A STUDY OF SLEEP PATTERN IN PREMATURE INFANTS

CHANTIMA CHARASTONG

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This descriptive research aimed to determine sleep patterns of premature infants and the effect of procedure on their sleep patterns. The sample was 30 growing premature infants, between the gestational ages of 32 to 37 weeks at birth, who had been admitted to the premature unit, Department of Pediatrics, Siriraj Hospital, between March and August 2001. The infants were selected by purposive sampling. Data were collected by chart audit and video taping of the infants an during 8 hour period. Videotape was analyzed by an assessment of sleep states and calculated in percentages.

The results found that the sleep patterns of subjects of a post-conceptional age of both 34-36 weeks and 37-39 weeks had sleep cycles distributed through the 8 hour period cycle. Each sleep cycle was 40-60 minutes, but the duration of the sleep cycle was prolonged in subjects with a post-conceptional age between 37-39 weeks. There were varieties of sleep patterns. The percentage of sleep for each gestational age was not different. However, the percentage of waking of growing preterm infants of a post-conceptional age of 37-39 weeks was more than the subjects of a post-conceptional age of 34 to 36 weeks, except for waking during drowsy sleep. Both groups slept for 57 % of the time, the percentage of quiet sleep being 21% (about 38% of the total sleep time) and the percentage of active sleep being 36% (about 62% of the total sleep time).

This study found that sleep patterns of premature infants was the same as the regular sleep pattern of full-term infants. The baby moves from quiet sleep to active sleep, then through drowsy sleep to quiet alert, active alert, and crying. Sleep patterns of individual subjects were different and changed according to received procedures. Procedures such as bathing, feeding, and painful procedures affected sleep patterns. The majority of procedures could be divided into 3 types: 1) Pain procedure such as a heel prick induced waking and crying. 2) Discomfort procedure such as bathing, bed –linen being changed, adhesive tape being removed and intravenous medication changed the sleep-wake state. 3) Disturbance had a minimal effect on the sleep wake state. Feeding and touch were procedures that promoted social interaction but some subjects were disturbed by these procedures.

Nurses and health teams should be aware and assess sleep-wake states in order to plan and promote natural sleep patterns for premature infants.

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จันทิมา จรัสทอง: แบบแผนการนอนหลับของทารกเกิดก่อนกำหนด (A STUDY OF SLEEP PATTERN IN PREMATURE INFANTS) คณะกรรมการควบคุมวิทยานิพนธ์: ฟองคำ ติลกสุกลชัย Ph.D.(Nursing), กรรณิการ์ วิจิตรสุคนธ์, M.Sc., ธราธิป โคละทัต, M.D., 130 หน้า ISBN 974-04-1103-7

การศึกษาครั้งนี้เป็นการวิจัยเชิงบรรยาย เพื่อศึกษาแบบแผนการนอนหลับและผลของหัตถการที่มีต่อแบบแผนการนอนหลับของทารกเกิดก่อนกำหนด ศึกษาในกลุ่มทารกที่มีอายุครรภ์ระหว่าง 32-37 สัปดาห์ เข้ารับการรักษาในหอผู้ป่วยทารกเกิดก่อนกำหนด ภาควิชากุมารเวชศาสตร์ โรงพยาบาลศิริราช ระหว่างเดือนมีนาคมถึงสิงหาคม 2544 คัดเลือกกลุ่มตัวอย่างแบบเฉพาะเจาะจงตามเกณฑ์ที่กำหนด จำนวน 30 ราย เก็บข้อมูลโดยบันทึกภาพด้วยวิดิทัศน์ เป็นระยะเวลา 8 ชั่วโมง วิเคราะห์ข้อมูลโดยใช้ค่าความถี่และร้อยละ

ผลการศึกษา พบว่า กลุ่มตัวอย่างมี 2 กลุ่ม คือ กลุ่มตัวอย่างที่มีอายุครรภ์ระหว่าง 34-36 สัปดาห์ และอายุครรภ์ระหว่าง 37-39 สัปดาห์ มีลักษณะการนอนหลับใน 8 ชั่วโมง ดังนี้ ลักษณะแบบแผนการนอนหลับเป็นวงจรที่สั้น พบได้ตลอด 8 ชั่วโมง วงจรการนอนหลับ ประมาณ 40-60 นาที ทารกจะมีการตื่น และจะตื่นในระยะง่วงซึม เปอร์เซนต์ของระยะเวลาการนอนหลับและระยะเวลาการตื่นทั้งกลุ่มที่มีอายุครรภ์ 34-36 สัปดาห์และอายุครรภ์ 37-39 สัปดาห์ใกล้เคียงกัน แต่กลุ่มตัวอย่างที่มีอายุครรภ์ 37-39 สัปดาห์จะมีระยะเวลาการนอนหลับนานมากขึ้นและมีจำนวนการนอนหลับที่สั้นกว่า ทั้ง 2 กลุ่มจะมีระยะเวลาการนอนหลับทั้งหมดประมาณ 57 % แบ่งเป็นระยะเวลาในระยะหลับลึกประมาณ 21% (38 % ของระยะเวลาหลับทั้งหมด) และระยะเวลาในระยะหลับตื้น ประมาณ 36 % (62% ของระยะเวลาหลับทั้งหมด) ซึ่งมีลักษณะการหลับแบบปกติ คือ จะเริ่มต้นการนอนหลับในระยะหลับตื้นก่อน ลักษณะการนอนหลับที่พบมากที่สุด คือ การเปลี่ยนจากระยะหลับตื้นไประยะหลับลึกและกลับมาระยะหลับตื้นอีกครั้ง ทั้งสองกลุ่มมีสัดส่วนของระยะหลับตื้นและหลับลึกใกล้เคียงกัน แบบแผนการนอนหลับจะมีลักษณะเฉพาะแต่ละคนและเปลี่ยนเมื่อได้รับหัตถการ สามารถแบ่งหัตถการออกเป็น 3 หมวด ได้แก่

หัตถการที่ทำให้เกิดความเจ็บปวด เช่น การเจาะเลือด ทำให้ตื่นและร้องไห้ หัตถการที่ก่อให้เกิดความไม่สุขสบาย ได้แก่ การเช็ดตัว การเปลี่ยนเตียง การแกะพลาสเตอร์ การฉีดยาทางหลอดเลือดดำ ทำให้เกิดเปลี่ยนแบบแผนการนอนหลับ แต่ชนิดของหัตถการอื่นและหัตถการที่ก่อให้เกิดความรำคาญมีผลเปลี่ยนแปลงน้อย สำหรับการให้อาหารและการสัมผัสเป็นหัตถการที่ทำให้เด็กหลับและสงบ แต่บางครั้งก็เป็นสาเหตุทำให้เกิดรบกวนการนอนหลับได้

ผู้ดูแลจะมีส่วนสำคัญในการให้การดูแลทารก ดังนั้นจึงควรมีการศึกษาและประเมินสภาวะการหลับตื่นและวางแผนการดูแลเพื่อวางแผนให้การพยาบาลที่เหมาะสมต่อไป

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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 & Fay, 1990: 285). 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: 129).

Newborn infants spend about two thirds of time sleeping in order to promote growth and development during the early phase of life (Kohyama, 1998: 73). Term infants spend 16 to 18 hours sleeping each day (Kick, 1996: 247). 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 & Holditch-Davis, 1990: 21). Arousal of newborn infant appears after one or two sleep cycles (Thomas, 1995: 28). 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&Fay, 1990: 285). 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 & Holditch-Davis, 1990: 21). 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 37 th week of gestation, still have an immature body system and CNS which affects their sleep patterns (Ashwill & Droske, 1992: 540-541). 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 & Lubchenco, 1993: 572). Also, premature infants are unprepared for life outside the uterine environment and demonstrate inappropriate adaptation which is linked to the immature function of neurophysiological development. They have an imbalance of all subsystems from the syndactive theory e.g., autonomic system, motor system, state organization system, attention/interactive and self-regulatory system. Especially, the state organization system involves the display of different ranges of sleeping and waking, and displays clarification of states where they are present (NANN, 1995: 3). This inappropriate adaptation results in most premature infants being admitted to a neonatal intensive care unit (Modrcin-McCarthy, McCue & Walker, 1997: 62). However, the extra-uterine environment of the hospital itself poses dangers to sleep. Environmental conditions which adversely affect normal 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 & Fay, 1990: 291).

Procedures are a major concern because they seriously disturb high-risk neonates (Peter, 1999: 83). Sick newborns or preterm infants usually receive a variety of procedures while they are hospitalized. Sparshott (1994) divided the categories of environmental disturbance and treatment into 3 categories; pain, discomfort and disturbance. Procedures which cause pain include intubation, chest drain insertion, venepuncture, and heel prick. Discomfort can be ascribed to such things as physical examination, rectal temperature measurement, intravenous medication, passage of orogastric tube and adhesive tape removal. Disturbances include nappy change, and feeding by OG tube (Sparshott, 1994: 267-269). Johnes et al said in their study that pain was ranked second to discomfort as a contributory factor to sleep loss (Webster & Thompson, 1986: 451). The study of Supatta et al aimed to determine the type and number of nursing activities which infants received while they were in the NICU. Data were collected by auditing the nursing activities received in the first 24 hours, the consecutive 72 hours and the 7 th day after admission. The results showed that all infants received nursing activities in each hour, averaging 98.28, 91.76 and 90.10 times in the first 24 hours, consecutive 72 hours and the 7 th day after admission respectively. In addition, the morning shift had more nursing activities than the other shifts (Jarungphan, Kasornchandra and Wongsingkhan, 1999). Even when premature infants are admitted to the intermediate care unit, the environment is similar to the intensive care unit (Holditch-Davis, Barham & O'Hale, 1995: 425). The effect of procedures can be seen in both the physiological and behavioral responses of the premature infants. The main physiological responses are increased heart and respiratory rates and decreased oxygen saturation (Zahr & Balian, 1995:179-185). The increased heart rate and respiratory rate lead to a greater energy requirement, resulting in higher oxygen demand and calorie consumption. These babies face prolonged stress and this may result in apnea and bradycardia. Energy depletion may finally lead to exhaustion and death (Mcdrcin-McCarthy, McCue & Walker, 1996: 67-71). Behavioral responses when babies received procedures showed a decrease in the amount of sleep and an increase in the amount of crying and waking (Zahr & Balian, 1995: 179-185). Sleep disruption may interfere with growth hormones during the REM (active) sleep of infants (Gardner, Gastand, Merenstein &Lubchenco, 1993: 572). So, providing such procedures throughout the day will affect the sleep pattern of those infants.

Considering all of the above, the researcher is interested in the effects of procedures on the sleep pattern of premature infants. The results will be advantageous to the planning of nursing care to promote growth and development for premature infants.

Research Questions

What is the sleep pattern of premature infants?

What do procedures affect the sleep pattern?

Purpose of the Study

1. To study the sleep patterns of premature infants during an 8-hour period.

2. To examine the effects of procedures on the sleep patterns of premature infants.

Conceptual Framework

Term infants possess the necessary adaptation to enable them to strive for equilibrium in their interactions between self and environment. Their appropriate interaction is expressed in both their physiological and behavioral responses (NANN, 1995: 3). The process of adaptation is a function of neurophysiological development. It can be described by the synactive thoery of infant development that consists of 5 subsystems i.e., autonomic system, motor system, state organization system, attention/interactive and self-regulatory system (Als et al, 1986). Each subsystem is dependent on the others, therefore, an imbalance in one subsystem may affect the other subsystems. The state organization system involves the display of different ranges of states from sleeping to waking and displays clarification of states where they are present (NANN, 1995: 5). Also, the immaturity of the central nervous system affects sleep patterns.

Premature infants have poor adaptation to the extra-uterine environment. They still have immaturity in their body systems in addition to an immature central nervous system which also affects sleep patterns (Balsmeyer, 1990: 447). It is the imbalance of all of the subsystems from the syndactive theory that has an influence on sleep patterns. Moreover, the limited physiology of premature infants causes most of them to be admitted to the nursery or intensive care unit. The study shows that the hospital environment itself poses sleep hazards, as the environmental conditions, for example; noise, light and procedures, adversely affect sleep-wake patterns (Schebler & Fay, 1993: 291).

Procedures that are found to mandate the frequent disturbance of sleep can be divided into 3 categories: pain, discomfort and disturbance (Sparchott,1994: 268).

Pain procedures include heel prick or venipuncture, and muscular injection. Discomfort and disturbance include bed bath, change of plaster or probe, and chest physiotherapy (Lynam, 1995 cited by Sparchott,1994: 268). These procedures have an effect on the motor system which is expressed in both behavioral and physiological responses (McCaffery & Pasero, Eds, 1999: 633). The most basic physiological responses are increased heart and respiratory rates and decreased oxygen saturation. Behavioral response when babies received procedure also showed a decrease in the amount of sleep and an increase in the amount of crying and waking (Zahr & Balian, 1995: 179-185). Procedure may cause changes between sleeping and waking states. Parmelee and Stern have categorized sleep-wake states into 6 types; quiet sleep, active sleep, drowsy sleep, quiet alert, active alert and crying (Parmelee& Stern, 1972; 200).

From the above mentioned, the researcher is interested in studying the sleep patterns in premature infants. This study is expected to help with the planning of nursing care to promote the growth and development of premature infants. Moreover, it could be useful for future studies of the sleep patterns of other groups of infants. The concept of this study is depicted in Figure I.

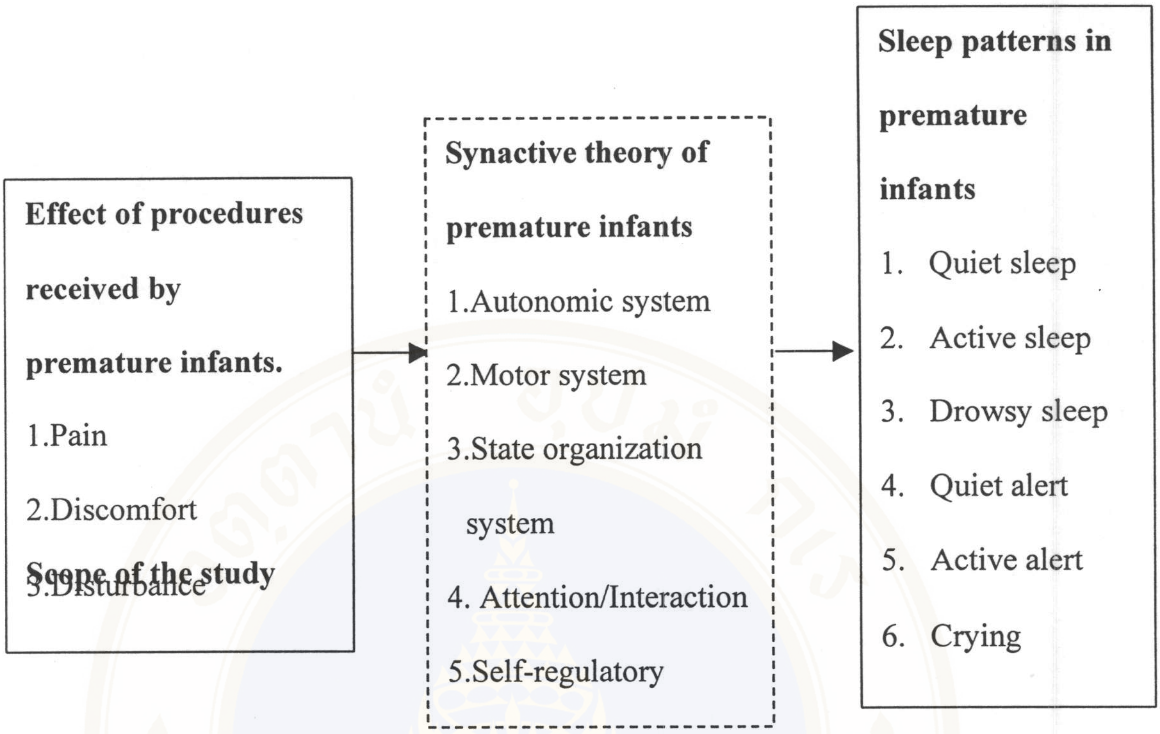


Figure 1: Conceptual framework of the study

Scope of this Study

This study focused on the sleep patterns of premature infants and the effect of procedures on their sleep patterns. The study was done on premature babies, born between the gestational ages of 32 – 37 weeks who had admitted to the Premature Unit, Siriraj Hospital, from March to August 2001.

Definition of terms

Procedures refer to all activities which the caregivers perform to take care of premature infants in the unit. The effects of treatment can be divided into 3 categories (Sparrshott, 1994: 268):

1. **Pain procedures** refers to all activities which the caregiver performs on premature infants which invade tissues, joint and muscular function, in response to which the infants feels and expresses pain e.g., lumbar puncture, intramuscular injection and heel stick.
2. **Discomfort procedures** refers to all activities which the caregiver performs on premature infants which involve the arousal of receptors in the skin and underlying tissue e.g., chest physiotherapy, and rectal temperature measurement
3. **Disturbance procedures** refer to all activities which the caregiver performs on premature infants that involve minimal contact and are related to social interaction e.g., handling, and physical examination.

Sleep patterns refer to the characteristics of sleep in premature infants that encompass everything from sleeping to waking state. The sleep pattern was assessed by Parmelee and Stern (1972; 200) and divided into 6 states;

1. **Quiet sleep** refers to the state of a premature infant with no response to stimulation. Characteristics of this state include relatively regular respiration, and abdominal movement; no movement or facial movement only; eyes closed.

2. **Active sleep** refers to the state of a premature infant who is still asleep but which involves body movement. Characteristics of this state include irregular respiration, predominantly costal in nature; movement of hands, feet, forearms or lower legs, whole limb movements, or total body movement; eyes closed with REM

3. **Drowsy sleep** refers to the state of a premature infant in transit between sleeping and wakefulness. Characteristics of this state, which can be with or without movement, are dull, glazed eyes; irregular respiration; eyes alternately opening and closing.

4. **Quiet alert** refers to the state of a premature infant who expresses a degree of wakefulness interacts with the caregiver. Characteristics of this state include open eyes which either do not focus or focus and follow; no movement or facial movement only; regular respiration.

5. **Active alert** refers to the state of a premature infant who fully expresses wakefulness and easily responds to stimulation. Characteristics of this state include open eyes, movement of hands, feet, forearms, or lower legs, or whole limb movement or total body movement; irregular respiration.

6. **Crying** refers to the state of a premature infant who expresses its response to unpleasant environmental stimuli. Characteristics of this state include increased motor activity and total movement; more irregular respiration, which is primarily costal in nature; eyes opened or closed.

Expected Outcomes and Benefits

The results can be used as a guideline for nurses and other health care providers in planning and promoting the sleep patterns of premature infants.

CHARPTER II

LITERATURE REVIEW

This research studies the sleep patterns in premature infants. From the current study and a review of various associated literature and research papers, the topics can be divided as follows;

1. Sleep patterns in premature infants
   - The development of sleep patterns
   - Sleep cycles in the premature infants
2. The Syndactive theory of Neurobehavioral development
3. Factors influencing the sleep patterns of premature infants in intermediate care units
4. Assessment of sleep patterns in premature infants

Sleep patterns in premature infants

Sleep is one of the basic needs of human beings and is very important for physical and mental health (Schibler & Susan, 1990: 285). The central nervous system (CNS) is the manageable system that controls sleep, its components, and the sleep/wake cycle. Most of the CNS changes across the lifespan. Neurological development continues throughout gestation to the edge of the first decade. Embryological development is divided into three stage (Crawford & Maris, 1994: 191-227; Skedon, 1996: 71-74):

1. Neurulation

This stage overspreads the post-conceptual age of 18-27 days. The basic material of the brain and spinal cord develops from the primitive, thickened area of ectoderm called the neural plate. The embryo develops from an initially flat, single-layer to become thickened, stratified, and separated into two neural folds with a central neural groove. The thickened folds soon begin to fuse into the neural plate. There are three distinct zones; the ependymal layer, the mantle layer and the marginal layer. The mantle layer goes on to form the gray matter of the CNS. The marginal layer will grow and become linked with other nerves and connect with various nerve centers. This layer will become the white matter of the brain and spinal cord. The topmost edges of the neural folds begin to fuse at approximately 22-24 days. The neural folds initially fuse near the middle, and continue in both cephalic (towards the top) and caudal (towards the bottom) directions. The neural tube is formed by the 4 th week of pregnancy.

2. Secondary canalization

This stage occurs between 28-51 days of gestation and is a period of explosive development. The neural tube is divided into three primary brain vesicles called the prosencephalon (the fore-brain), the mesencephalon (the mid-brain) and the rhombencephalon (the hind-brain). The prosencephalon and rhombencephalon subsequently subdivide into two additional secondary regions. However, the mesencephalon remains undivided.

Early in the fourth post-conceptional week, the prosencephalon subdivides into the telencephalon and the diencephalons. The telencephalon becomes the cerebral hemispheres that separate into two lateral outpouchings, each containing a lateral ventricle. The cerebral hemispheres become more prominent in the sixth week of conceptional age and expand rapidly until they overgrow the diencephalons and mesencephalon during the middle of gestation. In higher vertebrates, the telencephalon, the most specialized and complex portion of the brain, can be divided into three distinct areas that differ in function: the corpus striatum which is directly continuous with the thalamus; the rhiencephalon; and the neopallium. After the seventh week of gestation, the three main regions of the diencephalon become the executive region for the regulation of all autonomic activity, including digestion, sleep, temperature regulation and emotional behavior. This is especially necessary for the establishment of centers that are basic for the control of the sleep/wake cycle and cycling within the sleep state itself.

The mesencephalon is fundamentally associated with reflexes of the eyes and head in response to visual stimuli. It is also an important area responsible for the characteristics and epi-phenomena of active (REM) sleep.

The rhombencephalon subdivides into two more specialized areas, the metencephalon and the myelencephalon. The metencephalon becomes the pons and cerebrallum. The pons is the primitive pathway for the conduction of impulses between the cerebellar cortex and the cerebral cortex. The cerebellum is responsible for the coordination of stimuli related to body position and movement. The junction of the metencephalon and myelencephalon contain executive centers required for regulation of chewing, tasting, swallowing, digestion, respiration and circulation. In the other part, the myelencephalon (primitive medulla oblongata) is the most caudal portion of the CNS

3.Retrogressive differentiation

This stage occurs between 52 and 80 days of gestation. During embryogenesis, the brain develops and there is rapid neuroblast multiplication. Neurogenesis is the process in which the positive neuroblastic epithelium separates and divides into neurons. As differentiation proceeds, each neuroblast becomes bipolar with outgrowths of a fiber-like process that will eventually become the axon. After this period, the main cell body becomes multipolar due to the development of dendrites. Migration of the neurons depends upon the depolarization of the neuron networks during development. The mass migration of cells is termed neurobiotaxis and is thought to be determined by the movement of cell bodies in the direction of the source from which they receive the majority of neuronal impulses. Neuronal activity during development appears to be responsible for the migration of neurons to their appropriate positions within the CNS, the degree of dendritic branching, and the strength of synaptic interconnection. During development, two internal processes result in a high degree of neuronal activity; the waking state and active (REM) sleep.

During the third trimester of pregnancy, the fetal brain undergoes rapid development which continues after birth, especially the autonomic nervous system (Modcin-McCarthy, McCue & Walker, 1996: 64).

Preterm infants (from 28 to 32 weeks of gestation) begin to achieve some degree of physiologic homeostasis. We found that the critical dendritic connection is important for the processing of impulses and for cell-to-cell communication. Lack of connections can result in hypersensitivity, poorly modulated behavior, and all-or-nothing responses (Nelson, 1987 cited by Kenner, Recknurn & Ann, 1998: 660). Also, the sleep-wake patterns of such infants are disturbed easily by environmental stimuli.

The development of sleep patterns

The modern conceptualization of sleep as an active and functional process began in 1937, when Loomis, Harvey, and Hobart discovered different stages of sleep based on the amplitude and activity of the brain during sleep as a result of electroencephalographic (EEG) monitoring during sleep. In 1953, periods of rapid eye movements (REM) were observed during sleep by Aserinsky and Kleitman (Beck, 1988: 253). Also, Rechtschaffen and Kales divided sleep into two categories; rapid eye movement (REM) and non-rapid eye movement (NREM). Their premise in developing the system was that wakefulness, REM sleep, and NREM sleep involve different levels of consciousness (Kick, 1996: 245-246).

For newborn infants, Asrinsky and Kleitman observed cyclic changes of sleep behavior in very young infants, alternating between quiet periods and periods of body movements associated with eye movements (Parmelee, Wenner, Akiyama, Schultz & Stern, 1967: 70).

Sleep is omnipresent throughout life, from the intra-uterine existence until death (Renaud, 1996: 27).

In intra-uterine existence, the sleep of the fetus, with spontaneous movements, can be identified from the 7th week of gestation, and a rhythmic cycling of periods of activity and quiescence can be recognized by the 23 rd week (James, Pillai & Solemic, 1995 cited by Kohyama, 1998: 74). The majority of the longest identifiable quiet intervals were less than 5 minutes up to the 24th week of pregnancy, whereas after 32 weeks, most quiet intervals were between 10 and 35 minutes in duration. This clearly shows that fetal inactivity is gestational age-dependent (Pillai, James & Parker, 1992: 174). Leake's studies of fetal activity during the last month of pregnancy are somewhat predictive of neonatal sleep and activity patterns (Renaud, 1996: 28). Much research has centered on the identification of a basic cycle of human movement, rest and alertfulness that might describe a fundamental characteristic of behavior organization and underlying brain activity that exists from early fetal life. Robertson (1987) has identified the existence of spontaneous mobility cycles in human newborns across all behavioral states of sleep and wakefulness (Gorski, 1999: 18).

After birth, infants remain alert, calm, and physiologically stable for the first 1 to 4 hours following normal delivery. Over the next 24 to 36 hours, newborn behavior is less predictable, in respect to alertfulness, fading, sleeping, and crying. Behavioral self-regulation, with increasingly predictable patterns of activity, rest, and attention, begins to emerge by the third day of life (Gorski, 1999: 18). The length of the sleep cycles and the amounts of REM and NREM in newborn infants varies among individuals and according to the developmental age (Wong et al, 1995: 130).

In premature infants, the differentiation between wakefulness and sleep is quite different from the two states of sleep present in the adult and even from that in animals mature at birth (Dreyfus-Brisac, 1968: 168). At the gestational age of 32 to 40 weeks, habituation in sleeping premature infants appears only in REM sleep, not in non-REM sleep. At around 36 weeks, non-REM sleep also starts to became patterned (Parmelee, 1979: 163). When CNS maturity is attained in these infant, their periods of sleep and wakefulness become longer, more easily differentiated, and more like the sleep periods of the term infant (Balsmeyer, 1990: 447).

Sleep cycles in premature infants

In the first three weeks of life, newborn infants spend about two thirds of their time asleep in order to promote growth and development during the early phase of life (Kohyama, 1998: 73). They spend approximately 16 to 18 hours of every 24-hour period in sleep. The length of each sleep cycle is shorter in infancy than in the older children (Kick, 1996: 247). The sleep pattern of a newborn infant 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). As sleep begins, the term infant enters active rather than quiet sleep. Active sleep duration varies from 10 to 45 minutes, whereas quiet sleep lasts about 20 minutes. Thus, the infant's sleep cycle is 50 to 60 minutes, as compared with the adult's 90 to 100 minute cycle (Garner, Garland, Merenstein & Lubchenco, 1993: 572). The arousal of a newborn infant appears after one or two sleep cycles (Thomas, 1995: 28). During the first 16 weeks of life, newborn infants' sleep duration decreases very slowly to 14-15 hours, with another small decrease to 13-14 hours at 6-8 months. The major changes are in the duration of single sleep periods and their placement in a 24-hour day. By 6 weeks, infants begin to sustain long, 5 to 6 hours sleep periods, though not necessarily at night. Gradually, this lengthens to 8 –9 hours and shifts to nighttime, so that a diurnal pattern actually starts soon after birth. After 3 months of age, there is a continuing development of the diurnal cycle and consolidation of daytime sleep into well-defined naps (Parmelee & Stern, 1972: 209).

Simultaneously, waking patterns change slightly. At first, infants awaken every 4 hours and stay awake for 1-2 hours. The longest sustained duration of wakefulness increases slowly from 2-3 hours at 1 week to 3-4 hours at 16 weeks (Parmelee & Stern, 1972: 209). Within the broad state of "wakefulness", defined as those periods when an infant's eyes are open, sub-classifications can be made. Wolff (1965) studied the maturation of states which he called "quiet awake", "active waken" and "crying". Infants seem to be most attentive, in the sense of selective looking or visual following, during the quiet-awake periods, which double in length during the first 4 weeks. Conversely, as the amount of crying decreases, other waking behaviors, such as babbling and manual toy manipulation, increase in frequency (Parmelee & Stern, 1972: 209). Newborns depend on an adequate amount of sleep to meet the needs of their rapid growth. Further, pituitary growth hormone is excreted during periods of deep sleep. While asleep, infants make many noises, such as sighing, gurgling, and coughing. Each infant develops a unique sleep pattern that changes as the nervous system develops (Kick, 1996: 247).

In preterm infants, active and quiet sleep are more poorly organized and of shorter duration. Premature infants fall asleep in active sleep, and a complete sleep cycle, consisting of both active and quiet sleep, lasts from 36 to 40 minutes. Active sleep is more responsive to stimuli than quiet sleep. Quiet sleep is a more controlled state and occurs more frequently in term than in premature infants. The preterm infant matures, has more quiet than active sleep, and has more awake, alert time. However, the preterm who is of 40 weeks post-conceptional age does not have as well-organized sleep patterns as the term newborn (Gardner, Garland, Merenstein &Lubchenco, 1993: 572). Preterm infants are rarely able to sustain quiet sleep during nursing intervention. Therefore frequent nursing interventions, are particularly liable to reduce the amount of quiet sleep that the infant experiences (Catlett & Holditch-Davis, 1990: 21).

The Syndactive Theory of Neurobehavioral Development

In infants, the process of adaptation is a function of neurophysiologic development. When a newborn infant interacts with the environment, the infant's physiological and behavioral subsystems are modified to promote an adequate fit with the environment. The infant's ability to interact with the environment is associated with the infant's level of maturity (NANN, 1995: 3).

The syndactive theory of development (Als, 1982) provides a model through which one can specify the degree of differentiation of behavior and the ability of infants to organize and control their behavior. This model is fundamental to the infant's primary route of communicating both functioning stability and the limits for stress (Kenner, Ambung & Flandermeyer, 1998: 660). The syndactive theory of development consists of 5 subsystems as follows;

1. **The autonomic system**

The autonomic system refers to physiological functioning and is related to the care of infant function. The subsystem is observable in the infant's color, respiratory function, and visceral functions (Miller & Quinn-Hurst, 1994: 506), such as bowel movements gagging and hiccoughing (NANN, 1995: 3).

The autonomic dimension is the first in which the infant must show improved control. Preterm infants respond to environmental stress with a wide variation in physiologic parameters. For example, if an alarm sounds, the infant's heart rate and respiration rate change, oxygen saturation drops, and its color changes from pink to gray. This response reflects physiological instability (Ludington-Hoe & Swinth, 1996: 691). Moreover, if an autonomically organized infant maintains autonomic stability, other systems will be compromised (Miller & Quinn-Hurst, 1994: 507).

2. The motor systems

The motor system refers to the behavior associated with muscle tone, posture and generalized body movements (NANN, 1995: 3). The younger an infant's gestational age, the less control it exerts over purposeless movements. When environmental change are perceived by the infant, over-reaction of gross motor movements may occur, with arm flailing, leg extension, chest heaving, and the turning of the head from side-to-side. With increasing maturity, the motor responses become less general and more specific, such as a simple grimace or flexion of the fingers. Random, disorganized body movements (twitches, tremors, extensor movements, jerks and startles) are signs of motor disorganization. Motor activity is predominantly observed when the infant is awake. A sleeping preterm infant also will exhibit a large number of motor movements in any consecutive 5- minute span (Ludington-Hoe & Swinth, 1996: 695).

3. The state organization system

The state organization system refers to the infant's ability to display a different range of states from sleep to arousal. This system is also associated with the infant's ability to move between states and display clarity of states when permissible (NANN, 1995: 3).

State organization is related to the infant's regulation of levels of alertness from deep sleep to quiet, alert and crying states. State organization also includes clarification of state, the degree to which behavior states are defined and the ease of transition from one state to another. State modulation of state organization refers to the infant's ability to adjust its behavior states in response to internal and external stimuli (Miller & Quinn-Hurst, 1994: 507).

The concept of state organization is vital to the understanding of stress responses in preterm infants and to correct interpretion of their behavioral cues, as infants who are disorganized exhibit frequent and rapid changes in their state (Modrcin-McCarthy, McCue & Walker, 1997: 66).

4. The attention & interaction system

The infant's attentional / interactional system is related to its ability to process and respond to input from the environment (NANN, 1995: 3): this represents the infant's ability to interact and take in cognitive and social emotional information. It is reliant on an infant's behavioral state control (Miller & Quinn-Hurst, 1994: 507). An interactional organized infant will respond to maternal input and presence in such a way as to encourage additional interaction without giving distress cues. It is rare in infants younger than 40 weeks post-conceptional age (Ludington-Hoe & Swinth, 1996: 699).

5. The self-regulatory system

The last system is associated with the infant's ability to achieve and maintain a balance of all the subsystems through self-consoling behavior, such as sucking or hand – to-mouth maneuvers. If the infant lacks a self-regulatory capacity, it is not able to return to integrated subsystem functioning, and so maladaptive behavior may result when confronted with environmental demands. This maladaptive behavior may result in clinical symptoms, such as alterations in heart rate and respiration, color change, erratic body movements, feeding difficulty, or prolonged periods of wakefulness. If these disturbances persist, life-threatening conditions may develop which may impede the infant's future growth and development (NANN, 1995: 3). Some examples of regulatory behavior include grasping to limit the movement of extremities, looking away to decrease the level of interaction, or becoming drowsy (changing behavior state) to avoid over stimulation (Miller & Quinn-Hurst, 1994: 507).

At term, the healthy infant attempts to attain regulation of the states of consciousness. However, the premature infant is still attempting to integrate this and other levels of subsystem functioning, and is still striving to maintain balance within the autonomic subsystem. As result, motor and state disorganization is crucial to our understanding of the stress response in preterm infants and to our interpretion of their related behavioral cues.

Also, a state organized infant can make smooth transitions between appropriate states and bring into play all of the physiological and behavioral conditioning to attain, sustain and withdraw from any given state (Ludington-Hoe & Swinth, 1996: 695-6). Although each subsystem may be observed independently, immaturity or disorganization in one system will affect the others. The high–risk infant may not have sufficient subsystem maturity (Miller & Quinn-Hurst, 1994: 507).

Factors Influencing the Sleep Patterns of Premature Infants in intermediate care units

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: 255).

Some of preterm infants may spend 3-4 months in the intensive care nursery (ICN). The noise and intervention in the nursery may provide continuous stimuli to the infants. This stimulation may interfere with the development of sleep during a critical period of central nervous system maturation (Mckenna, Thoman, Anders, Sadeh, Schechtman and Glotzback, 1993: 277). From this study and review literature, the researcher can conclude that factors influencing sleep patterns in premature infants are as follows:

1. **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: 4).

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 (Walke, 1987: 987). Most research has indicated that continuous exposure to light can result in endocrine changes, changes in biological rhythm, and sleep deprivation (Catlett & Holditch-Davis, 1990: 23). Low birth-weight infants have under-developed retinopathy of prematurity (ROP) or other visual disorders. The bright light in the nursery, which is a major source of stimulation, may interfere with the infant state and sleep patterns (Lotas, 1992: 40). It is worth considering decreasing the exposure to light by covering the top of the incubator with a blanket as dim lighting will improve sleep patterns, decrease motor activity, decrease heart rate, improve feeding experience and increase the weight-gain of the infant. Also, all these things can decrease the incidence of retinopathy of prematurity (NANN, 1995: 8).

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 & Holditch-Davis, 1990: 22). Noise pollution leads to a decrease in oxygenation, an increase in intracranial pressure, heart rate, and respiration rate. Noise will disrupt the sleep state 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 & Chambers, 1995: 72).

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: 9).

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: 928). Medical and nursing care present the main problems to preterm infant that survive the neonatal period (Catlett & Holditch-Davis, 1990: 19-21). 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 paediatrician 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: 987). Most published data isolate the factors that create the tactile symbols: duration, location, action, intensity, frequency and sensation (Liaw, 2000: 84). Sparshott (1994) divided procedures into 3 categories of environmental disturbance.

1. Pain

Several studies have shown that premature infants are capable of responding differentially to tissue damage versus handling. Pain response demonstrated by the infants has both behavioral and physiological components (Johnston, Stevens, Franch, Jack, Stremier & Platt, 1999: 587). In the newborn infant, crying is a recognized behavioral index of stress, while cortisol is its biological index. High levels of corticosteroids are found during periods of fussiness or crying, whereas a low corticosteroid level is associated with sleep (Gill, White & Anderson, 1984: 216). An increase in corticosteroid may induce hyperglycemia and metabolic acidosis in a premature infant, and serum growth hormones are decreased in stressed infants (Modrcin-McCarthy, McCue & Walker, 1997: 66). Painful procedures include intubation, chest drain insertion, venupuncture, heel prick, suctioning, intramuscular injection, wound cleansing, lumbar puncture, aterial or suprapubic stab (Sparshott, 1994: 269).

All infants responded to six identified painful forms of procedures: venipuncture or heelstick; suctioning; dressing changes; insertion of a naso-gastric tube; application and removal of tape; and discontinuation of an intravenous catheter (Evans, Volgelpohl, Bourguignon & Morcott, 1996: 33-34). During painful procedures, the infants are more likely to be awake and less likely to be in quite sleep than during routine nursing care. All but the youngest and sickest preterm infants are likely to cry, although the length of time until crying begins depends on the sleeping or waking state the infant is in at the beginning of the procedure. Healthy full-term infants have the longest latency to cry when in quiet sleep, but whether preterm infants show a similar pattern is unknown. Immediately after a painful procedure, the full term infant is likely to remain awake (Holditch-Davis, 1998: 930).

2. Discomfort

Jones et al found that discomfort was ranked the prime factor to sleep loss in the intensive care unit (Webster & Thomoson, 1986: 451). Discomfort can be ascribed to such things as such as monitoring, physical examination, extubation, taking chest physiotherapy, electrode removal, rectal temperature measurement, passage of nasogastric or orogastric tube, intravenous medication, splinting, physical restraint, urine bag removal and adhesive tape removal (Sparshott, 1994: 267). Intravenous administration of medication is not considered to be painful although some antibiotics are somewhat caustic to the blood vessel, and the pressure of the IV administration bolus can be uncomfortable (Evans, Vogelpohl, Bourguignon & Morcott, 1997: 36). The integrity of the skin is vital to both the physiology and psychology of the newborn baby. Nurses should be aware of this when siting an electrode and using adhesives. Following a traumatic procedure, the caregiver should console the baby in the way that suits it best, and parents should be encouraged to play the role of comforter, placing one hand very gently over the top of the baby's head and the other hand very gently over the trunk (Sparshott, 1994: 270-271).

3. Disturbance

A growing premature infant is subjected to procedures in this category most of all. Disturbances include nappy change, position change, nakedness, weighing, overhandling, feeding by naso-gastric or oro-gastric tube or bottle-feeding in a weak infant (Sparshott, 1994: 269). 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 caregiving situations (Brandon, Hoditch-Davis & Beylea, 1999: 226). 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 stimulation (Peter, 1999: 92).

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 & tucker, 1995: 424-5).

2. Age

Age is the most powerful determinant of a person's sleep behavior (Webster & Thompson, 1986: 450). 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 & Sclabassi, 1995: 316). 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 &

Gartside, 1999: 463). 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 & Gastside, 1999; 467).

3. Severity of illness

The sleeping and waking states of infant interaction involve 3 interactive systems.

3.1 Respiratory system

The respiratory system is more affected by sleeping and waking states than the circulatory system. The nervous system's control of breathing varies in different states. In quiet sleep, metabolic controls and the maintenance of acid-base and oxygen homeostasis is the primary stimulus for breathing. Respiratory activity responds differently to chemical stimulation in different states. Both arterial oxygen and carbon dioxide levels are lower in active sleep because of hypoventilation inequalities in this state. In addition, arousal in response to hypoxia is shown in active sleep. As a result of these different neurologic controls on breathing, a number of respiratory variables in both term and preterm infants are influenced by sleep and waking states. Respiration rates are higher and more variable in active sleep. Active sleep has also been shown to result in hypoventilation in preterm infants because of the central inhibition of spinal motorneurons and poor coordination between chest and abdominal muscles. In addition, paradoxic movements of the chest wall and abdominal muscles during breathing are common during active sleep in the premature infant (Holditch-Davis, 1998: 928).

3.2 Neurological system

There is a close relationship between sleep/wake states and CNS functioning, because sleeping and waking states are assumed to reflect the underlying activation of the CNS. Four factors depict this interrelationship. First, sleeping and waking states exhibit a large amount of development in the first year of life, which is the time of the most rapid CNS development. Sleeping and waking states affect neurologic responses. Infants with neurologic abnormalities exhibit abnormal sleeping and waking patterns. Finally, sleeping and waking states can predict the developmental outcome. Infants exhibit different neurologic responses in different sleeping and waking states. The magnitude of neurologic reflexes is known to differ greatly in different states. At term, a premature infant with intraventricular hemorrhage has lower arousal, determined by the NBAS scoring system, than a healthy term infant. Abnormal crying patterns have been observed in infants with neurologic injuries, hyperbilirubinemia or at risk to Sudden Infant Death Syndrome (SIDS). In addition, infants exposed prenatally to drugs or alcohol exhibit abnormalities in their sleep/wake state patterns, possibly as the result of the neurologic impact of the substances (Holditch-Davis, 1998: 927).

3.3 Circulatory system

Sleeping and waking states affect the infant's circulatory system. Overall, heart rate is higher in the waking than in the sleeping state. The mean heart rates of the two sleep states are very similar, but the heart rate is more variable in active sleep. This difference in variability is so large that it is possible to differentiate between the two sleep states on the basis of heart rate variability. Sleeping and waking states also affect the infant's circulation. Cerebral blood flow is highest in waking. It is significantly higher in active sleep than in quiet sleep in full terms (Holditch-Davis, 1998: 928). Cyclic fluctuations (CF) in cerebral blood flow (CBF) and velocity (CBFV) occur with a frequency ranging from 1.5 to 5 cycles/min. These fluctuations probably result from an immature, underdamaged autoregulation of the cerebral vasculature. In the neonate, cerebral blood-flow is known to be affected by behavioral state. Metabolic linkage of brain blood –flow is related to the level of neuronal activity under both physiological and pathological conditions. Rehan et al (1996) reported that the prevalence of cyclic fluctuations in cerebral circulation in a healthy premature infant was not affected by the sleep/wake state or respiratory pattern. The amplitude of these cyclic fluctuations was significantly greater in AS than in QS and in the periodic or apniec type of respiratory pattern than during regular breathing. These findings suggest that sleep states and the respiratory pattern affect the cerebral blood flow variability (Rehan et al, 1996: 357-367).

4. Gestational influences.

Newborn behavior develops over the course of gestation under the influence of genetics as well as exposure to maternal metabolic and phychological 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: 16).

Research indicates 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, that 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 awake and crying (Roughton, Schneider, Browley & Coe, 1997: 92). 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: 957).

5. 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 apniec pauses in premature infants (McKenna, Thoman, Anders, Scdeh, Schechtman & Glotzbach, 1993: 16).

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. Core temperature, for instance, has a strong effect on sleep architecture. Temperature changes affect respiratory control systems in the immature central nervous system. Elevation in ambient and core temperatures not only increases apneic episodes, but also increases the amount of active sleep or changes the number of transitions into active sleep. The phenomenon of state-dependent changes in mean rectal temperature in neonates based on electroencephalographic sleep is unreported. Higher mean rectal temperature during active sleep and the alteraction of temperature responses during transition to quiet sleep in the preterm infant suggest alteraction in brain function because of a preterm infant's adaptation to the extrauterine experience (Scher, Dokianahis, Sun, Steppe, Guthrie & Sclabassi, 1994: 191-4). The preterm infant has a very small diurnal fluctuation in body temperature, the amplitude of which increases with increasing age. In many of these infants, a servo-control probe attached to the abdomen or back is used to maintain the infant's body temperature at a fixed level. Given the small amplitude of body temperature rhythm seen in premature infants, it is of interest to discover how the neonatal intensive care unit influences the evolving temperature rhythm and, hence, other development systems, such as sleep and wakefulness (Mekenna et al, 1993: 277).

6. Sleep position

One method of understanding the acute clinical effects of sleeping positions would be to routinely place infants in both the prone and supine positions during sleep before discharge from the hospital at a post-conceptional age of 36 weeks, because most preterm infants are discharged from the hospital around this corrected age and the results are clinically applicable for discharge planning. Masterson et al, demonstrated that preterm infants with gestational ages ranging from 28 to 34 weeks recorded over 12 to 57 postnatal days spent more time in wakefulness, had less sleep and higher metabolic rates in the prone position than in the supine position. They suggested that less sleep was the result of a reduction in QS and increased wakefulness because there is no change in the percentage of time spent in AS between the two positions. Goto et al also found that the sleeping position affected the sleep architecture and heart rate variability in preterm infants, predominantly in the first sleep cycle after feeding. It is known that the ingestion of food increases the metabolic rate. This change in the metabolic rate could influence the temporal pattern of sleep during interfeed periods. The duration of QS is less in the supine sleeping position but overall percentages of sleep state and total sleep were not affected by the sleeping position (Goto et al, 1999: 603-9).

7. Feeding time

Feeding is a very demanding task, often exceeding what has been asked of an infant up to that point. If the infant is preterm, it has an immature CNS with weak movement patterns, disorganized state, and oral structures that do not function as those of a term neonate. Its tongue and jaw movements are affected by immature development, leading to poorer control of sucking, swallowing, and breathing patterns. Behavioral patterns include weak, poorly sustained sucking and inadequate state control during feeding (Morris & Klein, 1987 cited by Blackburn & Vandenberg, 1998: 958).

Feeding times and hunger are known to have a great influence on the patterns of sleep and wakefulness in newborn infants. Quiet wakefulness or a sleep condition is most often found after feeding (Karch et al, 1982: 40). In normal infants born at term, Harper and his colleagues found that the sequence and cyclicity of active or rapid eye movement (REM) sleep followed by quiet or non-rapid eye movement (NREM) sleep was more predictable following feedings than following non-feeding periods of wakefulness. Based on these findings, it was suggested that feeding serves to reset the mechanisms that regulate the timing of sleep-state cycles (Harper, 1977 cited in Myers et al, 1998: 344). Feeding the premature infant may be difficult, because the baby gets lazy during feedings. The usual parental ministrations of talking to the baby, soothing with touch, or holding it upright on the shoulder may not work with a fussy, irritable preterm infant. The preterm infant's behavior may be so disorganized, unpredictable, or misunderstood by the parents that an appropriate response is not possible (Dryfus-Brisac, 1970: 582). Similar to term infants, preterm infants demonstrate differences in sleep-wake patterns based on methods of feeding, with preterm breastfeeding infants crying significantly more. In general, both feeding methods groups evidenced the onset of day-night cycling, with more sleep during the night than the day and more wakefulness during the day than night, whereas infants exhibiting early evening crying were more likely to be formula-feed, suggesting differing patterns of crying with feeding type. Feeding methods and postnatal age were the only factors that were found to explain sleep-wake pattern differences in this sample of preterm infants (Thomas, 2000: 146-9).

The pattern infants in our sample had increasing ability to maintain quiet alertness from 34 to 40 weeks PCA during the nutritive sucking segment of the protocol. The infants in our study who were most often in a drowsy or low level alert state at the beginning of our protocol became aroused when they were placed in the arms of the research nurse at the beginning of data collection, with the increased quiet alertness noted at the initiation of feeding at least briefly at 34 weeks PCA and more so at 40 weeks PCA. It appears that nutritive sucking modulates and enhances the infant's behavioral state to a more quiet alert state (Medoff-Cooper, McGrath & Bilker, 2000: 64-70).

8. Drugs

Sleep pattern disturbance is frequently found to be a side effect of drugs prescribed for pain relief. Barbiturates, meperidine and morphine tend to decrease REM sleep. Sedatives are not effective when used alone in the management of sleep pattern disturbances. Especially, chloral hydrate is a useful sedative because it facilitates relaxation and eases sleep stage transitions with minimal effect on REM sleep (Schibler, 1990: 291). Drugs used to treat reactive airway diseases, such as theophylline, also affect all these respiratory variables, resulting in a decrease in respiratory pauses and periodic respiration (Holditch-Davis, Edwards & Wigger, 1994: 298). The methylxanthines increase the amount of wakefulness and decrease the amount of active sleep in addition to their direct effects on respiration (Holditch-Davis, 1998: 92).

Assessment of sleep patterns in premature infants

Sleep and wake state are ubiquitous among humans and animals, appearing before birth and continuing through adult life (Groome, Swiber, Atterbury, Bentz & Holland, 1997:127). Characteristic of sleeping and waking states are clusters of behavior that tend to occur together and represent the individual level of arousal its responsiveness to external stimulation, and the underlying organization of central nervous system activity (Ashton, 1973 cited in Holditch-Davis, 1998: 661). Prechtl (1974) said that the consolidation of spontaneous behaviors and physiological system into discrete states is a reflection of the maturation of brain inhibitory and feedback control mechanisms. Furthermore, behavioral states act as both a gating mechanism for the infant's perception of internal processes and external events, and a moderating mechanism for the infant's behavior. These functions play an important role in mediating interactions between an infant and the caregiver, suggesting that behavioral states reflect ongoing CNS activity while helping to shape the infant's neurobehavioral development (Groome, Swiber, Atterbery, Bentz & Holland, 1997: 127). As for the interaction of infants, Gorski, Davidson and Brazelton found that the preterm infant had three stage of neurosocial behavioral development. The first stage is a period of physiological reorganization or "turning in". The infant less than 32 gestational weeks of age may be overwhelmed by the environmental stimuli. The second stage is the beginning of organized behavioral responsiveness or "coming-out". By 34 to 35 weeks of conceptual age, the infant has achieved a minimal capacity to maintain physiological homeostasis and begins to respond readily to, and occasionally seek out, social interaction. The final state is a period of active reciprocity with the social environment. This phase of development is seen between 36 and 40 weeks of conceptual age and continues throughout infancy (Blackburn, 1983: 79).

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 which begin to emerge at approximately 35 weeks 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, Porges & McClenny, 1996: 786).

There are three approaches to sleep measurement: polysomnography, self-reports, and observations. Although polysomnography is considered the most accurate, self-reports and observations have been used more often by nurse investigators (Beck, 1988:257). Newborns' sleep states have been studied using direct behavioral observations, film and video recording, parental reports, electrophysiologic recordings and motility recordings. For most studies, the periods of observation have been relatively brief, lasting from 30 minutes to 3 hours. Only a few studies have used longer observation, ranging from 6 to 24 hours (Freudigman & Thoman, 1993: 373). Parmelee et al coded records of both term and preterm infants according to two different methods and found similar discrepancies. The present investigation has identified trends in the distribution of sleep and wakefulness within the range of previous findings. Results of validation studies with the present system show that good agreement between observers exists in recognizing behavioral and EEG patterns in both term and preterm infants (Stefanski, Schulze, bateman, Kairam, Pedley, Masterson & Jame, 1984; 61).

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 & Garbanati cited in Yabuichi, Watanabe & Okada, 1987: 134).

1. 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 17 weeks. Dreyfus-Brisac (1968) describes the respiration of the 24 to 26 week premature infant as predominantly irregular or semiregular and with change during movement. By 28-30 weeks, the respirations are almost exclusively irregular. We observed 6% of 20 sec epochs as having regular respiration at 32 weeks, 24% at term, and 54% at 8 months. Again, there is evidence for the increasing development of a CNS controlling mechanism (Parmelee & Stern, 1972: 203).

At 31 weeks of gestation, in phase relationships between thoracic and abdominal respiratory movements prevail in quiet sleep, and 180-degree phase-shift respiratory movements dominate over active sleep. These "see-saw" respiratory efforts may result from the rib cage collapse caused by intercostal muscle hypotonia during active sleep (Kohyama, 1998: 75).

2. Eye movements

In premature infants, 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 (1963) credits Denisova and Figurin (1926) as being the first to describe changes in body activity and respiratory rate in babies while sleeping. Dreyfus-brisac (1967) 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 clustered 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 (Parmelee & Stern, 1972: 202-3). Defining the minimum interval between rapid 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: 76).

3. 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 by Eckstein and Paffrath, 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 movement. The numbers of no movement epochs increase to 60% at term and 81% at 8 months. The frequency of periods of movement decrease accordingly. These changes indicate a rapid growth in inhibition of body activity in sleep during this period (Parmelee & Stern, 1972: 202).

Currently, four standardized systems for scoring behavioral observations of sleep-wake states are used. The systems were developed by Brazelton (1984), Thoman (1990), Als (1982) and Anderson (Gill et al, 1988). These systems define states in very similar ways and are probably equally useful for clinical purposes (Holditch-Davis, 1998: 93-23). All of these behavioral observation systems are outlined below;

1. Brazelton's state scoring system

T. Berry Brazelton is a pediatrician from Harvard University in Cambridge, Massachusetts. He and his colleagues developed a state scoring system to be used as a part of behavioral evaluation of newborn infants, the Neonatal Behavioral Assessment Scale or NBAS (Brazelton, 1984). This state scale was derived both from Dr.Brazelton's clinical experiences and from the existing state systems of Prechtl and Beintema, and Thoman. Brazelton's state scoring system consists of six states: deep sleep, light sleep, drowsy, alert, considerable motor activity, and crying. This state system is easy to use because the differences between the states are fairly obvious, so it is in widespread use. However, this scoring system does have some limitations for use in research. Firstly, because there are only six states, it is not sensitive enough to identify differences between normal full-term infants and infants with perinatal complications. Moreover, the NBAS state scoring system is appropriate for use only with infants between 36 and 44 weeks' gestation and those born after 44 weeks' gestation are not well served by this system (Holditch-Davis, 1998: 923). Each state serves a critical purpose; sleep for rest and renewal; crying for emotional release and need cueing, and quiet alert for learning and interaction. Drowsy and active alert states provide transitions between the others (Karl, 1999: 282).

2. Thoman's State Scoring system

Evelyn B.Thoman is a psychobiologist working at the University of Connecticut. She developed her first state scoring system in 1975 based on the work of Wolff(1966) and Kornes (1972). The Thoman state scoring system consists of 10 sleeping and waking states: alert, non alert, waking activity, fuss, crying, daze, drowsiness, sleep-wake transition, active sleep, active-quiet transitional sleep, and quiet sleep. Thoman's state scoring system has a number of advantages. The documented reliability and validity of this system is of value to researchers. The sleeping and waking states are sufficiently differentiated to enable them to be used with infants with perinatal complications. This system has also been used with preterm infants and with infants older than one month after term. The states in this system can also be combined when an investigator does not need such fine discrimination. However, this scoring system has two disadvantages. Firstly, a 10-state system is somewhat more difficult to learn than a 6-state system and, as it is not as generally used as Brazelton's, it is more difficult to obtain training in its use (Holditch-Davis, 1998: 923).

3. Als'State Scoring System

Heidelise Als is a psychologist working at Harvard Medical School with Dr. Brazelton and his colleagues. She has worked with these colleagues to modify the NBAS to make it more appropriate for use with the premature infants. The Assessment of Preterm Infants' Behavior (APIB) is administered in the same way as the NBAS, but the infant's behavior is scored in much greater detail so as to quantify not only the infant's skills but also the infant's reactivity and stress in response to environmental stimulation. The APIB test is administered to infants between 36 and 44 week' GA. The 13 states are: very still deep sleep, deep sleep, light sleep, "noisy" light sleep, drowsy with more activity, drowsy, awake and quiet, hyperalert, bright alert, active, considerable activity, crying, and lusty crying. The Als' state scoring system has a number of advantages and disadvantages for the clinician and researcher. Firstly, Als' system is much more complicated than Brazelton's, on which it is largely based. Secondly, in as much as the APIB was never intended for use with infants older than one month after term, the state scale may not adequately capture the states of older infants (Holditch-Davis, 1998: 924).

4. Anderson's State Scoring system

Gene Granston Anderson has a doctorate in nursing and is now a researcher working at Western Reserve University in Cleveland, Ohio. She has developed a 12 state scoring system, the Anderson Behavioral States Scale (ABSS), to be used with preterm infants based on her own observations of these infants and on the work of Parmelee and Stern (1972). The ABSS consists of: very quiet sleep, quiet sleep with irregular respiration, restless sleep, very restless sleep, drowsy, quiet awake, alert inactivity, restless awake, very restless awake, fussing, crying and hard crying. The ABSS is the newest state scoring scale and it has had only limited trials outside of the nursery. Thus, the reliability and validity of this scale are as yet not established. Because the ABSS was designed for use with preterm infants, the utility of this scale for full-term infants and older infants is unknown, although it should be applicable for healthy full-term infants. The ABSS may also be difficult to learn because of the complexity of its 12 states, so this is not a good scoring system to use if one is primarily interested in studying sleep states and wants to compare findings with other studies (Holditch-Davis, 1998: 924).

However, the ABSS is particularly useful for preterm infants because it breaks down the typical five or six states into 12 states. This very fine delineation more closely captures the behavioral states exhibited by preterm infants because differentiating sleep-wake states are more difficult in these infants. Scoring involves observation during a 60 second spell and then scoring the highest state of occurrences and nonoccurrences recorded by inter-observers (Medoff-Cooper & McCranth & Bilker, 2000: 67).

This research used the observation of behavioral states from the scale originated by Parmelee and Stern (1972). They said, "In our behavioral studies of prematures and newborns, we decided to use eyes open and eyes closed and amount of body activity as one measure of state. This was a practical decision based on the fact that these criteria can be readily observed and used over a wide age range, including the fetus and premature infants. These two variables were combined into our scale and for coding directly observed, not electronically monitored" (Parmelee & Stern, 1972: 200). The scores are grouped into sleep scores (0-4): quiet sleep (0-1) and active sleep (2-4), quiet alert (5-6), active alert (7-8), and crying (12) (Michaelis, Parmelee, Stern, Haber, 1972: 211). These characteristics can be described as follows:

1. Quiet sleep

Quiet sleep is considered the most important state for the study of the evolution of the central nervous system's control of behavior, because each parameter shows evidence of the development of inhibitory and feedback controlling mechanisms. Furthermore, the concordance of these parameters for sustained quiet sleep periods requires complex interaction of the brain stem and higher centers for some unity to control. It is tempting to speculate that the progressive development of this highly controlled state is a manifestation of the development of cortical control. This idea is supported by the evidence for cortical control of show wave sleep in animals, particularly the forebrain inhibiting area. However, it must be kept in mind that facilitory and inhibitory mechanisms are maturing at all levels of the CNS during infancy, so not all of the changes in sleep states can be attributed to the cortex (Parmelee & Stern, 1972: 213-4). Caregivers trying to feed infants in deep sleep will probably find the experience frustrating. Infants will be unresponsive, even if caregivers use disturbing stimuli to arouse infants (Blackburn, 1983: 81). The isolettle should be covered so as not to overstimulate the baby. If at all possible, the baby should not be interrupted for medical procedures or for social interaction as the baby needs this quiet time (Healey, 1985: 5).

2. 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 infants spend about 80%. (Balsmeyer, 1990: 447). REM or active sleep, in which the brain and 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: 159-160). Especially, it is readily more responsive to internal and external stimuli. While infants stay in 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: 80s). 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 or two beforehand (Healey, 1985: 5).

3. Drowsy state

The drowsy state acts as a transition between the other states. Newborns move smoothly through the range of these states, using each one purposefully. Some newborns are unable to manage states appropriately, such as those who are too often either crying or drowsy (Karl, 1999: 286). The drowsy premature infant may be unable to engage in eye-to-eye contact with the parents or be able to sustain it only for short a period of time (Gardner, Garland, Merenstein & Lubchenco; 1993: 583). Drowsiness increases over time during routine and procedural care, there being more drowsiness in routine care than in either contact or procedural care (Brandon, Holditch-Davis & Beylea, 1999: 223). Caregivers can provide something for infants to see, hear, or suck, as this may arouse them to a quiet alert state, a more responsive state. Infants left alone without stimuli may return to sleep state (Blackburn, 1983: 805). Also, many babies can be held, providing they show none of the aversive responses. It is a quiet time to interact with the baby, generally by holding the baby if she tolerates this, positioning the baby, and/or just putting one hand on the baby's abdomen or back. Many times, just contact by hand is the most appropriate intervention that we can give a baby. If we have been interacting with the baby and the baby starts to drop into this state, we should realize that the baby is getting overloaded and is starting to fatigue (Healey, 1985: 6).

4. Quiet alert

Quiet alertness is the most fleeting state. It usually progresses to fussing and crying relatively quickly. Newborns who spend more time in this state are likely to receive move social stimulation and have a slight advantage in cognitive development (Berk, 1996: 159). Preterm infants can reach the quiet alert state, but often only for a few seconds. As the baby matures, its periods of quiet alertness will increase (Zaichkin, 1996: 59). In this state, the infant has a bright alert look, with attention focused. The quiet alertness can be noted at the limitation of feeding, at least briefly, at 34 weeks PCA and increases at 40 weeks PCA (Medoff-Cooper, McCrath & Bilker, 2000: 64-70). The development of attentive behavior proceeds simultaneously with the development of quiet sleep and sustained sleep periods. These concurrent events again suggest the development of inhibitory and controlling feedback mechanisms made possible by development (Parmelee & Stern, 1972; 209). This state is the best time to have auditory and/or visual input. It is also very important only to present one type of modality at a time. An example of this would be holding the baby up and just visually fixating on her face. Many times this is more than enough stimulation for the baby. If the baby appears to tolerate she, we can begin talking to the baby. Again, always be sure to look for the physiological signs of head turning away, skin mottling, fisting of the hands, arching irritability, lethargy, or what is called shutdown. These are signs that the baby is getting too much input (Healey, 1985: 6).

5. Active alert

The infant's activity increases in the active alert. During this state, the baby is unable to focus attention and has a decreased tolerance for continued stimulation. If we continue to speak to the baby or try to make eye contact, it may escalate to crying. Conversely, if we lower our voice or discontinue the interactions, it may return to the quiet alert state (Zaichkin, 1996: 59). A baby is unable to maximally attend to caretakers or the environment, either internally (hunger, fatigue) or externally (wet, noise, handling). The stimuli of caretakers and the environment will increase motor activity and sensitivity (Gardner, Garland, Merenstein & Lubchenco, 1993: 571). In the preterm infant, this state is where we often try to soothe the baby back into state four. This can be done very easily by swaddling the baby, holding the baby with firm, gentle pressure or holding she in a flexed, semi-upright position (Healey, 1985: 7).

6. 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: 160). 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 (Holditch-Davis, 1998: 924). The premature's maintenance of states in the quiet awake and active awake range indicates an ability to inhibit excessive arousal and to sustain a better controlled state while the full-term's steady crying represents uncontrolled and excessive irritability (Parmelee, Wenner, Akiyama, Schultz & Stern, 1967: 73).

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: 18-19).

CHAPTER III

METHODOLOGY

Research Design

This study is descriptive research, designed to study sleep patterns in premature infants. The focus was to determine sleep patterns of premature infants and the effects of procedures on their sleep patterns.

Population and Sampling

In this study, the population was premature infants who were admitted to the premature unit, Department of Pediatrics, Faculty of Medicine, Siriraj Hospital, Mahidol University. Thirty subjects were selected by purposive according to the following criteria:

1. Growing preterm infants with a gestational age of between 32 - 37 weeks at birth.
2. Admitted for more than 1 week.
3. No history of maternal substance abuse, alcohol consumption, no sedation during labor and no abnormalities of the endocrine system.
4. Absence of neurological, respiratory, circulatory and congenital anomalies.
5. Not receiving sedative substance and bronchodilator drug for at least 8 hours before study.

6. Receiving cranial ultrasonography.

Setting

This study was conducted at the premature infant unit with a total of 36 sick infants in the intermediate and convalescent stages. On admission, the premature infant must be kept warm in an incubator in order to treat and observe clinical sign. The incubator temperature was set at a level necessary to maintain normal body temperature. Afterwards, the premature infant must receive continuous care every day until she was physiologically stable and her condition changes to that of a growing premature infant. Procedures such as assessing infants, taking vital signs, changing diapers, sometimes heel stick and feeding were organized around the feeding schedule, which took place every 3 hours. At the time of this study, all infants slept in a supine position and in a nest. The room temperature was between 25-26 ^{0} C. The environment in the premature infant unit was brightly and noisy. All isolettle incubators were covered with a blanket.

Instrumentation

The instruments used in this study were as follows:

I. Demographic data of infants including gender, birth weight, gestational age, post-conceptual age, date of birth, diagnosis, treatment, drug, feeding schedule and temperature control.

II. The observation record for duration, sleep-wake state and type of procedure of premature infants.

III. Criteria of sleep states assessment was modified from the sleep-wake state of premature infants devised by Parmelee & Stern (1972: 200) divided into 6 categories: deep sleep, active sleep, drowsy sleep, quiet alert, active alert and crying.

IV. The observation record of procedures took place over 8 hours, a modification of the method used in a study by Jarungphan et al. (1999).

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

a. Video camera Panasonic Model. No. NV-Vx7EN

b. Video cassette (size 4x7.3 inches)

Validity and Reliability

1.Validity

The researcher asked five experts in this field to validate the tests. Two of them were instructors in the nursing department; one of them was a specialist neonatologist; one had experience in the premature infant unit; and one had experience in the neonatal intensive care unit. Their suggestions were incorporated in this instrument. All five experts paid special attention to the accuracy and appropriateness of the content and were also in complete agreement.

2. Inter-rater reliability

The researcher and research assistant observed the sleep-wake state of premature infants from videotape. The research and assistant saw the video recording together, assessed the sleep-wake states and wrote on the observation record details of duration, sleep-wake state and type of procedure of premature infants from the 3 premature infant samples. The inter-rater reliability factor was analyzed by using a formula suggested by Polit and Hungler, in which the reliability coefficient should be .90 or better (Polit & Hungler, 1999:233) as follows:

$$\text{Inter-rater reliability} = \frac{\text{Number of agreements}}{\text{Number of agreements + disagreement}}$$

In this study, inter-rater reliability of assessing sleep-wake state minute by minute = 0.90

Data collection

The researcher and research assistant (16 years experience as a neonatal nurse) collected data as follows:

1. The researcher requested permission to collect data from the Faculty of Medicine, Siriraj Hospital.

2. The researcher explained the objective of the study and process of data collection to the head nurse and staff of the premature infant unit.
3. The researcher approached the parents of premature infants who met the study criteria to ask them to participate in this study. They were informed of the purpose 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.
4. After receiving consent from the parents, the researcher recorded data from the medical charts.
5. Data collection was conducted by the following procedures:
    5.1 The researcher located a camera beside the incubator 30 minutes before recording.
    5.2 The researcher recorded the sleep patterns of premature infants continuously from 7.00 a.m. to 3 p.m.
6. When the data collection was finished, the researcher assessed and reviewed the videotape again.

Protection of Human Subjects

The researcher ensured the protection of the subjects by meeting with the premature infants' parents to give them information about the advantages and disadvantages of participation in this study and the data collection strategy. The researcher answered the questions that they asked about the study. The parents of the premature infants had the right to decide whether participate in this study or not. After reassuring the parents of the subjects, they were asked to sign the consent form, but they could still cancel or withdraw from the study at any time.

Data analysis

The data was analyzed as follows:

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

2. Number of subjects and highest frequency of procedures classified by type of procedure.

3. Sleep patterns of premature infants between the post-conceptional ages of 34-36 weeks and 37-39 weeks

The researcher observed the sleep patterns of premature infants from videotape, and coded in the observation record for duration, sleep-wake states and type of procedures for the premature infants according to criteria states in the form as follows:

1. The researcher wrote a time (7.00 a.m.) in the start timing channel on the first record page. The complete data was collected for one hour. On the next page, the start of the next hour (8.00a.m.) was written in the start timing channel and so on until the 8 hours were completed.

2. The researcher assessed the sleep-wake states of the premature infants using the following criteria: eyes open or closed, respiratory pattern and body movement (See criteria of sleep –wake states in Appendix). The sleep-wake state had to be stable for at

least 1 min. The researcher counted and identified this state and wrote signals in the appropriate part of the time channel (QS, AS, DS, QA, AA and Cry).

3. If the infants received procedure while the researcher collected data, the researcher marked the time when the procedure began in the time channel and assessed the sleep-wake state pre-procedure, intra-procedure and post-procedure. The time was marked after the procedure was finished. About 1 minute after it was finished, the researcher's observation was continued for 5 minutes. For at least 3 in 5 minutes, a symbol indicating the type of the sleep-wake states was written in the part of the time channel (QS, AS, DS, QA, AA and Cry).

The researcher categorized procedure from the observation record over 8 hours, a modification of the study by Supatta Jarungphan et al (1999).

4. The researcher assessed sleep-wake states continuously for a total of 8 hours.

CHAPTER IV

RESULTS

This study was descriptive research aimed to determine the sleep patterns of premature infants and the effects of procedures on their sleep patterns. The sample consisted of 30 growing premature infants, between the gestational ages of 32 to 37 weeks at birth, who had been admitted to the premature infants' unit, Siriraj Hospital, between March and August 2001. The results of the study are presented as follows.

Part I Characteristics of the subjects

Part II Type of procedures

Part III Sleep patterns of premature infants

Part I Characteristics of the Subjects

Table I Frequency and percentage of the subjects classified by demographic data

Demographic Data	Frequency	Percentage
Sex		
Male	15	50.00
Female	15	50.00
Gestational age (weeks)		
32-33	14	46.67
34-35	13	43.33
36-37	3	10.00
Post-conceptional age (weeks)		
34-36	17	56.66
37-39	13	43.34
Birth weight (grams)		
1,000-1,250	2	6.67
1,251-1,500	7	23.33
1,501-1,750	15	50.00
1,751-2,000	3	10.00
2,001-2,250	3	10.00

Table I (continued)

Demographic Data	Frequency	Percentage
Relation between gestational age and birth weight		
SGA	6	20.00
AGA	24	80.00
Result of brain ultrasonography		
Normal	23	76.67
IVH grade I	7	23.33

As shown in Table I, the number of male and female subjects was equal. The majority of the subjects had a gestational age range of between 32 and 33 weeks (46.67%), a post-conceptional age range of between 34 and 36 weeks (56.66%), and a birth weight range of between 1,501-1,750 grams (50.00%). Most of the subjects were AGA (80.00%) and most of the results of the brain ultrasonography were normal (76.67%).

Part II Types of procedures

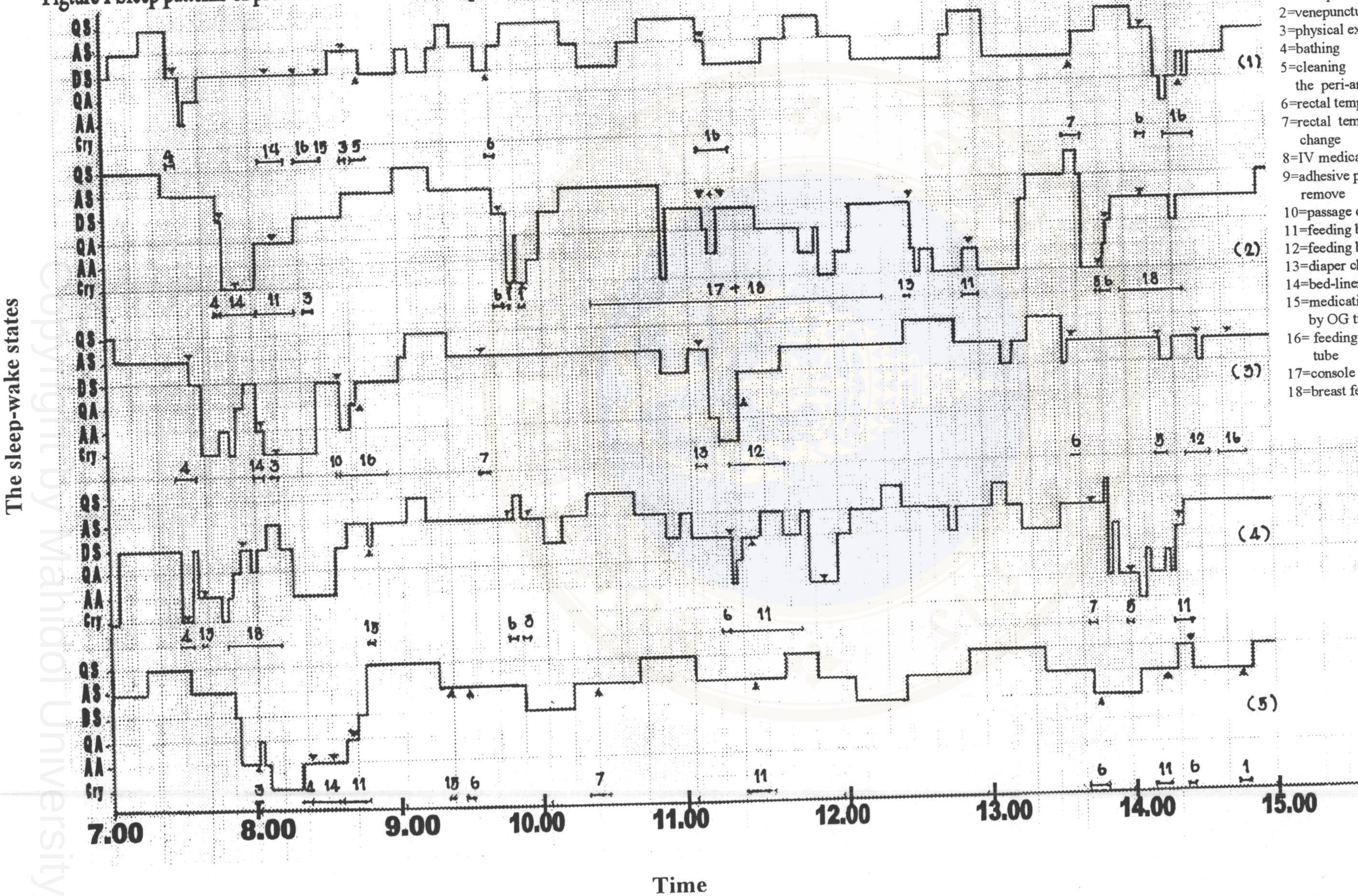
Table II Number of subjects classified by highest frequency of each procedure in 8 hours

Type of procedure	Number of the subjects	Highest frequency
1.Pain		
Heel prick	8	2
Venepuncture	2	1
2·Discomfort		
Rectal temperature	30	4
Physical examination	30	1
Bathing	30	1
Feeding by spoon	15	3
Cleaning the peri-anal region	20	4
Feeding by cup	10	3
Rectal temperature + diaper change	13	1
I.V. medication	2	1
Adhesive tape removal	2	1
Passage of OG tube	3	1
3.Disturbance		
Bed linen change	27	1
Diaper change	30	6
Feeding by OG tube	17	3
Medication by OG tube	11	1

As shown in Table II, the most frequent procedure that the majority of subjects received was diaper change (highest frequency of 6 times among all 30 subjects), while rectal temperature taking reached the highest frequency of 4 times among 30 subjects and cleaning the peri-anal region 4 times among 20 subjects.

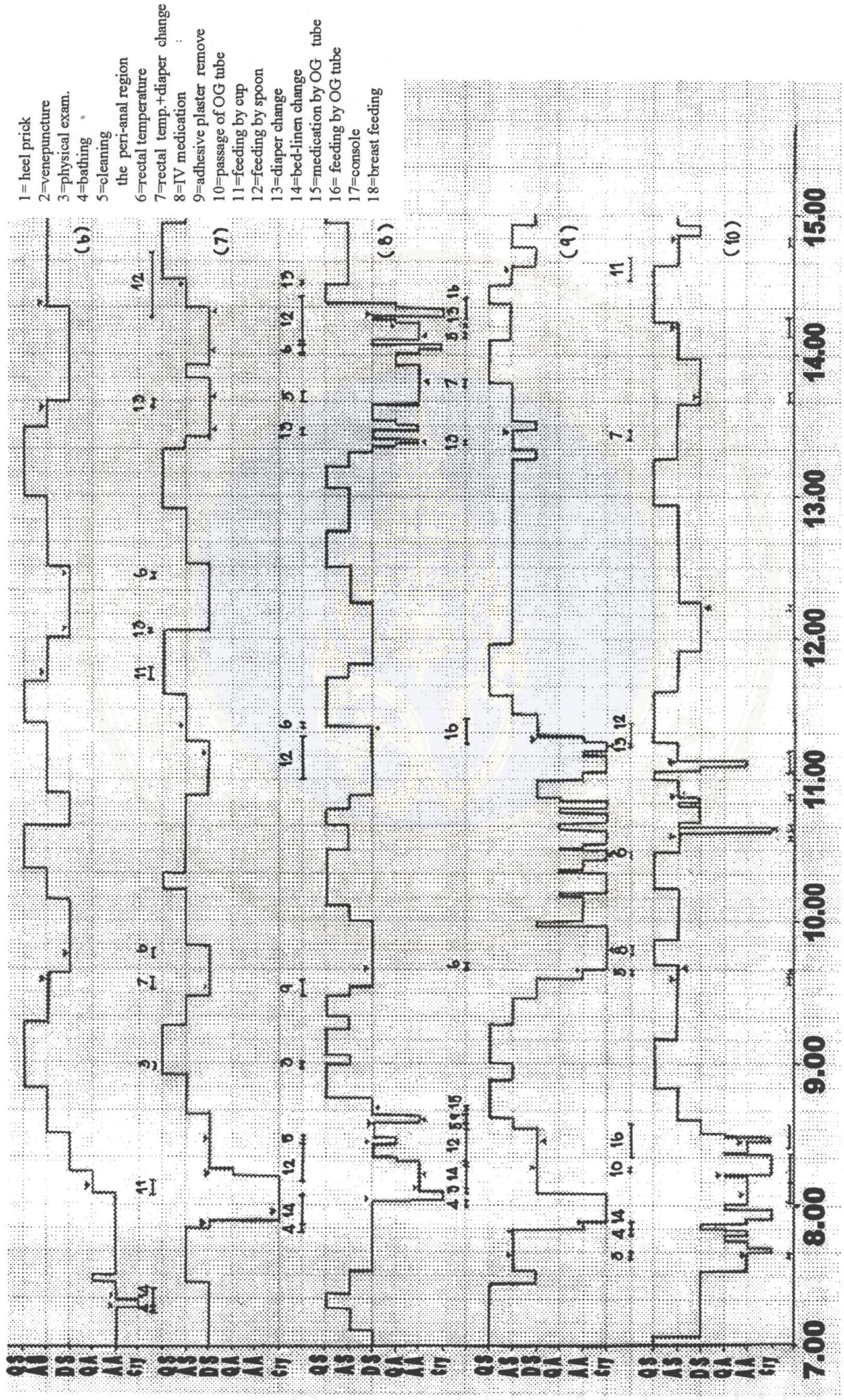
Part III Sleep patterns of premature infants

Figure I Sleep patterns of premature infants between post-conceptional age 34& 36 weeks



1= heel prick
2=venepuncture
3=physical exam.
4=bathing
5=cleaning the peri-anal region
6=rectal temperature
7=rectal temp.+diaper change
8=IV medication
9=adhesive plaster remove
10=passage of OG tube
11=feeding by cup
12=feeding by spoon
13=diaper change
14=bed-linen change
15=medication by OG tube
16= feeding by OG tube
17=console
18=breast feeding

Figure I (continued)



The sleep-wake states

Time

Figure I (continued)

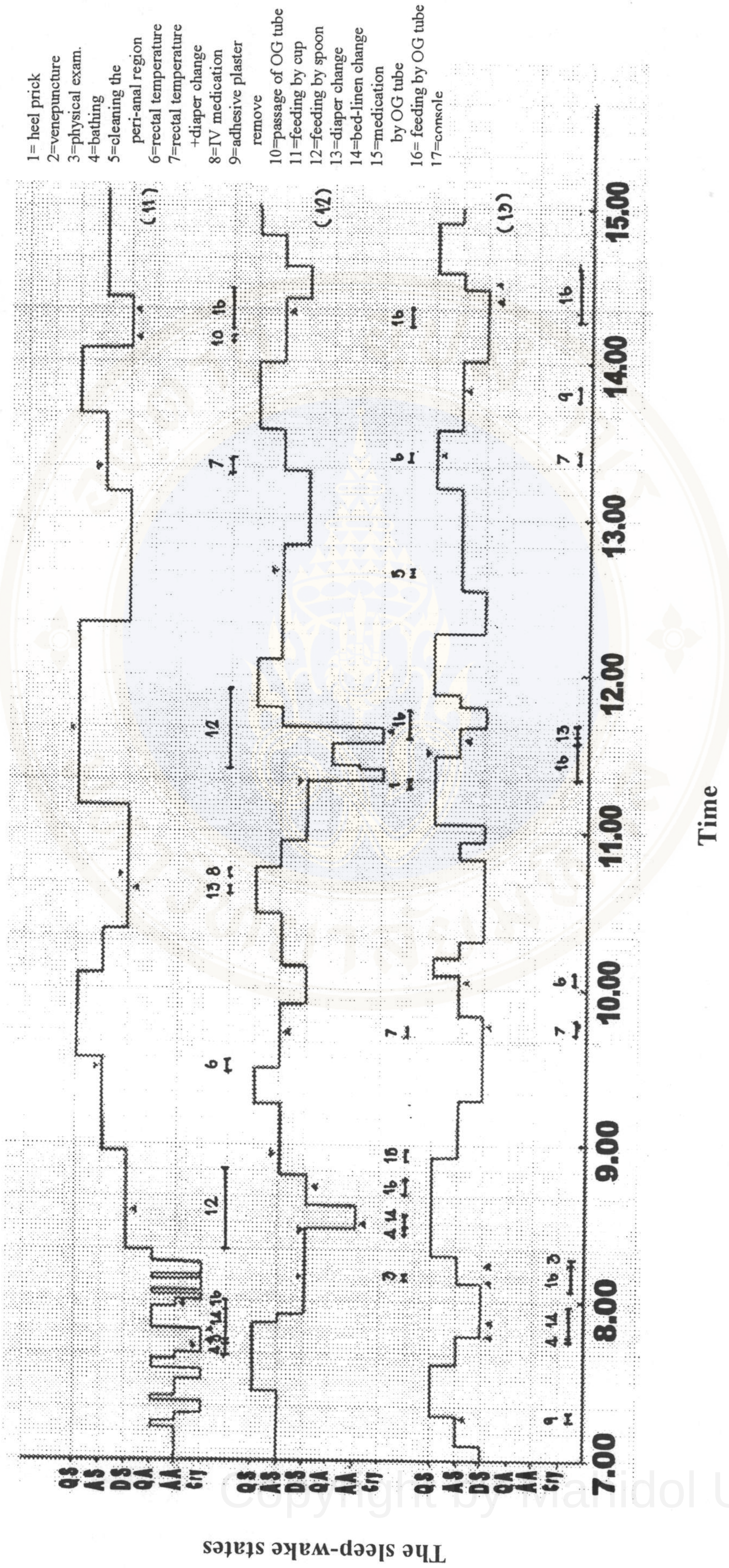


Figure I (continued)

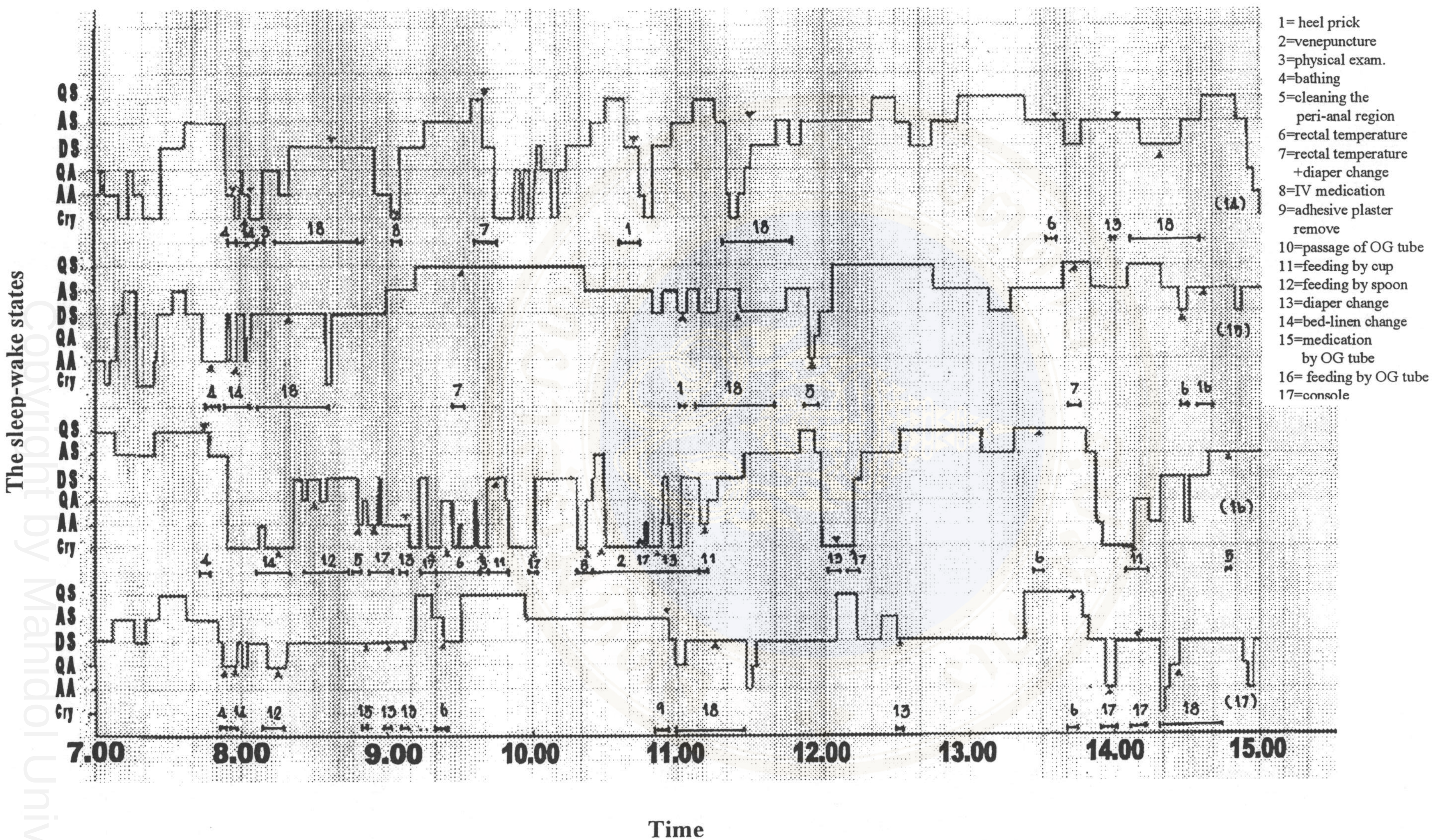


Figure I, shows that seventeen subjects had a post-conceptional age ranging of between 34 to 36 weeks. The subjects had an average total sleeping time of 270 minutes (56.25% of the total observation time) and average total waking time of 210 minutes (43.75% of the total observation time). The sleeping time can be divided into 2 states: quiet sleep and active sleep. The average duration of quiet sleep was 103 minutes (21.46% of the total observation time and 39 % of the total sleep time), while the average duration of active sleep was 167 minutes (34.79% of the total observation time and 61% of the total sleep time). The sleep state ratio of active sleep/quiet sleep was 61: 39. The waking time can be divided into 4 states: drowsy sleep, quiet alert, active alert and crying. The average duration of drowsy sleep was 141 minutes (29.38% of the total observation time); the average duration of quiet alert was 16 minutes (3.33% of the total observation time); the average duration of active alert was 26 minutes (5.42% of the total observation time); and the average duration of crying was 27 minutes (5.63% of the total observation time).

Sleep pattern of subjects aged between 34-36 weeks.

Sleeping patterns could be described as follows:

7.00 am - 9.00 am

During this period, the sleep pattern of the subjects were individually different and changed according to the procedures received. Most of the procedures consisted of bathing and changing bed linen. After bathing, the sleep pattern of most subjects changed from active sleep to crying state. In some cases, the sleep patterns changed from active sleep state to either drowsy sleep state or no change at all. The second most frequent procedure was bed linen change. This led to a change in the sleep pattern from active alert to crying state. The subjects were fed afterwards from 8.00 am to 8.30 am. After feeding (8.30 am – 8.45 am), they continued sleeping.

Besides bathing and changing bed linen, the subjects were also subjected to physical examinations, administration of medication by OG tube and adhesive tape removal. These caused little change or had no effect on their sleep patterns.

9.00 am - 11.00 am

During this period, most of subjects had similar sleep patterns which did not change when receiving procedures. They continued sleeping until 9.30 am – 10.00 am and woke up about 20 – 30 minutes thereafter. Most of the procedures were rectal temperature measurement and diaper change. After receiving these procedures, the sleep pattern of most subjects either changed from drowsy sleep to quiet alert state or remained in the original state. In some cases, their sleep patterns changed from active sleep to quiet sleep state.

According to the observation, 2 subjects (the 2nd and 14th subject) received heel prick during this time. As a result of this, their sleep patterns changed from active sleep to crying state and back to the original state after 6-10 minutes. In addition, one subject (the 9th subject) had her peri-anal region cleaned at 9.30 am, which led to a change from active alert to crying state. She then had an intravenous medication inserted causing her to be alert until 11.20 am and then she continued sleeping after feeding. . Furthermore, there was one subject (16th subject) who remained alert from 7.15 am to 11.00 am due to procedure all of this time.

11.00 am - 1.00 pm

During this period, most of the subjects had similar sleep patterns and did not change when receiving procedures. Most of the subjects woke up between 11.00 am and 11.30 am, and stayed in drowsy sleep. At this time, the subjects were fed. They continued sleeping after feeding (11.45 am). The sleep patterns of most subjects changed from drowsy sleep to active sleep and active sleep to quiet sleep. There were 1-2 cycles of sleep patterns during this time, covering from 17-108 minutes. Between 12.00 am and 12.30 am, they woke up and then continued sleeping again.

However, the 2 nd subject was alert all the time due to being fed and touched by her mother.

1.00 pm – 3.00 pm

During this period, most of the subjects had similar sleep patterns and did not change when receiving procedures. They continued sleeping until from 1.45 pm to 2.15 pm. Most of the procedures consisted of rectal temperature measurement and diaper change. These had little effect on their sleep patterns or no effect at all. Most of the subjects were awake. They were then fed their milk between 2.00 pm and 2.30 pm and then continued to sleep. The sleep patterns of most subjects changed from drowsy sleep to active sleep and active sleep to quiet sleep. There were 1-2 cycles of sleep pattern, which took about 22-65 minutes before waking.

It is interesting to note that even though one of the subjects (the 5th subject) received heel prick, the sleep pattern did not change. In addition, two subjects (the 4th and the 8th subject) who woke up for 60 minutes before feeding returned to the sleep state.

In conclusion, the sleep patterns of the subjects had active sleep at the onset. This lasted from 2 to 88 minutes ($\bar{x}$ = 17), then changed to quiet sleep for 3 to 70 minutes ($\bar{x}$ = 20) and then returned to active sleep again. The total of sleep cycles was between 4 and 11 cycles. Each sleep cycle lasted from 17 to108 minutes ($\bar{x}$ = 56).

In 8 hours, all subjects received an average of 12 types of procedures. The majority of the procedures involved feeding, temperature record and diaper change. The range of disruption was 42 to 203 minutes ($\bar{x}$ = 96). Seventeen subjects had varieties of sleep-wake transitions before they received the first procedure. While the subjects received procedures for the first time in the morning, they were always awake. Afterwards, they were fed. All the subjects then entered a drowsy state lasting from 2 to 52 minutes and then passed into sleeping states. The subjects were aroused after one to three sleep cycles. The total duration of waking time was 2-152 minutes. During waking, most of the subjects were in a drowsy state. The duration of this state was from 1 to 54 minutes ($\bar{x}$ = 15.80). Other recorded states were quiet alert for 1 to16 minutes ($\bar{x}$ = 3.26); active alert for 1 to19 minutes ($\bar{x}$ = 9.17) and crying for 1 to 22 minutes ($\bar{x}$ = 4.47).

<u>The Effects of procedures on sleep patterns</u>

Sleep-wake state transitions occurred around 20 to 70 times during the 8 hours ($\bar{x}$ = 36.5). They occurred due to both endogenous (infant) determinants (from 19 to 50 times [$\bar{x}$ = 27.70]) and exogenous (care giving) determinants (from 3 to 39 times [$\bar{x}$ = 10.65]).

Pain procedures

Heel prick

Six subjects received heel pricks once or twice per subject, with a total of 7 times and duration of 1 to 7 minutes ($\bar{x}$ = 3.21). During this procedure, in two cases the subjects' sleep pattern did not change, while the sleep pattern on most the other cases changed from the original state to crying.

Venepuncture

Only one subject received venepuncture during the period under study. The procedure time was 18 minutes ($\bar{x}$ = 18). During this procedure, the subject's sleep pattern changed to crying. It took 28 minutes to return to her original state.

Discomfort procedure

Physical examination

Seventeen subjects received physical examination, with a total of 17 times and duration of 1 to 3 minutes ($\bar{x}$ =1.56). During this procedure, there were twelve cases in which the subjects' sleep pattern did not change, while the sleep pattern on most of the other cases change from active sleep to drowsy sleep. The subjects approximately 2 minutes to return to their original states.

Bathing

Seventeen subjects were bathed, with a total of 17 times. The range of the procedure time was 2 to 8 minutes ($\bar{x}$ = 3.62). During this procedure, there were two cases in which the subjects' sleep pattern did not change, while the sleep pattern on most of the other cases changed mostly from active sleep to crying. Immediately after bathing, almost all subjects received a bed linen change.

Bed linen Change

Fifteen subjects received bed linen change, with a total of 15 times. The range of the procedure time was 2 to 11 minutes ($\bar{x}$ = 6.66). During this procedure, there were six cases in which the subjects' sleep pattern did not change, while the sleep pattern on most of the other cases changed from active alert to crying. Immediately after bed linen change, almost all the subjects were fed.

Cleaning the peri-anal region

Twelve subjects received peri-anal region cleaning, with a total of 15 times, once or twice per subject. The range of the procedure time was 1 to 5 minutes ($\bar{x}$ = 2.07). During this procedure, there were five cases in which the subjects' sleep pattern did not change, while the sleep pattern on most of the other cases changed from active alert to drowsy sleep. The subjects took approximately 5 to 10 minutes to return to their original states.

Rectal temperature

Seventeen subjects received rectal temperature measurement, with a total of 26 times, ranging from once to four times per subject. The range of procedure time was 2 to 5 minutes ($\bar{x}$ = 2.63). During this procedure, there were fourteen cases in which the subjects' sleep pattern did not change, while the sleep patterns on most of the other cases changed from quiet sleep or drowsy sleep to active sleep. The subjects took approximately 5 minutes to return to their original states.

Rectal temperature and diaper change

Seven subjects received rectal temperature measurement and diaper change, with a total of 16 times. The range of the procedure time was 3 to 4 minutes ($\bar{x}$ = 3.15). During this procedure, there were nine cases in which the subjects' sleep pattern did not change, while the sleep patterns on most of the other cases changed from drowsy sleep to active sleep. The subjects took approximately 5 to 30 minutes to return to their original states.

Remarks: three of the subjects had their rectal temperature measurement three -four times due to having hypothermia or hyperthermia.

Intravenous medication

Four subjects received intravenous medication, with a total of 4 times, once per subject. The range of procedure time was 1-2 minutes ($\bar{x}$ = 1.33). During this procedure, there were two cases in which the subjects' sleep pattern did not change, while the sleep pattern on the other cases changed mostly from crying to active sleep or drowsy sleep. After the procedure was finished, the subjects tended to calm down.

Adhesive tape removal

Five subjects received adhesive tape removal, with a total of 5 times, once per subject. The range of procedure time was 2 to 7 minutes ($\bar{x}$ = 5.4). During this procedure, there were two cases in which the subjects' sleep pattern did not change, while the sleep patterns on most of the other cases changed from crying to active alert or drowsy sleep.

Passage of OG tube

Two subjects received passage of OG tube, with a total of 2 times, once per subject. The range of procedure time was 2 minutes ($\bar{x}$ = 2). During this procedure, the sleep pattern of both subjects did not change.

Feeding by cup

Seven subjects received feeding by cup, with a total of 9 times, one to three times per subject. The range of procedure time was 4 to 14 minutes ($\bar{x}$ = 7).

In the majority of the cases, the subjects were in active sleep before feeding; during feeding they stayed in this state and changed to drowsy sleep. When the feeding was finished, the subjects returned to active sleep. In the cases when the subjects were awake in quiet alert before feeding, during feeding they stayed in this state and then changed to drowsy state. Those subjects who stayed in quiet alert after feeding was finished, then changed to drowsy state and before passing to active sleep. Those subjects who were awake in active alert and crying before feeding, changed to quiet alert after feeding commenced. After they finished feeding, they changed to drowsy sleep and then progressed to active sleep.

Feeding by spoon

Three subjects received feeding by spoon, with a total of 9 times, one to three times per subject. The range of procedure time was 5 to 29 minutes ($\bar{x}$ = 18.38). In majority of cases, the subjects were awake in drowsy sleep before feeding. The subjects stayed in this state while feeding and then changed to active sleep and remained in this state after finishing. In one case, the subject changed her state to quiet alert and remained in this state after finishing and then changed to drowsy state. In one case, the subject was in quiet sleep when she began feeding. She stayed in this state for 29 minutes until she had finished feeding and remained sleeping in this state. Those subjects who were awake in quiet alert or crying, changed to drowsy sleep while feeding. After they had finished feeding, they stayed in this state before reaching the sleep cycle.

Disturbance

Diaper change

Seventeen subjects received diaper change, with a total of 20 times, ranging from one to three times per subject. The range of the procedure time was 1 to 4 minutes ($\bar{x}$ = 1.2). During this procedure, there were thirteen cases in which the subjects' sleep pattern did not change, while the sleep patterns on most of the other cases changed from active sleep to quiet sleep. The subjects took approximately 5 minutes to return to their original states.

Medication by OG tube

Six subjects received administration of medication by OG tube, with a total of 6 times, once per subject. The range of the procedure time was less than one minute ($\bar{x}$ ~ <1). During this procedure, there were five cases in which the subjects' sleep pattern did not change, while the sleep patterns on the remaining case, the subject changed from active sleep to drowsy sleep and then returned to active sleep again.

Feeding by OG tube

Seven subjects received feeding by OG tube, with a total of 16 times, from one to three times per subject. The range of procedure time was 4 to 21 minutes ($\bar{x}$ = 11.63). In majority of the cases, the subjects were in drowsy sleep before feeding. They stayed in this state after starting to feed and remained in this state after finishing. Some subjects changed to quiet sleep and then passed to drowsy sleep before reaching the sleep cycle. In some cases the subjects were in active alert or crying before feeding. They remained in this state, then changed to quiet alert, progressed to drowsy sleep and remained in this state after finishing feeding, and finally passed to the sleep cycle.

Touch

Three subjects received touch, with a total of 9 times, three times per subject. The range of the procedure time was 1 to 116 minutes ($\bar{x}$ = 62.25). In majority of the cases, the subjects were in a crying state. The subjects were consoled by touch while the procedures were being administered. They stayed in drowsy sleep for 3 minutes and then had a variety of sleep/wake transitions, moving between crying, quiet alert and active alert, each for an interval of 4 to 6 minutes. One of this group moved on to quiet alert and then fell into drowsy sleep for 2 minutes. When the procedure was finished, she progressed to active sleep.

Breast-feeding

Six subjects received breast-feeding, with a total of 9 times, one to three times per subject. The range of procedure time was 16 to 72 minutes ($\bar{x}$ = 31.38). In majority of the cases the subjects were in quiet alert. When they began feeding, they remained in this state for 2 to 4 minutes. One of these subjects changed to active alert before all of them went back to drowsy sleep. When they finished feeding, they changed to the original state (active alert) for 2 to 7 minutes. One subject changed to quiet alert for 2 minutes. The last one changed to crying for 4 minutes. Then, they returned to drowsy sleep.

The subjects were in active alert when they began feeding and remained in this state for 14 minutes before changing to active sleep for 10 minutes. Between feeding, their mothers burped their backs at intervals, and they soon changed to drowsy state.

Figure II Sleep patterns of premature infants between post-conceptional age 37& 39 weeks

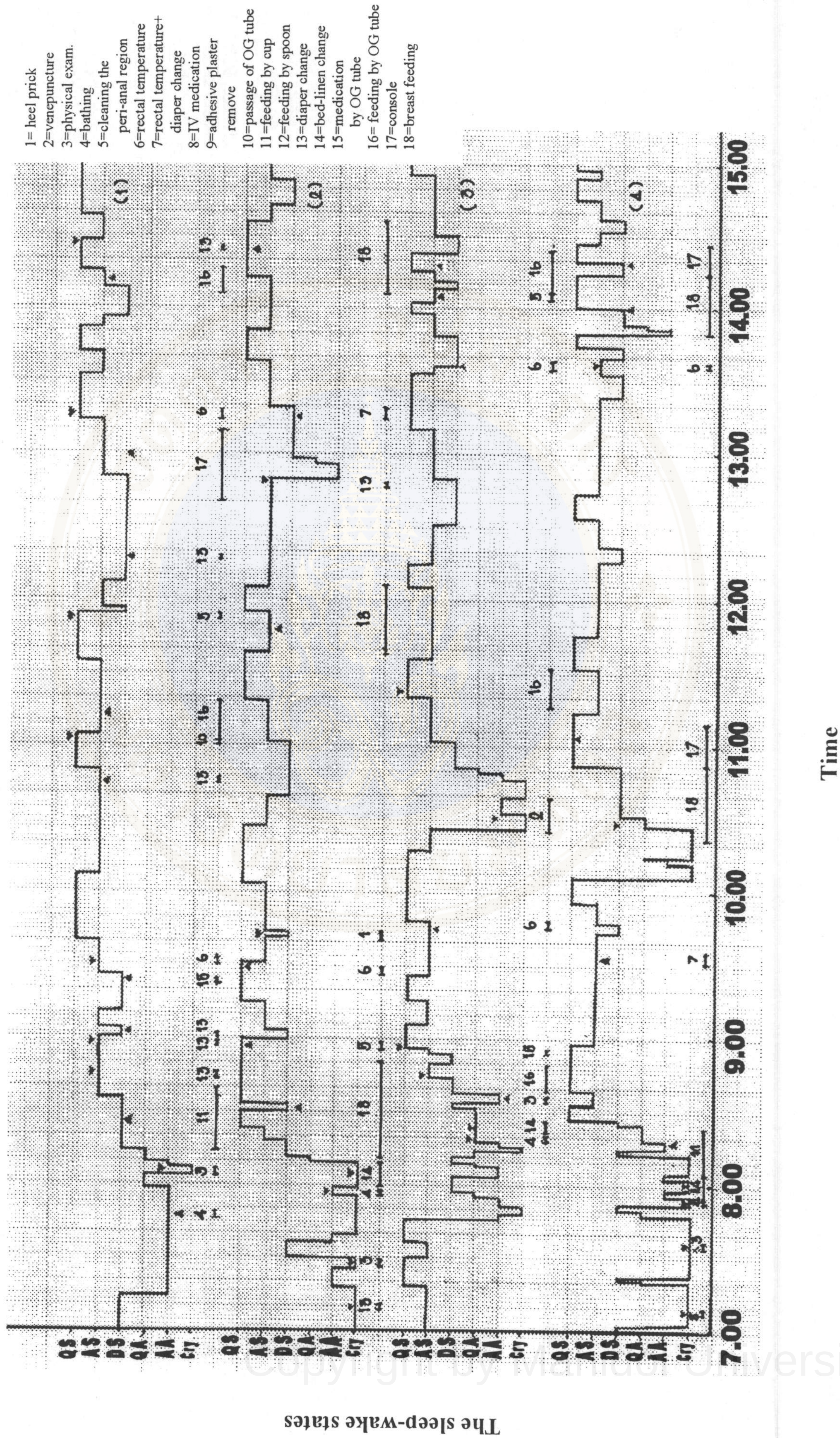


Figure II (continued)

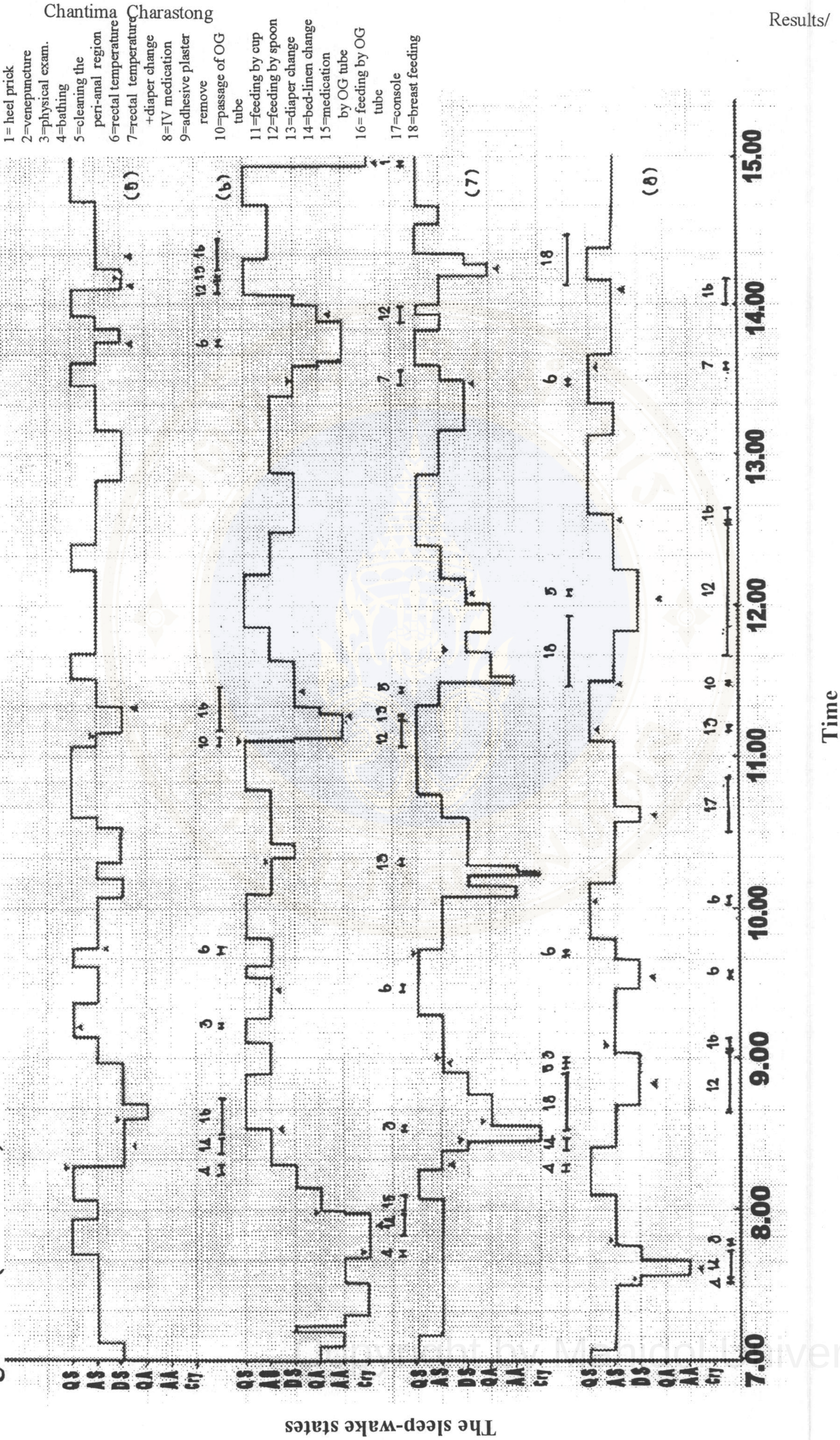


Figure II (continued)

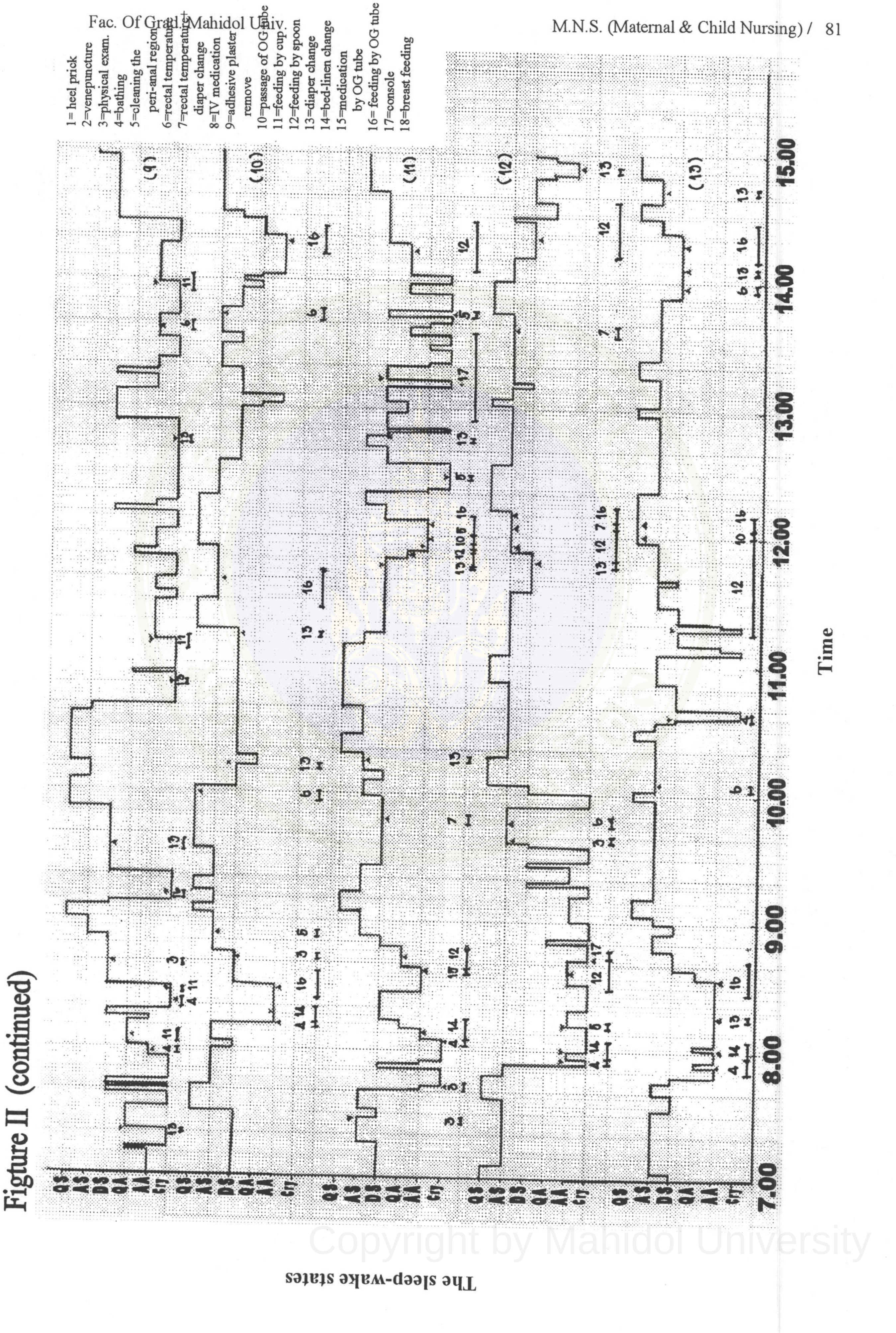


Figure II, shows that thirteen subjects had post-conceptional ages ranging between 37 and 39 weeks. The subjects had an average total sleeping time of 275 minutes (57.26% of the total observation time) and an average total waking time of 204 minutes (42.59% of the total observation time). The sleep time can be divided into 2 states: quiet sleep and active sleep. The average duration of quiet sleep was 99 minutes (20.68% of the total observation time and 37% of the total sleep time), and the average duration of active sleep was 176 minutes (36.58% of the total observation time and 63 % of the total sleep time). Sleep state ratio of active sleep/quiet sleep was 63: 37. The waking time can be divided into 4 states: the average duration of drowsy sleep was 108 minutes (22.41% of the total observation time); the average duration of quiet alert was 16 minutes (3.3% of the total observation time); the average duration of active alert was 39 minutes (8.16% of the total observation time); and the average duration of crying was 42 minutes (8.75% of the total observation time).

Sleep pattern of subjects aged between 37-39 weeks.

Their sleeping patterns could be described as follows:

7.00 am - 9.00 am

During this period, the sleep patterns of the subjects were individually different and changed according to receiving procedures. Most of the procedures consisted of bathing and changing bed linen. After bathing, the sleep pattern of most subjects changed from quiet sleep to crying state and then the majority passed into active alert. However, in some cases, the sleep patterns did not changed after bathing.

The second procedure was bed linen change. This led to a change of sleep patterns from active alert to crying state. The subjects were fed afterwards from 8.00 am to 8.15 am. After feeding (8.30 am – 8.45 am), they continued sleeping.

Besides bathing and change of bed linen, the subjects also received physical examinations, administration of medication by OG tube and adhesive tape removal. These had little change or no effects on their sleep patterns.

Nevertheless, one subject (the 9th subject) remained awake from feeding (7.00 am) until 8.30 am. She was in drowsy state and continued to sleep at 8.50 am. Another subject (the 12th subject) was alert until 9.00 am.

9.00 am - 11.00 am

During this period, most of the subjects had similar sleep patterns and did not change according to receiving procedures. They continued sleeping until 10.15 am – 10.30 am and woke up about 10 – 30 minutes thereafter. Most of the procedures were rectal temperature measurement and diaper change. After received these procedures, the sleep pattern of most of the subjects either changed from quiet sleep to active sleep or remained in the original state.

One subject received heel prick during this time. As a result of this, her sleep pattern changed from active sleep state to drowsy state and back to the original state after finishing. Another subject (the 3rd subject) was given venepuncture, which led to the change of her active sleep to crying state. She went back to the original state after 24 minutes. The sleep patterns of the sixth subject changed from active alert state to crying state after peri-anal region cleaning. Thereafter, she had intravenous medication inserted which caused her to study awake until 11.20 am, and she continued sleeping after feeding. The 12th subject was also alert from 7.50 to 10.00 am even while receiving normal procedures.

11.00 am - 1.00 pm

During this period, most of the subjects had similar sleep patterns which did not change while to receiving procedures. Most of the subjects woke up between 0.30 pm and 1.00 pm which were in drowsy sleep. At this time, the subjects were fed. They entered to sleep again after feeding. Sleep pattern of most subjects changed from drowsy sleep to active sleep and active sleep to quiet sleep. There were 1-4 cycles of sleep patterns during this time, which took about 52-70 minutes. Between 12.00 am and 12.30 am, they woke up and then continued sleeping again.

However, the 9th and 11th subjects were alert all the time after their feeding.

1.00 pm- 3.00 pm

During this period, most of the subjects had similar sleep patterns which did not change while receiving procedures. They continued sleeping until 2.10 pm to 2.30 pm. Most of the procedures were rectal temperature measurement and diaper change. Most of the subjects were awake. They were then fed and returned continued to sleep. There were 1-2 cycles of sleep pattern, which lasted about 12-46 minutes before waking.

However, the 6th subject had a heel prick, leading to a change in the sleep pattern from quiet sleep to crying state. Additionally, the 9th and the 11th subjects were awake a long time (from 10.50 am to 2.40 pm) before returning to their sleep cycles.

In conclusion, the sleep patterns of the subjects had a sleep onset at active sleep. They began with active sleep for 2 to 60 minutes ($\bar{x}$ = 14.95), then changed to quiet sleep for 4 to36 minutes ($\bar{x}$ = 15.62) and then returned to active sleep again. There was a total of between 3 and 9 cycles. Each sleep cycle lasted from 20 to 70 minutes ($\bar{x}$ = 44.91).

During the 8 hours, all subjects received an average total of 12 types of procedures. The majority of procedures involved feeding, temperature record and diaper change. The range of disruption per subject was 52 to 168 minutes ($\bar{x}$ = 94.6). All thirty subjects had a variety of sleep-wake state transitions before they received the first procedure. When the subjects received procedures for the first time in the morning, they were always awake. Afterwards, they were fed. All the babies then entered a drowsy state lasting from 2 to 52 minutes and then passed into sleeping states. The subjects were aroused after one to three sleep cycles. The total duration of waking time was 2-258 minutes. During waking, most of the subjects were in a drowsy state. The duration of this state was 1 to 60 minutes ($\bar{x}$ = 11.44). Other recorded states were quiet alert for 1 to15 minutes ($\bar{x}$ = 4.42); active alert for 1 to45 minutes ($\bar{x}$ = 7.13) and crying for 2 to 26 minutes ($\bar{x}$ = 4.17).

<u>The Effects of procedures on the sleep pattern</u>

Sleep-wake states transition have changed around 29 to 56 times during the 8 hours ($\bar{x}$=31.25). They occurred due to both endogenous (infant) determinants (from 16 to 64 times [$\bar{x}$ = 32.03]) and exogenous (care giving) determinants (from 4 to 21 times [$\bar{x}$ = 12.88]).

Pain procedures

Heel prick

Two subjects received heel pricks during the period under study. The range of procedure time was 1 to 2 minutes ($\bar{x}$ = 1.5). During this procedure, the sleep pattern of one subject changed from active sleep to drowsy sleep and returned to active sleep again.

Venepuncture

Only one subject received venepuncture during this period. The procedure time was 19 minutes ($\bar{x}$ = 19). During this procedure, the subject's sleep pattern changed from active sleep to crying.

Discomfort procedure

Physical examination

Thirteen subjects received physical examinations, with a total of 14 times and a duration of 1 to 3 minutes ($\bar{x}$ = 1.67). During this procedure, there were nine cases in which the sleep pattern did not change, while the sleep pattern on most of the other cases, the subjects changed from crying to active sleep or drowsy sleep. They took from 4 to 6 minutes to return to their original states.

Bathing

Thirteen subjects were bathed, with a total of 13 times, once per subject. The range of procedure time was 1 to 4 minutes ($\bar{x}$ = 2.17). During this procedure, there were four subjects whose sleep pattern did not change, while the sleep pattern of most of the rest of the subjects changed from quiet sleep to active alert. They took from 4 to 6 minutes to return to their original states.

Bed –linen change

Eleven subjects received bed-linen change, with a total of 11 times and a duration of 4 to 12 minutes ($\bar{x}$ = 6.10). During this procedure, there were five cases in which the subjects' sleep pattern did not change, while the sleep pattern on most of the other cases changed from active alert to crying. They took from 4 to 6 minutes to return to their original states.

Cleaning the peri- anal region

Seven subjects received peri-anal region cleaning, with a total of 8 times, 1 or 2 times per subject. The range of the procedure time was 1 to 3 minutes ($\bar{x}$ = 2.23). During this procedure, there were six cases in which the subjects' sleep pattern did not change, while the sleep pattern on the remaining two cases subject changed from quiet sleep to active sleep. The subjects took from 5 to 10 minutes to return to their original states.

Rectal temperature

Thirteen subjects received rectal temperature measurement, with a total of 20 times, 1 or 2 times per subject. The range of the procedure time was 2 to 5 minutes ($\bar{x}$ = 2.29). During this procedure, there were thirteen cases in which the subjects' sleep pattern did not change, while the sleep pattern on most of the other cases changed from quiet sleep to active sleep or from drowsy sleep to active sleep.

Rectal temperature and diaper change

Six subjects received rectal temperature and diaper change, with a total of 6 times, once per subject. The range of procedure time was 2 to 5 minutes ($\bar{x}$ = 3.1). During this procedure, there were five cases in which the subjects' sleep pattern did not change, while the sleep pattern on the remaining case changed from active sleep to quiet sleep.

Remarks: 3 subjects were suffering from hypothermia and 3 subjects from hyperthermia

Passage of OG tube

Five subjects received passage of OG tube, with a total of 5 times, once per subject. The range of the procedure time was 1 to 2 minutes ($\bar{x}$ = 1.5). During this procedure, there were four cases in which the subjects' sleep pattern did not change, while the sleep patterns on most of the other cases changed from quiet sleep to active sleep or from active sleep to drowsy sleep.

Feeding by cup

Two subjects received feeding by cup, with a total of 5 times, one to three times per subject. The range of the procedure time was 3 to 9 minutes ($\bar{x}$ =6.17).

In the majority of cases, the subjects were in a crying state before feeding, during feeding they stayed in active alert, then changed to quiet active. When finished feeding they remained in this state continuously for 4 to10 minutes. Then, they changed to drowsy sleep before reaching the sleep cycle.

For those subject who was fed by cup twice, the first time, she was awake in quiet alert while feeding, then when feeding finished she changed to drowsy sleep, then to active alert and crying. The caregiver administered an additional feeding and she changed from crying to drowsy sleep when feeding was finished, remaining in this state for 17 minutes before progressing to active sleep.

Feeding by spoon

Six subjects received feeding by spoon, with a total of 9 times, 1 to 3 times per subject. The range of procedure time was 3 to 31 minutes ($\bar{x}$ = 17.69). In the majority of cases, the subjects were in a crying state before feeding. During feeding they were in active alert and then changed to quiet alert. When feeding was finished they remained in this state before passing to drowsy sleep and entering the sleep cycle.

In the cases when the subjects were in quiet sleep before feeding, during feeding they entered drowsy sleep and then changed to active sleep. When these subjects were burped, they changed to quiet alert before entering the sleep cycle.

When the subjects were in active alert before feeding, during feeding they changed to quiet alert for 5 minutes, then when finished feeding, they remained in this state for 2 minutes before passing to drowsy sleep, finally entering the sleep cycle.

Disturbance

Diaper change

Eleven subjects received diaper change, with a total of 24 times, from 1 to 6 times per subject. The range of the procedure time was 1 minute ($\bar{x}$ = 1). During this procedure, there were sixteen cases in which the subjects' sleep pattern did not change, while the sleep patterns on most of the other cases changed from active sleep to quiet alert. The subjects took from 5 to 30 minutes to return to their original states.

Administering medication by OG tube

Four subjects received this procedure a total of 4 times, once per subject. The range of procedure time was <1 minute ($\bar{x}$ ~<1). During this procedure, the sleep pattern of all four subjects did not change.

Feeding by OG tube

Eight subjects received feeding by OG tube, with a total of 16 times, from 1 to 3 times per subject. The range of the procedure time was 5 to 27 minutes ($\bar{x}$ = 13.39). In the majority of the cases, the subjects were in active sleep before feeding. During feeding, they remained in this state for 4 to 15 minutes, then when feeding was finished they remained in this state continuously. In the cases when the subjects were in active alert before feeding, during feeding they remained in this state for 6 to 8 minutes, changed to quiet alert for 4 minutes and then to drowsy sleep for 4 to 6 minutes. When feeding was finished they progressed to the sleep cycle.

Touch

Three subjects received touch, with a total of 5 times, 1 to 3 times per subject. The range of the procedure time was 4 to 52 minutes ($\bar{x}$ = 21.5). In the majority of the cases, the subjects were in active sleep before touch. During touching, they were in drowsy sleep then changed to active sleep. When touching was finished they remained in this state.

When the subjects were in a crying state, during touching they changed to active sleep and drowsy sleep, then when touching was finished they reverted to crying again.

Breastfeeding

Three subjects received breast-feeding, with a total of 8 times, 2 to 3 times per subject. The range of the procedure time was 17 to 38 minutes ($\bar{x}$ = 26.45). In the majority of the cases, the subjects were in active sleep before feeding. During feeding they changed to active alert, then to quiet alert and on to drowsy sleep. When feeding was finished they entered the sleep cycle.

In the cases subjects when the subjects were in a crying state, during feeding they remained in this state for 1 to 2 minutes, changed to quiet alert and progressed to drowsy sleep. When feeding was finished, they entered the sleep cycle.

CHAPTER V

DISCUSSION

This study was descriptive research to determine the sleep patterns of premature infants and the effect of procedures on their sleep patterns. The sample was 30 growing premature infants, between the gestational ages of 32 and 37 weeks at birth. In this chapter, the discussion of the results is presented as follows:

The sleep patterns of premature infants

The finding of this study divided the subjects into 2 groups: the subjects who had post-conceptional ages ranging between 34 and 36 weeks and 37-39 post-conceptional ages because there are behaviors that more predictable behaviors at specific gestational ages.

The subjects who had post-conceptional ages ranging between 34 and 36 weeks had an average total sleeping time of 270 minutes (56.25 % of the total observation time) and an average total waking time of 210 minutes (43.75% of the total observation time). The sleeping time can be divided into 2 states: quiet sleep and active sleep. The average duration of quiet sleep was 103 minutes (21.46% of the total observation time) and the average duration of active sleep was 167 minutes (34.79% of the total observation time). The sleep state ratio of active sleep /quiet sleep was 61: 39.

Those subjects who had post-conceptional ages ranging between 37 and 39 weeks had an average total sleeping time of 275 minutes (57.26 % of the total observation time) and an average total waking time of 204 minutes (42.59 % of the total observation time). The average duration of quiet sleep was 99 minutes (20.68% of the total observation time) and the average duration of active sleep was 176 minutes (36.58% of the total observation time). In sleep state, the ratio of active sleep /quiet sleep was 63: 37.

The average totals of sleeping/waking time and the sleep/wake ratio were nearly the same for both groups. This confirms the study of Fajardo et al (1990) which noted that premature infants spend 35.7% time in quiet sleep compared to 61.1 % in active sleep (Fajardo et al, 1990 cited by Zahr & Balian, 1995: 184). Stafanski and his collaborators (1984) mode a behavioral study of 15 infants between 30 and 36 weeks CA by using EEG recordings made over 2 hours and found 18.9% of QS of the total observation time (Holditch-Davis, 1990 cited in Ingersole & Thomas, 1999: 9). This research had different results than other studies of the states of premature infants because there were cases of hypothermia in both groups, especially among the 34-36 post-conceptional ages. They had an increased amount of active sleep due to increased metabolic activity during active sleep and increased oxygen consumption during active sleep which resulted in increased heat production in both term and preterm infants (Scher et al, 1994: 194).

Infant sleep-wake development is characterized by increasing organization of sleep states, a decrease in total sleep time, an increase in the percentage of quiet sleep, a decreased percentage of active sleep, and an increased amount of active and quiet waking (Thomas, 2000: 146). The ratio of active sleep to quiet sleep is sometimes considered an indicator of maturation (Sheldon, 1996: 17). Studies show that the fetus (29-32 weeks) spends 80% of sleep time in active-sleep time in intra-utero, while in the term newborn, active sleep occupies about 50% of sleep time (Gardner, Garland, Merenstein& Lubchenco, 1993: 572). In contrast, this study found a decreased percentage of quiet sleep and an increased percentage of active sleep because some preterm infants stayed in waking state, especially with prolonged crying, associated with feeding and painful procedures (Karch, Rothe, Jurisch, Heldt-Hiedebrandt, Lubbesmeier & Lemburm, 1982: 40).

Term infants spend 16 to 18 hours sleeping each day (Kick, 1996: 247). The sleep pattern of newborn infants is a cycle. Each cycle lasts from 50 to 60 minutes. Normally, the sleep pattern begins with active sleep for about 10 to 45 minutes and is followed by quiet sleep lasting about 20 minutes (Catlett & Holditch-Davis, 1990: 21). Arousal of newborn infants appears after one or two sleep cycles (Thomas, 1995: 28). This study found similar patterns to the sleep pattern of newborn infants in which the onset of sleep is active sleep. The findings of this study indicate that the sleep patterns of both the 34-36 week post-conceptional age group and the 37-39 week post-conceptional age group were distributed through 8 hours and was a cycle. They had shorter sleep cycles. Each sleep cycle lasted 40-60 minutes, with the duration of the sleep cycle being prolonged in subjects who had a post-conceptional age range between 37-39 weeks. They spent less time in quiet sleep and more time in active sleep. While awake, most preterm infants were in a drowsy state. It has been found that if the infants stay in active alert for a long time, they will enter a crying state afterwards.

There were varieties in the sleep pattern. The subjects were aroused after one to three sleep cycles. Most sleep patterns began with active sleep, changed to quiet sleep and then returned to active sleep again. Infants in the 34-36 weeks post-conceptional age group began with active sleep for 2 to 88 minutes ($\bar{x}$= 17), then changed to quiet sleep for 3 to 70 minutes ($\bar{x}$= 20). Each sleep cycle lasted from 17 to 108 minutes ($\bar{x}$ = 56). Infants in the 37-39 weeks post-conceptional age group began with active sleep for 2 to 60 minutes ($\bar{x}$= 14.95), then changed to quiet sleep for 4 to 36 minutes ($\bar{x}$= 15.62). Each sleep cycle lasted from 20 to 70 minutes ($\bar{x}$ = 44.91). In contrast, the duration of the sleep cycle of premature infants was shorter than the sleep cycle of mature infants. The infant spends two-thirds of the time in sleep periods, beginning with active sleep at 3 weeks of age. After the first 12 weeks of life, the sleep-onset is through quiet sleep. Young infants manifest active sleep latencies shorter than 8 minutes. Older infants produce a mixed distribution of short and long active sleep latencies (Sheldon, 1996: 17). Studies of the organization of sleep stage cycle found that it occurs along a developmental continuum from neonates to adults. Anders & Keener (1983), who have studied the development of sleep patterns, reported that significant changes occur from the neonate to the adult. The most substantial change is in the ratio of active sleep to quiet sleep. Active sleep predominates in the immature infant and declines with maturation. Thus, sleep begins with active sleep during early life and gradually changes to quiet sleep as the first sleep state. (Milner, 1982 cited by Schibler & Susan, 1990: 287-288). Young infants are believed to have a special need for the stimulation of active sleep because they spend little time in an alert state, when the environment can easily disturb them. Active sleep is a way in which the brain stimulates itself. Sleep researchers believe that this stimulation is vital for the growth of the central nervous system. In support of this idea, the percentage of active sleep is shown to be especially great in preterm babies, who are even less able to take advantage of external stimulation than are full-term newborns (Berk,1996: 160). Preterm infants who are convalescent have the physiological reserves to deal with brief interaction because they have adequate sensory processing abilities and tolerate social touch better than painful procedures (Holditch-Davis, Barham, O'Hale Tucker, 1994: 424).

The effect of procedures on sleep patterns

During the 8 hours, all the subjects received an average total of 12 types of procedures. The majority of procedures involved feeding, temperature record and diaper change (Table2). Subjects had a variety of sleep-wake transitions before they received the first procedure. While the subjects received procedures for the first time in the morning, they were always awake. Afterwards, they were fed. All the babies then entered a drowsy state and then passed into sleeping states. The subjects were aroused after one to three sleep cycles. The sleep-wake transition had individual variations in the infant's control over responsiveness to environmental input, and sleep-wake patterns. Some babies spontaneously arouse themselves from active sleep to quiet alertness, while others move directly from sleep to crying, becoming alert only after being consoled (Zuckerman, 1991: 36). A healthy infant passes through a cycle of states everyday. The baby moves from deep sleep to light sleep, then through drowsiness to quality awake and alert state, and from wakefulness with considerable motor activity and to fussy crying (Brazelton, 1984 cited by Sparchott, 1994: 261). Infant responses are variable and dependent on many parameters, including gestational age, post-conceptional age, prior exposure to stress, infant behavioral state, and the infant's illness acuity (Peter, 1999: 95).

This study also observed sleep-wake transition states occurring about 5 times per hour. This confirms the findings of Zahr & Balian (1995) who cited that infants change their states an average of 6 times per hour, do not remain in a single state for a prolonged period and with the number of state-changes decrease with age (Fajardo et al, 1990 cited by Zahr & Balian, 1995: 184). The sleep-wake transition occurs due to both endogenous (infant) and exogenous (caregiving) determinants. Most of these transitions occur due to endogenous determinant that change the sleep interval. The direction of state-change passes from sleeping, through the waking span and back to sleep again. There are both exogenous determinants and endogenous determinants related to the specific cause of state change wake period. As the infant becomes aroused, shifting to a state of wakefulness on the basis of its own endogenous rhythm, the effects on the caregiver are correspondingly arousing, as he/she picks up the baby, changes it, bathes it and so on (Sander, Stechlr, Burns & Lee, 1979: 380-381).

The majority of procedures came under the category of procedural nursing and can be divided into 3 types:

1. Pain

Pain procedures consisted of only two types; heel prick and venepuncture. Preterm infants were in a sleep state. When one of the pain procedures was administered, they suddenly changed to crying. After the procedure was finished, they either went back to the same state, in the case of the heel prick, or they stayed in a waking state, in the case of venepuncture. During painful procedures, infants are more likely to be awake and less likely to be in quiet sleep than during routine nursing care. All the youngest and sickest preterm infants are likely to cry although the length of time until the crying begins depends on the sleeping and waking state the infant is in at the beginning of the procedure (Holditch-Davis, 1998: 930). The premature's lower responsivity is indicative of immaturity. In contrast, the premature's maintenance of states in the quiet awake and active awake range indicates an ability to inhibit excessive arousal and to sustain a better controlled state, while the full term's steady crying represents uncontrolled and excessive irritability (Michaelis, Parmelee, Stern & Haber, 1972: 213). When considering the duration of the two procedures, heel prick takes less time than venepuncture. It can cause stress-induced analgesia, which may lead to a release of endorphins, that will protect the subject from the pain of the procedure (Pokela, 1993: 360-7).

2.Discomfort

In this category are physical examination, cleaning of the peri-anal region, rectal temperature measurement, rectal temperature measurement & diaper change and passage of OG tube. These caused minimal change in the sleep-wake state, which remained largely unchanged pre-procedure, during procedure and post-procedure. However, IV medication, adhesive tape removal, bathing and bed-linen change, feeding by cup and feeding by spoon which resulted in varieties of sleep-wake transition.

This study found that the main nursing procedure which aroused the preterm, was bath time. This changed the sleep-wake transition during procedure. The majority of these transitions were to active alert and crying. The pre-procedural state of the next procedure, change of bed linen, was the same as the post-procedural bath-time state. Only one of the subject who was hugged during bed-linen change remained in active sleep. Peters reported that the majority of bath time, which includes washing the incubator and changing the linen, was spent in direct physical touch or "wet touch". This was followed by a lift to facilitate changing the linen and then the "dry touch" of resetting the infant following the procedure (Peter, 1999: 24). This activity was done before feeding at 9.00 am. (Zolkiewicz, 1996: 320).

In this study, adhesive tape removal caused the infants to change to crying. The skin has many functions, including sensation and protection. Premature infants are immature and their skin is unable to act as a barrier. The numerous fibrils connecting the epidermis to the dermis are fewer and more widely spaced than in the term infant. Therefore, premature infants are more vulnerable to blistering and have a tendency to the stripping of the epidermis when adhesives are removed (Blackburn, 1996: 143).

3. Disturbance

The majority of the procedures in this category were diaper change, medication administered by OG tube and feeding by OG tube. These had a minimal effect on the infants.

As has already been noted feeding makes great demands on the infant and the immature development of preterm infant leads as poor control of sucking and swallowing and problematic behavioral patterns (Morris & Klein, 1987 cited by Blackburn & Vandenberg, 1998: 958). This study found that the caregivers tried feeding young premature infants over a prolonged time by spoon. However, nipping even small amounts can lead to exhaustion and flaccidity with problems of respiratory control (Morris & Klein, 1987 cited by Blackburn & Vandenberg, 1998: 958). It is commonly believed that preterm infants are not able to successfully nipple feed prior to 34 weeks: it is not until 32 to 34 weeks that the mechanisms of sucking, swallowing and breathing become more functionally coordinated with maturation and increasing PCA (Medoff-Cooper, 1991; Medoff-Cooper et al, 1993 cited by Medoff-Cooper, 2000: 65).

The method of feeding affects the sleep wake state differently. There were 4 methods: by cup, by spoon, by OG tube and breastfeeding. In OG feeding, the infants did not change from their initial states. They continued in this state and entered the sleep cycle after half of the feeding time. In cup, spoon or breast- feeding, they changed their state suddenly when they began feeding. If they were in a waking state, they passed to drowsy sleep and entered the sleep cycle. Breast-fed and formula fed infants demonstrate different sleep-wake patterns. In a study of breast-fed and formula-fed healthy infants, no differences in the number or duration of sleep cycles were found (Thoman, 2000: 50). If they were in sleeping states while feeding for 3 to 5 minutes, the caregiver aroused them from sleep state, except quiet sleep, and feeding will take a long time. Gentle stimulation (rubbing or patting on the baby's back) wakes it up and reminds it to breathe (Zotkiewicz, 1996: 318).

Preterms of all ages spend the majority of their time in active sleep even though the total amount of time in active sleep decreases with post-conceptional age. The decrease in active sleep is replaced by an increase in drowsiness. During routine care, comprised of feeding, bathing and diaper change, the infant is awake for nipple feeding and aroused during changing and bathing. It is able to sleep during tube feedings. This may explain the fact that routine care includes both the most alert and most drowsy of any of the care giving situation (Brandon, Holditch-Davis& Beylea, 1999: 217-229). Handling has been found most consistently to cause disruption of the infant's sleep pattern (Wolke, 1987: 988). Caregivers are unable to assess sleep-wake states accurately while procedures are being administered and this leads to misjudgments of temperament. Also, the care giving pattern is an important organizer of infant behavior and an important external cue for circadian rhythm development (Thomas, 1995: 70).

Gorski, Huntington & Lewkowicz (1990) studied extensive recordings of preterm infants' heart rates and oxygenation as related to both the timing and content of caregiver stimulation, including medical and social forms of touching. They found that even gentle social interaction could lead to physiological decompensation in the infants, and they concluded that the nature as well as the timing of interventions is important (Gorski, Huntington & Lewkowicz ,1990 cited by Ingersoll & Thoman, 1999:8). In this study, when the parents touched their babies, they did not change their sleep-wake state except for one infant who was in active sleep and was awakened by touch. Touch is prolonged during feeding (the range of procedure time was 116 minutes). Not only are there varieties of sleep-wake transition but also crying occurred after feeding. However, touch has limited ability to console. The caregivers were less interested in the crying state and did not respond to it. Even though touching can calm and stop crying, preterm infants may not tolerate it for too long (Liaw, 2000: 84-103). Gottfried' s study found that nurses responded to only half the cries of premature infants in intermediate or convalescent care (Gottfried ,1985 cited by Holditch-Davis, Barham, O'Hale Tucker, 1994: 424).

The findings of this study support the hypothesis of the synactive theory of development (Als,1982) which provides a model through which one can specify the degree of differentiation of behavior and the ability of infants to organize and control their behavior. This model is based on the assumption that the infant's primary route of communicating both functional stability and the limits for stress is through behavior. Behavior that indicates immature, ineffective responses relating to state regulation include inability to modulate state, and sudden state changes. Infants who are disorganized exhibit frequent and rapid changes in their state (Parmelee, 1979: 156-163). The concept of state organization is central to an understanding of the stress response in preterm infants and for an interpretion of their related behavioral cues.

Als and her colleagues proposed that infants interact with their environment in five ways. Optimal self –regulation occurs when stability is attained in all the subsystems. If an infant does not attain central nervous system (CNS) maturity, signs of disorganization can occur, causing difficulty in the infant's ability to tolerate stimulation and maintain organization when exposure to sensory stimulation exceeds the infant's tolerance level. A state of physiological and behavioral instability will then develop. As stress increases, self-regulation coping signals are typically seen, including leg bracing, hand-on-face sucking, fisting, and shifting to lower behavioral states (drowsy or light sleep) (Roughton, Schncider, Bromlus & Coe, 1998: 91). Clinically stable infants aged 33 post-conceptional weeks, have the ability to integrate a multisensory experience. Intervention to promote the infant's behavior responsiveness and social interactive abilities might include the use of auditory, tactile, visual and vestibular (White-Traut, Nelson, Burns & Cunningham, 1993: 395-398). There is evidence that the neurogical systems of preterm infants of less than 35 weeks gestation are so immature that they are not significantly altered by environmental stimulation (Parmelee, 1979: 156).

In conclusion: This study found that sleep patterns of premature infants are the same as regular sleep patterns. Procedures such as bathing, feeding and painful procedures effect sleep patterns. The majority of transitions were caused by endogenous determinants.

CHAPTER VI

CONCLUSION

Summary of the Study

This descriptive research aimed to determine the sleep patterns of premature infants and the effect of procedures on their sleep patterns. The sample was 30 growing premature infants, between the gestational ages of 32 to 37 weeks at birth, who had been admitted to the premature unit, Department of Pediatrics, Faculty of Medicine, Siriraj Hospital between March and August 2001. The thirty subjects were selected by purposive sampling.

These growing premature infants had been admitted for more than 1 week, had no histories of maternal substance abuse, alcohol consumption, receiving sedation during labor or abnormalities of the endocrine system; they had an absence of neurological, respiratory, circulatory and congenital anomalies; they did not receive sedative substance or bronchodilator drug for at least 8 hours before the study; and they had received cranial ultrasonography.

The instruments of the data collection were composed of a demographic data form, the observation record for duration, sleep-wake state and type of procedure of premature infants. The criteria for sleep states assessment was modified from the sleep-wake state of premature infants devised by Parmelee & Stern (1972) and the observation record of

Procedures took place over 8 hours, a modification of the method used in a study by Supatta Jarungphan et al (1999). A color video camera and video cassette were used for recording.

The researcher collected data by contacting the parents of the infants who met the selection criteria to introduce herself and informed them of the objectives of the study. Their permission was asked to let their child participate in the study. If permission was granted, verbal and written consent was then obtained. The demographic data were collected by the researcher from the medical charts. The researcher recorded the sleep patterns of the premature infants continuously from 7.00 am to 3.00 pm by video camera. After the study was complete, the researcher observed the sleep patterns of premature infants from videotape, and coded the observation record for the duration, sleep-wake states and type of procedures of the premature infants.

The results found that the sleep patterns of both the 34-36 post-conceptional age group and the 37-39 post-conceptional age group of premature infants was distributed through 8 hours and was a cycle. The sleep patterns of subjects had a sleep onset at active sleep. They began with active sleep for 14 to 17 minutes, then changed to quiet sleep for 16 to 20 minutes and then returned to active sleep again. Each sleep cycle was 40-60 minutes. This study found that the duration of the sleep cycle was prolonged in subjects with a post-conceptional age range of between 37-39 weeks. While awake, most preterm infants were in a drowsy state. It was been found that if the infants stay in active alert for a long time, they will enter a crying state afterwards. There were varieties in the sleep pattern. The subjects were aroused after one to three sleep cycles. Most sleep patterns began with active sleep, changed to quiet sleep and then returned to active sleep again. The percentage of sleeping in both gestational age groups was not different. However the percentage of waking in growing preterm infants in the 37-39 weeks post-conceptional age group was more than the subjects in the 34-36 weeks post-conceptional age group, except for drowsy sleep. Both groups had 57 % of total sleep time, the percentage of quiet sleep being 21% (about 38% of the total sleep time) and the percentage of active sleep was 36% (about 62% of the total sleep time). This study found that the sleep pattern of premature infants was the same as the regular sleep pattern. The subjects moved from quiet sleep to active sleep, then through drowsy sleep to quiet alert, active alert and crying. The sleep patterns of the subjects were individually different and changed according to the received procedures. The majority of the procedures could be divided into 3 types:

1. Painful procedures

Painful procedures consisted of only two types: heel prick and venepuncture. Preterm infants were in a sleep state. When the procedure was administered, they suddenly changed to crying in the case of the heel prick after the procedure was finished, they went back to the original state.

2.Discomfort procedures

Procedures in this category were physical examination, cleaning the peri-anal region, rectal temperature measurement, rectal temperature measurement & diaper change and passage of OG tube. They caused minimal change in the sleep-wake state, which remained largely unchanged before, during and after receiving the procedure.

3. Disturbance procedures

Most of the procedures in this category were diaper change, medication by OG tube and feeding by OG tube. These procedures had minimal effects on the infants' sleep pattern.

Implications and Recommendations

Implications and Applications of Research Findings

The results of this study demonstrate that even though the sleep patterns of premature infants were the same as regular sleep patterns; they were affected by such procedures as bathing, feeding, and painful procedures. Therefore, the implications for nursing care are as follows:

1. Nurses or other health care teams should assess the sleep-wake state of premature infants before providing procedures. If the infants are in sleep state, these procedures should be delayed.
2. Nurses should cluster some procedures together in order to decrease the amount of disturbance to the infants.
3. Nurses should set a "quiet hour", a time that allows infants to sleep and reset without any disturbing procedure.

Implications for Further Studies

Further studies should be initiated:

To study the sleep patterns of premature infants and the effects of procedures on their sleep patterns in a 24 hour period.

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สุพัฒตรา จรุงพันธ์ ลัดดาพร เกษรจันทร์ และสุพิชญา วงศ์สิงห์ขันธ์. (2542). **การศึกษาชนิดและจำนวนของกิจกรรมการพยาบาลที่ทารกแรกเกิดได้รับขณะรับการรักษาในหออภิบาลทารกแรกเกิด** งานการพยาบาลกุมารเวชศาสตร์ โรงพยาบาลศิริราช.

APPENDIX

APPENDIX A

LIST OF EXPERTS

APPENDIX A

List of Expert

The experts who validated the instrument are as follows:

1. Asst. Prof. Pimol Srisuparp,

   Department of Pediatrics

   Faculty of Medicine, Siriraj Hospital, Mahidol University.

2. Asst. Prof. Lamyong Rusmeemala,

   Head Nurse of Pediatric Nursing Department

   Faculty of Medicine, Ramathibodi Hospital, Mahidol University.

3. Assoc. Prof. Wilai Lerdthumthevee,

   Department of Pediatric Nursing

   Faculty of Nursing, Mahidol University

4. Mrs. Luddaporn Kasornchandra,

   Head Nurse of The Premature Unit, Pediatric Nursing Division

   Faculty of Medicine, Siriraj Hospital, Mahidol University.

5. Miss Pikul Khamsriboos,

   Professional Nurse 8 of Neonatal Intensive Care Unit, Department of Pediatric Nursing

   Faculty of Medicine, Siriraj Hospital, Mahidol University

APPENDIX B

CONSENT FORM

APPENDIX B

Consent to Participate in Research Study

แบบยินยอมเข้าร่วมการศึกษา

วันที่ .... เดือน .... พ.ศ ....

ข้าพเจ้า .... อายุ .... ปี

อาศัยอยู่บ้านเลขที่ ....ถนน .... แขวง ....

เขต .... จังหวัด .... ได้รับทราบรายละเอียดของโครงการวิจัยเรื่อง ศึกษาแบบแผนการนอนหลับของทารกคลอดก่อนกำหนด ผู้วิจัยมีความสนใจศึกษาลักษณะแบบแผนการนอนหลับของทารกเกิดก่อนกำหนดและผลกระทบของหัตถการที่มีต่อแบบแผนการนอนหลับ โดยจะบันทึกภาพด้วยวิดิทัศน์ เป็นระยะเวลา 8 ชั่วโมง ทารกจะได้รับการ ดูแลรักษาตามปกติและจะไม่มีผลกระทบใดใดต่อทารกทั้งสิ้น ผลการศึกษาดังกล่าวจะนำไปเป็นประโยชน์ เพื่อเป็นแนวทางและวางแผนการดูแลทารกเกิดก่อนกำหนด ต่อไป

ข้าพเจ้ามีสิทธิ์ที่จะของดเข้าร่วมการศึกษาวิจัยนี้ และการงดเข้าร่วมการวิจัยนี้จะไม่มีผลกระทบต่อการได้รับบริการหรือการรักษาที่ข้าพเจ้าหรือผู้เกี่ยวข้องมีสิทธิ์จะได้รับแต่ประการใด อีกทั้งได้รับทราบจากผู้วิจัยว่า จะไม่เปิดเผยข้อมูลหรือผลการวิจัยของข้าพเจ้าหรือผู้เกี่ยวข้องกับข้าพเจ้าเป็นรายบุคคลต่อสาธารณชน

ข้าพเจ้าและผู้เกี่ยวข้องกับข้าพเจ้า ได้รับทราบข้อมูลจากผู้วิจัยจนหมดข้อสงสัยโดยตลอดแล้วและยินดีตอบแบบสอบถามของการวิจัยนี้ จึงได้ลงลายมือชื่อไว้เป็นหลักฐานต่อหน้าพยาน

ขอขอบคุณในความร่วมมือ
นางสาวจันทิมา จรัสทอง
นักศึกษาปริญญาโท

ลงชื่อ .... ผู้ยินยอมหรือผู้แทน โดยชอบธรรม
( )

ลงชื่อ .... พยาน
( )

APPENDIX C

INSTRUMENT

APPENDIX C

INSTRUMENT

แบบบันทึกแบบแผนการนอนหลับของทารกเกิดก่อนกำหนด

ลำดับที่ ....

<u>ส่วนที่ 1</u> ข้อมูลส่วนตัว

ชื่อ – นามสกุล ....เพศ ....

อายุครรภ์ ....สัปดาห์ (by date ,by score)อายุครรภ์หลังเกิด ....ชั่วโมง

น้ำหนักแรกเกิด .... กรัม

การวินิจฉัยโรค ....

การรักษาที่ได้รับ ....

....

....

....

ยาที่ได้รับ ....

....

....

....

ปริมาณนมที่ได้รับ..................ซี.ซี.ทุก..........ชั่วโมง

วิธีให้ ....

อุณหภูมิตู้อบ ....องศาเซลเซียส (servo mode, air mode)

อุณหภูมิร่างกาย ....องศาเซลเซียส อุณหภูมิห้อง......องศาเซลเซียส

ผลการตรวจสมอง ....

ส่วนที่ 2 แบบบันทึกระยะเวลา สภาวะการหลับและตื่นและหัตถการของทารกเกิดก่อนกำหนด

ลำดับที่ .... วันที่.. ท่านอน ....

●——● = quiet sleep (QS)　　━━━ = active sleep (AS)　　∼ = drowsy sleep(DS)

●··–··● = quiet alert (QA)　　— · · — = active alert (AA)　　∿∿ = crying (Cry)　　.............. = procedure (P)

เวลาที่เริ่ม..........　　　นาที　　รวม

0	1	2	3	4	5	6	7	8	9	10	QS	AS	DS	QA	AA	Cry	P
10	11	12	13	114	I 15	I16	17	18	19	20							
20	21	22	23	24	25	26	27	28	29	30							
30	31	32	33	34	35	36	37	38	39	40							
40	41	42	43	44	45	46	47	48	49	50							
50	51	52	53	54	55	56	57	58	59	60							

รวม quiet sleep ....นาที

active sleep ....นาที

drowsy sleep .... นาที

quite alert .... นาที

active alert .... นาที

crying .... นาที

procedure ชนิด.................................... ใช้เวลา.............. นาที การเปลี่ยนแปลงสภาวะหลับตื่น ....

ชนิด.................................... ใช้เวลา.............. นาที การเปลี่ยนแปลงสภาวะหลับตื่น ....

ชนิด.................................... ใช้เวลา.............. นาที การเปลี่ยนแปลงสภาวะหลับตื่น ....

ชนิด.................................... ใช้เวลา.............. นาที การเปลี่ยนแปลงสภาวะหลับตื่น ....

ชนิด.................................... ใช้เวลา.............. นาที การเปลี่ยนแปลงสภาวะหลับตื่น ....

ชนิด.................................... ใช้เวลา.............. นาที การเปลี่ยนแปลงสภาวะหลับตื่น ....

เกณฑ์การประเมินสภาวะการหลับตื่นของทารกเกิดก่อนกำหนด

การประเมินสภาวะการหลับตื่นของทารกเกิดก่อนกำหนด สังเกตจากการปิดเปิดเปลือกตา การเคลื่อนไหวร่างกาย และลักษณะการหายใจ ซึ่งปรับมาจากแบบประเมินสภาวะการหลับตื่นของปาร์มิลีและสเทิรน์ (Parmelee & Stern, 1972) ซึ่งนำมาแบ่งดังนี้

สภาวะการหลับตื่น (Sleep-wake state)	**สัญลักษณ์**	**การเปิด-ปิดของตา**	**ลักษณะการหายใจ**	**การเคลื่อนไหวของร่างกาย**
ระยะหลับลึก(Quiet sleep)		ตาปิด	**หายใจสม่ำเสมอและใช้กล้ามเนื้อหน้าท้องเคลื่อนไหว**	**ไม่มีการเคลื่อนไหวหรือมีการเคลื่อนไหวเล็กน้อย อาจพบสะดุ้ง**
ระยะหลับตื้น(Active sleep)		ตาปิด มี REM	หายใจไม่สม่ำเสมอและใช้กล้ามเนื้อซี่โครงเคลื่อนไหว	มีการเคลื่อนไหวของแขนม ขา, มือ, เท้า, ศีรษะและลำตัว หรือทั้งร่างกาย
ระยะง่วงซึม(Drowsy sleep)		ตาหนัก ตาปิดหรือเปิดครึ่งตา	หายใจไม่สม่ำเสมอ	มีหรือไม่มีการเคลื่อนไหวร่างกาย
ระยะตื่นสงบ(Quiet alert)		ตาเปิด จ้องมองนิ่ง	หายใจสม่ำเสมอ	มีการเคลื่อนไหวเล็กน้อยของแขน, ขา, มือ, เท้า, ศีรษะ เป็นบางส่วนหรือไม่มีการเคลื่อนไหว
ระยะตื่นเต็มที่(Active alert)		ตาเปิดเต็มที่	หายใจไม่สม่ำเสมอ	มีการเคลื่อนไหวทั้งแขน,ขา, หน้า, ศีรษะ, ลำตัว หรือทั้งร่างกาย
ระยะร้อง(Crying)		ตาเปิดหรือปิด	หายใจไม่สม่ำเสมอ มีการเคลื่อนไหวทรวงอกเร็วขึ้น	มีการเคลื่อนไหวทั้งร่างกาย มีการดึงตัวของกล้ามเนื้อ

แบบบันทึกชนิดหัตถการที่ทารกเกิดก่อนกำหนดได้รับ ประยุกต์ใช้มาจากการศึกษาของสุพัฒตรา จรุงพันธ์ และคณะ(2542) เกี่ยวกับชนิดและกิจกรรมการพยาบาลของทารกแรกเกิดที่ได้รับขณะได้รับการรักษาในหออภิบาลทารกแรกเกิด โรงพยาบาลศิริราช

รหัส	ชนิดของหัตถการ
1.	เจาะเลือดทางส้นเท้า
2.	แทงเส้นให้สารน้ำทางหลอดเลือด
3.	การตรวจร่างกาย
4.	การทำความสะอาดร่างกาย
5.	การทำความสะอาดหลังขับถ่าย
6.	การวัดอุณหภูมิร่างกาย การเปลี่ยนท่า
7.	การวัดอุณหภูมิร่างกาย และเปลี่ยนผ้าอ้อม
8.	การฉีดยาทางหลอดเลือดดำ
9.	แกะ/ติดพลาสเตอร์
10.	การใส่สายให้อาหารทางปาก
11.	การให้อาหารด้วยถ้วย
12.	การให้อาหารด้วยช้อน
13.	การเปลี่ยนผ้าอ้อม
14.	การเปลี่ยนเตียง

รหัส	ชนิดของหัตถการ
15	ให้ยารับประทานทางสายยาง ฉีดยา
16.	ให้อาหารทางสายยาง
17	การปลอบโยน
18	การเลี้ยงลูกด้วยนมแม่
19	เปลี่ยนท่า
20	ติดถุงปัสสาวะ
21	ทำแผล
22	ชั่งน้ำหนัก
23	เช็ดตา
24	ฟิลม์ x-ray
25	ติด probe วัดค่าความอิ่มตัวของออกซิเจน
26	เจาะเลือดทางหลอดเลือด
27	ดูดเสมหะ
28	การทำสีรีรบำบัดทรวงอก
29	การวัดความดันโลหิต

BIOGRAPHY

NAME	Chantima Charastong
DATE OF BIRTH	26 th March 1971
PLACE OF BIRTH	Nonthaburi, Thailand
INSTITUTE ATTENDED	Mahidol University, 1989-1993: Bachelor of Science in Nursing Mahidol University, 1999-2001: Master of Nursing Science (Maternal and Child Nursing)
POSITION & COLLEGE	1993-1995, Neonatal Ward. 1996-Present, Neonatal Intensive Care Unit (NICU), Pediatric Nursing Division, Faculty of Medicine Siriraj Hospital. Position: Registered Nurse.