Sleep deprivation and cognitive performance of shift workers in Bangladesh

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Md. Salim Hossain

[A dissertation submitted in partial fulfillment of the requirements for the degree of Doctor of Philosophy in Psychology at the University of Dhaka]

April 2024

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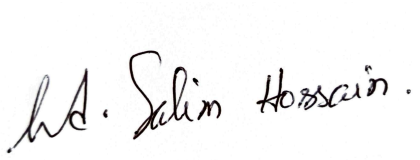
Declaration

I hereby declare that this is an original doctoral dissertation of my own study and it has not been accepted for the award of any degree or diploma in this university or in any other institution. I also confirm that this doctoral dissertation does not contain any material previously published or written by any other author, except where due reference is stated in the text.



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Certificate

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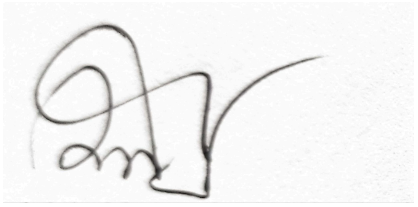

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Dedication

To my mother and daughters:

Momtaz Begum, Sabeeh Avisha Ishitto & Shareen Aribaah Irha

and

To all my students who kept faith in Industrial-Organizational Psychology

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Abstract

Number of studies revealed that shift workers experience disturbed sleep and excessive sleepiness (Akerstedt, 2003). Sleep has been found to be essential for cognitive performance, especially memory consolidation and changes in mood (Stickgold, 2005; Philibert, 2005). Our present study was aimed at investigating the effect of sleep deprivation on cognitive performances of shift workers in Bangladesh. In investigating so, we took 462 healthcare shift workers from five districts of Bangladesh. Among them 152 were male and 310 were female. The participants ranged from 19 to 65 years of age. We took the participants on the basis of convenience sampling technique from 30 hospitals and medical centers. To collect data we administered Bangla version of Pittsburgh Sleep Quality Index (PSQI), Montreal Cognitive Assessment (MoCA), Epworth Sleepiness Scale (ESS), and The Grit Scale. All these psychometric tools have high reliability and validity. Findings of our study revealed that sleep deprivation and shifts are marginally dependent ($\chi^2 = 11.56$, $p = 0.07$). However, sleep quality has been found independent of shifts ($\chi^2 = 4.31$, $p = 0.12$). We didn't find any significant correlation between sleep deprivation and overall cognitive performances. But we found significant correlation of sleep deprivation with attention ($r = -0.106$, $p < 0.05$) and delayed recall ($r = 0.149$, $p < 0.01$). In our study we found a significant correlation between sleep quality and overall cognitive performances ($r = 0.196$, $p < 0.01$). Subcomponent-wise correlation revealed significant correlation of sleep quality with attention ($r = -0.132$, $p < 0.01$) and delayed recall ($r = 0.103$, $p < 0.05$). In regression analysis, we found sleep quality as a significant predictor of cognitive performances ($\beta = 0.20$, $p < 0.01$) but not the sleep deprivation. Shift-wise analyses yielded that sleep deprivation is high ($\mu = 7.56$) and sleep quality is worse ($\mu = 3.78$) in rotating shift workers in comparison to fixed and regular shift workers. Results also revealed significant shift-wise differences in cognitive performances (F

= 3.511, $p<0.05$) of shift workers. Shift-wise differences were evident in executive functions (F = 5.443, $p<0.01$), language (F = 13.816, $p<0.01$), and abstraction (F = 7.818, $p<0.01$). Significant gender differences were observed in overall cognitive performances (t = 2.036, $p<0.05$), naming (t = 2.204, $p<0.05$), abstraction (t = 2.201, $p<0.05$), and orientation (t = 2.044, $p<0.05$), and sleep deprivation (t = -2.380, $p<0.05$) of the shift workers in Bangladesh. Sleep quality was found better outside of metropolitan city (t = -3.258, $p<0.01$). Moreover, results showed significant differences in overall cognitive performances (t = -5.227, $p<0.01$), executive functions (t = -1.990, $p<0.05$), naming (t = 3.051, $p<0.01$), abstraction (t = 5.966, $p<0.01$), delayed recall (t = 2.459, $p<0.05$), and perseverance (t = -2.005, $p<0.05$), between inside and outside of metropolitan city shift workers. Designation-wise differences were found in overall cognitive performances (F = 11.173, $p<0.01$), executive functions (F = 8.082, $p<0.01$), language (F = 5.510, $p<0.01$), abstraction (F = 20.849, $p<0.01$), and sleep quality (F = 16.902, $p<0.01$) of the healthcare shift workers. Experiences of the shift workers were not found significantly correlated with sleep quality and sleep deprivation. We have discussed the results in terms of previous findings and contemporary theories. Recommendations are proposed in the light of our findings in conclusion.

Chapter One: Introduction

Introduction

Sleep deprivation is a widespread issue that affects various aspects of an individual's life, including cognitive performance. It has been shown to have detrimental effects on cognitive performance, including impaired reaction time (Krause et al., 2017), accuracy (Deepalakshmi et al., 2017), visual attention (Hudson et al., 2019), and memory (Frenda & Fenn, 2016). These effects can have negative implications for the quality of work performed by shift workers. When those shift workers are in the medical field, it can potentially compromise patient safety (Basner et al., 2017). Medical professionals play a vital role in safeguarding public health. However, the demanding nature of their work, particularly for those involved in shift work, can lead to sleep deprivation. Sleep deprivation in medical shift workers has been linked to increased risks of accidents and errors (Ramadan & Al-Saleh, 2015), as well as decreased job performance (Deepalakshmi et al., 2017) and overall quality of life (Redeker et al., 2019). Research suggests that sleep deprivation can also lead to mood disturbances, decreased motivation, and increased stress levels among medical shift workers (Pérez-Olmos & Ibáñez-Pinilla, 2014). Shift work disrupts the body's natural circadian rhythm, making it difficult to achieve adequate sleep duration and quality. This sleep disruption can negatively impact cognitive performance, potentially compromising patient care. In the context of Bangladesh, where the medical profession is very demanding, and often requires long and irregular hours, understanding the impact of sleep deprivation on the cognitive performances of medical shift workers is crucial for assessing their well-being and ensuring patient safety. This study aims to explore the effects of sleep deprivation on the cognitive performances of shift workers in Bangladesh, shedding light on potential interventions and policies to mitigate these effects. Given the demanding nature of the medical profession and the prevalence of shift work in Bangladesh, it is imperative to

investigate the specific challenges faced by medical shift workers in this context. This study aims to delve into the unique experiences of Bangladeshi medical professionals, examining the intersection of sleep deprivation and cognitive performance within the local healthcare landscape. By shedding light on these issues, the findings of this study can inform the development of targeted interventions and policies to support the well-being of medical shift workers and ultimately enhance the quality of healthcare delivery in Bangladesh.

1.1 Sleep Deprivation

Sleep deprivation refers to a condition characterized by the lack of sufficient or quality sleep, either due to external factors or internal disturbances, often resulting in a chronic state of inadequate rest, which can lead to various physiological and neurobehavioral deficits. It is a common issue that many people face in today's fast-paced world. It can have a significant impact on both physical and mental well-being, affecting cognitive function, mood, and overall health (Johnson, 2023). Sleep deprivation is a serious issue that can have a wide range of negative effects on both our physical and mental health. In today's fast-paced world, many people struggle to get the recommended 7-9 hours of sleep each night, leading to chronic sleep deprivation. This can lead to a variety of health problems, including an increased risk of heart disease, dibetes, obesity, and mental health disorders such as anxiety and depression (Sexton-Radek, 2019). Furthermore, sleep deprivation can also have a significant impact on cognitive function (Durmer & Dinges, 2024). It can impair decision-making, attention, and reaction times (Salfi et al., 2020), which can be particularly dangerous when it comes to activities such as driving or operating heavy machinery. Additionally, chronic sleep deprivation has been linked to a weakened immune system, making individuals more susceptible to illness and infection (Worley, 2018). It's

important to address sleep deprivation and prioritize healthy sleep habits in order to maintain overall well-being.

1.1.1 Types of Sleep Deprivation

There are two primary types of sleep deprivation: acute and chronic (Boland et al., 2017). Acute sleep deprivation refers to a short-term lack of sleep, often due to specific events or circumstances, such as pulling an all-nighter to meet a deadline, stress, travel, new parenthood, or caring for a sick family member. On the other hand, chronic sleep deprivation is a long-term pattern of insufficient sleep, typically occurring over an extended period. Acute sleep deprivation can lead to immediate consequences, such as fatigue, irritability, and reduced cognitive function (Řežábková & Joneš, 2021). However, these effects are often reversible with a few good night's sleep. On the other hand, chronic sleep deprivation has more serious and lasting impacts on health and well-being, as discussed earlier. Understanding the differences between these two types of sleep deprivation can help individuals recognize their own patterns of sleep deficiency and take steps to address them effectively. It's important to identify the underlying causes of sleep deprivation and implement healthy sleep practices to promote overall wellness and mitigate the associated risks.

1.1.2 Components of Sleep Deprivation

Sleep deprivation can be attributed to several components, including lifestyle factors, sleep disorders, and environmental influences. Lifestyle factors such as excessive workload, irregular work hours, and poor sleep hygiene can contribute to sleep deprivation (Krause et al., 2017). Additionally, engaging in stimulating activities before bedtime, such as using electronic

devices or consuming caffeine, can disrupt the natural sleep-wake cycle, leading to inadequate rest (Worley, 2018). Sleep disorders, such as insomnia, sleep apnea, or restless legs syndrome, can also play a significant role in sleep deprivation (Medic et al., 2017). These conditions interfere with the ability to achieve restorative sleep, resulting in persistent tiredness and diminished overall well-being (Patrick et al., 2017). Furthermore, environmental influences, such as noise pollution, uncomfortable sleeping conditions, or disruptions in the sleep environment, can impact the quality and duration of sleep, contributing to sleep deprivation (Okano et al., 2019). Addressing these components of sleep deprivation requires a comprehensive approach that involves identifying and modifying relevant lifestyle factors, seeking appropriate treatment for any underlying sleep disorders, and creating a conducive sleep environment. By recognizing and addressing these components, individuals can take proactive steps to improve their sleep quality and overall health.

1.1.3 Impact of Sleep Deprivation on Cognitive Performances

Sleep deprivation has a significant impact on cognitive performance. The effects of sleep deprivation on cognitive function are well-documented, and research has shown that inadequate sleep can impair various aspects of cognitive performance (Patrick et al., 2017). Some of the cognitive functions that are particularly vulnerable to the effects of sleep deprivation include attention, memory, decision-making, and reaction times (Fournier et al., 2018). One study published in the journal Nature, for example, found that sleep-deprived individuals exhibited reduced activity in the prefrontal cortex (Whitney et al., 2017), the area of the brain responsible for higher-level cognitive functions such as decision-making and social behavior. This decreased activity was associated with impaired decision-making and increased risk-taking behavior.

Furthermore, sleep deprivation has been shown to have a negative impact on memory consolidation (Dai et al., 2020), which is the process by which newly acquired information is transferred into long-term memory. Research has demonstrated that sleep plays a crucial role in memory consolidation (Brodt et al., 2023), and insufficient sleep can lead to deficits in both the encoding and retrieval of information (Cousins & Fernández, 2019). In addition to attention and memory, reaction times are also affected by sleep deprivation. Individuals who are sleep-deprived often experience slower reaction times (Hudson et al., 2019), which can have serious implications for activities that require quick decision-making, such as driving or operating machinery. Given the significant impact of sleep deprivation on cognitive performance, it is crucial to prioritize healthy sleep habits and ensure that individuals are getting an adequate amount of rest each night. By addressing the underlying causes of sleep deprivation and implementing strategies to improve sleep quality, individuals can mitigate the negative effects on cognitive performance and overall well-being.

1.1.4 Sleep Deprivation among Medical Shift Workers

Medical shift work is a demanding and essential aspect of the healthcare industry, ensuring continuous patient care around the clock. However, the irregular and often long shifts that medical professionals work can take a significant toll on their health due to sleep deprivation (Freeman et al., 2020). Medical shift workers often face challenges in shift timings. This disruption to the body's internal clock, known as the circadian rhythm, can lead to chronic sleep deprivation and its associated health risks (Fishbein et al., 2021). The irregular schedule can make it difficult for healthcare workers to obtain the recommended amount of sleep, as their shifts may interfere with normal sleep hours. Chronic sleep deprivation among medical shift

workers can have profound effects on their physical and mental well-being. Studies have shown that healthcare professionals working irregular shifts are at a higher risk of developing health conditions such as cardiovascular disease, obesity, and diabetes (Nena et al., 2018). Furthermore, inadequate sleep can also compromise cognitive function, leading to decreased alertness, impaired decision-making, and reduced job performance (L. R. James et al., 2023). This has serious implications for the quality of patient care and the safety of both the healthcare workers and their patients. Recognizing the unique challenges faced by medical shift workers, it is imperative to implement strategies to mitigate the impact of sleep deprivation. This may include providing education and support for establishing healthy sleep habits, creating optimal sleep environments in healthcare facilities, and implementing scheduling practices that prioritize the well-being of medical staff. Additionally, access to resources such as nap rooms or designated rest breaks during shifts can provide opportunities for healthcare workers to replenish their energy and reduce the risk of sleep deprivation. Addressing the issue of sleep deprivation among medical shift workers is crucial for ensuring the health and safety of both the healthcare professionals and the patients under their care. By taking proactive measures to support healthy sleep patterns and mitigate the effects of irregular shift work, healthcare organizations can promote the well-being and performance of their valuable staff, ultimately contributing to the delivery of high-quality patient care.

1.2 Cognitive Performance

Cognitive performance refers to the ability of the brain to process and retain information, make decisions, solve problems, and perform everyday tasks. It encompasses various aspects of mental function including attention, memory, processing speed, and executive function. Several

factors can impact cognitive performance, such as sleep quality, nutrition, exercise, stress levels, and overall mental well-being (Renke et al., 2022). Research has shown that regular physical activity can improve cognitive function by increasing blood flow to the brain and promoting the growth of new brain cells (Sannino et al., 2020). Additionally, a balanced and nutritious diet rich in antioxidants, omega-3 fatty acids, and other beneficial nutrients can support brain health and cognitive performance (Quigley et al., 2020). Furthermore, practicing mindfulness and stress-reduction techniques can help enhance cognitive performance by reducing the impact of chronic stress on the brain (Puri et al., 2023). Engaging in activities that challenge the brain, such as puzzles, learning a new skill, or playing musical instruments, can also contribute to maintaining and improving cognitive function (Zhou et al., 2020). Understanding the various factors that influence cognitive performance and incorporating lifestyle changes to support brain health can lead to improved mental acuity and overall well-being.

1.2.1 Factors Affecting Cognitive Performance

In addition to the lifestyle factors mentioned earlier, there are several other elements that can significantly impact cognitive performance. One such factor is social interaction and engagement (Hwang et al., 2018). Research has indicated that maintaining strong social connections and participating in meaningful conversations and activities can have a positive effect on cognitive function (Evans et al., 2018). This involvement helps in stimulating the brain and maintaining mental agility. Furthermore, ongoing learning and intellectual stimulation are crucial for preserving and enhancing cognitive abilities (Jangwan et al., 2022). Contributing to acquiring new knowledge and skills, whether through formal education, online courses, or self-directed learning, can contribute to cognitive reserve, which is the brain's ability to

withstand neuropathological damage. Moreover, the physical environment in which individuals spend their time can also influence cognitive performance (Weaver & Jaeggi, 2021). Exposure to natural light, a well-ventilated and organized space, and minimizing distractions can all play a role in fostering optimal cognitive function (Jones et al., 2021). Additionally, the inclusion of regular relaxation and rejuvenation activities, such as meditation, yoga, or spending time in nature, can support overall cognitive well-being (Y. J. Zhang et al., 2018). Understanding the multifaceted nature of cognitive performance and integrating various strategies to support it can lead to long-term benefits for overall brain health and mental acuity.

1.2.2 Measuring Cognitive Performance

Measuring cognitive performance involves using various assessments and tools to evaluate different aspects of mental function. One common method is through neuropsychological testing, which assesses cognitive abilities such as attention, memory, language, and executive function. These tests can provide valuable insights into an individual's cognitive strengths and areas that may need improvement. Additionally, brain imaging techniques, such as functional magnetic resonance imaging (fMRI) and positron emission tomography scans, can map brain activity and help identify patterns associated with different cognitive processes (Wu et al., 2021). Furthermore, cognitive performance can be measured through standardized cognitive tests that assess specific domains, such as processing speed, working memory, and visuospatial abilities (Asensio & Duñabeitia, 2023). These tests provide quantifiable data that can be used to track changes in cognitive function over time and evaluate the effectiveness of interventions aimed at improving cognitive performance. It's important to consider that cognitive performance can vary across different age groups, and there are

age-appropriate assessments designed to account for these differences. For example, cognitive assessments for older adults may focus on areas such as verbal fluency, decision-making, and episodic memory, while assessments for children may emphasize attention, learning, and cognitive flexibility. Understanding how cognitive performance is measured can help individuals and healthcare professionals identify areas of strength and areas for improvement, allowing for targeted interventions and personalized strategies to support cognitive health and overall well-being.

1.2.3 Components of Cognitive Performance

Cognitive performance is a complex construct that involves several interconnected components. These components contribute to an individual's overall cognitive abilities and can be assessed through various methods. Some of the components are attention, memory, processing speed, and executive function. Attention is a fundamental component of cognitive performance, enabling individuals to focus on specific stimuli while ignoring distractions (Lindsay, 2020). It plays a crucial role in learning, memory, and problem-solving. Assessments for attention often involve tasks that measure sustained attention, selective attention, and divided attention, providing insights into an individual's ability to concentrate and switch focus as needed (Burgoyne & Engle, 2020). Memory encompasses the processes of encoding, storing, and retrieving information (Zlotnik & Vansintjan, 2019). Assessing memory involves evaluating short-term memory, long-term memory, and working memory (Smith et al., 2021). Memory assessments can reveal strengths and weaknesses in an individual's ability to retain and recall information, which is essential for everyday functioning and learning new skills. Processing speed refers to the rate at which an individual can perceive and process information (Haigh et al.,

2018). It influences how quickly tasks can be completed and how efficiently information is handled. Cognitive assessments often include measures of processing speed to gauge an individual's cognitive efficiency and information processing capabilities. Executive function encompasses higher-level cognitive processes responsible for goal setting, planning, decision-making, and impulse control (Ozawa et al., 2022). Assessments for executive function evaluate skills such as cognitive flexibility, inhibitory control, and working memory (Nyongesa et al., 2019). These assessments provide valuable insights into an individual's ability to organize thoughts, regulate behavior, and solve problems effectively. Understanding the components of cognitive performance is essential tailoring interventions and strategies to address specific areas of cognitive function. By recognizing the interconnected nature of these components, individuals and healthcare professionals can develop targeted approaches to support cognitive health and empower individuals to optimize their mental acuity.

1.2.4 Role of Executive Function as Cognitive Performance

The effect of sleep deprivation on executive function is a critical area of study within cognitive neuroscience. Executive functions, which include processes such as planning, decision-making, error correction, and conflict resolution, are essential for daily life. These functions are primarily mediated by the prefrontal cortex and are highly susceptible to sleep loss (Krause et al., 2017). Sleep deprivation can lead to significant impairments in executive functions, affecting an individual's ability to concentrate, make decisions, and remember information (Patrick et al., 2017). The prefrontal cortex, which is responsible for managing these tasks, shows reduced activity when sleep is restricted (Farahani et al., 2019). This reduction in activity correlates with a decrease in cognitive flexibility, problem-solving skills, and inhibitory

control, all of which are key components of executive function. Moreover, sleep deprivation can alter emotional regulation, another aspect of executive function (Floros et al., 2021). This can result in mood swings, increased stress levels, and difficulty in managing social interactions. The interplay between cognitive and emotional components of executive function suggests that sleep deprivation not only impairs logical thinking and planning but also affects an individual's emotional responses (Patrick et al., 2017). The cumulative effect of these changes can be profound, particularly in professions that demand high levels of cognitive control and decision-making. For example, healthcare professionals, pilots, and drivers must maintain a high degree of vigilance and quick decision-making capabilities, which can be compromised by lack of sleep. In summary, sleep deprivation has a detrimental effect on executive function, leading to a decline in cognitive abilities and emotional regulation. This essay highlights the importance of sleep for maintaining executive function and sets the stage for further exploration of the mechanisms underlying the relationship between sleep deprivation and cognitive performance. Understanding these mechanisms is crucial for developing interventions to mitigate the negative effects of sleep deprivation and enhance cognitive health and productivity.

1.2.5 Effect of Sleep Deprivation on Executive Function

Perseverance, often understood as the steadfastness in doing something despite difficulty or delay in achieving success, is a pivotal trait in the realm of cognitive performance. It plays a multifaceted role in cognitive tasks and learning processes, and it can be the defining factor between mediocrity and excellence. At its core, perseverance is the engine that drives individuals to overcome obstacles and continue striving towards their goals (Olaguer & Pelayo, 2023). In cognitive endeavors, whether academic or professional, perseverance manifests as the relentless

pursuit of knowledge and mastery over a subject. It is the quality that compels a student to spend extra hours on a complex mathematical problem or a researcher to continue their inquiry despite numerous failed experiments (Määttänen et al., 2021). Learning is not a linear process; it involves encountering challenges and setbacks. Perseverance plays a critical role in this context as it encourages learners to view failures not as insurmountable barriers but as stepping stones to greater understanding. It is the grit that enables learners to push beyond their comfort zones, engage with difficult material, and ultimately achieve a deeper comprehension and retention of knowledge. Cognitive performance is often measured by one's ability to process information, solve problems, and make decisions (Datu, 2021). Challenges in these areas are inevitable, but perseverance equips individuals with the resilience to face these challenges head-on. It fosters a growth mindset, where the focus is on progress and improvement rather than on innate ability or intelligence. Empirical studies have shown that perseverance is a strong predictor of success in various cognitive tasks (Martín et al., 2020). It is not merely the intelligence or talent that one possesses but the willingness to persist in the face of adversity that often determines the level of achievement. Perseverance ensures that individuals remain engaged, practice deliberately, and learn from their mistakes, all of which are essential for cognitive growth. Perseverance is an indispensable component of cognitive performance (Sudina et al., 2020). It is the driving force that propels individuals to engage deeply with tasks, persist through difficulties, and emerge with enhanced skills and knowledge. Cultivating perseverance can transform the way we approach cognitive challenges, turning potential failures into opportunities for learning and growth. As such, perseverance is not just a companion to cognitive performance; it is its very foundation.

1.2.6 Role of Perseverance as Cognitive Performance

Perseverance, often understood as the steadfastness in doing something despite difficulty or delay in achieving success, is a pivotal trait in the realm of cognitive performance. It plays a multifaceted role in cognitive tasks and learning processes, and it can be the defining factor between mediocrity and excellence. At its core, perseverance is the engine that drives individuals to overcome obstacles and continue striving towards their goals (Olaguer & Pelayo, 2023). In cognitive endeavors, whether academic or professional, perseverance manifests as the relentless pursuit of knowledge and mastery over a subject. It is the quality that compels a student to spend extra hours on a complex mathematical problem or a researcher to continue their inquiry despite numerous failed experiments (Määttänen et al., 2021). Learning is not a linear process; it involves encountering challenges and setbacks. Perseverance plays a critical role in this context as it encourages learners to view failures not as insurmountable barriers but as stepping stones to greater understanding. It is the grit that enables learners to push beyond their comfort zones, engage with difficult material, and ultimately achieve a deeper comprehension and retention of knowledge. Cognitive performance is often measured by one's ability to process information, solve problems, and make decisions (Datu, 2021). Challenges in these areas are inevitable, but perseverance equips individuals with the resilience to face these challenges head-on. It fosters a growth mindset, where the focus is on progress and improvement rather than on innate ability or intelligence. Empirical studies have shown that perseverance is a strong predictor of success in various cognitive tasks (Martín et al., 2020). It is not merely the intelligence or talent that one possesses but the willingness to persist in the face of adversity that often determines the level of achievement. Perseverance ensures that individuals remain engaged, practice deliberately, and learn from their mistakes, all of which are essential for cognitive growth. Perseverance is an

indispensable component of cognitive performance (Sudina et al., 2020). It is the driving force that propels individuals to engage deeply with tasks, persist through difficulties, and emerge with enhanced skills and knowledge. Cultivating perseverance can transform the way we approach cognitive challenges, turning potential failures into opportunities for learning and growth. As such, perseverance is not just a companion to cognitive performance; it is its very foundation.

1.2.7 Effect of Sleep Deprivation on Perseverance

Perseverance, the sustained effort towards achieving goals despite difficulties, is a critical component of success in various domains of life. However, this steadfastness is not impervious to the physiological and psychological impacts of sleep deprivation (Holding et al., 2019). The intricate relationship between sleep and cognitive performance is well-documented, with a growing body of evidence suggesting that inadequate sleep can significantly impair an individual's ability to persist in the face of challenges. The cognitive determinants of sleep deprivation are manifold, impacting attention, memory, decision-making, and problem-solving abilities (Hudson et al., 2019). These cognitive domains are foundational to perseverance, as they enable an individual to plan, initiate, and maintain goal-directed behavior. When sleep is compromised, the cognitive machinery underpins perseverance (Whitney et al., 2023). One of the most immediate effects of sleep deprivation is a decrease in alertness and an increase in daytime sleepiness. This state of reduced vigilance can lead to a diminished capacity to engage with tasks persistently, as the individual may struggle to maintain focus and resist distractions (Holding et al., 2019). Furthermore, the impairment in executive functions, such as planning and inhibitory control, can disrupt an individual's ability to stay the course when faced with obstacles or competing demands. Emotional regulation is another critical aspect of perseverance that is

adversely affected by sleep deprivation (Schoeni et al., 2015). The ability to manage emotions and remain composed under stress is essential for sustained effort. Sleep-deprived individuals often exhibit heightened emotional reactivity and a propensity for negative mood states, which can undermine their resolve and lead to premature disengagement from tasks (Engle-Friedman et al., 2018). Moreover, the physiological stress associated with chronic sleep deprivation can exacerbate the challenge of persevering. The body's stress response systems, particularly the hypothalamic-pituitary-adrenal (HPA) axis, can become deregulated, leading to increased levels of cortisol, the stress hormone (Krause et al., 2017). This hormonal imbalance can further impair cognitive function and diminish the capacity for sustained effort. Sleep deprivation poses a significant threat to the cognitive and emotional underpinnings of perseverance. As this thesis will explore, the restoration of adequate sleep is not merely a matter of personal well-being but a crucial factor in enhancing and maintaining cognitive performance, particularly the vital trait of perseverance.

1.3 Shift Workers

Shift work is a common employment arrangement in many industries, requiring employees to work outside of the traditional 9-5 schedule. While it offers flexibility and opportunity for those who cannot work regular hours, it can also have significant impacts on health and well-being (Johnson, 2023). Research has shown that shift work can disrupt the body's natural circadian rhythm, leading to sleep disturbances, fatigue, and increased risk of certain health conditions such as heart disease, diabetes, and obesity (Leung & Martinez, 2020). Additionally, shift workers may experience challenges in maintaining a work-life balance and face social isolation due to working non-traditional hours (Foster, 2020). Despite these

challenges, there are strategies that can help shift workers manage their schedules and prioritize their health. Implementing a consistent sleep schedule, creating a relaxing pre-sleep routine, and making healthy food choices can positively impact the well-being of shift workers (Potter & Wood, 2020). Moreover, employers can play a crucial role in supporting their shift workers by offering resources such as wellness programs, flexible scheduling options, and creating a supportive work environment (McHugh et al., 2020). By addressing the unique needs of shift workers, companies can improve employee satisfaction, retention, and overall productivity.

1.3.1 Medical Shift Workers

In the healthcare industry, shift work is not just a common employment arrangement, but a necessity for providing round-the-clock patient care. Medical shift workers, including doctors, nurses, and other healthcare professionals, often face unique challenges that can impact their well-being and patient care (Klinefelter et al., 2023). The demanding nature of medical shift work can lead to increased levels of stress, fatigue, and burnout among healthcare professionals. Research has shown that irregular working hours can disrupt sleep patterns, leading to fatigue and impaired cognitive function, which in turn can affect decision-making and patient care outcomes (McHugh et al., 2020). Moreover, the erratic schedule can make it difficult for medical professionals to maintain a healthy work-life balance, leading to increased risk of mental health issues and decreased job satisfaction (Sweileh, 2022). Despite these challenges, medical shift workers can implement strategies to mitigate the negative impacts of their work schedules. In addition to maintaining a consistent sleep schedule and creating a relaxing pre-sleep routine, healthcare professionals can prioritize self-care activities such as exercise, mindfulness practices, and seeking social support to cope with the demands of their work (Brown et al., 2020).

Furthermore, healthcare organizations can support their medical shift workers by providing access to mental health resources, promoting a culture of work-life balance, and implementing policies that allow for adequate rest between shifts. By prioritizing the well-being of their medical staff, healthcare organizations can improve patient care outcomes, reduce turnover rates, and foster a healthier and more productive workforce.

1.3.2 Medical Shift Workers in Bangladesh

In Bangladesh, medical shift workers face unique challenges that are influenced by the country's healthcare infrastructure and socio-economic factors. The demanding nature of providing healthcare in a resource- constrained environment can lead to heightened stress and burnout among medical professionals (Shahjalal et al., 2021). Additionally, irregular working hours can make it difficult for healthcare workers to access adequate rest and maintain a healthy work- life balance, impacting their overall well-being and job satisfaction (Saha et al., 2020). Furthermore, the limited availability of mental health resources and support systems can exacerbate the challenges faced by medical shift workers in Bangladesh. Without proper access to resources for coping with the demands of their work, healthcare professionals may experience increased levels of fatigue, mental health issues, and decreased job satisfaction (Rai et al., 2021). To address these challenges, it is crucial for healthcare organizations in Bangladesh to prioritize the well-being of their medical staff. This can be achieved by implementing policies that ensure adequate rest between shifts, promoting a culture of work-life balance, and providing access to mental health support services (Hossain et al., 2020). Additionally, creating opportunities for skill development and career advancement can contribute to the overall job satisfaction and well-being of medical shift workers in Bangladesh. By recognizing and addressing the unique

challenges faced by medical shift workers in Bangladesh, healthcare organizations can not only improve the well- being of their staff but also enhance patient care outcomes and contribute to a more resilient and productive healthcare workforce.

1.3.3 Shift Scheduling and Sleep Disruption

Shift scheduling and sleep disruption can have a significant impact on the well- being and performance of shift workers. Studies have shown that irregular working hours can disrupt the body's natural circadian rhythm, leading to sleep disturbances and fatigue (Brown et al., 2020). This disruption not only affects the quantity of sleep but also the quality, as shift workers may struggle to achieve restorative deep sleep during non-traditional hours. The resulting fatigue and sleep deprivation can impair cognitive function, decision-making abilities, and overall job performance (Ganesan et al., 2019). Moreover, the inconsistency in shift schedules can make it challenging for shift workers to establish a regular sleep pattern, leading to chronic sleep deprivation and related health issues (Wickwire et al., 2017). Sleep deprivation has been linked to an increased risk of developing chronic conditions such as cardiovascular disease, diabetes, and obesity (S. James et al., 2017). The cumulative effect of inadequate sleep can also contribute to mental health issues and decreased overall well-being among shift workers (Rivera et al., 2020). To address these challenges, it is essential for both individuals and employers to prioritize sleep hygiene and establish supportive policies. Encouraging the implementation of consistent sleep schedules, creating a conducive sleep environment, and providing education on the importance of sleep can significantly improve the well-being of shift workers (Shriane et al., 2020). Additionally, employers can consider offering opportunities for nap breaks during long shifts, implementing policies that allow for adequate rest between shifts, and providing access to

resources for managing sleep disturbances. By recognizing the impact of shift scheduling on sleep disruption and taking proactive measures to support the sleep needs of shift workers, organizations can promote a healthier and more productive workforce while enhancing the overall well-being of their employees.

1.3.4 Impact of Shift Work on Cognitive Performance

The impact of shift work on cognitive performance is a critical aspect that often affects the well-being and productivity of shift workers. Research has indicated that irregular working hours and disrupted sleep patterns can have a detrimental effect on cognitive function (Leso et al., 2021). The body's natural circadian rhyth, which regulates sleep-wake cycles, can be significantly disturbed by shift work, leading to difficulties in maintaining optimal cognitive performance (Cheng et al., 2017). Cognitive functions such as attention, memory, and decision-making abilities can be compromised due to fatigue and sleep deprivation resulting from shift work (Wickwire et al., 2017). This impairment in cognitive performance can have far-reaching consequences, especially in professions that require high levels of concentration and quick decision-making, such as healthcare. Moreover, the chronic nature of shift work and its impact on cognitive function can also lead to long-term cognitive issues. Prolonged exposure to irregular working hours has been associated with a decline in cognitive abilities over time, posing a significant concern for the overall well-being and job performance of shift workers (Gan et al., 2022). The cognitive impact of shift work goes beyond the individual level and can also affect organizational outcomes. Decreased cognitive performance among shift workers may lead to compromised patient care, reduced productivity, and an increase in medical errors in healthcare settings (Rhéaume & Mullen, 2017). Furthermore, in other industries, impaired

cognitive abilities can result in decreased work efficiency and potential safety hazards. To address these challenges, a deeper understanding of the impact of shift work on cognitive performance is crucial. Both individuals and employers need to implement strategies that prioritize cognitive health, such as regular cognitive assessments, providing cognitive-enhancing activities during breaks, and offering opportunities for skill development to mitigate the potential long- term effects of shift work on cognitive function (Sweileh, 2022). By recognizing and addressing these cognitive impacts, organizations can foster a supportive and healthy work environment for shift workers, leading to improved job performance and overall well-being.

1.4 Importance of Executive Function in Healthcare Shift Workers

The landscape of healthcare is often punctuated by the demanding and erratic schedules of medical professionals, particularly the shift workers. The cognitive demands of medical practice are immense, requiring a high level of executive function for optimal patient care (Leso et al., 2021). Executive functions are a set of cognitive processes that are necessary for the cognitive control of behavior: selecting and successfully monitoring behaviors that facilitate the attainment of chosen goals (Skidmore et al., 2023). These functions are crucial for medical shift workers who must maintain a high level of cognitive performance despite the challenges posed by irregular work hours and sleep deprivation. Executive functions encompass a range of cognitive processes including problem-solving, working memory, cognitive flexibility, and inhibitory control (Chan et al., 2021). In the context of medical shift workers, these functions are paramount. They enable the integration of complex information, quick decision-making in emergency situations, and the ability to adapt to new and unexpected scenarios within the clinical environment (Hudson et al., 2019). The prefrontal cortex, which plays a significant role in

mediating these functions, is particularly sensitive to sleep deprivation. Research has shown that shift work can impair executive function, as evidenced by poorer performance on tasks that assess these cognitive domains (Muzio et al., 2020). Sleep deprivation, a common consequence of shift work, further complicates the cognitive landscape for medical professionals. It has been proposed that sleep disturbances might be predictive of cognitive decline, with night work or long working hours leading to cognitive impairment (Ning et al., 2020). This impairment can manifest in various cognitive domains, particularly those related to attention, memory, and response inhibition. The cumulative effect of sleep deprivation can lead to a progressive worsening of cognitive performance over consecutive night shifts or following exposure to very long work shifts (Zhao et al., 2022). Understanding the importance of executive function in medical shift workers is not only critical for patient safety but also for the well-being of the healthcare professionals themselves. It is imperative that healthcare institutions recognize the potential cognitive risks associated with shift work and implement strategies to mitigate these effects (Alfonsi et al., 2021). This could include optimizing shift schedules, providing opportunities for restorative sleep, and developing policies that support cognitive health among shift workers. The importance of executive function in medical shift workers cannot be overstated. As the fulcrum upon which critical medical decisions pivot, the preservation and support of executive function in this population are essential (Peng et al., 2022). This thesis will delve deeper into the effects of sleep deprivation on cognitive performance, with a focus on executive function, to highlight the challenges faced by medical shift workers and explore potential interventions.

1.5 Importance of Perseverance in Healthcare Shift Workers

In the relentless and high-stakes environment of healthcare, medical shift workers are the unsung heroes who ensure continuity of patient care. Their ability to persevere through long hours, sleep deprivation, and emotional stress is not just commendable but essential for the functioning of healthcare systems (Sweileh, 2022). This essay explores the importance of perseverance in medical shift workers, highlighting how this trait is indispensable in managing the challenges posed by their demanding roles. Perseverance is the steadfastness in doing something despite difficulty or delay in achieving success (Ryu & Shim, 2021). For medical shift workers, this translates to the relentless pursuit of patient well-being and the unwavering commitment to professional duties, even when faced with the physical and psychological toll of shift work. It is the perseverance of these individuals that upholds the quality of patient care during the odd hours of the night and the early mornings, times when the rest of the world sleeps (Ganesan et al., 2019). The nature of shift work inherently involves irregular hours that can disrupt the body's circadian rhythms, leading to sleep disturbances and fatigue. These challenges can impair cognitive functions, including those related to executive function, which are critical for effective clinical decision-making (Alfonsi et al., 2021). Perseverance becomes a key factor in not only enduring these hardships but also in maintaining a high standard of care despite them. Burnout is a significant risk for those in the medical profession, particularly for shift workers. The ability to persevere helps in building resilience against the emotional exhaustion, depersonalization, and reduced personal accomplishment that characterize burnout (X. Zhang et al., 2020). By fostering a mindset of growth and continuous improvement, perseverance enables medical shift workers to adapt and thrive in the face of adversity. Perseverance is not an innate trait but one that can be cultivated through supportive work environments, adequate rest, and

recognition of the efforts of shift workers (Karaferis et al., 2022). Healthcare institutions play a crucial role in nurturing this trait by providing resources for stress management, ensuring fair work schedules, and fostering a culture of appreciation and support. The role of perseverance in medical shift workers is a testament to their dedication and commitment to patient care. It is a crucial trait that enables them to navigate the complexities of their work environment and to continue providing high-quality care. As this thesis progresses, the focus will remain on understanding the multifaceted challenges faced by medical shift workers and on developing strategies to support their well-being and enhance their ability to persevere.

1.6 Cognitive Consequences of Sleep Deprivation among Healthcare Shift Workers

Sleep deprivation is a pervasive issue among medical shift workers, with significant implications for cognitive processes that are critical to their daily functioning and overall performance. The demanding nature of shift work, particularly in the medical field, often leads to irregular sleep patterns and a chronic state of sleep restriction (Johnson, 2023). This, in turn, can impair cognitive abilities, including executive functions and perseverance, which are essential for maintaining high standards of patient care and making critical decisions (Leso et al., 2021). Executive function, a set of cognitive processes including working memory, flexible thinking, and self-control, is particularly vulnerable to sleep deprivation. Medical shift workers often experience disruptions in their circadian rhythms, leading to decreased alertness and impaired decision-making abilities (Krause et al., 2017). The prefrontal cortex, which plays a pivotal role in executive function, is sensitive to sleep loss. As a result, sleep-deprived medical professionals may struggle with tasks that require planning, problem-solving, and error correction. Perseverance, the ability to sustain effort and attention over extended periods, is also

compromised by insufficient sleep (Cheng et al., 2017). The need for sustained vigilance in medical settings is paramount; however, sleep deprivation can lead to a decline in attentional resources, increased susceptibility to distractions, and a higher likelihood of errors (Hudson et al., 2019). The cumulative effect of sleep loss can exacerbate these issues, potentially leading to burnout and a decrease in the quality of patient care. The cognitive consequences of sleep deprivation extend beyond individual health care workers to affect the broader medical community and patient safety (Patrick et al., 2017). It is crucial to understand the pathways through which sleep deprivation impacts cognitive functions to develop interventions that can mitigate these effects. Addressing sleep-related issues among medical shift workers is not only a matter of individual well-being but also a critical component of maintaining a reliable health care system.

1.7 Rationale of the Study

Sleep is a fundamental physiological need, crucial for maintaining homeostasis and cell repair. Insufficient sleep can lead to significant impairments in brain function, especially those associated with the frontal lobe, which is involved in critical cognitive processes such as alertness, attention, decision-making, and executive functions. Shift workers are particularly vulnerable to sleep deprivation due to irregular work hours that conflict with natural circadian rhythms. This can result in decreased cognitive performance, affecting their ability to perform tasks safely and efficiently. The consequences of impaired cognitive performance due to sleep deprivation extend beyond individual health, potentially impacting public safety, productivity, and overall quality of life.

Despite massive significance, sleep loss has only focused on memory, attention, and reasoning. There are other cognitive areas that are definitely connected with sleep loss have received lower attention such as executive functions, abstraction, orientation etc. Although a few studies aimed to investigate those cognitive functions, however, the findings could not offer any specific conclusion.

Moreover, the study of sleep loss and cognitive performances are seen to suffer from many methodological issues. For example, most of those studies were conducted in laboratory conditions with few participants and they involved participants with already existing sleep problems. It is also observed that some studies recruited participants who were not controlled for using medication and stimulants, and practice effect in taking cognitive tests.

Finally, the effects of sleep deprivation may vary across different cultures and environments. Therefore, it is essential to study these effects within the specific context of Bangladesh to develop culturally relevant interventions and recommendations. There is a need for more research in non-Western settings to understand the global impact of sleep deprivation on cognitive performance. This study aims to fill this gap by focusing on the Bangladeshi population. The findings from this study could inform policy makers and employers about the importance of sleep for cognitive function, leading to better scheduling practices and work environments that promote adequate rest for shift workers. This research is justified by the need to understand the complex relationship between sleep deprivation and cognitive performance in a specific cultural setting, which has implications for individual health, occupational safety, and societal well-being.

1.8 Significance of the Study

The study of sleep deprivation's impact on cognitive performance is of paramount importance, particularly for shift workers who represent a substantial portion of the workforce in Bangladesh. This research is significant for several reasons: It addresses a critical public health issue, as sleep deprivation is known to have detrimental effects on brain function, particularly on the frontal lobe which is involved in executive functions such as alertness, attention, decision-making, and cognitive processes. Understanding the cognitive ramifications of sleep deprivation can lead to improved workplace safety. Poor sleep can impair motor skills, attention span, and judgment, which are essential for preventing accidents and maintaining safety standards. The study has economic implications, as cognitive impairment due to sleep deprivation can affect productivity and efficiency, leading to significant costs for businesses and the economy at large. The findings can inform policy development for shift workers, promoting work schedules that minimize health risks and optimize cognitive performance. It contributes to the academic literature by providing localized insights into the effects of sleep deprivation in the context of Bangladesh, which may differ from findings in Western countries due to cultural and environmental differences. The research can guide healthcare professionals in Bangladesh to better understand and manage the cognitive health of shift workers, potentially leading to improved interventions and support systems. In essence, this study holds the potential to enhance our understanding of the intricate relationship between sleep patterns and cognitive abilities, thereby fostering a safer, more productive, and health-conscious society.

1.9 Objectives

The general objective of the study was to investigate the effect of shift work on sleep deprivation and cognitive performances of shift workers in Bangladesh.

1.9.1 Specific objectives

The specific objectives of the present study were

1. to explore the current state of sleep deprivation and sleep quality of shift workers.

2. to investigate the effect of sleep deprivation on cognitive performances of shift workers.

3. to investigate the effect of sleep quality on cognitive performances of shift workers.

4. to investigate the effect of shifts on cognitive performances.

5. to investigate the effect of shift on perseverance.

6. to investigate whether there are any gender differences in sleep deprivation, sleep quality, cognitive performances and perseverance of shift workers.

7. to investigate whether there are any area-wise differences in sleep deprivation, sleep quality, cognitive performances and perseverance of shift workers.

8. to investigate whether there are any designation-wise differences in sleep deprivation, sleep quality, cognitive performances and perseverance of shift workers.

9. to investigate the relationship among experiences, sleep deprivation, and sleep quality.

1.10 Hypotheses

On the basis of the prior research findings and existing theoretical frameworks we formulated following hypotheses.

1. Rotating healthcare shift workers will have more sleep deprivation and poor sleep quality than the fixed and regular healthcare shift workers.

2. Sleep deprivation and sleep quality will affect cognitive performances of the healthcare shift workers.

3. Rotating healthcare shift workers will have poor cognitive performances than the fixed and regular healthcare shift workers.

4. Regular healthcare shift workers will have better perseverance in comparison to the fixed and rotating healthcare shift workers.

5. There will be significant gender differences in sleep deprivation, sleep quality, cognitive performances and perseverance of the healthcare shift workers.

6. There will be significant area-wise differences in sleep deprivation, sleep quality, cognitive performances and perseverance of the healthcare shift workers.

7. There will be significant designation-wise differences in sleep deprivation, sleep quality, cognitive performances and perseverance of the healthcare shift workers.

8. Healthcare shift workers with more experiences will have less sleep deprivation and better sleep quality.

Chapter Two: Methodology

Methodology

2.1 Study area and study population

We conducted this study on the shift workers. To find out proper shift workers we took healthcare workers as our population. These included doctors, nurse, midwives, and administrative healthcare staffs. We took a total number of 462 healthcare workers from five (05) different districts of Bangladesh. Those participants were included from 30 hospitals and clinics. The five districts of Bngladesh are Dhaka, Madaripur, Narayanganj, Sirajganj, and Tangail. The list of the 30 hospitals and clinics are given as follows.

Table 1

List of hospitals and clinics

Serial	Name of the hospitals/clinics	District
1	Upazila Health Complex	Sirajganj
2	Ullapara Sadar Hospital	Sirajganj
3	Sheikh Fazilztunnesa Mujib General Hospital	Sirajganj
4	Sirajganj Sadar hospital	Sirajganj
5	Zila Sadar Hospital	Sirajganj
6	Sheikh Hasina Medical College	Tangail
7	Life Care	Tangail
8	50 Bed General Hospital	Tangail
9	250 Bed General Hospital	Tangail

10	Pro Active Medical College	Narayanganj
11	300 Bed Hospital	Narayanganj
12	Mirpur General Hospital	Dhaka
13	National Cancer Hospital	Dhaka
14	Islamia Eye Institute & Hospital	Dhaka
15	Green Life Hospital	Dhaka
16	Dhaka Medical College and Hospital	Dhaka
17	Eye Science Institute	Dhaka
18	Sahik Hospital	Dhaka
19	Ayesha Memorial Hospital	Dhaka
20	BRB Hospital	Dhaka
21	Sadar Hospital	Madaripur
22	Niramay Hospital	Madaripur
23	Swadhin Bangla Nursing	Tangail
24	Doyal Diagnostic and Hospital	Tangail
25	Orbit Medical College Hospital	Tangail
26	Supreme Nursing College	Tangail
27	Prof. Suhrab Uddin Nursing College	Tangail
28	Nursing & Midwifery College	Tangail
29	NTC	Tangail
30	Principal Mizanur Rahman Nursing College	Tangail

2.2 Participants

The sample size was calculated using following formula:

$$n = [t^2pq/d^2] \times DEFF = [(2.045)^2 (.2)(.8)/(.05)^2] \times 1.5 = \mathbf{401}$$

Where, n = desired sample size

t = linked to 95% confidence interval for cluster sampling (2.045)

p = expected prevalence (20%)

q = 1- p (expected non-prevalence: 80%)

d = relative desired precision (5%)

DEFF = Design Effect (1.5)

Data were collected from 462 shift workers. All of them were related to healthcare services. Among them 152 participants were male and 310 participants were female. They were ranged from 19 years to 65 years of age.

Table 2

Area and gender-wise distribution of participants

		Area		Total
		Inside Dhaka	Outside Dhaka	
Gender	Male	55	97	152
	Female	78	232	310
	Total	133	329	462

2.3 Study design & Sampling technique

The data of the study were collected following cross-sectional survey research design. To take data from the healthcare shift workers we primarily selected five districts from Bangladesh. Then we took 30 hospitals, clinics and diagnostic centers from those districts. Research assistants then approached the healthcare workers for data collection. In this sense the data were collected following convenience sampling technique.

2.4 Psychometric tools

We used several psychometric tools to collect data from the shift workers. Following are the list of tools that we used for the study.

1. Personal Information Form (PIF)

2. Pittsburgh Sleep Quality Index (PSQI)

3. Montreal Cognitive Assessment (MoCA)

4. Epworth Sleepiness Scale (ESS)

5. The Grit Scale

6. Paper & pencils etc.

2.4.1 Personal Information Form (PIF).

The personal information form consists of participants' demographic and personal information. These include name (optional), gender, age, height, weight, designation, institute name, district, shifts, total experiences, experiences in in current position, use of sleeping aids, use of stimulants, sleep disorders etc. A form has been attached in the appendix (Appendix 01).

2.4.2 Pittsburgh Sleep Quality Index (PSQI).

The Bangla version of Pittsburgh Sleep Quality Index was used to collect data regarding sleep quality of the shift workers. The Bangla version of PSQI was adapted by Dr. Bipasha Singha (Singha, 2018). The overall index has a Chronbach Alpha of 0.71. The split-half reliability coefficient of the Bangla version was found 0.69. A 15-days test-retest reliability was found 0.84. Component Matrix Analysis showed that the items have high degree of construct validity. This indicates that the Bangla version of PSQI is a reliable and valid tool to assess sleep quality.

PSQI is a self-report instrument that consists of 18 individual items. It generates 7 component score namely, subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbances, use of sleep medication, and daytime dysfunction. Each component has a score range from 0-3 points. In all components "0" indicates no difficulty and "3" indicates severe difficulty in sleep. The total score range from 0-21 where high score means higher difficulties in sleep and low score means lower difficulties in sleep. The PSQI has a cut off score of 5. The original PSQI was developed by Buysse et al. (1989) of the University of Pittsburgh. A copy of PSQI has been enclosed as appendix (Appendix 2).

2.4.3 Montreal Cognitive Assessment (MoCA).

The Bangla version of the Montreal Cognitive Assessment (MoCA) was used to collect data regarding the cognitive domains of shift workers. It assesses cognitive domains like, attention, executive functions, language, abstraction, orientation, delayed recall, and naming. The Bangla version of MoCA was adapted by Kabir et al. (2013). It was originally developed by Dr. Ziad Nasreddine in 1996. The MoCA has 30 items and it takes 10 to 15 minutes to administer. All it includes drawing, remembering, repeating and performing some calculations. Correct response scores one (01) point while incorrect response as zero (0). The score ranges from 0-30. It has good internal consistency as yielded in Chronbach's alpha of 0.64. It also has high test-retest reliability of 0.87. Thus we see that the Bangla version of MoCA is a valid and reliable measure of cognitive performances. A score of 26 in MoCA is considered as normal. Following are the breakdown of the scoring of MoCA.

a. Normal: 26 or above

b. Mild Cognitive Impairment: 20 – 25

c. Significant Cognitive Impairment: Below 20

A copy of Bangla version of the MoCA has been enclosed as an appendix (Appendix 3).

2.4.4 Epworth Sleepiness Scale (ESS).

We used the Bangla version of Epworth Sleepiness Scale (ESS) to collect data on sleep deprivation of the shift workers. The ESS is a simple, self-administered questionnaire to measure

participants' daytime sleepiness. The Bangla version of ESS was adapted by Habibullah & Hossain (2022). The scale rate the likelihood of falling asleep in eight different daily life situations, such as sitting and reading, sitting inactive in public place, or watching TV. A "0" to "3" point rating is taken with "0" indicating "no chance of dozing" and "3" indicating "high chance of dozing". The total score ranges from "0 to 24". The higher score in ESS indicates higher daytime sleepiness and the lower score indicates lower daytime sleepiness. The Bangla version of ESS has a Chronbach alpha of 0.71 and a split-half reliability of o.76. It has also good internal consistency. The scoring of the ESS is calculated by adding up the numbers of each item. The total score of ESS is interpreted as follows.

a. Lower chance of dozing off: 0 - 5

b. Moderate chance of dozing off: 6 - 10

c. High chance of dozing off: 11 - 12

d. Very high chance of dozing off: 13 - 24

The original scale was developed by Dr. Johns. A copy of the Bangla version of ESS has been enclosed as an appendix (Appendix 4).

2.4.5 The Grit Scale.

We used the Bangla version of the Grit scale to collect data regarding the perseverance of the shift workers. It measures an individual's perseverance of effort and passion for long-term goals. The Bangla version of Grit was developed by Rani & Hossain (2022). It consists of eight

self-reported items. Each item is rated in Likert 5-point scale. The individual item score ranges from “0” to “5”. Here “0” indicates “not like me at all” to “5” indicates “very much like me”. The scoring of Grit scale is done by summing up the item scores and then divides it by total number of items. Hence the resulting score ranges from 1 (low grit) to 5 (high grit). Although there is no specific cut-off points to define “high” or “low” grit, some research suggests a score of 3.5 or more as higher levels of grit. The Bangla version of Grit scale has a Chronbach’s alpha of 0.81 and a split-half reliability coefficient of 0.83. The scale also has a good internal consistency measure. The original Grit scale was developed by Duckworth et al. in 2007. A copy of the Grit scale has been enclosed as Appendix 5 with this report.

2.4.6 Paper & pencils.

To collect the data of sleep deprivation and cognitive performances of the shift workers, we used paper-pencil tests and questionnaire. For each participant there were separate set of questionnaire and test. They filled it up using pencil.

2.5 Ethical Approval

We applied for the review and approval of our study to the ethical review committee of the Faculty of Biological Sciences of University of Dhaka. After a thorough review the study was approved by the faculty. The reference number of the ethical approval is *229/Biol. Scs*. A copy of ethical review approval is enclosed as Appendix 6.

2.6 Procedures

Collecting data from the healthcare shift workers was a challenging part. These professionals are very much busy in their duties. We had to make a thorough planning for the data collection. First of all we prepared all the psychometric tools for the study. After preparing the tools we appointed six (06) enumerators and test administers. All of them went through two-days training and one-day of practicing. Once they were trained, we assigned them to different districts of Bangladesh. It took almost four months to collect data from different districts of Bangladesh.

The enumerators and the test administrators approached the healthcare workers for data collection. However, as it was a lengthy process the participants in most of the cases didn't participate in first trial. Then the test administrators took appointment from the participants and they visited them on the scheduled day and time. There were five three sets of scale and one test. To complete a full set of data collection it took around 40 minutes to 60 minutes. Some relevant personal and demographic information were collected also.

Prior to the data scale and test administration the enumerator verbally instructed them and also provided the written instruction. A consent form was provided and written consent was taken from each participant. A copy of consent for has been enclosed with this report as Appendix 7. Once the data collected, the administrators thanked the participants and assigned a unique identification number for each data set. In few cases, the participants couldn't complete the entire set due to office emergencies or so. In such cases we had to drop that data set. After checking the data the administrators entered the data in MS Excel.

Figure 1. Flow chart of data collection procedure

2.7 Statistical analyses

After collecting the data from the participants we checked whether it was complete or not. We entered the complete data using MS excel. After the total data entry we exported those data into Statistical Packages for Social Sciences (SPSS 20). The data were properly coded and categorized in SPSS. Then we ran comprehensive statistical analyses to obtain results of our study. In statistical analyses we used descriptive statistics like, mean, standard deviation, frequency distribution, correlation, regression, chi-square test, independent sample t-test, and one way ANOVA.

Chapter Three: Results

Results

To analyze the data obtained from our cross-sectional survey we carried out several statistical operations. For better comprehension we have presented our findings in different sections. Following are the sections of the findings.

1. Sleep deprivation and sleep quality of the shift workers

2. Sleep deprivation and cognitive performances of shift workers

3. Sleep quality and cognitive performances of shift workers

4. Sleep deprivation, sleep quality, & cognitive performances

5. Sleep quality of shift workers

6. Sleep Deprivation (ESS) of shift workers

7. Shift work & Cognitive Performances

8. Shift work & Perseverance (Grit)

9. Gender differences in sleep deprivation (ESS), sleep quality (PSQI), cognitive performances and perseverance

10. Area wise differences in sleep deprivation, sleep quality, cognitive performances and perseverance of shift workers

11. Designation wise differences in sleep deprivation, sleep quality, cognitive performances, & perseverance

12. Experiences & Sleep

We analyzed the data using Microsoft Excel and Statistical Packages for Social Sciences (SPSS V. 20). To test the normality and randomness of the data we employed Kolmogorov-Smirnov test (K-S test) and Runs test. K-S test ensures the normality of the normality of the tested variables. Runs test for the sequence of the values for gender indicates the randomness of the data ($p > 0.05$). Different descriptive statistics like mean, standard deviation, variances, correlation were calculated. In addition to these linear regression analyses were carried out. To investigate the differences in different groups we carried out independent sample t-test, one way ANOVA etc.

3.1 Sleep deprivation and sleep quality of shift workers

Shift-wise descriptive statistics of sleep deprivation has been presented in the table no. 3.

Table 3

Shift-wise descriptive statistics of sleep deprivation (ESS)

Shift	***N***	**Sleep Deprivation Mean**	***Sd***
Fixed	101	6.87	2.95
Regular	238	7.06	2.37
Rotating	123	7.56	3.13
Total	462	7.15	2.73

Data has been categorized to see whether there is any difference of shifts on sleep deprivation of the shift workers. In the following table no. 4 we have presented the percentages of shift-workers who have lower to very high level of sleep deprivation.

Table 4

Percentages of Shift-wise sleep deprivation (ESS)

Shift	**Lower**	**Moderate**	**High**	**Very High**	**Total**
Fixed	32 (31.7%)	54 (53.5%)	11 (10.9%)	4 (4%)	101
Regular	65 (27.3%)	157 (66%)	15 (6.3%)	1 (0.4%)	238
Rotating	30 (24.4%)	76 (61.8%)	13 (10.6%)	4 (3.2%)	123
Total	127 (27.4%)	287 (62.1%)	39 (8.4%)	9 (2%)	462

The data report that around 10% shift-workers suffer from high to very high sleep deprivation. Both the fixed shift workers and rotating shift workers have more percentages than the regular shift workers in terms of sleep deprivation. We investigated whether there is a link between shifting and level of sleep deprivation. A chi-square test of independence showed that there was no significant association between shifting and sleep deprivation, $\chi^2 = 11.56$, $p = .07$.

Table 5

Chi-Square test of independence between shifts and sleep deprivation

	Value	***df***	**Asymptotic Sig.**
Pearson Chi-Square	11.56	6	0.073
Likelihood Ratio	12.29	6	0.056
Linear by Linear Association	0.58	1	0.446
N	462		

We categorized the data in terms having sleep difficulties or not. A total score of 5 or more in PSQI has been considered as having sleeping difficulties.

Table 6

Shift-wise sleep quality (PSQI) in shift workers

Shift	**No sleep difficulty**	**Sleep difficulties**	**Total**
Fixed	79 (78.2%)	22 (21.8%)	101
Regular	162 (68%)	76 (32%)	238
Rotating	82 (66.7%)	41 (33.3%)	123
Total	323 (70%)	139 (30%)	462

We can see from the table no. 6 that, the highest percentages of sleeping difficulties occurred in rotating shift workers (33.3%) whereas, 32% of regular shift workers reported sleep difficulties and only 21.8% fixed shift workers reported so. We investigated whether there is a link between shifting and sleep difficulty. A chi-square test of independence showed that there was no significant association between shifting and sleep deprivation, $\chi^2 = 4.31$, $p = .12$.

Table 7

Chi-Square test of independence between shifts and sleep deprivation

	Value	***df***	**Asymptotic Sig.**
Pearson Chi-Square	4.31	2	0.116
Likelihood Ratio	4.51	2	0.105
Linear by Linear Association	3.26	1	0.071
N	462		

3.2 Sleep deprivation & cognitive performances

To see the relationship between sleep deprivation and cognitive performances, we carried out Pearson product moment correlation. The findings of the correlation are as follows.

Table 8

Correlation between sleep deprivation (ESS) and cognitive performances (MoCA)

	Sleep deprivation (ESS)	**Sig. (*p*)**	***df***
Cognitive Performances	0.062	0.181	462

The correlation between sleep deprivation (ESS) and cognitive performances (MoCA) haves been found to be not significant ($r = 0.062$, $p>0.05$, $df=462$). To further digging inside, we carried out correlation between the subcomponents of MoCA. The results are as follows.

Table 9

Correlation between sleep deprivation (ESS) and subcomponents of MoCA

	Sleep deprivation (ESS)	**Sig. (*p*)**	***df***
Executive functions	0.045	0.337	462
Naming	-0.048	0.299	
Attention	-0.106*	0.023	
Language	0.046	0.328	
Abstraction	0.031	0.504	
Delayed Recall	0.149**	0.001	
Orientation	0.043	0.356	

*significant with an alpha level 0.05 ($p<0.05$)

**significant with an alpha level of 0.01 ($p<0.01$)

The results from table 9 indicate that there is a significant negative correlation between sleep deprivation and attention (r = -0.106, p<0.05, df = 462). A significant positive correlation has been found with delayed recall also (r = 0.149, p<0.01, df = 462).

We also carried out the correlation between sleep deprivation and perseverance of the shift workers. A simple Pearson product moment correlation yields following findings.

Table 10

Correlation between sleep deprivation (ESS) and perseverance (Grit)

	Sleep deprivation (ESS)	**Sig. (*p*)**	***df***
Perseverance	0.070	0.130	462

We didn't find any significant correlation between sleep deprivation and perseverance (r = -0.070, p>0.05, df = 462) of the shift workers as shown in table 10.

3.3 Sleep Quality and Cognitive Performances of shift workers

To see the relation between sleep quality and cognitive performances we carried out Pearson product moment correlation with sleep quality and cognitive performances.

Table 11

Correlation between sleep quality (PQSI) and cognitive performances (MoCA)

	Sleep Quality (PQSI)	**Sig. (*p*)**	***df***
Cognitive Performances	0.196**	0.000	462

**significant with an alpha level of 0.01 (p<0.01)

Significant correlation has been observed between sleep quality (PQSI) and Montreal Cognitive Assessment (MoCA). It indicates that sleep quality and cognitive performances are significantly correlated.

Table 12

Correlation between sleep quality and subcomponents of MoCA

Subcomponents	**Sleep quality (PSQI)**	**Sig. (*p*)**	***df***
Executive functions	-0.049	0.292	462
Naming	-0.061	0.189	
Attention	-0.132**	0.005	
Language	-0.024	0.607	
Abstraction	-0.086	0.064	
Delayed Recall	0.103*	0.027	
Orientation	0.066	0.157	

*significant with an alpha level 0.05 ($p<0.05$)

**significant with an alpha level of 0.01 ($p<0.01$)

Table 12 reveals that, sleep quality is significantly correlated with attention ($r = -0.132$, $p<0.01$, $df = 462$) and delayed recall ($r = 0.103$, $p<0.05$, $df = 462$).

We also conducted a Pearson product moment correlation between sleep quality and perseverance of the shift workers. However, sleep quality has not been found to be significantly correlated with perseverance of the shift workers as seen in table 12.

Table 13

Correlation between sleep quality (PSQI) and perseverance (Grit)

	Sleep Quality (PSQI)	**Sig. (*p*)**	***df***
Perseverance	0.015	0.749	462

3.4 Sleep deprivation, sleep quality, & cognitive performances

To see the effect of sleep deprivation and sleep quality on cognitive performances, we ran a linear regression taking cognitive performances as dependent variables. The regression outputs are as follows.

Table 14

Regression model of sleep deprivation and sleep quality on cognitive performances

Model	***R***	***R* Square**	**Adjusted *R* Square**	**Std. Error of the Estimate**
1	.209[a]	.044	.040	3.397

a. Predictors: (Constant), Sleep deprivation, Sleep quality

The regression model indicates that sleep deprivation and sleep quality can explain 4% variance of cognitive performance of shift workers.

The following table shows that the regression model of sleep deprivation and sleep quality on cognitive performances is a significant ($F = 10.527$, $p < 0.01$).

Table 15

Regression model of the effect of sleep deprivation and sleep quality on cognitive performances

Model		**Sum of Squares**	***df***	**Mean Square**	***F***	**Sig.**
1	Regression	242.962	2	121.481	10.527	.000[b]
	Residual	5296.821	459	11.540		
	Total	5539.784	461			

a. Dependent Variable: Cognitive performances

b. Predictors: (Constant), Sleep deprivation, Sleep quality

The regression model also indicates that sleep quality is a significant predictor of cognitive performances of shift workers ($\beta = .20$, $p<0.01$). However, sleep deprivation has been found as a non-significant predictor of cognitive performances for the shift workers.

Table 16

Coefficients and its' significance of sleep deprivation and sleep quality on cognitive performances

Model		Unstandardized Coefficients		Standardized Coefficients	*t*	Sig.
		B	Std. Error	Beta		
1	**(Constant)**	24.391	.564		43.219	.000
	Sleep Quality	.456	.104	.200	4.380	.000
	Sleep Deprivation	-.095	.058	-.075	-1.636	.102

a. Dependent Variable: Cognitive performances

3.5 Sleep quality of shift workers

To see the differences of sleep quality in different types of shift works we carried out a one way ANOVA. Our findings of one way ANOVA are as follows.

Table 17

Shift-wise descriptive statistics of sleep quality (PSQI)

Shift	***N***	**Sleep Quality Mean**	***Sd***
Fixed	101	3.39	1.414
Regular	238	3.60	1.585
Rotating	123	3.78	1.468
Total	462	3.60	1.521

The above table shows that rotating shift workers have the highest score in sleep quality. This means that they have the worst sleep quality in comparison to other two groups of shift workers. Moreover, to see these differences are significant or not we carried out ANOVA. The findings reveal that although there is difference in sleep quality but it is not significant.

Table 18

One way ANOVA for shift-wise differences in sleep quality (PSQI)

	Sum of Squares	***df***	**Mean Square**	***F***	**Sig.**
Between Groups	8.629	2	4.314	1.871	.155
Within Groups	1058.291	459	2.306		
Total	1066.920	461			

3.6 Sleep Deprivation (ESS) of shift workers

Data has been analyzed to see whether there are any differences in sleep deprivation of the shift workers in terms of shifts.

Table 19

Shift-wise descriptive statistics of sleep deprivation (ESS)

Shift	***N***	**Sleep Deprivation Mean**	***Sd***
Fixed	101	6.87	2.95
Regular	238	7.06	2.37
Rotating	123	7.56	3.13
Total	462	7.15	2.73

Although it shows that rotating shift workers have the highest score in sleep deprivation, however, these differences are not significant in a one way ANOVA. The outputs of ANOVA have been presented in table no. 20.

Table 20

One way ANOVA for shift-wise differences in sleep deprivation (ESS)

	Sum of Squares	***df***	**Mean Square**	***F***	**Sig.**
Between Groups	30.415	2	15.207	2.046	0.130
Within Groups	3411.674	459	7.433		
Total	3442.089	461			

No significant differences in sleep deprivation (ESS) have been observed in terms of shifts of the shift workers.

3.7 Shift work & Cognitive Performances

To see the effect of shifts on cognitive performances we conducted a one way ANOVA of shifts taking cognitive performances (MoCA) as dependent variable. To further broaden our understanding we ran ANOVA taking the subcomponents of cognitive performances (MoCA). The findings of the ANOVA are as follows.

Table 21

Descriptive statistics of cognitive performances according to shifts

Shift		Executive Functions	Naming	Attention	Language	Abstraction	Delayed Recall	Orientation	Cognitive Performances
Fixed	**Mean**	3.81	2.75	5.16	1.24	1.14	3.46	5.70	24.55
	N	101	101	101	101	101	101	101	101
	Std. Deviation	1.102	.434	.845	.737	.664	1.507	2.124	3.545
Regular	**Mean**	4.11	2.84	5.05	1.05	1.18	3.60	5.67	25.61
	N	238	238	238	238	238	238	238	238
	Std. Deviation	.977	.396	.975	.810	.729	1.285	.696	3.637
Rotating	**Mean**	4.24	2.80	5.12	1.52	1.46	3.72	5.49	25.52
	N	123	123	123	123	123	123	123	123
	Std. Deviation	.860	.398	.864	.853	.631	1.501	.706	2.954
Total	**Mean**	4.08	2.81	5.09	1.22	1.25	3.60	5.63	25.35
	N	462	462	462	462	462	462	462	462
	Std. Deviation	.986	.406	.919	.828	.700	1.395	1.169	3.467

Table 22

Shift wise one way ANOVA for Cognitive Performances (MoCA)

		Sum of Squares	*df*	Mean Square	*F*	Sig. (*p*)
Executive Function	**Between Groups**	10.386	2	5.193	5.443	.005**
	Within Groups	437.962	459	.954		
	Total	448.348	461			
Naming	**Between Groups**	.614	2	.307	1.871	.155
	Within Groups	75.377	459	.164		
	Total	75.991	461			
Attention	**Between Groups**	.967	2	.483	.572	.565
	Within Groups	388.031	459	.845		
	Total	388.998	461			
Language	**Between Groups**	17.964	2	8.982	13.816	.000**
	Within Groups	298.391	459	.650		
	Total	316.355	461			
Abstraction	**Between Groups**	7.441	2	3.721	7.818	.000**
	Within Groups	218.429	459	.476		
	Total	225.870	461			
Delayed Recall	**Between Groups**	3.749	2	1.875	.963	.382
	Within Groups	893.367	459	1.946		
	Total	897.117	461			
Orientation	**Between Groups**	3.367	2	1.684	1.233	.292
	Within Groups	626.598	459	1.365		
	Total	629.965	461			
Cognitive Performances	**Between Groups**	83.474	2	41.737	3.511	.031*
	Within Groups	5456.309	459	11.887		
	Total	5539.784	461			

*The difference is significant at 0.05 level.

** The difference is significant at 0.01 level.

We can see from the table no. 22, that there are significant differences in cognitive performances of shift workers in terms of shifts. Significant differences are also evident in *executive functions, language, & abstraction*. However, no significant differences have been observed in naming, attention, delayed recall and orientation.

To further broaden our understanding we carried out a Post Hoc multiple comparisons of the subcomponents those were found significant in differences in terms of shifts. The findings of Post Hoc multiple comparisons are presented in table no. 23.

Table 23

Post Hoc (Bonferroni) multiple comparisons of shift-wise cognitive performances (MoCA)

Dependent Variable	(I) Shift	(J) Shift	Mean Difference (I-J)	Std. Error	Sig.
Executive functions	Fixed	Regular	-.293*	.116	.035
		Rotating	-.424*	.131	.004
	Regular	Fixed	.293*	.116	.035
		Rotating	-.131	.108	.686
	Rotating	Fixed	.424*	.131	.004
		Regular	.131	.108	.686
Language	Fixed	Regular	.187	.096	.154
		Rotating	-.283*	.108	.028
	Regular	Fixed	-.187	.096	.154
		Rotating	-.470*	.090	.000
	Rotating	Fixed	.283*	.108	.028
		Regular	.470*	.090	.000
Abstraction	Fixed	Regular	-.046	.082	1.000
		Rotating	-.317*	.093	.002
	Regular	Fixed	.046	.082	1.000
		Rotating	-.270*	.077	.001
	Rotating	Fixed	.317*	.093	.002
		Regular	.270*	.077	.001
Cognitive Performances (MoCA)	Fixed	Regular	-1.055*	.409	.031
		Rotating	-.966	.463	.113
	Regular	Fixed	1.055*	.409	.031
		Rotating	.089	.383	1.000
	Rotating	Fixed	.966	.463	.113
		Regular	-.089	.383	1.000

*The mean difference is significant at the 0.05 level.

Note: Only significant subcomponents are reported here in Post Hoc

3.8 Shift work & Perseverance (Grit)

We investigated the impact of shift on the perseverance of the shift workers. To do so, we carried out a one way ANOVA taking perseverance as dependent variable. Our analysis revealed following outputs.

Table 24

Descriptive statistics of perseverance according to shits

Shift	***N***	**Perseverance Mean**	***Sd***
Fixed	101	3.19	.538
Regular	238	3.11	.539
Rotating	123	3.24	.590
Total	462	3.16	.554

Table 25

One way ANOVA for shift-wise differences in perseverance (Grit)

	Sum of Squares	***df***	**Mean Square**	***F***	**Sig.**
Between Groups	1.440	2	.720	2.351	0.096
Within Groups	140.543	459	.306		
Total	141.983	461			

No significant differences in perseverance (ESS) have been observed in terms of shifts of the shift workers.

3.9 Gender differences in sleep deprivation (ESS), sleep quality (PSQI), cognitive performances and perseverance

From the following table no. 26 we can see the number of male and female according to shifts.

Table 26

Gender distribution of shift workers

Shift	Male	Female	Total
Fixed	31	70	101
Regular	91	147	238
Rotating	30	93	123
Total	152	310	462

We conducted independent sample t-test to investigate the gender differences of sleep deprivation, sleep quality, cognitive performances & perseverance of the shift workers. Our findings of the independent sample t-test are presented in the following table no. 27.

Table 27

t-test statistics of gender differences

	Gender	*N*	Mean	Std. Deviation	*t*	*df*	Sig. (*p*)
Sleep Quality	Male	152	3.52	1.611	-0.789	460	0.430
	Female	310	3.64	1.476			
Executive functions	Male	152	4.09	.945	0.249	460	0.803
	Female	310	4.07	1.007			
Naming	Male	152	2.87	.339	2.204	460	0.028*
	Female	310	2.79	.433			
Attention	Male	152	5.22	.839	2.148	460	0.032*
	Female	310	5.03	.950			
Language	Male	152	1.23	.809	0.251	460	0.802
	Female	310	1.21	.839			
Abstraction	Male	152	1.35	.748	2.201	460	0.028*
	Female	310	1.20	.671			
Delayed recall	Male	152	3.65	1.186	0.581	460	0.561
	Female	310	3.57	1.488			
Orientation	Male	152	5.75	.531	2.044	460	0.042*
	Female	310	5.57	1.375			
Cognitive Performances	Male	152	25.82	3.531	2.036	460	0.042*
	Female	310	25.13	3.417			
Sleep Deprivation	Male	152	6.72	2.574	-2.380	460	0.018*
	Female	310	7.36	2.787			
Perseverance	Male	152	3.10362	.555074	-1.7765	460	0.078
	Female	310	3.20040	.553024			

*The mean difference is significant at 0.05 level.

Independent sample *t*-test revealed that, there is a significant gender difference in cognitive performances of shift workers (t=2.036, p<0.05). Further investigation of the subcomponents of cognitive performances yielded that significant gender differences are evident in *naming* (t=2.204, p<0.05), *attention* (t=2.148, p<0.05), *abstraction* (t=2.201, p<0.05) and in *orientation* (t=2.044, p<0.05). No significant gender differences were observed in executive functions, language, and delayed recall.

Significant gender difference has been found in *sleep quality* of the shift workers (t= -2.380, p<0.05). However, no significant gender differences were observed in sleep quality and perseverance of the shift workers.

3.10 Area wise differences in sleep deprivation, sleep quality, cognitive performances and perseverance of shift workers

We investigated the data on the basis of area where the shift workers currently living. To see the area wise differences, we carried out independent sample t-test for the shift workers of inside Dhaka (Metropolitan city) and outside of Dhaka. Our tests revealed following outputs of the shift workers.

Table 28

Area wise differences in sleep deprivation (ESS), sleep quality (PSQI), cognitive performances and perseverance

	Area	*N*	Mean	Std. Deviation	*t*	*df*	Sig. (*p*)
Sleep Quality	Inside Dhaka	133	3.24	1.399	-3.258	460	0.001**
	Outside Dhaka	329	3.74	1.547			
Executive Functions	Inside Dhaka	133	3.92	1.155	-1.990	460	0.048*
	Outside Dhaka	329	4.14	.903			
Naming	Inside Dhaka	133	2.89	.332	3.051	460	0.002**
	Outside Dhaka	329	2.78	.429			
Attention	Inside Dhaka	133	5.20	1.043	1.512	460	0.132
	Outside Dhaka	329	5.05	.861			
Language	Inside Dhaka	133	1.20	.621	-0.402	460	0.688
	Outside Dhaka	329	1.22	.899			
Abstraction	Inside Dhaka	133	1.50	.517	5.966	460	0.000**
	Outside Dhaka	329	1.14	.737			
Delayed Recall	Inside Dhaka	133	3.81	1.038	2.459	460	0.014*
	Outside Dhaka	329	3.51	1.508			
Orientation	Inside Dhaka	133	5.80	1.869	1.490	460	0.138
	Outside Dhaka	329	5.56	.705			
Cognitive Performances	Inside Dhaka	133	24.13	3.086	-5.227	460	0.000**
	Outside Dhaka	329	25.85	3.493			
Sleep Deprivation	Inside Dhaka	133	6.95	3.045	-0.930	460	0.354
	Outside Dhaka	329	7.23	2.596			
Perseverance	Inside Dhaka	133	3.08741	.576526	-2.005	460	0.046*
	Outside Dhaka	329	3.20137	.543470			

*The difference is significant at 0.05 level.

**The difference is significant at 0.01 level.

Our findings revealed that there is a significant difference of *sleep quality* between metropolitan city and outside of the metropolitan city (t=-3.258, p<0.01). However, no significant differences were observed in sleep deprivation of the shift workers between metropolitan city and outside of the metropolitan city.

Independent sample t-test also revealed a significant difference in overall *cognitive performances* (t= -5.227, p<0.01) of the shift workers dwelling inside metropolitan city and outside of the metropolitan city. This difference is also evident in the *executive functions* (t= -1.990, p<0.05), *naming* (t=3.051, p<0.01), *abstraction* (t=5.966, p<0.01) & in *delayed recall* (t=2.459, p<0.05) of the shift workers.

We found significant difference is *perseverance* (t= -2.005, p<0.05) of the shift workers between metropolitan city and outside of the metropolitan city.

3.11 Designation wise differences in sleep deprivation, sleep quality, cognitive performances, & perseverance

To investigate the designation wise differences in sleep deprivation, sleep quality, cognitive performances and perseverance of the shift workers, we carried out one way ANOVA. The findings of the one way ANOVA have been tabled as follows.

Table 29

Descriptive statistics of cognitive performances (MoCA), sleep deprivation, sleep quality and perseverance according to designation of the shift worker

Designation		Executive	Naming	Attention	Language	Abstraction	Delayed	Orientation	Cognitive Performances	Sleep Quality	Sleep Deprivation	Grit
Doctor	**Mean**	4.48	2.81	5.04	1.47	1.40	3.87	5.56	26.99	4.35	7.37	3.17
	N	99	99	99	99	99	99	99	99	99	99	99
	Std. Deviation	.761	.396	.903	.973	.820	.965	.772	2.971	1.402	2.328	.499
Nurse	**Mean**	4.00	2.81	5.15	1.20	1.25	3.47	5.68	24.71	3.26	7.09	3.14
	N	241	241	241	241	241	241	241	241	241	241	241
	Std. Deviation	.926	.424	.838	.774	.631	1.429	1.458	3.469	1.547	2.845	.558
Midwife	**Mean**	3.85	2.78	4.92	1.10	.84	3.64	5.44	25.50	3.92	7.50	3.17
	N	88	88	88	88	88	88	88	88	88	88	88
	Std. Deviation	1.078	.414	1.020	.831	.585	1.696	.771	3.223	1.261	2.763	.492
Administrative	**Mean**	4.00	2.94	5.29	.91	1.79	3.62	5.94	24.82	2.97	6.09	3.33
	N	34	34	34	34	34	34	34	34	34	34	34
	Std. Deviation	1.371	.239	1.169	.514	.479	1.280	.239	3.912	1.291	2.745	.785
Total	**Mean**	4.08	2.81	5.09	1.22	1.25	3.60	5.63	25.35	3.60	7.15	3.16
	N	462	462	462	462	462	462	462	462	462	462	462
	Std. Deviation	.986	.406	.919	.828	.700	1.395	1.169	3.467	1.521	2.733	.554

Designation wise differences of sleep deprivation, sleep quality, cognitive performances and perseverance are shown in the following table.

Table 30

One way ANOVA statistics of designation wise differences

		Sum of Squares	*df*	Mean Square	*F*	Sig.
Executive Functions	**Between Groups**	22.542	3	7.514	8.082	.000**
	Within Groups	425.807	458	.930		
	Total	448.348	461			
Naming	**Between Groups**	.638	3	.213	1.292	.276
	Within Groups	75.354	458	.165		
	Total	75.991	461			
Attention	**Between Groups**	5.035	3	1.678	2.002	.113
	Within Groups	383.963	458	.838		
	Total	388.998	461			
Language	**Between Groups**	11.019	3	3.673	5.510	.001**
	Within Groups	305.336	458	.667		
	Total	316.355	461			
Abstraction	**Between Groups**	27.140	3	9.047	20.849	.000**
	Within Groups	198.730	458	.434		
	Total	225.870	461			
Delayed Recall	**Between Groups**	11.414	3	3.805	1.967	.118
	Within Groups	885.703	458	1.934		
	Total	897.117	461			
Orientation	**Between Groups**	7.524	3	2.508	1.845	.138
	Within Groups	622.441	458	1.359		
	Total	629.965	461			
Cognitive Performances	**Between Groups**	377.769	3	125.923	11.173	.000**
	Within Groups	5162.014	458	11.271		
	Total	5539.784	461			
Sleep Quality	**Between Groups**	106.349	3	35.450	16.902	.000**
	Within Groups	960.571	458	2.097		
	Total	1066.920	461			
Sleep Deprivation	**Between Groups**	55.012	3	18.337	2.480	.061
	Within Groups	3387.077	458	7.395		
	Total	3442.089	461			
Perseverance	**Between Groups**	1.117	3	.372	1.211	.305
	Within Groups	140.865	458	.308		
	Total	141.983	461			

**The difference is significant at 0.01 alpha level

One way ANOVA findings reveal that, there are significant designation wise differences in executive functions (F=8.082, p<0.01), language (F=5.510, p<0.01), abstraction (F=20.849, p<0.01), overall cognitive performances (F=11.173, p<0.01) and sleep quality (F=16.902, p<0.01). However, no significant difference was observed in sleep deprivation, perseverance and other subcomponents of cognitive performances.

To further understand the designation wise differences, we conducted a Post Hoc multiple comparison analysis. The findings of the Post Hoc analysis are presented in the following table.

Table 31

Post Hoc multiple comparison analysis of designation and cognitive performances

Dependent Variable	(I) Designation	(J) Designation	Mean Difference (I-J)	Std. Error	Sig.
Executive Functions	Doctor	Nurse	.485*	.115	.000
		Midwife	.633*	.141	.000
		Administrative	.485	.192	.071
	Nurse	Doctor	-.485*	.115	.000
		Midwife	.148	.120	1.000
		Administrative	.000	.177	1.000
	Midwife	Doctor	-.633*	.141	.000
		Nurse	-.148	.120	1.000
		Administrative	-.148	.195	1.000
	Administrative	Doctor	-.485	.192	.071
		Nurse	.000	.177	1.000
		Midwife	.148	.195	1.000
Language	Doctor	Nurse	.280*	.097	.026
		Midwife	.372*	.120	.012
		Administrative	.563*	.162	.003
	Nurse	Doctor	-.280*	.097	.026
		Midwife	.093	.102	1.000
		Administrative	.283	.150	.353
	Midwife	Doctor	-.372*	.120	.012

		Nurse	-.093	.102	1.000
		Administrative	.191	.165	1.000
	Administrative	Doctor	-.563*	.162	.003
		Nurse	-.283	.150	.353
		Midwife	-.191	.165	1.000
Abstraction	Doctor	Nurse	.151	.079	.333
		Midwife	.563*	.097	.000
		Administrative	-.390*	.131	.018
	Nurse	Doctor	-.151	.079	.333
		Midwife	.412*	.082	.000
		Administrative	-.541*	.121	.000
	Midwife	Doctor	-.563*	.097	.000
		Nurse	-.412*	.082	.000
		Administrative	-.953*	.133	.000
	Administrative	Doctor	.390*	.131	.018
		Nurse	.541*	.121	.000
		Midwife	.953*	.133	.000
Cognitive Performances	Doctor	Nurse	2.285*	.401	.000
		Midwife	1.490*	.492	.016
		Administrative	2.166*	.667	.008
	Nurse	Doctor	-2.285*	.401	.000
		Midwife	-.795	.418	.348
		Administrative	-.118	.615	1.000
	Midwife	Doctor	-1.490*	.492	.016
		Nurse	.795	.418	.348
		Administrative	.676	.678	1.000
	Administrative	Doctor	-2.166*	.667	.008
		Nurse	.118	.615	1.000
		Midwife	-.676	.678	1.000
Sleep Quality	Doctor	Nurse	1.092*	.173	.000
		Midwife	.433	.212	.251
		Administrative	1.383*	.288	.000
	Nurse	Doctor	-1.092*	.173	.000
		Midwife	-.659*	.180	.002
		Administrative	.291	.265	1.000
	Midwife	Doctor	-.433	.212	.251
		Nurse	.659*	.180	.002
		Administrative	.950*	.292	.007
	Administrative	Doctor	-1.383*	.288	.000
		Nurse	-.291	.265	1.000
		Midwife	-.950*	.292	.007

3.12 Experiences & Sleep

To see whether there is any significant relationship between experiences of shift workers and sleep, we calculated Pearson product moment correlation between them.

Table 32

Correlation between experiences, sleep deprivation and sleep quality

		Sleep Quality	**Sleep Deprivation**
Total experience	Pearson Correlation	.069	-.024
	Sig. (2-tailed)	.141	.605
	N	462	462
Current position experience	Pearson Correlation	.072	-.066
	Sig. (2-tailed)	.123	.157
	N	462	462

Pearson product moment correlation coefficient revealed that there is no significant correlation among total experiences, sleep quality, and sleep deprivation. Similar findings were found in case of current position experiences, sleep quality and sleep deprivation.

Chapter Four: Discussion

Discussion

Sleep deprivation is a common issue among shift workers (Johnson, 2023), and its impact on cognitive performance is a matter of concern. The long and irregular working hours of shift workers often disrupt their natural sleep-wake cycles, leading to insufficient and poor-quality sleep (Leso et al., 2021). This can result in a range of cognitive deficits affecting memory, attention, decision-making, and overall mental acuity (Chellappa et al., 2019). The impact of sleep deprivation on cognitive performance is multifaceted and can manifest differently in individuals. For example, some shift workers may experience decreased alertness and slower reaction times, while others may struggle with impaired memory and reduced problem-solving abilities (Holding et al., 2021). Understanding these variations in cognitive impact is crucial for addressing the specific needs of shift workers and implementing effective interventions to mitigate the negative effects of sleep deprivation. Factors such as the duration and timing of shifts, inadequate rest periods between shifts, and the physical and mental demands of the job can all contribute to the level of sleep deprivation experienced by shift workers.

The research findings clearly indicate that shift work has a significant impact on the sleep quality and overall well-being of workers. The prevalence of sleep deprivation among shift workers, particularly rotating shift workers, is a cause for concern. The data shows that a substantial portion of shift workers experience sleep difficulties, with rotating shift workers being the most affected. These findings highlight the need for employers to address the challenges faced by shift workers in maintaining good sleep quality. Implementing measures such as providing education on sleep hygiene, offering flexible shift schedules, and creating optimal working environments can help mitigate the negative effects of shift work on sleep

patterns. Furthermore, the disparities in sleep difficulties between fixed shift workers, rotating shift workers, and regular shift workers emphasize the importance of tailored interventions that take into account the specific challenges faced by each group. Addressing these disparities can lead to improved overall well-being and productivity among shift workers.

Sleep deprivation among shift workers has been found to have a significant impact on cognitive performance. The results of the study revealed a strong negative correlation between sleep deprivation and attention, indicating that as sleep deprivation increases, attention levels decrease. This finding highlights the critical importance of adequate rest and sleep for individuals working in shifts, as it directly influences their ability to maintain focus and attentiveness during work hours. Surprisingly, the research also uncovered a significant positive correlation between sleep deprivation and delayed recall. This suggests that individuals experiencing sleep deprivation may show improved delayed recall abilities, possibly as a result of heightened cognitive effort and compensatory mechanisms in response to sleep loss. These findings underscore the complex nature of the relationship between sleep deprivation and cognitive performances, emphasizing the need for further research to better understand the underlying mechanisms at play. Moreover, these results have practical implications for shift workers and highlight the importance of implementing strategies to mitigate the adverse effects of sleep deprivation on cognitive functions in this population.

The significant correlation between sleep quality and cognitive performance in shift workers is an important finding that highlights the potential impact of sleep on overall job performance and safety. The results of this study suggest that addressing and monitoring sleep quality could be beneficial for maintaining optimal cognitive function in shift workers. The

specific correlation between sleep quality and attention, as well as delayed recall, further underscores the potential implications for workplace productivity and safety. These findings support the idea that interventions aimed at improving sleep quality among shift workers could have a positive impact on their cognitive abilities, potentially reducing errors and improving overall job performance. Future research could delve deeper into the specific mechanisms through which sleep quality influences cognitive performance, and explore potential interventions or strategies to improve sleep quality in shift workers. Additionally, longitudinal studies could help to determine the long-term effects of improved sleep quality on cognitive performance and overall well-being in this population.

The findings of this research suggest that the type of shift schedule has a significant impact on the cognitive performance of shift workers. The study revealed that there are distinct differences in cognitive performances among shift workers based on their shift types, whether fixed, regular, or rotating. These findings are consistent with previous research indicating that rotating shift schedules can lead to greater cognitive impairment compared to fixed or regular shifts. The cognitive performance of individuals working rotating shifts has been shown to be more negatively affected due to the disruption of the circadian rhythm and irregular sleep patterns. The implications of these findings are important for organizations that employ shift workers, as they highlight the need to carefully consider the design of shift schedules in order to minimize the potential negative impact on cognitive performance. Further research and interventions focused on managing the cognitive effects of shift work are warranted to ensure the well-being and performance of shift workers in various industries.

The research findings reveal significant gender differences in the cognitive performances of shift workers. Specifically, the study uncovered marked disparities in naming, attention, abstraction, and orientation between male and female shift workers. This suggests that there are unique cognitive challenges faced by individuals of different genders in a shift work setting. However, it is worth noting that no significant gender differences were observed in executive functions, language, and delayed recall, indicating certain cognitive aspects are not influenced by gender in this context. Additionally, the investigation uncovered a significant gender difference in the sleep quality of shift workers. This sheds light on the potential impact of gender on the sleep patterns and experiences of individuals working non-traditional hours. Interestingly, no significant gender differences were observed in the perseverance of the shift workers, suggesting that the determination and resilience to overcome challenges in a shift work environment are not influenced by gender. These findings have implications for workplace policies and interventions aimed at supporting the cognitive performance and sleep quality of shift workers, highlighting the importance of considering gender-specific factors in such efforts. Further research in this area could explore the underlying reasons for these gender differences and develop targeted strategies to address them.

The results of the study show that there are significant differences in sleep quality, cognitive performance, and perseverance of shift workers between those dwelling in metropolitan areas and those outside of the metropolitan city. Specifically, the research found that there is a significant difference in sleep quality, with shift workers in metropolitan areas experiencing lower sleep quality compared to those outside the metropolitan city. However, no significant differences were observed in sleep deprivation among the shift workers between these two areas. Moreover, the study revealed a significant difference in overall cognitive

performance, including executive functions, naming, abstraction, and delayed recall, of shift workers inside and outside of the metropolitan city. In addition to cognitive performance, there was also a significant difference in the perseverance of shift workers based on their location. These findings highlight the need for further investigation into the factors contributing to these differences and the potential implications for the well-being and performance of shift workers in different geographical locations.

Chapter Five: Conclusion

Conclusion

In this study, we explored the intricate relationship between shift work, sleep deprivation, and cognitive functions. It is evident that sleep deprivation has significant implications for the cognitive performances of shift workers. The findings of the research revealed that, a total of 10.4% healthcare shift workers are suffering from high to very high sleep deprivation and 30% have sleep difficulties. Among three shifts, rotating shift healthcare workers have high sleep deprivation and more sleep difficulties. Sleep deprivation is affecting their attention and recollection of information. Moreover, sleep quality has been found to be significantly affecting the cognitive performances of the healthcare shift workers. Throughout the investigation, we found sleep quality as a significant predictor of cognitive performances of the healthcare shift workers in Bangladesh. We also noticed significant differences of cognitive performances among three shifts.

The results of our study suggest that, intervention strategies are needed to mitigate the adverse effects of sleep deprivation on cognitive function. One way to improve sleep deprivation among shift workers is to implement flexible scheduling that allows for adequate rest between shifts. Additionally, providing education and training on healthy sleep habits and promoting a supportive work environment that values the importance of sleep can also help address the issue. Furthermore, the use of strategic napping and promoting the importance of proper nutrition and exercise can have a positive impact on mitigating the effects of sleep deprivation on cognitive performance. It is crucial for employers and policymakers to recognize the importance of addressing sleep deprivation among shift workers and to implement measures that prioritize the well-being and cognitive function of these individuals. By taking proactive steps to improve

sleep quality, organizations can enhance the overall productivity and safety of their workforce. Our findings underscore the critical importance of addressing sleep-related challenges faced by shift workers. Here are key takeaways and recommendations.

1. *Sleep Hygiene:* Encouraging shift workers to prioritize sleep hygiene are paramount. Simple practices such as maintaining a consistent sleep schedule, creating a cool and dark sleep environment, and minimizing caffeine intake before bedtime can significantly improve sleep quality.

2. *Strategic Napping:* Implementing planned naps during extended shifts can mitigate the effects of sleep deprivation. Short, well-timed naps have been shown to enhance alertness and cognitive performance.

3. Circadian Rhythm Management: Recognizing the impact of circadian rhythm misalignment is crucial. Night work disrupts the body's natural sleep-wake cycle, leading to cognitive impairments. Efforts to align work schedules with circadian rhythms can mitigate these effects.

4. Fatigue Management: Organizations should develop fatigue management plans. These may include strategic use of caffeine, regular breaks, and fostering an environment conducive to rest during work hours.

5. Education and Awareness: Educating shift workers about the consequences of sleep deprivation on cognitive function are essential. Awareness campaigns can promote healthier sleep habits and emphasize the importance of adequate rest.

In summary, addressing sleep-related challenges among shift workers requires a multifaceted approach. By implementing evidence-based strategies, we can enhance cognitive performance, reduce safety risks, and improve overall well-being in this vulnerable population.

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Appendices

Appendices

Appendix 1 Personal Information Form (PIF)

ID:……
……

আমি মোঃ সেলিম হোসেন। ঢাকা বিশ্ববিদ্যালয়ের মনোবিজ্ঞান বিভাগের একজন পি এইচ ডি গবেষক। আমার পি এইচ ডি গবেষণার তথ্য উপাত্তের জন্য আপনার নিকট থেকে ঘুম ও অবহিতিমূলক কিছু তথ্য সংগ্রহ করছি। আপনার সসকল তথ্য শুধুমাত্র গবেষণার উদ্দেশ্যেই ব্যবহৃত হবে এবং তথ্যের গোপনীয়তা বজায় রাখা হবে। আমাদের উক্ত গবেষণা সামগ্রিকভাবে মানবকল্যানে ব্যবহৃত হবে। এই গবেষণায় সময় দিয়ে অংশগ্রহন করার জন্য আপনাকে অগ্রীম ধন্যবাদ জানাচ্ছি।

নামঃ……

লিঙ্গঃ পুরুষ ☐ নারী ☐

বয়সঃ .....

উচ্চতাঃ……

ওজনঃ ……

পদবীঃ……

প্রতিষ্ঠানের
নামঃ……
…

প্রতিষ্ঠানের
অবস্থানঃ……

কাজের শিফটঃ Regular ☐ Rotating ☐ Fixed ☐

সামগ্রিক কাজের অভিজ্ঞতাঃ .....……

এই প্রতিষ্ঠানে কাজের অভিজ্ঞতাঃ.....

ঘুমানোর জন্য কোন ঔষধ/পিল/বড়ি সেবন করেন কি না? হ্যাঁ ☐ না ☐

কোন প্রকার উত্তেজক দ্রব্য (যেমনঃ কফি, চা, সিগারেট ইত্যাদি) গ্রহন করেন কি না?

হ্যাঁ ☐ না ☐

আপনার ঘুমসংক্রান্ত কোন রোগ আছে কি নাঃ হ্যাঁ ☐ না ☐

Appendix 2 Pittsburgh Sleep Quality Index (PSQI)

নিচের প্রশ্নগুলো আপনার গতমাসের সাধারণ ঘুমের অভ্যাস সম্পর্কিত। আপনার উত্তরগুলো যেনো আপনার গত মাসের অধিকাংশ দিন ও রাতের তুলনায় সবচেয়ে নির্ভুল হয়। অনুগ্রহপূর্বক সবগুলো প্রশ্নের উত্তর দিন।

১। গতমাসে আপনি সাধারণত কয়টায় ঘুমাতে যেতেন?

স্বাভাবিক ঘুমাতে যাওয়ার সময় _____

২। গত মাসে প্রতি রাতে ঘুমিয়ে পরতে আপনার সাধারণত কতক্ষণ (মিনিটে) সময় লেগেছে?

সময় মিনিটে _____

৩। গত মাসে আপনি সাধারণত সকালে কয়টায় ঘুম থেকে উঠেছেন?

স্বাভাবিক ঘুম থেকে উঠার সময় _____

৪। গত মাসে, প্রতি রাতে আপনি প্রকৃতপক্ষে কত ঘন্টা ঘুমিয়েছেন? (প্রকৃত ঘুমের সময় বিছানায় কাটানো সময়ের চেয়ে আলাদা হতে পারে)

প্রকৃত ঘুমের সময় _____

পরবর্তী প্রশ্নগুলোতে গতমাসের জন্য আপনার জন্য সবচেয়ে সঠিক উত্তরটিতে টিক (✓) চিহ্ন দিন।

৫। গতমাসে কতবার আপনার ঘুমের সমস্যা হয়েছে কারণ আপনি/আপনার...

বিবৃতিসমূহ	গতমাসে একবারও হয়নি	সপ্তাহে একবারেরও কম	সপ্তাহে একবার অথবা দুইবার	সপ্তাহে তিনবার বা তার বেশী
ক) ৩০ মিনিটের ভেতর ঘুমিয়ে পরতে পারেননি				
খ) মধ্যরাতে অথবা খুব ভোরে ঘুম ভেঙ্গে গেছে				
গ) বাথরুম ব্যবহারের উদ্দেশ্যে উঠতে হয়েছে				
ঘ) নিঃশ্বাস নিতে অসুবিধা হচ্ছিলো				
ঙ) জোরে কেশেছেন বা নাক ডেকেছেন				
চ) খুব বেশী ঠান্ডা অনুভব করেছেন				
ছ) খুব বেশী গরম অনুভব করেছেন				
জ) দুঃস্বপ্ন দেখেছেন				
ঝ) ব্যাথা অনুভব করেছেন				
ঞ) অন্যান্য কারণে গত মাসে আপনার ঘুমের সমস্যা হয়ে থাকলে, অনুগ্রহ করে কারণসমূহ এবং _____ গত মাসে এই কারণে আপনার কতবার ঘুমের সমস্যা হয়েছে?				

৬। সামগ্রিকভাবে আপনি আপনার গত মাসের ঘুমের গুণগত মানকে কীভাবে মূল্যায়ন করবেন?

খুব ভালো	মোটামুটি ভালো	মোটামুটি খারাপ	খুব খারাপ

৭। গত মাসে আপনি ঘুমানোর জন্য কতবার ঔষধ খেয়েছেন(প্রেসক্রিপশন সহ অথবা প্রেসক্রিপশন ছাড়া)?

গত মাসে একবারও নয়	সপ্তাহে একবারেরও কম	সপ্তাহে একবার অথবা দুইবার	সপ্তাহে তিনবার বা তার বেশী

৮। গত মাসে কতবার আপনার গাড়ি চালানোর সময়, খাবার খাওয়ার সময় অথবা সামাজিক কাজে নিযুক্ত থাকার সময় সজাগ থাকতে সমস্যা হয়েছে?

গত মাসে একবারও নয়	সপ্তাহে একবারেরও কম	সপ্তাহে একবার অথবা দুইবার	সপ্তাহে তিনবার বা তার বেশী

৯। গত মাসে, কোন একটি কাজ শেষ করার জন্য যথেষ্ট উদ্যম ধরে রাখতে আপনার কতটা সমস্যা হয়েছে?

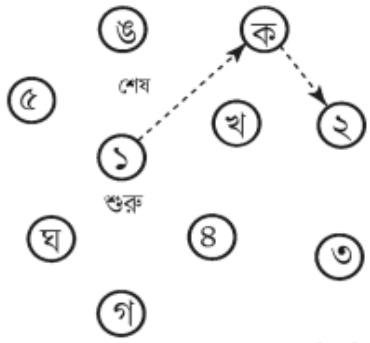
কোন সমস্যা হয় নি	খুবই সামান্য সমস্যা	বেশ সমস্যা	খুব বেশী সমস্যা

Appendix 3 Montreal Cognitive Assessment (MoCA)

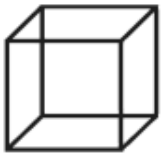
MONTREAL COGNITIVE ASSESSMENT (MOCA)
Version 7.1 Bengali Version

NAME :
Education : Date of birth :
Sex : DATE :

VISUOSPATIAL / EXECUTIVE — POINTS



[ ] [ ]



ঘনক আঁকা

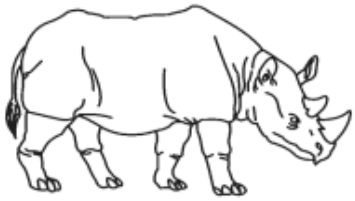
ঘড়ি আঁকা (এগারোটা বেজে দশ) (3 points)

[ ] Contour [ ] Numbers [ ] Hands

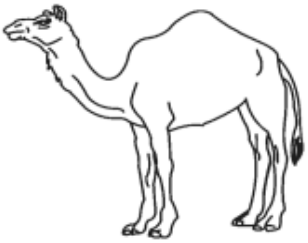
/5

NAMING

[ ]



[ ]



[ ]

/3

MEMORY শব্দগুলি পড়ুন, আর আপনার বলার পরীক্ষার্থীকে বলতে বলুন। ২ বার করে শব্দগুলি পড়ুন। প্রথমবারে সব শব্দগুলি ঠিক ঠিক মনে থাকলেও দ্বিতীয়বার শব্দগুলিকে আবার পড়ুন। ৫ মিনিট পরে আবার শব্দগুলি জিজ্ঞাসা করুন।

	চোখ	শাড়ি	মন্দির	গোলাপ	নীল
১ বার					
২ বার					

No points

ATTENTION নম্বরের তালিকাটি পড়ুন (১ নং/সেকেন্ড) সোজা- আমি নম্বরগুলি যেভাবে বলছি আপনি সেভাবে বলুন [ ] ২ ১ ৮ ৫ ৪
উল্টো- আমি নম্বরগুলি যেভাবে বলছি আপনি সেইগুলি উল্টো বলুন [ ] ৭ ৪ ২

/2

অক্ষরগুলো পড়ুন। যখনই 'এ' শুনবে, পরীক্ষার্থীকে আঙুল দিয়ে টোকা মারতে হবে। No points if ≥ 2 errors

[ ] ফ ব এ স ম ন এ এ জ ক ল ব এ ফ এ ক ড আ এ এ এ জ এ ম ও ফ এ এ ব

/1

ক্রমান্বয় ১০০ থেকে ৭ বিয়োগ [ ] ৯৩ [ ] ৮৬ [ ] ৭৯ [ ] ৭২ [ ] ৬৫
4 or 5 correct subtractions : **3 pts**, 2 or 3 correct : **2 pts,** 1 correct : **1 pt,** 0 correct : **0 pt**

/3

LANGUAGE বলুন : আমি শুধু জানি রাম-ই সেই যার আজকে যাওয়ার ছিল না।
বেড়াল শুধু খাটের তলায় লুকিয়ে পড়ে কুকুরগুলো ঘরে এলে।

/2

এক মিনিটের মধ্যে 'প' দিয়ে যেকটা শব্দ জানা আছে বলতে থাকুন [ ] (— N ≥ 11 words)

/1

ABSTRACTION মিল কি - যেমন : কলা- কমলা লেবু = ফল [ ] ট্রেন - সাইকেল [ ] ঘড়ি - স্কেল

/2

DELAYED RECALL

	আগের শব্দগুলি স্মরণ করা সাহায্য ছাড়া	চোখ [ ]	শাড়ি [ ]	মন্দির [ ]	গোলাপ [ ]	নীল [ ]	Points for UNCUED recall only
Optional	দলগত বৈশিষ্ট্যমূলক সাহায্য						
	একাধিক পছন্দ						

/5

ORIENTATION [ ] তারিখ [ ] মাস [ ] বছর [ ] দিন [ ] এলাকা [ ] শহর

/6

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TOTAL /30
Add 1 point if ≤ 12 yr edu

Administered by: _____

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Appendix 4 Epworth sleepiness scale

আপনি ক্লান্ত না এমন অবস্থায় নিম্নোক্ত পরিস্থিতিতে অল্প অথবা বেশি সময়ের জন্য ঘুমিয়ে পরার সম্ভাবনা কতোটুকু? এটি আপনার সাম্প্রতিক সময়ের স্বাভাবিক জীবন যাত্রাকে নির্দেশ করে।

এমন কি সাম্প্রতিক সময়ে এই জিনিসগুলোর কিছুই যদি করে না থাকেন তবে এইগুলো কিভাবে আপনাকে প্রভাবিত করেছে তা প্রকাশ করুন।
যে বিকল্পটি ভালো বর্ণনা করে সেটি সংখ্যায় পাশের বক্সে লিখুন।
0 = কখনই ঘুমাই নি
১ = ঘুমানোর সম্ভাবনা সামান্য
২ = ঘুমানোর সম্ভাবনা মাঝামাঝি
৩ = ঘুমানোর সম্ভাবনা অনেক
আপনার প্রতিটি প্রশ্নের যথাসাধ্য উত্তর দেয়া গুরুত্বপূর্ণ।

অবস্থা	ঘুমানোর সম্ভাবনা (০-৩)
১। বসে থাকা এবং পড়া (বই, ম্যাগাজিন ইত্যাদি)	
২। টিভি দেখা অবস্থায়.....	
৩। পাবলিক জায়গায় নিস্ক্রিয় (কর্মহীন বা চুপচাপ) বসে থাকা অবস্থায়..... (যেমন: একটি থিয়েটার বা মিটিং)	
৪। যাত্রী হিসেবে কোন গাড়ীতে একটানা একঘন্টা থাকা অবস্থায়.....	
৫। অনূকূল পরিস্থিতিতে বিকেলে বিছানায় বিশ্রামরত অবস্থায়.....	
৬। বসে বসে কারো সাথে কথা বলা অবস্থায়.....	
৭। দুপুরের খবারের পর চা কফি ছাড়া চুপচাপ বসে থাকা অবস্থায়.....	
৮। কয়েক মিনিটের জন্য যানজটের মধ্যে কোনো গাড়িতে থেমে থাকা অবস্থায়.....	
মোট.....	

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Appendix 5 Short Version of Grit Scale

নির্দেশনাবলীঃ অনুগ্রহ করে নিম্ন লিখিত ৮টি প্রশ্নের উপর আপনার প্রতিক্রিয়া জানান। আপনার ক্ষেত্রে প্রযোজ্য বিকল্পটিতে টিক চিহ্ন দিন- এখানে ভুল বা শুদ্ধ বলে কিছু নেই ।

১। নতুন কোন ধারণা এবং প্রকল্প মাঝে মাঝে আমাকে পূর্বের ধারনা বা প্রকল্প থেকে বেশি বিভ্রান্ত করে।

→ অনেকটা আমার সাথে মিলে

→ প্রায়ই আমার সাথে মিলে

→ কিছুটা আমার সাথে মিলে

→ তেমন আমার সাথে মিলে না

→ একেবারেই আমার সাথে মিলে না

২। বাধা-বিপত্তি আমাকে নিরৎসাহিত করে না।

→ অনেকটা আমার সাথে মিলে

→ প্রায়ই আমার সাথে মিলে

– কিছুটা আমার সাথে মিলে

→ তেমন আমার সাথে মিলে না

→ একেবারেই আমার সাথে মিলে না

৩ । আমি অল্প সময়ের জন্য একটি নির্দিষ্ট ধারণা বা প্রকল্পে আচ্ছন্ন থাকি কিন্তু পরে আগ্রহ হারিয়ে ফেলি।

→ অনেকটা আমার সাথে মিলে

→প্রায়ই আমার সাথে মিলে

→কিছুটা আমার সাথে মিলে

→তেমন আমার সাথে মিলে না

→ একেবারেই আমার সাথে মিলে না

৪। আমি পরিশ্রমী।

→ অনেকটা আমার সাথে মিলে

→ প্রায়ই আমার সাথে মিলে

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→ কিছুটা আমার সাথে মিলে

→তেমন আমার সাথে মিলে না

→ একে বারেই আমার সাথে মিলে না

৫ । আমি প্রায়ই একটি লক্ষ্য ঠিক করি কিন্তু পরে ভিন্ন একটি লক্ষ্য বেছে নিয়ে তা অনুসরণ করি।

→ অনেকটা আমার সাথে মিলে

→প্রায়ই আমার সাথে মিলে

→ কিছুটা আমার সাথে মিলে

→তেমন আমার সাথে মিলে না

→একে বারেই আমার সাথে মিলে না

৬। যে প্রকল্পগুলো সম্পন্ন করতে কয়েক মাসের বেশি সময় লাগে সেগুলোতে মনোযোগ বজায় রাখতে আমার অসুবিধা হয়।

→ অনেকটা আমার সাথে মিলে

→ প্রায়ই আমার সাথে মিলে

→ কিছুটা আমার সাথে মিলে

তেমন আমার সাথে মিলে না

→ একে বারেই আমার সাথে মিলে না

৭। আমি যা শুরু করি তা শেষ করি।

→ অনেকটা আমার সাথে মিলে

→ প্রায়ই আমার সাথে মিলে

→ কিছুটা আমার সাথে মিলে

→ তেমন আমার সাথে মিলে না

→ একে বারেই আমার সাথে মিলে না

৮। আমি অধ্যবসায়ী (সফলতা না পাওয়া পর্যন্ত কোন কিছুর সাথে লেগে থাকা) ।

→ অনেকটা আমার সাথে মিলে

→ প্রায়ই আমার সাথে মিলে

→ কিছুটা আমার সাথে মিলে

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→ তেমন আমার সাথে মিলে না

→ একে বারেই আমার সাথে মিলে না।

Appendix 6 Ethical Approval

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ডিন অফিস
জীববিজ্ঞান অনুষদ
ঢাকা বিশ্ববিদ্যালয়, ঢাকা-১০০০, বাংলাদেশ

Tel : 58613243
PABX : 9661900-59/4355, 7545
Fax : 880-2-9667222
E-mail : deanbio@du.ac.bd
kmhasan47@yahoo.com

Ref. No. 229/Biol. Scs. **August 30, 2023**

Ethical Review Committee

Professor Dr. Md. Kamal Uddin
Department of Psychology
University of Dhaka

Sub: Ethical Clearance.

Dear Dr. Md. Kamal Uddin,

With reference to your application on the above subject, this is to inform you that your research proposal entitled "Sleep deprivation and cognitive performance of shift workers in Bangladesh" has been reviewed and approved by the Ethical Review Committee of the Faculty of Biological Sciences, University of Dhaka.

I wish for the success of your research project.

30.08.2023

Professor Dr. A K M Mahbub Hasan
Dean, Faculty of Biological Sciences
University of Dhaka

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Appendix 7 Informed Consent

Informed Consent Form

Title: **Sleep deprivation and cognitive performance of shift workers in Bangladesh**

Principal Investigator: Md. Salim Hossain

Contact Information: salim087@du.ac.bd

Phone Number: 01819079386

Introduction:

You are invited to participate in a research study titled "Sleep Deprivation and Cognitive Performance of Shift Workers in Bangladesh." The purpose of this study is to investigate the effects of sleep deprivation on cognitive performance among shift workers in Bangladesh. The study aims to contribute to a better understanding of the challenges faced by shift workers and potentially inform strategies to improve their well-being and job performance.

Participation:

Your participation in this study is voluntary, and you have the right to decline participation or withdraw from the study at any time without any consequences. Your decision to participate or not will not affect your current or future professional relationship with us.

Procedures:

If you agree to participate in this study, you will be asked to:

1. Complete a demographic questionnaire, providing basic information such as age, gender, work schedule, and sleep habits.

2. Undergo cognitive performance tests to assess executive functions, perseverance, attention, memory, and problem-solving skills. These tests may include tasks on a computer or paper-based tests.

3. Keep a sleep log to track your sleep patterns while working different shifts.

4. Provide consent to access your work schedule and any relevant work-related data.

Risks and Discomforts:

Participating in this study may involve some minimal risks and discomforts, including mild fatigue or drowsiness during the cognitive tests. However, all reasonable efforts will be made to ensure your comfort and safety throughout the study.

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Benefits:

While there may be no immediate benefits to you personally, the findings from this study may contribute to the advancement of knowledge regarding shift work and sleep deprivation. The results may also help develop strategies to improve the work environment and promote better sleep habits among shift workers.

Confidentiality:

All information collected during this study will be treated with strict confidentiality. Your data will be assigned a unique identifier, and no personal identifying information will be included in any reports or publications resulting from this research. Only the research team will have access to the data, and it will be securely stored for the duration of the study following institutional guidelines.

Voluntary Participation:

Your participation in this study is entirely voluntary. If you decide to participate, you may withdraw at any time without providing a reason, and this will not affect our professional relationship with in any way.

Questions and Contact Information:

If you have any questions or concerns about this study, please feel free to contact the principal investigator, Md. Salim Hossain, at salim087@du.ac.bd or 01819079386. Additionally, if you have any concerns about your rights as a research participant, you may contact the Ethical Review Committee of Faculty of Biological Sciences, University of Dhaka, Bangladesh.

Consent:

By signing below, you indicate that you have read and understood the information provided in this consent form. You voluntarily agree to participate in the study "Sleep Deprivation and Cognitive Performance of Shift Workers in Bangladesh" and provide your informed consent for the research procedures described herein.

Participant's Signature: _____ Date: _____

Printed Name: _____

Principal Investigator's Signature: _____ Date: _____

Representative (Witness) Signature: _____ Date: _____

(Note: A copy of this consent form will be provided to you for your records.)

Appendix 8 Originality Report

Sleep deprivation and cognitive performance of shift workers in Bangladesh

ORIGINALITY REPORT

3%
SIMILARITY INDEX

PRIMARY SOURCES

1	fastercapital.com Internet	56 words — < 1%
2	rulrepository.ru.ac.bd Internet	30 words — < 1%
3	www.google.com Internet	29 words — < 1%
4	www.mdpi.com Internet	29 words — < 1%
5	docplayer.net Internet	28 words — < 1%
6	www.world-today-news.com Internet	20 words — < 1%
7	essay365.x10.mx Internet	19 words — < 1%
8	C McDaid, S Griffin, H Weatherly, K Durée, M van der Burgt, S van Hout, J Akers, R Davies, M Sculpher, M Westwood. "Continuous positive airway pressure devices for the treatment of obstructive sleep apnoea–hypopnoea syndrome: a systematic review and economic analysis", Health Technology Assessment, 2009	18 words — < 1%

04.04.24
Prof. Dr. M. Nasiruddin Munshi
Librarian (In-charge)
University of Dhaka

04/04/2024