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Sleep Pattern and Efficiency in Thai Children Aged 3-6 Years

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ABSTRACT

The ultimate purpose of this study was the provision of care that is more conductive to children's rest and sleep. This study was the descriptive research and aimed to determine the characteristics of sleep pattern and sleep efficiency in Thai children. 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 the comparison of the sleep efficiency between the night and day time recording of the participants with 3-6 years, 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 .05. In the comparison of the sleep efficiency between the night and day time recording, the mean percentage of stage 1, 2 NREM and REM sleep during the night time recording was longer than during the day time recording. Sleep has been shown to be an essential component of health, affecting the well-being and quality of life of individuals.
Key words: Thai; Children; Health; Sleep pattern; Sleep efficiency

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INTRODUCTION

Sleep is one of the basic needs of human beings and is very important for physical and mental health [1]. For children, each child, especially the newborn, has an individual sleep pattern with a different amount and length of sleeping time [2]. Sleep is the best rest and basic to human survival. One-third of the human life span spends on sleeping [3-5]. The sleep-wake cycle, which follows the circadian rhythm in a 24- hour cycle, is mediated by the neurotransmitters, hormone level and temperature [5]. From the onset of sleep, the individual 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 [5-8]. A good quality of sleep is important to human being, either normal or ill [8]. 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 [5-6]. 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 [9].

In the contrary, having insufficient sleep affects both physically and psychologically. Signs of sleep deprivation differ according to which phase of the sleep cycle the person is mainly deprived [6, 10]. 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 response. 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 thinking, hallucinations, irritability, visual illusions, and slurred speech, may occur within 48 hours. [6, 8, 11-15]. Considering all of the above, the authors were then interested in the factor affecting the sleep pattern of children aged about 3.1-6 years using several measurements. The results will be advantageous to the planning of nursing care to promote growth and development for children.

MATERIALS AND METHODS

Population

The target population of this study was both male and female Thai children who were 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) no seizure symptom, (5) must not a premature baby, (6) no illness before 7 days and during the experiment, (7) no history of sleep abnormality or disorder, (8) should sleep with his/her parents, and (9) parents are fully agreed and sign the agreement of the experiment.

Sample size

Sample size was based on the principle of Polit and Hungler [16], 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. This study used change-over design, in which all subjects served as their own control so they were in both the control and the intervention/investigation period. Moreover, limited sample size was due to high cost of the instrument used for data collection [16]. Therefore, the sample size for this study was 27 participants. Participants aged 3-6 years old.

Instrumentation

The instruments for data collection were consisted of (1) Portable polysomnography (PSG) used for evaluating the sleep efficiency in terms of the following aspects including (a) sleep efficiency index (SEI) is the percentage of time spent asleep in any stage compared to the overall time in bed, (b) 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, (c) sleep latency (SL) is the time in minutes from the beginning of the PSG monitoring to onset of sleep, and (d) total sleep time (TST) is the number of hours spent on sleep per night, and (2) Instruments for data collection of the sleep-wake patterns in premature infants. It was a video camera Panasonic Model. No. NY -Vx7EN, Video cassette (size 4x7.3 inches).

Polysomnographic Recording

Before each test, started sleep at p.m. the researcher and the research assistant placed electroencephalogram (EEG), electrooculogram (EOG), electromyogram (EMG) electrodes and wristband to the participants. Electrodes were placed on the specific area after skin preparation. After completing all the leads connections, the researcher set up the Sleep I/T device with the software on notebook computer followed the standard procedures. 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. 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 researcher observed the sleep patterns of children from videotape, coded in the observation record for duration and sleep-wake states. The researcher assessed the sleep-wake states of the children using the criteria: eyes open or closed respiratory pattern and body movement. The result of the sleep wave of each participant in each period had been read and calculated in term of percentage of sleep efficiency index (SEI), the time spent in each sleep stage (stages 1, 2, 3 and 4 NREM sleep), sleep latency (SL) and total sleep time (TST). Data obtained was analyzed by using the Software Package of Social Statistic / Personal Computer (SPSS / PC) Version 11.5. Unpaired *t*-test was used to compare the difference in each sleep parameter between the night time and day time recordings. All significant data is measured at level of .05.

RESULTS

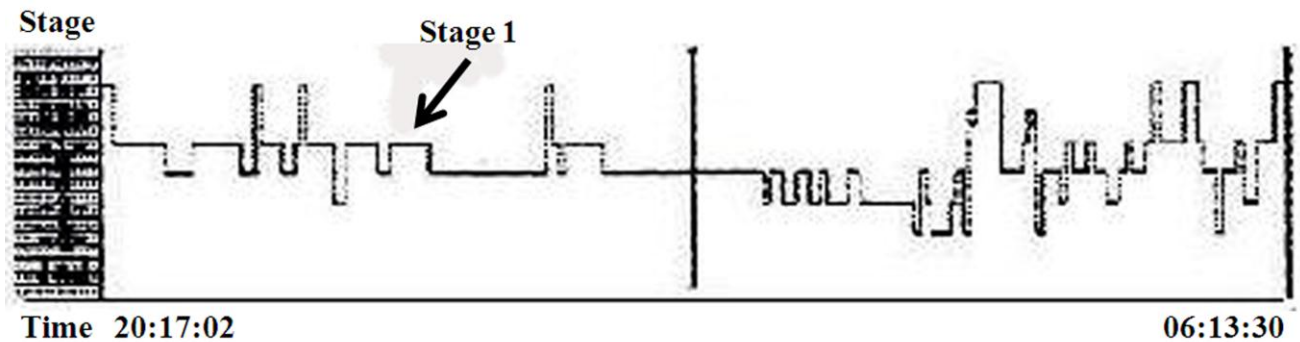
The sleep efficiency was objectively measured by Portable Polysomnography (PSG), which utilized the electroencephalography (EEG), the electromyogram (EMG) and the electrooculogram (EOG). PSG represented SEI, time spent in each sleep stage (stages 1, 2, 3 and 4 NREM sleep, REM sleep), SL and TST while the participants slept during the night and day time. The overall sleep efficiency of the participants with 3-6 years was good. The average percentage of the SEI of the participants in both periods of the recording was higher than 80%. During the 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 .05 (see Table 1).

Table 1: Comparison of the sleep efficiency between the night and day time recording of the participants with 3-6 years (n=27)

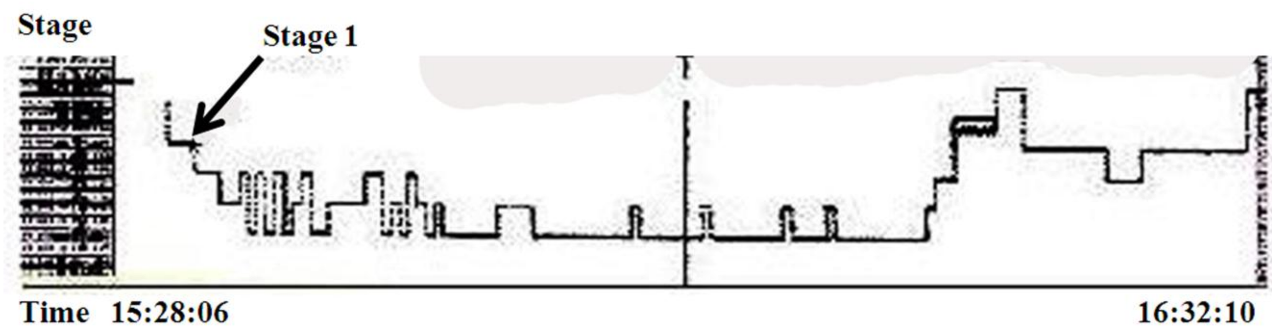
Sleep efficiency	Night time		Day time		t	p
	M	SEM	M	SEM		
Sleep Efficiency index (%)	81.33	2.80	90.14	1.81	2.25	0.04
Sleep Stages (%)						
Stage 1 NREM	21.20	3.15	8.43	3.20	2.85	0.01
Stage 2 NREM	36.24	2.93	16.19	4.98	3.47	0.002
Stage 3 NREM	7.89	1.16	9.02	2.63	0.39	0.70
Stage 4 NREM	20.53	1.88	18.62	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)	7.09	0.24	0.62	0.19	21.38	<0.0001

REM = Rapid eye movement; NREM = Non-rapid eye movement; M = Mean; SEM = Standard Error of Mean

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 .05 (see Figure 1).



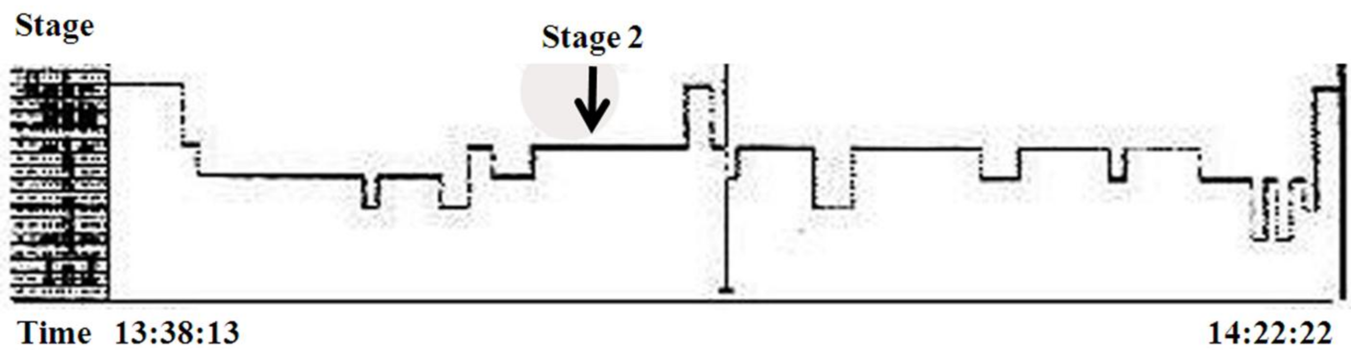
(a) Stage 1 NREM sleep of the night time recording



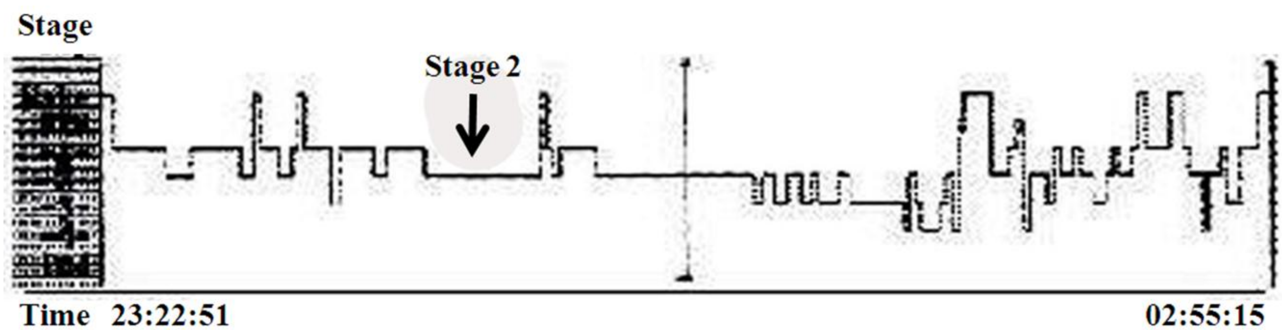
(b) Stage 1 NREM sleep of the day time recording

Figure 1 (a,b): Comparison of the stage 1 NREM sleep of the participants with 3.1-6 years old during the night time and day time recordings.

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 .05 (see Figure 2).



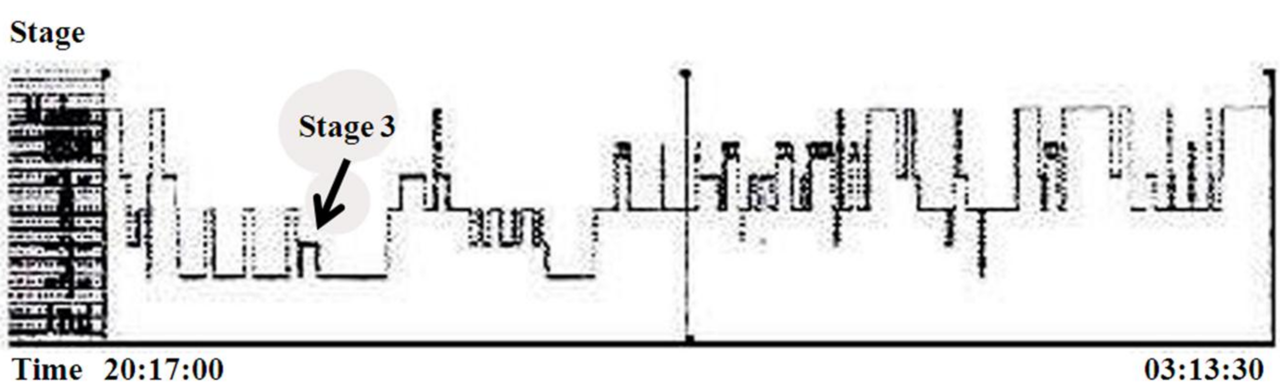
(a) Stage 2 NREM sleep of the night time recording



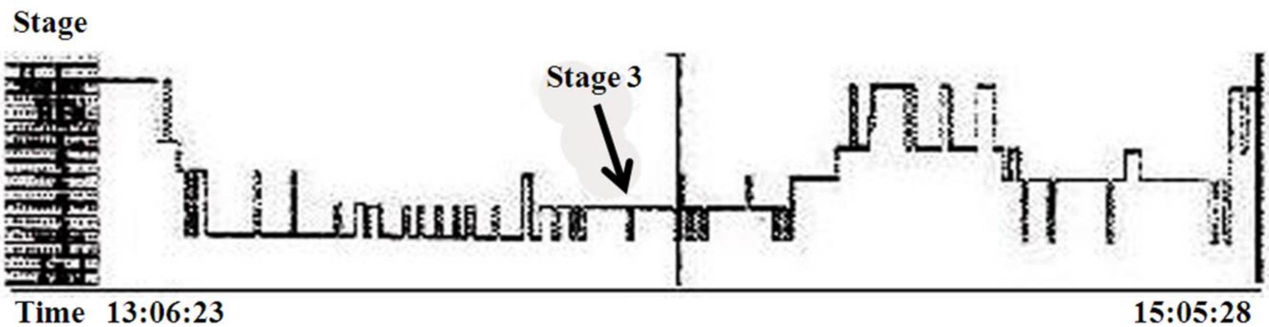
(b) Stage 2 NREM sleep of the day time recording

Figure 2 (a,b): Comparison of the stage 2 NREM sleep of the participants with 3.1-6 years old during the night time and day time recordings

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 Figure 3).



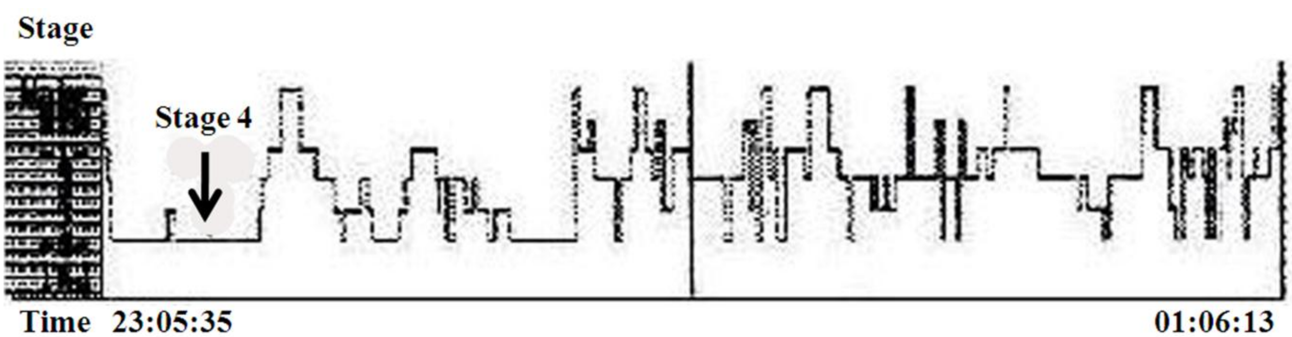
(a) Stage 3 NREM sleep of the night time recording



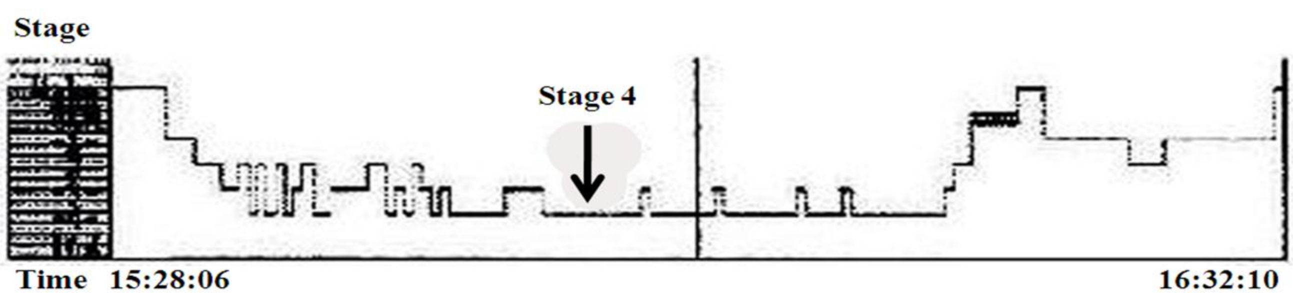
(b) Stage 3 NREM sleep of the day time recording

Figure 3 (a,b): Comparison of the stage 3 NREM sleep of the participants with 3.1-6 years old during the night time and day time recordings

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 Figure 4).



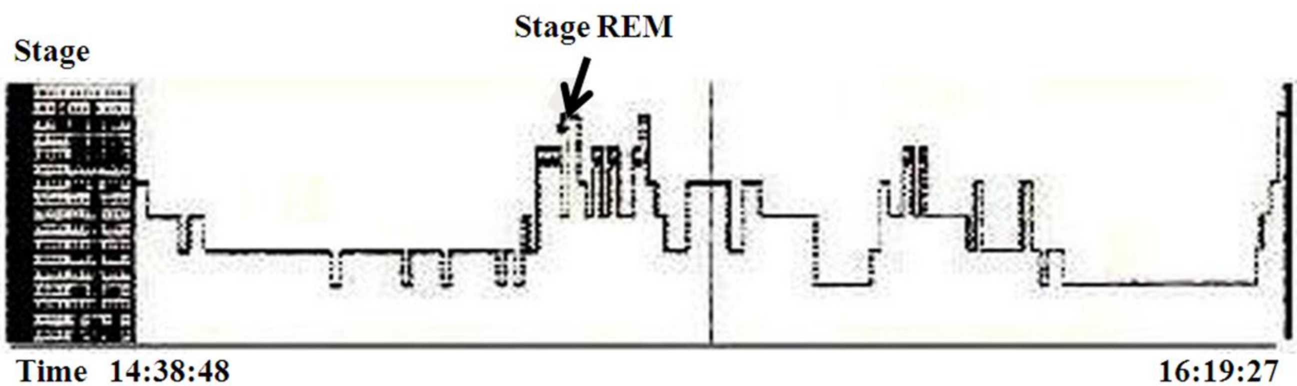
(a) Stage 4 NREM sleep of the night time recording



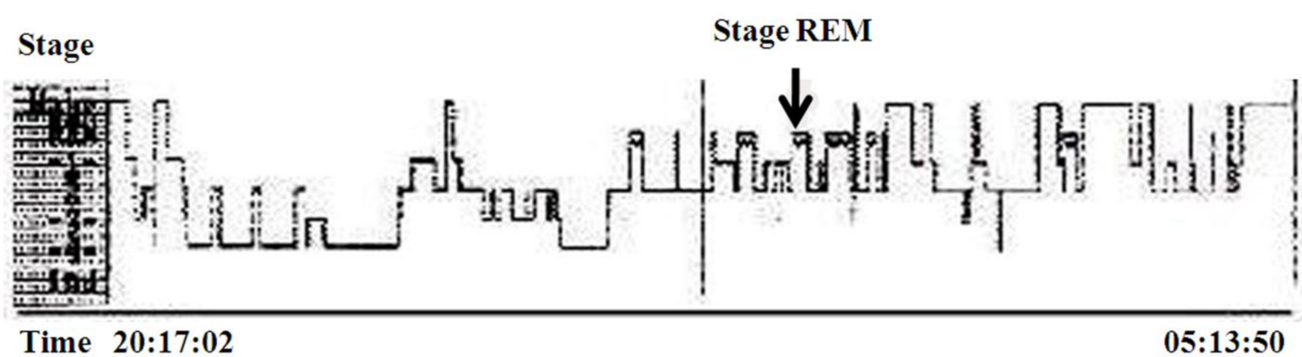
(b) Stage 4 NREM sleep of the day time recording

Figure 4 (a,b): Comparison of the stage 4 NREM sleep of the participants with 3.1-6 years old during the night time and day time recordings

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 .05 (see Figure 5).



(a) REM sleep of the night time recording



(b) REM sleep of the day time recording

Figure 5 (a,b): Comparison of the REM sleep of the participants with 3.1-6 years during the night time and day time recordings

Consequently, 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 .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 .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 .05. The average SLL during both periods of recording was longer than TST.

DISCUSSION

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. The REM was also rebound after REM deprivation, reduced TST and sleep efficiency [15, 17-19]. 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 [15]. They had more intra-sleep awakenings, and fewer REM periods [20]. 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 [19]. 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. 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 affecteds perception of a noise stimulus [21]. Pongam [22] 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 [22] also 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 [22]. However, the cross-over study design used in this study was aimed to minimize the factor of individual difference related to sleep pattern.

In addition, 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 [7]. 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 [23]. Therefore, the 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.

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CONCLUSION

In the comparison of the sleep efficiency between the night and day time recording of the Thai children with 3-6 years, 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 .05. 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. The ultimate purpose of this study was, thus, the provision of care that is more conductive to children's rest and sleep.

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