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Neurocognitive Effects of 12-hour Shifts on Bedside Nurses

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Abstract

The student researcher conducted a research study to determine if there was a significant difference in the neurocognitive abilities of bedside nurses at the beginning of a 12-hour shift versus the end of the same shift. The student researcher hypothesized there was a significant difference in the neurocognitive abilities of bedside nurses at the beginning of one's shift as compared to the end of the same shift. Conversely, the null hypothesis stated there was no significant difference in the neurocognitive abilities of bedside nurses at the beginning of one's shift as compared to the end of the same shift. An iPad version of the Stroop test (Appendix C) and a printed copy of the OFER scale (Appendix B) were used to assess neurocognitive abilities and associated fatigue among the accessible population. Of the 25 participants from the small rural hospital in the southeastern United States, 22 participants completed the study. The statistical data analysis revealed there was a significant difference in the neurocognitive abilities of bedside nurses at the beginning and end of a 12-hour shift based on their response times to the Stroop test. Therefore, the student researcher rejected the null hypothesis. Predominantly, the participants in this study also reported acute fatigue in relation to 12-hour shifts. The nursing implication in this study was to assess potential patient safety concerns related to nurse cognition at the end of a 12-hour shift. Further research regarding the benefits and risks of 12-hour shifts to both patients and caregivers is recommended.

Chapter 1

Origin of the Problem

In the field of nursing, reaction time is of the essence. A nurse must be able to respond quickly to the needs of one's patients. Nearly 44,000 patients die in relation to medical errors each year. Patient safety is a primary concern of nursing, yet with more and more nurses working 12-hour shifts it calls into question how well a nurse can deliver care near the end of such a long shift. Research has suggested nurses who are sleep deprived will report more errors in patient care (Johnson, Jung, Brown, Weaver, & Richards, 2014).

When nurses work long hours, they are also more likely to regret decisions made during a shift. Working long shifts for several days shows a positive correlation to nurses who express decision regret. Decision regret likely correlates to fatigue and sleep deprivation that is common among nurses. This impairment may lead to medication errors or work left undone, which may lead to poor patient outcomes (Scott, Arslanian-Engoren, & Engoren, 2014).

Nursing Theory

The student researcher believed the focus of nursing was patient-centered care. The way nurses effectively provide safe and personalized care for each patient has been essential to improving patient outcomes. Based on the principles of Abdellah's patient-centered care theory, a nurse must take responsibility for the quality of care a patient receives during one's shift. The student researcher made an inference from this theory that a nurse's focus on a patient's care will directly impact the outcomes of the patient (Potter, Perry, Stockert, & Hall, 2017).

Abdellah's theory suggests the nurse's roles included meeting patients' physical, psychological and social needs. The student researcher inferred that a nurse could not properly meet these needs if chronically fatigued. For this reason, it is important to investigate the

neurocognitive abilities of nurses after working 12-hour shifts. Based on Abdellah's nursing theory of patient-centered care, patient outcomes will directly correlate with a nurse's ability to appropriately administer personalized care (Potter, Perry, Stockert, & Hall, 2017).

Clinical Observations that Precipitated Interest in Problem

Throughout the student researcher's time in the hospital clinical settings, she observed many instances of nurse fatigue toward the end of 12-hour shifts. While not each of these led to patient neglect or error, many times the student researcher noted patient needs being put off until the next shift. Sterile technique and hand hygiene were less strict toward the end of the shift. The student researcher began to question what detrimental effects a 12-hour shift had on a nurse's cognitive abilities. Nurse fatigue had been previously determined to impact patient care and patient safety. Many nurses became more dismissive of patient care in the late evening hours, which may have contributed to poorer patient outcomes. The student researcher thought the relationship between neurocognition at the beginning of a shift versus the end may be directly related to fatigue and increasing errors on a 12-hour shift.

Significance of the Problem

The student researcher was concerned that 12-hour shifts may have directly affected patient outcomes and patient care toward the end of the shift. The student researcher was determined to compare the neurocognitive abilities of bedside nurses at the beginning of a shift, versus the end. Rheaume and Mullen (2018) concluded that working 12-hour shifts led to poorer sleep quality and in turn more reported errors. Impaired cognition because of fatigue increased the likelihood that medical errors were made, ultimately decreasing patient safety. Safety is part of the Quality and Safety Education for Nurses (QSEN) competencies and directly affects patient

outcomes. A nurse's neurocognitive abilities during a 12-hour shift directly affect the ability to perform patient-centered care and impaired cognition may lead to poor patient outcomes.

Statements

Problem Statement. Is there a significant difference in the neurocognitive abilities of bedside nurses at the beginning and end of a 12-hour shift?

Purpose Statement. Identify whether bedside nurses working 12-hour shifts pose a patient safety concern.

Research hypothesis. There is a significant difference in the neurocognitive abilities of bedside nurses at the beginning of one's shift as compared to the end of the same shift.

Null hypothesis. There is no significant difference in the neurocognitive abilities of bedside nurses at the beginning of one's shift as compared to the end of the same shift.

Definitions

For the purpose of the study, the following terms were defined:

Bedside Nurse: Any registered nurse with either an Associate of Science in Nursing (ASN) or Bachelor of Science in Nursing (BSN) degree who is in direct care of patients for an entire 12-hour shift.

Beginning of Shift: The beginning of a shift will be defined as the 45-minute window between the hours of 6:45 AM and 7:30 AM for day shift and between the hours of 6:45 PM and 7:30 PM for night shift.

End of Shift: The end of a shift will be defined as the 45-minute period between the hours of 6:45 PM and 7:30 PM for day shift and between the hours of 6:45 AM and 7:30 AM for night shift.

Neurocognitive Abilities: Neurocognitive abilities will be defined as reactivity and alertness of a nurse.

Assumptions

For the purpose of the study, the following assumptions were made:

1. Patient outcomes are improved when nurses are more alert.
2. The tool used to measure neurocognitive abilities is reliable.
3. The participants will truthfully answer questions and utilize the tool to the best of their abilities.
4. The touchscreen format of the tool will not alter results.

Chapter II

Review of Literature

The neurocognitive abilities of nurses throughout a complete shift has been crucial to providing safe patient care. To further research the variances in nurses' cognitive abilities at the beginning and end of a shift, the student researcher explored studies applicable to nurse shift length, patient safety, fatigue, and neurocognitive tools that would be applicable to the research. Each article utilized was a peer-reviewed, research study conducted within the last five years, or was a validation study, therefore indicating relevance and credibility of each article. The studies reviewed and acknowledged problems of nurse fatigue, sleep deprivation, impaired cognition, and the importance of alert nurses in patient care. The studies also reinforced relevance of the student researcher's study regarding neurocognitive effects 12-hour shifts had on bedside nurse's ability to safely and effectively care for one's patients.

Patient Safety

Clendon and Gibbons (2015) conducted a systemic review of the literature regarding shift length and errors. The purpose of this study was to evaluate the effect of working 12 or more hours in one shift, compared with working 12 or fewer hours in one shift, on the rates of errors among nurses in acute care hospitals. Studies published in English before 2014 were selected for the systematic review. To be relevant for the study the articles had to examine nurse error, 12-hour shifts, and acute care. Of the initial 5429 publications, only 26 broadly met the requirements of Clendon and Gibbons' study. According to Clendon and Gibbons (2015) the remaining 26 were "assessed for methodological quality as per the JBI critical appraisal process" (Clendon & Gibbons, 2015, p.1233).

Of those 26, only 13 were sufficient for use in the systemic review. The remaining 13 articles led Clendon and Gibbons to define errors as a lack of attentiveness, lack of agency concern, inappropriate judgment, medication error, missed health care provider orders, lack of interventions on the patient's behalf, documentation errors, and a lack of prevention. Errors were found to be more prevalent when a nurse worked 12 or more hours. Such research supported Clendon and Gibbons' theory that working in excess of 12-hours would increase the likelihood that errors would be made. While much of the literature supported this assertion, a few articles contradicted these findings. In fact, four studies showed an increase in errors after only 8-hour shifts, which further increased the student researcher's concern regarding 12-hour shifts. Clendon and Gibbons attributed inconsistencies to limitations and confounding factors of the studies. However, based on the remaining nine studies, Clendon and Gibbons did conclude that there was enough evidence to support that hospitals and agencies that conform to standard 12-hour shifts may need to reevaluate and consider limiting to 8- or 10-hour shifts (Clendon & Gibbons, 2015).

Griffiths et al. (2014) conducted a cross-sectional survey to determine the relationship between shift length and nursing care. The purpose of this study was to examine if there is a positive correlation between the length of a shift and the nurse reported quality, safety, and care left undone. The researchers gathered a sample of 31,627 registered nurses in 12 European countries. The survey was mailed directly to the registered nurses (RN) on random medical-surgical wards at numerous hospitals. Bedside RNs were asked to complete and return surveys. The International Hospital Outcomes Study Questionnaire was utilized to provide valid and measurable results. The survey resulted in a large majority of nurses who work 12 or more hours in a shift reporting poor patient safety and more care left undone (Griffiths et al., 2014).

Johnson, Jung, Brown, Weaver, and Richards (2014) conducted a cross-sectional correlational study to investigate the effect sleep deprivation had on nursing errors. The study focused on night shift nurses. Few studies had examined sleep deprivation and errors made by nurses at this time. The study consisted of 289 night shift nurses. Each participant answered a questionnaire developed by the researchers. This questionnaire asked the nurses how much sleep they had received the previous night, and how much they needed to feel rested. If a nurse reported receiving the same or more sleep then they reported was necessary to feel rested, they were not categorized as sleep deprived (Johnson, et al., 2014).

Johnson et al., (2014) concluded that 56% of the 289 nurses in the study reported being sleep-deprived, and in turn concluded that sleep deprivation caused more errors among nurses. This research suggested further investigation into improving sleep quality and quantity among night shift nurses was needed. The authors also concluded that decreasing sleep deprivation among nurses will improve patient outcomes (Johnson, et al., 2014).

Scott, Arslanian-Engoren and Engoren (2014) conducted a nonexperimental study to examine how sleep and fatigue correspond to decision regret. The study examined nurses in critical care environments. Decision regret is more common in critical care environments. Questionnaires were sent out to a large pool of 3,500 nurses from a list generated from the membership of the American Association of Critical-Care Nurses. The researchers received 605 useable responses. Scott et al. (2014) hypothesized that 40% of the respondents would express decision regret (Scott et al., 2014).

Self-Reports, the Pittsburgh Quality Index, Epworth Sleepiness Scale, Sleep Quantity Assessment, Occupational Fatigue Exhaustion/Recovery Scale (OFER) Clinical Decision Self-Efficacy, and a 100-mm horizontal Visual Analog Scale (VAS) were used to assess the decision

regret among critical care nurses. The researchers analyzed results and developed three separate ways to predict decision regret. These methods were looking at measures of sleep, all sleep related variables and nurse characteristics, and finally, at all findings in the first two methods plus nurse satisfaction and confidence in their patient care decisions. The results yielded that being male, working 12 or more hours, and those who were dissatisfied with their personal patient care decisions were more likely to report decision regret. Only 29% of the respondents reported decision regret. Those who reported decision regret also reported more fatigue and difficulty recovering from shifts. The researchers found a positive correlation between fatigue and reports of decision regret in the critical care environment (Scott et al., 2014).

Nurse Fatigue

Martin (2015) launched a pilot study to examine the effects of shift length on nurse fatigue. The purpose of this study was to compare the differences in fatigue levels between nurses on 8- and 12-hour shifts. The Rosswurm and Larabee model was used to conduct this study. The researcher assessed the need for change, standardized the language, created the question, and determined a change to be made. The change in this study was allowing participants to switch from 12-hour shifts to 8-hour shifts for 4 weeks. Nurses could volunteer to make the change and participate in the research study. A total of nine nurses from an acute care hospital chose to volunteer for the study (Martin, 2015).

The OFER scale was utilized to assess the nurses' fatigue during their last week of working 12-hour shifts, and after the 4 weeks of 8-hour shifts. The small sample size resulted in the use of the Wilcoxon matched pairs test. This test aids in determining whether findings correlate. The small sample size lead to results that were inconclusive and suggests that further research into the implications of a 12-hour shift should be conducted (Martin, 2015).

Han, Trinkoff, and Geiger-Brown (2014) conducted a study with the purpose of determining the relationship between work and non-work factors that contribute to fatigue and impaired recovery between shifts. The study surveyed 80 nurses from medical-surgical floors and critical care units in a large teaching hospital. The researchers used survey data from the Nurses Sleep Study (NSS) to assess the fatigue and neurocognitive performance. The researchers collected data on an off day before a nurse was scheduled to work three consecutive 12-hour shifts. The OFER scale is utilized to measure acute and chronic fatigue as well as inter-shift recovery. The researchers determined they would define nurses with high fatigue as those falling in the 75th percentile. Psychological aspects of fatigue were measured using the Job Content Questionnaire and the Copenhagen Psychosocial Questionnaire (COPSOQ) (Han, Trinkoff, & Geiger-Brown, 2014).

Han et al. (2014) determined that nurses who reported higher levels of acute fatigue also had more psychological demands and less job satisfaction. Additionally, nurses who reported a high level of chronic fatigue often reported decreased sense of purpose at work along with low job satisfaction. These suggested psychological job demands were found to be related to the lack of inter-shift recovery and growing fatigue among nurses who worked 12-hour shifts. This study added to the body of research that suggested the work system currently in practice should be reevaluated (Han et al., 2014).

Kaliyaperumal, Elango, Alagesan, and Santhanakrishanan (2017) conducted a cross-sectional study regarding sleep deprivation and shift work among nurses. The sample was composed of 100 staff nurses on rotating schedules. The staff members in the study were posted to day shift for one month and night shift for one month as part of a rotating schedule. The aim was to compare the cognitive function at the end of the day shift cycle to the cognitive function

at the end of the night shift cycle. The participants had to be working 8-hour shifts for six days, have no significant medical conditions, and have at least one year of experience on the rotating schedule. The Epworth Sleepiness Scale (ESS) was utilized to assess for sleep deprivation. The researchers ranked participants' likelihood of falling asleep on a 0-3 during eight different situations at different points during their daily activities. The total was given by adding all 8 scores together (Kaliyaperumal, Elango, Alagesan, & Santhanakrishanan, 2017).

Kaliyaperumal, et al. (2017) utilized several tests for cognitive function. The researchers used the Montreal Cognitive Assessment (MoCA) to test for general intellect. The Stroop test was selected by the researchers as the preferred tool to test for response inhibition. A vigilance test, similar to the Mackworth clock test, was utilized to assess participants' attentiveness. A simple reaction time test was also used via a mobile application. The researchers used a 25-problem math test given at different hours during the shift to test the mental speed of the participants. The researchers expressed sleep deprivation as a percentage for comparisons. The tests suggested most of the participants had moderate sleep deprivation related to shift work. The researchers also determined there was an increase in cognitive deficits when working nights and when working extended hours (Kaliyaperumal et al., 2017).

Reinke, Özbay, Dieperink, and Tulleken (2015) conducted a study among intensive care unit (ICU) nurses and issues with fatigue. The purpose of this study was to determine whether the chronotype that determines sleeping and activity pattern affects night shift performance. Chosen to participate in this study were 96 night-shift nurses. The researchers determined the chronotypes of the nurses before the nurses started the shift work and before off days. The researchers addressed the chronotype and also the effects the levels of sleepiness and fatigue had on the nurses' psychomotor vigilance and mathematical problem solving (Reinke, Özbay,

Dieperink, & Tulleken, 2015).

Reinke et al. (2015) concluded most subjects had an affinity for early morning tasks, meaning they were a morning chronotype. This means these nurses were more likely to nap before a shift. No effect on psychomotor vigilance was found among the night shift nurses despite fatigue and sleepiness. The mathematical problem-solving scores also remained high. The results showed significant adaptation to the night time work environment from the nurses on night shift (Reinke et al., 2015).

Cognitive Function

Lees and Lal (2016) conducted a small study to address the possible correlation between stress and neurocognitive performance. The purpose of this study was to determine if stress from being a bedside nurse negatively impacted patient care. Several tests were utilized with previous validation to measure neurocognitive status of nurses (Lees & Lal, 2017).

Selected to participate in the study were 36 nurses. Participants were subjected to the Lifestyle Appraisal Questionnaire, electroencephalogram, Mini-Mental State Exam, and Cognistat. These methods of data collection yielded no relationship between stress levels and neurocognitive performance. The nurses all yielded normal neurocognitive results. It was determined that the relationship between stress and cognitive function requires further research (Lees & Lal, 2017).

Rheaume and Mullen (2018) conducted a small study regarding the impact of shift work and long hours on the cognitive errors made by nurses. There is growing concern of the impact irregular work patterns and excessive length of each shift has on the performance and well-being of a nurse. The researchers had 28 participants in the study and these nurses worked either 8-or 12-hour shifts. The study utilized an actigraphy and sleep diary at the beginning of four

consecutive shifts, as well as an after-work questionnaire (Rheaume & Mullen, 2018).

Rheaume and Mullen (2018) determined nurses who worked 12-hour shifts had poorer quality of sleep than those who worked 8-hour shifts. This study determined there was no difference in cognitive errors made by the two groups, but those who worked 12-hour shifts also napped more. The researchers concluded that while sleep quality was poorer in the nurses who worked 12-hour shifts, there was no evidence to suggest a nurse working 12-hours would make more errors than those who worked 8-hour shifts. This suggests increasing flexibility in working environments should be investigated (Rheaume & Mullen, 2018).

Research Tools

Winwood, Winefield, Dawson, and Lushington (2005) conducted a research study into fatigue measurement in the workplace. The purpose of this study was to develop a functional scale to measure and distinguish between acute and chronic fatigue and how effectively workers recover from fatigue. The researchers critiqued existing literature on fatigue and existing tools used to measure fatigue. Chosen as the basis for the development of a new tool were 30 items. The researchers decided that utilizing a seventeen-point Likert scale would yield the most valid results. A 0-6 scale was used with a formula developed to score the data between 0 and 100. It was decided that 10/30 items would be negatively keyed to prevent the manufacture of artificial results. The researchers set out to conduct a pilot study to determine the validity of the scale (Winwood, Winefield, Dawson, & Lushington, 2005).

Winwood et al. (2005) conducted an initial pilot study consisting of 247 nurses, most of which were female, and 232 quarry workers, most of which were men. Due to the gender disparity in the groups, the study provided an opportunity for any evident gender bias to be revealed. The initial pilot study suggested 20 of the 30 items that had been selected for use

correlated favorably with results of the Maslach Burnout Inventory (MBI) and Checklist Individual Strength (CIS) scales. The significant correlation between the OFER scale and both the MBI and CIS prompted the researchers to formulate a validation study. The validation study was a poll of 1,600 nurses in an Australian metropolitan hospital using the scale that had now been termed the Occupational Fatigue Exhaustion Recovery (OFER) scale. Of this large sample, 770 nurses responded. The researchers then requested a retest from the participants and received 281 valid emails to do so (Winwood et al., 2005).

Winwood et al. (2005) yielded favorable results for the OFER scale. The scale was shortened into a 15-item questionnaire based on the validity of the items. This tool can accurately measure acute and chronic fatigue as well as recovery between shifts. The scale was determined to be free of gender bias. The three subscales of the OFER scale, chronic fatigue, acute fatigue, and inter-shift recovery were all proven to provide meaningful and accurate results. The researchers successfully created a tool to measure not only chronic and acute fatigue, but also to measure inter-shift recovery of shift workers such as nurses (Winwood et al., 2005).

Debray, Biswas, Biswas, Saha, and Sudan Pal (2015) conducted a small study of the cognitive effects of exercise on male college students by utilizing a computerized version of the Stroop test. For the purpose of this study, 28 male participants were selected. The participants were healthy sedentary college students in Bengali. Selection of the participants was done utilizing random sampling. Debray et al. (2015) aimed to identify the effect aerobic exercise had on cognitive attention. Consent was obtained from all participants after thorough explanation of the procedure and purpose of the study. The Stroop test was utilized to identify cognitive performance of mental attention. The participants were not allowed to practice the Stroop test before the test was given for data collection. Significance was determined to be results that

yielded less than or equal to 0.05 for each analysis (Debray, Biswas, Biswas, Saha, & Sudan Pal, 2015).

The participants were given a set amount of choices to make with the Stroop test and were timed from start to completion. The average time before exercise was determined to be 194.3 seconds. After the completion of aerobic exercises, which consisted of three minutes of a step-up exercise, it was determined the average time for completion was 160.4 seconds. Results of the Stroop test yielded a 17% reduction in the time it took to complete. Debray et al. (2015) concluded cognitive attention as measured by the Stroop test was improved after completion of short-term aerobic exercises in young adult men. This indicated the Stroop test is a valid tool for examination of cognitive function (Debray et al. (2015).

Arsintescu, Mulligan, and Flynn-Evens (2017) conducted a study of three techniques for performing a psychomotor vigilance task (PVT) on a touch screen device. The purpose of this study determined latency of a touch screen version of the psychomotor vigilance task. The researchers developed a method to accurately determine if touch screen devices were suitable for administration of the PVT (Arsintescu, Mulligan, & Flynn-Evens, 2017).

Thirteen participants were selected to partake in this study. These subjects completed a five-minute version of the PVT while holding the touch screen device in different positions. The researchers defined three positions for the touch screen device to be held while the test was administered. These positions were sitting the device on the table and answering with the index finger, holding the device in one's hand vertically and answering with the index finger, and holding the device in one's hand horizontally and answering with the thumb. The subject's reaction times to the different orientations were compared. The first session was recorded using a high speed video camera to determine the time lapse between the subject touching the screen and

the device documenting a reaction time (Arsintescu et al., 2017).

Participants had a significantly quicker reaction time when utilizing the landscape and thumb approach. The device latency was determined to vary greatly between individuals. The orientation and latency of touch screen devices must be taken into account when providing a test for research purposes (Arsintescu et al., 2017).

Conclusion

Longer work hours led to impaired sleep quality and increased patient care errors. The student researcher recognized many nursing errors within the literature that resulted from impaired cognitive function likely related to impaired sleep quality. Several of the studies recognized the impact of long work hours on patient care. Many studies suggested improvements to shift length to improve patient care. These long hours negatively impact patient outcomes and nurse satisfaction. It is vital to understand the relationship between shift length and cognition to improve patient care and decrease nurse burnout.

Chapter III

Research Design

The student researcher used a non-experimental comparative design that did not manipulate the independent variables. The data was collected by the student researcher using a prospective study format and without introducing any external variables. The comparative design helped conclude the differences between the neurocognitive function at the beginning of a shift versus the end. This design provided sufficient sampling for the student researcher's hypothesis (Nieswiadomy, 2012).

Variables

In this study, the independent variable was the nurse's shift length. The dependent variable was the nurse's neurocognitive function. The student researcher controlled the research tools, which were the Stroop test and OFER scale. The tools were available for all participants for the same amount of time. The same tools were used for each participant. Some of the extraneous variables that could not be controlled for the purpose of the research study were the units in which the nurses worked, the acuity of the patients on the day the data was gathered, and previous knowledge of the tools. Other extraneous variables that could have affected results include years working 12-hour shifts and age of the participants. Due to time constraints, the student researcher only examined bedside nurses working 12-hour shifts in one small rural hospital (Nieswiadomy, 2012).

Selection of Subjects and Setting

The target population of the study was licensed RNs who work in the hospital setting and are in direct care of patients during the duration of a 12-hour shift. The accessible population included practicing RNs at one small rural hospital in the southeastern United States.

Convenience sampling was utilized. This method of sampling led to the possibility that the accessible population may not have exemplified a complete sample of the target population. The student researcher employed the non-probability method of convenience sampling due to the availability of the population and the time constraints (Nieswiadomy, 2012).

Utilizing the convenience method of sampling may have had several effects on the study. First, the student researcher collected data from bedside RNs at the beginning and end of their shifts. The student researcher obtained consent from the Institutional Review Board (Appendix H) at Mississippi University for Women and the facility involved (Appendix I). The rights of the participants were protected by the student researcher throughout the study. The participants were provided a cover letter (Appendix A), which allowed for informed consent to be obtained before individuals participated in the study and provided clear instructions. Participants were informed that participation would not affect their current employment status. Participants were also informed their initials would be collected on an initial collection form (Appendix J) to match morning versus evening results, but would then be promptly disposed of and would not be included on the research. The research study was conducted in the hospital setting during both morning and evening shift change (Nieswiadomy, 2012).

Data Collection

The data collection method utilized was a printed copy of the OFER scale (Appendix B) and a mobile iPad version of the Stroop test (Appendix C) to assess the registered nurse's neurocognitive function at the beginning and end of a shift. The mobile version of the Stroop test was conducted for 300 seconds. No participant was permitted to practice the Stroop test prior to actual administration, so as to ensure more accurate statistical data collection. The participants were instructed to set the iPad on a hard surface in landscape position and use the dominant

index finger to answer. The OFER scale was utilized to measure acute and chronic fatigue, as well as the inter-shift recovery. Demographic questions were added to identify participant age, years of work, and unit of work. The combination of the Stroop test and OFER scale was brief and comprehensive, and provided appropriate data to accurately be part of the student researcher's study. The Stroop test and the OFER scale had established validity and reliability. The Stroop test and the OFER scale have been utilized in extensive previous research, thus have established validity and reliability (Nieswiadomy, 2012).

Statistical Analysis

The student researcher utilized a paired samples test to interpret the data collected. The paired samples test was chosen because the student researcher selected a directional hypothesis, where at the end of a 12-hour shift cognition was hypothesized to be less acute than the beginning of the same 12-hour shift. The paired samples test was adequate for this research study because it can analyze and compare data before and after a shift. The paired samples test can be used for nearly any sample size and is particularly useful for the small sample size of 22 participants the student researcher collected. In this study, the mean values of each nurse's beginning shift versus end shift response times were compared. The data were collected and a 0.05% significance level was utilized (Nieswiadomy, 2012).

Limitations

Several limitations were apparent to the student researcher. Nurses working in different units may have differing levels of fatigue based on their patient populations. Nurses who have worked 12-hour shifts longer may have become accustomed to lengthier shifts. Some nurses' patient load may not be comparable to others. Another limitation was the accessibility of the population to the student researcher due to geographical location and time constraints.

Convenience sampling was utilized and therefore only RNs employed at one small rural hospital in the southeastern United States were studied. The population assessed may not have been representative of the target population. The participants were also not allowed to practice before the test was administered and prior knowledge of the Stroop test was not assessed.

Chapter IV

Results of the Study in Terms of the Original Hypothesis

The purpose of the student researcher's study was to determine if there was a significant difference in the neurocognitive abilities of bedside nurses at the beginning of their shift versus the end. The student researcher hypothesized that there would be a significant difference between a bedside nurse's neurocognitive abilities at the beginning of their shift versus the end. The null hypothesis was there is no significant difference in the neurocognitive effects of bedside nurses at the beginning of a shift versus the end of the same shift. Upon completion of collection and analysis of data, the student researcher determined there was a significant difference in the neurocognitive effects of bedside nurses after a full 12-hour shift. This was determined by using the response times at the beginning and end of the shifts. Due to the study's results, the student researcher rejected the null hypothesis.

Statistical Analysis

The Stroop Test (Appendix C) was available to the participants for five minutes at the beginning of their shift, and five minutes at the end of their shift. The OFER scale was distributed at the end of the shift. There was a total of 25 participants in the study; 22 participants completed all aspects of the study, while three were marked as incomplete. The two-marked incomplete were discarded. Only 22 participants were used for data analysis. The Stroop test (Appendix C) and OFER scale (Appendix B) were distributed to the sample population by the student researcher.

After analyzing the responses, the student researcher determined the neurocognitive effects of 12-hour shifts on bedside nurses. There were 15 questions on the OFER scale. Five of these questions measured acute fatigue, five were used to assess chronic fatigue, and five

determined inter-shift recovery. These questions helped determine if fatigue played a role in the neurocognitive abilities of the bedside nurses. The student researcher also collected four demographic questions to categorize the data.

The average response to the OFER scale was analyzed. The OFER scale is scored on a 100-point scale. The closer to 100 a participant scores the more strongly the data correlates to either acute or chronic fatigue, or adequate inter-shift recovery being obtained. The average chronic fatigue score was 38.79 which is relatively low and indicates the participants in the study are not chronically fatigued from their work and is not a significant problem at this time. The average response for acute fatigue at the end of a 12-hour shift was 71.06. This acute fatigue score is high and indicates potentially detrimental effects of 12-hour shifts. For future studies, a larger sample size should be collected and a comparison should be drawn with nurses working 8-hour shifts. The average response to inter-shift recovery was 47.73 where as a score of zero means no inter-shift recovery has occurred and a score of 100 means there is ample inter-shift recovery. This score indicates that rest periods between the already fatiguing 12-hour shifts may be inadequate to properly recover. Further studies regarding acute fatigue and inter-shift recovery are necessary to improve patient and nurse satisfaction in the hospital settings.

The student researcher assessed the data that was collected and used the results of the Stroop test and OFER scale to determine the significance of the study. The paired samples test analysis revealed a significant difference in the neurocognitive abilities of bedside nurses at the beginning and end of one shift. The *t* value was 3.224, the degrees of freedom were 21, and the significance level was 0.004. Therefore, the student researcher rejected the null hypothesis that stated there is no significant difference in the neurocognitive abilities of bedside nurses at the beginning of one's shift as compared to the end of the same shift.

The following chart shows the difference in the beginning and end of shift response times among the 22 participants. The average beginning of shift response time was 1.47 seconds and the average end of shift response time was 1.34 seconds. The overall results determined that there was a significant difference between the beginning of shift response times and the end of shift response times. This indicated a significant difference in the neurocognitive abilities of bedside nurses.

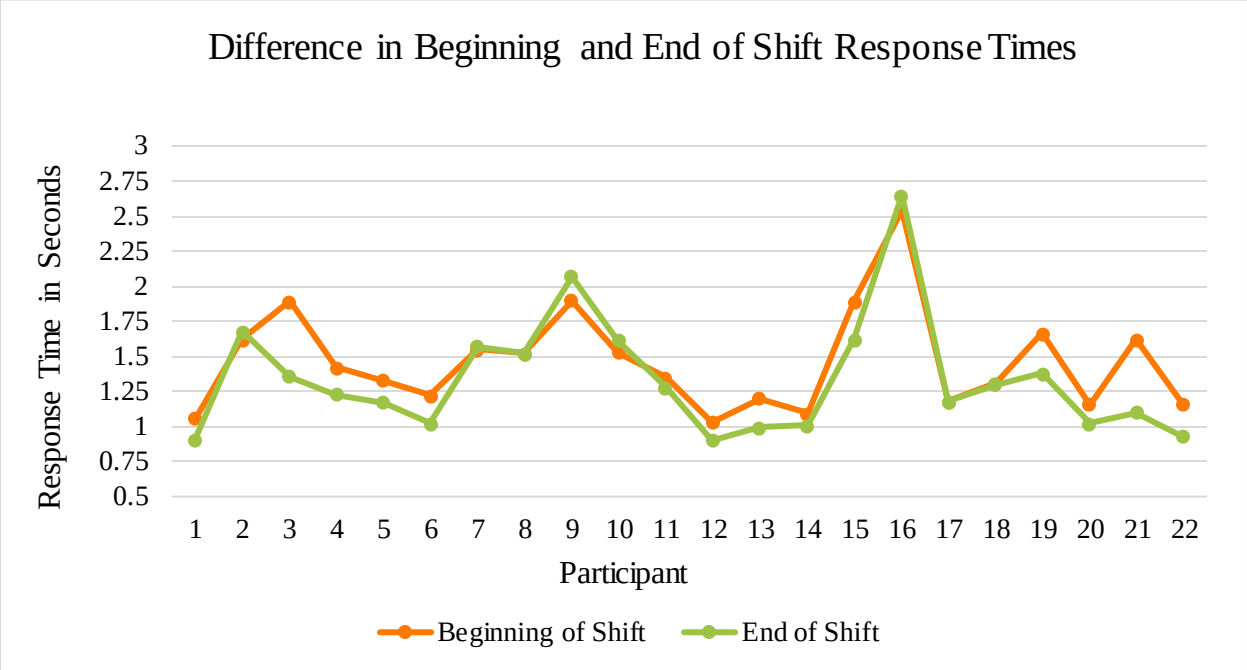

Table 1. Difference in Beginning and End of Shift Response Times

Findings from Related Research

The student researcher studied the effects of 12-hour shifts on bedside nurses. The student researcher determined there is a significant difference in the neurocognitive abilities of bedside nurses at the beginning of one's shift as compared to the end of the same shift. This seemed to correlate to the literature the student researcher investigated.

Griffiths et al. (2014) reported that nurses working 12 or more hours typically also reported more patient care errors and general care left unfinished. The increase in patient errors

toward the end of a 12-hour shift indicates a correlation between time worked and a nurse's ability to perform his or her designated tasks. This correlation indicates it is likely the neurocognition of a nurse suffers toward the end of a shift. This study further supports the student researcher's results that there is a significant difference in the neurocognitive abilities of nurses at the end of their shifts.

Another study conducted by Clendon and Gibbons (2015) found that a majority of the studies in the systematic review supported the fact that errors increased when 12-hour shifts were practiced. Since the errors increased near the end of a 12-hour shift it can be concluded that there was a correlation between shift length and nurse errors. A correlation between increasing errors and shift length further suggests that the neurocognition of nurses may be impaired in the late hours of a 12-hour shift. This study backs up the student researcher's findings that there is a significant difference in the neurocognitive abilities of bedside nurses at the beginning and end of a shift.

Johnson et al., (2014) determined that a majority of the nurses in the study were sleep deprived. This study showed there was a positive correlation between sleep deprivation and nurse error. Since acute fatigue can be related to sleep deprivation this study supports the student researcher's findings that there is a correlation between elevated acute fatigue scores on the OFER scare and impaired cognition.

These studies back the student researcher's findings that neurocognition is potentially impaired at the end of a 12-hour shift. This impairment could potentially result in numerous complications for both patients and health care providers. It is for this reason that further research must be conducted to examine the detrimental effects 12-hour shifts have not only on patient care, but also on nurse health and job satisfaction.

Negative/Contradictory Findings

After completion of the research study regarding the neurocognitive abilities of bedside nurses, the student researcher concluded that there were contradictory or negative findings between prior related research and the current research. The student researcher rejected the null hypothesis, meaning there was a significant difference in the neurocognitive effects of 12-hour shifts on bedside nurses. The prior research investigated the relationships between stress and neurocognition, neurocognition between 8 and 12-hour shifts, and fatigue and psychomotor vigilance. These studies ruled the relationship insignificant. Therefore, the student researcher presumed there were contradictory or negative findings between prior related studies and the current research.

While no studies specifically contradict the current research study, Rheaume and Mullen (2018) determined that there was no significant difference in the neurocognitive function of bedside nurses who worked 8-hours than those that worked 12. This indicates there is need for further investigation into the neurocognitive effects of 12-hour shifts on bedside nurses with comparison to nurses who work 8-hours.

Lees and Lal (2016) also found no correlation between stress and impaired cognition, while the student researcher found a direct correlation between acute fatigue and impaired cognition. Although these two are not identical in nature they are not mutually exclusive either. This suggests that there is need for further studies regarding the impact acute fatigue has on stress levels and how this further correlates to impaired cognitive performance.

Reinke et al. (2015) determined despite fatigue, the nurses in the study had no significant difference in the psychomotor vigilance. Psychomotor vigilance is similar to neurocognitive

abilities. Further investigation into the neurocognitive abilities of bedside nurses and the correlation the student researcher found to fatigue is warranted.

Limitations

The student researchers observed the following limitations while conducting the research study:

1. There was a small sample size of only 22 completed tests out of 25 participants.
2. The sample may not be representative of the entire target population, as the sample was conveniently selected from areas accessible to the student researcher.
3. There were limited days the student researcher was available for data collection.

Alterations to the Proposal and Serendipitous Findings

One serendipitous finding was that there was a direct correlation between the increasing acute fatigue scores on the OFER scale and the difference in the before and after shift accuracy of the nurses on the Stroop test. This finding concluded that as fatigue increased, neurocognitive function suffers. The following tables show the relationship between the accuracy of the bedside nurses who reported acute fatigue scores of 71.06 or greater on the OFER scale.

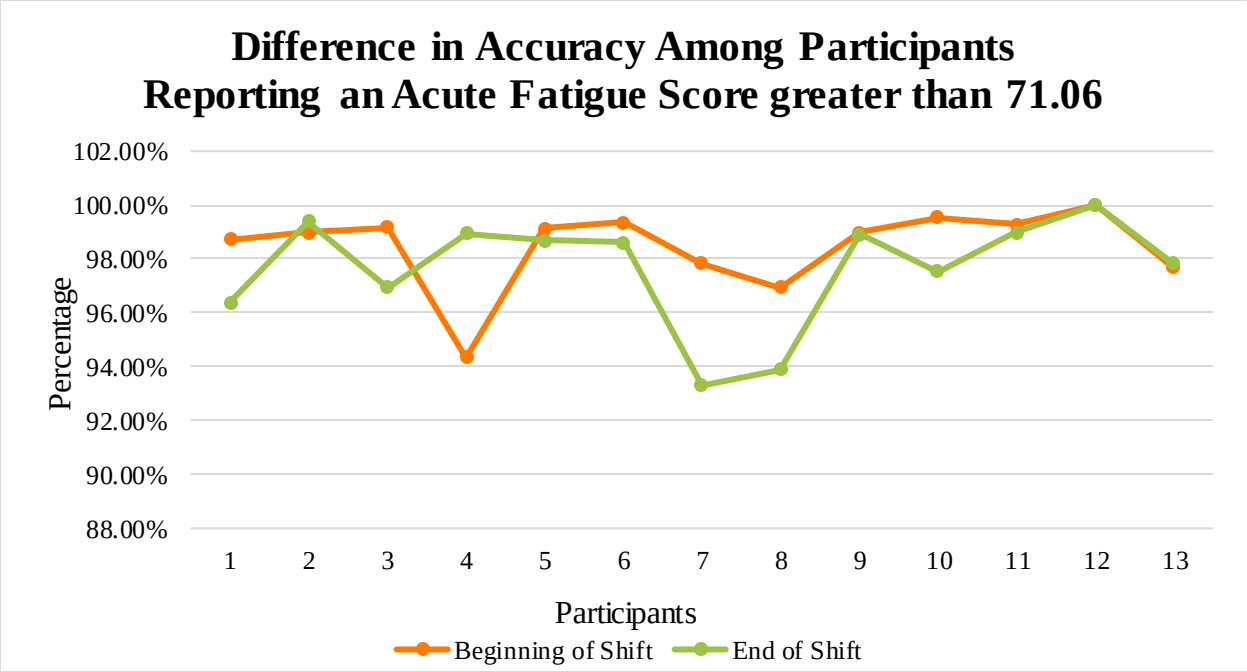

Table 2. Difference in Accuracy Among Participants Reporting an Acute Fatigue Score greater than 71.06

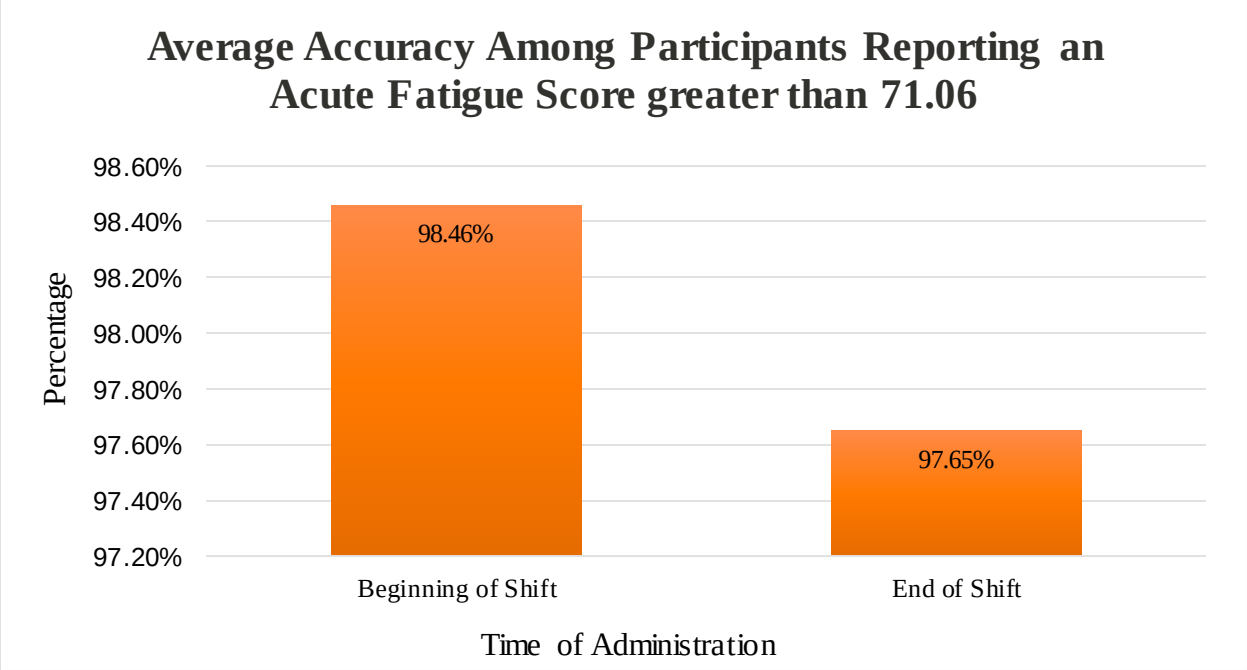

Table 3. Average Accuracy Among Participants Reporting an Acute Fatigue Score greater than 71.06

Chapter V

Summarize Highlights

The objective of this study was to determine if there was a difference in neurocognitive abilities among bedside nurses at the beginning and end of a 12-hour shift. The null hypothesis stated that there would be no significant difference in the neurocognitive abilities of bedside nurses after a 12-hour shift. The student researcher used an experimental comparative design and administered the Stroop test and OFER scale among 25 RNs at a small rural hospital with 22 viable scores. The OFER scale had a total of 15 questions. Five questions assessed acute fatigue, five analyzed chronic fatigue, and five questions investigated inter-shift recovery. The student researcher used a paired samples test to analyze the results of both the Stroop test and the OFER scale. The statistical data showed that there was a significant difference in the neurocognitive abilities of RNs after a 12-hour shift. Therefore, the student researcher rejected the null hypothesis.

State Conclusions

The student researcher accurately concluded that there was a significant difference in the neurocognitive abilities of registered nurses after a 12-hour shift. This conclusion was based on the findings represented in the statistical analysis. The student researcher concluded the reason these results were collected was because 12-hour nursing care requires a high level of critical thinking, which can become mentally draining. Long hours and shift work results in acute fatigue that contributes to mental fatigue. When mentally fatigued the student researcher, determined neurocognition suffers. Another contributing factor is likely that nurses are often overworked and understaffed. As a result, there is a significant difference in the participant's before and after

shift response times. Since the student researcher defined neurocognitive abilities as reactivity and alertness, the response time in seconds was used to determine the significance of the study.

Important Implications

In the healthcare setting, nurses must always be alert in order to care for patients. Based on the findings that there is a significant difference in the neurocognitive abilities at the beginning and end of a 12-hour shift, it is plausible to conclude 12-hour shifts are potentially detrimental to patient and nurse well-being. Further research must be done to ascertain if 12-hour shifts are to blame for the impaired cognition, or if it is simply a result of any nursing shift regardless of length.

Based on the literature and the student researcher's findings, it would appear that further research is required to determine the effects of long hours and shift work on patient and nurse well-being. 12-hour shifts are normalized in today's society, but many research studies speak to the possibility that this common practice may need revaluation. Nurses are often overworked and understaffed, which may contribute to the issues with patient safety. The student researcher's results determined that neurocognition is significantly different before and after a 12-hour shift and therefore hospitals should begin investigating ways to improve nurse cognition. This may be providing adequate breaks during the shift, shortening the shift, or ensuring adequate staffing. These may all play a role in the significant results the student researcher found, and should be appropriately addressed and further research should be conducted.

Recommendations

The student researchers provided the following recommendations to improve future research studies regarding the attitudes about naloxone administration.

1. Obtain a larger sample size of each subset to complete the study.

2. Collect the data from a broader geographic area and use random sampling.
3. Give a broader time frame when defining beginning and end of shift.
4. Ensure participants understand what is being measured with the test.
5. Utilize multiple electronic devices to administer the test more efficiently.
6. Ask the participants what day in their schedule they are in (i.e. day 4 of 4 shifts).

Theoretical Application

Abdellah's patient-centered care theory suggests that nurses must do their best to ensure each patient receives optimal treatment. If nurses are fatigued patient care will be neglected. It is important to understand the impact of 12-hour shifts on nurses in order to best understand how to improve patient centered care. Due to the results of this study it is imperative to reevaluate if a 12-hour shift truly supports Abdellah's theory of patient-centered care and other nursing values. If sufficient evidence is available to call into question the validity of normalizing 12-hour shifts, then it is unethical for further investigation to not take place if patient safety is a genuine concern.

Conclusion

In conclusion, the purpose of this study was to determine the neurocognitive effects of 12-hour shifts on bedside nurses. The student researcher hypothesized that there would be a significant difference in the neurocognitive effects of a 12-hour shift on bedside nurses. The student researcher concluded that the data showed there is a significant difference in the neurocognitive abilities of bedside nurses at the beginning and end of their shifts. Therefore, the student researcher rejected the null hypothesis, which stated that there is no significant difference in the neurocognitive abilities of bedside nurses at the beginning of one's shift as compared to

the end of the same shift. These results warrant further investigation into the normalization of 12-hour shifts for bedside nurses.

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Appendix A

Participation Cover Letter

Dear Participant,

Thank you for taking your time to participate in this study. The overall purpose of the study is to investigate if 12-hour shifts negatively impact a nurse's neurocognitive abilities. The study is important to further the research regarding 12-hour shifts and patient safety. Your participation in this study will not impact your employment and/or benefit status. There are no penalties for not participating in this study. All responses will be kept confidential. Your initials will be collected on a separate form in order to pair your results at the beginning of your shift to the end. A number will be assigned to you and your initials will be shredded as soon as the data has been collected.

There are two parts to this study. The Occupational Fatigue Exhaustion Recovery (OFER) scale and a mobile version of the Stroop test. By completing these research tools, you are consenting to be part of the study conducted by MUW BSN-nursing senior Caroline Miller under the direction of Dr. Sacha Dawkins. After completion of both research tools, you may choose to enter a raffle for a $50 Walmart gift card. Information on the raffle tickets will be confidential and shredded after a winner is selected.

Instructions:

The OFER scale simply requires you select the answer choice that most accurately describes your feelings. Please do not put your name on the scale. Please answer these questions honestly and do not share answers. After completing the OFER scale please fold it and return it to the student researcher.

The Stroop test is a color/word recognition test that will be administered on an iPad. Color words will appear on the screen and you will select the color the word is written in rather than the actual word (i.e. Red may be written in yellow). This will be administered for 5 minutes in the morning and 5 minutes in the evening. Please set the iPad on a hard surface and select your answer with your dominant pointer finger. Upon completion please notify the student researcher.

Thank you for your time and participation in this study. Please let me know if you are in need of assistance at any point during this study.

Caroline Miller

MUW-BSN

Appendix B

Occupational Fatigue Exhaustion Recovery (OFER) Scale

These Statements are about your experience of FATIGUE and STRAIN at Work and Home OVER THE LAST FEW MONTHS

Circle a number from 0-6: "Strongly Disagree" to "Strongly Agree" which best indicates your response.

	Strongly Disagree	Disagree	Slightly Disagree	Neither Agree or Disagree	Slightly Agree	Agree	Strongly Agree
1) I often feel I'm 'at the end of my rope' with my work	0	1	2	3	4	5	6
2) I often dread waking up to another day of my work	0	1	2	3	4	5	6
3) I often wonder how long I can keep going at my work	0	1	2	3	4	5	6
4) I feel that most of the time I'm just "Living to Work"	0	1	2	3	4	5	6
5) Too much is expected of me in my work	0	1	2	3	4	5	6
6) After a work shift I have little energy left	0	1	2	3	4	5	6
7) I usually feel exhausted when I get home from work	0	1	2	3	4	5	6
8) My work drains my energy completely every day	0	1	2	3	4	5	6
9) I usually have lots of energy to give to my family or friends	0	1	2	3	4	5	6
10) I usually have plenty of energy left for my hobbies and other activities after I finish work	0	1	2	3	4	5	6
11) I never have enough time between shifts to recover my energy completely	0	1	2	3	4	5	6
12) Even if I'm tired from shift, I'm usually refreshed by the start of the next shift	0	1	2	3	4	5	6
13) I rarely recover my strength fully between shifts	0	1	2	3	4	5	6
14) Recovering from work fatigue between shifts isn't a problem for me	0	1	2	3	4	5	6
15) I'm often still feeling fatigued from one shift by the time I start the next one	0	1	2	3	4	5	6

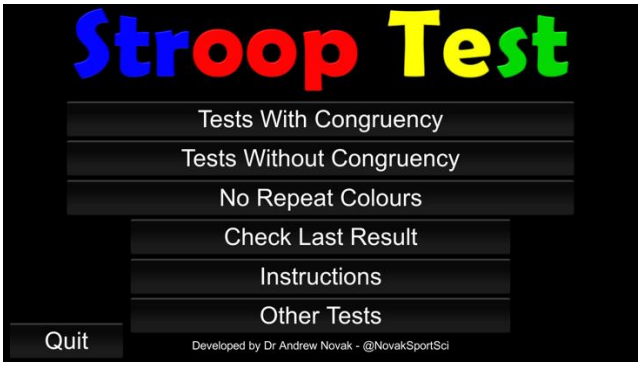
How old are you?_____ How long have you been a nurse working 12-hour shifts? _____

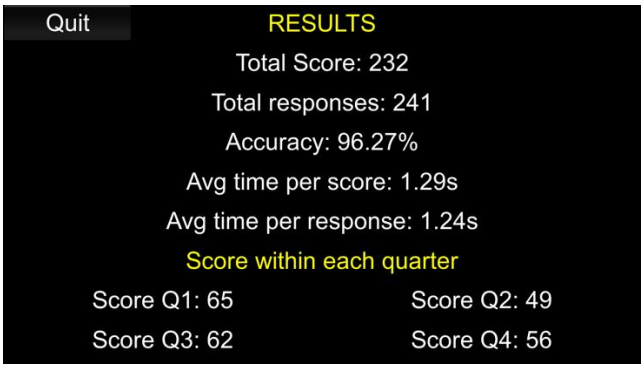
What type of floor/unit do you work on? Circle one: Med-Surg Critical Care Other:_____

What shift are you on? Circle one: Nights Days

Appendix C

The Stroop test requires participants to select the COLOR the word is printed in as opposed to the actual color word that is written. The Stroop test with Congruency was utilized in this research study, meaning some color words may be written in that color (i.e. "Red" written in red). The app provides information on total number of responses within the 300-second time frame, accuracy of the answers, and average time per response.





Appendix D

Request for Permission to use the OFER Scale

Caroline Miller <cnmiller@myapps.muw.edu> Mon, Sep 10, 2018 at 3:14 PM

To: Peter.Winwood@unisa.edu.au

Dear Dr. Winwood,

This email is regarding the Occupational Fatigue Exhaustion Recovery (OFER) Scale that was developed and validated by the School of Psychology at the University of South Australia. I am a senior baccalaureate nursing student from Mississippi University for Women in the honors college and I am conducting a small study assessing the variances between registered nurses' cognitive ability at the beginning of a shift versus the end of a shift. My study is entitled *Neurocognitive Effects of a 12-hour Shift on Bedside Nurses.* I am asking permission to use the scale as a tool for my research study. I plan to add a section of demographic questions (education level, experience, etc.) but I do not plan to alter the original scale.

Please kindly respond to your agreement or declination regarding the use of this tool at your earliest convenience, as I am very eager to begin my research to add to the body of knowledge. Your response may be directed to this email address. If you need any further information regarding the intent of my study, please feel free to ask.

Thank you for your time,

Caroline Miller
Mississippi University for Women
Ina E. Gordy Honors College

Appendix E

Permission to use the OFER Scale

Peter Winwood <Peter.Winwood@unisa.edu.au> Tue, Sep 11, 2018 at 1:14 AM

To: Caroline Miller <cnmiller@myapps.muw.edu>

Hello Caroline
Thank you for your kind request
The OFER scale has become the 'go to' measure for work related fatigue, particularly in the Health Industry, and is in use in scores of studies worldwide.
It is a commercial scale. However, I do not charge students licencing fees to use it contingent on them agreeing not to share their OFER copy or the scoring key with any other person.
You will need to purchase the OFER Manual, though, which costs $US 100.
If you would like to proceed please write again and I will send an invoice you can pay with any credit card using PayPal.
Peter Winwood (Dr).

Appendix F

Request for use of the Stroop test app from Dr. Andrew Novak:

Dear Dr. Novak,

This email is regarding the Reaction Time Tests for Science app and the Tapping Test app you have on the app store. I apologize for messaging you via twitter. I am a senior baccalaureate nursing student from Mississippi University for Women in the honors college and I am conducting a small study assessing the variances between registered nurses' cognitive ability at the beginning of a shift versus the end of a shift. My study is entitled Neurocognitive Effects of a 12-hour Shift on Bedside Nurses. I am asking permission to use the apps as tools for my research study pending the purchase of the apps. Please kindly respond to your agreement or declination regarding the use of these tools at your earliest convenience, as I am very eager to begin my research to add to the body of knowledge. Your response may be directed to this twitter account, or cnmiller@myapps.muw.edu if you would prefer to correspond via email. If you need any further information regarding the intent of my study, please feel free to ask.

Thank you for your time,

Caroline Miller

Mississippi University for Women

Ina E. Gordy Honors College

Appendix G

Permission to use the Stroop test and other apps:

Dr. Andrew Novak

@NovakSportSci

Hi Caroline, Thanks for your message. Yes, you are more than welcome to use the apps in your research - I designed them for research purposes. Thank you for checking with me though! Your research sounds interesting and I'm sure will be beneficial for Nurses. I'd love to hear about your findings after the research is completed. Just a quick suggestion - it might worth looking at the Stroop Task app as well or perhaps instead of the tapping test - I know there are some other researchers using the Stroop app to explore the effects of mental fatigue. Regards, Andrew

Appendix H

IRB Approval

The Mississippi University for Women
A Tradition of Excellence for Women and Men

Provost and Vice President for Academic Affairs
1100 College St. MUW-1603
Columbus, MS 39701-5800
(662) 329-7142
(662) 329-7141 Fax
www.muw.edu

January 24, 2019

Sacha Dawkins, Ph.D.
Mississippi University for Women
College of Nursing and Health Sciences
1100 College Street, MUW-910
Columbus, MS 39701

Dear Dr. Dawkins:

I am pleased to inform you that the members of the Institutional Review Board (IRB) have reviewed the following proposed research and have approved it as submitted:

Name of Study:	Neurocognitive effects of 12-hour shifts of bedside nurses
Research Faculty/Advisor:	Sacha Dawkins
Investigators:	Caroline Miller

I wish you much success in your research.

Sincerely,

Scott Tollison

Scott Tollison, Ph.D.
Interim Provost and Vice President for Academic Affairs

ST/tc

pc: Irene Pintado, Institutional Review Board Chairman

Appendix I

Facility Consent

Your facility is being asked to take part in a research study that is designed to compare the neurocognitive abilities of bedside nurses before and after 12-hour shifts. The student researcher will have a questionnaire called the Occupational Fatigue/Exhaustion Recovery (OFER) scale. This scale will look at acute and chronic fatigue as well as inter-shift recovery. The OFER scale will require no more than five minutes to complete. The student researcher will also have a mobile version of the Stroop test to analyze beginning and end of shift cognition. The Stroop test is a simple color/word recognition test that will be administered over five minutes in the morning and evening. The study will require about 15-minutes total from the participants. The student researcher will contact the nurse manager before coming to his or her floor. The supervising advisor in this study is Dr. Sacha Dawkins at Mississippi University for Women.

The overall purpose of the study is to investigate if 12-hour shifts negatively impact a nurse's neurocognitive abilities. The study is important to further the research regarding 12-hour shifts and patient safety.

Should the facility choose to participate in the study, the student researcher will enter the facility on several days for no more than four weeks to administer the tests. Any information obtained in the study will be kept confidential.

There will be no costs associated with participation. The participants will be given the option to enter a raffle for a $50 Walmart gift card. The benefit of participating in the study is to evaluate the impacts of 12-hour shifts and help improve patient safety.

The student researcher will protect participant confidentiality. This is a voluntary study. It is the facility's choice to participate. After the scores from the tools are analyzed for the study,

the results will be destroyed. The data from the tools will be stored in a password protected computer database. The participants can withdraw from the study at any time before submitting their results. After submitting the results, withdrawal of participation will not be possible due to anonymity of response.

The Mississippi University for Women Institutional Review Board (IRB) is the committee that protects the rights of participants and research studies. The IRB may review the study records periodically to be sure that the participants in the research study are being treated fairly, and that the study is being carried out as planned.

If the facility has any questions about the study or the rights of the facility as a participant in a research study, please feel free to contact my advisor at any time by email at: sddawkins@muw.edu

I have read the consent form. The study has been explained to me. The facility understands what it will be required to do. The facility agrees to participate and allow the Mississippi University for Women senior BSN-nursing major Caroline Miller to enter (facility's name) _____ to obtain data to add to the body of research in nursing. I will receive a copy of this consent form to keep.

_____

Signature of Facility Supervisor Date

_____

Investigator Date

Appendix J

Initial Collection Form

Nurse Number	**Initials**	**Nurse Number**	**Initials**
1		**16**	
2		**17**	
3		**18**	
4		**19**	
5		**20**	
6		**21**	
7		**22**	
8		**23**	
9		**24**	
10		**25**	
11		**26**	
12		**27**	
13		**28**	
14		**29**	
15		**30**	