQ: Nurses Work Functioning Questionnaire.

^Independent Sample T-Test, ~One-Way ANOVA, *p-value ≤ 0.05

Part VI: Correlations between Sleep Quality (Good Sleeper Vs Bad Sleeper) and Sociodemographic Characteristics and Total Scores of NWFQ (N= 200 Critical Care Nurses)

Table 23 illustrates Independent Sample T-Test and Chi square test analysis of Sleep Quality (Good Sleeper Vs Bad Sleeper) and Sociodemographic Characteristics and Total Scores of NWFQ The analysis showed that the results of:

There is a relationship between gender and sleep quality. Females have significantly higher proportion of bad sleepers compared to males (93.1% vs. 80%, p=0.017) according to Chi Square test. Moreover, married critical care nurses have a significantly higher proportion of bad sleepers compared to singles (92.4% vs. 77.6%), and those experience 11 to 15 years have significantly higher bad sleepers than those working for the last 6 - 10 years (97.7% vs. 81.6%).

However, the is no relationship found between sleep quality score rate and age, level of education, and having children.

Finally, the results show a strong relationship between sleep quality rate and critical care nurses work performance; bad sleepers reported significantly higher impaired work dysfunction compared to good sleepers (61.9±16.2 vs. 8.3±3.2, $p<0.0001$).

Table 23: Comparison of Sleep Quality (Good Sleeper Vs Bad Sleeper) With NWFQ And Demographic Characteristics of the Critical Care Nurses (n=200)

Sociodemographic Characteristics		Sleep Quality				
		Good sleeper		Bad sleeper		
		Count	Row N %	Count	Row N %	P- value
Gender	Male	11	20.0%	44	80.0%	**0.017~***
	Female	10	6.9%	135	93.1%	
Age (Years)	20-30	5	12.2%	36	87.8%	
	31-40	11	14.9%	63	85.1%	
	41-50	5	6.8%	68	93.2%	0.151~
	51-65	0	0.0%	12	100.0%	
Education Level	Diploma	3	9.7%	28	90.3%	0.339~
	Bachelor	16	9.9%	146	90.1%	
	Master	2	28.6%	5	71.4%	
Marital Status	Single	9	22.5%	31	77.5%	**0.006~***
	Married	12	7.6%	145	92.4%	
	Divorced/Separated	0	0.0%	3	100.0%	
Children	No	10	17.2%	48	82.8%	0.072~
	Yes	11	7.7%	131	92.3%	
Experience (Years)	1	0	0.0%	5	100.0%	
	2-5	4	8.5%	43	91.5%	
	6-10	16	18.4%	71	81.6%	**0.006~***
	11-15	1	2.3%	43	97.7%	
	>15	0	0.0%	17	100.0%	
	Sleep Quality	**N**	**Mean**	**SD**		**<0.0001^***
NWFQ	Good sleeper	22	8.3386	3.28274		
	Bad sleeper	178	61.9251	16.27418		

PSQI: Pittsburgh Sleep Quality Index, NWFQ: Nurses Work Functioning Questionnaire.
^Independent Sample T-Test, ~ Chi square test, *p-value ≤ 0.05

Chapter V

Discussion

DISCUSSION

Overview

This chapter will further elaborate upon the results presented in Chapter 4 to provide a critical discussion of the findings and initial analysis, when set against the existing literature as discussed in Chapter 2. The sample and research questions which were studied will be described in more detail. The discussions surrounding the theoretical framework and research sample for this study will be addressed.

Discussion of Research Sample

The sample of critical nurse participants in this study was large and representative, so it was a credible sample of the target population. A sample plan that details the criteria for choosing participants and the number of people to include is a crucial step in increasing generalization capacity and the efficacy of statistical inference. A high response rate of 93% was achieved with 200 questionnaires completed and returned. There were no exceptions to the inclusion criteria among participants who returned questionnaires.

To summarize, the sample was comprised of more female than male nurses at a ratio of 29:11 with an age range of 21 to 65 years old and mean (SD) experience of 8.92 (±4.654) . Several studies involving the nursing population in relation to sleep quality and work performance provided a sociodemographic overview. However, female critical care nurses represent the majority of study sample making the results less generalizable to male critical care nurses. Previous studies have demonstrated the same finding (Huang et al., 2021, Park et al., 2018, Giorgi et al., 2018). The nursing being dominated by female nurses since beginning due to their hospitality nature. Therefore, there is a chance for gender biased.

Discussion of Key Findings

This study is the first to describe sleep quality and work performance among critical care nurses working shift – work in Bahrain. Although other studies looking at numerous predictors of sleep quality and work performance exist, this appears to be the first study to incorporate the combination of all of the potential predictor variables. As a result, new information concerning what variables may correlate, predict, and affect sleep quality and work performance may be gained directly and indirectly.

The integrated analysis of results revealed five key findings. The first key finding was that the total PSQI scores of all critical care nurses in this study was 13.6 ± 4.9 with prevalence of 89% indicating very poor sleep quality. The second finding was the sleep pattern based on individual components of PSQI, each with a possible range of 0-3, the highest observed ranges were subjective sleep quality 2.5 ±0.8, sleep latency 2.4 ±0.9, daytime dysfunction 2.3 ±0.9, sleep disturbances 2.2 ±0.9, sleep duration 2.1 ±0.7, use of sleeping medication 1.8 ±0.9, and habitual sleeping efficiency 0.3 ±0.5. With the exception of habitual sleep efficiency, these scores indicate some level of sleep difficulty in this study population. The third finding was the association factors that contribute to poor sleep quality among critical care nurses including: gender, marital status, education level, length of clinical experience, nursing designation, and shiftwork schedule. The fourth finding was the association factors that contribute to poor work performance among critical care nurses including: education level, area of practice, nursing designation, and shiftwork. The five finding was the positive correlation between sleep quality and work performance among shiftwork critical care nurses.

Collectively, these four key findings, which are discussed in detail in the following sections, shed light on significant aspects of sleep quality and work performance in shift work critical care nurses in Bahrain.

Key Finding 1: The Total Scores of Pittsburgh Sleep Quality Index

Our study revealed that sleep quality was poor on the whole, but worse in the nurse working three shift schedules. The majority (n=178, 89%) of nurses working in intensive care unit of one Bahraini government hospital had poor sleep quality, as evidenced by their global sleep quality scores of 5 or more (13.6 ± 4.9), , a salient finding. This study's conclusion is concerning because critical care nurses in Bahrain had a significantly greater prevalence of sleep problems than nurses in other countries: 43.1% to 86% among healthcare workers in Iran (Burton& Walker (2020); Bazrafshan et al. (2019); Akbari & Hajian (2015); Ghalichi et al. (2013)), 79.8% among night duty nurses in Korea (Park et al. 2018), 78% among shift work nurse in United Kingdom (UK) (McDowall et al., 2017), 69% of shift working nurses in India (Kaliyaperumal, 2017), 65.4% in Ethiopia (Berhanu et al., 2018), 30.8% to 56% in shifts work nurses in 2017 and 2018 in United States (Sleep health. Sleep Health (2020); National sleep foundation (2020)), 54.8%, to 83% in nurses in China (Deng et al. (2020); Sun et al. (2019); Dong et al. (2017)), 57% in nurses in Taiwan (Shao et al. 2010), 48.6% to 59.8% in nurses in Saudi Arabia (Al-Omran et al. (2019); Olawale et al. (2017); Alshahrani et al. (2017)), and 43.2% to 58.3% in nurses in Nigeria (Fadeyi et al. (2018); Kolo et al. (2017)).

The high prevalence of poor sleep quality among critical care nurses at one Bahraini government hospital may be related to overly demanding working conditions, particularly in intensive care units, such as nursing shortages, an excessive workload, long working

hours, fatigue, prolonged time away from family, fear of spreading the disease to the families, and workplace safety concerns. This can result in distress and burnout among the nursing staff members. The Eastern Mediterranean Region (including Bahrain) has a critically low number of nurses in practice: 15.6 nurses per 10,000 residents (WHO, 2019), which illustrates the need to teach and hire more local nurses (Renjith et al., 2021). Nurses suffering from sleep problems may be a result of this discrepancy. In the Eastern Mediterranean Region, nurse shortages and staffing levels are 17% compared to other regions (WHO, 2019). In view of nurse staffing levels, long shifts no longer serve as a statistically reliable indicator of patient safety (WHO (2019): Renjith et al.(2021)). Therefore, in order to alleviate nurses' sleep problems, it is critical to provide an adequate nursing environment.

An additional reason that may have contributed to the higher prevalence of poor sleep quality in this study compared to earlier studies is anxiety about the COVID-19 pandemic's contagiousness, whereas earlier studies were conducted before the outbreak. As the frontline providers of healthcare, nurses are deeply concerned about the COVID-19 outbreak. They face the danger of catching the virus and getting infected from their patients all the time. Additionally, they are under a great deal of pressure to protect their families and themselves from sickness. Poor sleep quality and short sleep duration could be caused by any one of these conditions. This conclusion is supported by a recent study done in Saudi Arabian (Meo et al., 2021).

Moreover, a high mean (±SD) global sleep quality score of 13.6 (±4.9) was found in this study. According to earlier research, nurses had significantly higher mean (SD) global sleep quality scores than the general population: Chinese nurses had scores of 7.32 (±3.24) (Dong et al., 2017) compared to the Chinese general population's 4.26 (±2.67) (Tang et al., 2017)

and Korean nurses had scores of 7.18 (±2.98) (Park et al., 2018) compared to the Korean general population's 5.8 (±3.4) (Lee et al., 2021).

Furthermore, it's probable that the discrepancy is due to the fact that nurses in past studies were only included if they worked during the day, whereas shift-workers were included in the current study. The findings suggested that working night shifts and taking on more shifts may considerably worsen nurses' sleep quality. Nurses who worked three shifts (morning, evening, and night) scored higher than those who worked one shift: 15.7 (±1.8) for three shift duty nurses compared to 1.4 (±1.0) for one shift duty nurses. Shiftwork sleep disorders, which reduce the quality of sleep, are strongly correlated with shift work.

Key Finding 2: The Individual Components of PSQI

Sleep patterns, based on PSQI component scores, provide evidence that sleep latency (how long to fall asleep), sleep duration (total hours of actual sleep per night), sleep disturbance (things that make it difficult to sleep), daytime dysfunction (trouble staying awake while daily life activities) and subjective sleep quality (good or bad) were "more severe" compared to the other component scores (Buysse et al. 1989).

Sleep Latency

The mean total sleep time to fall asleep was 54.3 ± 34.4 minutes. These results confirmed earlier findings in that nurses reported having difficulty in falling asleep easily and that their sleep tended to be light (Zeng et al. 2019; Axelsson et al. 2018; Tarhan et al. 2018; Alshahrani et al. 2017;).This was evidenced by a higher shiftwork critical care nurses sleep latency score of 2.4± 0.9. Presleep is typically a 10- to 30-minute stage before sleep begins (Kline, 2020). It can take an hour or more for those who have difficulty falling asleep to fall asleep (Kline, 2020), which is in line with the results of our study that critically care nurses

couldn't get to sleep within 30 minutes (n. 164, 82%) and needed more than 60 minutes to fall asleep (n. 124, 62%) determine prolonged sleep onset (sleep latency). Due to the prolonged time in bed, sustained sleep may have been compromised (Langenberg et al., 2016).

Moreover, in our study, sleep latency scores for nurses working rotating shifts schedule were higher than those for day shifts. This is in context to other published studies, whereby nurses that working night shift had higher sleep latency than those working in day or evening shifts (Mollazadeh et al. 2021; Stimpfel et al. 2020; Shiffer et al. 2018). One explanation for this might be that circadian rhythms are influenced by a shift work schedule. Due to that, it is difficult to adjust to a different sleep and wake schedule, which leads to difficulty falling asleep, staying asleep, and sleeping at the right time.

Sleep Duration

Sleep duration is one of the elements of sleep quality, and therefore, is an important aspect to note. Our results indicated the mean total sleep time was 4.9 ± 1.1 hours in line with findings from other studies (Kline, 2020; National sleep foundation, 2020; Langenberg et al. 2016). The National Sleep Foundation, the American Academy of Sleep Medicine, and the Sleep Research Society recommended that sleep duration per night for adults aged 18 to 64 is 7 to 9 hours for optimal health (National sleep foundation, 2020; Chaput et al. 2018).Yet, many studies suggest that average sleep quantity have decreased from 9 hours in 1910 to as barely 4 to 6 hours on working days in 2018 (Kline, 2020; Sleep health, 2020; National sleep foundation, 2020; Langenberg et al. 2016), indicating that individuals are obtaining insufficient sleep on working day, then trying to "catch up "on off days (Di Muzio et al. 2020).

A study conducted by Di Muzio et al, in 2019, revealed that 92% of nurses who work on day-evening regular shifts achieve four hours of restorative sleep a night while for night workers, only 6.3% manage to sleep for at least four hours which is lower than the recommended sleep duration of 7 to 9 hours (Di Muzio et al. 2019). It was highlighted that sleep quality and quantity is significantly lower for those working in rotating shift works (Di Muzio et al. 2019; Di Muzio et al. 2020) similar to our study findings. Additionally, according to Wheaton and Shokey (2017), healthcare practitioners represent two of the five occupational groups with the highest prevalence of poor sleep quality and short sleep duration (Shockey et al. 2017).

Similarly, in a study done by Stimpfel et al. in 2020, results show that nurses who worked consecutive night shifts only slept for 5.68 hours between nights and 6.79 hours between days. In non-working days, nurses recovered with over 8 hours of sleep. There is an increasing risk of sleep disorders, insomnia, and excessive daytime sleepiness due to night shift work among healthcare workers (Booker et al., 2018; Rosa et al., 2019). Nurses sleep less than recommended before shiftwork on average; this may be attributed to the fact that night shift work increases the risk of sleep disorders, insomnia, and excessive daytime sleepiness. A family background, such as marriage, can contribute to insomnia related to increased family responsibilities (Booker et al., 2018).

Sleep Disturbances

Sleep disturbances was prevalent in our study with mean (SD) of 2.2 ±0.9, the highest perceived interruptions while sleep among shiftwork critical care nurse were waking up in the middle of the night or early morning and experiencing pain 82% (n. 164) three or more times per week.

Study finding demonstrated that sleep disturbances increased specifically among shift-work critical care nurses, as well as the highest percentage of involvement. This finding is in line with previous studies done by Marques et al. in 2020; Mirmohammadi et al. in 2019 and more recent study Mollazadeh et al. in 2021 which reported that night shift work significantly impacts sleep disturbance in general. However, to the best of researcher knowledge, there is no research found examine specifically the most disparage interruptions while sleep among shiftwork critical care nurses.

Nursing staff personnel may experience pain, anxiety, and burnout as a result of this poor sleep quality due to overly demanding working conditions, particularly in intensive care units, such as nursing shortages, an excessive workload, long working hours, fatigue, prolonged time away from family, fear of infecting family members, and workplace safety concerns. Bahrain (Eastern Mediterranean Region) has an alarmingly low number of practicing nurses: 15.6 nurses per 10,000 people (WHO, 2019), emphasizing the need to educate and hire more local nurses (Renjith et al., 2021). Nurses who are having trouble sleeping may be suffering from this disparity. The convergence of studies on the subject of insufficient sleep quality reveals a global problem that may or may not be tied to differences in ethical origins, cultures, geographic region environment, economics, and genetics between populations.

Additionally, the disparity is likely related to the fact that nurses were only included in previous research if they worked during the day, whereas shift workers were included in the current study. Working night shifts and taking on extra shifts, according to the data, may significantly impair nurses' sleep quality. Nurses who worked three shifts (morning, evening, and night) outperformed those who worked only one shift: 15.7 (±1.8) for three shift duty nurses versus 1.4 (±1.0) for one shift duty nurses. Shiftwork sleep disorders, which diminish

sleep quality, are significantly linked to shift work similar in other studies (Huang et al. 2021; Di Muzio et al. 2020; Marques et al. 2020; Kang et al. 2020; Booker et al. 2019; Sun et al. 2019; McDowall et al. 2017; Fadeyi et al. 2018; Kecklund & Axelsson, 2016).

Use of Sleeping Medication

The findings show that nurse use sleeping medication with mean (SD) 1.8 ±0.9. These results are not in line with Park et al. (2018) study. They showed that the use of sleeping medication had the lowest PSQI score 0.06 ±0.32. The decision not to take sleeping medication may have been influenced by nurses' professional understanding of drug usage, effects, and negative effects, as well as drug dependence, and culture.

Daytime Dysfunction

We found that nurses who work night shifts experience pathologic levels of sleepiness. As determined by PSQI, found that an estimated 43% of the critical care nurses surveyed reported trouble staying awake while driving, eating meals, or engaging in social activity three or more times per week, and 43.5% reported having problem to keep up enthusiasm to get things done Once or twice a week. This prevalence was particularly high among critical care nurses doing three shiftwork schedules, especially night shift. This is in resemblance to other published studies; a study done by Huang et al. in (2021) concludes that one of the most common complaints among shift work nurses is falling asleep when working nights (Huang et al. 2021). Almost 35.5% of the nurses working shift work reported falling asleep during the night shift at least once a week, and only 20.7% of nurses working only day-evening shifts (Huang et al. 2021; Hughes, 2008). Another survey found that nearly one-fifth of nurse working shifts, mostly night duty, reported struggling to stay awake during their shift (Habiburrahman et al. 2021). Therefore, it is critical to address poor sleep quality

in nursing as they are at high risk of sleep deprivation and making errors that affect patient care and safety.

Overall, the individual components of PSQI scores indicate some level of sleep difficulty among critical care nurses working shiftwork. One more clarification for this might be that because our nurses had no prior sleep hygiene training, different ICU environments, prior nursing sleep hygiene training, and different inclusion criteria. may account for the difference in results.

Key Finding 3: The Contributing Factors to Poor Sleep Quality

To help identify the risk of poor sleep quality in shift-work critical care nurses, a number of variables have been collected by sample characteristics form. The reliability and significance of each level of variable have been established by the available evidence (Pappa et al., 2021). Yet, insignificant research has been finalized on factors contributing to sleep quality specific to critical care nurses; much more literature is related to nursing in general. The contributing factors to poor sleep quality includes:

Demographic factors and Sleep Quality: Female Gender, Marriage, and Older Age

In the current study, it was discovered that those who were female, and married had statistically significantly worse sleep quality than those who single. This finding is in accordance with other studies (Chang & Yang, 2020; Shao et al. 2010) which concluded that poor sleep quality is more prevalent among married female gender than male. Equally, Lajoie et al. (2015) have presented gender differences that are associated with disturbed sleep – wake cycle, and poor sleep quality (Lajoie et al. 2015). Furthermore, a study done by Langenberg et al. in 2016 indicated that female nurses had poorer sleep quality in all shift types (Langenberg et al. 2016). In contrast, Fadeyi et al. 2018 and Akbari et al. 2016 don't

find any major correlation between gender and sleep quality (Fadeyi et al. 2018; Akbari et al. 2016)

Compared to males and single person, the complaints about sleep problems increased with female gender and married person may for their physiological differences and taking care of their family members and work commitments. The study's findings that there are differences between the sexes may be explained by the proportion of male nurses who work in critical care.

In this study, age wasn't statistically significantly with poor sleep although older age quality is connected to a decline in sleep quality as well as a gradual shortening of sleep quantity (Chaput et al. 2018). On the contrary, according to Pérez-Fuentes et al. (2019) and Salari et al. (2020), increasing a nurse's age was linked to worsening sleep quality. They highlight that as nurses getting older, their sleep duration shortens, and their sleep quality deteriorates.

Level of Education and Sleep Quality

Nurses with master's degrees were more likely to have good sleep quality than nurses with diploma and bachelor's degrees (8.4 ± 6.4 vs. 12.6 ± 4.3 and 14.1 ± 4.8, $p<0.0001$). As opposed to that, Omar et al., 2022 found that nurses with higher educational level experienced poor sleep quality. Although the studies suggests that nurses who continue postgraduate education have improved critical thinking and decision-making skills, leadership qualities that enable them to confront inferior practice, and the competences required for advanced clinical practice roles (Clark et al. 2015). A study by Revathi et al. in 2016 concluded that education plays an important role in sleeping behavior change, thus increased sleep quality (Revathi et al. 2016).

There is no doubt that development and renewal of self through nursing profession make advanced nurse practice direct at marking, what caring is, and how caring occurs from many perspectives, and through reviewing of evidence-based literature and practice. Starting by understanding self (professionhood) and what is required of nurses by the nursing profession (professionalism) which exist together, each informing the other accounting for large numbers of biological, behavioral, social, environment and economic factors and the complex interaction between them promote a positive balance for the best possible client outcomes (Grace & Uveges, 2022).

Length of Clinical Experience and Sleep Quality:

This study found that having more work experience of at least 6 years may be connected with better sleep quality in line with study done in Korean and Egypt (Park et al. 2018; Omar et al.2022) . Longer experience in working shift duties experience has been shown to reduce the risk of poor sleep quality by assisting workers in adapting to their surroundings. However, a longer history of shift work was linked to poorer sleep quality (Giorgi et al. 2018).

Shift work and Sleep Quality

Working shifts was an independent risk factor for sleep deprivation and decreasing work performance. The timely, efficient, and safe delivery of patient care depends on shiftwork (Chang & Peng, 2021). However, shift work-related sleep deprivation may severely lower sleep quality and nurse performance. Nurses working shift work were more likely to have poorer sleep quality than nurses working one or two shifts duty (15.7 (±1.8) vs 1.4 (± 1) and 9.2 (± 0.9), $p<0.0001$). In support, the literature reports a significant number of nurses had compromised sleep quality (Jotheeswari et al. 2020; Bazrafshan et al. 2019; Burghi et al.

2013), particularly shift work nurses had a high degree of sleep deficiency (Marques et al. 2020; Kang et al. 2020), and the night nurses had especially lower sleep quality comparing to another shift (Chang & Peng, 2021; Di Muzio et al. 2020; Kim et al. 2019).

The sleep quantity of shift work nurses was less than non- shift work nurses (Westwell et al. 2021). In a study by Niu et al. in 2017, nurses working shift work showed lower sleep efficiency, and used more sleep medication (Niu et al. 2017). Another two studies concluded that most shift work nurses have high sleep latency especially after the night shift, they struggle to properly cycle into the deeper sleep stages (Mollazadeh et al. 2021; Demir& Arslan, 2011).

However, the above findings are in contrast to Beebe et al. (2017), and McDowall et al. (2017), which showed that neither did the type of shift schedule have any significant association with poorer sleep quality (Beebe et al. 2017; and McDowall et al. 2017). The difference is likely caused by the fact that these findings are limited by the shiftwork pattern (12hrs vs 8hrs) and the number of nurses participants and in the study. Likewise, the trigger was not simply noises or various disturbance during the daytime. A system of irregular rotating shift works can disturb nurses' circadian rhythm and motive sleep deprivation (Chang & Peng, 2021). Therefore, the sleep debt (sleep loss) can only be restored during their nonworking days; it is probably due to this, that more than two days off after night shifts are needed, to improve nurses' quality of sleep and their mental health (Sun et al. 2019; Choi & Joo, 2018)

Nursing Designation and Sleep Quality

Furthermore, nurse designation has been found to be associated with sleep quality in this study. Both nursing supervisors and head nurses reported significantly better sleep quality than the registered nurses (2.8 (± 3.6) and 4.3 (± 4.9) vs. 14.3 (± 4.2), $p<0.0001$), which previous studies have not found any association between them. One possible explanation for this disparity is because nursing supervisors and head nurses are more likely to work one shift duty, mostly morning duty.

These characteristics are mediated by person chronotype, morning type individuals sleep and awaken early, feeling active without consumption of a stimulant such as caffeine (Mollazadeh et al. 2021). On the other hand, Evening type individuals sleep late at night and have problem in waking up within the morning; they become stimulated at the highest degree within the afternoon, and therefore show higher performance all through the afternoon and nighttime hours (Mollazadeh et al. 2021; Demir, & Arslan, 2011). Varies studies have established that nurses with a morning type had better sleep quality between morning shifts (Reiter et al. 2019), while evening type was associated with irregular sleep and frequent awake during their sleep, leading to insufficient sleep duration and poor sleep quality (Mollazadeh et al. 2021).

However, Tu et al. (2020) did not discover any proof that sociodemographic characteristics such as (age, marital status, level of education, working years, etc.) were significantly associated with poor sleep quality. Sleep quality, which is impacted by an irregular shift pattern, can have an impact on work performance in terms of productivity, efficiency, job execution speed, and supervision (Giorgie et al, 2017). Along side with other risk factors.

Key Finding 4: The Contributing Factors to Poor Work Performance

In this study, it was observed that female nurses with children reported significantly higher impaired contact with patients and their family. This outcome might be explained by psychological and physiological characteristics unique to women. Female nurses must balance their work and family commitments. As a result, they face greater life pressure than male nurses. This could be due to females having more duties for taking care of the house and children, as well as doing the largest portion of housework, which can aggravate anxiety and depression (Chang & Yang, 2020). As a result, they may be more easily influenced in some aspects of their work performance.

With regards to work-related characteristics, intensive care unit (ICU) and pediatric intensive care unit (PICU) nurses ($p=0.012$) reported the highest impaired work function when compared to the other three units. This is in line with the finding of Momen et al. in 2016 which reported that majority of ICU nurses had moderate 66.1% to 27.2% low quality of work life (Momeni et al. 2016). This may directly to ICU can be an extremely stressful environment and demanding high nursing care taking varies multiple life threating diseases. Also, both nursing supervisors and head nurses reported significantly better sleep quality than the registered nurses (2.8 ± 3.6 and 4.3 ± 4.9 vs. 14.3 ± 4.2, $p<0.0001$) and lower work functioning impairment when compared with the supervisors and the head nurses (24.9 ± 27.3 and 11.7 ± 1 0.7 vs 58.9 ± 20.3, $p<0.0001$). Different studies reported that poor sleep quality and low work performance were more frequent in registered nurses than nurse managers (Stimpfel et al. 2020; Booker et al. 2019; Rahimi-Moghadam et al. 2017; Kecklund & Axelsson, 2016), which is consistent with the finding of the present study. The possible factors for the difference are that registered nurses have shiftwork, direct contact with patients and their families, high workload, and high work stress than non-shift nurses.

In this regard, Rahimi-Moghadam et al. demonstrated that one shift work nurses were more likely to have a high job satisfaction, less work-related incidents, high sleep quality, and less mental and physical illnesses than shift work nurses (Rahimi-Moghadam et al. 2017).

Key Finding 5: The Correlation of Sleep Quality and Work Performance

In the present study, on shift-work nurses' sleep quality and work performance correlated positively. A short duration of sleep is statistically significantly associated with lower ratings of quality of nursing care and patient safety (Stimpfel et al. 2020). The seven components comprising sleep quality showed a strong significant associated with lower nurses' work functioning questionnaire ($r = +0.680$, $p<.0001$). This finding is in line with Giorgie et al. in 2017 reported that work performance related to productivity, efficiency, task execution speed and supervision, can be affected by sleep quality (Giorgie et al. 2017). Huang et al. (2021) and Gómez-García et al. (2016) identified that nurses with good sleep quality; have greatly willingness and ability to provide quality health care services and directly affect the success of health care interventions. While sleep-deprived nurse has been cited as a reason for unscheduled absenteeism during their work performance (Almadani et al. 2020; Abeer et al. 2018). Nursing performance may be affected as a result of poor sleep (Park et al. 2018). A short sleep duration is statistically strongly linked to worse ratings of nursing care quality and patient safety (Stimpfel et al. 2020). It is indicated that since statistical significance was found in the current study, this could result in work accidents or medical errors.

In this regard, a study by Xiong et al. (2021) found that shift workers who reported an error or near miss nursing service had significantly lower sleep quality compared to non-shift nurses who did not record an error or near miss. Similarly, a study done by Harris et al (2019) found a positive correlation between work-related accidents, near-accidents, and dozing off

at work. It also found that poor sleep quality and night work relate to work-related accidents. The study in line with our result found a significant causal link between poor sleep quality and night shift employment on harming nurses, patients, other healthcare professionals, and medical equipment.

Hence, to ensure that nurses work at a high level, it is important to make sure they are inspired, given enough time to rest to increase sleep quality, taught, and given the right motivations and promotions.

Summary

This study describes the effects of shift work in a sizable sample of nurses and supports earlier findings using the PSQI and NWFQ. Particularly, compared to daytime shifts, nurses working quickly rotating shifts reported feeling sleepier and more exhausted just after the end of the night shift. Nurses working rotating night shifts perform less well on the job than those working day shifts, which is related to the impacts of sleepiness and fatigue. We have carefully accounted for any factors that could affect how alertness and performance are affected during shiftwork scheduled. Importantly, only nurses who had poor sleep (>5 PSQI scores) showed a decline in sustained attention after the night shift. . More of a connection between the quality of sleep and work performance was seen for women, education level, designation, and years of experience.

Chapter VI

Conclusion, Limitation and Recommendations

CONCLUSION, LIMITATION AND RECOMMENDATIONS

Overview

The following sections will focus on the conclusions, and implications of this thesis. Identified limitations and weaknesses of the research will also be discussed, followed by recommendations for future research. Finally, the main conclusions of this research will be summarized.

Conclusion

Based on the findings of the present study, it is concluded that poor sleep quality is very prevalent among shift work critical care nurses in Bahrain, and the correction revealed a strong positive and statistically significant relationship between sleep quality and work performance. Working shifts, female gender, years of work experience, nursing designation, and education level all had a significant impact on sleep quality.

Thus, worksite healthy sleep program including training and education services needed to detect, prevent, manage, and follow up nurses with poor sleep quality, in order to maintain nurse's wellbeing and health caused by shiftwork.

Limitation

The researchers faced the challenge of potential threats to study that were considered were the cooperation of critical care nurses to be compliant with study questionnaires. Also, consideration was given that some critical care nurses may have attitudes and preconceptions about expectation of sleep quality, work performance, and shiftwork which could affect the study. For example: the nurse is supposed to sleep less working shift duty.

The study has limitations related to the:

- The subjects selected from only one government hospital, so the result of this study may not be representative of the critical care nurses from non-government hospitals in Bahrain. Thus, generalizability of the study result is limited,
- and the limitation of a questionnaire-based tool study is that the information that will be gathered may be influenced by subject's response bias because of the self-reporting nature of the questionnaire. Which means the nurses may give responses that appear more desirable about their practice because of the way it might reflect on nurses.

Recommendations

Based on the finding of the current study, the following recommendations are suggested:

- Implement a policy to screen for sleep quality at each required yearly fitness check-up at occupation health clinic especially shift worker.
- Worksite healthy sleep program including training and education services needed to detect, prevent, mange, and follow up nurses with poor sleep quality.
- Integrate sleep hygiene practices among nursing students to prepare them to shift – working duty from the beginning.
- Modify the workplace health programming to promote alertness with environment interventions including napping, availability of stimulants such as caffeine, bright lighting, maintaining the temperature, two off days after a night shift, recruit sufficient number of nurses to fill the shortage of nurses and control noise.

For further study:

- Study the quality of sleep, work performance, and psychological stress among shift-work critical care nurses.
- Study the quality of sleep, work performance, and anthropometric information among shift-work critical care nurses.
- Study the quality of sleep and work performance among night critical care nurses and other shift workers.
- Study the factor affecting the shiftwork among critical care nurses and other shift workers.
- Study to test hospital – based interventions such as mid-shift naps and its effect on nurses' sleep quality and work performance.
- Study of sleep hygiene practice and sleep quality among shift work critical care nurses.

Summary

In summary of this research study, it can be seen that there is a strong and direct relationship between sleep quality and work performance. The main findings of this study are in complete agreement with previous research, and they go further to account for the fact that relationships and correlations are increased in intensive care units. Poor sleep quality phenomenon had also been observed in the literature; however, the primary research in this study further confirmed its existence in Bahrain in one government hospital in in intensive care setting. Finally, the advice outlined above allows organizations to precisely target their nurses aimed at increased sleep quality.

Chapter VII

Summary

This research study, with its quantitative, descriptive, cross-sectional survey methods design, allowed the researcher to obtain knowledge and a comprehensive understanding of nurses' sleep quality and work performance during their shifts in intensive care units. Overall, it is apparent that the five key findings identified in this research are related through the core issue of nurses' sleep quality and work performance. Findings identified areas representing research and practice gap with respect to shiftwork critical care nurse sleep quality; widespread prevalence of poor sleep quality that correlated positively with lower work performance, and prevailing shiftwork that influenced sleep quality and work performance among shiftwork nurses working in intensive care units, such that some nurses' sleep quality was worse according to shiftwork schedule particularly night shift; and finally, nurses, who have three shiftwork schedule encountered a great deal of suffering and poor sleep quality on a daily basis and lower work performance in the intensive care unit environment, expressed signs of physiology and psychological symptoms and may possible be at risk for self-injury and patient care errors.

There are numerous studies whose result support and inform the key findings in the present research study, as noted in the foregoing discussion. Moreover, this study has been able to identify some of the ways that are implicated in sleep quality among nurses. The recommendation offers insights that may also have important applicability to nurse sleep management in other geographic regions, in the ICU as well as in other units. Implementation of these strategies has the potential to ameliorate not only the poor sleep quality of nurse, but also to contribute to the important goal of reducing the significant and costly burden of health care and patient safety errors.

ARABIC SUMMARY

الإطار العام : الانسان حتى يعمل لا بد له من قوة جسدية ولا تكتمل إلا بالنوم الجيد فمن الطبيعي إذا الممرض لا ينام بشكل جيد سيقلل ذلك من أداءه في عمله في مقابل النوم الجيد الذي يعطيه قوة وطاقة للعمل بكل كفاءة، وعلى الرغم من أن الجميع يسلم لهذه المعلومة بديهيا قبل علميا و يسلم لصحتها الجاهل قبل العالم ، إلا أننا لم نشهد بحثا اجرائيا شاملا قد طرح في مملكتنا الغالية مملكة البحرين لإيجاد الرابط بين النوم وأداء الممرضين .

لا يخفى عليكم أهمية النوم السليم ذي الجودة العالية وإيجابياته المتمثلة في تكوين مناعية حصينة ، ودعم أداء العمل، وسلامة العمل. هذه الحاجات مهمة جدا لجميع العاملين و بشكل خاص في من يمتهن مهنة التمريض لأنهم يواجهون نمط تحول مختلف لساعات العمل ، فتكثر لدينا المخاطر المرتبطة بجودة النوم فلدينا مشاكل متمثلة بالنوم السيء كالمشكلات المعرفية، وتغييرات المزاج، وزيادة الاكتئاب، وزيادة الانفعال السلبي، وانخفاض أداء العمل، وانخفاض الدافع، وزيادة مخاطر عدم سلامته المهنية، والتغيرات الفسيولوجية .

أهداف البحث : أن يتم تحديد رابط خط أساس يمثل جودة النوم وأداء الممرضين في العمل مع نظام عمل غير ثابت في وحدة العناية القصوى بالسلمانية مملكة البحرين ، وما إذا كان هناك علاقة بين جودة النوم وأداء العمل في المستشفيات الحكومية في مملكة البحرين .

الطريقة: تم استخدام مؤشر بيتسبرغ جودة النوم (PSQI) واستبيان وظيفة عمل ممرضة (NWFQ) في دراسة استقصائية متشابكة من قبل عينة عشوائية بسيطة من 200 ممرض وممرضة يعملون في خمس وحدات العناية المركزة في مستشفى حكومي واحد في البحرين .(NWFQ) بالنسبة لتحليل البيانات، والإحصاءات الوصفية، اختباراتT-Test ، ANOVA، ارتباط بيرسون، واستخدمت الانحدار المدمج.

النتائج: كان هناك ارتفاع كبير في جودة النوم الفقيرة (89٪) مع متوسط (SD) من 13.6 (± 4.9)، كان له أهمية إحصائية مع مستوى أداء الممرضين. وكان الاستبيان الوظيفي لعمل الممرضين متوسط (SD) من 56.3 (± 22.5). تتكون جودة النوم من سبعة مكونات: الكمون النومي(P = 0.758) ، ونوعية النوم ذاتية (P = 0.530)، خلل وظيفي خلال النهار(P = 0.112) ، اضطرابات النوم(P = 0.833) ، كفاءة النوم المعتادة(P = 0.792) ، تم العثور على مدة النوم(P = 0.801) ، واستخدام الدواء النائم (P = 0.840) من الناحية الإحصائية من أداء عمل الممرضين، إلى جانب عمل التحول(P <0.0001) ، الممرضات الإناث P) (0.010 =و وجود أطفال(P = 0.043) ، المستوى التعليمي للممرضات(P <0.0001) ، وتعيين الممرضات .(P <0.0001)

الخلاصة: قد تؤدي جودة النوم السيئة إلى أداء عمل تمريضي أقل من الطبيعي والمتوقع .

ممارسة البحث: قد غفل الكثير عن أهمية جودة النوم للمرضين فأصبحت القضية كما يقال السهل الممتنع فنلاحظ القلة من يركز بين جودة النوم وأداء العمل في أدب التمريض البحريني؛ فتهدف هذه الدراسة إلى ملء هذه الفجوة. والجدير بالذكر أن هناك حاجة إلى خدمات التدريب والتعليم في موقع العمل للكشف عن الممرضين، ومعاناتهم، وإدارتهم، ومتابعتهم للذين لديهم جودة نوم سيئة للحفاظ على رفاهية الممرضات والصحة، مما يزيد جودة أداء عمل التمريض .

الكلمات المفتاحية: جودة النوم، أداء العمل، تمريض الرعاية الحرجة، شفتات العمل.

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APPENDICES

Appendix I

Tool I

Part One

Sample Characteristics Form

DEMOGRAPHIC INFORMATION

Age ☐ 20-30 ☐ 31-40 ☐ 41-50 1-65 ☐ > 66 **Gender** ☐ Male ☐ Female

Marital Status ☐ Married ☐ Single ☐ Divorced ☐ Separated ☐ Widowed **Children** ☐ with ☐ without

Level of Education ☐ Diploma ☐ Bachelor ☐ Master ☐ Doctorate

ANTHROPOMETRIC INFORMATION

Weight: **Height:** **BMI:**

LIFESTYLE INFORMATION

Exercises ☐ Yes ☐ No **Caffeine intake** ☐ Yes ☐ No

Smoking ☐ Yes ☐ No **Family Support** ☐ Yes ☐ No

Occupation Stress ☐ Yes ☐ No

WORK - RELATE INFORMATION

Years of Experience ☐ ≤1year ☐ 2-5years -15years ☐ ≥ 16 years

Area of Practice ☐ ICU ☐ CCU ☐ Burn Intensive Unit ☐ N-ICU ☐ PICU

Nursing Position ☐ RN ☐ Supervisor ☐ Head of Nursing

Shifts Status ☐ Fixed one shift ☐ Two shift duty ☐ Three shift duty

Occupation Stress ☐ Yes ☐ No

HEALTH – RELATE INFORMATION

Pregnancy ☐ Yes ☐ No **Diabetic Mellitus** ☐ Yes ☐ No

Hypertension ☐ Yes ☐ No **Heart Disease** ☐ Yes ☐ No

Heritage Disease ☐ Yes ☐ No **Other:**

Appendix 2

Tool 2

Part Two

The Nurses Work Functioning Questionnaire (NWFQ)

The Nurses Work Functioning Questionnaire

To what extent did you experience difficulty in meeting the following aspects **of your work** in the **past 4 weeks**?

		no difficulty						great difficulty
1	Keeping sufficient overview of your tasks.	□	□	□	□	□	□	□
2	Not forgetting something one day.	□	□	□	□	□	□	□
3	Working efficiently.	□	□	□	□	□	□	□
4	Carrying out your work activities in general.	□	□	□	□	□	□	□
5	Carrying out your work independently.	□	□	□	□	□	□	□
6	Staying alert in your work.	□	□	□	□	□	□	□
7	Working accurately.	□	□	□	□	□	□	□
8	Preventing incidents in your work.	□	□	□	□	□	□	□
9	Working carefully.	□	□	□	□	□	□	□
10	Contact with patients and their family.	□	□	□	□	□	□	□
11	Showing sufficient empathy towards patients and their family.	□	□	□	□	□	□	□
12	Taking time for your patients.	□	□	□	□	□	□	□
13	Competently handling aggressive patients or family members.	□	□	□	□	□	□	□
14	Error-free administering/handing medication.	□	□	□	□	□	□	□

Relate the following statement **to your work** in the **past 4 weeks**. How much do you agree with it?

		totally disagree	disagree	disagree a little	not agree/ not disagree	agree a little	agree	totally agree
15	I make mistakes more often than before.	□	□	□	□	□	□	□

With respect to the **past 4 weeks**, are you someone who...

		(almost) never	once in a while	some-times	regularly	often	very often	(almost) always
16	... has the feeling to have lost control over the work?	□	□	□	□	□	□	□
17	... does not look forward to a working day/ shift?	□	□	□	□	□	□	□
18	... starts the working day/ shift already moaning and groaning?	□	□	□	□	□	□	□
19	... works without any enthusiasm?	□	□	□	□	□	□	□

How often did you think the following in the **past 4 weeks**?

20	I have great difficulty in getting through a working day.	□	□	□	□	□	□	□
21	I have the need for an extra day off to be able to get through the working week well.	□	□	□	□	□	□	□

How often did the following situations occur **in your work** in the **past 4 weeks**?

22	I do not succeed in listening well to my patients.	□	□	□	□	□	□	□
23	I notice myself that I treat patients too roughly.	□	□	□	□	□	□	□

How often were the following situations **with respect to your work** applicable to you in the **past 4 weeks**?

		not once	1 x per month	2 - 3 x per month	on average 1 x per week	on average 2 - 3 x per week	on average 1 x per day	on average more than 1 x per day
24	The tone of voice I use with my patients or their family is not too friendly.	□	□	□	□	□	□	□
25	I am curt towards patients or their family.	□	□	□	□	□	□	□

Answer the questions below with respect to the **past 4 weeks**.
How often did you...

26	... almost caused incidents in your work?	□	□	□	□	□	□	□
27	... almost made a mistake in the administration/handing of medicines?	□	□	□	□	□	□	□
28	... underestimated the seriousness of a situation?	□	□	□	□	□	□	□

How often did something go wrong while you were carrying out the tasks below in the past 4 weeks?

29	Initiating infusion.	□	□	□	□	□	□	□
30	Assessing which (nursing) care a patient needs.	□	□	□	□	□	□	□
31	Performing and reporting actions (e.g. in the nursing plan or treatment plan).	□	□	□	□	□	□	□

How often did you almost do something wrong while carrying out the tasks below in the past 4 weeks?

32	Performing and reporting actions (e.g. in the nursing plan or treatment plan).	□	□	□	□	□	□	□

Indicate how often in the past 4 weeks the following has happened.

		(almost) never	some-times	regularly	often	(almost) always
33	Friction between you and someone from your team.	□	□	□	□	□
34	Being irritated during work.	□	□	□	□	□
35	Tensions between you and your colleagues.	□	□	□	□	□

How often was the behavior below applicable to you in the past 4 weeks?

36	Leaving for a moment so you can be alone.	□	□	□	□	□
37	Avoiding conversations with your colleagues.	□	□	□	□	□
38	Avoiding common areas.	□	□	□	□	□
39	Avoiding working together with your colleagues.	□	□	□	□	□

Relate the following statements **to your work** in the **past 4 weeks**. How much do you agree with it?

		disagree	disagree a little	not agree/ not disagree	agree a little	agree
40	Making decisions I leave to my colleagues.	□	□	□	□	□
41	I often only do what is absolutely necessary.	□	□	□	□	□
42	Meetings and evaluations I avoid as much as possible.	□	□	□	□	□
43	I prefer to do only routine jobs.	□	□	□	□	□
44	I am often astonished at how easy it is for others to upset me.	□	□	□	□	□
45	I often react irritated towards colleagues/ managers.	□	□	□	□	□
46	I often get angry about matters at work.	□	□	□	□	□
47	I often have conflicts with my manager.	□	□	□	□	□

Appendix 3

Tool 3

Part Three

The Pittsburgh Sleep Quality Index (PSQI)

Instructions: The following questions relate to your usual sleep habits during the past month only. Your answers should indicate the most accurate reply for the majority of days and nights in the past month. Please answer all questions. During the past month,

1. When have you usually gone to bed? _____
2. How long (in minutes) has it taken you to fall asleep each night? _____
3. When have you usually gotten up in the morning? _____
4. How many hours of actual sleep do you get at night? (This may be different than the number of hours you spend in bed) _____

5. During the past month, how often have you had trouble sleeping because you...	Not during the past month (0)	Less than once a week (1)	Once or twice a week (2)	Three or more times week (3)
a. Cannot get to sleep within 30 minutes				
b. Wake up in the middle of the night or early morning				
c. Have to get up to use the bathroom				
d. Cannot breathe comfortably				
e. Cough or snore loudly				
f. Feel too cold				
g. Feel too hot				
h. Have bad dreams				
i. Have pain				
j. Other reason(s), please describe, including how often you have had trouble sleeping because of this reason(s):				
6. During the past month, how often have you taken medicine (prescribed or "over the counter") to help you sleep?				
7. During the past month, how often have you had trouble staying awake while driving, eating meals, or engaging in social activity?				
8. During the past month, how much of a problem has it been for you to keep up enthusiasm to get things done?				
	Very good (0)	Fairly good (1)	Fairly bad (2)	Very bad (3)
9. During the past month, how would you rate your sleep quality overall?				

• **Please completed form and send by email to fatemaalaradi@gmail.com**

Appendix 4

Participants Information Sheet

Request for Participation in the Research

Dear volunteer,

I am Fatema Ateya Alaradi, Master student at nursing department of College of Health Sciences, UOB. I am conducting a research about Sleep Quality and Work Performance of Shift Work – Nurses in the Critical Care Units as a partial fulfillment of Postgraduate program. The purpose of my research is intended to research and measure the sleep quality among critical care nurses caused by shift work, most specifically how sleep quality relate to nurse's mind, body, and spirit. Maintaining a high quality sleep among nurses is a universal goal for hospital administration because sleep is one of the major experiences, which can minimize nursing care and job performance. I believe that the result of this research will contribute to the quality of nurse productivity at SMC. This study is based on descriptive, cross-sectional survey research design will be used.

You have been identified as a member who meets the criteria for this study. Thus, this letter is written to request your participation in my research. If you are willing to participate, I would like to provide an informed consent document to you, and your identity will be kept confidential.

Participation is completely voluntary and if you choose not to participate, there are no consequences. Though the results of this study may be published, your responses will be anonymous. If you wish to discuss the research or if you have any further questions, please feel free to contact me via phone or email me at the address below.

Thank you for your time and consideration.

Yours faithfully,

Name: Fatema Ateya Alaradi

Email: fatemaalaradi92@gmail.com

Telephone: 36659996

Appendix 5

Participant Informed Consent form

Consent for Participation in Research

Research Title: Sleep Quality and Work Performance of Shift Work – Nurses in the Critical Care Units
Researcher: Ms. Fatema Ateya Alaradi
Educational Institution: UOB – Collage of Health and Sport Sciences

I, voluntarily agree to participate in the research regarding "Sleep Quality and Work Performance of Shift Work – Nurses in the Critical Care Units ". I am willing to contribute my experiences for the benefit of the study and will respect the confidentiality of all participants involved. I have been fully informed of the need, purpose and methods of the study.

I understand that this research is being undertaken by Ms. Fatema Ateya Alaradi and will be part of her study in Master Program. I understand that the research methods involved include completing a Pretest and Posttest.

I grant permission for the research information generated to be used for future academic publication.

I understand that any individual information will not be included in the report or any future publications.

I have been concerned to participate in the research study. No penalty will occur if I choose not to be involved.

Signed _____ (Research Participant) Date _____

Appendix 6

Ethical Approval Letters

UNIVERSITY OF BAHRAIN

College of Health Sciences

جامعة البحرين

كلية العلوم الصحية

October 1, 2020

To: The Chairperson of the Research Technical Support Team
Ministry of Health
Kingdom of Bahrain

Dear Madam/Sir,

Greetings from the College of Health and Sport Sciences, University of Bahrain!

RE: Research study on "Sleep Quality and Work Performance of Shift Work – Nurses in the Critical Care Units "- CHSS SRPC Recommendation No: 3/2020-21 dt. Oct 1,2020.

The Scientific Research and Publication Committee, College of Health and Sport Sciences (CHSS), University of Bahrain (UOB), has reviewed and recommended the research proposal (CHSS SRPC Recommendation No: 3/2020-21 dt. October 1, 2020) entitled "Sleep Quality and Work Performance of Shift Work – Nurses in the Critical Care Units" to the MoH RTST. Ms. Fatema Ateya Mohamed Ali Nass Alaradi, a student enrolled in M.Sc Adult Health Nursing -Nursing Program of CHSS, UoB would be carrying out the study under the supervision of Dr. Gayathripriya Narayanan Assistant Professor, Nursing Program, CHSS, UoB and Dr. Fariba Abdul Wahab Al-Darazi as Master's Thesis. Notably, the outcome of the research is expected to benefit the patients admitted in the hospitals ICU/CCU in the Kingdom of Bahrain. Therefore, I request to do the needful considering the paucity of time to complete the Master's Thesis.

Thank you for supporting scientific research at the CHSS, UOB.

Kind Regards,

Dr. Asokan.G.V.
Vice Chairperson, Scientific Research and Publication Committee
College of Health and Sport Sciences
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للموارد البشرية والخدمات

No: AURS/ 358 /2020
Date: 30/11/2020

To: Ms. Fatima Alaradi
College of Health Sciences
University of Bahrain

Subject: Letter of Approval for Research Proposal:

"Sleep Quality and Work Performance of Shift Work – CCN"

Dear Ms. Fatima,

Thank you for submitting your research proposal documents, which have been considered by members of the Research Technical Support Team (RTST) on 17th November 2020.

We would like to inform you that the team found no major ethical issues or methodological problems that would hinder the conduct of this survey. We are thus pleased to approve the above application.

This approval is subject to the following conditions:

1. We expect that the study will begin within 6 months of the date of this approval.
2. Approval from an MOH Research Committee does not automatically imply that the researcher is granted access to data, medical records or biological samples from MOH healthcare facilities. Researchers must seek permission and follow procedures as dictated by the concerned departments after presenting them with a valid MOH approval letter.
3. Any significant change, which occurs in connection with this study and/or which may alter its ethical consideration, must be reported immediately to the RTST.
4. This approval is valid for up to **1 year** from the date of approval. If the study extends beyond this date, a progress report must be sent to the RTST to renew the approval.
5. The RTST must be informed when the research has been completed and a copy of the final research report must be submitted for our records.

We wish you all the best in this study.

Yours sincerely,

Fatima A. Wahid Al Ahmed
Assistant Undersecretary for Resources and Services

هاتف: ١٧٣٦٩٣٩٧ (٩٧٣+) – فاكس: ١٧٣٦٩٣٩٨ – ص.ب: ١٢ – المنامة، مملكة البحرين

22G45-40-01925

KINGDOM OF BAHRAIN
MINISTRY OF HEALTH
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البحرين - الخليج العربي

No. ..... الرقم :

Date 13-10-2020 التاريخ :

Research Proposal Ethical Approval

Dear **S. Fatema Ateya Alaradi,**

We would like to inform you that the **Secondary Health Care Research Sub Committee (SHCRC)** has approved your research proposal titled: " **Sleep Quality and Work Performance of Shift Work-Nurses in the Critical care Units**"; approval date 12/10/2020.

We all wish you a successful research and request you to update us with its progress.

Best wishes.

Regards,

On behalf of the **SHCRC**

Dr. *Eman Farid*
Head of the SHCRC

Dr. Eman Farid
Consultant Immunologist
Pathology Department SMC
Code No. 413

Ministry of Health
Secondary Health Care Research
Subcommittee
اللجنة الفرعية لبحوث الصحة بالرعاية الثانوية
وزارة الصحة

NB: No file retrieval from Medical Record Department is allowed currently due to COVID-19 circumstances.

Appendix 7

Publication (Articles)

Sleep Quality and Work Performance Among Shift Work Critical Care Nurses: A Cross-Sectional Study

Fatema Ateya Alaradi, BSc, MSc* Gayathri Priya, MSN, PhD** Fariba Al-Darazi, MSc, MFPH***

ABSTRACT

Background: Sufficient sleep quality empowers a well-balanced immunity, and supports work performance and work safety. Sleep quality is particularly important in the population of nurses.

Objectives: To determine the association between nursing shift work in intensive care units and sleep quality and work performance.

Setting: Salmaniya Medical Center (SMC), Bahrain.

Design: Survey using the Pittsburgh Sleep Quality Index (PSQI) and Nurse Work Function Questionnaire (NWFQ).

Methods: The study was performed from 1st February 2021 to 30th April 2021. PSQI and NWFQ were used in a cross-sectional survey in random sample of 200 nurses working in five intensive care units in SMC. For data analysis, descriptive statistics, t-tests, ANOVA, Pearson's correlation, and stepwise regression were used.

Results: One hundred seventy-eight (89%) reported poor sleep quality, with a mean (SD) of 13.6 (± 4.9); it was significantly associated with nurse performance level. One-hundred forty-five (72.5%) nurses were females; 159 (79.5%) were over 31; 157 (78.5%) were married, and 142 (71%) had a bachelor's degree. Their age ranged from 24 to 65 years old. One hundred eighty-eight (94%) were staff nurses; 178 (89%) were shift workers; 164 (82%) worked three-night shifts. One hundred forty-eight (74%) had worked for more than six years. The following were found to be significant predictors of nurse work performance: Sleep latency, subjective sleep quality, daytime dysfunction, sleep disturbances, habitual sleep efficiency, sleep duration, and use of sleeping medication, shift work, Female nurses and having children, nurses' educational level, and nurses' job designation.

Conclusion: Poor sleep quality might lead to decreased nursing work performance.

Keywords: Sleep quality, Work performance, Critical care nursing, Shift work schedule

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JDUHS

ORIGINAL ARTICLE

Shift Changes' Effects on Sleep Quality and Work Performance among Nurses Working in Bahrain's Intensive Care Units

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ABSTRACT

Objective: To determine the difference in the sleep quality and work performance of nurses between one shift duty, two shifts duty, and three shifts duty in intensive care units at a government hospital in the Kingdom of Bahrain.

Methods: This cross-sectional study was conducted at a government hospital of Bahrain from February to April 2021. A total of 200 nurses worked for at least one year in an intensive care units were eligible for the study. A questionnaire was administered online to collect data. The Pittsburgh Sleep Quality Index (PSQI) was used to measure sleep quality while Nurse Work Function Questionnaire (NWFQ) was used to measure work performance.

Results: There were 145 (72.5%) females and 55 (27.5%) males with a mean age of 38.2 ± 8.2 years. Most of the nurses were staff nurses 188 (94%), and shift workers 178 (89%). The mean PSQI of nurses who work only one shift reported normal sleep quality of 1.3 ± 1.0 where those who work two shifts had poorer sleep quality measured 9.2 ± 0.8 and nurses who work three shifts had reported even worse sleep quality with a statistically significant difference 15.6 ± 1.8 (p-value <0.0001). Moreover, the more variety of shifts the critical care nurses work, the more impaired their performance was (p-value <0.001).

Conclusion: The more shift work schedules the nurse works, the worse is the reported sleep quality and work performance.

Keywords: Critical Care Nursing, Shift Work Schedule, Sleep Quality, Work Performance.

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INTRODUCTION

Nursing is a stressful and physically demanding professional; add to it impaired sleep quality due to consecutive shift work.[1] Literature review described shift work as a heavy burden, work hazards, and the most common reason for the poor sleep quality of nurses; for the psychological, physical, spirit, and work performance complications that followed it.[2] Shift work produces chronic and increased fatigue by reducing both sleep quantity and quality.[3] A system of irregular rotating shift works can disturb nurses' circadian rhythm and motive sleep deprivation.[4] Therefore, the sleep debt (sleep loss) can only be restored during their nonworking days.[5]

Additionally, shift-working nurses appeared to have poorer work performance than non-shift workers, sleep loss significantly affected decision making, initiative, integration of information, high-attention tasks, planning and plan execution, and vigilance.[6,7] Apart from the effects of current shift work, various literature review stated that even those who had previously done shift work were substantially more likely to have poor sleep quality than those who had never done shift work.[8]

The extent to which shiftwork nurses are influenced by sleep deprivation is alarming; during working years that eventually can lead to errors and unsafe patient care.[9] Therefore, it is critical to address poor sleep quality in nursing as they are at high risk of sleep deprivation and making errors that affect patient care and safety.[3]

Although Bahrain has a considerable workforce of competent and well-trained nurses, there is a gap in our knowledge regarding the sleep quality of shift-work nurses and how it affects work performance of the shift-work nurses. This study was therefore conducted to evaluate the sleep quality and work performance of shift-work critical care nurses in intensive care units in Bahrain.

METHODS

A descriptive cross-sectional study was conducted in a

critical care setting of a government hospital in Bahrain from February to April 2021 to investigate the impact of shiftwork on critical care nurses' sleep quality and work performance. Ethical clearance was obtained from the Institutional Review Board (IRB) of Collage of Health and Sport Sciences, Bahrain. Reference Number is 3/2020-21 dt. October 1,2020. Also, from Ministry of Health (MOH), Bahrain. Reference Number is AURS/ 358/ 2020. Participants were asked to consent, and the purpose and specifics of the study were described. No form of personal identification was incorporated into the survey; therefore, confidentiality and anonymity of the respondents was guaranteed.

The study population consisted of 400 nurses working in a critical care setting of government hospital in Bahrain. Of these 400 nurses, the study sample constituted 200 (50%) randomized nurses who voluntarily participated and were not on (sick) leave while the study was conducted. The hospital where the study was conducted had five main critical care settings and the nurses worked for 48 hours a week in three different shifts (morning 6:30 am to 2:30pm, evening 2:30pm to 10:30 pm, and night 10:30 pm to 6:30 am). The supervisor nurses worked from 6:30 a.m. to 2:30 p.m.

An online questionnaire was designed and reviewed to collect nurses reported information. It consisted of three parts to achieve the aim of study.

(1) Sociodemographic Characteristics Questionnaire: includes age, gender, level of education, marital status, and number of children while work related variables includes years of experience, area of practice, position, shifts pattern (fixed duty or two shifts duty morning/ evening or three shifts duty morning/evening/night. The form was developed by the researcher and in consultation with two academic supervisors. The validity of the sample characteristics form done by consultation with an academic supervisor. Since demographic characteristics represent relatively simple constructs, the validity establishing is more straightforward.

(2) The Pittsburgh Sleep Quality Index (PSQI): includes subjective self – rated items to elevate sleep quality and has been commonly used in sleep literature.[10] The PSQI comprise eighteen items across seven factors of sleep quality which include: Subjective sleep quality (one item), Sleep latency (four items), Sleep duration (one item), Sleep efficiency (four items), Sleep disturbance (one item), Daytime dysfunction (one item), and Use of sleeping medications (four items). [10] The total of all factors provides the measure for overall sleep quality. Scores range from 0 (good sleep) – 21 (poor sleep), and 5 indicate poor sleep quality. Its validity was checked based on subjects in three groups: good sleepers, poor sleepers, and disordered sleepers.[10]The internal consistence (Cronbach's) was 0.83 for total score, and test – retest reliability correlation coefficient was 0.85 for total score and 0.65 to 0.84 for each domain, [10] and 0.921 with all scale's components showed very high affinity to the scale reflected by moderate to high item-total correlation that ranged from 0.71 to 0.98 in this study.

(3) The Nurses Work Functioning Questionnaire (NWFQ): includes subjective self–rated items to elevate impairments in work functioning due to common mental disorders in health care workers during previous 4 weeks, and the worker chooses a response on a Likert scale of between 5 and 7 categories.[11] The NWFQ enclose a 50-items self-report questionnaire consisting of seven subscales: cognitive aspects of task execution (11 items), impaired decision making (3 items), causing incidents at work (8 items), avoidance behavior (8 items), conflicts and irritations with colleagues (7 items), impaired contact with patients and their family (8 items), and lack of energy and motivation (5 items).[11] The total of all factors provides the measure for overall job performance with standard sum score ranges from (1 to 100) to calculate final total score.[11] Scores range from 'totally disagree' to 'totally agree' with it. Relation (e.g., 'almost never' to 'almost always') and total frequencies (e.g., 'not once' to 'more than once a day'), and an additional option to record that the statement 'does not apply to my job are also included.[11] Overall reliability and convergent validity were satisfactory for six of the subscales except one subscale (impaired decision making) lacked reproducibility and validity and required additional work before use.[11]Therefore, in this study, researcher included all subscales except impaired decision-making scale. In this study, the NWFQ subscales showed excellent reliability according to the Cronbach's alpha measure of internal consistency except for the avoidance behavior subscale which recorded acceptable reliability. Their reliability index ranged from as low as 0.777 for the avoidance subscale to as high as 0.933 for the cognitive aspect. All subscales' items showed very high affinity to their respective scale reflected by moderate to high item-total correlation that ranged from 0.43 to 0.91.

Data entry and analysis were performed using a Statistical Package for Social Sciences (SPSS) version 20.0. Mean ± SD were computed for quantitative variables like, age (years), PSQI score and NWFQ score while frequency and percentages were computed for categorical variables like gender, education level, marital status, having children, area of practice,

designation, experience, and shift schedule. Inferential statistics were explored using Independent t-test and One-way ANOVA to compare mean difference of PSQI and NWFQ score with demographic and clinical characteristics of the participants. The p-value of ≤ 0.05 was considered statistically significant.

RESULTS

Of 200 critical care nurse respondents the mean age was 38.2 ± 8.2. There were 145 (72.5%) females and 55 (27.5%) males. Majority of the participants were married 157 (78.5%), having children 138 (86.2%), had graduated with bachelor's degree 142 (71%), working in intensive care unit (ICU) 80 (4.0%) and neonatal intensive care unit (NICU) 74 (37.0%) department, and having working experience 6 to 10 years 87 (43.5%). Most of the nurses were staff nurses 188 (94%), and shift workers 178 (89%), including one shift duty (none-shift duty) 22 (11%), two shift duty 14 (7%), and the three-shift duty 164 (82%). (Table 1)

The mean PSQI score was found significantly lower in master's degree holder nurses 8.4 ± 6.4 as compared to diploma 12.6 ± 4.2 and bachelor's degree holder 14.0 ± 4.8 (p-value 0.005). Similarly, the mean NWFQ score was found significantly lower in master's degree holder nurses 26.7 ± 20.4 as compared to diploma 49.7 ± 16.1 and bachelor's degree holder 58.8 ± 22.6 (p-value <0.001). Nurses working as a supervisor showed lowest mean PSQI score 2.7 ± 3.5 as compared to head nurses 4.3 ± 4.9 and staff nurses 14.3 ± 4.1 (p-value <0.001). Similar findings were found in NWFQ score. (Table 2)

The mean PSQI of nurses who work only one shift reported normal sleep quality of 1.3 ± 1.0 where those who work two shifts had poorer sleep quality measured 9.2 ± 0.8 and nurses who work three shifts had reported even worse sleep quality with a statistically significant difference 15.6 ± 1.8 (p-value <0.0001). The nurse work functioning questionnaire had an overall mean (SD) of 56.3 ± 22.5. Interestingly, the more variety of shifts the participants work, the higher the impaired work functions they suffer (p-value <0.001). In table 3 we stratified shift work on the basis of education level and designation because these two variables were found significant in both PSQI and NWFQ. After stratification the findings showed statistically significant mean difference in both PSQI and NWFQ score (p-value ≤ 0.05) except head nurse PSQI score (p-value 0.065).

DISCUSSION

Little is known about the impact of shift work on sleep quality and work performance in Bahraini nursing literature today. The key finding of this study was working shifts was an independent risk factor for sleep deprivation and decreasing work performance. The timely, efficient, and safe delivery of patient care depends on shiftwork.[5] However, shift work-related sleep deprivation may severely lower nurse performance.

Sleep difficulties among nurses, including insufficient sleep, disturbed sleep pattern, thus poor sleep quality, are widely prevalent.[12] The literature reports a significant number of nurses had compromised sleep quality, particularly shift work nurses had a high degree of sleep deficiency and the night nurses had especially lower sleep quality comparing to another shift.[5,12-18]

In fact, it was estimated that up to 85% of shift work nurses suffer from poor sleep quality[19] similar to our study of 89%, and, consequently, up to 61.0% sever from sleep deprivation.[20] According to Shokey *et al.*, (2017), healthcare practitioners represent two of the five occupational groups with the highest prevalence of poor sleep quality and short sleep duration.[21] The extent to which shiftwork nurse are influenced by sleep deprivation is alarming; during working years that eventually can lead to errors and unsafe patient care.[22] Therefore, it is critical to address poor sleep quality in nursing as they are at high risk of sleep deprivation and making errors that affect patient care and safety.

Poor sleep quality and the following factors were statistically significantly correlated among shift-work critical care nurses: experience, education level, marital status, designation, and gender. In support, numerous studies have presented gender differences are associated with disturbed sleep – wake cycle, and poor sleep quality.[23] A study done by van de Langenberg *et al.*, (2016) indicated that female nurses had poorer sleep quality in all shift types.[24] The complaints about sleep problems increased with female gender and married nurses may be because of their physiological differences and taking care of the family members. Nurses with master's degrees were more likely to have good sleep quality and work performance than nurses with diploma and bachelor's degrees. As opposed to that, Omar *et al.*, 2022 found that nurses with higher educational level experienced poor sleep and work quality.[25] Although the studies suggests that nurses who continue postgraduate education have improved critical thinking, decision-making skills, and leadership qualities that enable them to confront inferior practice, and the competences required for advanced clinical practice roles.[2] This study found that having more work experience of at least 10 years may be connected with

Table 1: Sociodemographic and clinical characteristics of the critical care nurse participants (n=200)

Age Group (Years)	**n (%)**
21-30	41 (20.5)
31-40	74 (37.0)
41-50	73 (36.5)
51-65	12 (6.0)
Gender	
Male	55 (27.5)
Female	145 (72.5)
Marital Status	
Single	40 (20.0)
Married	157 (78.5)
Divorced/Separated	3 (1.5)
Having Children (n= 160) [$]	
Without	22 (13.8)
With	138 (86.2)
Education Level	
Diploma	31 (15.5)
Bachelor	162 (81.0)
Master	7 (3.5)
Area of Practice	
Burns unit	10 (5.0)
CCU	27 (13.5)
ICU	80 (40.0)
NICU	74 (37.0)
PICU	9 (4.5)
Length of Clinical Experience (Years)	
≤ 5	52 (26.0)
6 to 10	87 (43.5)
> 10	61 (30.5)
Designation	
RN	188 (94.0)
Supervisor	9 (4.5)
Head Nurse	3 (1.5)
Work Shifts Schedule	
One Shift	22 (11.0)
Two Shifts	14 (7.0)
Three Shifts	164 (82.0)

- CCU: Critical Care Unit, ICU: Intensive Care Unit, NICU, Neonatal Intensive Care Unit, PICU: Pediatric Intensive Care Unit, RN: Registered Nurses

[$] Only 160 individuals who ever married were included, All data presented as number (%)

Table 2: Mean comparison of PSQI and NWFQ with demographic and clinical characteristics of the critical care nurse participants (n=200)

Characteristics	PSQI		NWFQ	
	Mean ± SD	p-value	Mean ± SD	p-value
Age Group (Years)				
21-30	13.1 ± 5.1	0.347~	57.8 ± 25.7	0.766~
31-40	13.0 ± 5.4		57.7 ± 26.0	
41-50	14.4 ± 4.4		54.3 ± 17.0	
51-65	13.6 ± 2.7		53.8 ± 17.7	
Gender				
Male	12.4 ± 6.2	0.034^	52.8 ± 27.8	0.181^
Female	14.0 ± 4.2		57.6 ± 20.1	
Marital Status				
Single	11.7 ± 6.2	0.020~*	51.6 ± 30.7	0.344~
Married	14.1 ± 4.4		57.4 ± 19.9	
Divorced/Separated	12.6 ± 4.0		55.7 ± 24.6	
Having Children (n= 160) $				
Without	13.9 ± 4.6	0.817^	51.9 ± 18.0	0.134^
With	14.1 ± 4.3		58.0 ± 20.31	
Education Level				
Diploma	12.6 ± 4.2	0.005~*	49.7 ± 16.1	<0.001~*
Bachelor	14.0 ± 4.8		58.8 ± 22.6	
Master	8.4 ± 6.4		26.7 ± 20.4	
Area of Practice				
Burns unit	12.9 ± 6.5	0.655~	47.9 ± 20.8	0.012~*
CCU	12.7 ± 4.7		49.3 ± 16.4	
ICU	13.8 ± 4.9		62.8 ± 27.2	
NICU	13.6 ± 5.0		52.6 ± 18.2	
PICU	15.4 ± 2.6		57.6 ± 11.2	
Length of Clinical Experience (Years)				
≤ 5	14.2 ± 4.3	<0.001~*	60.1 ± 20.0	0.356~
6 to 10	12.0 ± 5.7		54.5 ± 28.8	
> 10	15.4 ± 3.2		55.5 ± 11.7	
Designation				
RN	14.3 ± 4.1	<0.001~*	58.9 ± 20.2	<0.001~*
Supervisor	2.7 ± 3.5		11.6 ± 10.7	
Head Nurse	4.3 ± 4.9		24.8 ± 27.2	

- CCU: Critical Care Unit, ICU: Intensive Care Unit, NICU, Neonatal Intensive Care Unit, PICU: Pediatric Intensive Care Unit, RN: Registered Nurses, PSQI: Pittsburgh Sleep Quality Index, NWFQ: Nurses Work Functioning Questionnaire, $ Only 160 individuals who were ever married were included

^Independent Sample t -test, ~One-Way ANOVA, *p-value ≤ 0.05

Table 3: Mean comparison of PSQI and NWFQ with working shift of the critical care nurse participants stratified with education level and designation (n=200)

Characteristics	PSQI		NWFQ	
	Mean ± SD	p-value	Mean ± SD	p-value
Work Shift (Overall)				
One Shift	1.3 ± 1.0	<0.001~*	9.2 ± 5.1	<0.001~*
Two Shifts	9.2 ± 0.8		33.5 ± 11.8	
Three Shifts	15.6 ± 1.8		64.5 ± 13.9	
Education Level				
Diploma (n=31)				
One Shift	1.0 ± 0.1	0.001~*	9.4 ± 0.6	<0.001~*
Two Shifts	8.0 ± 0.1		26.2 ± 6.8	
Three Shifts	14.3 ± 1.1		56.1 ± 5.4	
Bachelor (n=162)				
One Shift	1.4 ± 1.1	0.001~*	9.7 ± 5.4	0.001~*
Two Shifts	9.5 ± 0.9		37.3 ± 12.8	
Three Shifts	15.8 ± 1.7		66.1 ± 14.5	
Master (n=7)				
One Shift	1.0 ± 0.1	0.001~*	4.4 ± 6.3	0.025~*
Two Shifts	9.2 ± 0.5		29.6 ± 10.9	
Three Shifts	20.0 ± 0.1		59.8 ± 0.1	
Designation				
RN (n=188)				
One Shift	1.5 ± 1.1	0.001~*	10.4 ± 5.2	0.001~*
Two Shifts	9.1 ± 0.9		32.4 ± 11.1	
Three Shifts	15.6 ± 1.8		65.5 ± 13.9	
Supervisor (n=9)				
One Shift	1.0 ± 0.81	0.001~*	6.8 ± 5.4	0.001^*
Two Shifts	9.0 ± 0.1		28.4 ± 3.7	
Head Nurse (n=3)				
One Shift	1.5 ± 0.7	0.065^	9.1 ± 1.1	0.019^*
Two Shifts	10.0 ± 0.1		56.3 ± 0.1	

-RN: Registered Nurses, PSQI: Pittsburgh Sleep Quality Index, NWFQ: Nurses Work Functioning Questionnaire

^Independent Sample t-test, ~One -Way ANOVA, *p-value ≤ 0.05

better sleep quality in line with study done in Egypt.[25] However, a longer history of shift work was linked to poorer sleep quality,[3] and older age quality is connected to a decline in sleep quality as well as a gradual shortening of sleep quantity.[26]

Additionally, both nursing supervisors and head nurses reported significantly better sleep quality than the registered nurses, which previous studies have not found any association between them. One possible explanation for this disparity is because nursing supervisors and head nurses are more likely to work one shift duty, mostly morning duty. Varies studies have established that nurses with a morning type had better sleep quality between morning shifts,[5] while evening type was associated with irregular sleep and frequent awake during their sleep,[12] leading to insufficient sleep duration and poor sleep quality.[20]

In this study, it was observed that nurses holding bachelors degree, working in intensive care unit, and registered nurses reported significantly higher impaired work performance. This is in line with the finding of Momeni *et al.*, which reported that the majority of ICU registered nurses had moderate 66.1% to 27.2% low quality of work life.[27] This may directly to ICU can be an extremely stressful environment and demanding high nursing care, and the possible factors for the difference are that registered nurses have shiftwork, direct contact with patients and their families, high workload, and high work stress than non-shift nurses.[28]

Shift work nurses have an impaired ability to quickly and correctly perform mental calculations compared to those who work in fixed shifts.[6] Shortened sleep quantity and poor sleep quality has been shown to decrease cognitive capabilities like attention span, concentration, and reaction time.[27] Univariate analyses have been made and observed that medication errors occur more frequently during occasional night shifts.[16] Hence shift work force poor sleep quality directly lead to decreased work performance of nurses.[28]

The strengths of this research are representative sample size selected through random sampling technique to eliminate sampling bias, and this is the first that examine impact of shiftwork on sleep quality and work performance among critical care nurses in Bahrain. However, the limitation of a questionnaire-based tool study is that the information that will be gathered may be influenced by subject's response bias because of the self-reporting nature of the questionnaire.

This study provides the baseline (ground) data for attention of researchers and administrate to provide satisfactory work conditions with minimum complication of sleep among critical care nurses, by implement a policy to screen for sleep quality at each required yearly fitness check-up at occupation health clinic especially shift worker. Moreover, integrate sleep hygiene practices among nursing students to prepare them to shift – working duty from the beginning.

CONCLUSION

This study has found that there is a significant prevalence of poor sleep quality and impaired work performance among shift work critical care nurses. To help these nurses, hospitals institutions should be aware of sleep disturbance, work performance, and the risk of shift work. Strategic and organizational objectives should also be taken into consideration when implementing interventions connected to shiftwork, sleep hygiene-related interventions, and improving work environment rather than only relying solely on an assessment.

ETHICAL APPROVAL: The ethical clearance was obtained from the Institutional Review Board of Collage of Health and Sport Sciences, Bahrain (Ref. No: 3/2020-21, dated October 01, 2020). Also from the Ministry of Health, Bahrain (Ref. No. AURS/358/2020, dated: Nov 11, 2020).

AUTHORS' CONTRIBUTIONS: FAA: Substantial contributions to conception and design, acquisition of data, or analysis, and interpretation of data.GP: Drafting the article or revising it critically for important intellectual content. FA: Final approval of the version to be published.

CONFLICT OF INTEREST: None to declare.

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