

**COGNITIVE RESPONSE OF LONG PERIOD
SURGICAL RESIDENT WORK**



**A THESIS SUBMITTED IN PARTIAL FULFILLMENT
OF THE REQUIREMENTS FOR
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(INDUSTRIAL HYGIENE AND SAFETY)
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Thesis
Entitled
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SURGICAL RESIDENT WORK**

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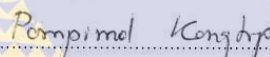
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COGNITIVE RESPONSE OF LONG PERIOD SURGICAL RESIDENT WORK

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ABSTRACT

This research is cross sectional to examine the effects of long hours work on the cognitive function of surgical residents. A sample group of 50 surgical residents from Ramathibodi hospital, were chosen, their prevalence rate of reducing cognitive function score was 80%. The residents working on-call hours per week was 139.65 hours, median shift length was 85 consecutive hours, mean workload was 16.95 hours a day and the age limit was at 29 years. Evaluation of research results was to assess cognitive function test scores during pre-call and post-call by 3 psychiatric sub-tests, namely, Digit Span, Digit Symbol, Stroop Test. The data collected from interviews was analyzed to rule out relations among all factors possibly causing a decrease of the cognitive function test score.

Research findings reveal that there was a significant decrease of cognitive function test scores in terms of memory, attention, reaction time and executive function after a night on-call duty. Moreover, after night on-call duty, subjects were prone to be drowsy under non-stimuli circumstances with significant implications. Workload, total work hours, total surgery, department of work, sleep hours during on duty and sleep efficiency had significant effects on the decrease of the cognitive function test scores. The relation between the factors of stress scores, shift length, age, work experience, academic year and hospitals before residency program and decrease of cognitive function was not significant.

Based on the findings, it is recommended that firstly the number of total work hours, workload and total surgery should be reduced. Secondly efficient sleep and the number of sleeping hours during on call should be increased. Lastly, night on-call duty rosters should be improved to promote work quality and health of practitioners.

KEY WORDS: COGNITIVE RESPONSE/ LONG PERIOD WORK/ SUGICAL RESIDENT

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ผลกระทบการทำงานของศัลยแพทย์ ต่อพุทธิปัญญา

(COGNITIVE RESPONSE OF LONG PERIOD SURGICAL RESIDENT WORK)

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บทคัดย่อ

การวิจัยครั้งนี้เป็นการวิจัยภาคตัดขวาง เพื่อศึกษาผลกระทบการทำงานที่ยาวนานต่อพุทธิปัญญาของกลุ่มแพทย์ประจำบ้านศัลยกรรม กลุ่มตัวอย่างเป็นแพทย์ประจำบ้านศัลยกรรมโรงพยาบาลรามธิบดี จำนวนทั้งสิ้น 50 คน ซึ่งมีอัตราการลดลงของคะแนนพุทธิปัญญาภายหลังทำงาน (Prevalence rate) 80% จำนวนชั่วโมงการทำงานเฉลี่ยต่อสัปดาห์ 139.65 ชั่วโมง ระยะเวลาการทำงาน 85 ชั่วโมงติดต่อกัน (ค่ากลาง) ปริมาณงานเฉลี่ย 16.95 ชั่วโมงต่อวัน และมีอายุเฉลี่ย 29 ปี การประเมินผลของการวิจัยนี้เป็นการประเมินผลคะแนนพุทธิปัญญาก่อนเริ่มทำงาน และ หลังสิ้นสุดการทำงาน จากแบบทดสอบย่อยด้านจิตเวช 3 แบบทดสอบคือ Digit Span, Digit Symbol, Stroop Test ประกอบกับข้อมูลจากการสัมภาษณ์เพื่อหาความสัมพันธ์ระหว่างปัจจัยต่างๆ ที่อาจมีผลต่อการลดลงของคะแนนพุทธิปัญญา

ผลการศึกษาวิจัยพบว่าภายหลังทำงานกะกลางคืนมีคะแนนพุทธิปัญญาด้านความจำ ความสนใจ ระยะเวลาตอบสนอง การวางแผนพฤติกรรมต่าง ๆ ในอนาคต ลดลง และง่วงนอนง่ายในเหตุการณ์ที่ไม่มีสิ่งกระตุ้น อย่างมีนัยสำคัญทางสถิติ ($p < 0.05$) และมีความสัมพันธ์กับปริมาณงาน จำนวนชั่วโมงการทำงานเฉลี่ยต่อสัปดาห์ ระยะเวลาการผ่าตัด สายการปฏิบัติงาน จำนวนชั่วโมงที่ได้นอนขณะทำงาน และคุณภาพการทำงาน อย่างมีนัยสำคัญทางสถิติ ($p < 0.05$) แต่ไม่พบความสัมพันธ์กับคะแนนความเครียด ระยะเวลาการทำงาน อายุ ประสบการณ์ทำงาน ชั้นปีการศึกษา และโรงพยาบาลที่ทำงานก่อนเรียนแพทย์ประจำบ้าน ($p > 0.05$)

ผลการศึกษาวิจัยแสดงให้เห็นว่า ควรมีการปรับลดจำนวนชั่วโมงการทำงานเฉลี่ยต่อสัปดาห์ ปริมาณงาน จำนวนชั่วโมงการทำผ่าตัด และเพิ่มประสิทธิภาพการนอนหลับและจำนวนชั่วโมงที่ได้นอนหลับขณะทำงาน รวมทั้งปรับแก้ไขตารางการปฏิบัติงานกะนอกเวลา เพื่อช่วยส่งเสริมคุณภาพการทำงานและสุขภาพของผู้ปฏิบัติงาน

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CONTENTS

	Page
ACKNOWLEDGEMENT	iii
ABSTRACT	iv
LIST OF TABLES	viii
LIST OF FIGURES	ix
CHAPTER	
I INTRODUCTION	
1.1 Background and rational	1
1.2 Objective	3
1.3 Hypothesis of the study	3
1.4 Research Variables	4
1.5 Research Assumption and scope of the study	4
1.6 Conceptual framework	6
1.7 Operational definitions	7
II LITERATURE REVIEW	
2.1 Shift work and its effects on sleep	9
2.2 Sleep deprivation	10
2.3 Cognitive function	16
2.4 Relevant/similar studies	20
III MATERIALS AND METHODS	
3.1 Research design	28
3.2 Population and sample of the study	28
3.3 Research instruments	28
3.4 Research procedure	29
3.5 Period of study	30

CONTENTS (CONTS.)

	Page
3.7 Data analysis	30
IV RESULTS	
Part 1 The Personal characteristics of the surgical resident of Ramathibodi hospital	31
Part 2 The work information of the surgical resident of Ramathibodi hospital	33
Part 3 The Correlation between factor- personal; stress score; sleep data; work duration and workload	34
Part 4 The Comparison of cognitive function test score between pre-call and post-call of working and categorized by factors-personal; stress score; sleep data; work duration and workload	41
V DISCUSSION	
5.1 Discussion of study design	52
5.2 Discussion on Research Results	53
VI CONCLUSION AND RECOMMENDATION	
6.1 Conclusion	59
6.2 Recommendation	64
6.3 Recommendations for future study	65
REFERENCES	67
APPENDIX	72
BIOGRAPHY	86

LISTS OF TABLES

Table	Page
4-1 The personal characteristics of the resident (N = 50)	32
4-2 The work information of the surgical resident (N = 50)	33
4-3 The correlation between decreased cognitive function test score and personal factors, sleep data, work duration-work load, stress score negative attitude, accident-near miss, error (N = 50)	35
4-4 The correlation between Day time sleepiness score and negative attitude errors found in work, accident (N = 50)	40
4-5 The comparison of cognitive function test score between pre-call and post-call of working (N = 50)	41
4-6 The Prevalence rate and comparison between post-call score and normal score (N = 50)	43
4-7 The comparison of decreased cognitive function test score and personal factors (N = 50)	44
4-8 The comparison of decreased cognitive function test score and work line factor(N = 50)	45
4-9 The comparison of decreased cognitive function test score and sleep information (N=50)	46
4-10 The comparison of cognitive function test score between pre-call and post-call of working in sleep deprivation group (N=44) and non-sleep deprivation group (N=6)	47
4-11 The comparison of decreased cognitive function test score and stress score (N=47)	49
4-12 The comparison of decreased cognitive function test score and time of work and workload (N=50)	50

LISTS OF FIGURES

Figure	Page
2-1 Digit symbol test paper	18
2-2 Table of Digit span test	20



CHAPTER I

INTRODUCTION

1.1 Background and Rationale

The level of continuing work and work hours of medical personnel is higher than other works of living, for instance, works on delivery and nuclear power industry (HRG publication#1570, 2002; NIOSH suggest, 2002). This brings about serious problems for residents during clinical practice, yet it depends on their experience to cope with it. Nonetheless, due to physicians must care for patients when they need care, regardless of time of day or the convenience or inconvenience to the clinicians. Hence, as said by surgeons (Robert Steinbrook, 2002) that their responsibilities often do not end when they leave the hospital

“Surgeons in practice are not performing shift work; they are responding to patient needs.”

Laser J Greenfield from Michigan
University

“The life of a surgeon in practice is responding when the phone ring”.

Dr. Thomas Russell, Executive of Surgery College, USA

Work on health is different from those with long and continuous work hours, such as, hotel service, works in clubs, restaurants and casino, industry with continuing production process, communication, and delivery including aviation and taxi drivers. The core difference is that nursery must take full responsibility on life of the patients, whose conditions and symptoms always change. Therefore, if shifts of doctors on duty have changed or the same doctors work less, these inevitably have impacts on patients (Laine et al, 1993). The impacts are found in terms of continuation of treatment and delay or errors in communication causing mistakes in treatment.

Moreover, doctors are also able to have side-line jobs to increase income adequately for their expenses (Li et al, 2000; Collier et al, 2002).

As above-mentioned reasons, doctors are forced to work longer (more than 8 hours / day). At present, it is revealed that almost all of residents work more than 80 hours / week. A survey in USA disclosed that doctors worked 95 hours / week, possibly up to 136 hours / week (Lagnado,1998) (19.4 hours on average) and shift length > 30 hours, often at 36 hours long (Greeb,1995;Daugherty et al,1998) and occasionally even longer. As for Thailand, statistical data concerning resident doctors' work hours have not been surveyed. Evaluation relied on questionnaire for practitioners and data collected from part-time rosters (or so-called in medical terms as on-call) of surgical residents of Ramathibodi Hospital are available. In January 2005, it showed that doctors worked 74 hours/week at least (4 weeks on average) at emergency unit and 112 hours/week at most (4 weeks on average), and shift length is approximately at 34 hours.

Because work hours are long and continuing, sleeping is restricted. Though sleeping is possible, that sleep would not be effective enough, and then fatigue is not surprisingly found among on-call residents (Daugherty et al, 1998). Such sleep deprivation and fatigue possibly have an effect on residents in various aspects, for example, impaired cognitive function, increased medical errors, dangers to resident health and negative impact on Professionalism.⁽³⁹⁾

Further to Impaired Cognitive Function, the studies conducted in USA reported that inadequate sleep plus fatigue from on-call duty would impair cognitive abilities, embracing memory, visual attention, concentration, and mathematical skills (OSHA Petition,2001) and would create unstable alertness and vigilance, cognitive slowing, ineffective solution and increase risks of accidents (Resident Duty Hours.ACGME,2003). As incident in January 1999, for example, a resident had just finished a night of on-call duty in the cardiac care unit and was driving to take a certification examination. He was killed in a one-car crash in rural Pennsylvania. His colleagues attribute this crash to fatigue (Henican, 1999). A study published in the Journal Anesthesiology surveyed the anesthesiology residents at the University of Pennsylvania. Seventeen percent of the residents reported crashes during residency that occurred while they were driving home after a night of on-call duty. Seventy-two

percent of the residents reported “near-misses”. One thirds of this group said having near misses ≥ 5 times. Moreover, a similar study at the medical college of Virginia also showed a decrement in cognitive function testing after a night of on-call duty. Later on, Melissa et al, 2003 had studied cognitive efficiency among groups of obstetric residents and interns before duty hour standards by ACGME (American Council Graduate Medical Education) had been set. The study confirmed the same result. Similar to earlier mentioned studies, Denisco et al, 1987 researched anesthesia residents after a night of sleep deprivation and found that those who had been on call and were sleep deprived scored less well on simulated critical events.

Most of said studies on effects of sleep deprivation in USA have given results against the good characteristics of doctors, consisting, decent consciousness, good management of urgent problems and relatively rapid response to stimulators, essentially in emergency cases (Tha et al, Nation Library Medicine section 62159) , dealing with works relating to surgery, childbirth, emergency medication, as such. This decreasing cognitive competency gears to critical concern about both resident and patient safety as well as professionalism. Resident duty hours became very controversial in USA, mainly in terms of reducing resident duty hours to decrease accidents prone to occur to residents and to enhance resident effectiveness in work and study. The restriction of work hours started in 2001 and has been developed into standards approved by ACGME in 2003 (Resident Duty Hours.ACGME, 2003) and AMSA (American Medical Student Association) in 2004 (Resident work hours.AMSA, 2004). The standards suggested by AMSA require residents to work not exceeding 80 hours/weeks and shift length at 24 hours. Those of ACGME allow extension of shift length up to 30 hours and 36 hours at maximum and in emergency 12 consecutive hours are allowed.

Compared with studies abroad, a number of researches on resident work hours in Thailand are much less. Most of them study exclusively work effectiveness focusing on increasing effectiveness of medical service as found in HA (Hospital Accreditation). Nevertheless, neither do those show serious awareness on excessive resident work hours, nor do agencies to follow-up and monitor the problem exist. Hence, the author is interested in finding the relations between sleep deprivation and its effects on cognitive functions in terms of memory, attention, decision-making,

problem-solving of critical issues and reaction time by applied psychiatric tests. The research results are aimed at use in planning prevention and promoting safety for the residents in the future.

1.2 Objective

1.2.1 General Objective

To study effects of resident work hours onto resident cognitive functions

1.2.2 Specific Objectives

1.2.2.1 To study relations between factors – personal characteristics, total work hour, workload, shift length, work stress, sleep deprivation and decrease in cognitive function test scores of residents.

1.2.2.2 To compare cognitive function test scores at pre call and post call of residents, categorized by factors – personal characteristics, total work hour/ week, workload, shift length, work stress, and sleep deprivation to rule out effects of night on-call duty as well as to suggest solutions.

1.2.2.3 To study relevant impacts incurred by night on-call duty and to make recommendations

1.3 Hypothesis of the study

1. Residents' cognitive function test scores during pre call are higher than those during post call.
2. Variables consisting of personal characteristics, work, level of stress and sleep are related to decrease of cognitive function test scores.
3. If variables consisting of personal characteristics, work, level of stress and sleep are different, their effects on the decrease of cognitive function test scores are different.

1.4 Research variables

Independent variables

- Work of surgeons
- Sleep deprivation
- Workload
- Stress from work
- Personal characteristics: age, working years, level of education

Dependent variables

- Cognitive function test scores
 - Digit span
 - Digit symbol
 - Stroop test

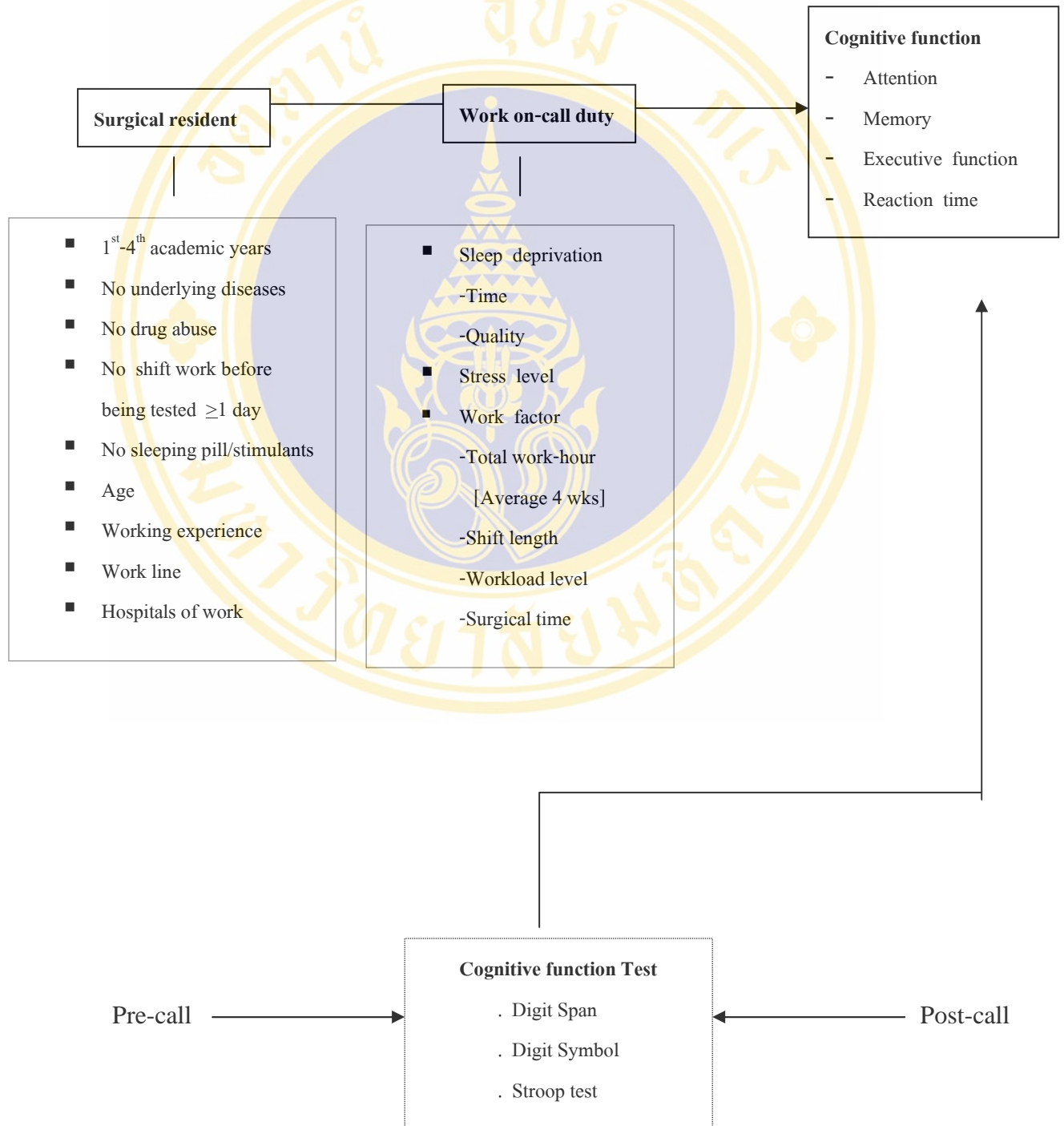
1.5 Research Assumption and Scope of the study

To study residents at surgery department at the 1st-4th years, Ramathibodi Hospital with these following attributes;

1. No underlying diseases
 - Chronic diseases, such as, diabetes, high blood pressure, Chronic arthritis
 - Thyroidtoxication
 - Psychosis
 - Drug- dependent stress
 - Brain Damage
2. No pregnancy
3. No shift work before test at least one day
4. No sleep problem
5. During the test, **NO**
 - smoke

- alcohol
- sleeping pills/substances
- drug/psychotropic stimulants

1.6 Conceptual Framework



1.7 Definitions of Terms

- **Surgical Resident** means only doctors who attained Medical Science and have passed the exam to continue their specialty in surgery pertaining to Surgical Curriculum of Ramathibodi Hospital.
- **On-call** means medical practice beyond official work hours with certain responsibilities, starting from 16:00 hrs of the beginning day until 07:00 hrs of the following day and ending when the official hours are over.
- **Night on-call duty** means work duration counted from official hours to on-call (medical meaning) and consecutive hours in caring patients in the next day, or else including studying time according to school timetable or conference schedule required by the curriculum.
- **Shift length** means time residents spent on night on-call duty
- **Pre call** means the beginning point of time of night on-call duty
- **Post call** means the ending point of time of night on-call duty
- **Sleep deprivation** means sleep that lasts less time than normal sleep, taking more or less 7-8 hours. A short sleeper need to sleep less than 6 hours/night, but a long sleeper need to sleep more than 9 hours/night (Kaplan, Sandock's, 1998)
- **Cognitive function** means process that brain receives sensory information, then exerts mental activity, such as ,perception , thought, planned action, motor function, works or acts it out in forms of behavior or concept (Kandel et al, 2000)
- **Cognitive function test scores** mean cognitive scores gathered from three psychiatric test forms, namely, Digit span, Digit symbol, Stroop test

- **Total work-hour** means a whole duration of work hours scheduled by Surgery Department and hours of on call duty in a month, divided by 4 weeks.
- **Workload** means duration of time really spent on work within 24 hours on average. It was calculated by a total amount of working time in one shift, divided by time provided in one shift and multiplied by 24 hours.
- **Routine work** includes regular patient visit, patient care in case of on request, and consultancy for other departments, monitoring patients after operation or in case of problems, and general medical service, such as, bandage, patient reception at OPD or emergency unit.
- **Crisis Care** embraces works in emergency or works demanding intensive care (in every 30-60 minutes), for instance, cardio pulmonary resuscitation (CPR) and works for patients in intensive care unit (ICU).
- **Operation** consists of operation according to schedule (or schedule operation) which the doctor knows in advance and emergency operation in which the doctors need to conduct more operations in accordance with patients' condition at that certain moment. Both operations can be of major case or minor case.

** **Note:** In this research, major case and minor case are different. In major case, patients will be generally anesthetized, but for the latter patients will have locally anesthetic injection. (Complying with principles of Ramathibodi Hospital)
- **Study hours (Study and learning) – required by surgical curriculum:** cover attendance in class and conference case, case presentation or discussion, preparation of grand round, for instance.

CHAPTER II

LITERATURE REVIEW

This research is a study on effects of work on call duty of residents on cognitive function. The author has reviewed ideologies, theories and researches concerning these following contexts;

1. Shift work and its effects on sleep
2. Sleep deprivation
3. Cognitive function
4. Relevant/ similar studies

1. Shift work and its effects on sleep

Definition of shift work

- **Extended work shift**

is defined as shifts longer than 8 hours. The total work hours are not restricted. Work schedules can also differ by the time of day (day, evening, night). However, shift rotation, duration of work shift in each day and a number of days off in each week are planned (Overtime and extended work shift, 2004).

- **Very long shift**

Means work shift that contains working hours longer than normal shift, found in a group of taxi drivers, doctors and medical staff whose work shift might last longer than 30 hours/shift (Overtime and extended work shift, NIOSH, 2004).

Reaction to shift work

Shift work, essentially night shift one, has effects on the sleep/wake cycle, which is a naturally biological clock. There are approximately 24.7

– 25.0 hours in a single human sleep/wake cycle. However, the cycle was adjusted to 24 hours because the influence of day/night (light) cycle, inducing human beings to sleep at night and wake during the day (Rupenfranz J, Kanuth P, 1998).

Shift work attributes to disturbance in Circadian rhythm, which is a biological rhythm of most body organs. This rhythm will move coherently within a 24 hour- round (Nukoon Taboonpong, 1993). Since shift workers need to work while their bodies and minds are in sleep phase of sleep/wake cycle, it makes their sleep/wake cycle immediately come off other biological cycle. That means the sleep/wake cycle does not work cooperatively with others, for example, body temperature and harmonization (Rupenfranz J, Kanuth P, 1998).

Effects on sleeping Since shift work attributes to disturbance in Circadian rhythm, incompatibility between the sleep/wake cycle and others and life style, it was reported that night shift workers would on average sleep less and sleep less effectively than morning shift workers (Somchai Bawonkitti, et.al., 1999). American Sleep Disorder Association (ASDA) defines irregularity of sleep caused by shift work in a group of Circadian rhythm sleep disorders. The sleep disorders mean a group of insomnia symptoms or oversleep, which temporarily happen due to change in working hours in daytime to bedtime. This condition results in sleep loss.

2. Sleep deprivation

Sleep Requirement

Sleep gives us rest, balance of body function and importantly saves energy and normal body temperature. Sleep is a period of recovery and restoration of physiological, neurological and/or psychological states (Freeman H., 1984).

In adults and children from 3-4 years-old, normal sleep is comprised of 2 different parts in terms of Physiological mechanism and Neurophysiological and behavioral, or so-called Non-rapid eye movement (NREM) and Rapid eye movement (REM) as follows; (Cooper R, 1994)

1. Non rapid eye movement or NREM can be staged into 4.

Stage 1 NREM or light sleep : this stage reveals superficial and dreamy sleep. Muscles start to relax. Heart and respiratory rate go slower. It is easy to get wakened. Usually this stage takes only 1-7 minutes (Morton, 1993).

Stage 2 NREM : a body becomes more relaxing with very few rapid eye movements or non rapid eye movement. Metabolism rate and body temperature decrease. To wake up with a start is likely when harshly stimulated. Stage 2 takes about 10-15 minutes. (Littrell&Schumann, 1990)

Stage 3 NREM : this stage starts a sound sleep, which is hard to be awakened. Heart and respiratory rate and blood pressure show decrement. Metabolism is at low level. Muscles relax. Brain waves are slow and big. These take place after the beginning of sleeping around 30-45 minutes. (Morton, 1993)

Stage 4 NREM : After the first stage of NREM is the course of deepest sleep. Heart and respiratory slow down. Growth hormone and other hormone start to flow in order to stimulate synthesis of protein, fat and carbohydrate to promote growth of muscle and bone as well as to fix damaged ones. Twenty percent of dream can be recalled when awaking. This stage represents quality of the whole night sleep (Fordham, 1991).

2. Rapid Eye Movement or REM : Sleep at this stage allows muscles to fully relax and not to react to stimulants except eye muscles. It is harder to be wakened up. This occurs after sleep has taken place about 90-100 minutes. (Elbersole&Hess, 1998)

Sleep pattern and need of sleep change following to increasing age. In adults, sleep is deep and a number of sleep hours are less. Adults need one sleep hour in every 2 wakeful hours, meaning adults require 7-8 sleep hours/ a night, possibly more or less due to idiosyncratic factors. To stay away from fatigue, it is advisable to sleep at least 5 hours within 24 hour-duration. (Robert Steinbrook, 2002)

A person with a short sleep pattern requires sleep hours less than 6 hours a night, but one with a log sleep pattern needs to sleep longer than 9 hours a night to maintain body balance to function well. (Kaplan, Sandock's, 1998)

Daytime sleep is typically 1.5 to 2 hours shorter than nocturnal sleep.

This is due to the rise in core body temperature during the day, together with the external time cues such as the daylight and increased social activity, opposing people's attempt to sleep. (Police-Shift work Guide, 2004)

Efficient Sleep

People start to sleep from the 1st to the 4th stage of non-REM sleep. Interruption from surrounding movement or arousals may occur 70-80 minutes after falling asleep and possibly brings them back to stage 3 or stage 2 shortly at least 5-10 minutes before continuing REM stage. Time from stage one of non-REM until stage one of REM takes about 90-110 minutes and this cycle takes place repeatedly around 4-6 times a night. Efficient sleep during the 3rd-4th stage of non-REM decreases when duration of REM increases. (Kandel et al, 2000)

Sleep Evaluation

Sleep Evaluation can be measured by 3 following means (Sorayuth, 1985)

1. Sleep Recorders

1.1 Polysomnography (PSG) is best used in finding out both quality of sleep and the actual

sleep time by assessing changes of EEG, EMG, EOG, body movement, gas level in blood,

hormone level, body temperature and blood pressure.

1.2 Night cap is a mobile tool, used to measure sleep from movements of body, eye and head.

1.3 Wrist Actigraph is put on wrist to measure sleep quantity, wakefulness. Its advantage is

convenience and low cost, but practical skill is needed.

2. Observation

Movement, respiratory rate and manners, muscle tension, reaction to stimulants, length of sleep/wake can be observed. However, this measure is inconvenient and cannot be widely practiced.

3. Self-report

Self-report can be conducted both qualitatively and quantitatively. Nonetheless, the downside is that recorded data is possibly manipulated and does not represent the fact due to prejudgment of interviewees. Self-reports, as follows, are among those of most acceptance.

3.1 Questionnaire on sleep of Saint Mary Hospital (Ellis, et.al., 1981)

3.2 Sleep Evaluation Form of Pittsburg (Buysee, et.al., 1989)

3.3 Sleep Measurement of Snyder Halpern & Verran (Snyder Halpern & Verran, 1987)

3.4 Sleep Diary : the diary owner will keep records of a number of sleep hours, time range from going to bed to falling asleep, a number of wakes during sleep, feelings of sleep deprivation and alcohol and sleeping pill intakes. This mean is convenient, simple and economical and it is commonly found used in clinics and researches.

Sleep Deprivation

Sleep deprivation refers to the accumulation of sleep deficit, caused by disruption in normal sleep from shift work or extended work shift, maybe from inefficient sleep and on-call duty. (Health and Safety Guidelines for shift work and extended working hours,ACTU,2002)

Adults need 7-8 hour sleep on average. A person with a short sleep pattern requires sleep hours less than 6 hours a night, but one with a log sleep pattern needs to sleep longer than 9 hours a night to maintain body balance to function well. (Kaplan, Sandock's, 1998)

Sleep deprivation leads to fatigue, decline in performance, such as, poorer concentration, poorer alertness, poorer decision making. These impaired

abilities increase risk of committing errors, which affect both personal safety and colleagues' safety.

Sleep Deprivation & Cognitive function

Generally, without sleep, there is only small physiological change or no change in human body, but there is impaired intellectual performance. Hence, sleep is regarded as maintenance of mental functions. Whenever performance deficits are found, it should be caused by the stress in trying to sleep rather than by intellectual capacity. Almost all of deficits can return to normal state when receiving strong motivation or analeptic drugs. (Kandel et al, 2000)

Neurobehavioral and cognitive effects of fatigue from inadequate sleep comprise as follows; (Resident Duty Hours, AMSA, 2004)

1. Alertness and vigilance become unstable as lapses of attention increase.
2. Cognitive slowing occurs and time pressure increases errors.
3. Working memory declines.
4. Tasks may be begun well, but performance deteriorates with increasing rapidity.
5. Preservation on ineffective solutions.
6. Growing neglect of activities judged to be nonessential (loss of situational awareness).
7. Involuntary microsleep attacks begin to occur.
8. Increased compensatory effort required to remain behaviorally effective.
9. Risks of critical errors.
10. Accidents and crashes increase.
11. Cognitive deficits can be masked by stimulation.

Over consecutive night shifts, shift workers accumulate loss of sleep or so-called "sleep debt," so that by the 5th night, they are 8-10 hours in debt. This can cause lapses in concentration and alertness and slower reaction times and decision making, leading to errors and accidents. (Police-Shift work Guide, 2004)

Age Tolerance

There is a growing body of evidence to indicate that as one gets older, typically between 40-45 years of age, changes occur in the internal biological clock which affect the coordination between various circadian rhythms such as core body temperature, hormone levels and the sleep/wake cycle, causing sleep to become more fragile and easily disrupted, particularly on night shifts. A number of researchers in this field, recognizing the adverse effect which ageing has on an individual's ability to cope with shift work, are now recommending that working night duty should be voluntary for those over 40 years of age. (Police-Shift work Guide,2004). A study by Reid and Dawson, 2001 also found similar results that a group of ageing subjects (44 years of age on average) responded to Tracking Test in day work shift and night work shift lower than those younger did. In a laboratory study of simulated 12- hour shifts and neurobehavioral performance in younger and older participants, older laboratory subjects were less able than younger subjects to maintain performance across 12-hour shifts.

Melatonin and Cortisol Hormone

Melatonin and Cortisol are hormones, which are released by the pineal gland in brain and are thought to help regulate the circadian rhythms and the sleep wake cycle. These hormones normally peak during the night because sunlight inhibits production. (Police-Shift work Guide, 2004)

Studies have shown that in permanent night shift workers the production of melatonin can be so affected that it disrupts the body clock and causes sleeping problems. Those working rotating shifts, however, do not suffer the same disruption in melatonin production. (Police-Shift work Guide, 2004)

Even though case studies have shown Melatonin taken in supplement form to be of benefit for ageing people who have low melatonin hormone, there is no actual evidence that melatonin could cure insomnia patients (when popularly used among them at present) (Kandel et al,2000)

Furthermore, other personal factors are found to help create sleep deprivation, namely, drug/stimulant intake, stress, underlying diseases, such as, paranoid, chronic diseases (diabetes, osteomyelitis, etc.)

3. Cognitive function

Cognitive function is a process in which brain receives sensory information and operate mental activity which can be realizing, thinking, planning, motoring, working or can present in terms of behaviors and ideas. (Kandel et al, 2000)

Cognition is composed of following brain functions;

- Attention
- Concentration
- Memory
- Visual perception
- Executive function (planned action)

Variables influencing cognitive functions

1. Brain injury/damage, essentially at Cerebral cortex which directly controls cognitive functioning.
2. Malnutrition
3. Stress
4. Sex; different sex has different impact on cognitive performance. Male can perform visuospatial task better; meanwhile, female can do verbal task better.
5. Alcohol intake
6. Age; increasing age heightens deterioration of thinking capacity. Ageing people have higher deterioration of thinking than other age groups.
7. Hormone (Halligan et al, 2003)

7.1 Cortisol

- is found in Hypercortisolism including steroid intake. High cortisol hormone in blood often causes mental problems, for instance, depression, paranoid, moody temper, psychosis. A research done by Lupien et al reported that high cortisol

hormone in adults for a long time correlates with deficient memory and selective attention.

- is found in Hypocortisolism, such as, Addison's disease causing short-term memory and interest.

7.2 Dehydroepiandrosterone (DHEA) is a hormone controlling behavioral and cognitive functions. Normally DHEA hormone enhances energy building, promotes deeper sleep, improves mood, helps to relax and increase capacity to manage stress. Thomas and Weigle's study found that ageing people have level of DHEA reducing and Barrett-Cannor's study revealed that the DHEA circulation in male was low.

8. Melatonin peaks at night and wanes to normality in the morning. The hormone commands body's circadian rhythms and leads to sleep. Studies have shown that cognitive functions provide important statistical implication to reaction time task. Since Melatonin keeps body temperature low and reduces rapidity of information process, this brings about cognitive fatigues. However, no data on Melatonin in blood and its direct effects on cognitive functions have been found.

9. Fatigue: fatigue is tired ness that results from physical and /or mental exertion. The level of fatigue experienced will depend on

- Workload imposed by a job
- Length of shift
- Previous hour and day worked (Cumulative fatigue)
- Time of day or night (Health and safety Guidelines for shift work and extended working hours,ACTU,2002)
- Physical / Mental work
- Shift start time
- Shift duration
- Rest period between shifts
- Break during shifts (Police-Shift work Guides,2004)

Evaluation of cognitive function by psychiatric tests (Halligan et al, 2003)

1. Digit Symbol [D. Wechsler, 1944, 1955, 1981]

Digit symbol is a test of Digital Symbol is the test used to measure attention, motor speed , visual scanning process , incidental learning. A study done by Schear and Sato found that visual acuity did not play important roles in a normal person’s performance or in this test.

This symbol substitution task is printed in the WIS test booklet. It consists of four rows containing, in all, 100 small blank squares, each paired with a randomly assigned number from one to nine. Above these rows is a printed key that pairs each number with a different nonsense symbol. Following a practice trial on the first seven to ten squares, the task is to fill in the blank spaces with the symbol that is paired to the number above the blank space as quickly as possible for 90 seconds.

Scoring : test attendants gain scores when symbols and numbers are paired correctly in time. Regularly, scale score is at 7. When scale score reduces to -1SD (Scale score=6), it is considered irregular. Scale scores can be decoded to raw scores grouped by age as follows;

- For 25-34 years of age , scale score at 7 is equivalent to raw score at 44-47, and scale score at 6 is equivalent to raw score at 36-43
- For 35-44 years of age, scale score at 7 is equivalent to raw score at 36-42, and scale score at 6 is equivalent to raw score at 30-35

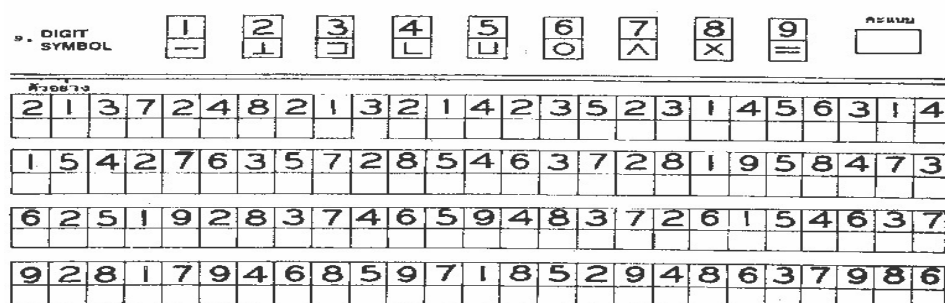


Figure 2-1 Digit symbol test

2. Stroop test

Stroop test is used to measure executive function on inhibition. The test is composed of 3 parts;

Part one: the subject reads randomized color names to examine whether subjects can call colors correctly.

Part two: the subject reads the color names printed in colored ink, ignoring the color of the print (the print color never corresponds to the color name).

Part three: the subject (given the card used in Part Two) has to name the color in which the color names are printed and disregard their verbal content.

Scoring depends on a number of words correctly read within 120 seconds (each part). Factors affecting the test are age and intellectual quality.

Mean score of normal cognitive function for age from 18-49 years old must present at 21st percentile or more, which is equivalent to 99 raw scores or more.

3. Digit Span

Digit span comprises 2 tests, namely, digit forward and digit backward. Digit Forward allows test attendants to repeat the numbers a tester has read. Digit Backward asks the attendants to read backward. Digit Forward tests working memory and attention; meanwhile, Digit Backward gauges working memory and mental control.

Each test item is conducted twice, though the first test has been passed. The test stops when the attendants read it wrong twice in each item. In normality, scale score should be at 7, equivalent to ≥ 11 of raw score for 25-34 years of age and ≥ 10 of raw score for more than 34 years of age.

FORWARD	score	BACKWARD	score
5-8-2	3	2-4	2
6-9-4	3	5-8	2
6-4-3-9	4	6-2-9	3
7-2-8-6	4	4-1-5	3
4-2-7-3-1	5	3-2-7-9	4
7-5-8-3-6	5	4-9-6-8	4
6-1-9-4-7-3	6	1-5-2-8-6	5
3-9-2-4-8-7	6	6-1-8-4-3	5
5-9-1-7-4-2-8	7	5-3-9-4-1-8	6
4-1-7-9-3-8-6	7	7-2-4-8-5-6	6
5-8-1-9-2-6-4-7	8	8-1-2-9-3-6-5	7
3-8-2-9-5-1-7-4	8	4-7-3-9-1-2-8	7
2-7-5-8-6-2-5-8-4	9	9-4-3-7-6-2-5-8	8
7-1-3-9-4-2-5-6-8	9	7-2-8-1-9-6-5-3	8

$$F \dots \dots \dots + B \dots \dots \dots = \dots \dots \dots$$

Figure 2-2 Table of Digit span test

4. Relevant/similar studies

Daugherty SR et al (1998:1194-1199) surveyed randomly selected second-year residents in all specialties and found that the longest period with out sleep during the first year of residency was an average of 37.6 hours. Twenty-five percent of the residents reported being on-call in the hospital for a total of more than 80 hours a week.

Friedman RC et al (1971:201-203) studied hours of sleep loss of residents. Based on evaluation of frequency of sleep loss scaling from 0(never) to 4 (everyday), it was found that almost all residents had sleep loss at 3 and 10 percent of them scaled at 4.

Wu AW et al (1991:2089-2094) studied detrimental effects of long hour work on errors in the delivery of medical care. An anonymous questionnaire was distributed to three internal medicine training programs; 45 percent of the respondents reported

medical errors. Of those respondents who reported errors, 41 percent of these residents attributed the mistake to fatigue.

Robbins J and Gottlieb F (1990:82-86) studied sleep deprivation stemmed from on-call duty and its effects on cognitive functions. The study involved 23 residents and demonstrated significant decreased cognitive function testing after a night of on-call duty at .05 level. Five people dropped out of the study because they were too tired after being on call to even participate in the testing. Similar to Robbins', a research done by Hart RP et al (1987) in a group of first year residents at Medical College of Virginia studied effects of inadequate sleep by considering reaction time, recall ability and mood conditions. The study also showed a decrease in cognitive function testing after a night of on-call duty.

Taylor and McFatter (1999:s151-s152) examined the relations between personality and cognitive performance under sleep deprivation in 28 college age samples (17-25 years old) using the Eysenck Personality Questionnaire Eysenck Personality (Eysenck,H.J. and Eysenck,S.B.G., 1975). Any participants displaying the following conditions or habits were excluded—pregnancy, hypertension or heart problems, possible mental illness, poor sleep habits, a possible sleeping disorder or working shift work, more than 15 units of alcohol intake per week and smoker. On the day of experiment, participants were called at 08:00 to ensure they were awake. Participants were not allowed to use any products alcohol, caffeine and nicotine, and they were not allowed to take naps. They reported at the lab at 20:00 and assigned to groups of less than 10. They were brought into the lab every 3 hours, starting at 21.00 to complete 30-45 minute of computer administered performance measures, consisted of eight neuropsychological tests from the Automated Neuropsychological Assessment Metrics, version 3.11, namely, time estimation, immediate recall, delayed recall, match to sample spatial processing, finger tapping, digit span, and Stroop color-word tasks. Between test periods, participants were kept in one main room and allowed to occupy themselves with various activities, such as, reading, board games, cards, watching television, drawing, etc. They were released at 07:00 the next morning. The authors found that under sleep deprivation, extraverts performed worse than introverts on all of the aforementioned tasks except the Stroop. The general findings were that

the poorer performance of extraverts compared with introverts was even more pronounced in neurotics than stables ($p < 0.05$).

Taffinder NJ et al (1998:1191) examined surgeon dexterity with a laparoscopic simulator. They found that surgeons who had been awake all night made 20 percent more errors and took 14 percent longer to complete the tasks than those surgeons who had had a full night of sleep ($p < 0.05$).

Melissa M Halbach et al (2003:1198-1201) studies relation between cognitive functions and workload in a group of 30 participants who were members of the obstetrics and gynecology house staff and to medical students at Emory University School of Medicine. Two standard cognitive functions tests (the Grooved Pegboard and California Verbal Learning Test II) were administered to measure visual motor coordination and to assess memory recall successively. Each test was administered twice, before and after on-call duty to determine whether cognitive function test results significant decreased after a typical night of on-call duty at .05 level. For the California Verbal Learning Test II, trial 5 showed a decrease in score after on-call duty and this finding suggests that cognitive function test scores do significant decrease after on-call duty at .05 level.

Mark Blagrove and Lucy Akehurst (2001:819-828) studied personality and the modulation of effects of sleep loss on mood and cognition in a sample group of 31 participants (males 15, female 16, mean age 21.4 years) who were deprived of sleep for 29-35 hour and a controlled group of 30 participants (males 15, female 15, mean age 21.5 years). Sleep hours for both group were similar at 8.74 and 8.75 hours a night successively. Logical reasoning test (Blagrove et al.1995, modified from Baddeley, 1968) was administered in both groups. It showed significant deficits on logical reasoning and on bipolar Profile of Mood states total mood ($p < 0.05$). Between external personality and internal personality, externals had more significant deficits in mood caused by sleep loss than internals did ($p < 0.05$).

Samkoff J.S and Jacques C.H.M. (1991:687-693) reviewed studies since 1970 onwards, concerning effects of sleep deprivation and fatigue on residents' performance. The authors found that numerous studies overwork and fatigue were

contributing to poor patient outcomes and resident morbidity. And sleep deprivation has a negative effect on residents' vigilance, fine motor skill and complex problem-solving abilities. Acute inadequate sleep caused the decrease residents' vigilance, reaction time, short term memory and errors especially found in repetitive work ($p < 0.05$).

Yvonne Harrison and James A. Horne (2000:236-249) reviewed studies relating effects of sleep deprivation on decision-making. They found that insufficient sleep in a group of decision-makers, for instance, managers, military commanders and one under critical conditions. They found that general repetitive routine works were more susceptible to effects of sleep deprivation than works requiring complex thinking ($p < 0.05$), analyzing and reasoning were.

Rosa Roger R. et al (1985:6-15) studied a group of 6 laborers, aged from 22-27 years old and working 4 days a week and 8 hour shifts for 6 days a week. Battery test 2 were used in forms of Grammatical reasoning and Digit addition at the first day and last day of each workweek to study effects on fatigue and alertness. It was found that 12 hour work for 4 days a week caused more fatigue and contributed to drowsiness, lack of concentration ($p < 0.05$). Highest fatigue was reached at the end of workweek.

Versey S. et al (2002:1116-1124) compiled 10 researches, studying effects of inadequate sleep and fatigue onto cognitive function, performance, and health of medical residents. They found that almost all research results agreed that insufficient sleep lead negative impacts on cognitive function, performance and health. Physical work showed less negative performance than mental work did ($p < 0.05$).

Wendy Macdonald and Salaheddine Bendak (2000:399-416) investigated the effects of varying workload level and shift duration both in the laboratory and in a workplace in Australia. The laboratory experiment served to study both physical and cognitive work tasks during standard versus extended shift durations (7.2 and 12 hours) of 2 male subjects and 2 female subjects. Their average age was 29.5 years old. For cognitive work, it also investigated the effects of workload levels (low and high), but for physical task, there was only a high level of physical work. Battery assessment items were consisted of bodily discomfort, alertness rating, workload rating and hand

steadiness, but critical flicker fusion, grammatical reasoning and reaction time. The battery was administered in the above order, at the start of the workday and at the end of each work block or approximately 4 hours. It was found that with high workload, subjects made slightly more errors on 12-hour workdays than on 7.2 – hour workday. A high physical workload decreased self-rated alertness and increased significant errors in grammatical reasoning ($p < 0.05$). As for high cognitive task, there was a greater increase in grammatical reasoning errors during 12-hour workdays than during 7.2 hour workdays ($p < 0.05$).

In a field study or at workplace, 34 workers were volunteered to participate in the study on three workdays each. Work tasks were divided into 2 shifts (12-hour shift and 8-hour shift). Half of these subjects (17) worked two 8-hour shifts and the other 17 subjects worked 12 hour-shifts. Their age range was 21-61 years of age. Job analysis and workload measurement was administered by using three statistical methods-- NASA-TLX, EWA and JDS to assess workload of half-day work. Personal characteristics questionnaire and assessment battery at the beginning, middle and end of the workday were also used to analyze data collected. It was evident that the combination of high workload and 12 hour workdays produced greater fatigue, as manifested in increased bodily discomfort, decreased alertness, decreased hand steadiness and increased errors on grammatical reasoning task ($p < 0.05$).

Dawson D and Reid K (1997:235) studied effects of insufficient sleep on fatigue, alcohol and performance impairment. It was observed that performance of such a task after 24 hours of sustained wakefulness was significant equivalent to the performance with a blood alcohol concentration of 0.10 percent at .05 level.

Steven W. Lockley et al (2004:1829-1837) studied effect of reducing Interns' weekly work hours on Sleep and attention failure and whether reduction in interns' work hour can increase sleep hours and decrease attention failures. Subjects were 24 residents (postgraduate year 1), who had accepted a position in internal – medicine residency training program at Brigham and Women's Hospital in Boston. The authors studied 20 interns during two three-week rotations in the medical intensive care unit (MICU) and coronary care unit (CCU) while they followed a traditional schedule with extended work shifts of 30 consecutive hours scheduled

every other shift and an intervention schedule in which work shifts were a maximum of 16 consecutive hours scheduled. The remaining 4 subjects were studied while they followed a pilot intervention schedule that was discontinued after the first MICU rotation. Work hours and details of interns' episodes were recorded in a daily log. At least three days per week during MICU or CCU rotations, interns underwent continuous ambulatory polysomnographic, monitoring while at work or at home. Attention failures were identified by means of continuous electrooculography (EOG) and defined as intrusion of slow-rolling eye movements into polysomnographically confirmed episodes of wakefulness during work hours. The number of slow eye movements recorded during all waking polysomnographic epochs was determined by a single scorer according to established criteria. The presence of slow-rolling eye movements during wakefulness is indicative of profound fatigue in both occupational settings and laboratory settings and correlated with performance failures on the psychomotor vigilance task. The authors found that 17 out of 20 residents worked more than 80 hours a week, following to the traditional schedule. Pertaining to the new intervention schedule, averaged work hours were less than 19.5 hours a day, allowing residents to sleep more than 5.8 hours a day and significant decrease of lack of work attention at .05 level.

Leonard et al (1998:22-25) compared pre-call shift (8-10 hours) and long 32 hour on-call shift of 16 junior pre-registration medical house officers, 23-28 years of age in Ireland. Shifts were randomly assigned and tested by Delayed Recall, Critical Flicker Fusion, Trail-making Stroop Color Word Test and Grammatical Reasoning at the end of one shift (4-6 p.m.). Data collected was analyzed by Wilcoxon matched pairs. They found that end of 32- hour on-call shift showed significant deterioration on median scores of alertness and concentration tests (Stroop Color Word Test, Trail-making Test), and no significant declines were reported in a test of psychomotor performance or a test of memory at .05 level (Delayed Story Recall, Critical Flicker Fusion, or Grammatical Reasoning Test).

Axelsson et al (1998) studied effects of 8-hour and 12-hour work on reaction time and vigilance of 28 power plant workers in Sweden whose gender/age were not clearly reported for performance testing. Comparison between 8-hour and 12-hour shift was conducted at the beginning and end of 3 day shifts and 3 night shifts

with fast forward rotation. They reported no significant difference in simple reaction time and vigilance task measures between 8- and 12- hour shifts in Swedish power plant workers at .05 level.

Schroeder et al (1998:307-321) studied effects of 8-hour fast backward rotation and 10-hour fast rotation on cognitive performance of 52 air traffic control controllers in USA, whose age range was 28-50 years old and mean age was at 37.9 years old. Cognitive performance was tested by NIOSH fatigue test battery, including choice reaction time, digit addition, grammatical reasoning, administered three times each workday for 3 weeks. Moreover, least squares regression, repeated measures ANOVA and Newman-Keuls tests were also used to determine significant mean differences across day of work week and test session. Results reported were that air traffic control personnel working four 10 hour shifts did not significantly differ from personnel working five 8 hour shifts on test of grammatical reasoning ($p < 0.05$); however, poorer performance for night shift were found and for both schedules ($p < 0.05$), decrements were observed on some of the NIOSH performance measures at the end of the workday and at the end of the workweek.

Smith et al (1995:235-244) studied 22 male nuclear power plant workers, 42 years of age on average in UK, who were grouped into 2. The first group consisted of 11 engineer, reactor and operators (EROP) and the second group was 11 craftsmen and maintenance (CMOP). Both groups worked 8-hour 3-shift backward rotation, but the EROP group also worked two 12-hour day shifts and two 12- hour night shifts in their 35-day cycle. Cognitive performance was tested by computerized test battery, namely, choice reaction time, memory search task (SAM-5) and by 20 pt. visual analog scale to subjectively assess alertness. ANOVA and Turkey's test were statistical methods used. It reported no significant declines in alertness or cognitive performance between 8- hour and 12- hour shifts in nuclear power plant shift workers and no major group by shift type or time on shift interaction effects were found at .05 level.

Fischer et al (2000:521-537) for 30 days recorded subjective alertness at 2nd, 6th, 10th hour of day and night shifts of 22 male workers at a petrochemical plant, 32.6 years of age on average, in Brazil. Visual analog scale, ANOVA and Tukey test [post hoc comparison] were statistical methods used. It was observed that there was

significant reduction in alertness on days from 2nd hour to 10th hour, on nights at 10th hour reduced from 2nd and 6th hour, and there was no reduction seen across successive night shifts at .05 level.

Mitchell and Williamson (2000:83-93) studied effects of work hour on cognitive function, health and performance of 27 male electrical power station employees, 44 years of mean age in Australia. Subjects had worked 8 hour 3-shift backward weekly rotation with 40 hours a week on average and changed to work 12-hour fast forward rotation with 42 hours a week on average. Data, collected before and 10 months after schedule change, includes sick leave records and workplace accident records. Standard Shift work Index was used to measure physical health, well-being, alcohol use, and Information and Performance Test System was used to study subjects' neurobehavioral performance. Data gathered was analyzed by ANOVA; Bonferroni correction method. Results reported by authors were more health complaints during 8- hour rotation than 12- hour rotation and more alcohol and cigarette used during 8- hour rotation than 12- hour rotation. Besides, on vigilance test 12-hour workers made more errors on infrequent stimuli at the end of both day and night shifts. On the other hand, significant improvements were observed for simple reaction time and grammatical reasoning tests given at the end of the 12-hour shift when compared to the beginning ($p < 0.05$).

CHAPTER III

MATERIALS AND METHODS

3.1 Research design

This research is cross sectional to find out the relations of night on-call duty with cognitive function of surgical residents, Ramathibodi Hospital. In data collection, three psychiatric tests are used to assess cognitive functions and rule out relationship of various factors with the decrease of post-call cognitive function test scores. Researching started in July 2005 and finished in December 2005.

3.2 Population and Sample of the study

54 surgical residents, Ramathibodi Hospital from the 1st-4th academic year, who worked night on-call duty, not less than 40 persons.

3.3 Research Instrument

Tools used to collect data are as follows;

1. Psychiatric test by Department of Surgery, Ramathibodi Hospital, referred to Psychiatric Association of Thailand is used to assess brain capacities in terms of memory, concentration, decision, and attention to solve critical problems and reaction time. The test is composed of 3 sub tests as following;

- Digit symbol
- Digit span
- Stroop test

2. Self-report questionnaire is consisted of 5 sections;
 - personal characteristics, including age, experience, academic year
 - a number of work hours and workload
 - sleep on duty
 - stress stemmed from work
 - symptoms/incidents found during nightshift

3.4 Research procedure

Research procedure consisted of

1. The researcher submitted a letter from graduate college to a Dean of Medical Science, Ramathibodi to ask for assistance in data collection and to ask for permission from Human Research Ethics Committee.
2. Tools (3 psychiatric tests : Digit Span , Digit Symbol , Stroop Color-word Test) were prepared. The researcher and assistant were taught how to use the tests by a specialist from psychiatric disease examination unit, Ramathibodi Hospital.
3. Surgical residents from each academic year were randomly selected, based on voluntary basis as well as identified qualifications. Residents were oriented objectives of the research to study possible effects of night on call duty onto cognitive functions. Resident subjects were also learnt a primary research agreement and requested to sign in 'Informed Consent Form' of Ramathibodi Hospital as well.
4. The **first test** on subjects was conducted during a pre call of night on-call duty. Three cognitive function tests were used together with interviews for personal data and sleepiness evaluation forms.
 - ****Test was cancelled** if subjects had done on-call duty at least 1 day before test day or a number of sleep hours of a night before being tested were less than normal sleep, or alcohol and coffee intake was found.
5. The **second test** was taken place during a post call of night on-call duty. The same cognitive function tests were again used to test subjects at least

30 days after the first test. Interviews on sleep during on call duty, workload, symptoms and incidents found during night on-call duty were also asked.

Remarks - the first and second tests were hosted in the same quiet room.

- The first test started only subjects were ready enough.
- Gap between the first and second test is not less than 30 days.

3.5 Data Analysis

SPSS (Statistical Packing for the Social Sciences) program was used. Research hypothesis was accepted only with significant implication at 0.05.

1. Descriptive statistics include means, standard deviation, frequency and percentage, used to explain general information, data on sleep, workload and stress, sleepiness as well as symptoms/incidents found during night on-call duty.
2. Pair Sample t-test was used to compare scores subjects made in Digit Span , Digit Symbol and Stroop Color-word tests during pre-call with those during post-call. Surgical residents were also grouped into two –those with sleep deprivation and those without sleep deprivation.
3. General Linear Model (One-way ANOVA) and Independent Sample t-test was used to compare cognitive function test scores, classified by following factors- - work, total work-hour, workload, shift length, stress from work, sleep deprivation.
4. Chi-square and correlation were used to seek correlations of following factors-- personal characteristics, total work hour, workload, shift length, stress from work, sleep deprivation with the decrease in cognitive function test scores of surgical residents.

CHAPTER IV

RESULTS

The studying of the effects of the long shift on cognitive function from 50 surgical residents of Ramathibodi Hospital has shown that age of samples who volunteered to participate in this study was 29 years old and they worked 139.65 hours per week [average 4 weeks]. Their shift length was 85 consecutive hours, and mean workload was at 16.9 hours a day. Evaluation of research results was to assess cognitive function test scores during pre-call and post-call by 3 psychiatric sub-tests. The results of data analysis are presented as follows:

Part 1 : The personal characteristics of the surgical resident of Ramathibodi hospital

Part 2 : The work information of the surgical resident of Ramathibodi hospital

- Sleep data
- Stress data
- Work duration and workload data

Part 3 : The correlation between personal factors, sleep data, work duration and workload, stress score and different of cognitive function test score

Part 4 : The comparison of cognitive function test score between pre-call and post-call of working and categorized by personal factors, sleep data, stress level, work duration and workload

Part 1 : The Personal characteristics of the surgical resident

From data analysis of the personal characteristics for the sample group, it was found that in Table 4-1

Table 4-1 The personal characteristics of the resident (N = 50)

Variable	Number	%
1. Sex		
Male	46	92.0
Female	4	8.0
2. Age		
25-29 years	32	64.0
30-34 years	17	34.0
35-39 years	1	2.0
$\bar{X} = 28.8$ years, S.D = 2.3		
3. Academic year		
L 1	17	34.0
L 2	16	32.0
L 3	17	34.0
4. Work experience		
1 - 5 years	30	60.0
6-10 years	20	40.0
$\bar{X} = 4.6$ years, S.D = 2.1		
5. Work lines		
gr.1(Plastic,Pred,Uro,Trauma,Elective)	17	34.0
gr.2(Gen A,CVT,ICU,ER)	16	32.0
gr.3 (Gen B,Neuro)	17	34.0
6. Hospital before residency		
Central hospital	15	30.0
Provincial hospital	7	14.0
District hospital	28	56.0

Table 4-1 showed 50 subjects include in data analysis. The personal characteristics were described below.

1. Sex: 92 percent of samples were male, 46 persons.

2. Age: 64 percent of sample's age were between 25-29 years, mean of the sample group's age was 28.84 ± 2.26 years.
3. Academic year: Academic year 1 and year 3-4 are equal, 34 percent.
4. Work experience: 60 percent of sample's work experience were between 6 to 10 years, mean of the sample's work experience was 4.64 ± 2.08 years.
5. Department of work: 46 percent of sample were low workload line, group of plastic surgery; pediatric surgery; urology surgery; Elective and trauma surgery.
6. Hospital before residency: 56 percent of sample work in District hospital.

Part 2 : The work information of the surgical resident of Ramathibodi hospital

Form data analysis of the work information for the sample group, it was found that in Table 4-2.

Table 4-2 The work information of the surgical resident (N = 50)

Variable	Mean (SD)	Minimum	Maximum
1. Normal sleep hours	6.75(1.15)	5.00	10.00
2. Hours slept during on-call duty	4.44(1.68)	1.00	8.00
3. Interruptions of sleep (No.)	1.56(1.68)	0	7.00
4. Day time sleepiness score	11.12(4.42)	4.00	24.00
5. Stress score	16.67(7.49)	7.00	40.00
6. Shift length (hours)	85.13(Median)	12.00	728.00
7. Total work hours(average 4 wks.)	139.65(24.81)	93.00	186.00
8. Workload (per day)	16.94(3.17)	9.00	23.00

Table 4-2 showed 50 subjects include in data analysis. The work information was described below.

1. Normal sleep: The mean of the sample group's normal sleep was 6.75 hours; minimum was 5.00 and maximum 10.00 hours.
2. Hours slept during on-call duty: The mean length of slept that was obtained during this period was 4.44 hours; minimum was 1.00 and maximum 8.00 hours.
3. Interruption of sleep: The mean number of interruption of sleep during on-call duty was 1.56, minimum 0 and maximum was 7.
4. Drowsy score: The mean of the sample group's drowsy score was 11.12, minimum was 4.00 and maximum was 24.00.
5. Stress score: The mean of the sample group's stress score was 16.67, minimum was 7.00 and maximum was 40.00. (data form 47 sample)
6. Shift length: The median length of the on-call duty, which was the total time spent in the hospital, was 85.13 hours.
7. Total work hours: The mean of the sample's total work hours [average 4 weeks] was 139.65, minimum was 93.00 and maximum was 186.00 hours.
8. Workload: The mean of the sample's workload per day was 16.94, minimum was 9.00 and maximum was 23.00 hours.

Part 3 : The correlation between personal factors, sleep data, work duration and workload, stress score, negative attitude, accident-near miss error and different of cognitive function test score

From data analysis for correlation between personal factors, sleep data, work duration-work load, stress score, negative attitude, accident-near miss, error and different cognitive function test, it was found that there were many details as shown in Table 4-3 – 4-4:

Table 4-3 The correlation between decreased cognitive function test score and personal factors, sleep data, work duration-work load, stress score, negative attitude, accident-near miss, error (N = 50)

Variables	χ^2	df	r	p-value
Digit Span-forward				
Age	-	-	0.02	0.86
Experience	-	-	-0.02	0.87
Academic year	0.33	2	-	0.85
Hospital before residency	0.14	1	-	0.77
Work line	1.70	1	-	0.46
Hours slept during on-call duty	-	-	-0.26	0.03*
Quality of sleep during on-call duty	1.87	1	-	0.20
Day time sleepiness score	-	-	0.14	0.33
Stress score	-	-	-0.18	0.22
Total work hours[average 4 wks]	-	-	0.33	0.02*
Shift length	-	-	0.14	0.32
Workload	-	-	-0.05	0.76
Total surgery hours	-	-	0.24	0.10
- Schedule surgery hours	-	-	0.21	0.15
- Emergency surgery hours	-	-	0.11	0.44
Routine work hours	-	-	-0.21	0.15
Study work hours	-	-	-0.02	0.88
Passiveness	-	-	-0.16	0.13
Brain got stuck	-	-	0.10	0.24
Attention declined	-	-	-0.003	0.28
Rushed to finish work because of fatigue	-	-	-0.02	0.44
Forgetful	-	-	-0.05	0.37
Needle puncture	-	-	0.06	0.33
Blade cut	-	-	-0.01	0.47
Car accident	-	-	-0.05	0.36
Falling asleep while driving	-	-	-0.11	0.22
Near miss of car crashes	-	-	-0.04	0.39
Order and drug error	-	-	-0.19	0.09
Wrong decision during surgery	-	-	0.30	0.02*
Digit Span-backward				
Age	-	-	-0.44	0.77
Experience	-	-	-0.03	0.86
Academic year	1.57	1	-	0.29
Hospital before residency	0.33	1	-	0.73
Work line	7.28	1	-	0.01*
Hours slept during on-call duty	-	-	-0.27	0.03*
Quality of sleep during on-call duty	0.79	1	-	0.45

Table 4-3 The correlation between decreased cognitive function test score and personal factors, sleep data, work duration-work load, stress score, negative attitude, accident-near miss, error (N = 50) (cont.)

Variables	χ^2	df	r	p-value
Digit Span-backward				
Day time sleepiness score	-	-	0.03	0.86
Stress score	-	-	-0.06	0.70
Total work hours[average 4 wks]	-	-	0.36	0.01*
Shift length	-	-	0.13	0.36
Workload	-	-	0.10	0.49
Total surgery hours	-	-	0.30	0.03*
- Schedule surgery hours	-	-	0.26	0.07
- Emergency surgery hours	-	-	0.12	0.43
Routine work hours	-	-	-0.11	0.44
Study work hours	-	-	-0.01	0.98
Passiveness	-	-	-0.01	0.24
Brain got stuck	-	-	0.17	0.11
Attention declined	-	-	-0.06	0.34
Rushed to finish work because of fatigue	-	-	0.12	0.20
Forgetful	-	-	-0.01	0.49
Needle puncture	-	-	-0.03	0.42
Blade cut	-	-	-0.01	0.48
Car accident	-	-	-0.13	0.18
Falling asleep while driving	-	-	-0.03	0.42
Near miss of car crashes	-	-	0.02	0.45
Order and drug error	-	-	-0.21	0.08
Wrong decision during surgery	-	-	-0.04	0.38
Digit Symbol				
Age	-	-	-0.07	0.63
Experience	-	-	-0.03	0.83
Academic year	1.09	1	-	0.46
Hospital before residency	0.08	1	-	>0.99
Work line	0.99	1	-	0.46
Hours slept during on-call duty	-	-	-0.08	0.30
Quality of sleep during on-call duty7.51	-	1	-	0.01*
Day time sleepiness score	-	-	0.30	0.03*
Stress score	-	-	0.10	0.49
Total work hours[average 4 wks]	-	-	0.05	0.75
Shift length	-	-	-0.16	0.28
Workload	-	-	0.25	0.04*

Table 4-3 The correlation between decreased cognitive function test score and personal factors, sleep data, work duration-work load, stress score, negative attitude, accident-near miss, error (N = 50) (cont.)

Variables	χ^2	df	r	p-value
Digit Symbol				
Total surgery hours	-	-	0.06	0.69
- Schedule surgery hours	-	-	0.04	0.81
- Emergency surgery hours	-	-	0.05	0.74
Routine work hours	-	-	0.14	0.33
Study work hours	-	-	0.13	0.36
Passiveness	-	-	0.08	0.30
Brain got stuck	-	-	0.40	0.01*
Attention declined	-	-	0.18	0.11
Rushed to finish work because of fatigue	-	-	0.27	0.03*
Forgetful	-	-	0.03	0.41
Needle puncture	-	-	-0.14	0.17
Blade cut	-	-	-0.14	0.17
Car accident	-	-	-0.09	0.27
Falling asleep while driving	-	-	-0.001	0.50
Near miss of car crashes	-	-	0.02	0.44
Order and drug error	-	-	0.20	0.09
Wrong decision during surgery	-	-	0.16	0.14
Stroop test form C-W				
Age	-	-	-0.05	0.66
Experience	-	-	-0.06	0.61
Academic year	1.23	2	-	0.54
Hospital before residency	0.06	1	-	>0.99
Hours slept during on-call duty	-	-	0.12	0.14
Quality of sleep during on-call duty	0.64	1	-	0.53
Work line	1.35	2	-	0.51
Day time sleepiness score	-	-	0.01	0.91
Stress score	-	-	0.07	0.50
Total work hours[average 4 wks]	-	-	0.05	0.63
Shift length	-	-	-0.05	0.60
Workload	-	-	0.11	0.44
Total surgery hours	-	-	0.01	0.93
- Schedule surgery hours	-	-	0.05	0.61
- Emergency surgery hours	-	-	-0.13	0.23

Table 4-3 The correlation between decreased cognitive function test score and personal factors, sleep data, work duration-work load, stress score, negative attitude, accident-near miss, error (N = 50) (cont.)

Variables	χ^2	df	r	p-value
Stroop test form C-W				
Routine work hours	-	-	0.13	0.23
Study work hours	-	-	-0.05	0.65
Passiveness	-	-	0.06	0.11
Brain got stuck	-	-	0.20	0.08
Attention declined	-	-	0.02	0.44
Rushed to finish work because of fatigue	-	-	0.21	0.08
Forgetful	-	-	-0.08	0.29
Needle puncture	-	-	-0.18	0.10
Blade cut	-	-	0.08	0.29
Car accident	-	-	-0.18	0.11
Falling asleep while driving	-	-	0.04	0.38
Near miss of car crashes	-	-	-0.18	0.11
Order and drug error	-	-	-0.17	0.13
Wrong decision during surgery	-	-	0.05	0.35

Based on the above-mentioned statistical data, the correlation between personal factors --sleep record, stress score, work hours workload, negative attitude, accident-near miss, error-- and the decrease of cognitive function test scores can be described as following;

1. Personal factor: Work lines significantly had correlation with the decrease of digit span-backward ($\Phi = 0.382$). Other personal factors; age, experience, academic year, hospital before residency; had no correlation with the decrease of cognitive function test score at 0.05.
2. Sleep data: A number of sleep hours during on-call duty significantly had inverse variation with the decrease of digit span-forward and digit span-backward ($r = -0.0261, -0.271$).
: Sleep quality significantly had correlation with the decrease of digit symbol ($\Phi = 0.387$).

: Day time sleepiness score significantly had correlation with the decrease of digit symbol ($\Phi = 0.30$).

3. Stress score: stress scores significantly had no correlation with the decrease of cognitive function test scores at 0.05. (The score from only 47 research attendants were analyzed and that from other 3 attendants were invalid.)
4. Work duration-work load: Total work hours significantly had correlation with the decrease of digit span-forward and digit span-backward ($r = 0.333, 0.359$).
 - : Workload significantly had correlation with the decrease of digit symbol ($r = 0.245$).
 - : Total surgery significantly had correlation with digit span-backward ($r = 0.303$).
 - : Shift length, schedule surgery, emergency surgery, routine work and study hours significantly had no correlation with the decrease of cognitive function test scores at 0.05.
5. Negative attitude: the decrease of Digit Symbol test score significantly had correlation with negative attitude on blocked brain, rush in work caused by fatigue at 0.05.
6. Accident and near miss : the decrease of cognitive function test score significantly has no correlation with accident and near-miss of car crashes at 0.05.
7. Errors shown in work: the decrease of cognitive function test score found in Digit Span-forward Test significantly has correlation with at wrong decision during surgery 0.05.

Hinged on the analysis of the correlation between day time sleepiness score and the decrease of cognitive function test score after on-call duty in Table 3, it was uncovered that the decrease of Digit Symbol score significantly has correlation with

Day time sleepiness score at 0.05. The decrease of Digit Symbol score significantly has correlation with negative attitude and work errors at 0.05.

Moreover, the correlation between day time drowsiness and negative attitude, accidents, and errors found in work was also analyzed as detailed in Table 4-4

Table 4-4 The correlation between Day time sleepiness score and negative attitude, errors found in work, accident

Variables	r	p-value
Passiveness	0.26	0.03*
Brain got stuck	0.39	0.002*
Attention declines	0.30	0.02*
Rushed to finish work because of fatigue	0.17	0.11
Forgetful	0.34	0.008*
Needle puncture	0.11	0.23
Blade cut	-0.14	0.16
Car accident	0.09	0.27
Falling asleep while driving	0.14	0.17
Near miss of car crashes	0.11	0.22
Order error	0.08	0.30
Drug error	0.37	0.004*
Wrong decision during surgery	0.39	0.002*

Table 4-4 has shown the data gained from 50 research attendants. The correlation between stress score and negative attitude towards on-call duty, accidents and work errors can be interpreted as follows;

1. Negative attitude: daytime drowsiness score significantly has the correlation with negative attitude on passiveness, blocked brain, devastated attention and forgetfulness at 0.05.
2. Work errors: daytime drowsiness score significantly has the correlation with errors found in work, e.g., order and drug error and wrong decision during surgery at 0.05.
3. Accident and near miss: daytime drowsiness score significantly has no correlation with accident and near miss at 0.05.

Part 4 : The comparison of cognitive function test score between pre-call and post-call of working and categorized by personal factors, sleep data, stress level, work duration and workload

From data analysis for comparison of cognitive function test; Digit Span-forward, Digit Span-backward, Digit Symbol, Stroop from C-W; between pre-test and post-test, it was found that there were many details as shown in Table 4-5:

Table 4-5 The comparison of cognitive function test score between pre-call and post-call of working

Variables value	mean (SD)		pair t-value	df	p-
	Pre-test(50)	post-test(50)			
Digit Span – Forward	12.10(1.69)	11.02(1.79)	3.80	49	<.001
Digit Span – Backward	10.50(2.32)	8.44(2.84)	5.44	49	<.001
Digit Symbol	72.20(10.08)	66.84(10.70)	5.46	49	<.001

Variables	n	mean rank	sum of ranks	z	p-value
Stroop Test form C					
Negative ranks	4	2.75	11.00	-1.11	0.50
Positive ranks	2	5.00	10.00		
Ties	44				
Stroop Test form C-W					
Negative ranks	26	16.96	441.00	-3.32	<.001
Positive ranks	6	14.50	87.00		
Ties	18				

Table 4-5 showed 50 subjects included in data analysis. The characteristics were described below.

1. Digit Span – Forward: The average score of pre-test was 12.10 with a standard deviation of 1.69. The average score decreased to 11.02 with a standard deviation of 1.79 in post-test. When conducting statistical test, it was found that digit span-forward was significant ($p\text{-value} < 0.001$) between pre-test and post-test.
2. Digit Span – Backward: The average score of pre-test was 10.50 with a standard deviation of 2.32. The average score decreased to 8.44 with a standard deviation of 2.84 in post-test. When conducting statistical test, it was found that digit span-backward was significant ($p\text{-value} < 0.001$) between pre-test and post-test.
3. Digit Symbol : The average score of pre-test was 72.20 with a standard deviation of 10.08. The average score decreased to 66.84 with a standard deviation of 10.72 in post-test. When conducting statistical test, it was found that digit symbol was significant ($p\text{-value} < 0.001$) between pre-test and post-test.
4. Stroop Test form C : The median score of pre-test was 112.0. The median score of post-call was 112.0. When conducting statistical test, it was found that stroop test form C was not significant ($p\text{-value} = 0.50$) between pre-test and post-test.
5. Stroop Test form C-W : The median score of pre-test was 110.0. The median score decreased to 108.0 in post-call. When conducting statistical test, it was found that stroop test form C-W was significant ($p\text{-value} < 0.001$) between pre-test and post-test.

The comparison between the pre-call cognitive function test score and the post-call one shown in Table 3 unveils that the post-call cognitive function test score has significantly decreased at 0.05 when compared with normal score criteria as well as prevalence rate as shown in table 4-6.

Table 4-6 The Prevalence rate and comparison between post-call score and normal score

	Post-call score	Normal score	Prevalence rate
Digit Span			78%
-Age 25-34 years	19.53	≥ 11	
- Age > 34 years	15.00	≥ 10	
Digit Symbol			80%
- Age 25-34 years	67.06	≥ 44	
- Age > 34 years	56.00	≥ 36	
Stroop test			52%
- Age 18-49 years	100.74	≥ 99	

Table 4-6 presents the comparison of the post-call cognitive function test score of 50 research attendants with the normal score criteria and the decreasing rate of cognitive function test scores gained from 3 test models as following;

1. Digit Span was used to evaluate cognitive functions relating working memory and attention. Digit span forward was used to test attention; meanwhile, digit span-backward was for mental control. The post-call cognitive function test score of research attendant, 25-34 years old was 19.53 and of which mean score was at ≥ 11 . That of attendants, more than 34 years old was 15, of which mean score was at ≥ 10 . The Prevalence rate was at 78%.
2. Digit Symbol was used to evaluate cognitive functions relating attention, motor speed, visual scanning process, incidental learning. The post-call cognitive function test score of research attendant, 25-34 years old was 67.06 and of which mean score was at ≥ 44 . That of attendants, more than 34 years old was 56.00, of which standard score was at ≥ 36 . The Prevalence rate was at 80%.
3. Stroop test is the evaluation of cognitive functions on Executive function relating inhibition. The post-call cognitive function test score of research attendant, 18-49 years old was 100.74 and of which standard score was at ≥ 99 . The Prevalence rate was at 52%.

Based on the relation between personal factors and the decrease of cognitive function test score shown in Table 3, it was reported in Digit Span-backward that work line significantly has correlation with the decrease of cognitive function test score at 0.05. P-coefficient was at 0.382. Comparing work line and other personal factors with the decrease of cognitive function test score is shown in Table 4-7 – 4-8.

Table 4-7 The comparison of decreased cognitive function test score and personal factors

Variable	Mean (SD)		df	t- test (z-test)	p-value	
	< 30(n=32)	≥ 30(n=18)				
Age						
Digit Span-Forward	1.09(1.86)	1.06(2.31)	48	0.06	0.47	
Digit Span-Backward	1.88(2.76)	2.39(2.57)	48	-0.65	0.26	
Digit Symbol	5.84(7.06)	4.50(6.83)	48	0.65	0.26	
Stroop C-W	27.56	21.83		-1.37	0.08	
Work experience						
	1-5years(n=30)	6-10 years(n=20)				
Digit Span-Forward	1.10(1.83)	1.05(2.31)	48	0.09	0.46	
Digit Span-Backward	1.87(2.90)	2.35(2.35)	48	-0.62	0.27	
Digit Symbol	5.67(7.58)	4.90(6.01)	48	0.38	0.35	
Stroop C-W	27.72	22.18		-1.35	0.09	
Hospital before residency						
	District (n=28)	Center & Provincial (n=22)				
Digit Span-Forward	1.21(1.91)	0.91(2.16)	48	0.53	0.30	
Digit Span-Backward	2.04(2.95)	2.09(2.35)	48	-0.07	0.47	
Digit Symbol	5.46(7.96)	5.23(5.55)	48	0.12	0.45	
Stroop C-W	27.21	23.32	48	-0.96	0.17	
Academic year						
	L1(n=17)	L2(n=16)	L3-4(n=17)			
Digit Span-forward	1.24(1.52)	0.94(2.05)	1.06(2.46)	47	0.09	0.92
Digit Span-backward	2.94(2.38)	1.31(3.30)	1.88(2.15)	47	1.62	0.21
Digit Symbol	7.12(7.79)	3.56(7.03)	5.29(5.83)	47	1.08	0.35
Stroop test form C-W					0.56	0.7

Table 4-7 showed 50 subjects included in data analysis. The characteristics were described below.

1. Age: Between a group of less than 30 years of age and a group of over 30 years of age, there was an insignificantly different decrease of their cognitive function test scores (p-value = 0.47,0.26,0.26,0.08).
2. Work experience: Between a group of 1-5 year work experience and 6-10 year work experience, there was an insignificantly different decrease of their cognitive function test scores (p-value = 0.46,0.27,0.35,0.09).
3. Hospital before residency: Between a group of residents from district hospital and a group of residents from provincial and center hospitals, there was an insignificantly different decrease of their cognitive function test scores (p-value = 0.30,0.47,0.45,0.17).
4. Academic year: Among academic years of residency, there was an insignificantly different decrease of their cognitive function test scores (p-value = 0.92,0.21,0.35,0.76).

Table 4-8 The comparison of decreased cognitive function test score and work line factor

Variable	Mean	SD	n	df	F-test	p-value
Digit Span-forward						
Gr.1	0.65	1.97	23	2	1.45	0.25
Gr.2	1.75	1.93	16			
Gr.3	1.00	2.05	11			
Digit Span-backward						
Gr.1	0.96	2.62	23	2	4.79	0.01*
Gr.2	2.56	1.71	16			
Gr.3	3.64	3.11	11			
Digit Symbol						
Gr.1	3.96	6.19	23	2	2.91	0.06
Gr.2	4.44	7.72	16			
Gr.3	9.64	6.02	11			
Stroop test form C-W						
Gr.1			23		1.95	0.38
Gr.2			16			
Gr.3			11			

Different group : Gr.1 ≠ Gr.3

Work line: Between residents from work line were more than or equal 1 line significant different decrease of their digit span-backward (p-value = 0.01)

Between residents from general B and neurology work line (Group 3) and those from Plastic; Urology; Pediatric; Transplant; Trauma; Elective surgery work line(Group 1), there was a significant decrease in digit span-backward in the former group more than the latter group (p-value = 0.01).

Based on data of sleep during on-call duty and the cognitive function test score shown in table 3, it was found that there was significantly correlation with the decrease of cognitive function test score at 0.05 by both Digit Span and Digit Symbol (p-value = 0.03, 0.01 successively). The comparison between quality of sleep, deprived sleep and the cognitive function test score is shown in table 4-9 – 4-10.

Table 4-9 The comparison of decreased cognitive function test score and sleep information

Variable	Mean (SD)		df	t- test (Z-test)	p-value
	Good(n=13)	Poor(=37)			
Quality of sleep during on-call duty					
Digit Span-Forward	0.69(2.14)	1.22(1.97)	48	0.81	0.21
Digit Span-Backward	0.69(2.98)	2.54(2.42)	48	2.23	0.02*
Digit Symbol	2.77(8.75)	6.27(6.06)	48	1.34	0.11
Stroop C-W				-0.85	0.20
Sleep deprivation					
	Yes (n=44) No (n=6)				
Digit Span-Forward	1.16(1.99)	0.50(2.26)	48	-0.75	0.23
Digit Span-Backward	2.23(2.51)	0.83(3.71)	48	-1.20	0.12
Digit Symbol	5.55(6.86)	4.00(8.05)	48	-0.51	0.30
Stroop C-W				-1.01	0.16

Table 4-9 showed 50 subjects included in data analysis. The characteristics were described below.

1. Quality of sleep during on-call duty: there was significant decrease of digit span-backward score in a group of good sleepers less than in a group of poor sleepers (p-value = 0.02).
2. Sleep deprivation: there was different decrease found in a group of adequate sleep and a group of insufficient sleep without significant of cognitive function test score.

From data analysis of the decreased of cognitive function test score with sleep deprivation as Table 4-9, it was found that the decreased of cognitive function test score was not significant. The comparison of cognitive function test score between pre-call and post-call of working in sleep deprivation group and non- sleep deprivation group , it was found that there were many details as show in Table 4-10:

Table 4-10 The comparison of cognitive function test score between pre-call and post-call of working in sleep deprivation group and non-sleep deprivation group

Variables	n	mean different	SD	p-value
Sleep deprivation group				
Digit Span-forward	44	1.16	1.80	<0.001
Digit Span-backward	44	2.23	2.80	<0.001
Digit Symbol	44	5.55	11.27	<0.001
Stroop test form C-W	44	4.05*	-	<0.001
Non-sleep deprivation group				
Digit Span-forward	6	0.42*	-	0.34
Digit Span-backward	6	-2.50*	-	0.28
Digit Symbol	6	2.34*	-	0.27
Stroop test form C-W	6	-1.80*	-	0.16

Note * result of Negative rank – Positive rank

Table 4-10 showed 44 subjects, sleep deprivation group and 6 subjects, non-sleep deprivation group included in data analysis. The characteristics were described below.

1. Sleep deprivation group

1.1 Digit Span – Forward: The average score of pre-test was 12.25 with a standard deviation of 1.64. The average score decreased to 11.09 with a standard deviation of 1.80 in post-test.

When conducting statistical test, it was found that digit span-forward was significant ($p\text{-value} < 0.001$) between pre-test and post-test

1.2 Digit Span – Backward: The average score of pre-test was 10.73 with a standard deviation of 2.24. The average score decreased to 8.50 with a standard deviation of 2.80 in post-test. When conducting statistical test, it was found that digit span-backward was significant ($p\text{-value} < 0.001$) between pre-test and post-test.

1.3 Digit Symbol : The average score of pre-test was 72.57 with a standard deviation of 10.51. The average score decreased to 67.02 with a standard deviation of 11.27 in post-test. When conducting statistical test, it was found that digit symbol was significant ($p\text{-value} < 0.001$) between pre-test and post-test.

1.4 Stroop Test form C-W : The median score of pre-call was 14.29. The median score decreased to 10.20 in post-call. When conducting statistical test, it was found that stroop test form C-W was significant ($p\text{-value} < 0.001$) between pre-test and post-test.

2. Non-Sleep deprivation group

Digit Span – Forward: The mean different of pre-call and post-call was 0.42. When conducting statistical test, it was found that not significant ($p\text{-value} = 0.34$) between pre-test and post-test.

Digit Span – Backward: The mean different of pre-call and post-call was -2.50. When conducting statistical test, it was found that not significant ($p\text{-value} = 0.28$) between pre-test and post-test.

Digit Symbol : The mean different of pre-call and post-call was 2.34. When conducting statistical test, it was found that not significant (p -value = 0.27) between pre-test and post-test.

2.4 Stroop Test form C-W : The mean different of pre-call and post-call was -1.80. When conducting statistical test, it was found that not significant (p -value = 0.16) between pre-test and post-test.

Having analyzed the correlation between stress score and the decrease of cognitive function test score shown in table 3, it was found that there was significantly no correlation with the decrease of cognitive function test score at 0.05. The comparison between levels of stress with the decrease of cognitive function test score is presented in Table 4-11.

Table 4-11 The comparison of decreased cognitive function test score and stress score

Variable	Mean (SD)			df	F- test (χ^2)	p-value
	Normal(n=29)	Little(n=13)	Mod.-Severe(n=5)			
Stress level						
Digit Span-forward	1.21(2.18)	1.54(1.85)	-0.40(1.34)	2	1.71	0.19
Digit Span-backward	2.34(2.41)	1.15(3.26)	1.20(2.17)	2	1.10	0.34
Digit Symbol	4.55(4.10)	5.62(5.17)	7.00(3.08)	2	0.29	0.75
Stroop test form C-W					1.19	0.55

Table 4-11 showed 47 subjects included in data analysis (incomplete 3 data). The characteristics were described that different levels of stress had insignificantly different effects on cognitive function test scores (p -value = 0.19,0.34,0.75,0.55).

Having analyzed the relations between work hours, workload and the decrease of cognitive function test score shown in table 3, it was revealed that total work hour/week, workload and totalsurgical hours significantly has correlation with the decrease of cognitive function test score at 0.05 (p -value = 0.02, 0.04, 0.03

successively). Nonetheless, shift length, routine work hours, study work hours, schedule surgery hours, emergency surgery hours significantly have no correlation with the decrease of cognitive function test score at 0.05. The comparison between the decrease of cognitive function test score and data on work hours and workload is further detailed in Table 4-12.

Table 4-12 The comparison of decreased cognitive function test score and time of work and workload

Variable	Mean (SD)		df	t-value	p-value (z-test)
	< 120 hr/wk(n=12)	≥ 120 hr/wk(n=38)			
Total work hours					
Digit Span-Forward	0.33(1.78)	1.32(2.04)	48	-1.49	0.07
Digit Span-Backward	0.08(2.91)	2.68(2.30)	48	-3.20	0.002*
Digit Symbol	4.83(6.79)	5.53(7.07)	48	-0.29	0.76
Stroop C-W				-0.26	0.40
Shift length					
	12 – 96 hr(n=27)	>96 hr(n=23)			
Digit Span-Forward	1.00(1.86)	1.17(2.21)	48	-0.30	0.38
Digit Span-Backward	1.48(2.83)	2.74(2.36)	48	-1.69	0.05*
Digit Symbol	4.89(6.93)	5.91(7.07)	48	-0.52	0.30
Stroop C-W				-1.23	0.09
Workload					
	≤ 16 hr/d(n=16)	> 16 hr/d(n=34)			
Digit Span-Forward	1.44(1.86)	0.91(2.08)	48	-0.30	0.20
Digit Span-Backward	2.13(2.28)	2.03(2.88)	48	-1.69	0.45
Digit Symbol	1.63(6.65)	7.12(6.44)	48	-0.52	0.004*
Stroop C-W				-0.03	0.49
Total surgery					
	1-4 hr/d(n=25)	5-9 hr/d(n=19)			
Digit Span-Forward	0.80(2.24)	1.79(1.69)	48	-1.61	0.06
Digit Span-Backward	1.36(2.45)	3.37(2.66)	48	-2.64	0.006*
Digit Symbol	4.52(7.18)	6.53(7.55)	48	-0.89	0.19
Stroop C-W				-0.85	0.20

Table 4-12 showed 50 subjects included in data analysis. The characteristics were described below.

1. There was a significant decrease of digit span-backward in residents with less than 120-hour total work hour/week less than those with more than or equal to 120-hour total work hour/week (p-value = 0.002).
2. There was a significant decrease of digit span-backward in residents with 12 to 96 -hour shift length less than those with more than 96-hour shift length (p-value = 0.05).
3. There was a significant decrease of digit symbol in residents with less than or equal to 16-hour workload less than those with more than 16- hour workload (p-value = 0.004).
4. There was a significant decrease of digit span-backward in residents with 1-4 hour total surgery/day less than those with 5-9 hour total surgery/day (p-value = 0.006).

CHAPTER V

DISCUSSION

The research examined effects of long shift work on cognitive function of 50 surgical residents, Ramathibodi Hospital. Averaged age of participants was 29 years. Their mean shift length was 34 hours and total work hours/week ranged from 74-112 hours a week on average (collected from on-call duty rosters dated in January 2005). All subject residents gave their consent to participation in this research project. Study discussion are separated into 2 sections;

5.1 Discussion of study design

5.1.1 Restrictions found in work patterns of subjects impeded data collection during pre-call (the actual time data was collected was more or less 2 hours after resident started night on-call duty when they felt most convenient and comfortable).

5.1.2 Repeated tests, essentially digit symbol for the same sample may cause test learning as an interfering factor because a group of samples are of high intellectual quality.

5.1.3. Due to limitations on budgets and time, small size of samples and narrowly demographic scope of study (only at Ramathibodi Hospital) lead to insufficient and undiversified data. When grouped and compared, data could not represent a clear-cut difference.

5.1.4 Workload questionnaire, rather than observation on actual work, could create data discrepancies, since subjects could not make comprehensive answers under limited time.

5.1.5 Only 3 sub-tests were administered within 10 minutes; therefore, the assessment of cognitive function could not be so clear as that of more comprehensive tests could be.

5.2 Discussion on Research Results

This study was cross sectional to examine effects of very long shift on cognitive function of surgical residents. Period of data collection was 2 months. A group of all surgical resident who had night on-call shift and whose shift length was 85 hours/shift and total work hour was 139.65hours were observed only under their consent. The study was aimed at comparing cognitive function test scores during pre-call and post-call and ruling out correlations among factors/variables, namely, personal characteristics, stress, sleep on duty and work, affecting the decrease of cognitive function test score during post-call.

Discussion on research results are as follows;

Results of studies in surgical subjects reported that there was a significant decrease (p -value < 0.001) in cognitive function test scores (from Digit Span (Forward and Backward), Digit Symbol and Stroop test) after night on-call duty which was a very long shift. The prevalence rate of the decrease of cognitive function score was at 80% by digit symbol, at 78% by digit span, and at 52% by Stroop test.

Comparison between pre-call and post-call cognitive function test scores revealed that pre-call cognitive function test scores were higher than post-call one with significant statistical implication (p -value < 0.001). Hinged on scores from Digit Span-forward measuring attention and working memory, from Digit Span-Backward for mental control and working memory, from Digit Symbol Test measuring attention, motor speed ,visual scanning process and incidental learning, from Stroop test measuring executive functions on inhibition, the results possibly represented that very long shift of residents caused working memory declines, response speed declines and lapse of attention and executive function. The long hour work created residents' sleep deprivation and fatigue, which impaired cerebral system controlling the speed of response to arousal. Similarly, Robbins J and Gottlieb F (1990) studied night on-call residents and found that there was decrease of cognitive function test score after on-call duty. Moreover, five subjects dropped out of the study because they were too tired after being on call to even participate in the testing. Hart RP et al, Melissa M Halbach et al (2003) found that long shift work of residents together with sleep loss decreased recall ability and reaction time. Similar to Robbins J and Gottlieb F, this

research also reported 2 subjects dropped out of the study because one was too exhausted and sleepy to be able to read research test and the other needed to admit the hospital because of respiratory disease after night on-call duty.

54 percent of subjects had sleepiness scores over standard. Mean sleepiness score was at 11.12 which belongs to a group of subjects prone to sleep. The research reported that there was a significant correlation ($R = 0.310$) between sleepiness scores and decrease in cognitive function test scores of attention, motor speed and visual scanning process after night on-call duty. Incidents found to induce sleep were reading, watching television or cinema, 1- hour passenger sitting, quiet and immobile sit after lunch and afternoon lean-back if available, most of which contained not much stimuli. Compatible with a study by Yvonne Harrison and James A. Horne (2000), they found that inadequate sleep in a group in high demand of decision-making were less susceptible to sleep than those in routine and repetitive work, since the former needed to think complicatedly, reason and be alert all the time.

A very long work shift leads to insufficient sleep and then fatigue. Level of fatigue was depended on workload, length of shift, previous days work, work shift, work characteristics, breaks during shifts and intervals between shifts. This research observed that a factor-- personal characteristic (work lines) had a significant correlation with decrease in working memory and mental control. Differences in department of work, shift length, workload then caused the decrease of cognitive function test scores unevenly. When comparing decrease of cognitive function test scores among work lines, there was significant decrease in working memory and mental control during post-call of a group of general surgery line B and Neurology surgery more than a group of Plastic, Urology, Pediatrics, Transplant, Trauma, Elective surgeries. Nonetheless, other personal characteristics (age, experience, hospitals before residency, academic resident year) revealed no correlation with the decrease of cognitive function test scores because other factors, such as, workload, shift length and age over 40 years were not controlled.

Stress scores had no significant correlation with the decrease of cognitive function test scores after night on-call duty. As for stress level, it was found that mean stress of residents was in normality. Levels of stress, when compared, caused the

decrease of cognitive function test scores similarly. This result was opposed to theory, possibly because most of stress scores of subject were normal. Consequently, the comparison could not report much of difference.

Sleep during on-call duty was considered in terms of a number of hours sleeping and efficiency of sleep during on-call duty. It unveiled that a number of hours sleeping had significant inverse variation with the decrease of working memory, attention and mental control ($r = -0.261$: Digit Span-Forward; $r = -0.271$: Digit Span-Backward), and efficiency of sleep had significant inverse variation with the decrease of attention, motor speed and visual scanning process at phi-coefficient 0.387. Moreover, there was significant decrease of working memory and mental control in a group of good sleepers less than in a group of poor sleepers. There was different decrease found in a group of adequate sleep and a group of insufficient sleep without significant implication likely because sizes of sample groups were greatly different (group of adequate sleep= 6, a group of deprived sleep=44). From the sleep deprived group, there was significant decrease of cognitive function test scores during pre-call more than that during post-call. Similarly, studies by Robbins J and Gottlieb F (1990) , Taylor and McFatter (1999) , Mark Blagrove and Lucy Akehurst (2001) reported that inadequate sleep had a significant effect on cognitive functions—recall ability and mood.

Further to relations between a factor-- work and decrease of cognitive function test scores, test results presented that there was no significant correlation between shift length and the decrease of cognitive function test score. This was because long shift length produced rather low workload and the sample group was small. When scores were interpreted, it could not represent the actual relations. However, when comparing a short shift length (12-96 hours) with a longer shift length (>96 hours), there was a significant decrease of cognitive function test scores in terms of working memory and mental control in a group with short shift length less than a group with long shift length. Similarly, Leonard et al (1998) studied effects of work hours onto cognitive function of medical residents. The authors reported that 32 on call caused a significant decrease of scores on feeling of alertness, attention and concentration. Likewise, Mitchell and Williamson (2000) also found that 12- hour

work shift had effects on vigilance and reaction time. In contrast, Axelsson et al (1998). Schroeder et al (1998), Smith et al (1995) studied shifts, of which length were relatively little different, say, 8-hour shift and 10-hour shift. Cognitive function test scores of reaction time, alertness and vigilance were indifferent in those 2 shifts.

Total work hours had significant effects on the decrease of attention, working memory and mental control after night on-call duty. The mentioned decrease partially contributed to fatigue stemmed from long work hours and decreasing short breaks. Between a group of lower than 120 total work hours and a group of ≥ 120 total work hours, there was a significant decrease of attention working memory and mental control in the former group less than the later group. Meanwhile, recommendations from ACGME (2003) and AMSA (2004) assigns that residents can work not exceeding 80 hours/ week. Nevertheless, data collected from residents of Ramathibodi hospital has reported that most of the residents worked more than 80 hours per week. Hence, in this research, work hours can be divided into 2, namely, a group of less than 120 work hours /week and a group of ≥ 120 work hours/week for comparative study.

Workload had a significant relation ($r = 0.245$) with the decrease of attention, motor speed and visual scanning process. Increasing workload and decreasing time of shift interval caused fatigue and sleep loss for residents. These then reduced a cognitive function in term of interest to environment. Based on interviews, 50 percent of residents rushed to finish works due to fatigue stemmed from works. Similarly, Samkoff J.S and Jacques C.H.M. (1991) indicated that almost all residents had worsening mood and attitudes when they were fatigued and sleep deprived. It was also found that there was a significant decrease in attention and speed of response in a group of high workload (> 16 hours/ day), when compared with a group of low workload (< 16 hours/day). Likewise, Wendy Macdonald and Salaheddine Bendak (2000) discovered that 12 hour workload increased errors in grammatical reasoning test, deteriorated alertness and reduced hand steadiness.

Works of residents can be grouped into 4 as following; routine work, operation work, study and learning following to resident curriculum requirements. Resident routine work was classified as physical work; whereas, operation work and study and learning were classified as mental work. It was found that total surgery

exclusively had effects on the decrease of working memory and mental control ($r = 0.303$). Similar to the mentioned result, Vessey S et al (2002) also reported that insufficient sleep and physical work had less negative effects on cognitive performance than mental work did.

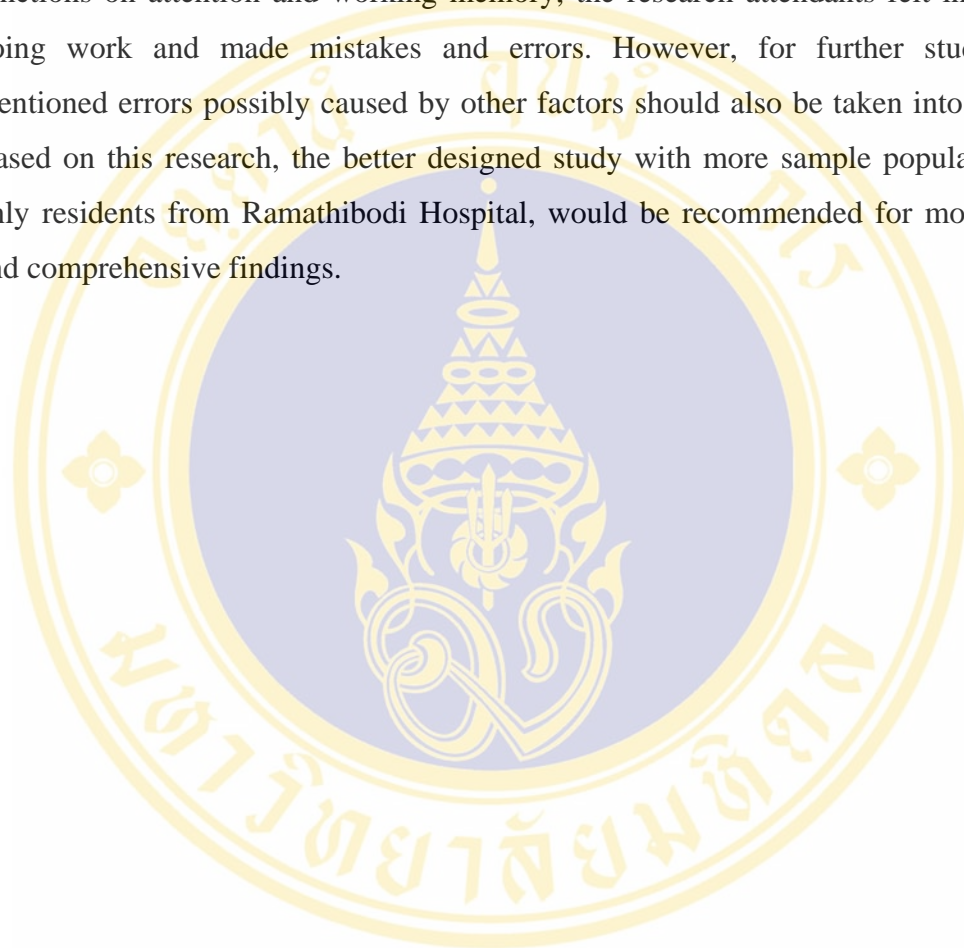
As for results from a study on schedule surgery or emergency surgery, there was no relation between the mentioned surgeries and the decrease of cognitive function because residents had more than 1 surgery during a night on-call duty. Moreover, size of studied subjects was small and unable to be separated for clearer analysis.

A comparative study showed that there was a significant decrease of working memory and mental control in a resident group with 5-9 hour surgery more than a group with 1-4 hour surgery. This explains that fatigue and stress from work had effects on the decrease of cognitive function. 40 percent of resident accepted that they were too exhausted to do anything; brain got stuck and forgetful; and attention declined. Research findings also indicated that resident subjects had fatigue, insufficient sleep during on duty (80 percent of residents were sleep deprived.) and mean sleepiness scores in drowsy group. These conditions made residents risky to commit errors have accidents or near-misses. 50 percent of subjects had negative attitude and fluctuating temper during night on-call duty. For instance, they rushed to finish work because of fatigue and decreasing concentration. 40 percent said they were too tired to do anything and inactive, and their brain got stuck.

Vital mistakes found included order error and drug management error (3 percent) and wrong decision during surgery (1.5 percent). Wu Aw similarly found that 45 percent of resident reported errors in drug management; and of which 41 percent were caused by residents' fatigue. Mentioned errors possibly have or have no effects on patients, since hospital administration system needs to delicately examine and cross-check preciseness or errors found from all parties concerned. Based on Incident Report of Ramathibodi Hospital, data on this concern were unfound.

Serious accidents or near-misses found were micro-sleeps while driving (6 percent), near-misses of car crashes (2 percent) and needle puncture (9 percent) as such. Having been analyzed, it was found that daytime drowsiness score and the

decrease of cognitive function test score significantly had correlation with negative attitude towards on-call duty (passiveness, blocked head, declined attention, forgetfulness) and work errors (order error and wrong surgical decision) at 0.05. Since on-call duty brought about sleep deprivation and negative impacts on cognitive functions on attention and working memory, the research attendants felt inactive in doing work and made mistakes and errors. However, for further studies, the mentioned errors possibly caused by other factors should also be taken into account. Based on this research, the better designed study with more sample population, not only residents from Ramathibodi Hospital, would be recommended for more useful and comprehensive findings.



CHAPTER VI

CONCLUSION AND RECOMMENDATION

This research is cross sectional to study effects of long hour shifts onto cognitive functions of a group of 50 surgical residents, working at Ramathbodi Hospital and 28.84 years of age on average. 92 percent of subjects are male. Works of the sampling group violated authorized labor standards. The studied residents worked more than 80 hours a week, and work shift lasted longer than 30 consecutive hours. Mean daily workload was over or equal to 12 hours/day. The aforementioned data was collected by surveys and from surgical on-call rosters, dated in January 2005. During 2 months of data collection and testing, subjects worked night on-call duty following to rosters as usual and tested by test forms twice. They voluntarily took part in data collection and testing processes.

Research methodology: the researcher started surveying data and information expected to be controversial for health and safety in order to indicate important problems and design suitable and comprehensive methodology of the research. The author had reviewed literatures concerned and submitted research proposal to the Research Proposal Examination Committee in April, which were then approved in May 2005. The author and her assistant were trained how to use the test forms and how to verify accuracy of collected data by psychiatric specialists, Ramathibodi Hospital. In addition, the author also made a request to Dean of Medical School, Ramathibodi Hospital and the Human Research Ethics Committee for permission in conducting data collection among all residents who worked night on-call duty. The collection started in August and ended in September 2005. Data was gathered twice by 1 group of samples during pre-call and post-call. Gap between 2 collections was one month. To keep a number of variables down and by the support of secretary to the Faculty, residents' advisors and co-shifts, the research orientation was hosted to select samples, according to specified qualifications and on voluntary basis. The researcher made appointment with each sample to collect data individually based on his/her

surgical rosters, convenience of the sample and research agreement. Preparatory procedures were also reiterated to residents one day before a pre-call test taken. Tests and interviews on work were repeated one month later.

The cognition test form used was composed of 3 sub-tests; Digit Span, Digit Symbol, and Stroop Test by Faculty of Psychiatry, Ramathibodi Hospital (quoted from Association of Psychiatry, Thailand). The tests used with interviews comprised 5 sections—section 1: Personal data, section 2: Data on sleep, section 3: Data on work, 4 Data on Sleepiness/Drowsiness and section 5: symptoms/incidents found during night on-call duty and evaluation form of sleepiness.

SPSS (Statistical Package for Social Sciences) and descriptive statistics including means, standard deviation, frequency and percentage were used to explain general data and data on sleep, workload, stress, drowsiness scores, symptoms/incidents found during night on-call duty. Besides, Pair Sample t-test was used to compare differences of scored gained from Digit Span, Digit Symbol and Stroop test during pre-call and post-call. General Linear Model and Independent Sample t-test were used to compare cognitive function test scores categorized by personal characteristics, work, stress and sleep. Chi-square and correlation were used to rule out relations between factors, namely, personal characteristic, work, sleep, stress and the decrease of cognitive function test scores.

6.1 Research Findings

1. General data of subjects

Almost all of research subjects were male (92.0 percent) with 1.5 year work experience (60 percent). Fifty-six percent used to work at district hospitals before being residents. 46.0 percent worked in light surgery line (Plastic, Pred., Uro., Trauma, and Elective). Mean age was 28.84 years. A number of residents from all academic years participating in the research were similar (32-34 percent).

2. Data on sleep and drug/stimulant intake

Most of subjects had late sleep habit (after 24:00 hrs) at 76.0 percent. Averaged sleep length was regularly 6.75 hour. Sleep on duty was 4.44 hours on average. During on duty, almost all of subjects (88.0 percent) had sleep loss and inefficient sleep. A number of being awakened was at 1.56 times and each time took 17.20 minutes on average. Conditions of bedroom were at medium suitable (54.0 percent). During night on-call duty, 64.0 and 94.0 percent of subjects did not drink coffee nor smoke successively. Mean scores on

3. Data on stress

Subjects had stress scores at 16.47 on average, classified as normal. Symptoms found when highly stressed were being to exhausted to do anything, being scared of making mistakes and being annoyed.

4. Data on work

Subjects were scheduled at 139.65 hours/week on average. Mean shift length was 153.89 consecutive hours. Median was 85.25 hours. Interval of shifts was 12.9 hours on average. Most subjects (56.0 percent) did not have sideline. Mean daily workload was 16.94 hours.

5. Symptoms/incidents found during night on-call duty

Most of subjects presented negative attitude toward on-call duty. 50 percent of them rushed to finish their work because of fatigue and decreasing concentration. Major errors made were order error, drug management error (3 percent), wrong decision during surgery (1.5 percent), critical accident/near-miss, such as, micro sleep when driving (6 percent), near-miss of car crashes (2 percent) and car accidents (2 percent), needle puncture (9 percent).

6. Comparative study: cognitive function test scores during pre-call and post-call

It was found that cognitive function test scores stemmed from 3 sub-tests during pre-call were significantly higher than those gained during post-call (p -value < 0.001). However, the post-call cognitive function test score of studied residents were

still above the mean score. Prevalence rate was at 78% from Digit Span, at 80% from Digit symbol and 52% from Stroop Test. Considering a sample group with inadequate sleep, it reported that cognitive function test scores stemmed from 3 sub-tests during pre-call were significantly higher than those gained during post-call (p -value < 0.001). As for a group with sufficient sleep, cognitive function test scores were shown variedly without significant implication (p -value = 0.34 , 0.28 , 0.27 , 0.16).

7. Comparative study on cognitive function test scores categorized by factors (personal characteristics, sleep and work)

Personal characteristics

Between a group of less than 30 years of age and a group of over 30 years of age, there was an insignificantly different decrease of their cognitive function test scores (p -value = 0.47,0.26,0.26,0.08).

Between a group of 1-5 year work experience and 6-10 year work experience, there was an insignificantly different decrease of their cognitive function test scores (p -value = 0.46,0.27,0.35,0.09).

Between a group of residents from district hospital and a group of residents from provincial and center hospitals, there was an insignificantly different decrease of their cognitive function test scores (p -value = 0.30,0.47,0.45,0.17).

Among academic years of residency, there was an insignificantly different decrease of their cognitive function test scores (p -value = 0.92,0.21,0.35,0.76).

Between residents from general B and neurology work line and those from Plastic; Urology; Pediatric; Transplant; Trauma; Elective surgery work line, there was a significant decrease in working memory and mental control in the former group more than the latter group (p -value = 0.01).

Stress

Different levels of stress had insignificantly different effects on cognitive function test scores (p -value = 0.19,0.34,0.75,0.55).

Sleep

There was a significant decrease of working memory and mental control in a group with sufficient sleep less than in a group with insufficient sleep. (p-value = 0.02)

Work

There was a significant decrease of working memory and mental control in residents with less than 120-hour total work hour/week less than those with more than or equal to 120-hour total work hour/week (p-value = 0.002).

There was a significant decrease of working memory and mental control in residents with 12 to 96 -hour shift length less than those with more than 96-hour shift length (p-value = 0.05).

There was a significant decrease of attention, speed of response and visual scanning process in residents with less than or equal to 16-hour workload less than those with more than 16- hour workload (p-value = 0.004).

There was a significant decrease of working memory and mental control in residents with 1-4 hour total surgery/day less than those with 5-9 hour total surgery/day (p-value = 0.006).

8. Correlations of factors (personal characteristics, stress, sleep, work, negative attitude, accident-near miss and error) with the decrease of cognitive function test scores

Personal Characteristics

Age, work experience, academic year and hospital before residency significantly had no correlation with the decrease of cognitive function test score at 0.05.

Work lines significantly had correlation with the decrease of working memory and mental control (Phi =0.382).

Stress

Stress scores significantly had no correlation with the decrease of cognitive function test scores at 0.05.

Sleep

A number of sleep hours during on-call duty significantly had inverse variation with the decrease of working memory, attention and mental control ($r = -.0261$, -0.271).

Sleep quality significantly had correlation with the decrease of attention, visual scanning process and speed of response ($\Phi = 0.387$).

Work

Total work hours/week significantly had correlation with the decrease of working memory, attention and mental control ($r = 0.333$, 0.359).

Workload significantly had correlation with the decrease of attention, visual scanning process and speed of response ($r = 0.245$).

Total surgery significantly had correlation with decrease of working memory and mental control ($r = 0.303$).

Shift length, schedule surgery, emergency surgery, routine work and study hours significantly had no correlation with the decrease of cognitive function test scores at 0.05.

Negative attitude, Accident, Error

Negative attitude on blocked brain, rush in work caused by fatigue significantly had correlation with the decrease of attention, visual scanning process and speed of response ($r = 0.40, 0.27$).

Accident and near-miss of car crashes significantly has no correlation with the decrease of cognitive function test score.

Errors shown in work on wrong decision during surgery significantly has correlation the decrease with decrease of attention, working memory ($r = 0.30$).

6.2 Recommendation

Findings unveiled that residents' long work hours had effects on their cognitive function and health and also lead to various types of risks. To maintain work balance, it is advisable that;

1. total work hours/week be restricted to less than 120 hours/week because a very long shift contributes to cumulative fatigue, which impairs practitioners' work effectiveness and safety.
2. workload, especially found in relatively busy work line, such as, General line B and Neurology surgery work line be reduced by distributing works and patients between surgery line A and line B proportionately. If distribution is unlikely, a number of residents in busy work line be increased.
3. night on-call duty rosters be limited or adjusted to not exceeding 4 consecutive days in case that workload is more than 16 hours a day. W. Lockley et al (2004) studied the adjustment of on-call shift and then proposed, in replacement of traditional work system requiring approximately 30-hour shift, a 16-hour shift and the 3rd shift (lasting 8-10 hours to) be added to allow a new resident to work while the previous resident is taking rest. The adjustment was found to reduce lack of work attention, and to significantly increase sleeping time more than 5.8 hours/day.
4. good administration and favorable allowance be considered to help residents reduce side-line and night on- call duty in order to keep total work hours/week limited.
5. efficient sleep during on-call duty and increasing hours of sleep be promoted and a number of sleep interruptions be declined. 20 percent of subjects asked for on-call bedroom renovation because the bed room
 - was relatively small, crowded and noisy;
 - was poorly ventilated, sometimes very dirty and hot with bed sheet unchanged;
 - was badly designed without partition for bedroom, dining room and living room;

- a number of beds are fewer than a number of residents.

6.3 Recommendation for further studies

For further studies, administrative department should be requested to schedule timetable for residents to have comfortable time in participating in data collection processes, particularly, during pre-call test. Personal sleep pattern, influencing on scores of pre-call test, should also be taken into account.

Sampling groups should be more diversified. Studies on residents from different departments, such as, those from anesthesiology, of which works are similar to surgery or from many hospitals, are highly recommended. Consequently, research findings can be expected to be wider practiced.

A factor -- work essentially, should be examined deeper and more comprehensively for the sake of better and clearer data analysis.

There should be some alteration of symbols shown in Digit Symbol to be different in 2 tests to avoid the problem of incidental learning.

For further studies, the comparative studies between results of sleep after night on-call duty and that of stimulants used are strongly advised to find solutions for problems of sleep deprivation and the decrease of cognitive functions.

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Include Form

รหัสประจำตัวแพทย์.....

1. ท่านเคยได้รับอุบัติเหตุ / การผ่าตัดเกี่ยวกับสมองหรือไม่

เคย

ไม่เคย

2. ปัจจุบันท่านป่วยด้วยโรคเหล่านี้หรือไม่

โรค/อาการป่วย	ใช่	ไม่	โรค/อาการป่วย	ใช่	ไม่
1. ไทรอยด์เป็นพิษ			5. โรคหัวใจ		
2. เบาหวาน			6. ภาวะเครียดชนิดพึ่งยา		
3. ความดันโลหิตสูง			7. มีปัญหาการนอนหลับ		
4. จิตเภท			8. โรคเรื้อรังอื่น ๆ		

3. ปัจจุบันท่านใช้สิ่งเหล่านี้บ่อย ๆ เป็นประจำทุกวัน

	ใช่	ไม่		ใช่	ไม่
1. ชา-กาแฟ > 3 แก้วต่อวัน			5. ยากระตุ้นการตื่น (Analeptic drug)		
2. บุหรี่ > 10 มวนต่อวัน			6. เครื่องดื่มกระตุ้นอื่น ๆ		
3. แอลกอฮอล์			7. ยาเสติยรอยด์ , สอร์โอมิน		
4. ขานอนหลับ/ยาที่ผลทำให้ง่วงนอน					

4. จากคำตอบข้อ 3 ท่านสามารถหยุดใช้สิ่งเหล่านั้นชั่วคราวขณะทำการทดสอบ (งานวิจัย) เป็นระยะเวลา 1-2 วัน ได้หรือไม่

ได้

ไม่ได้

ไม่แน่ใจ

5. ท่านกำลังอยู่ในภาวะ การตั้งครรภ์ (ตอบเฉพาะแพทย์ผู้หญิง)

ใช่

ไม่ใช่

6. ท่านมีความประสงค์เข้าร่วมงานวิจัยครั้งนี้

เข้าร่วม

ไม่เข้าร่วม

แบบสอบถาม

ปัจจัยส่วนบุคคล (Personal factor)

Code.....6Q1
วันที่บันทึก.....

1. อายุ ปี เดือน
2. ท่านจบแพทยศาสตรบัณฑิต เดือน พ.ศ.
3. ก่อนเข้าเรียนหลักสูตรแพทย์ประจำบ้านศัลยกรรม ร.พ. รามาธิบดี ท่านปฏิบัติงานที่ใดเป็นที่สุดท้าย (ตอบเพียง 1 ข้อ)
 - ร.พ. ศูนย์ ขนาด เดียง
 - ร.พ. ทั่วไป ขนาด เดียง
 - ร.พ. ชุมชน ขนาด เดียง
4. ชั้นปีการศึกษาของแพทย์ประจำบ้าน
 - ปี 1
 - ปี 2
 - ปี 3
 - ปี 4
5. ในรอบ 30 วันก่อนวันนี้ ท่านทำงานพิเศษอื่น นอกจากการอยู่เวรของภาควิชาศัลยศาสตร์
 - คลินิก ชม./สัปดาห์
 - ร.พ. เอกชน ชม./สัปดาห์
 - ศูนย์การแพทย์สิริกิติ์ ชม./สัปดาห์
 - อื่น ๆ (ระบุ)..... ชม./สัปดาห์
6. เมื่อคืนท่านนอนหลับ ชั่วโมง ลักษณะการนอนหลับ
 - นอนหลับสนิทต่อเนื่อง
 - นอนไม่หลับ
7. โดยปกติท่านต้องใช้เวลาในการนอนหลับ ชั่วโมง ที่จะทำใหู้รู้สึกสดชื่น กระปรี้กระเปร่า และเริ่มนอนเวลา น. ตื่นเวลา น.
8. ในรอบ 30 วันก่อนวันนี้ ท่านทำงานแต่ละกะ ห่างกันเฉลี่ย ชั่วโมงและได้มีเวลานอนหลับระหว่างกะนั้น ๆ ชั่วโมง
9. การทำงานกะกลางคืน (Night on-call duty) ครั้งนี้เริ่ม น. สิ้นสุด น. (จนท.กรอกเอง)

แบบสอบถาม

ข้อมูลการนอนหลับ (Sleep data)

Code.....6Q2
วันที่บันทึก.....

1. เมื่อคืนท่านอยู่เวร ได้นอนหลับ ชั่วโมง และเริ่มนอนเวลา น. ถึงเวลา น.
2. ขณะที่นอนหลับ ท่านถูกตามไปดูดูแลผู้ป่วย ครั้ง ครั้งละประมาณ นาที
3. การนอนหลับขณะอยู่เวร (ตอบเพียง 1 ข้อ)

- | | ครั้งนี้ | ส่วนใหญ่ |
|-------------------|--------------------------|--------------------------|
| หลับสนิทต่อเนื่อง | <input type="checkbox"/> | <input type="checkbox"/> |
| นอนไม่หลับ | <input type="checkbox"/> | <input type="checkbox"/> |
4. ในขณะที่อยู่เวรเมื่อคืน ท่านมีการใช้สิ่งเหล่านี้เพียงใด

ยานอนหลับ	เม็ด	<input type="checkbox"/>
กาแฟ	แก้ว	<input type="checkbox"/>
บุหรี่	มวน	<input type="checkbox"/>
อื่น ๆ		<input type="checkbox"/>
ไม่ได้ใช้		<input type="checkbox"/>
 5. สภาพห้องนอนมีความเหมาะสมต่อการนอนหลับเพียงใด

เหมาะสมมาก	<input type="checkbox"/>
เหมาะสมปานกลาง	<input type="checkbox"/>
เหมาะสมน้อย	<input type="checkbox"/> เหตุผล

แบบสอบถาม

ปริมาณงาน (Work duration and Workload)

Code.....6Q3
วันที่บันทึก.....

คำอธิบาย

- โปรดระบุเวลาที่ใช้ทำกิจกรรมดังกล่าว เป็นจำนวนชั่วโมง/นาที ที่ท่านปฏิบัติงานจริง
- ผู้วิจัยจะแบ่งช่วงเวลาการทำงาน เป็น 3 ช่วง คือ ก่อนที่ท่านจะอยู่เวร On-call ขณะอยู่เวร และการทำงานต่อภายหลังอยู่เวร เพื่อให้ง่ายต่อการกรอกรายละเอียด

ภาระงาน	ก่อนอยู่เวร on-call	อยู่เวร on-call	หลังอยู่เวร on-call
I. Routine Work			
1. Round ward (ผู้นำ, ผู้ร่วมทีม)
2. ตรวจวินิจฉัย / รักษาผู้ป่วยที่ OPD/ER
3. Monitoring Post-op Case
4. ทำหัตถการ เช่น ทำแผล
5. กำหนดตารางการผ่าตัด
6. รับรักษาผู้ป่วยต่างแผนก / ในแผนก
II. Crisis Care : CPR ICU			
III. Operation			
1. Schedule operation
2. Emergency operation
IV. Study and Learning			
1. เรียนตามหลักสูตร
2. เตรียมงาน Present, Journal
Grand Round
V. Other			
.....
.....

แบบสอบถาม

ความเครียด (Stress data)

Code.....6Q4
วันที่บันทึก.....

ในระยะเวลา 2 เดือนที่ผ่านมา

ท่านมีอาการ พฤติกรรมหรือความรู้สึกต่อไปนี้มากน้อยเพียงใด

โปรดขีดเครื่องหมาย ✓ ลงในช่องแสดงระดับอาการที่เกิดขึ้นกับตัวท่าน ตามความเป็นจริงมากที่สุด

อาการ พฤติกรรมหรือ ความรู้สึก	ระดับอาการ			
	0	1	2	3
	ไม่เลย	เป็นครั้งคราว	เป็นบ่อย	เป็นประจำ
1. นอนไม่หลับเพราะคิดมากหรือกังวลใจ				
2. รู้สึกหงุดหงิด รำคาญใจ				
3. ทำอะไรไม่ได้เลยเพราะประสาทตึงเครียด				
4. มีความวุ่นวายใจ				
5. ไม่อยากพบปะผู้คน				
6. ปวดหัวข้างเดียว หรือปวดบริเวณขมับทั้ง 2 ข้าง				
7. รู้สึกไม่มีความสุขและเศร้าหมอง				
8. รู้สึกหมดหวังในชีวิต				
9. รู้สึกว่าชีวิตตนเองไม่มีคุณค่า				
10. กระวนกระวายอยู่ตลอดเวลา				
11. รู้สึกตนเองไม่มีสมาธิ				
12. รู้สึกเพลียไม่มีแรงจะทำอะไร				
13. รู้สึกเหนื่อยไม่อยากทำอะไร				
14. มีอาการหัวใจเต้นแรง				
15. เสี่ยงสั้น ปากสั้น หรือมือสั้นเวลาไม่พอใจ				
16. รู้สึกกลัวผิดพลาดในการทำสิ่งต่าง ๆ				
17. ปวด หรือเกร็งกล้ามเนื้อ บริเวณท้ายทอยหลัง หรือไหล่				
18. ตื่นเต้นง่ายกับเหตุการณ์ที่ไม่คุ้นเคย				
19. มึนงงหรือเวียนศีรษะ				
20. ความสุขทางเพศลดลง				
คะแนนรวม				

อ้างอิง : กรมสุขภาพจิต กระทรวงสาธารณสุข

ผลการประเมินและวิเคราะห์ความเครียด

ระดับคะแนน 0-5 ท่านมีความเครียดอยู่ในระดับต่ำกว่าเกณฑ์ปกติ ความเครียดในระดับต่ำมากเช่นนี้ อาจมีความหมายว่า

- ท่านตอบไม่ตรงตามความเป็นจริง
- ท่านอาจเข้าใจคำถามคลาดเคลื่อนไป
- ท่านอาจเป็นคนที่ขาดแรงจูงใจ มีความเฉื่อยชา
- ชีวิตประจำวันซ้ำซากจำเจ น่าเบื่อ ปราศจากความตื่นเต้น

ระดับคะแนน 6-17 ท่านมีความเครียดอยู่ในเกณฑ์ปกติ สามารถจัดการกับความเครียดที่เกิดขึ้นในชีวิตประจำวันและสามารถปรับตัวกับสถานการณ์ต่าง ๆ ได้เหมาะสม รู้สึกพึงพอใจเกี่ยวกับตนเองและสิ่งแวดล้อมเป็นอย่างมาก ความเครียดในระดับนี้ถือว่ามิใช่ประโยชน์ในการดำเนินชีวิตประจำวัน เป็นแรงจูงใจที่นำไปสู่ความสำเร็จในชีวิตได้

ระดับคะแนน 18-25 ท่านมีความเครียดอยู่ในระดับสูงกว่าปกติเล็กน้อย ซึ่งถือว่าเป็นความเครียดที่พบได้ในชีวิตประจำวัน อาจไม่รู้ว่ามีความเครียดหรืออาจรู้สึกได้จากการเปลี่ยนแปลงของร่างกาย อารมณ์ ความรู้สึก และพฤติกรรมบ้างเล็กน้อย แต่ไม่ชัดเจนและยังพองทนได้ อาจต้องใช้เวลาในการปรับตัวแต่ในที่สุดท่านก็สามารถจัดการกับความเครียดได้และความเครียดระดับนี้ไม่เป็นผลเสียต่อการดำเนินชีวิต

ในกรณีนี้ ท่านสามารถผ่อนคลายความเครียดด้วยการหากิจกรรมที่เพิ่มพลัง เช่น การออกกำลังกาย เล่นกีฬา ทำสิ่งที่สนุกสนาน เพลิดเพลิน เช่น ดูหนัง ฟังเพลง อ่านหนังสือ หรือทำงานอดิเรกต่าง ๆ หากท่าน ต้องการป้องกันไม่ให้ความเครียดมากขึ้นในอนาคต ท่านอาจฝึกความเครียดตามวิธีในหัวข้อต่อไป

ระดับคะแนน 26-29 ท่านมีความเครียดอยู่ในระดับสูงกว่าปกติปานกลาง ขณะนี้ท่านเริ่มมีความตึงเครียดในระดับค่อนข้างสูง และได้รับความเดือดร้อนเป็นอย่างมากจากปัญหาทางอารมณ์ที่เกิดจากปัญหาความขัดแย้ง และวิกฤตการณ์ในชีวิตเป็นสัญญาณเตือนขึ้นต้นว่าท่านกำลังเผชิญกับภาวะวิกฤตและความขัดแย้ง ซึ่งท่านจัดการแก้ไขด้วยความลำบากลักษณะดังกล่าวจะเพิ่มความรุนแรง ซึ่งมีผลกระทบต่อการทำงานจำเป็นต้องหาวิธีแก้ไขข้อขัดแย้งต่าง ๆ ให้ลดน้อยลงหรือหมดไป ด้วยวิธีการอย่างใดอย่างหนึ่ง

สิ่งแรกที่ต้องรีบจัดการคือ ท่านต้องมีวิถีคลายเครียดที่ดีและสม่ำเสมอทุกวัน วันละ 1-2 ครั้ง ๆ ละ 10 นาที โดยนั่งในที่สบาย หายใจลึก ๆ ให้น้ำท้องขยาย หายใจออกช้า ๆ นับ 1-10 ไปด้วย ท่านจะใช้วิธีนั่งสมาธิหรือสวดมนต์ก็ได้

ท่านควรแก้ไขปัญหาคิดขึ้น โดยค้นหาสาเหตุของปัญหาที่ทำให้เกิดความขัดแย้ง หาวิธีแก้ไขปัญหาหลาย ๆ วิธี พร้อมทั้งพิจารณาผลดีผลเสียของแต่ละวิธี เลือกวิธีที่เหมาะสมกับภาวะของตนเองมากที่สุด ทั้งนี้ต้องไม่สร้างปัญหาให้เพิ่มขึ้น หรือทำให้ผู้อื่นเดือดร้อน วางแผนแก้ไขปัญหาเป็นลำดับขั้นตอน และลงมือแก้ปัญหา

ระดับคะแนน 30-60 ท่านมีความเครียดอยู่ในระดับสูงกว่าปกติมาก กำลังตกอยู่ในภาวะตึงเครียดหรือกำลังเผชิญกับวิกฤตการณ์ในชีวิตอย่างรุนแรง เช่น การเจ็บป่วยที่รุนแรง เรือร้าง ความพิการ การสูญเสีย ปัญหาความรุนแรงในครอบครัว ปัญหาเศรษฐกิจซึ่งส่งผลต่อสุขภาพกายและสุขภาพจิตอย่างชัดเจน ทำให้ชีวิตไม่มีความสุข ความคิดฟุ้งซ่าน ตัดสินใจผิดพลาด ขาดความยับยั้งชั่งใจ อาจเกิดอุบัติเหตุได้ง่าย บางครั้งอาจมีพฤติกรรมก้าวร้าวรุนแรง เช่นเอะอะโวยวาย ขว้างปาข้าวของ

เกณฑ์การให้คะแนน

เกณฑ์การให้คะแนน รวมคะแนนไม่เกิน 60 คะแนน โดยจำนวนคำถาม 20 ข้อ ตอบว่า

ไม่เคยเลย = 0 คะแนน เป็นบ่อย ๆ = 2 คะแนน

เป็นครั้งคราว = 1 คะแนน เป็นประจำ = 3 คะแนน

แบบสอบถาม

ทัศนคติเชิงลบ-อุบัติเหตุ-ความผิดพลาดที่พบขณะปฏิบัติงานกะกลางคืน

Code.....6Q5
วันที่บันทึก.....

ในช่วง 1 เดือนที่ผ่านมาและครั้งนี้

โปรดขีดเครื่องหมาย ✓ ลงในช่องแสดงระดับอาการที่เกิดขึ้นกับตัวท่าน-เพื่อนของท่าน ตามความเป็นจริงมากที่สุด

เหตุการณ์	ทุกครั้งหลังอยู่เวร	ไม่ทุกครั้ง แต่บ่อย ๆ ≥ 50%	ไม่บ่อยแต่ บางครั้ง < 50%	ไม่เคยเลย
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I. รู้สึกตนเอง

- | | | | | |
|---|-------|-------|-------|-------|
| 1. ไม่กระฉับกระเฉง | | | | |
| 2. เพลียจนไม่อยากทำอะไร | | | | |
| 3. ความคิดไม่เด่น | | | | |
| 4. หลงลืมง่าย | | | | |
| 5. ต้องการรีบทำงานให้เสร็จอันเป็นผล
จากความล้า | | | | |

II. ทำงานผิดพลาดอันเป็นผลจากความล้า

- | | | | | |
|-------------|-------|-------|-------|-------|
| (ระบุ)..... | ..... | ..... | ..... | ..... |
| | | | | |
| | | | | |
| | | | | |

III. อุบัติเหตุ

- | | | | | |
|--------------------|-------|-------|-------|-------|
| 1. เข็มตำมือ | ..... | ..... | ..... | ..... |
| 2. ไขมีดบาด | ..... | ..... | ..... | ..... |
| 3. อุบัติเหตุทางรถ | ..... | ..... | ..... | ..... |
| 4. เดินสะดุดล้ม | ..... | ..... | ..... | ..... |
| 5. น้ำร้อนลวก | ..... | ..... | ..... | ..... |
| 6. .... | ..... | ..... | ..... | ..... |
| 7. .... | ..... | ..... | ..... | ..... |

IV. เกือบเกิดอุบัติเหตุ (Near-miss)

- | | | | | |
|-------------|-------|-------|-------|-------|
| (ระบุ)..... | ..... | ..... | ..... | ..... |
| | | | | |
| | | | | |

แบบประเมินความง่วงนอน (Day time Sleepiness score)

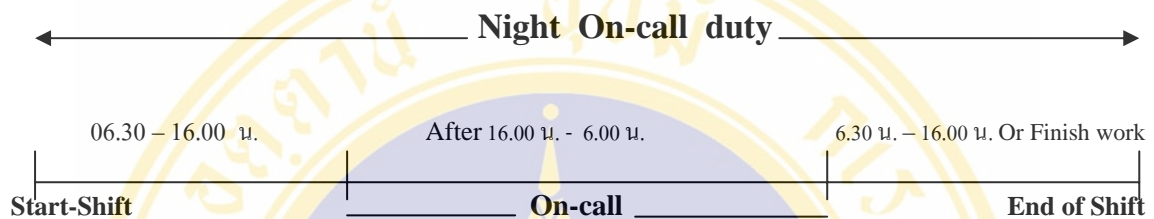
กรุณาให้คะแนนโอกาสที่ท่านจะผล็อยหลับในสถานการณ์ต่อไปนี้ (ช่วงเดือนที่ทำการทดสอบ)

ไม่ว่าจะตั้งใจหรือไม่ตั้งใจก็ตาม

โดยให้คะแนน 0 = ไม่เคยหลับเลย 2 = มีโอกาสหลับปานกลาง
 1 = มีโอกาสหลับน้อย 3 = มีโอกาสหลับสูง

	ไม่เคยหลับเลย	มีโอกา สหลับ น้อย	มีโอกา สหลับ ปานกลาง	มีโอกา สหลับ สูง
1. กำลังนั่งและอ่านหนังสือ	<input type="checkbox"/> 0	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3
2. กำลังชมรายการโทรทัศน์หรือดูหนังใน โรงภาพยนตร์	<input type="checkbox"/> 0	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3
3. นั่งอยู่เฉย ๆ ในที่สาธารณะเช่น ศูนย์การค้า สวนสาธารณะ	<input type="checkbox"/> 0	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3
4. นั่งเป็นผู้โดยสารนาน 1 ชั่วโมงติดต่อกัน	<input type="checkbox"/> 0	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3
5. เอนหลังนอนพักในตอนบ่าย ถ้าสถานการณ์ เอื้ออำนวย	<input type="checkbox"/> 0	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3
6. กำลังนั่งและพูดคุยกับคนบางคน	<input type="checkbox"/> 0	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3
7. นั่งเฉย ๆ เียบ ๆ หลังอาหารมือเที่ยงโดยไม่ได้ ดื่มเครื่องดื่มที่มีแอลกอฮอล์	<input type="checkbox"/> 0	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3
8. ในรถ ขณะรถกำลังติดอยู่ได้ 2-3 นาที	<input type="checkbox"/> 0	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3

ผังการปฏิบัติงานของแพทย์ประจำบ้าน



Night On-call duty ประกอบด้วย

- ช่วงแรก : เป็นช่วงปฏิบัติงานในเวลาราชการ ซึ่งจะหมุนเวียนสลับระหว่างไอทีดี (หน่วยตรวจผู้ป่วยนอก และห้องผ่าตัด หรือบางกรณีจะเป็นแพทย์รับปรึกษาและดูแลผู้ป่วยบนหอผู้ป่วย (เฉพาะบางหอผู้ป่วยเท่านั้น) ขึ้นอยู่กับสายการปฏิบัติงาน สำหรับห้องฉุกเฉินจะมีแพทย์ประจำ และแพทย์กลุ่มนี้จะไม่ต้องปฏิบัติหน้าที่อื่น
- ช่วงสอง : เป็นช่วงที่ปฏิบัติงานนอกเวลาราชการ (ตามความหมายทางการแพทย์จะเรียกว่า “อยู่เวร On-call”) ซึ่งจะหมุนเวียนอยู่เวรตามตารางของภาควิชาศัลยศาสตร์ จัดโดย Shift Resident ในกรณีที่มีการอยู่เวร On-call ติดต่อกันหลายวัน ช่วงนี้จะใช้เวลาเท่ากับจำนวนวันที่อยู่เวรคูณด้วย 14 ชั่วโมง (16.00 – 6.00 น.)
- ช่วงสาม : เป็นช่วงที่แพทย์ต้องปฏิบัติงานในเวลาราชการของวันต่อมาจากการอยู่เวร On-call นับระยะเวลาตั้งแต่ 06.30 น. หรือบางสายการปฏิบัติงาน 07.00 น. จนถึงสิ้นสุดความรับผิดชอบงาน ซึ่งนานกว่า 06.30 หรือ 07.00 – 16.00 น.

Group 1

Transplant

ปี	code	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	หมายเหตุ
3	256				*	*	*									*	*	*								*	*	*					เดือนสิงหาคม

Pred.

ปี	code	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	หมายเหตุ	
4	126	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*		เดือนกันยายน

Elective

ปี	code	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	หมายเหตุ	
4	516	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*		เดือนสิงหาคม

Plastic

ปี	code	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	หมายเหตุ	
1	406	*				*				*	*	*			*				*	*	*		*	*	*	*								เดือนกันยายน
1	356			*		*		*		*	*	*			*	*			*	*	*		*	*	*	*								เดือนสิงหาคม
1	166					*		*		*	*	*			*	*			*	*	*		*	*	*	*								เดือนสิงหาคม
1	036					*		*		*	*	*			*	*			*	*	*		*	*	*	*								เดือนสิงหาคม
1	146					*		*		*	*	*			*	*			*	*	*		*	*	*	*						*		เดือนสิงหาคม
2	176					*		*		*	*	*			*	*			*	*	*		*	*	*	*						*		เดือนสิงหาคม
2	226					*		*		*	*	*			*	*			*	*	*		*	*	*	*						*		เดือนสิงหาคม

Group 1 (ต่อ)

Trauma

ปี	code	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	หมายเหตุ	
1	306			*	*				*		*	*		*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	เดือนสิงหาคม	
2	346				*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	เดือนสิงหาคม
2	196			*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	เดือนสิงหาคม
2	136								*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	เดือนกันยายน	
4	576				*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	เดือนกันยายน

Uro.

ปี	code	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	หมายเหตุ	
1	156	*			*				*		*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	เดือนสิงหาคม
1	116				*			*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	เดือนกันยายน
2	076				*				*		*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	เดือนสิงหาคม
2	056				*				*		*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	เดือนสิงหาคม
2	026				*				*		*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	เดือนสิงหาคม
3	546				*				*		*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	เดือนกันยายน
4	536				*				*		*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	เดือนกันยายน
4	266				*				*		*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	เดือนสิงหาคม

Group 2

Gen A

ปี	code	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	หมายเหตุ
1	316	*		*		*		*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	เดือนสิงหาคม
2	366		*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	เดือนกันยายน
2	106	*		*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	เดือนสิงหาคม
3	296		*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	เดือนสิงหาคม
3	446	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	เดือนสิงหาคม
4	556	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	เดือนกันยายน
4	396	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	เดือนสิงหาคม

ICU

ปี	code	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	หมายเหตุ	
1	096		*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	เดือนกันยายน

ER

ปี	code	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	หมายเหตุ
1	46	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	เดือนสิงหาคม

Group 2 (ต่อ)

CVT

ปี	code	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	หมายเหตุ
1	336	*		*					*		*					*					*										*	เดือนสิงหาคม	
1	016		*							*		*					*												*		*	เดือนสิงหาคม	
2	286			*						*		*				*													*		*	เดือนสิงหาคม	
3	066			*					*		*					*					*								*		*	เดือนสิงหาคม	
3	566			*					*		*					*					*								*		*	เดือนกันยายน	
4	206			*						*		*				*					*								*		*	เดือนสิงหาคม	
4	236			*								*				*					*								*		*	เดือนสิงหาคม	

Group 3

Neuro.

ปี	code	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	หมายเหตุ
2	276	*		*		*		*		*		*		*		*		*		*		*		*		*		*		*		*	เดือนสิงหาคม
	086		*		*		*		*		*		*		*		*		*		*		*		*		*		*		*		เดือนสิงหาคม
3	246		*		*		*		*		*		*		*		*		*		*		*		*		*		*		*		เดือนสิงหาคม
	216		*		*		*		*		*		*		*		*		*		*		*		*		*		*		*		เดือนสิงหาคม

Gen B

ปี	code	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	หมายเหตุ		
1	186	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*		เดือนสิงหาคม	
	496		*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	เดือนกันยายน	
	416		*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*		เดือนสิงหาคม
2	506		*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*		เดือนกันยายน
	436		*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*		เดือนสิงหาคม
	426		*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*		เดือนสิงหาคม
3	456		*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*		เดือนสิงหาคม

BIOGRAPHY

NAME	Miss Chalor Puriansil
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