CHARACTERISTICS OF SLEEP IN THAI CHILDREN (0-6 YEARS) IN THAILAND

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Chayanon Awikunprasert.

CHARACTERISTICS OF SLEEP IN THAI CHILDREN (0-6 YEARS) IN THAILAND

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ABSTRACT

The objective of this investigation is to determine the characteristics and patterns of sleep in normal Thai children aged between 0-6 years in Thailand. Twenty-seven children were selected from 135 children in Bangkok and the central part of Thailand, who parents had responded to questionnaires and recorded their sleep patterns by Sleep Log. These children also met inclusion criteria, and had normal development by DENVER II screening assessment. The selected subjects were studied for two consecutive nights by 8 channel polysomnographic recording with Sleep IT.

On average Thai children age 0-3, and 3-6 years a sleep total of 12 hours and 49 minutes per day, and 10 hours per day, respectively. This is almost 2 hours less than the mean values of the total sleep time 14 – 16 hours per day in 0 – 3 years old and 11 -13 hours per day in 3 to 6 years old children reported in various journals and quoted in many textbooks on sleep. The average percentages of REM-sleep in the total sleep time are 14.08% and 14.17% during the night time sleep and 14.64% and 7.75% during the day time sleep respectively for 0-3 and 3-6 years respectively. These values are between 20 to 25% less than previous reports. The stages 1, 2, 3 and 4 of N-REM sleep did not significantly differ during day-time and night-time sleep or between 0-3 and 3-6 years old groups. Both groups of children slept with approximately 80% Sleep Efficiency index. The lower total sleep time and percentage of REM-sleep might be attributed to change in lifestyles in Thai families. Parents now also sleep less because of disturbances from lighting, television, electronic and computer games, interfering noises, air particle pollution and other environmental factors.

In conclusion, this investigation found that the average total sleep times for 0-3 and 3-6 years old Thai children were significantly lower than previous studies suggest. This trend of reduction in sleep during early child development (ECD) may have significant impacts on their brain development, cognitive and memory functions, personality and adjustment, and health status in later life. It is important that parents and child care givers are aware of the impacts of good sleep on early child development.

KEY WORDS: SLEEP IN CHILDREN / NON-REM SLEEP / REM SLEEP / TOTAL SLEEP TIME / and SLEEP EFFICIENCY.

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บทคัดย่อ

การวิจัยนี้เพื่อศึกษาการนอนหลับในเด็กปกติที่มีอายุระหว่าง 0 -6 ปี ในประเทศไทย โดยใช้กลุ่มตัวอย่างจากเด็กปกติ 27 คน จากการคัดเลือกจากเด็กที่ตอบแบบสอบถามและแบบบันทึกการนอนหลับ (Sleep Log) ทั้งหมด 135 คนในเขตกรุงเทพฯและภาคกลาง โดยเด็กกลุ่มตัวอย่างจะถูกทำการทดสอบแบบตรวจสอบพัฒนาการ (DENVER II) เพื่อดูพัฒนาการเด็กว่าเป็นไปตามช่วงวัยหรือไม่ โดยเด็กกลุ่มตัวอย่างจะได้รับการตรวจสภาพการนอนหลับ 2 คืน ติดต่อกันด้วยเครื่องบันทึกกราฟการนอนหลับ (Sleep IT)

ในการศึกษาครั้งนี้พบว่าเด็กไทยอายุระหว่าง 0-3 ปี มีค่าเฉลี่ยการนอนหลับที่วันละ 12 ชั่วโมง 49 นาที และเด็กไทยอายุระหว่าง 3-6 ปี มีค่าเฉลี่ยการนอนหลับที่วันละ 10 ชั่วโมง ซึ่งน้อยกว่าค่าเฉลี่ยการนอนหลับในเด็กที่ได้เคยมีรายงานไว้ในวารสารวิชาการและตำราเกี่ยวกับการนอนหลับประมาณ 2 ชั่วโมง ช่วงการนอนหลับแบบการกลอกลูกตาไปมาอย่างรวดเร็ว (REM Sleep) มีค่าเฉลี่ย14.08%และ 14.17%ตามลำดับในเวลากลางคืน 14.64% และ 7.75% ตามลำดับในเวลากลางวัน ซึ่งน้อยกว่าที่เคยมีรายงานมาแล้วอย่างมากคือ 20-25% ซึ่งอาจเกิดขึ้นเนื่องจากการเปลี่ยนแปลงรูปแบบการดำเนินชีวิตในครอบครัวที่ทำให้บิดามารดาและผู้เลี้ยงดูมีเวลานอนหลับน้อยลง รวมถึงมีอุปกรณ์อำนวยความสะดวกเช่น โทรทัศน์, เครื่องเล่นเกมส์, อินเตอร์เนต และแสงสว่าง, เสียง, ฝุ่นเป็นต้นซึ่งเป็นสิ่งรบกวนการนอนหลับมากขึ้นในสิ่งแวดล้อม

ส่วนช่วงระยะเวลาต่างๆในวงจรการนอนหลับพบว่าการนอนในช่วงหลับแบบไม่มีการกลอกลูกตาเร็ว (NREM Sleep) ขั้นที่ 1, 2 , 3 และ 4 ไม่แตกต่างกันอย่างมีนัยสำคัญทางสถิติระหว่างช่วงการนอนกลางวันและกลางคืน ในช่วงอายุ 0-3 ปี และ 3-6 ปี ซึ่งในเด็กทั้ง 2 กลุ่มพบค่าเฉลี่ยการนอนหลับมากกว่าในช่วงเวลานอนกลางคืนเมื่อเปรียบเทียบกับเวลาการนอนในช่วงกลางวันอย่างมีนัยนัยสำคัญทางสถิติ ($p<0.0001$) ซึ่งตรงกับข้อมูลที่แสดงว่าการนอนในเวลากลางคืนของเด็กไทยจะนอนหลับพักผ่อนได้ลึกกว่าในเวลากลางวัน

สรุปผลการศึกษาครั้งนี้แสดงว่าการนอนหลับในเด็กปฐมวัยที่อายุ 0-3 และ 3-6 ปี ในเด็กไทยมีค่าเฉลี่ยการนอนหลับโดยเฉลี่ยต่อวันลดลง ซึ่งอาจจะเป็นปัจจัยสำคัญที่มีผลต่อพัฒนาการทางด้านสมอง, การเรียนรู้, ความจำ และบุคลิกภาพนิสัยการปรับตัวของเด็กไทย จำเป็นต้องทำให้บิดามารดาและผู้เลี้ยงดูเด็กปฐมวัยมีความตระหนักถึงความสำคัญของการนอนหลับที่เพียงพอต่อพัฒนาการด้านต่างของเด็กปฐมวัยต่อไป

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LIST OF ABBREVIATIONS

EEG	Electroencephalogram
EMG	Electromyogram
EOG	Electrooculogram
NREM	Non-rapid eye movement
REM	Rapid eye movement
PSG	Polysomnogram
TST	Total Sleep Time
SL	Sleep latency
SLL	Sleep Log latency

CHAPTER I

INTRODUCTION

Background and Significance of the Study

Sleep is one of the basic needs of human beings and is very important for physical and mental health (Schibler and Fay, 1990). For children, each child, especially the newborn, has an individual sleep pattern with a different amount and length of sleeping time (Wong et al, 1999). Sleep is the best rest and basic to human survival. One-third of the human life span spends on sleeping (Eveloff, 1995; Shaver and Giblin, 1989; Thelan, Davie, Urden, and Lough, 1994). The sleep-wake cycle, which follows the circadian rhythm in a 24-hour cycle, is mediated by the neurotransmitters, hormone level and temperature (Thelan, et al., 1994). From the onset of sleep, the individual adult normally progresses through repetitive cycles, beginning with non-rapid eye movement (NREM) sleep stage 1 through 4, and then return to stage 2.From stage 2, the individual enters rapid- eye movement (REM) sleep and the cycle repeats. These cycles occur at approximately 90-minute interval, therefore, four or five cycles are normally completed in a sleep period (Dines-Kalinowski, 2002; Hayter, 1980; Parker, 1995; Thelan, et al., 1994). A good quality of sleep is important to human being, either normal or ill (Parker, 1995). Stages 3 and 4 of NREM sleep is a time for energy conservation, body renewal, and tissue building. Growth hormone (GH) is secreted by an anterior pituitary gland during stage 4 NREM sleep. Its functions are promoting protein synthesis and repairing tissue, such as the repair of epithelial and specialized cells of the brain, skin, bone marrow, and gastric mucosa (Dines-Kalinowski, 2002; Thelan, et al., 1994). During REM sleep, the sympathetic nervous system predominates. The consequences of sleep deprivation include the elevating of heart rate, respiratory rate, blood pressure, oxygen consumption, and temperature. Moreover, REM sleep filters information stored from the day's activities and helps to psychologically integrated activities, such as problem solving. REM sleep facilitates emotional adaptation to the physical and psychological environment (Lower, Boonsack, and Guion, 2002).

On the contrary, having insufficient sleep affects both physical and psychological processes and health. Signs of sleep deprivation differ according to which phase of the sleep cycle the person is mainly deprived (Dines-Kalinowski, 2002; Lukasiewicz- Ferland, 1987). For example, the lack of NREM sleep primarily results in fatigue. A lack of this type of sleep impairs the immune system and depresses the body's defense mechanism, making the patient more vulnerable to disease and complications. Typical signs include anxiety, increased severity of illness, increased sensitivity to pain, poor judgment, and decreased immune responses. In contrast, deprivation of REM sleep causes hyperactive responses. The patients may become agitated, restless, and confused. Behavioral changes, such as combativeness, disorientation of time, place, and identity, delusion of thinking, hallucinations, irritability, visual illusions, and slurred speech, may occur within 48 hours. (Burton, 1992; Dines-Kalinowski, 2002; Honkus, 2003; Luce, 1965 cited in Synder-Halpern, 1987; Mornhinweg and Voignier, 1995; Parker, 1995; Richards and Bairnsfather, 1988; Snyder-Halpern and Verran, 1987). Newborn infants spend about two thirds of time sleeping in order to promote growth and development during the early phase of life (Kohyama, 1998). Term infants spend 16 to 18 hours sleeping each day (Kick, 1996). The sleep pattern of newborn infants is a cycle which can be divided into 2 states; active sleep or rapid eye movement (REM) and quiet sleep or non rapid eye movement (NREM). Each cycle lasts from 50 to 60 minutes. Normally, the sleep pattern will begin with active sleep for about 10 to 45 minutes, followed by quiet sleep which lasts about 20 minutes (Catlett and Holditch-Davis, 1990). Arousal of newborn infant appears after one or two sleep cycles (Thomas, 1995). Sleep in the newborn infant, especially quiet sleep, will enhance growth and restore basic tissue: this is necessary for recovery and rehabilitation of health (Schibler and Fay, 1990). In addition, quiet sleep produces the highest oxygenation level which may be beneficial for infants with respiratory problems. Active sleep is important for memory, learning and psychological adaptation and it has been hypothesized as being necessary for brain development (Catelett and Holditch-Davis, 1990). The sleep pattern of newborn infants is controlled by the relative maturity of the central nervous system (CNS) (Balsmeyer, 1990:447). Healthy newborn infants always demonstrate the sleep pattern as described above. Premature infants, who are born before the end of the last day of the 37th week of gestation, still have an immature body system and CNS which affects their sleep patterns (Ashwill and Droske, 1992). Both the active and quiet sleep of premature infants are poorly organized and of short duration, as they easily respond to stimuli and move from quiet sleep to active sleep (Gardner, Garland, Merenstein and Lubchenco, 1993). Also, premature infants are unprepared for life outside the uterine environment and demonstrate inappropriate adaptation which is linked to the immature functions of neurophysiological development. They have an imbalance of all subsystems i.e., autonomic system, motor system, state organization system, attention/interactive and self-regulatory system. Each subsystems is dependent on the other, therefore, an imbalance in one subsystem may affect the other subsystems. The state organization system involves the display of different ranges of sleeping to waking, and displays clarification of states where they are present (NANN, 1995). This inappropriate adaptation results in most premature infants being admitted to a neonatal intensive care unit (Modrcin-McCarthy, McCue and Walker, 1997). However, the extra-uterine environment of the hospital itself poses dangers to sleep. Environmental conditions which adversely affect neonatal sleep-wake patterns during hospitalization include poorly established light-dark differences, the continuous noise of monitors and staff conversation, exposure to activities and treatment protocols which mandate frequent interruption of sleep (Schibler and Fay, 1990).

Since the normal patterns of sleep and sleep efficiency are important to various aspects of growth and development in children and may also determine the status of health and diseases in their later parts of life, therefore, it is very important to investigate the patterns of sleep in normal Thai Children where no previous reports can be obtained. In addition, various factors, e.g. bio-psycho-social and cultural factors, which influence the normal patterns of sleep and sleep sufficiency in Thai Children, will also be necessary information for parents and medical care providers to promote optimal growth and development for Thai children. In this study, it is also necessary to employ objective measurements of sleep efficiency including the use of sleep recording by Sleep Log and the ambulatory polysomnography (PSG), which is the continuous recording of electroencephalogram (EEG), electrooculogram (EOG), and electromyogram (EMG). The PSG is the only accurate measure of specific sleep cycle and its efficiency (Closs, 1988; Schwab, 1994). Sleep efficiency was measured by portable PSG in terms of sleep efficiency index (SEI), sleep stages, sleep latency (SL), and total sleep time (TST).

Research Question

1. What are sleep patterns of normal Thai children aged during 0 – 6 years?

2. Are there any differences of sleep patterns between normal Thai children and data from similar studies previously reported from other countries?

Research Objectives

1. To study the characteristic of sleep in normal Thai children aged about 0-6 years using Sleep questionnaires, Sleep Log and sleep I/T, and eight-channel ambulatory PSG. These characteristics include:

    1.1. Sleep patterns.

    1.2. Number of sleep cycles during night time.

    1.3. Number of sleep cycles during daytime.

    1.4. Total sleep time during night time and daytime.

    1.5. The Percentage of REM sleep (% REM) of total sleep time.

    1.6. The Percentage of NREM sleep (% NREM) of total sleep time.

2. Compare the characteristics of sleep in the subjects during daytime and night time in this study the subjects are divided into two groups, 0 to 3 and more than 3 to 6.

3. Compare the characteristics of sleep between the subjects in this study and the data reported previously by other authors.

Research Hypotheses

1. The sleep patterns in normal Thai children both aged 0 – 3 years and 3.1 – 6 years are different from the data reported previously from other studies.

2. Patterns of sleep are also different in normal Thai Children aged between 0 – 3 years and 3 – 6 years.

Expected Outcome and Benefits

The results of the study can be applied as follows:

1. To understand the normal patterns of sleep and sleep efficiency among Thai Children aged from 0 to 6, and some factors which man influence their sleep.

2. The information from this study can be used to support and enhance the promotion of normal sleep and sleep efficiency among children in Thailand.

Definition of Terms

The operational definitions of the terms used in this study are as follows:

Sleep Efficiency: is defined as a restful night sleep which is likely to promote health and restorative effects. It will be measured objectively by a portable polysomnography (PSG), which involves the continuous recording of electroencephalogram (EEG), electromyogram (EMG), electrooculogram (EOG) and body movement from the onset of sleep to final awakening. Better sleep efficiency is reflected either by a higher percentage of Sleep Efficiency Index, a short Sleep Latency, or a longer amount of the Total Sleep Time. Brain wave activity is shown by increasing the NREM stages 3 and 4 and the REM sleep, while decreasing the stage of NREM stages 1 and 2.

Sleep Efficiency Index (SEI): is the percentage of time in bed spent asleep in any stage i.e. % of asleep in the total time in bed or total sleep time (TST). It is calculated by dividing minutes asleep by the total minutes of the time in bed. Good sleep efficiency is reflected by a high percentage of SEI (Richards and Baimsfather, 1988).

Sleep Stages: is the time spent in each of the sleep stage. Normal sleep stages are shown in percentage, which are compared to the TST.

-Stage 1 NREM sleep accounts for only approximately 2 to 5 % of the TST.

-Stage 2 NREM sleep accounts for 45 to 55 % of the TST.

-Stages 3 NREM sleep accounts for 3 to 5 % of the TST.

- Stages 4 NREM sleep accounts for 10 to 15 % of the TST.

-REM sleep accounts for 20 to 25 % of the TST

(Kryger MH et al, 1989)

Sleep Latency (SL): is the time in minutes from the beginning of the PSG monitoring to onset of sleep i.e. the appearance of sleep spindles and K-complex in the EEG. Good sleep efficiency is reflected by a short Sleep latency. Normal sleep onset has been found to take about 13-35 minutes in adults (Lai and Good, 2005).

Total Sleep Time (TST): is the number of hours spent in sleep, approximately 7 to 7.5 hours per night (not less than 3-4 hours per night). The longer TST (not exceed 10 hours), the better the sleep.

Sleep patterns refer to the characteristics of sleep in premature infants that encompass everything from sleeping to waking state. The sleep patterns in children have been previously studied and reported by Parmelee and Stem (1972) who divided normal sleep patterns in children into 6 states; (1) Quiet sleep, (2) Active sleep, (3) Drowsy sleep, (4) Quiet alert, (5) Active alert and (6) Crying.

CHAPTER II

LITERATURE REVIEW

Sleep is a behavioral state that alternates and interchanges with waking. Sleep is complex and important physiologic processes in human beings which occupy one third of a lifetime. Among children, sleep not only impacts on physical growth, behavior, and emotional development but also is closely related to cognitive development and functioning, learning, and attention. This purpose of this study is to investigate the characteristics of sleep, especially sleep patterns, in Thai children age between 0 to 6 years old. This chapter reviews current and associated literatures and research papers on the following topics of sleep.

1. The definitions of sleep
2. The nature of sleep
3. Theory of sleep Functions
4. Stages of sleep
5. Generalizations about sleep in the normal young adult human
6. Sleep efficiency
7. Monitoring and staging of human sleep.

2.1 Definitions of sleep

Sleep is a natural periodic state of rest for the mind and body, in which the eyes usually close and consciousness is completely or partially lost, so that there is a decrease in bodily movement and responsiveness to external stimuli. During sleep the brain in humans and other mammals undergoes a characteristic cycle of brain-wave activity that includes intervals of dreaming.

Although, the definition of sleep and its functions have confused the scientists since the beginning, in 1997, Moruzzi described the historical development of **"The deafferentation hypothesis of sleep"**; quoted the concept Lucretius articulated 2000 years ago that sleep is an absence of wakefulness. A variation of the same concept was expressed by Hartly in 1749, and then in 1830 by Macnish, defined that sleep is as a suspension of sensorial power in which the voluntary functions are in abeyance but the in voluntary powers, such as circulation or respiration, remain intact.

Definition of normal sleep is difficult. Although normality is an intuitive concept, the task is quite difficult. For practical purposed a normal sleep can be considered as the sleep of people without sleep disturbances. Sleep can be described by behavioural, physiological and psychological criteria and, more recently, by the new knowledge about the brain mechanics and function from neuroscience. Today sleep can be described mostly by the electrical activities of the brain (EEG), eye movements (EOG) and muscle tones (EMG) recorded by polysomnography (PSG). Sleep is described in terms of pattern and distribution of stages and it is also included other physiological parameters like oxygen saturation, cardiac activity, chest and abdominal movement and airflow. The average time spent asleep falls from about 16 hours in every 24 hours in neonates, to 8 hours at the age of 12, 7 hours in adults and 6 hours in extreme old age (www.Newcastls_sleep_disorder_center.com).

2.2 Nature of sleep

Sleep functions as a reversible behavioral state of decreased responsiveness and interaction with the environment (Carskadon and Dement, 1989). However, the complex functions of sleep or essential functions remain to be fully elucidated. Sleep is considered a time in which the body and mind rest and recuperate, but in actuality, sleep is a period of considerable physiological and neurological activities (Zee and Turek, 1999). Sleep is not merely a state of rest but also is a period of intense brain activities involving higher cortical functions. It was surprising that at time, the brain during a specific stage of sleep is more active than in wakefulness (Dahl, 1998). Infants and young children spend a majority of their time asleep, suggesting that sleep is essential for the developing body and brain. By 3 years old, the typical child has spent more time sleeping than in all wakeful activities (Dahl, 1998).

A number of studies suggested that sleep is essential in maintaining optimal health. Most of the information known about the possible functions of normal sleep is based on studies, investigating the effect of sleep deprivation and anecdotal evidence documenting the effect of sleep loss. Sleep deprivation studies in animal and adult humans have focused on immunological and physiological consequences of sleep loss and suggest that sleep is involved in maintenance of normal body functions and optimal immune performances (Everson, 1993; Rogers, Szuba, Staab, Evans and Dinges, 2001).

Inadequate sleep quality or quantity can have a negative impact on the ability to pay attention and concentration (Chervin et al., 2002; Chervin, Dillon, Bassetti, Ganoczy and Pituch, 1997), and behavioral, cognitive and emotional functioning (Dahl, 1996; Weissbulth, 1987). Moreover, sleep is believed to play a role in the growth and healing body tissues, and central nervous system repair (Zee and Turek, 1999). Comparable studies with infant and young children, however, remain to be conducted.

According to a simple behavioral definition, sleep is a reversible behavioral stage of perceptual disengagement from and unresponsiveness to the environment and usually accompanied by postural recumbence, quiescence, closed eyes, and all the other indicators one commonly associates with sleeping. Therefore, it can conclude with the following criteria (www.sleephomepages.org):

1. Little movements, walking, talking, writing, etc. usually preclude a judgment of sleep. (www.sleephomepages.org)

2. A stereotypic posture, usually we are lying down when we are asleep, and with rare exception, it is safe to say that people, who are, for example, standing their on hands, are not asleep. (www.sleephomepages.org)

3. A reduced response to stimulation, we do not response to low intensity sound, touches, etc., which we would be aware of instantly during wakefulness.

4. Reversibility, we know that we can readily awake from sleep, which distinguished it from coma or death. These criteria constitute a behavioral definition of sleep which corresponds to **“the layman's concept of sleep**”. (ww.sleephomepages.org)

Nevertheless, the scientists rarely study sleep by observing the behaviors of sleep. One reason is testing response thresholds and reversibility interrupt the sleep we want to study. A second reason is observing and behavior continuously is very cumbersome and time consuming. In practice, the scientist defines sleep by certain physiological measures which are so well correlated with sleep that setting a measure of one provides a pretty good measure of the other. Although these physiological measures derive their value from their correlation with behavioral sleep, they also give us information about different kinds or stages of sleep which are not so apparent in behavioral observations.

Based on the electroencephalographic recordings of sleep in normal adults, sleep can be divided sleep into two distinct phases, slow-wave or more recently and frequently referred to as the non-rapid eye movement (NREM) sleep and the rapid eye movement (REM) sleep.

NREM sleep is conventionally subdivided into four stages, which are relatively and precisely, though somewhat arbitrarily, defined along one measurement axis, the electroencephalogram (EEG). The EEG pattern in NREM sleep is commonly described as synchronous.

Stage I: alpha activity decreases, activation is scarce, and the EEG consists mostly of low voltage, mixed frequency activity, much of it at theta band, 3-7 Hz. Rapid eye movements are absent, but slow rolling eye movements appear. The EMG is moderate to low activities.

Stage II: against a continuing background of low voltage, mixed frequency activity, bursts, of distinctive 12-14 Hz sinusoidal waves called "**sleep spindle**" and a large amplitude vertex slow-wave called “**K-complex**” appear in the EEG. Eye movements are rare, and the EMG is low to moderate.

Stage III: high amplitude (>75 mV), slow (0.5-3 Hz) waves called "delta wave" appear in the EEG. The EOG and EMG continue as before.

Stage IV: there is a quantitative increase in delta waves more than 50% of the EEG so that they come to dominate the EEG tracing.

REM sleep, by contrast, is defined by EEG activation, muscle atonia, and episodic bursts of rapid eye movements. The EEG reverts to a low voltage, mixed frequency pattern similar to that of stage I or waking. Bursts of prominent rapid eye movements appear. The EMG is virtually absent, but many small muscle twitches may occur against this low EMG activity. (www.sleephomepages.org)

NREM and REM sleep alternate cyclically throughout the night. Except in certain pathological conditions, a night of sleep begins with about 80 minutes of NREM sleep, followed by a REM period of about ten minutes. This 90 minute NREM-REM cycle then repeated about 3-6 times during the night.

Sleep biology

Among the explanations for the biological functions of sleep, two hypotheses have dominated the field: (1) **sleep is restorative** for brain metabolism and (2) **sleep serves memory consolidation and learning** (Benington, 1995). Considering such vital functions for the organism, sleep must be regulated by biological processes. Specific biological processes: circadian and homeostatic play important roles in determining the duration and timing of sleep (Borbely, 2000). The endogenous nature of sleep and its regulation have been well described on the basis of general mechanisms, but human beings obviously demonstrate considerable inter-individual differences in their sleep patterns as well as in their ability to compensate for deviations from "normal" sleep.

It has been reported that the inter-subject variability of habitual sleep duration has a biological basis through the individually programmed circadian clock (Aeshbach, 2003). The large variability between individuals is also reflected in their biologically preferred bedtimes.

2.3 Theories of sleep's function

In spite of a century of scientific study of sleep, including three decades of intensive research, the function of sleep remains a biological enigma. There is a paucity of theories of sleep function. The term "function," applied to a physiological or behavioral process that can take on different meanings, depending on one's disciplinary interest and level of analysis. Consideration of the following hypotheses of the function(s) of sleep focus primarily on those postulate a primordial biological function, because the evidence for such hypotheses is easier to evaluate than for those principally concerned with subsequent In any case, the evidence pertaining to the various hypotheses indicated no single hypothesis can account for all the data. Several theories of the function have been proposed, and these are described briefly below.

The restorative theory: sleep serves to restore biochemical and/or physiological processes that are progressively degraded during prior wakefulness.

The energy conservation theory: sleep serves to reduce metabolic rate and body temperature in endothermic (warm-blooded) animals, mammals and birds during periods of rest to offset the high energetic costs of endothermy.

The adaptive theory: sleep is an adaptive behavior that allows the creature to survive under a variety of environmental conditions.

The instinctive theory: sleep is as an instinct, which relates to the theory of adaptation and energy conservation.

The theory of memory reinforcement and consolidation: this theory applies particularly to REM sleep, which is thought to facilitate memory and learning. Sleep-waking related fluctuations of hormone and neurotransmitters may be modulation of memory processes.

2.4 Function of sleep

Sleep is a period of bodily and brain restoration. There are many theories about the functions of sleep. For example, there is a theory that the major function of sleep is to conserve our energy. Another suggestion is that as the hunger mechanism is suppressed during sleep, we sleep in order to conserve food supplies. That means that sleep is a protective mechanism developed early in man's revolution (J. Allan Hobson, 2000)

Two main processes are believed to regulate sleep and wakefulness; the circadian process, an internal rhythm or clock that dictates periods of sleep and wakefulness based on a light-dark cycle, and the homeostatic process in which the requirement for sleep builds during waking hours and it relieved by sleep (Davis, Heller and Frank, 1999). Although the circadian and homeostatic processes are distinct and function independently, together they influence the timing and duration of sleep and wakefulness. During sleep, an ultradian rhythm determines the timing and duration of sleep states, each of which are quite different (Zee and Turek, 1999).

The circadian rhythm (derived from the Latin term ***circa diem***, translated) functions as an internal clock, which incorporates cues from the external environment to regulate the timing of sleep and wakefulness. The circadian rhythm is actually about 25 hours in absence of synchronization with cues from the environment, a bit longer than our 24-hour clock day. Light exposure signals waking and darkness signals sleep, thus synchronizing the internal circadian rhythm to the external environment (Zee and Turek, 1999). Therefore, not surprisingly, changes in exposure to light or darkness can shift the circadian rhythm. Light exposure prior to the onset of sleep can interfere with sleep onset, such as with a child exposed to bright indoor lights, television, or sunlight on long summer days, and light exposure near sleep’s end can accelerate awakening. Many other social and environmental cues affect the circadian rhythm, including feedings/ mealtimes, ambient temperature, noise, bedtime routines, physical activity, pain, and medications (Zee and Turek, 1999). There is also a circadian rhythm to a myriad of other functions, including endocrine hormone secretion, core body temperature, and sensory processing (Harrington and Mistlberger, 2000; Mistlberger and Rusak, 2000).

The homeostatic process is the mechanism that drives the body to sleep. This process involves the sleep debt that is accumulated during waking hours, which leads to an increase in the sleep drive. In other words, the longer the period of wakefulness, the stronger is the drive to sleep. During a normal schedule of activity during the day and sleep at night, sleep pressure develops during the day and is relieved by daytime naps and nighttime sleep. This process enables the body and mind to rejuvenate and restores alertness (Sack, 2002).

2.5 Control of sleep

The neural regulation of sleep and wakefulness is primarily depends on the activity of nerve cells in the brain stem and diencephalons. However, many regions of the brain are involved in complex interactions which determine sleep-wakefulness states. Wakefulness is maintained by nerve cell activity in the reticular structures of the upper brainstem and the posterior hypothalamus. Primary hypnogenic or sleep-producing areas appear to be located in the lower brain stem, anterior hypothalamus, median raphe nuclei and midline thalamic nuclei. The two systems for wakefulness and sleep are interrelated. In general, they are antagonistic systems. Both are influenced by neuronal input from the central and peripheral nervous system.

A biochemical regulation of sleep accompanies the effects of the anatomic neuronal pathways. Chemical transmitters alter the excitability of postsynaptic nerve cells. Neurons are stimulated (depolarized) or inhibited (hyperpolarized) by the transmitters. Other chemical substances have a more general effect by altering or modulating the metabolic activity of neurons. The transmitters and modulators involved in the biochemical regulation of sleep and wakefulness include: serotonin, norepinephrine, dopamine, acetylcholine, amino acids, and peptides. Many other chemical systems and putative transmitters may be involved in the regulation process.

2.6 The Stage of Sleep

The ultradian rhythm refers to the alternation of two distinct types of sleep non rapid eye movement (NREM) and rapid eye movement (REM) throughout the sleep period. Each type of sleep is associated with distinctive levels of arousal, autonomic response, brain activity, and muscle tone. Based on electroencephalogram (EEG) recordings, NREM sleep has been categorized into four distinct stages. The stages represent gradations in depth of sleep and difficulty of arousal, with stage 1 being the lightest and stage 4 being the deepest (Zee and Turek, 1999).

When a normal child starts to sleep, the child enters stage 1 NREM sleep, which is typified by reduced body movements, drowsiness, and reduced responsiveness. This stage is considered to be a transitional phase between sleep and wakefulness and the child can be easily awakened from this stage of sleep.

Stage 1 NREM sleep comprises approximately 2% to 5% of total sleep, with the majority occurring in the beginning of the sleep period (Adair and Bauchner, 1993).

Stage 2 sleep quickly follows stage 1 and is considered the onset of true sleep. Decreased eye movements, reduced muscle tone, and deceleration of respirations and heart rate characterize this stage. As, previously described, the stage 2 sleep starts with the appearance of **“Sleep spindle and K-complex”** on the EEG tracing. The child is able to move freely and reposition in the bed. About half of the total sleep time is spent in stage 2, with the majority occurring in the middle of the night. Stage 2 sleep generally comprises about 45 to 55% of sleep. (Adair and Bauchner, 1993).

Stages 3 and 4 are nearly identical and are collectively called **“Delta, deep, or slow-wave sleep”** (SWS) (Zee and Turek, 1999). A relaxed body position, slow and rhythmic breathing, and a decreased heart rate characterize these stages. Arousal is difficult and if awakened, the child will appear confused and disoriented. The preponderance of stage 3 and 4 sleep is seen in the early hours of the sleep period, and these stages constitute approximately 20% of total sleep time (Adair and Bauchner, 1993).

REM sleep is characterized by bursts of rapid eye movement, intense EEG low-voltage high-frequency asynchronous activities, muscle paralysis, and dreaming. EEG activity is similar to that of the awake state, suggesting that higher brain functioning is actively involved during the REM sleep period (Anders, Sadeh, and Appareddy, 1995). The muscle paralysis in the presence of intense brain activity seen in REM sleep has led to the synonymous term **“Paradoxical sleep”** (Zee and Turek, 1999). Muscle twitches, facial expressions, and vocalizations related to dream activity are observed. However, the child remains essentially paralyzed, which is thought to protect the sleeper from physically acting out the action in dreams. Dreams are often vividly remembered and frequently depict very active or unusual themes. Frequent changes in respiration and heart rate are also common in REM sleep. REM sleep is thought to be a time for the brain to assimilate images by replaying them during dreams and “learn” from the experiences of the day (Adair and Bauchner, 1993). The proportion of REM sleep is highest in infancy (55%) and declines to about 25% to 20% by age 5 years (Anders et al., 1995).

The sleep cycle

A normal sleep cycle is approximately 90-120 minutes long and is characterized by the progression of stages from stage 1-2-3-4-3-2- stage REM (Hilton, 1976). The average normal night sleep consists of 4-5 sleep cycles. A person awakened during this 90 minute cycle must start again with NREM stages 1 and proceeds though the stages to REM sleep (Figure2.1).

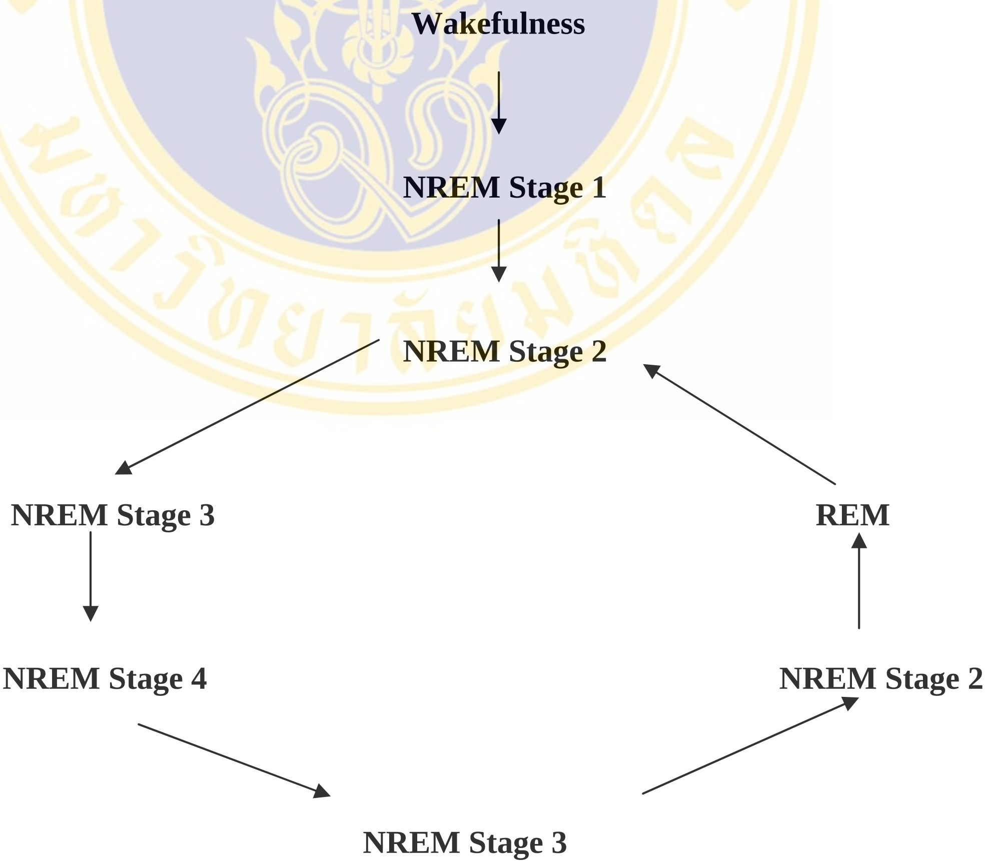


Figure 2.1: Sleep cycle (from Helan et al, 1994)

2.7 Generalizations about sleep in the normal young adult human

A number of general statements can be made regarding sleep in the normal young adult individual who is living on a conventional sleep wake schedule and who is without sleep complaints (Kryger MH et al, 1989):

1. Sleep is normally entered through NREM

2. NREM sleep and REM sleep alternate with a period approximately 90 min.

3. Slow wave sleep predominated in the first third of the night and is linked to the initiation of sleep.

4. REM sleep predominates in the last third of night and is linked to the circadian rhythm of body temperature.

5. Wakefulness within sleep usually accounts for less than 5 % of night.

6. Stage 1 sleep generally comprises about 2 to 5% of sleep.

7. Stage 2 sleep generally comprises about 45 to 55% of sleep.

8. Stage 3 sleep generally comprises about 3 to 8% of sleep.

9. Stage 4 sleep generally comprised about 10 to 15% of sleep.

10. NREM sleep, therefore, is usually 75 to 80% of sleep.

11. REM sleep is usually 20 to 25% of sleep, occurring in four to six discrete episodes.

Young et al, 1993 studied the occurrence of sleep disordered breathing among middle aged adults and represented the time the study subjects spent in each sleep stage since the percentages of total sleep spent in each sleep stage were similar to normative values for adults and the number of REM periods indicated adequate repeated sleep cycles.

Normal Sleep in Children

Early-infant sleep is quite different from the sleep of adults. Infants younger than six months spend 50 percent of their sleep time in active rapid-eye-movement (REM) sleep, compared with 20 percent in adults. **Infants enter sleep through an initial active REM stage, in contrast to adults, who don't commonly enter REM sleep until 90 minutes into the sleep cycle.** Active REM emerges more often during a sleep cycle in infants, resulting in shorter sleep cycles. Until six months of age, **quiet REM (also known as quiet or indeterminate sleep)** cannot be subdivided into the four electroencephalographic (EEG) stages known in the mature sleep pattern. By six months, the infant's sleep architecture closely resembles that of an adult's. After an initial "settling" period that typically takes 10 to 20 minutes, the infant drifts from stage 1 Non-REM (NREM) sleep into stage 3 or 4. The infant may return to stage 1 and cycle again. After one to two cycles of NREM sleep, REM is entered at about 60 to 90 minutes. The first one third of the night is mostly deep sleep (NREM stages 3 and 4). The last one half of the night is predominately stage 2 NREM and REM. **In newborns, the amount of sleep is divided fairly equally between night and day.** Nighttime sleep gradually becomes consolidated over the first year into a single uninterrupted block of time, and daytime sleep gradually decreases over the first three years. By the age of four, most children no longer require a daytime nap. Nighttime sleep requirements also gradually decrease, so that by adolescence they are similar to the sleep needs of an adult.

2.8 Sleep efficiency

Measurement of sleep

There are several approaches to the measurement of the sleep. They are divided into groups of methods: **objective** and **subjective sleep measurements**.

Objective Sleep Measurement

The objective measurements include **Polysomnography (PSG)**, measuring body movement and bedside monitor system.

Polysomnography (PSG): Polysomnographic recordings include EEG traces of the electrical activity of the brain, simultaneous recordings of EOG and EMG traces. The EMG and EOG are useful in distinguishing between REM and NREM sleep. The later recordings provide information about eye movement and muscle tone, respectively (Frisk and Nordstrom, 2003). PSG method provides the most reliable way of measuring all sleep parameters such as sleep latency (SL) or the time taken to fall asleep; latency to the various sleep stages; the percentage of time spent in each stage; sleep efficiency or the time spent sleeping while in bed; and the arousal index or the number of awakenings (Parker, 1995). It remains the best validated method to assess sleep. Its reliability and validity are documented in many studies (Frisk and Nordstrom, 2003).

Unfortunately, some disadvantages preclude the use of PSG as a routine method to measure sleep in Critical Care Units. PSG is expensive, time –consuming and requires technical training personnel to operate the equipment and score sleep stages. A polygraph machine, EEG machine, paper or computer discs, electrodes, paste and collodion for electrode application are costly (Snyder-Halpern and Verran, 1987). Due to its large size, this equipment requires more space in the Critical Care Unit. Whereas this technique is selected for measurement of sleep depends on the suitability and the individual’s objectives. At the present, portable polysomnography is more appropriate for using in Critical Care Unit than PSG, as it is contained in a smaller and compact portable case and still provides valid and reliable sleep efficiency measurements.

Body movements: Information about sleep quality may be drawn from measurements of body movements, especially when combined with other measurements. During sleep, body movements will decrease, particularly in REM sleep. Many different technologies are used to measure body movements such as night cap, wrist actigraph and static charge-sensitive bed.

Night cap: a night cap is a small portable sleep monitor which has been developed to assess body movements. The night cap can not distinguish among sleep stages 1 to 4 because it does not measure brain waves. Data about sleep are derived from using eyelid and head movement sensors to discriminate among wakeful, NREM and REM sleep.

Wrist actigraph: a wrist on the wrist like a watch. By measuring body movements over 24- hour periods, actigraph can differentiate sleep and wakefulness. Actigraph can be used on the individuals of various ages, from infancy to adulthood. When using in critically ill patients, actigraph is relatively less obtrusive. Its disadvantages are similar to those of polysomnography in which requirement of extensive technical training for data reduction and analysis is essential

Bedside monitor system: is used to assess sleep indirectly in the home. Many physiological parameters have been shown to vary during sleep. Respiratory rate decrease during NREM sleep and increase whilst show greater variability during REM sleep. Though the information about sleep from this technique is not as complete as that of polysomnography, it can provide additional information to assess sleep and wake states.

Subjective Sleep Measurements

A subjective measure of sleep assesses the qualitative and quantitative aspects of information from patients' perceptions of their experiences (Closs, 1988). The examples of quantitative sleep aspect include the usual time of sleeping, the estimation sleep duration, sleep latency, or the number of arousals, the number of awakenings, the number of nightmares and the amount of dreams. Other qualitative sleep aspects are the depth of sleep, the restfulness of sleep, the ease of getting to sleep, and the ease of wakening. Subjective methods of assessing sleep include visual analogue scale, subjective rating scale, questionnaire, interview, sleep diary, and personal observation.

2.9 Factors influencing the sleep patterns of infant

Several factors have an influence on sleep patterns. Normal sleep/wakefulness patterns are disrupted by physical and emotional responses to illness, drugs, treatment, and changes in environment due to hospitalization (Beck, 1988).

Environment in the intermediate unit

Environmental factors, including lighting, noise, temperature, and/or smells, are described as external conditions or episodes that interact with the infant. Episodes might include handling, touching, positioning, talking, rocking, holding and performing procedures (NANN, 1995).

Light

The intensity of light in the office recommended by the Occupational Safety and Health Administration (OHSA) is 40-50 foot-candles. The American Academy of pediatricians and the American College of Obstetricians and Gynecologists state that the illumination of 60 foot-candles is sufficient for most procedures, such as heat or phototherapy lamps, or light. Infants in special care baby units are often exposed to such intensity 24 hours a day. Most research has indicated that continuous exposure to light can result in endocrine changes, changes in biological rhythm, and sleep deprivation (Catlett and Holditch-Davis, 1990).

Noise

Noise is another variable that can influence an infant's sleep patterns. A noisy environment can have more serious effects on an acutely ill infant than an adult (Catlett and Holditch-Davis 1990). Noise pollution leads to a decrease in oxygenation, an increase in intracranial pressure, heart rate, and respiration rate. Noise will disrupt the sleep stage and sleep-wake cycle and affect the neonate's recovery and growth. In addition the energy used in noise-induced arousal may decrease the neonate's ability for social interaction. (DePaul and Chambers, 1995).

Studies have indicated that excessively loud noise (greater than 60 db) may interfere with the infant's sleep, increase the infant's heart rate and induce peripheral vasoconstriction. Sudden loud noise has been associated also with increase in intracranial pressure (NANN 1995: 8). It is recommended that there should be a limit to the use of radios in the patient care area, speech should be soft, tapping on the incubator should be avoided and a blanket should be useful decrease noise (NANN, 1995).

Procedures

The sleep and wake states of the infant are affected by the types and duration timing of stimulation from the environment. Nursing intervention in hospitals has the potential effect of either promoting or disrupting stable organization (Holditch-Davis, 1998). Medical and nursing care presents the main problems to preterm infant that survive the neonatal period. On average, a preterm infant in a special care unit is handled 130 times every 24 hours. The rest periods between handling are only from 4.6 to 19.2 minutes. The main disturbers include nursing and support staff, the pediatrician and the parents. Handling has been found most consistently to cause disruption to the infant's sleep patterns and leads to a high incidence of hypoxemia, bradycardia, apnoea and behavioral distress (Wolke, 1987). Most published data isolate the factors that create the tactile symbols: duration, location, action, intensity, frequency and sensation (Liaw, 2000). Sparshott (1994) divided procedures into 3 categories of environmental disturbance.

Disturbance

A growing premature infant is subjected to procedures in this category most of all. Disturbances include nappy change, position change, and nakedness, weighing, over handling, feeding by naso-gastric or oro-gastric tube or bottle-feeding in a weak infant (Sparshott, 1994). Routine care includes feeding, bathing and diaper changing. The infant is awake for breast-feeding and aroused during diaper change or bathing. But the infant can sleep during tube feeding. This may explain the fact that routine care includes both the highest levels of alertness and drowsiness of all the care-giving situations (Brandon, Hoditch-Davis and Beylea, 1999). Generally, bath-time also includes cleaning the incubator and changing the linen. Caregivers should be aware that the majority of infant handling is composed of a number of complex steps, embedded with a variety of tactile simulation (Peter, 1999).

The intermediate care environment is similar to that of intensive care, as the light levels and number of technical procedures are decreased. The premature infant who is convalescing has the physiological reserve to deal with brief interaction because she has adequate sensory processing abilities and tolerates social touch better than painful procedures. Thus, the intermediate care environment should be altered to provide the type of stimulation appropriate for the convalescing preterm infant. The sleep and wake states are influenced by aspects of the intermediate care environment, such as handling for routine nursing care, high level of light, painful procedures, and interaction between the infants and their parents. Also, determining how the intermediate care nursery environment affects sleep-wake states is important for optimal nursing care for a developing preterm infant (Holditch-Davis, Barham, O'Hale and tucker, 1995).

Age

Age is the most powerful determinant of a person's sleep behavior (Webster and Thompson, 1986). Specific physiological parameters of sleep change with maturation, and contribute to differences in neonatal sleep organization between preterm and term infants in accordance with post-conceptional term age (Scher, Steppe, Banks, Guthrie and Sclabassi, 1995). Age-related changes in behavioral state, expression and Organization take place from 28 to 36 weeks post-conceptual age. With increasing age, quiet sleep increases and active or indeterminate sleep decreases (McCain, Donovan and Gartside, 1999**)** Age has an effect on the behavioral responses to care giving. Older infants, 30 to 33 weeks post-conceptual age, more often express wakeful and fussy/crying behavior when compared to younger infants (McCain, Donovan and Gastside, 1999).

Gestational influences.

Newborn behavior develops over the course of gestation under the influence of genetics as well as exposure to maternal metabolic and physiological states and placental circulation. The developing brain and nervous system are constantly exposed and responsive to various conditions including substances, stimuli within the fetal-placental circulation and from the external environment. Among the known fetal environmental influences on newborn behavior and development, most of the studies include maternal metabolic imbalance, in intra-utero drug exposure, hypoxic-ischemic encephalopathy, and maternal stress and depression (Gorski, 1999).

A number of researches indicated that infants and children from pregnancies involving maternal substance abuse, stress, or both show a range of deficits, including growth deficiency and behavioral and intellectual impairments, which are secondary to the effects of the perturbation, including expose to substances of abuse. Such infants often appear to have difficulty maintaining a quiet alert, attentive state, usually fluctuating between crying and distress and glassy-eyed, drowsy states. Similarly, Streisuguth et al (1983) linked alcohol use during pregnancy to a low level of arousal in the newborn, with infants exposed to alcohol prenatally alternating between awake and drowsy states rather than between wake and crying (Roughton, Schneider, Browley and Coe, 1997). Newborn infants of mothers who smoked during pregnancy spend less time in active and quiet sleep and less time awake than infants whose mothers did not smoke (Katzer, 1994 cited by Holditch- Davis, 1998).

Temperature

Infants have a limited capability to behaviorally manipulate their thermal environment. Thus, an increase in environmental temperature can increase both the frequency and duration of apiece pauses in premature infants (McKenna, Thoman, Anders, Scdeh, Schechtman and Glotzbach, 1993).

Ambient and core temperatures influence sleep cycling. Neuronal mechanism that underlines the modulation of sleep by thermal stimuli involves multiple areas of the central nervous system.

Sleep culture

Cultures are the sets of beliefs, norms and expectations. Numerous aspects of sleep are influenced by diverse cultural standards. Culture influences sleeping and waking times including whether sleep is consolidated into a single continuous period and thus is associated with a single specific "bedtime" (a term reflecting the cultural assumptions of those societies sleeping on beds); whether it is confined to nighttime or to private spaces or may also occur acceptably in daytime or in public spaces; whether it is tied to seasonal, cosmological, religious, or spiritual periods and events; and so forth. Worthman and Melby (2002) reported on several tribal societies across the globe whose sleep patterns include lengthy daytime sleep in social groups including children; periods of both daytime and nighttime sleep with frequent arousals that may include intervals of conversation, play, or other social interaction; and acceptability of individual napping in the presence of others.

Numerous anthropologic studies describe, as a feature of a more complete cultural ethnography, associations of sleep with cosmologic and religious or spiritual events, particularly as the observance of these culturally significant phenomena may supercede otherwise usual patterns of sleep. Variability among cultures in regard to sleep-patterning expectations, and interpretations is enormous, and one can find for almost any preference, pattern, or norm its opposite number in some other cultural setting.

Cultural regulation of sleep patterns both encodes and responds to larger cultural values and social pressures, which are not in and of themselves actually "about" sleep. These include such matters as values placed on independence or interdependence of individuals and establishment of the sense of self (Doi, 1981); establishment and maintenance of social class or rank identity and the behavioral emblems of their differentiation (Stearns, 1996); gender roles (e.g., whether women rise earlier than others and prepare the household and its members for the day or whether men retire later than others because of work or social activities to which they are mandated or entitled); idealized family structures and behaviors (including not just the question of co-sleeping of children and parents but also that of co-sleeping of spouses); definition and enactment of religious duty; concepts of character and of moral and admirable behavior as persons; and so forth (Richter, 2003).

Cross-cultural comparative research among societies of different political, economic, ideological, and historical backgrounds will provide an opportunity to delineate the respective roles of culture and biology on sleep behavior and its interpretation. Cultural changes over time may be gradual or rapid and dramatic, with sudden shifts (Yi L, 2003). In contrast, biological change is slow. Low variability across cultures and over time would indicate that biological processes contribute to sleep behavior to a greater extent than do culture.

Studies of children's sleep in the medical and scientific literature have focused primarily on a few key aspects of sleep behavior, sleep problems and sleep terrors.

Bedtime Routines

Bedtime routines usually take place within the core family, in the bedroom allocated to an individual child, under firm parental supervision, and with strict procedures and explicit organization.

Consistent bedtime routines are not always typical for Western industrialized societies. New and Richman, 1996 for example, compared infant care practices in families from the greater Boston area with those in families from a small town north of Rome, Italy. Whereas in American families bed- time rituals were well established and children were required to go to bed regardless of their resistance, Italian children were typically allowed to participate in the family's late-evening life and to fall asleep in the carriage or in someone's lap instead of their own rooms. Parents of Italian children were less concerned about the sleep habits of their children than were American parents and believed that their children were getting adequate amounts of sleep. On the contrary, American mothers were worried about whether their infants got "enough" sleep even when they showed strong resistance to bedtime and naps.

In still other societies, the wake-to-sleep transition of children is not a culturally "marked" event, set apart from other social activities in specialized ways. There is no formalized "bedtime"; indeed, in several cultures, it is probably more accurate to say that there is no such concept as "bedtime" per se, and there are no specific preparations of children for sleep.

Sleep Aids

Winnicott 1975, introduced the concept of **"Transitional objects and transitional phenomena"** associated with facilitating children's transitions from waking into sleep. These sleep aids, commonly objects such as pacifiers, blankets, toys, stuffed animals, or children's thumbs for sucking, are depicted as facilitating children's falling asleep by providing a sense of comfort and security.

Children in industrialized societies (and particularly in urban areas) frequently use sleep aids, whereas in non-industrialized cultures there is a much lower prevalence of object attachment associated with sleep. It has been hypothesized that more physical contact between parents and children during both day and night may explain the lower incidence of sleep aids in these cultures (Hong, 1976).

Sleeping Arrangements

Sleeping arrangements have been subjected to intensive cross-cultural analysis (Liu, 2003 and Morelli, 1992); in part because they have attracted the attention of clinicians and researchers on the basis of their high cultural visibility and the extent to which they have been regarded as "strange" (and therefore calling for explanation) in their distinction from norms in the scholars' own cultures. A number of thorough, well- written, insightful reviews are available (Worthman, 2002 and Stearns, 1996). Less attention has been paid to historical shifts in sleeping arrangements within a single country or culture (Stearns, 1996).

2.10 Assessment of sleep patterns in infants

In the full-term infant, the behavioral states of quiet and active sleep are associated with parallel physiological sleep state differences. Although it is possible to code behavioral states in preterm infants and fetuses, these behavioral states are not yet organized reflections of underlying physiological components defining **typical active sleep begin to emerge at approximately 35 weeks of conceptional age and that of quiet sleep at approximately 37 weeks.** Thus, active and quiet sleep states in the preterm infant, although easy to code behaviorally, do not reflect the same neurophysiological substrate as observed during sleep states in the full-term infant (Doussard-Roosevelt, and McClenny, 1996).

The concept of states has made it possible for us to bring movements and physiological parameters together into definable entities so that we can follow their progressive organization as the nervous system matures. The most commonly studied parameters of states are heart rate and respiratory variability, body and eye movements, sometimes EMG and EEG, with ontogeny of each of these parameters studied individually and in the combinations used to define states in preterm and full-term newborn infants. The three most commonly used parameters are body movements, eye movements and respiratory variability (Parmelee and Garbanati cited in Yabuichi, Watanabe and Okada, 1987).

Respiratory patterns

Respiratory patterns are probably only useful in defining states during sleep. When the eyes are open, respiration is almost always irregular, whereas during sleep a cycling of regular and irregular respiratory patterns can be observed. Respiratory patterns and eye movements are also easily observed state parameters but are not as useful to use with the fetus and premature of low gestational age as body movements. The respiratory efforts of the fetus at 9 weeks gestation are confined to occasional gasps, but rhythmic respiratory movements can be observed by of the 24 to 26 week premature infant as predominantly irregular or semi-regular and with change during movement. By 28-30 weeks, the respirations are almost exclusively irregular. (Parmelee and Stern, 1972).

Eye movements

It is difficult to determine sleep and wakefulness on the basis of whether the eyes are open or closed and more so with increasing prematurity. The presence or absence of eye movements, observed under the closed eyelids or electronically recorded, is an important state criterion. Kleitman (1953) gave credits to Denisova and Figurin (1926) as being the first to describe changes in body activity and respiratory rate in babies while sleeping. Dreyfus-Brisac (1968) reported that they are very infrequent at 24-26 weeks and never appear in bursts. At 28-30 weeks, they are sparse, occurring at a rate of 1-4/min, but almost continuously present. Continuous periods without eye movements are generally short, the longest recorded being 12 min. By 32 weeks, the infant displays periods of much dense eye movement activity which progresses from being almost totally absent at the earliest age, to infrequent and widely scattered, to cluster by 32 weeks. After 40 weeks conceptional age, a marked decrease in the amount occurs and this progression also supports the concept of increasing cerebral inhibition (Parmeelee and Stern, 1972). Defining the minimum interval between eye movements that form 4 bursts as 0.5 second, no significant age-related change in the rate of rapid eye movement burst is observed until pre-adolescence (Kohyama, 1998).

Body movements

The first elicited fetal movement occurs at 7-8 weeks of post-conceptual age while the first spontaneous movement is observed at 9-10 weeks. Therefore, potential for activity exists very early in the premature infant of 24-26 weeks gestation. Most of the reports found that continuous movement was generally localized to the extremities. There is some rhythmic fluctuation in this activity but not pronounced. At 28-30 weeks, very brief quiet periods begin to appear. These have some periodicity as illustrated who also emphasized that this periodicity is very unstable. By 32 weeks conceptional age, body movements are absent in 53% of the 20 sec epochs of 2-3 hr sleep recordings. The modal observation score is taken for each 20 sec; thus a period scored as "no movement" may include a brief body jerk or other short lasting. The numbers of no movement epochs increase to 60% at term and 81 % at 8 months. The frequency of periods of movement decrease accordingly rapid growth in inhibition of body activity in sleep during this period {Parmelee and Stem, 1972).

Active sleep

Newborns spend a greater proportion of their total sleep in active or REM sleep than do adults. Full-term infants spend 50% of their sleep time in this stage; premature infant spend about 80%. (Balsmeyer, 1990). REM or active sleep, in which the brain parts of the body are highly active with electrical brain wave activity, is remarkably similar to that of the waking state. Sleep researchers believe that this stimulation is vital for the growth of the central nervous system (Berk, 1996). Especially, it is readily more responsive to internal and external stimuli. While infants stay this state, and both internal and external stimuli occur, they may remain in this state, return to deep sleep, or become aroused to drowsiness (Blackburn, 1983). This is a time in general not to interact with the baby, as the baby is still in a sleeping state. Often covering and swaddling the baby appropriately will help she achieve deep sleep, When alerting babies for feeding, it is desirable to see them pass through states one onto beforehand (Healey, 1985).

Crying

Crying is the first way of infant communication. During a few weeks after birth, all the babies seem to have some fussy periods when they are difficult to console (Berk, 1996). When an infant is alone, it may elicit parental attention, but if crying occurs during social exchanges it may actually disrupt the parent-infant relationship. In sick infants, crying may have more ominous implications, and is directly related to the heart rate of the infant. The higher the heart rate, the greater the energy consumption of the infant. The infant who spends a lot of time crying will need more calories to grow (Hololditch-Davis, 1998).

Nurses should incorporate developmentally focused care into their routine, be able to assess behavior and to interpret its meaning in the context of internal and external factors. In addition, it is essential that nurses determine an appropriate plan of care in order to support the goal of improved medical and developmental outcome for infants undergoing special care and to enhance parent-infant interaction and subsequent psychosocial relationships (Boxwell, 2000).

2.11 Monitoring and staging human sleep.

The term polysomnography (PSG) was proposed by Holland, Dement, and Raynal in 1974 to describe the recording, analysis, and interpretation of multiple, simultaneous physiologic parameters. PSG is essential in the formulation of diagnoses for sleep disorders patients and in the enhancement of our understanding of both normal sleep and its disorders (Chokroverty S. et al, 1994).

Procedures for monitoring sleep. The EEG is the core measurement of polysomnography .The four stages of NREM sleep are distinguished from one another principally along this dimension (Kryger MH et al, 1989).

The quality of the tracing generated in the sleep laboratory depends a great deal on the quality of the electrode application (Carkadon MA, 1982). Before any electrode or monitor is applied the patient should be instructed about the procedure and given an opportunity to ask questions. The first step in the electrode application procedure involves measurement of the patient's head (Chokroverty S. et al, 1994).

The international 10-20 System of electrode placement is used to localize specific electrode placements. The following sections address the application process for EOG, EMG, and ECG channels.

Electroencephalogram (EEG). Standard electrode derivations for monitoring EEG activity during sleep are C3-AI or C4-A2, and OI-A2 or 02-AI, but in many situations there may be a need for additional electrodes (Chokroverty S. et al, 1994).

For recording EEG, a gold cup electrode with a hole in the Center is commonly used. Silver-silver chloride electrodes are also useful to record EEG, though they may have limitations such as increased maintenance and the inability to attach these electrodes to the scalp (Chokroverty S. et al, 1994).

The placement of C3, C4, O1 and O2 is determined by the international l0-20 system of electrode placement. Reference electrodes are placed on the bony surface of the mastoid process. The name of the system derives from measurements made at intervals of 10 or 20 percent of the total distance between landmarks. The four landmarks of the system are the nasion, inion (external occipital protuberance), and left and right preauricular points. Thus, the measurements are specific to each individual (Chokroverty S. et al, 1994).

The preferred method of application for EEG scalp and reference electrodes is the collodion technique. This technique ensures long term placement and allows for correlation of high impedances, those over 5,000 Ohms after application.

Electrooculogram (EOG). The EOG is a recording of the movement of the cornea-retinal potential difference that exists in the eye. It is important to recognize that it is the movement of this dipole, not muscle activity of the eyes that is recorded. Gold-cup electrodes or silver-silver chloride electrodes can be used to monitor the EOG. The most obvious is to record the cardinal sign of REM sleep the phasic bursts of rapid eye movements which is an essential sleep stage scoring criterion. In addition, the onset of sleep in most humans is heralded or accompanied by slow, rolling eye movements, which also occur with transitions .to stage I during the night. Although these slow eye movements (SEMs) are not essential to sleep staging, they often provide very useful information.

The EOG recordings are based on the small electropotential difference from the front to the back of the eye. The cornea is positive with respect to the retina. Thus, the eyeball exists in the head as a potential field within a volume conductor. Because of this essentially constant potential difference, movement of the eyes can be measured from electrodes placed beside the eyes. An electrode nearest the cornea will register a positive potential; an electrode nearest the retina will register a negative potential. As the eye moves, the positions of the cornea and retina change relative to the fixed position of the electrode, and a potential change will register as a pen def1ection of the polygraph.

An electrode is typically applied at the outer can thus of the right eye (ROG) and is offset 1 cm above the horizontal. Another electrode is applied to the outer can thus of the left eye (LOG) and is offset by 1 cm below the horizontal. The reference electrodes are connected to the contra lateral ears. Additional electrodes can be applied infraorbital and supraorbital electrodes enhance the ability to detect eye movement that occur in the vertical plane and can be particularly useful in the MST. EOG electrodes are typically applied to the surface of the skin with an adhesive co1ar this method avoids the risk of collodion contacting the patient's eyes.

Electromyogram. In a standard polysomnogrphic recording, the EMG from muscles beneath the chin is used as a criterion for staging REM sleep. The EMG recordings from other muscle groups can also be used in the diagnosis of sleep disorders. The intercostals EMG may be used to monitor respiratory effort. Most EMG recordings during sleep require taping electrodes to the skin over the muscle group of interest. A gold cup or a silver-silver chloride electrode attached with an adhesive collar is used to record EMG activity from the mentalis and submentalis muscles. At least three EMG electrodes are applied to allow for an alternative electrode, in the event that an artifact develops in one of the others. The additional electrode can be placed over the masseter muscle to enhance the ability to detect bursts of EMG activity associated with bruxism.

CHAPTER III

METHODOLOGY

Research Design

The sleep pattern and sleep efficiency was studied among the normal Thai children. Participants in this study were screened by using the developmental assessment scale DENVER II for their normal development. The parents of these normal children were asked to complete a Sleep related questionnaire about their child's sleep characteristics and also to record their sleep-waking patterns by the Sleep Log. In addition, each participant was studied by an objective sleep measurement with the eight-channel ambulatory computerized polysomnography or the Sleep I/T. A quasi-experimental study design included two-age (0 to 3 and more than 3 to 6 years old) groups was used in order to control some personal factors related to sleep, such as age, gender and sleep patterns. Comparison between the two periods; during night time and day time, and between the two age group; 0-3 years old and 3.1-6 years old, were recorded and performed.

Population and Sample

The target population of this study was both male and female normal Thai children who lived central part of Thailand. Data collection was conducted in a two-month period during February to March 2006. Twenty-seven Thai children were selected by purposive sampling based on criteria as follows:

1. Normal delivery
2. Normal birth weight (More than 2,500 grams, less than 4,000 grams)
3. Have no head injury during delivery
4. There are no seizure symptoms
5. The child must be a full-term and not premature at birth

6. There are no illnesses before 7 days and during the experiment
7. No history of sleep abnormality or disorders
8. The newborn should sleep with his/her parents
9. Both parents fully understand details of the study, agreed to allow their child to be studied and signed the consent forms for the experiment.

Sample size

Sample size was based on the principle of Polit and Hungler (1995), who suggested the sample of 20-30 cases. For comparison purpose, the number of samples in each group should not be less than 10 cases depending on the research design. Moreover, limited sample size was due to high cost of the instrument used for data collection (Polit and Hungler, 1995). Therefore, the sample size for this study was 30 participants. Participants aged from 0 to 6 years were divided into two groups. The first group was aged 0-3 years old (18 participants totally) and the second group was aged 3.1 – 6 years old (9 participants totally). Three participants were excluded from the study because of error data.

Instrumentation

The instruments for data collection were consisted of:

1. Portable polysomnography (PSG) was used to evaluate sleep efficiency in terms of the following aspects.

-Sleep efficiency index (SEI) is the percentage of time spent asleep in any stage compared to the overall time in bed.

-Time duration spent in each sleep stage (stages1, 2, 3, and 4 NREM sleep, REM sleep) measured in minutes and as percentage of the total sleep time.

-Sleep latency (SL) is the time in minutes from the beginning of the PSG monitoring to onset of sleep.

-Total sleep time (TST) is the number of hours spent on sleep per night.

2. The demographic data recording form was developed by the researcher which consisted of

- Usual sleep pattern at home including bedtime, wake time, total sleep time, daily living activities before sleep and sleep disturbing factor.

3. Instruments for data collection of the sleep-wake patterns in premature infants:

- Video camera Panasonic Model. No. NY -Vx7EN
- Video cassette (size 4x7.3 inches), each cassette recorded 120 to 180 minutes in Long-play (LP) mode.

Quality of the instruments

Portable polysomnography (PSG)

Portable PSG (The CNS Sleep Integrated Technology System: Sleep I/T) was used to measure sleep efficiency. The convenient handheld Sleep I/T device and an IBM-compatible computer were used by enters patient information and customizes the channels to record patient's data. The Sleep l/T is composed of Electroencephalogram (EEG), Electrooculogram (EOG), Electromyogram (EMG) and limb activity.

EEG: EEG was used to record the sleep stages during a period of the study night through two electrodes. The first one was placed in the C3 electrode position at the top of the head whilst the second electrode was placed behind the ear. Another ground electrode was placed behind the opposite ear. These leads were used to determine the stage of sleep the patient was in during the duration of the study night.

EOG: One electrode was placed above and to the outside of the right eye, and another electrode was placed below and to the outside of the left eye. These leads record the movements of the eyes during sleep and serve to determine sleep stages related to rapid eye movement.

EMG: Two electrodes were placed at the outer calf. As an alternative, it can be placed on the same leg, two inches apart to record movements during sleep. These leads demonstrate muscle activities.

Limb activity sensor (Wristband): The wrist cuff slid over either wrist was used to determine the number of hours spent on sleep during the study period.

After the data was recorded, the researcher then transferred data from the Sleep l/T device to a notebook computer wherein a few minutes, the Sleep l/T system automatically displays and analyzes the data. Next morning, the research assistant brought the Sleep I/T device and notebook computer to the neuro-behavioral biology center. The thesis advisor, an expert of the neuro-behavioral biology center, who was uninformed of the participants' period assignments, read, interpreted sleep efficiency and printed out a report that included the information on limb activity and sleep staging.

The standard sensitivity for a polygraph is 7 mm/50mV. The polysomnography equipment was calibrated before each recording session while sleep efficiency was recorded under standardized procedures. The standard paper speed on a polygraph was 10 mm/sec Recording began start sleep at p.m. and ended sleep at a.m. of the next morning.

Protection of Human Subjects

The research proposal was approved by the Committee on Human Rights Related to Research Involving Human Subjects of the Mahidol University. The eligible participants were approached and asked to participate in the study. The researcher introduced herself to the participants and explained the objectives, methods, characteristic of the instruments and expected benefits of the study in non-technical terms. The protection of human rights had been given to the participants and indicated their willingness to participate by signing a consent form. The researcher allowed the participants to ask for any additional information whenever they felt uncertain on the study. The participants were confirmed that they were not restricted to participate and could stop or withdraw from the study at anytime without any affected on the treatment or nursing care wherein the information on the participants was treated in strict confidence.

Data Collection

Data collection was done by the researcher and the research assistant following step procedures as follows:

1. A request for permission from the Faculty of Graduate Studies, Mahidol University is submitted. After the study protocol was approved by the Ethics Committee of Mahidol University, the researcher met supervisor and parents of the participants.

2. The researcher explained the study protocol to the parents and requested for permission to study their child's sleep. The parents signed the consent form.

3. The researcher reviewed the participants' history and approached the potential participants for cooperation based on eligible criteria.

4. The researcher approached the participants, introduced himself/herself, and explained the objectives of the study, methods, characteristic of the instruments and expected benefits in non-technical terms. The protection of human rights had been given to the participants by whom the participants indicated their willingness to participate by signing the consent form.

5. The researcher approached the parents of normal mature infants who met the study criteria to ask them to participate in this study. They were informed of the purposes of the study and their right to refuse participation or to withdraw from the study at any time. They were informed about the potential risks and benefits of participation and protection of confidentially.

6. After receiving consent from the parents, the researcher recorded data from the medical charts.

7. Data collection was conducted by the following procedures.

   a. Recording of subject information

b. Recoding of Sleep questionnaire and Sleep Log

c. Recording of Sleep by ambulatory computerized polysomnography, Sleep I/T

d. Video recoding of sleep behaviours, the environment and movements during sleep

e. The analysis of Sleep data by interactive computerized program.

8. The participants were asked to fill in the demographic and clinical data, usual sleep pattern at home and habit of musical listening form.

9. All twenty seven participants served as their own control. They were told that their sleep efficiency would be recorded by the PSG for two consecutive nights.

PSG Recording

1. Before each test, started sleep at p.m. the researcher and the research assistant placed EEG, EOG, EMG electrodes and wristband to the participants.

2. Electrodes were placed on the specific area after skin preparation.

3. After completing all the leads connections, the researcher or research assistant set up the Sleep I/T device with the software on notebook computer followed the standard procedures.

4. The Sleep I/T monitored sleep efficiency started sleep at p.m. and recorded throughout the night until the ended sleep at a.m. or before in the event the participants were awaken in the morning.

5. During the recording session the researcher stayed by the monitoring room to observe the participant's condition. Whereas the number of awakening and any interrupted events to the patient's sleep were recorded accordingly.

Data Analysis

The data was analyzed as follows:

1. Frequency and percentage of the subjects classified by demographic data.

2. The researcher observed the sleep patterns of children from videotape, coded in the observation record for duration and sleep-wake states.

3. The researcher assessed the sleep-wake states of the children using the criteria: eyes open or closed, respiratory pattern and body movement (See the sleep - wake states in Appendix).

Interpretation of the PSG results:

The Sleep I/T is equipped with an automated and interactive program to analyze and construct the sleep diagram or "Hypnogram" which show the continuous changes of sleep stages during the entire recoding period. In addition, the raw data recordings of EEG, EOG and EMG can be reviewed at every 30 second interval (Epoch) to verify the correct sleep staging according to the International Sleep Staging Criteria (Aserinsky and Kleitman, 1954). The sleep expert can also interact with the program and correct specific staging data. The automated computer program also analyzed and reported the following parameters:

-Percentage of sleep efficiency index (SEI)

-The time spent in each sleep stage (stages 1, 2, 3 and 4 NREM s1eep)

-Sleep latency (SL)

-Total sleep time (TST)

Data obtained was further analyzed statistically by using the Software Package of Social Statistic / Personal Computer (SPSS / PC) Version 11.5 as follows:

1. The demographic data were reported by descriptive statistics as frequency, percentage, mean and standard deviation.

2. Unpaired t- Test was used to compare the significant differences between each sleep parameters and between the night time and day time recordings.

CHAPTER IV

RESULTS

This study described the characteristics of sleep in normal Thai children (two groups: 0-3 and more than 3 to 6 years old). Comparison of sleep efficiency in terms of sleep efficiency index (SEI), the time spent in each sleep stage (stage 1, 2, 3, 4 and rapid eye movement (REM) sleep), sleep latency (SL), and total sleep time (TST) between the night and day time would be presented. In this chapter, the results of the data analysis were divided into two parts; (1) Demographic data and (2) Comparison of each parameters of sleep efficiency between the two groups of normal Thai children.

Part 1 Demographic data

Demographic data including normal sleep patterns at home and other factors involving the sleep pattern of the participants are described.

Demographic characteristics of the participants

The participants of this study were normal Thai children who lived in the central part of Bangkok, Thailand. The data was collected from February to March 2006. Twenty-seven participants who met the inclusion criteria were approached. Demographic characteristics of the participants are shown in Table 1. They were more female (n=79, 58.52%) than male (n=56, 41.48%). Their age ranged from 0-6 years with the mean and standard deviation of 3.19 and 0.50 years, respectively. More than half of the participants (n=85, 62.97%) were 0-3 years.

Table 1. Demographic characteristics of the participants (n=135)

Characteristics	Frequency	Percentage
Gender		
Boy	56	41.48
Girl	79	58.52
Age (years)		
0-3	85	62.96
3.1-6	50	37.04

This table shows the number and the percentages that calculated from the frequency of the subjects, which are divided into two large groups, gender (boys/girls) and age (0-3 and 3.1-6) differences.

Table 2. Status of the child's behavior and emotion (n=135)

Characteristics	Frequency	Percentage
Confirm or disconfirm of no-illness 1 week prior the experiment?		
No illness	92	68.15
Yes, some illnesses	43	31.85
Under frequent medication?		
No	123	91.11
Yes	12	8.89
Seizure symptom?		
No	135	100
yes	0	0
Personal history of medical and illness attention?		
No	123	91.11
Yes	12	8.89
History in head injury?		
No	117	86.66
Yes	18	13.34
Having Positive emotion?		
Yes	119	88.15
No	16	11.85
Socialization/friendly ?		
Yes	123	91.11
No	12	8.89
Become easily aggressive when the child can not get something desired?		
Yes	14	10.38
No	121	89.62

Table 2. Status of child's behavior and emotion (n=135) (Cont'd)

Characteristics	Frequency	Percentage
Timid?		
Yes	12	8.89
No	123	91.11
Actively moving and not inactive?		
Yes	98	72.60
No	37	27.40
Dependent on the mother and/or care giver?		
Yes	58	37.03
No	77	42.97
Flexible and adaptable?		
Yes	107	79.26
No	28	20.74
Adhere to routine activity? (e.g., Times to bed and eating)		
Yes	113	83.70
No	22	16.30
Mode of activity with others/ socialization?		
Single	27	20.00
Group	108	80.00

This table indicates the behavioural conditions and the children's emotion prior the experimental procedures. The purpose of this questionnaire collection is to test if the children who applied to participate in the experiment have met the requirement and the criteria of the interests. For example, the children responded with the negative attitude in the question such as if they are not able to socialize, can be eliminated from the experiment. At the mean time, it is important to understand the status and condition of the children as well if they have any history of medical illnesses or head injuries, which might affect their brain and normal sleep patterns.

Table 3. Activity before bed (n=135)

Characteristics	Frequency	Percentage
Continuous postpone bedtime?		
Often (4-7day/week)	2	1.48
Sometimes (2-3day/week)	23	17.04
A few (1day/week)	31	22.96
Never	79	58.52
Not willing to go to bed?		
Often (4-7day/week)	3	2.22
Sometimes (2-3day/week)	20	14.81
A few (1day/week)	15	11.11
Never	97	71.86
Fully cooperate to go to bed?		
Often (4-7day/week)	74	54.82
Sometimes (2-3day/week)	23	17.03
A few (1day/week)	20	14.81
Never	18	13.34
Dependent on sleep aids?		
Often (4-7day/week)	32	23.70
Sometimes (2-3day/week)	12	8.89
A few (1day/week)	3	2.22
Never	88	65.19
Rolling of head / body before sleep?		
Often (4-7day/week)	2	1.48
Sometimes (2-3day/week)	9	6.67
A few (1day/week)	0	0
Never	124	91.85

Table 3. Activity before bed (n=135) (Cont'd)

Characteristics	**Frequency**	**percentage**
Praying or pay respect to Buddha?		
Often (4-7day/week)	31	22.96
Sometimes (2-3day/week)	13	9.63
A few (1day/week)	7	5.19
Never	84	62.22
Touch body parts for self-comfort?		
Often (4-7day/week)	7	5.19
Sometimes (2-3day/week)	0	0
A few (1day/week)	10	7.41
Never	118	87.40

This table demonstrates the results of the questionnaire collection regarding the subjects' behavior and adjustment to the strictly set time to bed. Although some of the behaviors above might be influenced or taught by the family members or the attractiveness of the environment (TV, toy, or climate), however, it might reflect on the children's willing to participation.

Table 4. Characteristics of sleep behavioral (n=135)

Characteristics	**Frequency**	**Percentage**
Person who take the children to bed?		
Parents	93	68.89
Grand parents / other	42	31.11
Sleep problem		
Insomnia		
Often (4-7day/week)	0	0
Sometimes (2-3day/week)	14	10.37
A few (1day/week)	33	24.44
Never	88	65.19
Sudden crying in the middle of the night		
Often (4-7day/week)	4	2.97
Sometimes (2-3day/week)	47	34.81
A few (1day/week)	39	28.89
Never	45	33.33
Wet bedding / Enuresis?		
Often (4-7day/week)	70	51.85
Sometimes (2-3day/week)	32	23.70
A few (1day/week)	11	8.15
never	22	16.30
Mumbling in the dream or sleep talking		
Often (4-7day/week)	3	2.22
Sometimes (2-3day/week)	10	7.41
A few (1day/week)	32	23.70
Never	90	66.67

Table 4. Characteristics of sleep behavioral (n=135) (Cont'd)

Characteristics	**Frequency**	**Percentage**
Sleep walking		
Often (4-7day/week)	0	0
Sometimes (2-3day/week)	0	0
A few (1day/week)	7	5.19
Never	128	94.81
Bruxism		
Often (4-7day/week)	0	0
Sometimes (2-3day/week)	4	2.96
A few (1day/week)	7	5.18
Never	124	91.85
Vigorous body movements or rolling during sleep?		
Often (4-7day/week)	88	65.18
Sometimes (2-3day/week)	31	22.96
A few (1day/week)	10	7.41
Never	6	4.44

Compare to the previous table, this table indicates more of the sleep behavior of the subjects instead of the activities before bed. According to this table, most of the subjects have the experience of wet bedding or enuresis (51.85%) and vigorous body movements and rolling in bed during sleep (65.18%), which can stimulate the subjects to wake up or start the new sleep cycle during the sleep duration.

Table 5. Sleeping environment (n=135)

Characteristics		Frequency	percentage
Room			
With mosquito net?			
	Yes	123	91.11
	No	12	8.89
With window for constant air flow?			
	Window	131	97.04
	No	4	2.96
Supplement to help air flow?			
	Air conditioner	82	60.74
	Fan	53	39.62
Brightness of the room?			
	Bright	0	0
	Dim	69	51.11
	Dark	66	48.89
Interfering noise?			
	Often (4-7day/week)	2	1.48
	Sometimes (2-3day/week)	20	14.81
	A few (1day/week)	10	7.41
	Never	103	76.30
Presence of air particles or pollution?			
	Often (4-7day/week)	29	21.48
	Sometimes (2-3day/week)	41	30.37
	A few (1day/week)	12	8.89
	Never	82	60.75

Table 5. Sleeping environment (n=135) (Cont'd)

Characteristics	Frequency	percentage
Interference by insect?		
Often (4-7day/week)	0	0
Sometimes (2-3day/week)	17	12.60
A few (1day/week)	32	23.70
Never	86	63.70
Interference by smell?		
Often (4-7day/week)	0	0
Sometimes (2-3day/week)	7	5.19
A few (1day/week)	21	15.55
Never	107	79.26
Interference by light?		
Often (4-7day/week)	3	2.22
Sometimes (2-3day/week)	21	15.55
A few (1day/week)	14	10.37
Never	97	71.86

This table shows the sleep environment of the children at home, which might also influence the children's sleeping behavior and attitude of following or postponing the bed time. According to this table, the subjects are not easy awaked during sleep via the environmental influence, it can be significantly altered the sleep cycle of the children and effect the results of the study.

Part 2 Comparison of each parameters of sleep efficiency between the groups of Thai children

Comparison of each parameter of sleep efficiency between the groups of Thai children during the day and night time recording was performed. The repeated One-way ANOVA and One-Sample t-Test analyses were used to determine the distribution of each parameter of sleep efficiency. The results of testing were shown as follows.

Table 6. Comparison of the sleep efficiency between the night and day time recording of the participants with 0-3 years (n=27)

Sleep efficiency	**Night time**		**Day time**		**t**	**p**
	M	**SEM**	**M**	**SEM**		
Sleep Efficiency index (%)	79.98	1.48	91.50	1.05	6.34	<0.0001
Sleep Stages (%)						
Stage 1 NREM	19.34	2.94	16.29	1.04	0.98	<0.0001
Stage 2 NREM	41.38	2.52	36.28	1.78	1.67	0.11
Stage 3 NREM	12.12	1.14	14.42	1.36	1.30	0.21
Stage 4 NREM	13.06	1.31	17.88	2.17	1.90	0.07
Stage REM	14.09	0.90	14.64	1.07	0.39	0.70
Sleep Latency (minutes)	19.88	1.44	21.29	2.06	0.56	0.57
Sleep Log (hours)(n=27)*	9.72	0.18	4.82	0.13	21.70	<0.0001
Sleep Log (hours) (n=135)	9.01	0.09	3.81	0.10	35.84	<0.0001

Total Sleep Time (hours) 12.83 ± 0.16

* Data from the 27 subjects who also participated in the objective sleep measurement by PSG recorded by the Sleep I/T.

The overall sleep efficiency of the participants was good. The average percentage of the SEI of the participants in both periods of the recording was approximately 80%. During the experimental period, during the night time recording, the mean SEI (79.98±1.48%) was lower than the period during the day time recording (91.50±1.95%). There was statistically significant difference of the mean SEI between the two periods of the study at level of $p < 0.05$.

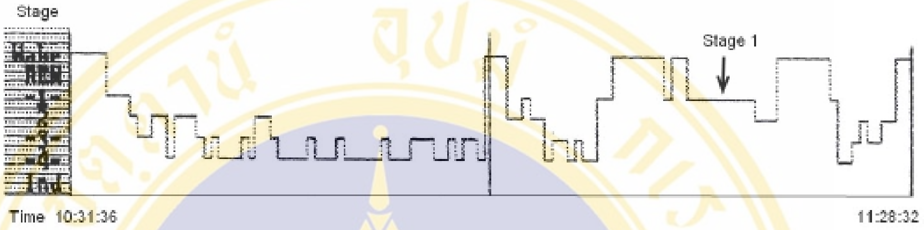
Time duration spent in each sleep stage was measured as the proportion of such stage compare to the TST. The mean percentage of stage 1 NREM sleep during the night time recording (19.34±2.94) was longer than during the day time recording (16.2±1.04). There was statistically significant difference of the mean percentage of stage 1 NREM sleep between the two periods of the study at level of $p < 0.05$ (see Fig. 4.1).

The mean percentage of stage 2 NREM sleep during the night time recording (41.38±2.52) was longer than during the day time recording (36.282±1.78). There was no statistically significant difference (see Fig. 4.2). Stage 3 NREM sleep during the night time recording (12.12±1.14) was shorter than during the day time recording (14.42±1.36). There was no statistically significant difference (see Fig. 4.3). Stage 4 NREM sleep during the night time recording (13.06±1.31) was shorter than during the day time recording (17.88±2.17). There was no statistically significant difference (see Fig. 4.4). In the same way, the mean percentage of stage REM sleep during the night time recording (14.09±0.90) was equal to during the day time recording (14.64±1.07). There was no statistically significant difference (see Fig. 4.5).

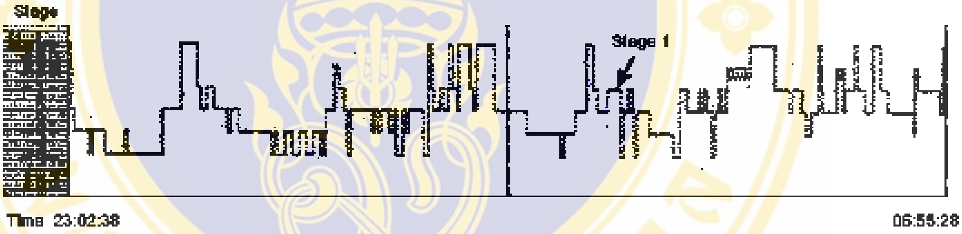
In conclusion, the mean percentage of stage 1 NREM sleep during the night time recording was longer than during the day time recording with statistically significant difference between the two recording periods at level of $p<0.05$. Stage 2 NREM sleep during the night time recording was also longer than during the day time recording, but no statistically significant difference. The mean percentage of stage 3, 4 NREM and REM sleep during the night time recording were shorter than during the day time recording. There was no statistically significant difference between the two periods

The mean duration of SL during the night time recording (19.88±1.44 minutes) was longer than during the day time recording (21.29±2.06 minutes), but no statistically significant difference.

For the children aged between 0 to 3 years old, the mean duration of Total Sleep Time (TST) recorded by Sleep Log was 12.83 ±0.16

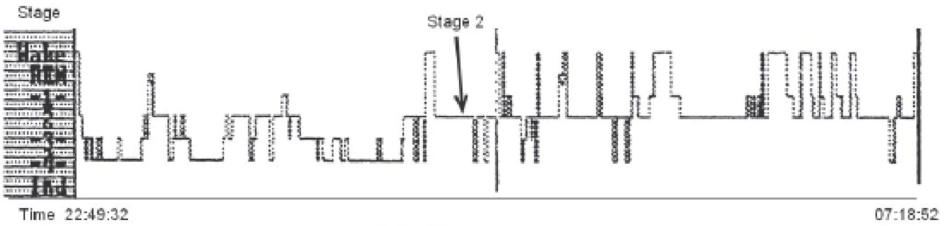


(a) Stage 1 NREM sleep of the day time recording

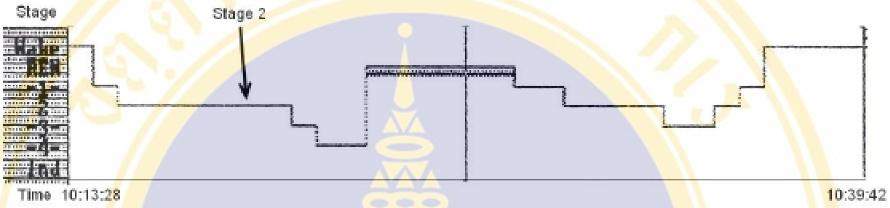


(b) Stage 1 NREM sleep of the night time recording

Figure 4.1 Comparison of the stage 1 NREM sleep of the participants with 0-3 years during the night time and day time recordings.

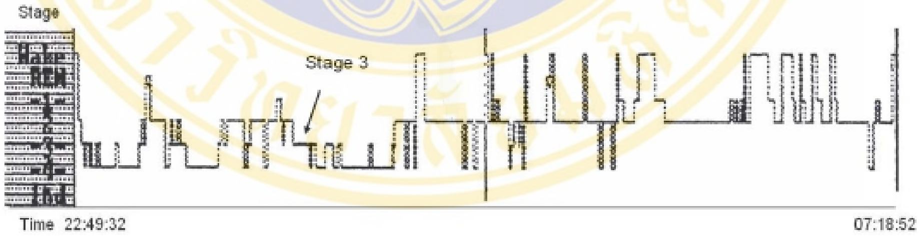


(a) Stage 2 NREM sleep of the night time recording

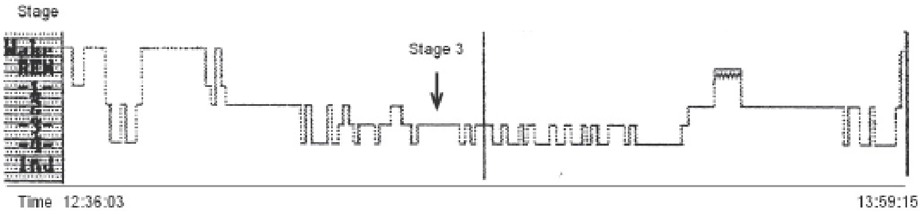


(b) Stage 2 NREM sleep of the day time recording

Figure 4.2 Comparison of the stage 2 NREM sleep of the participants between 0-3 years old group during the night and day time recordings.

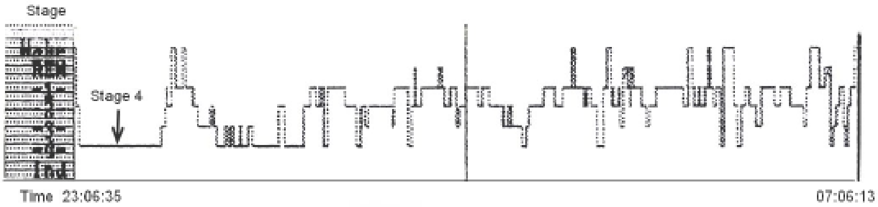


(a) Stage 3 NREM sleep of the night time recording

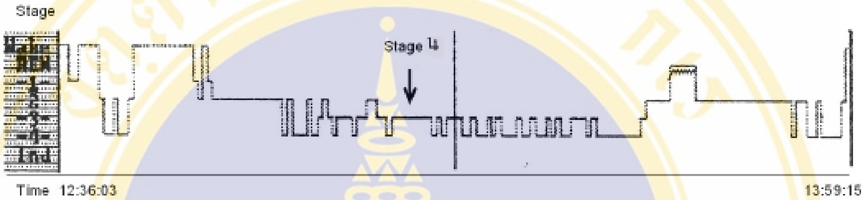


(b) Stage 3 NREM sleep of the day time recording

Figure 4.3 Comparison of the stage 3 NREM sleep of the participants with 0-3 years old during the night time and day time recordings

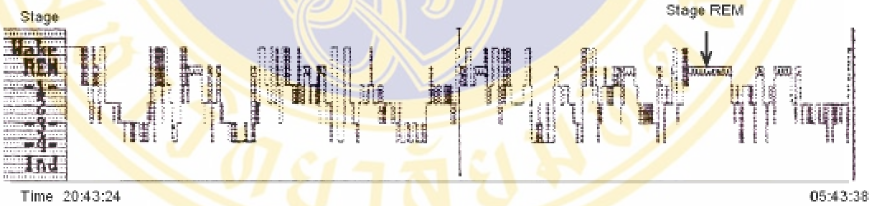


(a) Stage 4 NREM sleep of the night time recording

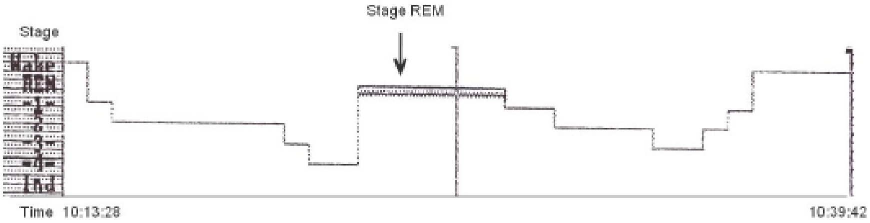


(a) Stage 4 NREM sleep of the day time recording

Figure 4.4 Comparison of the stage 4 NREM sleep of the participants with 0-3 years old during the night time and day time recordings



(a) REM sleep of the night time recording



(b) REM sleep of the day time recording

Figure 4.5 Comparison of the REM sleep of the participants with 0-3 years old during the night time and day time recordings

Table 7. Comparison of the sleep efficiency between the night and day time recording of the participants with 3.1-6 years (n=27)

Sleep efficiency	**Night time**		**Day time**		**t**	**p**
	M	**SEM**	**M**	**SEM**		
Sleep Efficiency index (%)	81.33	2.80	90.14	1.81	2.25	0.04
Sleep Stages (%) Stage 1 NREM	21.20	3.15	8.43	3.20	2.85	0.01
Stage 2 NREM	36.24	2.93	16.19	4.98	3.47	0.002
Stage 3 NREM	7.89	1.16	9.02	2.63	0.39	0.70
Stage 4 NREM	20.53	1.88	18.62	6.41	0.13	0.90
Stage REM	14.17	0.92	7.75	2.30	2.59	0.02
Sleep Latency (minutes)	26.10	4.12	14.70	4.89	1.78	0.09
Sleep Log (hours) (n=27)*	7.96	0.21	2.28	0.27	16.93	<0.0001
Sleep Log (hours) (n=135)	8.14	0.09	1.87	0.11	43.38	<0.0001

Total Sleep Time (hours) 10.01 ± 0.14

* Data from 27 subjects who also participated in the objective sleep measurement with PSG as recorded by the Sleep I/T.

The overall sleep efficiency of the participants with 3.1-6 years was good. The average percentage of the SEI of the participants in both periods of the recording was higher than 80%. During the experimental period, during the night time recording, the mean SEI (81.33±2.80%) was shorter than during the day time recording (90.14±1.81%). There was statistically significant difference of the mean SEI between the two periods of the recording at level of $p<0.05$.

Time duration spent in each sleep stage was measured as the proportion of such stage compare to the TST and SLL. The mean percentage of stage 1 NREM sleep during the night time recording (21.20±3.15) was longer than during the day time recording (8.43±3.20). There was statistically significant difference of the mean percentage of stage 1 NREM sleep between the two periods of the recording at level of $p<0.05$ (see Fig. 4.6).

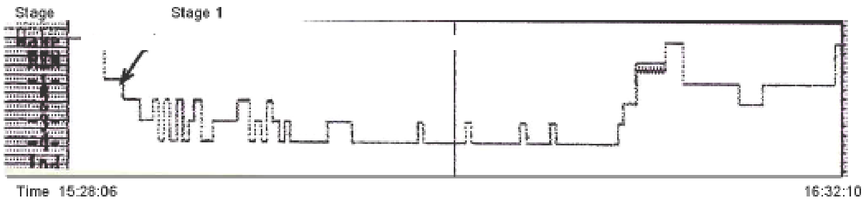
The mean percentage of stage 2 NREM sleep during the night time recording (36.42±2.93) was longer than during the day time recording (16.19±4.98). There was statistically significant difference of the mean percentage of stage 2 NREM sleep between the two periods of the recordings at level $p<0.05$ (see Fig. 4.7). Stage 3 NREM sleep during the night time recording (7.89±1.16) was shorter than during the day time recording (9.02±2.63). There was no statistically significant difference (see Fig. 4.8). Stage 4 NREM sleep during the night time recording (20.53±1.88) was longer than during the day time recording (18.62±6.41). There was no statistically significant difference (see Fig. 4.9). However, the mean percentage of stage REM sleep during the night time recording (14.17±0.92) was longer than during the day time recording (7.75±2.30). There was statistically significant difference of the mean percentage of REM sleep between the two periods of the recordings at level $p<0.05$ (see Fig. 4.10).

In conclusion, the mean percentage of stage 1, 2 NREM and REM sleep during the night time recording was longer than during the day time recording with statistically significant difference between the two recording periods at level of $p<0.05$. On the other hand, stage 4 NREM sleep during the night time recording was also longer than during the day time recording, but no statistically significant difference. Only the mean percentage of stage 3 NREM sleep during the night time recording was shorter than during the day time recording with no statistically significant difference between the two periods.

The mean duration of SL during the night time recording (26.10±4.12 minutes) was longer than during the day time recording (14.70±4.89 minutes), but no statistically significant difference.

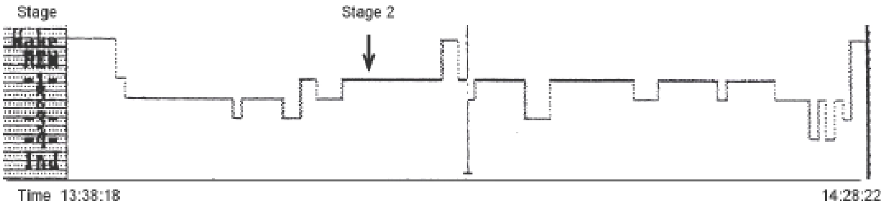
The mean duration of TST during the night time recording (7.09±0.24) was longer than during the day time recording (0.62±0.19). There was statistically significant difference at level of $p<0.05$. In the same way, the mean duration of SLL during the night time recording (7.96±0.21) was longer than during the day time recording (2.28±0.27). There was statistically significant difference at level of $p<0.05$. The average SLL during both periods of recording was longer than TST.

(a) Stage 1 NREM sleep of the night time recording

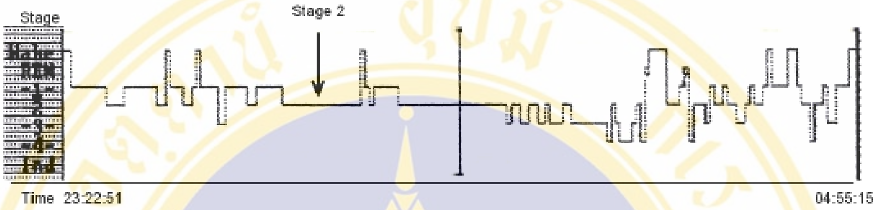


(b) Stage 1 NREM sleep of the day time recording

Figure 4.6 Comparison of the stage 1 NREM sleep of the participants with 3.1-6 years old during the night time and day time recordings.

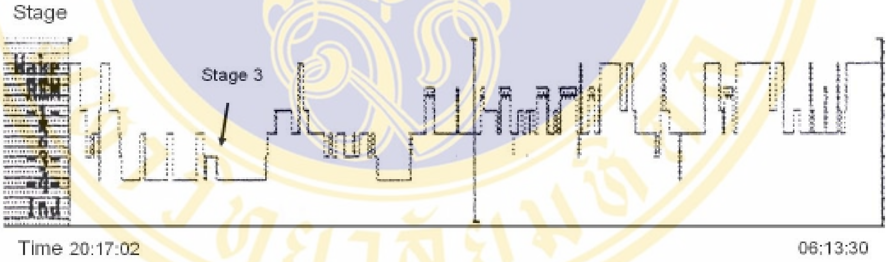


(a) Stage 2 NREM sleep of the day time recording

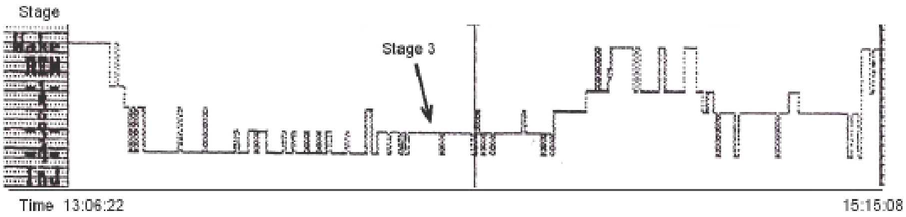


(b) Stage 2 NREM sleep of the night time recording

Figure 4.7 Comparison of the stage 2 NREM sleep of the participants with 3.1-6 years old during the night time and day time recordings

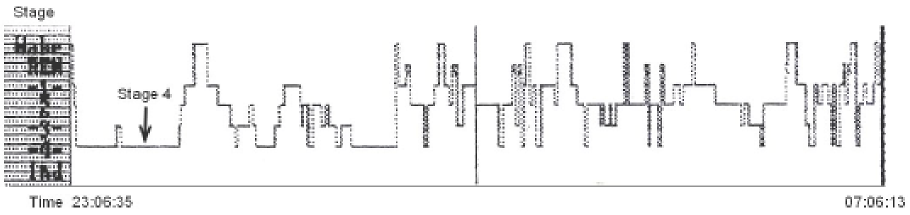


(a) Stage 3 NREM sleep of the night time recording

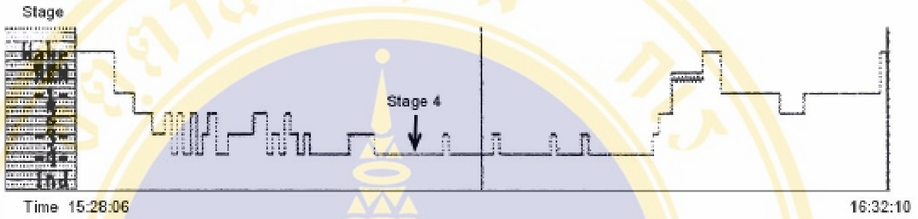


(b) Stage 3 NREM sleep of the day time recording

Figure 4.8 Comparison of the stage 3 NREM sleep of the participants with 3.1-6 years old during the night time and day time recordings

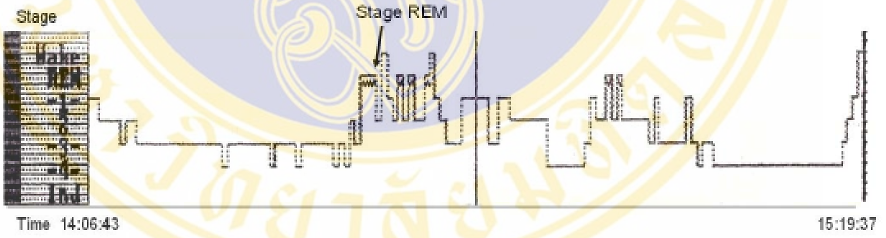


(a) Stage 4 NREM sleep of the night time recording

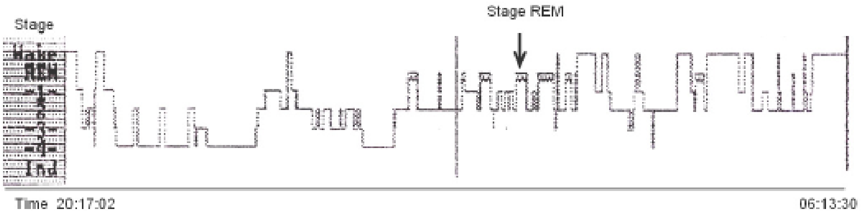


(b) Stage 4 NREM sleep of the day time recording

Figure 4.9 Comparison of the stage 4 NREM sleep of the participants with 3.1-6 years old during the night time and day time recordings



(a) REM sleep of the day time recording



(b) REM sleep of the night time recording

Figure 4.10 Comparison of the REM sleep of the participants with 3.1-6 years during the night time and day time recordings

For children aged between 3.1 to 6 years old, the total Sleep Time (TST) was 10.01 ± 0.14 hours per day.

Table 8. Comparison of the sleep efficiency of the participants between 0-3 years and 3.1-6 years during the day time recording (n=27)

Sleep efficiency	**Day time**		**Day time**		**t**	**p**
	M	**SEM**	**M**	**SEM**		
Sleep Efficiency index (%)	91.50	1.05	90.14	1.81	0.65	0.52
Sleep Stages (%) Stage 1 NREM	16.29	1.04	8.43	3.20	2.83	0.01
Stage 2 NREM	36.28	1.77	16.19	4.98	4.54	0.0001
Stage 3 NREM	14.42	1.36	9.02	2.63	2.02	0.05
Stage 4 NREM	17.88	2.17	18.62	6.41	0.13	0.90
Stage REM	14.64	1.07	7.75	2.30	3.08	0.005
Sleep Latency (minutes)	21.29	2.06	14.70	4.89	1.43	0.16
Sleep Log (hours)(n=27)	4.82	0.13	2.28	0.26	9.50	<0.0001
TST day (hours) (n=135)	3.81	0.97	1.87	0.78	11.86	<0.0001

The overall sleep efficiency of the participants with 0-3 years old and 3.1-6 years old during day time sleep recording was good. The average percentage of the SEI of the participants in both age ranges was higher than 80%. During the recording period, the mean SEI (91.50±1.05%) of participants with 0-3 years old was longer than during the 3.1-6 years old (90.14±1.81%), but no statistically significant difference (see Fig. 4.11).

Time duration spent in each sleep stage was also measured and compared between age groups as the proportion of such stage compare to the TST and SLL. The mean percentage of stage 1 NREM sleep of the 0-3 year's old group (16.29±1.04) was longer than the 3.1-6 year's old group (8.43±3.20). There was statistically significant difference of the mean percentage of stage 1 NREM sleep between the two groups at level of $p<0.05$ (see Fig. 4.12).

The mean percentage of stage 2 NREM sleep of the 0-3 year's old group (36.28±1.77) was longer than the 3.1-6 year's old group (16.19±4.98). There was statistically significant difference of the mean percentage of stage 2 NREM sleep between two age groups at level $p<0.05$ (see Fig. 4.13). Stage 3 NREM sleep of the 0-3 year's old group (14.42±1.36) was longer than the 3.1-6 year's old group (9.02±2.63). There was statistically significant difference of the mean percentage of stage 3 NREM sleep between two age groups at level $p<0.05$ (see Fig. 4.14). On the other hand, stage 4 NREM sleep of the 0-3 year's old group (17.88±2.17) was shorter than the 3.1-6 year's old group (18.62±6.41), but no statistically significant difference (see Fig.4.15). However, the mean percentage of stage REM sleep of the 0-3 year's old group (14.64±1.07) was longer than the 3.1-6 year's old group (7.75±2.30). There was statistically significant difference of the mean percentage of REM sleep between two age groups at level $p<0.05$(see Fig. 4.16).

In conclusion, the mean percentage of stage 1, 2, 3 NREM and REM sleep of the 0-3 year's old group was longer than the 3.1-6 year's old group with statistically significant difference between two age groups at level of $p<0.05$. On the other hand, stage 4 NREM sleep of the 0-3 year's old group was shorter than the 3.1-6 year's old group with no statistically significant difference.

The mean duration of SL of the 0-3 year's old group (21.29±2.06 minutes) was longer than the 3.1-6 year's old group (14.70±4.89 minutes), but no statistically significant difference. (See Fig. 4.17).

The mean duration of TST of the 0-3 year's old group (3.81±0.97) was longer than the 0-3 year's old group (1.87±0.78), and highly statistically significant difference at the level p<0.0001. In the same way, the mean duration of SLL of the 0-3 year's old group (4.82±0.13) was longer than the 3.1-6 year's old group (2.28±0.26) with statistically significant difference between two age groups at level of p<0.05. The average SLL of both age groups was, however, longer than TST.

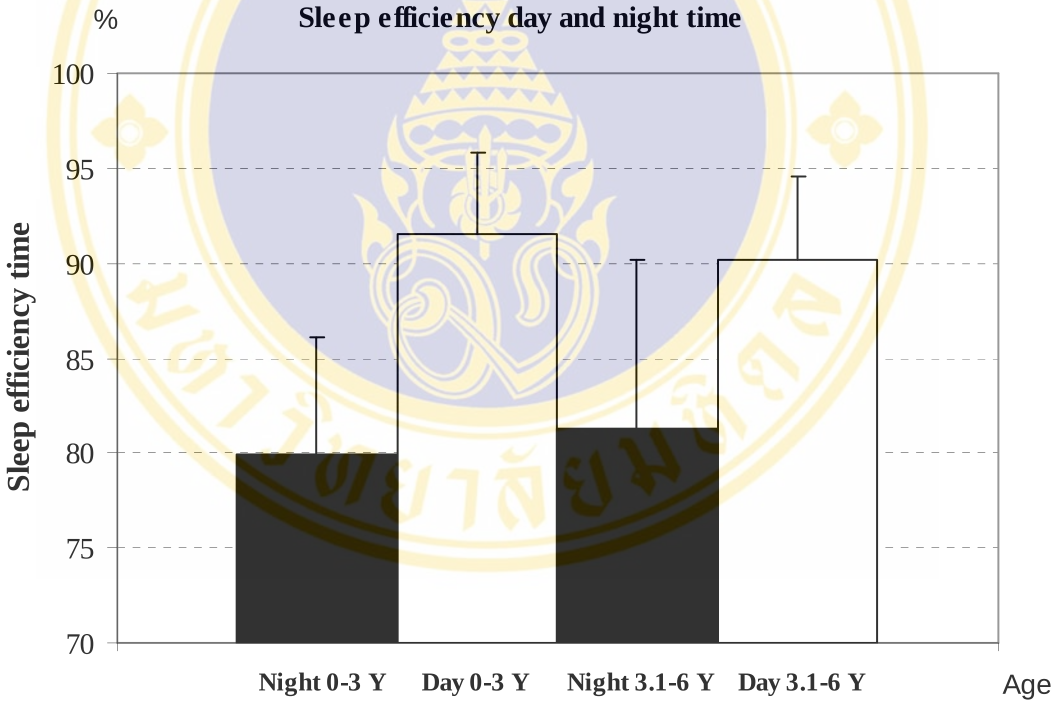


Figure 4.11 Comparison of the sleep efficiency of the participants between 0-3 years and 3.1-6 years during the day time and night time recording

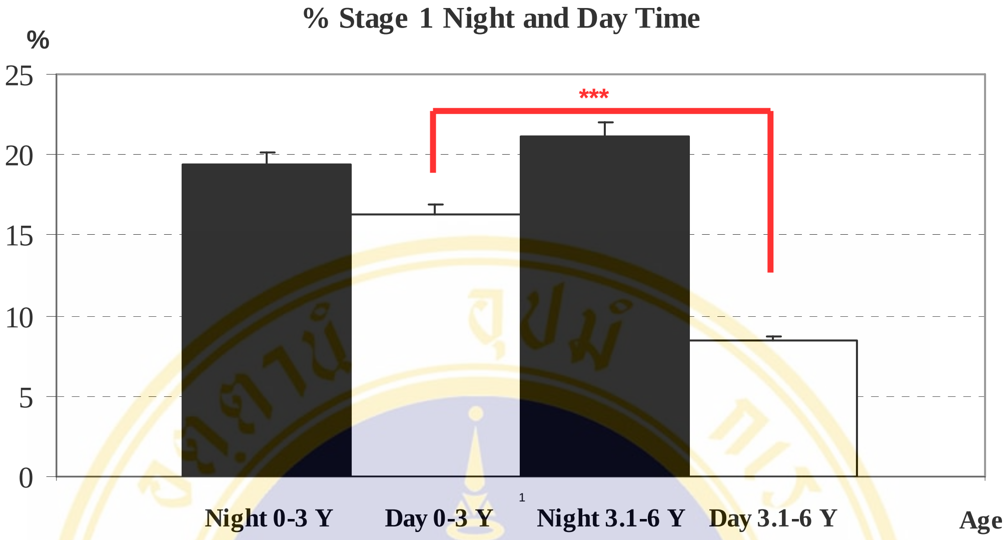


Figure 4.12 Comparison of the stage 1 NREM sleep of the participants between 0-3 years and 3.1-6 years during the day time and night time recording

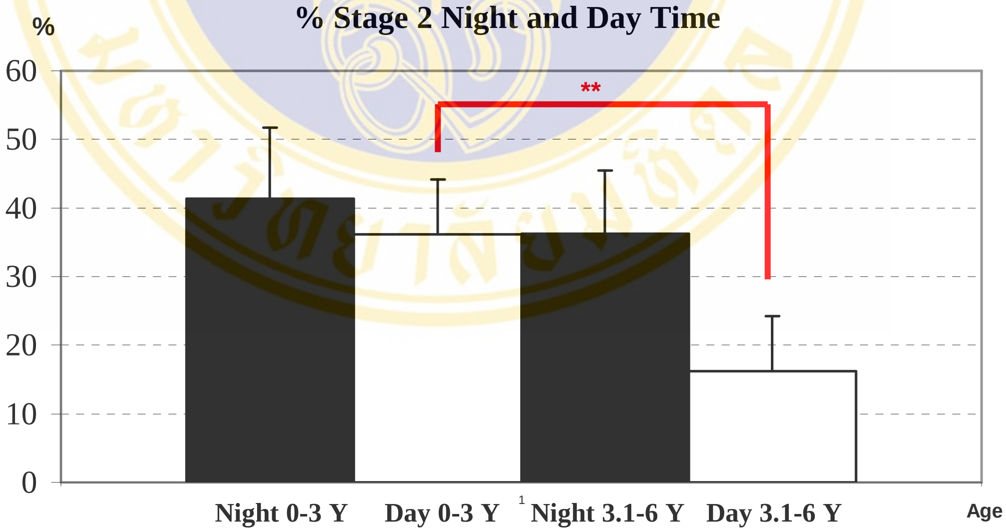


Figure 4.13 Comparison of the stage 2 NREM sleep of the participants between 0-3 years and 3.1-6 years during the day time and night time recording

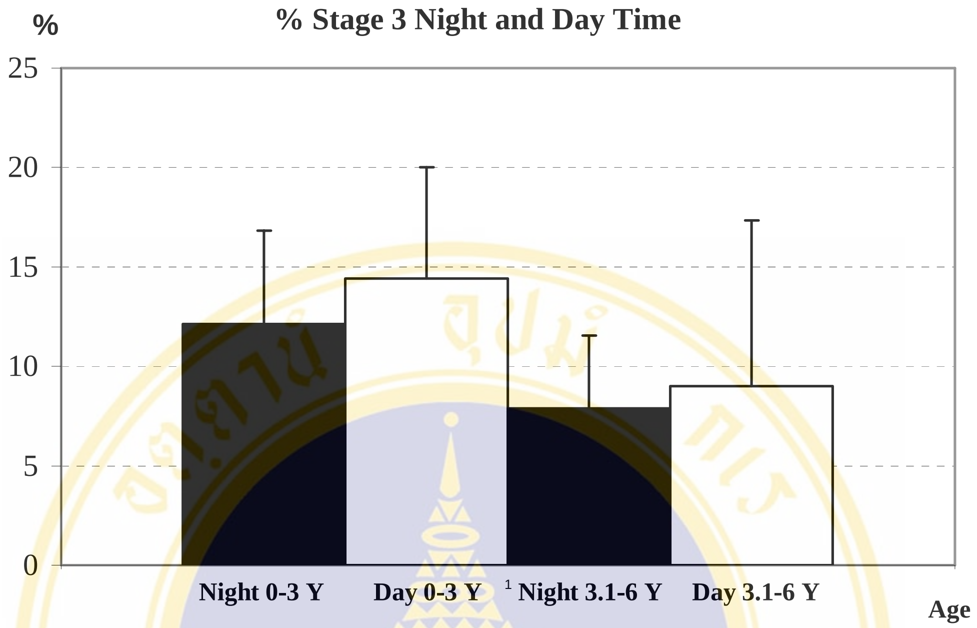


Figure 4.14 Comparison of the stage 3 NREM sleep of the participants between 0-3 years and 3.1-6 years during the day time and night time recording

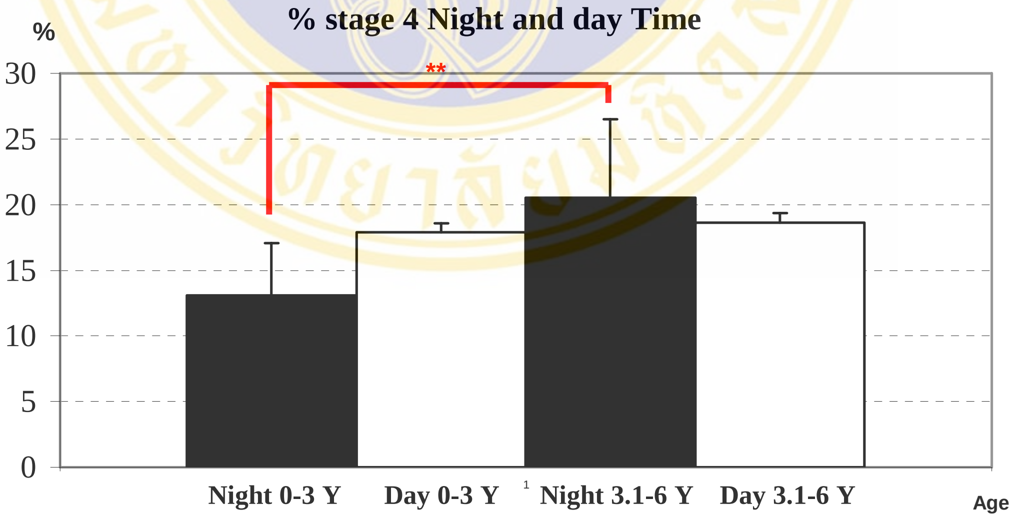


Figure 4.15 Comparison of the stage 4 NREM sleep of the participants between 0-3 years and 3.1-6 years during the day time and night time recording

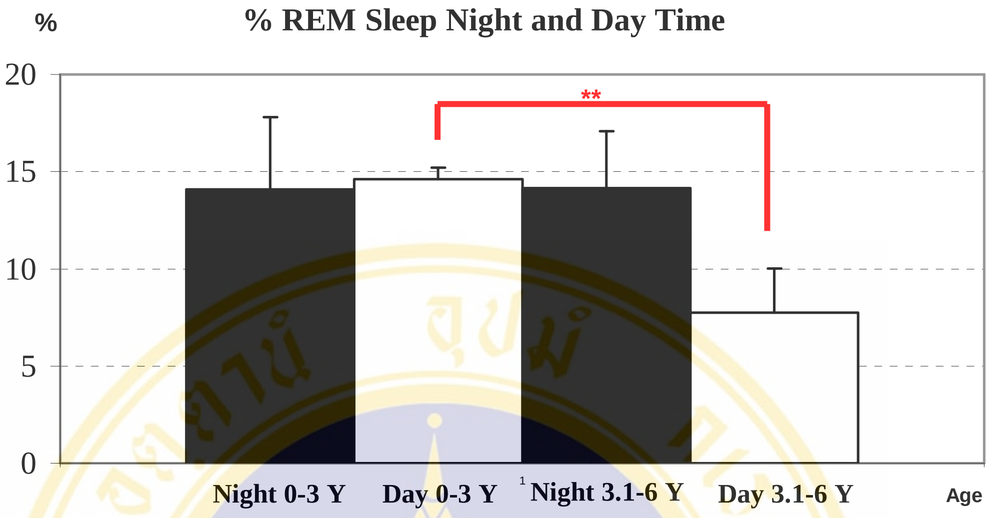


Figure 4.16 Comparison of the REM sleep of the participants between 0-3 years and 3.1-6 years during the day time and night time recording

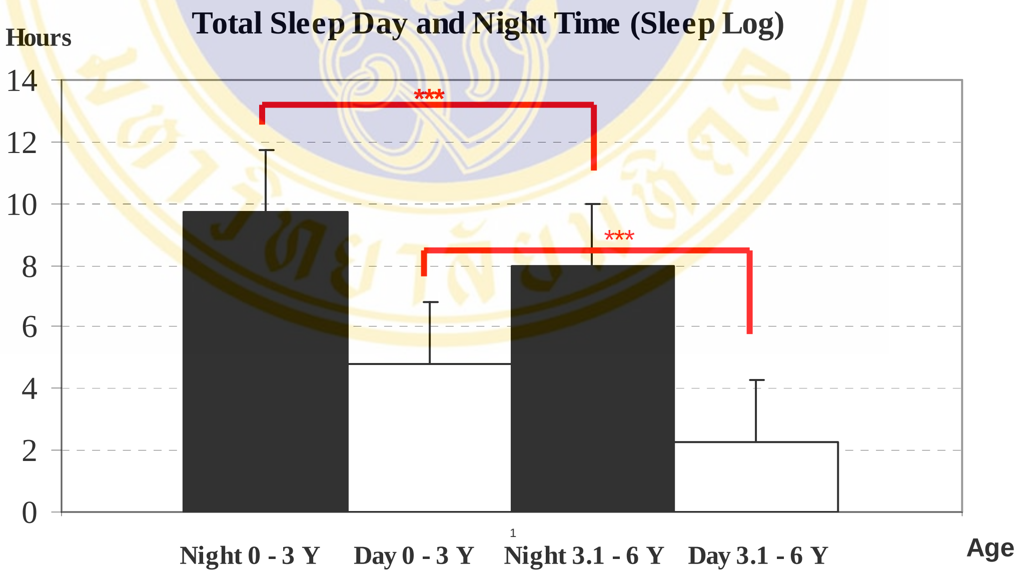


Figure 4.17 Comparison of the total sleep time by sleep log of the participants between 0-3 years and 3.1-6 years during the day time and night time recording

Table 9. Comparison of the sleep efficiency of the participants between 0-3 years and 3.1-6 years during the night time recording (n=27)

Sleep efficiency	**Night time**		**Night time**		**t**	**p**
	M	**SEM**	**M**	**SEM**		
Sleep Efficiency index (%)	79.98	1.48	81.33	2.80	0.47	0.64
Sleep Stages (%)						
Stage 1 NREM	19.34	2.94	21.20	3.15	0.41	0.69
Stage 2 NREM	41.38	2.52	36.24	2.93	1.29	0.21
Stage 3 NREM	12.12	1.14	7.89	1.16	2.44	0.02
Stage 4 NREM	13.06	1.31	20.53	1.89	3.34	0.003
Stage REM	14.09	0.90	14.17	0.92	0.06	0.95
Sleep Latency (minutes)	19.88	1.44	26.10	4.12	1.70	0.10
Sleep Log (hours) (n=27)	9.72	0.18	7.96	0.21	6.16	<0.0001
TST night (hours) (n=135)	9.01	0.09	8.14	0.09	5.96	<0.0001

The overall sleep efficiency of the participants with 0-3 years old and 3.1-6 years old during night time sleep recording was good. The average percentage of the SEI of the participants in both age groups was higher than 80%. During the recording period, the mean SEI (79.98±1.48%) of participants with 0-3 years old was shorter than during the 3.1-6 years old (81.33±2.80%), but no statistically significant difference (see Fig. 4.11).

Time duration spent in each sleep stage was also measured and compared between two age groups as the proportion of such stage compare to the TST and SLL. The mean percentage of stage 1 NREM sleep of the 0-3 year's old group (19.34±2.94) was shorter than the 3.1-6 year's old group (21.20±3.15), but no statistically significant difference (see Fig. 4.12).

The mean percentage of stage 2 NREM sleep of the 0-3 year's old group (41.38±2.52) was longer than the 3.1-6 year's old group (36.24±2.93), but no statistically significant difference (see Fig.4.13). Stage 3 NREM sleep of the 0-3 year's old group (12.12±1.14) was longer than the 3.1-6 year's old group (7.89±1.16). There was statistically significant difference of the mean percentage of stage 3 NREM sleep between two age groups at level $p<0.05$(see Fig. 4.14). On the other hand, stage 4 NREM sleep of the 0-3 year's old group (13.06±1.31) was shorter than the 3.1-6 year's old group (20.53±1.89) with statistically significant difference of the mean percentage of stage 4 NREM sleep between two age groups at level $p<0.05$(see Fig. 4.15). In the same way, the mean percentage of stage REM sleep of the 0-3 year's old group (14.09±0.90) was shorter than the 3.1-6 year's old group (14.17±0.92), but no statistically significant difference (see Fig. 4.16).

In conclusion, the mean percentage of stage 3 NREM sleep of the 0-3 year's old group was longer than the 3.1-6 year's old group whereas the mean percentage of stage 4 NREM sleep of the 0-3 year's old group was shorter than the 3.1-6 year's old group. There was statistically significant difference between two age groups at level of $p<0.05$at these two stages of sleep. On the other hand, both stage 1 NREM and REM sleep of the 0-3 year's old group was shorter than the 3.1-6 year's old group whereas stage 2 NREM sleep of the 0-3 years old group was longer than the 3.1-6 years old group, but no statistically significant difference.

The mean duration of SL of the 0-3 year's old group (19.88±1.44 minutes) was longer than the 3.1-6 year's old group (26.10±4.12 minutes), but no statistically significant difference. The mean duration of TST of the 0-3 year's old group (9.01±0.09) was longer than the 3.1-6 year's old group (8.14±0.09), and highly statistically significant difference at the level of p<0.0001. On the other hand, the mean duration of SLL of the 0-3 year's old group (9.72±0.18) was longer than the 3.1-6 year's old group (7.96±0.21) with statistically significant difference between two age groups at level of p<0.05. The average SLL was shorter than TST in the 0-3 years group whereas the average SLL was longer than TST in the 3.1-6 years group.

CHAPTER V

DISCUSSIONS

The purpose of this study is to determine the characteristics of sleep patterns in normal Thai children (0-6 years). Comparison of sleep efficiency in terms of sleep efficiency index (SEI), the time spent in each sleep stage (stage 1, 2, 3, 4 and rapid eye movement (REM) sleep), sleep latency (SL), and total sleep time (TST) between the night and day time would be presented. In this chapter, the discussion shall start with the participants' demographic data followed by the sleep efficiency of and comparison of each sleep parameters.

Demographic data

The participants of this study were normal Thai children who lived in the central part of Bangkok, Thailand. The data was collected from February to March 2006. Data were collected from one hundred and thirty five (N=135) participants who met the inclusion criteria. Demographic characteristics of the participants were shown in Table 1. Gender were more girl (n=79, 58.52%) than boy (n=56, 41.48%). Their age ranged from 0-6 years with the mean and standard deviation of 3.19 and 0.50 years, respectively. More than half of the participants (n=85, 62.97%) were 0-3 years. The data can reasonably represent norms for Thai Children, and comparable to other previous studies in other countries, e.g., USA, (Xianchen et al, 2005), Japan (Michio et al, 2005) and Swiss (Oskar et al, 2005)

Status of the child's behavior and emotion

Regarding to the subjects' status, the result of this study demonstrates that the health conditions, the children's emotion and behavior prior the experimental procedures are relatively within normal limits (Michio et al, 2005). The purpose of the sleep questionnaire collection is to test if the children who participated in the experiment have met the requirement and the criteria of the interests. For example, the children respond with severe negative attitudes in the questions, can be eliminated from the experiment. At the mean time, it is important to understand the health condition of the children as well if they have any history of medical illnesses or head injuries, which might affect the results of the experiment.

The majority of the participants were having positive emotion (88.15%), socialization/friendly (91.11%), not too timid (91.11%), actively moving and not inactive (72.60%), flexible and adaptable (79.26%), adhere to routine activity (83.70%) and mode of activity with others play group (80.00%). Most participants were never continuous postponing bedtime (58.52%), no never willing to bed (71.86%), often fully cooperate to go to bed (54.82%), never belonging dependent on sleep aids (65.19%), never rolling of head / body before sleep (91.85%), never praying or pay respect to Buddha (62.22%) and never touch body parts for self-comfort (87.40%).

Characteristics of Sleep Behavioral

Sleep environment of the children at home was one of the main factors which might influence the children’s sleeping behavior and attitude of following or postponing the bed time. The result of this study shows that the participants are easy awaked during sleep via the environmental influence. More importantly, it can significantly alter the sleep cycle of the children and affect the results of the study. Additionally, the result of this study indicates more of the sleep behavior of the subjects instead of the activities before bed. That is to say, most of the subjects have the experience of wet bedding or enuresis (51.85%) and unstable in sleep (65.18%), which can stimulate the subjects to wake up or start the new sleep cycle during the sleep duration.

Most of the participants sleep in the rooms which have mosquito net (91.11%), opened window for constant air flow (97.04%), some participants have air conditioner supplements to help air flow (60.74%), more than half of the subjects sleep in the dim lighted room (51.11%) and the rest in darkened rooms (48.89%).

The majority of the participants were not interfered by sleeping environment with noise (76.30%), or air particle pollution (60.75%), or interfere by insect (63.70%), smell (79.26%) and light (71.86%) 4-7 day/week.

Sleep pattern and efficiency

The sleep efficiency was objectively measured by portable Polysomnography (PSG), which utilized the electroencephalography (EEG), the electromyogram (EMG) and the electrooculogram (EOG). PSG program reports the SEI, time spent in each sleep stage (stages 1, 2, 3 and 4 NREM sleep, REM sleep), SL and TST while the participants slept during the night and day time.

Sleep pattern and efficiency in normal Thai children with 0-3 years

From this study, it was found that the overall sleep efficiency of the participants was good. The average percentage of the SEI of the participants in both periods of the recording was higher than 80%, which reflected good sleep efficiency as they were normal children (Richards and Bairnsfather, 1988). During the experimental period, during the night time recording, the mean SEI (79.98±1.48 %) was lower than the period during the day time recording (91.50±1.95%). There was statistically significant difference of the mean SEI between the two periods of the study at level of $p<0.05$.

Time duration spent in each sleep stage was measured as the proportion of such stage compare to the TST. The mean percentage of stage 1 NREM sleep during the night time recording (19.34±2.94%) was longer than during the day time recording (16.2±1.04%). There was statistically significant difference of the mean percentage of stage 1 NREM sleep between the two periods of the study at level of $p<0.05$.

The mean percentage of stage 2 NREM sleep during the night time recording (41.38±2.52%) was longer than during the day time recording (36.282±1.78%). There was no statistically significant difference.

Stage 3 NREM sleep during the night time recording (12.12±1.14%) was shorter than during the day time recording (14.42±1.36%). There was no statistically significant difference.

Stage 4 NREM sleep during the night time recording (13.06±1.31%) was shorter than during the day time recording (17.88±2.17%). There was no statistically significant difference. In the same way, the mean percentage of stage REM sleep during the night time recording (14.09±0.90%) was equal to during the day time recording (14.64±1.07%). There was no statistically significant difference.

In conclusion, the mean percentage of stage 1 NREM sleep during the night time recording was longer than during the day time recording with statistically significant difference between the two recording periods at level of p<0.05. Stage 2 NREM sleep during the night time recording was also longer than during the day time recording, but no statistically significant difference. The mean percentage of stage 3, 4 NREM and REM sleep during the night time recording were shorter than during the day time recording. There was no statistically significant difference between the two periods.

The mean duration of SL during the night time recording (19.88±1.44 minutes) was longer than during the day time recording (21.29±2.06 minutes), but no statistically significant difference. According to Lai and Good (2005), normal sleep onset for adult was 13-25 minutes (Lai and Good, 2005). Therefore, the mean duration of SL in both periods of the study was within the normal range.

The mean duration of TST during the night time recording (9.01±0.09 hours per day) was longer than during the day time recording (3.81±0.10 hours per day). There was highly statistically significant difference at level of p<0.0001. In the same way, the mean duration of SLL during the night time recording (9.72±0.18 minutes) was longer than during the day time recording (4.82±0.13 minutes). There was statistically significant difference at level of p<0.05.

Sleep pattern and efficiency in Thai children with 3.1-6 years

From this study, it was found that the overall sleep efficiency of the participants with 3.1-6 years was good as they were all normal children. The average percentage of the SEI of the participants in both periods of the recording was higher than 80%. During the experimental period, during the night time recording, the mean SEI (81.33±2.80%) was shorter than during the day time recording (90.14±1.81%). There was statistically significant difference of the mean SEI between the two periods of the recording at level of p<0.05.

Time duration spent in each sleep stage was measured as the proportion of such stage compare to the TST and SLL. The mean percentage of stage 1 NREM sleep during the night time recording (21.20±3.15%) was longer than during the day time recording (8.43±3.20%). There was statistically significant difference of the mean percentage of stage 1 NREM sleep between the two periods of the recording at level of $p<0.05$.

The mean percentage of stage 2 NREM sleep during the night time recording (36.42±2.93%) was longer than during the day time recording (16.19±4.98%). There was statistically significant difference of the mean percentage of stage 2 NREM sleep between the two periods of the recordings at level $p<0.05$.

Stage 3 NREM sleep during the night time recording (7.89±1.16%) was shorter than during the day time recording (9.02±2.63%). There was no statistically significant difference.

Stage 4 NREM sleep during the night time recording (20.53±1.88%) was longer than during the day time recording (18.62±6.41%). There was no statistically significant difference. However, the mean percentage of stage REM sleep during the night time recording (14.17±0.92%) was longer than during the day time recording (7.75±2.30%). There was statistically significant difference of the mean percentage of REM sleep between the two periods of the recordings at level $p<0.05$.

In conclusion, the mean percentage of stage 1, 2 NREM and REM sleep during the night time recording was longer than during the day time recording with statistically significant difference between the two recording periods at level of $p<0.05$. On the other hand, stage 4 NREM sleep during the night time recording was also longer than during the day time recording, but no statistically significant difference. Only the mean percentage of stage 3 NREM sleep during the night time recording was shorter than during the day time recording with no statistically significant difference between the two periods.

The mean duration of SL during the night time recording (26.10±4.12 minutes) was longer than during the day time recording (14.70±4.89 minutes), but no statistically significant difference.

The mean duration of TST during the night time recording (8.14±0.09 hours per day) was longer than during the day time recording (1.87±0.11 hours per day). There was highly statistically significant difference at level of $p<0.0001$. In the same way, the mean duration of SLL during the night time recording (7.96±0.21 minutes) was longer than during the day time recording (2.28±0.27 minutes). There was statistically significant difference at level of $p<0.05$.

Polysomnographic studies in critically ill patients have demonstrated a predominance of stage 1 NREM sleep with a reduction of time spent in other sleep stages, including significant decreased in SEI, REM sleep, and slow-wave sleep and numerous awakenings. Also see was REM rebound after REM deprivation, reduced TST and sleep efficiency (Aurell and Elmquist, 1985; Fontaine, 1989; Herdegen, 2002; Hilton, 1976; Richards and Bainsfather, 1988). Moreover, polysomnography data indicated that subjects in the noise condition had lower scores for SEI, spent less time (in minutes) asleep, decreased or absent stage 3, 4 NREM sleep and REM sleep, shortened REM periods, and sleep fragmentations (Freedman et al., 2001; Richards and Bairnsfather, 1988; Schwab, 1994). They had more intra-sleep awakenings, and fewer REM periods (Topf, 1992). A comparison of the subjects' normal sleep patterns and the norms cited in the literature indicated that patients had less TST than normal. The percentages of time in the sleep stages were not that of the normal cycle (Hilton, 1976). The PSG measurement might have an instrumentation effect since this method of using need to place seven electrodes.

Some people are more sensitive to noise than others (Baker, 1993). Disturbance depended on the ambient noise level for the area and habituation of the person to noise. Personal variables such as age, sex, anxiety level, And state of health affect perception of a noise stimulus (Hansell, 1984; Rylander, 1983). Snook (1964) found that patients most annoyed by hospital noise were 40-to 59-year-old men. A personal characteristic, noise sensitivity, was identified when some people rated a low or moderately loud noise as "highly annoying" while others rated the same sound "lower" on an annoyance scale. Pongam (2005) found that seven electrodes that were used for data collection and activity-limited were also annoyed them. Additionally, the tools may have increased the frequency of interruptions (Pongam, 2005). However, the cross-over study design used in this study was aimed to minimize the factor of individual difference related to sleep pattern.

Most studies found great individual variability in objective measure of sleep thus, statistically significant trends have rarely been demonstrated. This variance stems in part from systematic changes in sleep patterns as the subjects become acclimated to the recording procedures and environment, as well as from the small number of subjects in each age group. The definitions of the various stages of polysomnographic sleep still rely upon age-dependent parameters, yet the coding system is not age-adjusted, and the definitions themselves are largely arbitrary and sometimes controversial (Dement et al., 1982). In this study, gender distribution was more female (n=14, 51.85%) than male (n=13, 48.15%). Their age ranged from 0-6 years with the mean and standard deviation of 3.19 and 0.50 years, respectively. More than half of the participants (n=17, 62.97%) were 0-3 years. Several unexpected findings are worthy of discussion wherein future research may help to clarify this finding.

A full sleep cycle of 90 minutes is needed to obtain full benefit. A person awakened during this 90-minute cycle must start again with stage 1 non-rapid eye movement (NREM) sleep and proceed through the stages before the rapid eye movement (REM) sleep (Hayter, 1980). It is; therefore, possible to cause sleep deprivation by waking someone at frequent intervals or limiting the number of completed cycles per night. REM sleep is commonly disrupted in this way, though stage 4 NREM sleep may be affected in the early part of the night. REM sleep occurs in the last part of the 90-minute cycle and increases in length as the cycle progress through the night. Consequently, REM sleep deprivation may occur if an individual sleeps for periods of less than an hour, or sleep less than four to five hours in a 24 hour period. This is precisely what can happen in Critical Care Units (McIntosh, 1989; Schwab, 1994).

Disruption of sleep caused by parent care may be minimized by planning and recognizing nursing procedures to perform as many together as possible, and reassessing the participant’s need for hourly observation which require personal contact.

In conclusion, sleep has been shown to be an essential component of health, affecting the well-being and quality of life of individuals. Sleep deprivation is a significant problem for patients. These patients had difficulty meeting their ‘normal’ needs for sleep due to frequent interruption and possible sleep-disturbing factors. They will deprive of TST, normal distribution of sleep stages and quality of sleep. The ultimate purpose of this study was the provision of care that is more conductive to children’s rest and sleep.

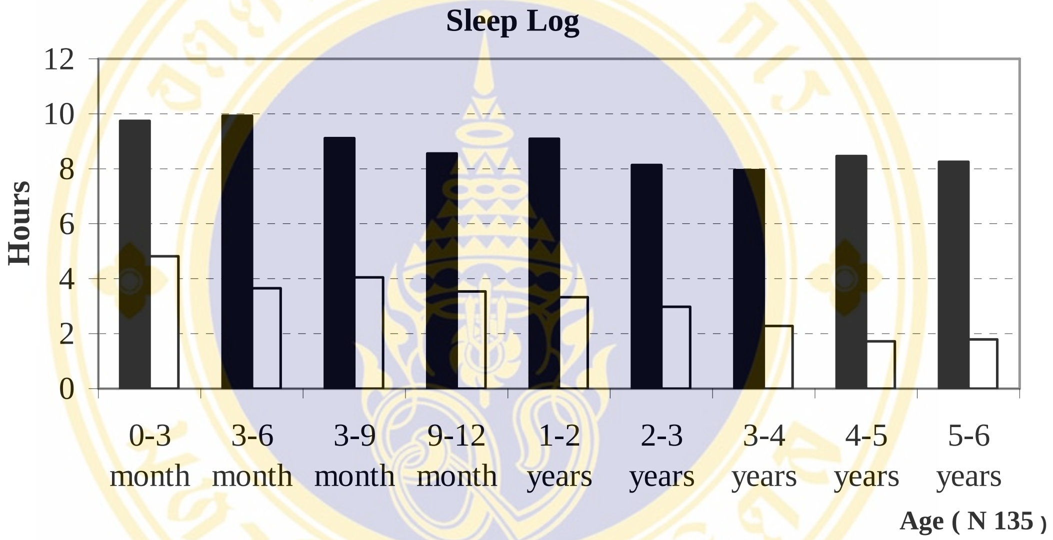


Figure 5.1 Comparison of the total sleep time by sleep log (n=135) during the day time and night time recording

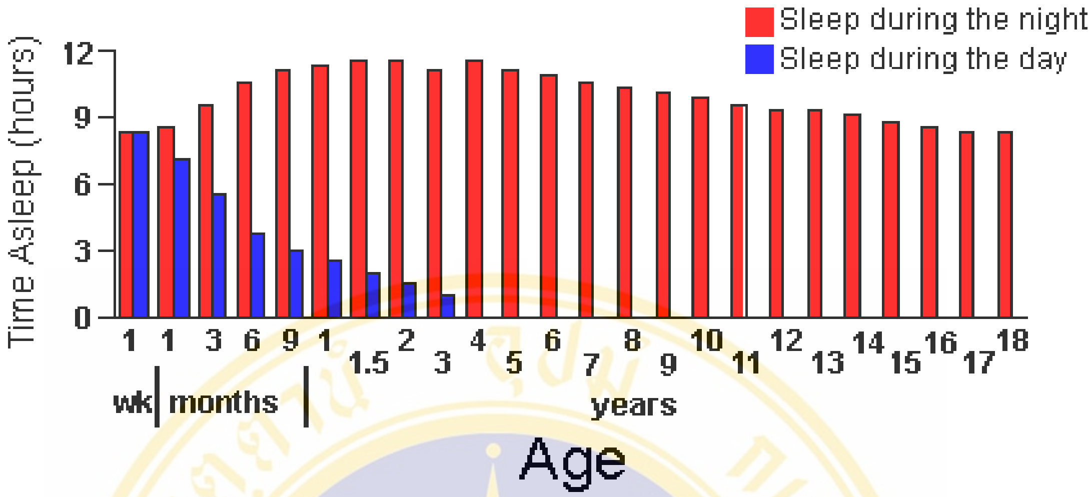


Figure 5.2 Graph bar show sleep during the night and day time by Howard, B.J. and Wong, J. Sleep disorders, Pediatrics in Review, 2001.

In the figure 5.1 and 5.2 show the comparison of the sleep log recordings between the present study and previous study by Howard and Wong in 2001. In Howard and Wong's study, they demonstrated the sleep duration following by the age differences from younger children to older children. According to figure 5.2, the children age 3 years old sleep less in the day time but increase the sleep duration at the night time. For the present study, according to the figure 5.1, using the Thai children as the subject groups, although they sleep less in day time (3 to 4 years old; 3 hours), there is no significantly different in the duration of night time sleep compare to the children aged 0 to 3 months old.

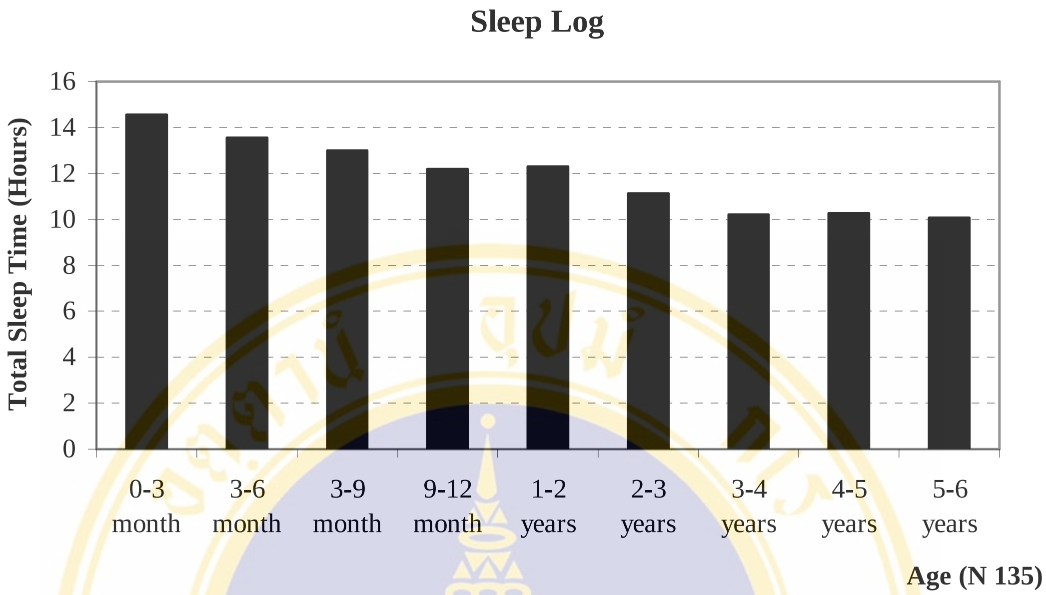


Figure 5.3 Comparison of the total sleep time by sleep log (n=135) recording

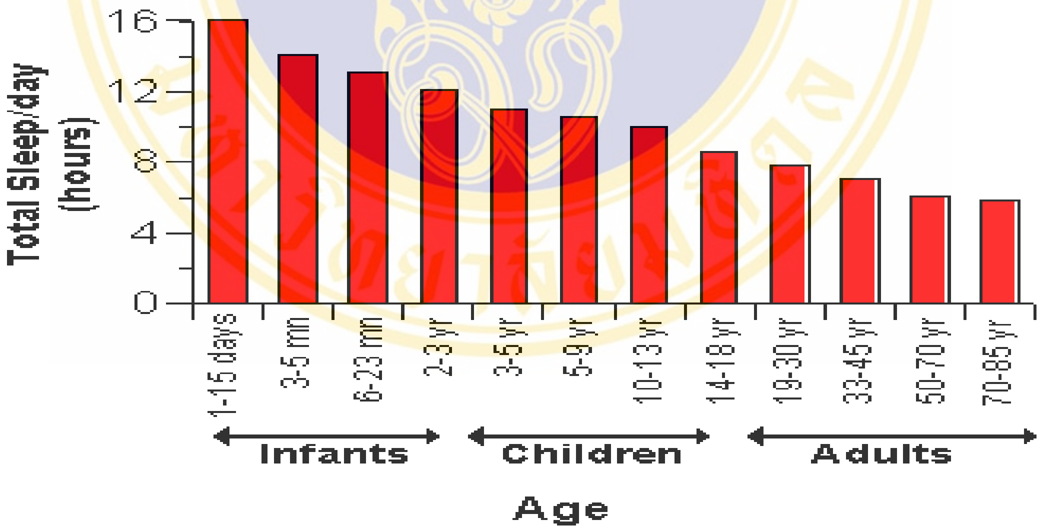


Figure 5.4 Graph bar show total sleep time by Roffwarg et al., Ontogenetic development of the human sleep-dream cycle, Science, 1966.

Figure 5.3 and 5.4 demonstrate the total sleep time following form the age difference. Roffwag et al, (1966) demonstrated that as the age increases, the total sleep time decreases and the graph shows a smooth declined. In the present study, also compare the total sleep time with the increase age groups, in the age 1 to 2 years, the total sleep time is more than the infants from 9 to 12 month old. In another word, compare to Roffwag's study in 1966, the total sleep of the present study has more than 1 hour different from Roffwag's. As the results, there are some alternative factors that influence the results from the present study compared to Roffwag's study in 1966, for example, the cultural and regional differences, such as the climate, religion, the living environment, and changes in lifestyles. Roffwag's work was published in 1966 which by now is more than 40 years ago. As societies develop and changes, children in the present Thai societies sleep more than one hour less than the children 40 years ago. It is very conceivable that the development of mass communication, e.g. TV, computer internet, video-games, and electronic toys etc., have changes the lifestyles that make human spends more and more time awaking than sleeping. In addition the increases in the levels of physical and mental or psychological stresses can lead to more insomnia or sleeplessness (Kotchabhakdi, 2004, and Oskar et al, 2005). The trends of this reduction in total sleep time can have significant impacts on physical growth and over-all development of the present and future children in Thai societies, as well as their health in later life. It is important that parents and medical care providers for the children have a good understanding and practical knowledge about sleep and the promotion of better sleep for the Thai children.

CHAPTER VI

CONCLUSION

In this chapter, the conclusion of the study is presented, followed by the limitations of the study and recommendations for further studies.

Conclusion of the study

The results of the study were reported as follows:

1. In the comparison of the sleep between the night and day time recording of the participants with 0-3 years, the mean duration of Total Sleep Time (TST) during the night time recording (9.01±0.09 hours per day) was highly statistically significant ($p<0.0001$) longer than during the day time recording (3.81±0.10 hours per day). In the same way, the mean duration of Sleep Latency from Sleep Log data during the night time recording (9.72±0.18 minutes) was statistically significant ($p<0.05$) longer than during the day time recording (4.82±0.13 minutes).

2. In the comparison of the sleep between the night and day time recording of the participants with 3.1-6 years, the mean duration of Total Sleep Time (TST) during the night time recording (8.14±0.09 hours per day) was highly statistically significant ($p<0.0001$) longer than during the day time recording (1.87±0.11 hours per day). In the same way, the mean duration of Sleep Latency from Sleep Log data during the night time recording (7.96±0.21 minutes) was statistically significant ($p<0.05$) longer than during the day time recording (2.28±0.27 minutes).

3. In the comparison of the sleep of the participants between 0-3 years and 3.1-6 years during the day time recording, the mean percentage of stage 1, 2, 3 NREM and REM sleep of the 0-3 year's old group was longer than the 3.1-6 year's old group with statistically significant difference between two age groups at level of $p<0.05$. On the other hand, stage 4 NREM sleep of the 0-3 year's old group was shorter than the 3.1-6

year's old group with no statistically significant difference. The mean duration of SL of the 0-3 year's old group (21.29±2.06 minutes) was longer than the 3.1-6 year's old group (14.70±4.89 minutes), but no statistically significant difference.

4. In the comparison of the sleep efficiency of the participants between 0-3 years and 3.1-6 years during the night time recording, the mean percentage of stage 3 NREM sleep of the 0 - 3 year's old group was longer than the 3.1 - 6 year's old group whereas the mean percentage of stage 4 NREM sleep of the 0 - 3 year's old group was shorter than the 3.1 - 6 year's old group. There was statistically significant difference between two age groups at level of $p<0.05$ at these two stages of sleep. On the other hand, both stage 1 NREM and REM sleep of the 0 - 3 year's old group was shorter than the 3.1 - 6 year's old group whereas stage 2 NREM sleep of the 0 - 3 years old group was longer than the 3.1 - 6 years old group, but no statistically significant difference. The mean duration of SL of the 0-3 year's old group (19.88±1.44 minutes) was shorter than the 3.1-6 year's old group (26.10±4.12 minutes), but no statistically significant difference. On the other hand, the mean duration of SLL of the 0-3 year's old group (9.72±0.18) was longer than the 3.1-6 year's old group (7.96±0.21) with statistically significant difference between two age groups at level of $p<0.05$. The average SLL was shorter than TST in the 0-3 years group whereas the average SLL was longer than TST in the 3.1-6 years group.

5**.** The mean duration of Total Sleep Time of the 0-3 year's old group (12.83±0.16 hours per day) was longer than the 3.1-6 year's old group (10.01±0.14 hours per day), but no statistically significant difference.

6. When compare with the data previously reported 40 years ago by Roffwarg et al. in 1966 (Ontogenetic development of the human sleep-dream cycle, Science, 1966.), the data show that normal Thai children sleep spend less time sleeping by more than one or two hour per days. (For 0 – 3 years old Roffwarg reported between 14 – 16 hours, in this study 12.83±0.16 hours per day; and for 3.1 to 6 years old, Roffwarg reported between 11 to 13 hours per day, in this study 10.01±0.14 hours per day).

7. The trends in which the present normal Thai children spend less time sleeping per day may have impacts on their physical growth and over-all development, and heath status in later life.

Limitation of the study

1. The study did not control confounding factors such as noise, lights, caring and nursing activities in the setting in both periods which could have some effects on the results of the study. Although these issues were previously considered in this study, some factors were scarcely controlled in the real setting.
2. The sample size in this study was considered a limitation due to high cost of the instrumentals use for data collection. However, the sample size (n=27) in this study, according to Polit and Hunger (1995) may assure an acceptable number of the sample due to a larger sample size providing greater confidence in generalize ability and increase the accuracy of the results.
3. The Polysomnographic recording instrument might have an instrumentation effect since the application required the placement of seven electrodes which could annoy the participants while going to sleep.

Recommendations

For nursing practice, education and future research

The findings of this study have provided important information of nursing practice, education and future research. The trends of this reduction in total sleep time can have significant impacts on physical growth and over-all development of the present and future children in Thai societies, as well as their health in later life. It is important that parents and medical care providers for the children have a good understanding and practical knowledge about sleep and the promotion of better sleep for the Thai children.

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APPENDIX

ใบยินยอมในการทำวิจัยในมนุษย์

การวิจัยเรื่อง การศึกษาลักษณะการนอนหลับในเด็กไทยอายุระหว่าง 0 – 6 ปี ในประเทศไทย

วันให้คำยินยอม วันที่ …….. เดือน ………………….. พ.ศ. …………………

ก่อนที่จะลงนามในใบยินยอมให้ทำการวิจัยนี้ ข้าพเจ้าได้รับการอธิบายจากผู้วิจัยถึงวัตถุประสงค์ของการวิจัย วิธีการวิจัย อันตราย หรืออาการที่อาจเกิดขึ้นจากการวิจัย และประโยชน์ที่จะเกิดขึ้นจากการวิจัย รวมทั้งได้ตอบคำถามที่ข้าพเจ้าสงสัยด้วยความเต็มใจ ไม่ปิดบังซ่อนเร้น จนข้าพเจ้าพอใจ

ข้าพเจ้าให้เด็กในอุปการะเข้าร่วมโครงการวิจัยโดยสมัครใจและมีสิทธิที่จะบอกเลิกการเข้าร่วมในโครงการวิจัยนี้เมื่อใดก็ได้ โดยจะไม่มีผลต่อการรักษาโรคที่เด็กในอุปการะของข้าพเจ้าจะพึงได้รับต่อไป

ผู้วิจัยรับรองว่าจะเก็บข้อมูลเฉพาะเกี่ยวกับตัวเด็กในอุปการะของข้าพเจ้าเป็นความลับและจะเปิดเผยได้เฉพาะในรูปที่เป็นสรุปผลการวิจัย การเปิดเผยข้อมูลที่เกี่ยวกับตัวเด็กในอุปการะของข้าพเจ้าต่อหน่วยงานต่างๆที่เกี่ยวข้อง กระทำได้เฉพาะกรณีจำเป็นด้วยเหตุผลทางวิชาการเท่านั้น

ในการวิจัยนี้จะมีการวัดคลื่นการนอนหลับเด็กในอุปการะของข้าพเจ้า เพื่อนำไปดำเนินการในการวิจัย ทั้งนี้ผู้วิจัยได้อธิบายให้ข้าพเจ้าทราบและเข้าใจแล้วว่าการวัดคลื่นการนอนหลับและการประเมินผลวิธีนี้จะไม่ก่อให้เกิดอันตรายใดๆแก่เด็กในอุปการะของข้าพเจ้าเลย

ผู้วิจัยรับรองว่าหากเกิดอันตรายใดๆอันเนื่องจากการวิจัยดังกล่าว เด็กในอุปการะของข้าพเจ้าจะได้รับการรักษาพยาบาลโดยไม่คิดมูลค่าตามมาตรฐานวิชาชีพ และจะได้รับการชดเชยรายได้ที่สูญเสียไประหว่างการรักษาพยาบาลดังกล่าว ตลอดจนเงินทดแทนความพิการที่อาจเกิดขึ้นโดยบุคคลที่รับผิดชอบเรื่องนี้คือ นายชยานนท์ อวิคุณประเสริฐ, รองศาสตราจารย์ ดร. นัยพินิจ คชภักดี, รองศาสตราจารย์ พญ.นิตยา คชภักดี, ผู้ช่วยศาสตราจารย์ นพ.จิตตินทร์ จินดาดวงรัตน์ และอาจารย์ ดร.วิเชียร สิทธิประภาพร สามารถติดต่อได้ที่โครงการวิจัยชีววิทยาระบบประสาทและพฤติกรรม สถาบันวิจัยแลพัฒนาวิทยาศาสตร์และเทคโนโลยี และสถาบันแห่งชาติเพื่อการพัฒนาเด็กและครอบครัว มหาวิทยาลัยมหิดล ศาลายา จังหวัดนครปฐม 73170 โทรศัพท์ 02-441-9321

ข้าพเจ้าได้อ่านข้อความข้างต้นแล้ว และมีความเข้าใจดีทุกประการ และได้ลงนามในใบยินยอมนี้ด้วยความเต็มใจ

ลงนาม .... ผู้ยินยอม
( )
ลงนาม .... พยาน
( )
ลงนาม .... พยาน
( )

ข้าพเจ้าไม่สามารถอ่านหนังสือได้ แต่ผู้วิจัยได้อ่านข้อความในใบยินยอมนี้ให้ข้าพเจ้าฟังจนเข้าใจดีแล้ว และข้าพเจ้าจึงลงนามหรือประทับลายนิ้วหัวแม่มือข้างขวาของข้าพเจ้าในใบยินยอมนี้ด้วยความเต็มใจ

ลงนาม .... ผู้ยินยอม
( )
ลงนาม .... พยาน
( )
ลงนาม .... พยาน
( )

ในกรณีที่ผู้ถูกทดลองยังไม่บรรลุนิติภาวะ จะต้องได้รับการยินยอมจากผู้ปกครองหรือผู้อุปการะโดยชอบด้วยกฎหมาย

ลงนาม ....ผู้ปกครอง/ผู้อุปการะ
( )
ลงนาม .... พยาน
( )
ลงนาม .... พยาน
( )

ในกรณีที่ผู้ถูกทดลองไม่สามารถตัดสินใจเองได้ (กรณีผู้ถูกทดลองเป็นโรคจิต/หรืออยู่ในภาวะหมดสติ) ให้ผู้แทนโดยชอบด้วยกฎหมาย หรือผู้ปกครอง หรือญาติที่ใกล้ชิดที่สุดเป็นผู้ลงนาม

ลงนาม ....ผู้แทน/ผู้ปกครอง/ญาติ
( )
ลงนาม .... พยาน
( )
ลงนาม .... พยาน
( )

แบบสอบถามลักษณะการนอนของเด็ก
วัยแรกเกิด – 6 ปี

วันที่สัมภาษณ์..............................
รหัส...

ชื่อ-นามสกุลเด็ก..
วัน/เดือน/ปีเกิด...อายุ.........ปี.........เดือน.........วัน เพศ..........
น้ำหนักแรกเกิด.. น้ำหนักปัจจุบัน..
ชื่อผู้ตอบสัมภาษณ์...เกี่ยวข้องเป็น......................
ที่อยู่ บ้านเลขที่........................หมู่.............ซอย......................ถนน............................ตำบล/แขวง...................
อำเภอ/เขต.............................จังหวัด.............................

ส่วนที่ 1 ภาวะสุขภาพและลักษณะทางอารมณ์ พฤติกรรมของเด็ก

1.1 ใน 1 สัปดาห์ที่ผ่านมาเด็กเคยเจ็บป่วยหรือมีปัญหาด้านสุขภาพหรือไม่
( )ไม่เคย ( )เคย ระบุ............................

1.2 ใน 1 สัปดาห์ที่ผ่านมาเด็กต้องกินยาเป็นประจำหรือไม่
( )ไม่กิน ( )กิน ระบุชนิดยา......................

1.3 เด็กเคยมีประวัติเป็นโรคลมชักหรือไม่ ( )ไม่มี ( )มี

1.4 เด็กมีโรคประจำตัวหรือไม่ ( )ไม่มี ( )มี ระบุโรค

1.5 เด็กเคยได้รับการกระทบกระเทือนทางศีรษะอย่างรุนแรงหรือไม่ เช่น ศีรษะแตก
( )ไม่เคย ( )เคย สาเหตุ........................

1.6 ลักษณะทางอารมณ์ พฤติกรรมของเด็ก (ตอบได้มากกว่า 1 ข้อ)
( ) 1) อารมณ์ดี ยิ้มแย้มแจ่มใส มีท่าทีเป็นมิตร
( ) 2) สนใจและตอบสนองต่อสิ่งแวดล้อมและคน
( ) 3) แสดงออกรุนแรงเมื่อรู้สึกขัดใจหรือกลัว เช่น ทุบตีคนอื่น,นอนร้องกลิ้งกับพื้น
( ) 4) ขี้อาย ใช้เวลานานกว่าจะคุ้นเคยกับคนอื่น
( ) 5) เด็กไม่อยู่เฉย เคลื่อนไหวมาก
( ) 6) ติดแม่และคนเลี้ยง
( ) 7) ปรับตัวได้ง่าย
( ) 8) เด็กกินและนอนเป็นเวลา
( ) 9) เล่นหรือทำกิจกรรม ( ) คนเดียว
( ) กับเด็กอื่นๆ

1.7 ใครเป็นผู้เลี้ยงดูเด็กเป็นส่วนใหญ่ ระบุ...

<u>ส่วนที่ 2</u> ลักษณะพฤติกรรมก่อนนอนหลับของเด็ก

2.1 ระยะเวลาตั้งแต่เริ่มเข้านอนจนหลับใช้เวลาประมาณ.................ชั่วโมง.............นาที

2.2 พฤติกรรมก่อนนอนของเด็กเป็นอย่างไร (ตอบได้มากกว่า 1 ข้อ)

	3 บ่อยมาก (4-7วัน/สัปดาห์)	2 มีบ้าง (2-3วัน/สัปดาห์)	1 น้อยมาก (1วัน/สัปดาห์)	0 ไม่มี
1. ร้องไห้โยเย	( )	( )	( )	( )
2. ผัดผ่อน (ขอยืดเวลาเข้านอน)	( )	( )	( )	( )
3. ขัดขืนไม่ยอมเข้านอน	( )	( )	( )	( )
4. เต็มใจเข้านอน	( )	( )	( )	( )
5. ติดสิ่งของระบุ....................	( )	( )	( )	( )
6. ติดบุคคลระบุ.....................	( )	( )	( )	( )
7. แปรงฟัน	( )	( )	( )	( )
8. ดูดนมจนหลับ	( )	( )	( )	( )
9. ดื่มนม/น้ำ/อาหาร ก่อนนอน	( )	( )	( )	( )
10. ดูดนิ้ว	( )	( )	( )	( )
11. ส่ายศีรษะ/โยกตัว	( )	( )	( )	( )
12. สวดมนต์/ไหว้พระ	( )	( )	( )	( )
13. สัมผัสร่างกายตัวเอง เช่น ผม	( )	( )	( )	( )
อื่นๆ ระบุ.............................				

<u>ส่วนที่ 3</u> ลักษณะการนอนหลับของเด็ก

3.1 การนอนหลับ

1. คนที่พาเด็กเข้านอนและอยู่กับเด็กจนหลับส่วนใหญ่คือ

( )พ่อ ( )แม่ ( )ปู่ ย่า ตา ยาย ( )พี่เลี้ยง

( )เด็กเข้านอนด้วยตัวเอง ( )อื่นๆ ระบุ.....................

2. เด็กนอนหลับกี่ครั้ง/วัน

( ) 1 ครั้ง ( ) 2 ครั้ง ( ) 3 ครั้ง ( ) มากกว่า 3 ครั้ง

3. เด็กนอนหลับพักผ่อนโดยเฉลี่ย.........................ชั่วโมง/วัน

3.2 ปัญหาพฤติกรรมการนอนของเด็ก (ตอบได้มากกว่า 1 ข้อ)

	3 บ่อยมาก (4-7วัน/สัปดาห์)	2 มีบ้าง (2-3วัน/สัปดาห์)	1 น้อยมาก (1วัน/สัปดาห์)	0 ไม่มี
1. หลับยาก ใช้เวลานานกว่าจะนอน	( )	( )	( )	( )
2. ตื่นในเวลากลางคืนและร้องไห้	( )	( )	( )	( )
3. ปัสสาวะรดที่นอน	( )	( )	( )	( )
4. นอนละเมอหรือฝันร้าย	( )	( )	( )	( )
5. เดินในขณะที่หลับ	( )	( )	( )	( )
6. นอนขบฟัน	( )	( )	( )	( )
7. นอนดิ้นมาก	( )	( )	( )	( )
8. อื่นๆ ระบุ..........................	( )	( )	( )	( )

<u>ส่วนที่ 4</u> สภาพแวดล้อมการนอนและสภาพครอบครัวของเด็ก

4.1 สภาพห้องนอนเด็ก/บริเวณที่เด็กนอนเป็นประจำ

1. ห้อง	( ) ไม่มีมุ้ง	( ) มีมุ้งลวด	( ) มีมุ้งผ้า
2. ในห้องมีอากาศถ่ายเท	( ) ไม่มี	( ) มีหน้าต่าง	
3. อุปกรณ์ช่วยถ่ายเทอากาศ	( ) ไม่ใช้	( ) ใช้พัดลม	( ) ใช้เครื่องปรับอากาศ
4. แสงสว่างในตอนนอน	( ) ปิดไฟ	( ) เปิดไฟสว่าง	( ) เปิดไฟสลัว

4.2 ท่านคิดว่าสิ่งเหล่านี้รบกวนต่อการนอนของเด็กมากเพียงใด

	3 มาก	2 มีบ้าง	1 น้อยมาก	0 ไม่มี
1. เสียง ระบุ....................	( )	( )	( )	( )
2. ฝุ่น/ควัน ระบุ.....................	( )	( )	( )	( )
3. แมลง ระบุ..................	( )	( )	( )	( )
4. กลิ่น ระบุ.................	( )	( )	( )	( )
5. แสง ระบุ.................	( )	( )	( )	( )

4.3 ข้อคิดเห็นเกี่ยวกับการนอนหลับของเด็กคุณมีความคิดเห็นว่าอย่างไร

....

....

ชื่อ-นามสกุล.. วันเดือนปีเกิด.. อายุ...............ปี รหัส....................................

วันที่เริ่มทำการบันทึก... น้ำหนักแรกเกิด... น้ำหนักปัจจุบัน..

วัน	6โมงเย็น	1ทุ่ม	2ทุ่ม	3ทุ่ม	4ทุ่ม	5ทุ่ม	เที่ยงคืน	ตี1	ตี2	ตี3	ตี4	ตี5	6โมง	7โมง	8โมง	9โมง	10โมง	11โมง	เที่ยงวัน	บ่าย1	บ่าย2	บ่าย3	บ่าย4	5โมงเย็น	เวลานอนรวม

หมายเหตุ ■ หมายถึง นอนหลับ
☐ หมายถึง รู้สึกตัว,ละเมอ
☐ หมายถึง ตื่น

ก หมายถึง รับประทานอาหาร
ล หมายถึง เล่น,วิ่งเล่น
ท หมายถึง ดูโทรทัศน์,เล่นคอมพิวเตอร์,ดูVDO
ร หมายถึง ร้องไห้
ถ หมายถึง เข้าห้องน้ำ อุจจาระ ปัสสาวะ

: แก้ไขดัดแปลงจาก; 1998 Henry L. Shapiro ,M.D., Developmental and Behavioral Pediatrics, All Children's Health System Center for Child Development, 801 6th St. South, Dept 7825, St. Petersburg, FL 33701.

No. MU 2006-040

Documentary Proof of Ethical Clearance
The Committee on Human Rights Related to
Human Experimentation
Mahidol University, Bangkok

Title of Project. Characteristics of Sleep in Thai Children (0-6 Years) in Thailand (Thesis for Master Degree)

Principle Investigator. Mr. Chayanon Awikunparsert

Name of Institution. National Institute for Child and Family Development

Approved by the Committee on Human Rights Related to Human Experimentation

Signature of Chairman. ....
(Professor Dr.Srisin Khusmith)

Signature of Head of the Institute. ....
(Professor Dr.Pornchai Matangkasombut)

Date of Approval. 1 5 MAR 2006

Date of Expiration. 1 4 MAR 2007

GLOSSARY OF TERMS USED IN SLEEP

Apnea: cessation of airflow at the nostrils and mouth lasting at least 10 seconds. There are three types of apnea: obstructive, central, and mixed. Obstructive apnea is secondary to upper airway obstruction; central apnea is associated with a cessation of all respiratory movements; mixed apnea has both central and obstructive components.

Alpha activity: An alpha eletroencephalogram (EEG) wave or sequence of waves with a frequency of 8-13 Hz.

Alpha Rhythm: An EEG rhythm with a frequency of 8-13 Hz. In human adults that is most prominent over the parietooccipital cortex when the eyes are closed. The rhythm is blocked by eye opening or other arousing stimuli. It is indicative of the waking state in most normal individual. It is most consistent and predominant during relaxed wakefulness, particularly with reduction of visual input. The amplitude is variable but typically is below 50 ~ V in adults. The alpha rhythm of an individual usually slows by 0.5 to 1.5 Hz. And it becomes more diffuse during drowsiness. The frequency range also varies with age; it is slower in children and older age groups than in young to middle-aged adults.

Arousal: An abrupt change from a deeper stage of non-REM (NREM) sleep to a lighter stage, or from REM sleep toward wakefulness, with the possibility of awakening as the final outcome. Arousal may be accompanied by increased tonic electromyographic (EMG) activity and hearth rate as well as body movements.

Beta activity: a beta EEG wave or sequence of waves with frequency greater than 13 Hz.

Beta Rhythm: An EEG rhythm in the range of 13 to 35 Hz, when the predominant frequency, beta rhythm, is usually associated with alert wakefulness or vigilance and is accompanied by a high tonic EMG. The amplitude of beta rhythm is variable but usually is below 30 ~ V. This rhythm may be drug induced.

Circadian Rhythm: An innate daily fluctuation of physiologic or behavioral functions, including sleep-wake states generally tied to the 24-hour daily dark-light cycle. Sometimes occurs at a measurably different periodicity when light- dark and other time cues are removed.

Deep sleep: Common term for combined NREM stage 3 and 4 sleep. In some sleep literature, deep sleep is applied to REM sleep because of is high awakening threshold to non-significant stimuli.

Delta activity: EEG activity with a frequency of less than 4 Hz (usually 0.1 to 3.5 Hz). In human sleep scoring, the minimum characteristics for scoring delta waves is conventionally 75 ~ V (peak to peak) amplitude, and 0.5 seconds' duration (2 Hz) or less.

Electroencephalogram (EEG): A recording of the electrical activity of the brain by means of electrodes placed on the surface of the head. With the EMG and electrooculogram (EOG), the EEG is one of the three basic variables used to score sleep stages and waking. Sleep recordings in humans utilizes surface electrodes to record potential difference between brain regions and a neutral reference point, or simply between brain regions. Either the C3 or C4 (central region) placement, according to the IntemationallO-20 System, is referentially (referred to an earlobe) recorded as the standard electrode derivation from which state scoring is done.

Electromyogram (EMG): A recording of electrical activity from the muscular system; in sleep recording, synonymous with resting muscle activity or potential. The chin EMG, along with EEG and EOG, is one of the three basic variables used to score sleep stages and waking. Sleep recording in humans typically utilizes surface electrodes to measure activity from the submentalis muscles. These reflect maximally the changes in resting activity of axial body muscles. The submentalis muscle EMG is tonically inhibited during REM sleep.

Electrooculogram (EOG): A recording of voltage changes resulting from shifts in position of the ocular gloves, as each glove is a positive (anterior) and negative (posterior) dipole; along with the EEG and EMG, one of the three basic variables used to score sleep stages and waking. Sleep recording in humans utilizes surface electrodes placed near the eyes to record the movement (incidence, direction, and velocity) of the eyeballs. Rapid eye movements in sleep form one part of the characteristics of REM sleep state.

Epoch: A measure of duration of the sleep recording, typically 20 or 30 seconds in duration, depending on the paper speed of the polysomnography. An epoch corresponds to one page of the polysomnogram.

K-Complex: A sharp, negative EEG wave followed by high-voltage slow wave. The complex duration is at least 0.5 second, and may be accompanied by a sleep spindle. K complexes occur spontaneously during NREM sleep, and begin and define stage 2 sleep. They are thought to be evoked responses to internal stimuli. They can also be elicited during sleep by external (particular auditory) stimuli.

Polysomnogram: The continuous and simultaneous recording of multiple physiologic variables during sleep (i.e., EEG, EOG, EMG the three basic stage scoring parameters electrocardiogram (ECG), respiratory airflow, respiratory movements, leg movements, and other electrophysiological variables.

Sleep Efficiency (Sleep Efficiency Index): The pro-portion of sleep in the episode potentially filled by sleep (i.e., the ratio of total sleep time to time in bed).

Sleepiness (Somnolence, Drowsiness): difficulty in maintaining alert wakefulness so that a person falls asleep if not actively aroused. This is not simply a feeling of physical tiredness or listlessness. When sleepiness occurs in inappropriate circumstances, it is considered excessive sleepiness.

Sleep Spindle: Spindle-shaped bursts of 11.5-15 Hz waves lasting 0.5 to 1.5 seconds. Generally diffuse, but of highest voltage over the central regions of the head. The amplitude is generally less than 50 UV. V in the adult. One of the identifying EEG features of NREM stage 2 sleep, it may persist into NREM stages 3 and 4 but is generally not seen in REM sleep.

Sleep Stage NREM: The other major sleep state apart from REM, it comprises sleep stages 1 to 4, which constitute levels in the spectrum of NREM sleep "depth" or physiologic intensity.

Sleep Stage REM: The stage of sleep with highest brain activity, characterized by enhanced brain metabolism and vivid hallucinatory imagery or dreaming. There are spontaneous rapid eye movements, resting muscle activity is suppressed, and awakening threshold to non-significant stimuli is high. The EEG is a low-voltage, mixed-frequency, non-alpha record. REM sleep is usually 20% to 25% of total sleep time. It is also called paradoxical sleep.

Sleep Stages: Distinctive stages of sleep best demonstrated by polysomnographic recordings of the EEG, EGG, and EMG.

Sleep Stage 1 (NREM Stage 1): A stage of NREM sleep that occur at sleep onset or that follows arousal from sleep stages 2, 3, 4, or REM. It consists of a relatively low-voltage EEG with mixed frequency, mainly theta activity and alpha activity less than 50% of the scoring epoch. It contains EEG vertex waves and slow, rolling eye movements; no sleep spindles, K complexes, or REM. Stage 1 normally represent 4% to 5% of the major sleep episode.

Sleep Stage 2 (NREM Stage 2): A stage of NREM sleep characterized by the presence of sleep spindles and K complexes present in a relatively low-voltage, mixed frequency EEG background. High voltage delta waves may comprise up to 20% of stage 2 epochs; usually accounts for 45% to 55% of the major sleep episode.

Sleep Stage 3 (NREM Stage 3): A stage of NREM sleep defined by at least 20% and not more than 50% of the episode consisting of EEG waves less than 2 Hz and more than 75 ~V (high amplitude delta waves). A delta sleep stage, with stage 4 it constitutes "deep" NREM sleep, so called slow wave sleep (SWS). It is often combined with stage 4 into NREM sleep stage 3/4 because of the lack of documented physiologic differences between the two. It appears usually only in the first third of the sleep episode; usually comprises 4% to 6% of total sleep time.

Sleep Stage 4 (NREM Stage 4): All statements concerning NREM sleep stage 3 apply to stage 4 except that high-voltage, EEG slow waves persist during 50% or more of the epoch. NREM sleep stage 4 usually represents 12% to 15% of total sleep time.

Slow Wave Sleep (SWS): Sleep characterized by EEG waves of duration slower than 4 Hz. Synonymous with sleep stage 3 plus 4 combined.

Spindle REM sleep: A condition in which sleep spindles persist atypically during REM sleep seen in chronic insomnia conditions, and occasionally in the first REM period.

Theta Activity: EEG activity with a frequency of 4 to 8 Hz, generally maximal over the central and tem Doral cortex.

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