A PILOT STUDY TO INVESTIGATE SLEEP-WAKE PATTERNS AMONG HEALTHY MUSLIM ADULTS IN KUANTAN, PAHANG

BY

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A thesis submitted in fulfilment of the requirement for the degree of Master in Pharmaceutical Sciences
(Pharmacy Practice)

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OCTOBER 2020

ABSTRACT

Sleep is known as one of the most important components for a good living. Nevertheless, nowadays, sleep deprivation and sleep disorders are becoming increasingly prevalent, affecting worldwide population. Like other nations, Muslims also juggle their responsibilities while sometimes compromising their sleep. Muslims' sleep-wake patterns are believed to be unique as compared to other nations as they are influenced by prayer times and other sleep-related Islamic practices. This study sought to investigate sleep-wake patterns among healthy Muslim adults in Kuantan, Pahang, Malaysia. This study also compared sleep parameters obtained from a self-reported sleep diary and a sleep-tracking mobile application over 14 consecutive days, and examined sleep disturbance and sleep quality among study population. Three instruments were utilized for data collection including baseline questionnaire, sleep diary, and mobile application. Data was analyzed using IBM SPSS Statistics for Windows, version 21.0 (IBM Corp., Armonk, N.Y., USA). Statistical analyses performed include descriptive analysis to analyze demographic data, sleep-related characteristics, responses on questionnaires, and sleep diary entries; independent t-test to analyze usual sleep habits and compare between gender and employment groups; paired samples t-test to compare total sleep time and sleep efficiency percentage obtained from sleep diary and mobile application; and Bland-Altman plots to analyze agreement between the two measures. A total of 59 adults (45 females and 14 males) were conveniently recruited via social media advertisement. The findings indicated mean bedtime of 12.10 ± 1.14 midnight, wake-up time of 6.35 ± 0.38 am, sleep onset latency of 10.7 ± 13.8 min, and total sleep time of 323.4 ± 58.6 min per day. Sleep diary was found to be in agreement with mobile application at measuring total sleep time. One-third (35.6%) of the participants reported having excessive daytime sleepiness while almost two-third (57.7%) of the participants reported having insomnia symptoms. About 27% of the participants claimed to be dissatisfied with their current sleep patterns. In summary, findings showed that sleep deprivation, daytime napping and wakefulness after sleep onset were common among study population. These findings are relevant to extend knowledge on Muslims' sleep-wake patterns. Furthermore, there is an urgent need to develop Muslim-friendly sleep-monitoring tools, for a more specific and better monitoring of Muslims' sleep-wake patterns.

خلاصة البحث

ومن المعروف أن النوم واحدا من أهم عناصر هامة في حياة جيدة. ومع ذلك، فإن الحرمان من النوم واضطرابات النوم في الوقت الحاضر أصبحت سائدة بشكل متزايد، مما يؤثر على سكان العالم. كما في في دول أخرى، يتلاعب المسلمون أيضًا بمسؤولياتهم بينما يعرضون نومهم أحيانًا للخطر. ويُعتقد أن أنماط النوم والاستيقاظ لدى المسلمين فريدة مقارنة بدول أخرى لأنها تتأثر بأوقات الصلاة والممارسات الإسلامية الأخرى المتعلقة بالنوم. وسعت هذه الدراسة إلى استكشاف أنماط الاستيقاظ من النوم بين البالغين المسلمين الأصحاء في كوانتان، باهانج، ماليزيا. وقارنت هذه الدراسة أيضًا معلمات النوم التي تم الحصول عليها من مذكرات النوم المبلغ عنها ذاتيًا وتطبيقات الهاتف المحمول لتتبع النوم، وفحصت اضطراب النوم وجودة النوم بين مجتمع الدراسة. وتم استخدام ثلاث أدوات لجمع البيانات بما في ذلك الاستبيان الأساسي، ومذكرات النوم، وتطبيقات الهاتف المحمول. وتم تحليل البيانات باستخدام الحزمة الإحصائية للعلوم الاجتماعية (SPSS)، الإصدار 21.0 لنظام ويندوز (IBM). تشمل التحليلات الإحصائية التي تم إجراؤها التحليل الوصفي، واختبار t المستقل، واختبار t للعينات المزدوجة ومؤامرات بلاند التمان. وتم توظيف 59 شخصًا بالغًا (45 من الإناث و 14 من الذكور) بشكل ملائم عبر إعلانات وسائل التواصل الاجتماعي. وأشارت النتائج إلى متوسط وقت النوم يبلغ 12.10±1.14 منتصف الليل ، ووقت الاستيقاظ 6.35±0.38 صباحًا، وزمن بدء النوم 10.7±13.8 دقيقة، وإجمالي وقت النوم 323.4±58.6 دقيقة في اليوم. وتم العثور على مذكرات النوم متوافقة مع تطبيق الهاتف المحمول في قياس إجمالي وقت النوم. وأفاد ثلث (35.6٪) من المشاركين وجود فرط النوم أثناء النهار بينما تقريبا الثلثين (57.7٪) من المشاركين عن وجود أعراض الأرق. وادعى حوالي 27٪ من المشاركين أنهم غير راضين عن أنماط نومهم الحالية. وبالإضافة إلى ذلك، أظهرت النتائج أن الحرمان من النوم والقيلولة أثناء النهار واليقظة بعد بداية النوم كانت شائعة بين مجتمع الدراسة. وهذه النتائج ذات صلة لتوسيع المعرفة بأنماط الاستيقاظ لدى المسلمين. وعلاوة على ذلك، هناك حاجة ملحة لتطوير أدوات مراقبة النوم الصديقة للمسلمين من أجل مراقبة أكثر تحديدًا وأفضل لأنماط الاستيقاظ للنوم لدى المسلمين.

APPROVAL PAGE

I certify that I have supervised and read this study and that in my opinion, it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a thesis for the degree of Master in Pharmaceutical Sciences (Pharmacy Practice)

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DECLARATION

I hereby declare that this thesis is the result of my own investigations, except where otherwise stated. I also declare that it has not been previously or concurrently submitted as a whole for any other degrees at IIUM or other institutions.

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ACKNOWLEDGEMENTS

Firstly, it is my utmost pleasure to dedicate this work to my dear parents, husband and family, who granted me the gift of their unwavering belief in my ability to accomplish this goal: thank you for your support and patience.

I wish to express my appreciation and thanks to those who provided their time, effort and support for this project. To the members of my dissertation committee, thank you for sticking with me.

Finally, a special thanks to Dr Norny Syafinaz, Dr Zaswiza and Dr Nor Ilyani for their continuous support, encouragement and leadership, and for that, I will be forever grateful.

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LIST OF ABBREVIATIONS

ACT	Actigraphy
ACTH	Adrenocorticotropic hormone
BMI	Body mass index
CRH	Corticotropin releasing hormone
EDS	Excessive daytime sleepiness
EE	Energy expenditure
ESS	Epworth Sleepiness Scale
HPA	Hypothalamic-pituitary-adrenal
IL	Interleukin
ISI	Insomnia Severity Index
MAOI	Monoamine oxidase inhibitor
NREM	Non-rapid eye movement
OSA	Obstructive sleep apnea
P.B.U.H	Peace Be Upon Him
PSG	Polysomnography
PSQI	Pittsburgh Sleep Quality Index
REM	Rapid eye movement
SD	Standard deviation
SE%	Sleep efficiency percentage
SOL	Sleep onset latency
SSRI	Selective serotonin reuptake inhibitor
SWS	Slow-wave sleep
TCA	Tricyclic antidepressant
TIB	Time in bed

TST	Total sleep time
WASO	Wakefulness after sleep onset

CHAPTER ONE

INTRODUCTION

1.1 BACKGROUND OF THE STUDY

Sleep has long been recognized as one of the important components for a good living. Sleep is defined as a reversible behavioral state of perceptual disconnection from unresponsiveness to the environment, and it involves a complex combination of physiological and behavioral processes (Carskadon & Dement, 2011). Sleep is an active and intricate process, which involves many parts of the brain and is associated with health and well-being (Everly & Lating, 2013). There are many biological functions associated with sleep, which includes physical restoration, learning and memory, neurobehavioral and neurocognitive performance (Assefa, Diaz-Abad, Wickwire, & Scharf, 2015).

Most people regard sleep as a 'down time' when their brain shuts off and their body rests (National Institute of Health (NIH), 2011). Typically, one-third of our lives are spent sleeping (Pagel & Parnes, 2001), during which our brains strive to form pathways of learning, creating memories, and constructing new ideas (NIH, 2011). People who sleep without disturbance often wake up feeling well-rested and energized. National Sleep Foundation (NSF) (2015) has recommended 7 to 9 hours of sleep for most adults, realizing that sleep needs are individual. Nevertheless, sleep deprivation and sleep disorders are prevalent and critically relevant in our society. More than one-third of American adults are not getting enough sleep on a regular basis (Centers for Disease Control and Prevention (CDC), 2016), and almost 70 million Americans suffer from chronic sleep disorders (American Sleep Association (ASA), 2018). The Philips Centre for Health and Well-being (TPCHW) in 2010 reported that 81% of 800

Malaysian adults interviewed did not get enough sleep at night, and the reasons behind lack of sleep reported by the participants include sleeping late and waking up early (56%), poor sleeper (30%), and worried or stressed about life (8%) (TPCHW, 2010).

When a perceived sleep deprivation occurs, people usually notice that their health is deteriorating (Colten & Altevogt, 2006). A study conducted on 53 healthy adults in a laboratory setting reported significantly greater stress, anger and anxiety in sleep-deprived participants (Minkel et al., 2012). The 2014 Sleep Health Index published by NSF reported high level of stress among those with shorter average sleep duration on working days and non-working days. Research also found that long-term effects of insufficient sleep have been associated with numerous deleterious health problems including an increased risk of hypertension, diabetes, obesity, depression, heart attack, and stroke (Colten & Altevogt, 2006). This shows that lack of sleep can eventually impair health-related quality of life and increase mortality risk.

1.2 STATEMENT OF THE PROBLEM

Despite knowing the importance of restful and quality sleep to humans, sleep deprivation and sleep disturbances such as insomnia, daytime sleepiness and tiredness have become among major health concerns worldwide. Sleep deprivation and disturbance have been associated with various negative impacts related to health, performance, and safety, yet it is underestimated among the community. Failure to obtain a quality sleep has been associated with work absenteeism, accidents, decreased daily functioning and eventually, chronic sleep disturbance can lead to impaired quality of life.

A self-reported study on 1629 adolescents aged 12 to 19 years old found that most adolescents in Hong Kong did not get enough sleep, and 40% of them suffered

from excessive daytime sleepiness (EDS) with Epworth Sleepiness Scale (ESS) score greater than 10 (Chung & Cheung, 2008). A community-based study on 1611 Malaysian adults aged 30 to 70 years old reported that about one-third of the subjects had insomnia symptoms while more than 10% suffered from chronic insomnia (Zailinawati, Ariff, Nurjahan, & Teng, 2008). Besides that, greater prevalence of impaired concentration, exhaustion, depressed feeling, poor memory and reduced productivity at work was also reported among subjects with insomnia.

Lack of awareness on sleep loss and sleep disorders among general population and healthcare professionals is among contributing factors to this burden of public health (Colten & Altevogt, 2006). Lack of availability of instruments for sleep monitoring in both home and primary healthcare settings makes it difficult to encourage community to pay attention to their sleep problems. Hence, development of home-based validated and reliable instruments is crucial in order to promote general public to self-monitor their sleep at home and seek for advice and/or treatment whenever they experience disturbance or irregularity in their sleep patterns.

Although there have been many studies examining the sleep-wake patterns among various groups, limited studies were focusing on Muslim subjects, particularly Muslim adults. This pilot study emphasizes understanding Muslims' sleep-wake patterns in relation to their lifestyle by utilizing home-based sleep monitoring tools. By understanding issues related to sleep-wake patterns in Muslim population, a proper intervention should be developed in the future to manage the problems accordingly. Effective solutions and interventions are necessary in order to increase awareness, especially among Muslims, to improve their sleep health as a whole. It is hoped that this study would provide a groundwork for a larger study in the future, addressing the issues of sleep among Muslims.

1.3 RESEARCH OBJECTIVES

This pilot study intends to achieve the following objectives:

1. To investigate sleep-wake patterns among healthy Muslim adults in Kuantan, Pahang.
2. To compare sleep parameters, particularly total sleep time (TST) and sleep efficiency percentage (SE%), measured using sleep diary and mobile application.
3. To evaluate sleep disturbance, particularly excessive daytime sleepiness (EDS) and insomnia, among the study population.
4. To examine sleep quality among the study population.

1.4 RESEARCH QUESTIONS

1. How are Kuantan's Muslim adults' sleep-wake patterns?
2. How comparable are sleep parameters measured using sleep diary and mobile application?
3. How many percent of the study population suffer from sleep disturbance, particularly EDS and insomnia?
4. How is the overall sleep quality of the study population?

1.5 SIGNIFICANCE OF THE STUDY

Muslims' sleep schedules are unique, as they are influenced by five obligatory prayer times, fasting month of Ramadan, as well as other sleep-related practices encouraged by the Islamic teaching (BaHammam, 2011). Islam encourages its followers to practice going to bed early after the last (*isha*) prayer (about 1.5 to 2 hours after sunset), and waking up early for dawn (*subh*) prayer (about one hour before sunrise) (BaHammam,

2011). Some Muslims may practice waking up early for dawn (*subh*) prayer and return to sleep until their work time, while some other Muslims may sleep continuously and wake up later for both dawn (*subh*) prayer and work (BaHammam, Sharif, Spence, & Pandi-Perumal, 2012). Muslims are also encouraged to wake up in the last third or any part of the night to perform midnight worship (*qiamullail*), and to practice midday napping (*qailulah*) during the day (BaHammam, 2011).

This study is significant because sleep disturbance is currently underestimated in the community. In Malaysia, about 60% of 28 million total population are Muslims (Islamic Tourism Centre of Malaysia (ITC), 2019). However, very limited studies have been conducted on sleep-related issues involving Muslim population in Malaysia. Like other nations, Muslims in Malaysia are also juggling the demands of work and home, and less concern is given to sleep-wake processes, while the processes actually play a vital role in good health and well-being. Adequate and restful sleep often leads to refreshed mood and positive feelings while conversely, insufficient sleep often results in daytime fatigue, impaired cognitive function, mood disturbances, depression, declined productivity at work, and impaired relationship with other people. Persistent sleep problems may eventually lead to increased morbidity and mortality risk.

This study seeks to better understand sleep-wake patterns of Muslim adults in Malaysia. This study is hoped to provide an overview to the Muslim community that sleep monitoring is crucial in order to ensure each individual is getting enough and quality sleep at night.

CHAPTER TWO

LITERATURE REVIEW

2.1 THE IMPORTANCE OF SLEEP

Sleep is defined as a reversible behavioral state of reduced perceptual engagement from the environment and responsiveness to it (Carskadon & Dement, 2011). Sleep is a dynamic process, which involves neurological behavior with physical immobility and increased arousal threshold, yet is rapidly reversible (Assefa, Diaz-Abad, Wickwire, & Scharf, 2015). Most people regard sleep as a part of normal life requirement as it allows brain to recharge and body to rest. Thus, inadequate sleep often leads to fatigue, daytime sleepiness, and mood disturbance.

Sleep requirement varies with age. The National Sleep Foundation (NSF), along with a multi-disciplinary expert panel, in 2015, have come up with new recommendations for appropriate sleep durations for different age groups. Of all age groups, the duration is longest for newborns (0 to 3 months), that is, 14 to 17 hours, and decreasing as individuals get older. Adults (18 to 64 years) require 7 to 9 hours, while older adults (65 years and above) require 7 to 8 hours of sleep each day (NSF, 2015).

Numerous scientific studies have been conducted to explore the roles of sleep in human beings. One of the important roles of sleep is energy conservation. Schmidt (2014) proposed the energy allocation model which suggested that sleep reallocates and shifts energy reserves for essential biological functions. Energy expenditure (EE) is found to be relatively smaller during sleep as compared to silent wakefulness due to reduced biological processes during sleep (Berger & Phillips, 1995). Jung et al. (2011) added to this finding by conducting a study on seven healthy participants aged 22±5 years, putting them on 8-hour baseline sleep, 25-40-hour sleep deprivation, and 8-hour

recovery sleep. During the first 24 hours of sleep deprivation, EE was significantly increased by 7% and decreased by 5% during recovery, compared to baseline. In comparison, at night time, EE was significantly increased by 32% during sleep deprivation and decreased by 4% during recovery sleep.

Sleep as well as circadian rhythm is believed to play a vital role in regulating immune functions. Mechanisms by which sleep-wake rhythm enhances immune system have been suggested by several studies. As an example, Lange, Dimitrov, and Born (2010) concluded that sleep, circadian rhythm and immune system assimilate to maximize adaptation following environmental changes by which during daytime, anti-inflammatory signals, cytokines and hormones carry immediate effector functions, while during nocturnal sleep, the initiation of adaptive responses occurs in lymph nodes. Dimitrov, Lange, Nohroudi, and Born (2007) found that sleep, in contrast to nocturnal wakefulness, selectively promotes the production of interleukin (IL)-12 which is crucial for the inititation of adaptive immune responses.

The importance of sleep for memory and cognitive functions have been broadly explored and well documented. In context of memory consolidation, different stages of sleep are connected with different memory tasks – non-rapid eye movement (NREM) sleep and its specific characteristics are associated with the consolidation of motor skill tasks, while slow-wave sleep (SWS) and rapid eye movement (REM) sleep are associated with the consolidation of visual skill memory (Stickgold & Walker, 2005). A cross-sectional analysis on 2932 women (mean age 83.5 years) have found a significant relationship between sleep and cognition, independent of multiple cofounders (Blackwell et al., 2006). This is parallel with a prospective cohort study on 1459 women and 3972 men aged 45-69 years which suggested that cognitive function is poorer with adverse changes in sleep duration (Ferrie et al., 2011).

Besides the positive impacts on energy conservation, immunity, memory and cognitive functions, sleep has been shown to influence psychological well-being, including self regulation and stress management. Based on a survey involving 502 community residents about sleep habits, symptoms of anxiety and depression, and psychological well-being, it is suggested that good sleepers (those who sleep between 6 to 8.5 hours) have fewer anxiety and depressive symptoms and greater environmental mastery, purpose in life, self acceptance, personal growth, and positive relations with others, compared to non-optimal sleepers (those sleeping less than 6 hours or more than 8.5 hours) (Hamilton, Nelson, Stevens, & Kitzman, 2007). This study supported the previous study by Ryff, Singer, and Love (2004) involving 135 older women, which reported greater environmental mastery with longer sleep duration and time in bed, faster onset of REM sleep, and longer duration of REM sleep.

2.2 ISLAMIC VIEWS OF SLEEP

Sleep is regarded as one of the signs of greatness of Allah, and Muslims are encouraged to explore this important sign. Topics on sleep including different sleep stages, importance of sleep, and good sleep habits, have been well discussed in the Holy book of *Quran*, *Hadith* of Prophet Muhammad (P.B.U.H), and Islamic literatures (BaHammam, 2011). As mentioned in the *Quran*;

> "*And among His signs is your sleep by night and by day and your seeking of His bounty, verily in that are signs for those who hearken.*" (*Quran* 30:23)

The teachings of Islam with regards to sleep highlights the importance of sleep to care for humans' lives, as failure to get sufficient and restful sleep will impair one's daily functioning and eventually lead to many health-related problems. In one *Hadith*, Prophet Muhammad (P.B.U.H) said;

"If anyone of you feels drowsy while praying, he should go to bed (sleep) till his slumber is over." (*Sahih Bukhari*: 210)

Islam encourages its followers to practice sleep manners in accordance with the practice of Prophet Muhammad (P.B.U.H). For example, prior to sleep, Muslims are encouraged to perform ablution (*wudoo*), clean the bed, turn the lights off, supplicate, and sleep on the right side (BaHammam, 2011).

Muslims' sleep schedules are influenced by prayer times (BaHammam, 2011). Muslims are obliged to perform five prayers per day – the first prayer starts at dawn (*subh*) which is about one hour before sunrise, while the last prayer (*isha*) is in the evening, about 1.5 to 2 hours after sunset, depending on the geographical region. It is obligatory for a Muslim to wake up and perform dawn (*subh*) prayer regardless of weekdays or weekends, and also to perform the other four prayers at specified times. Some Muslims may practice "split sleep" in which they wake up for dawn (*subh*) prayer early and stay awake for about 30 to 45 minutes and then sleep again until work time, while some other Muslims may practice "consolidated sleep" in which they sleep continuously, wake up later for the prayer and do not get back to sleep until work time (BaHammam, 2011). It was reported that Muslims' rise times on weekdays and weekends were earlier compared to Christians and others (Borchers & Randler, 2012). In addition, morning-typology was found to be more common in Muslims than those from Western countries, in which they tend to go to sleep early, wake up early, and perform better in the morning (BaHammam, Almestehi, Albatli, & Alshaya, 2011).

Islam encourages Muslims to practice midday napping (*qailulah*), about an hour before afternoon (*dhuhr*) prayer. This is in accordance to the Sunnah of Prophet Muhammad (P.B.U.H). Which completes the sleep taken at night and allows body to recharge, especially if a person feels sleepy and tired (Yusof et al., 2014). Recent studies

have shown that short daytime napping can improve cognitive function, memory consolidation, vigilance (Ficca, Axelsson, Mollicone, Muto, & Vitiello, 2010). Midday napping (*qailulah*) has become a common practice among Muslims in Saudi Arabia with up to 88% Saudis nap in the afternoon (Wali et al., 1999). However, this practice is not yet popular among Malaysian Muslim workers from various sectors (Yusof et al., 2014).

Daytime napping has been widely practiced by people around the globe; however, time, duration, and frequency vary accordingly. In neuroscience perspective, midday napping consists of stage 2 and the rest of NREM sleep which helps to boost memory and performance (Tumiran et al., 2015). Samuels and Alexander (2013) suggested that midday napping should occur between 2 pm to 4 pm, and not after 4 pm, as it may disturb the following night sleep. Length of midday nap that have been studied and found to have health benefits varied between 10 to 30 minutes; however, a 10-minute nap was found to be the most effective afternoon nap duration studied (Brooks & Lack, 2006).

Islam also encourages Muslims to wake up in the last third or other parts of the night to perform midnight worship (*qiamullail*). As *qiamullail* involves loss of some sleep, practise of *qailulah* compensates the sleep loss and helps Muslims to perform their daily activities optimally (Tumiran, et al., 2015).

Fasting during the holy month of Ramadan, which is the fourth pillar of Islam, is practiced by more than 1.5 billion Muslims worldwide every year, from dawn to sunset (BaHammam & Gozal, 2012). Previous literatures suggested that experimental fasting affects sleep-wake patterns by which food deprivation increases wakefulness and shortens REM sleep, however this cannot be extrapolated to Ramadan fasting due to shorter duration of Ramadan fasting than experimental fasting (BaHammam, 2006).

Ramadan fasting is unique – it causes abrupt change in circadian eating pattern allowing more caloric intake at night, and adaptation may follow due to its longer duration of practice. Several changes in sleep patterns have been observed during Ramadan such as early awakening for predawn meal (*suhur*) and prayer, and delayed sleep time (BaHammam, 2006). Conflicting results have been reported with regard to sleep latency and total sleep time; however, the proportion of REM sleep was reported to be decreased during Ramadan (BaHammam, 2006).

2.3 SLEEP ARCHITECTURE

The basic structural organization of sleep, known as "sleep architecture", consists of two types of sleep – REM sleep and NREM sleep. NREM sleep is further divided into four stages – stage 1, 2, 3, and 4, progressing from lightest to deepest sleep (Bloom et al., 2009). The onset of sleep in human adults under normal condition is through NREM sleep (Carskadon & Dement, 2011). REM sleep only occurs after 80 minutes or longer following NREM sleep (Carskadon & Dement, 2011). A complete sleep cycle of alternating REM and NREM for an adult takes approximately 90 minutes (Bloom et al., 2009).