

**EFFECTS OF MULTI-MODALITIES SENSORY STIMULATION  
PROGRAM ON THE BODY WEIGHT AND SLEEPING  
PERIOD OF PREMATURE INFANTS**



**A THESIS SUBMITTED IN PARTIAL FULFILLMENT  
OF THE REQUIREMENTS FOR  
THE DEGREE OF MASTER OF NURSING SCIENCE  
(PEDIATRIC NURSING)  
FACULTY OF GRADUATE STUDIES  
MAHIDOL UNIVERSITY**

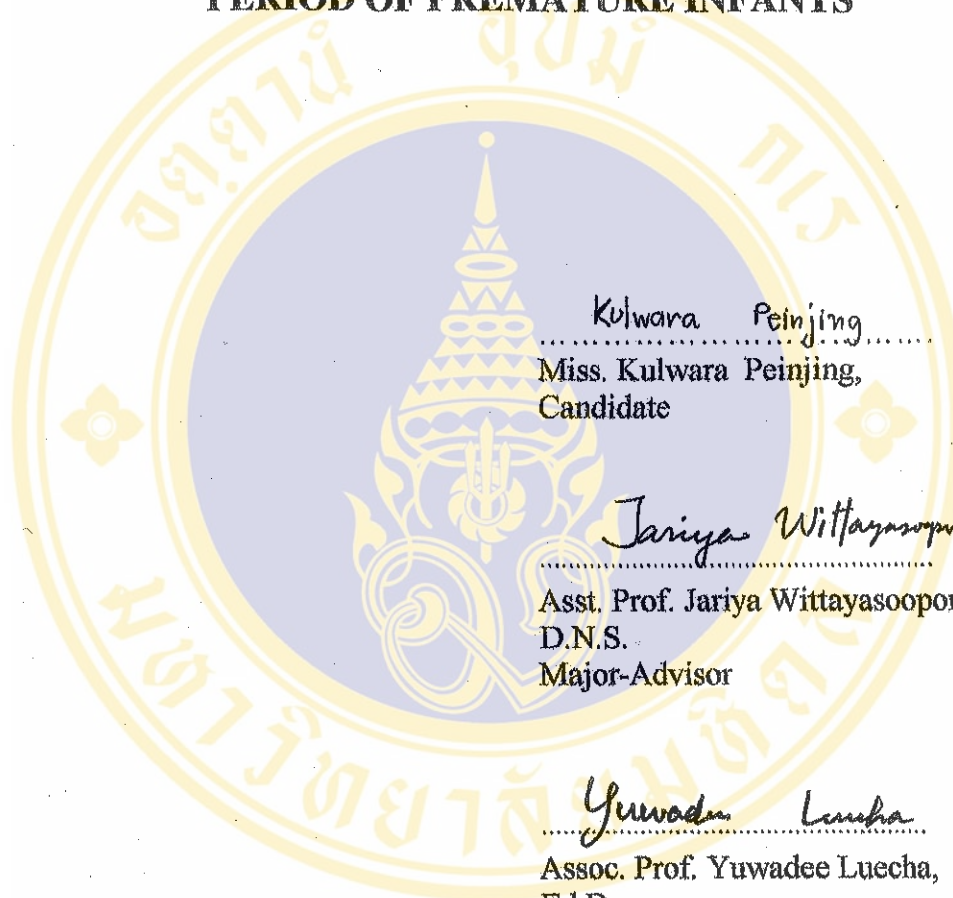
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was submitted to the Faculty of Graduate Studies, Mahidol University  
For the degree of Master of Nursing Science (Pediatric Nursing)

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Kulwara Peinjing

**EFFECTS OF MULTI-MODALITIES SENSORY STIMULATION PROGRAM ON THE BODY WEIGHT AND SLEEPING PERIOD OF PREMATURE INFANTS**

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**ABSTRACT**

The purpose of this quasi-experimental research aimed to compare the body weight and sleeping period of premature infants between a control group and an experimental group under the multi-modalities sensory stimulation program. Based on the conceptual framework of the synactive theory (Als, 1982) the selected sample was 40 cases of premature infants in Sawanpracharuk Hospital, 20 cases for each group. The control group received only conventional nursing care. The experimental group received both conventional nursing care and the multi-modalities sensory stimulation program. Body weight was assessed by weighing. The Sleep-wake State by Parmelee & Stern was used to measure sleep-wake cycle. Data were analyzed using t-test.

The results showed that the body weight gain per day of premature infants in the experimental group was significantly higher than in the control group ( $p < .05$ ). The total sleep period in the experimental group was significantly longer than the control group ( $p < .05$ ). The feeding intake in the experimental group was significantly higher than the control group ( $p < .05$ ) and the quiet sleep period in the experimental group was longer than the control group but there was no statistically significant difference between the two groups of subjects ( $p > .05$ ).

This resulted in the conclusion that the multi-modalities stimulation programs will promote the sleeping period, the body weight gain and the feeding intake in premature infants. So a health care plan incorporating this program should be recognized for premature infants to shorten hospitalization.

**KEY WORDS: MULTI-MODALITIES SENSORY STIMULATION PROGRAM /  
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ผลของโปรแกรมการกระตุ้นประสาทสัมผัสหลายรูปแบบต่อน้ำหนักตัวและระยะเวลาการหลับของทารกเกิดก่อนกำหนด (EFFECTS OF MULTI - MODALITIES SENSORY STIMULATION PROGRAM ON THE BODY WEIGHT AND SLEEPING PERIOD OF PREMATURE INFANTS)

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### บทคัดย่อ

การศึกษานี้เป็นการวิจัยกึ่งทดลอง มีวัตถุประสงค์เพื่อศึกษาผลของโปรแกรมการกระตุ้นประสาทสัมผัสหลายรูปแบบ ต่อน้ำหนักตัว และระยะเวลาการหลับของทารกเกิดก่อนกำหนด โดยใช้กรอบแนวคิด the synactive theory (Als,1982) กลุ่มตัวอย่างเลือกแบบเจาะจง จำนวน 40 คน กลุ่มละ 20 ในหน่วยทารกแรกเกิด โรงพยาบาลสวรรค์ประชารักษ์ คนทั้งสองกลุ่มได้รับการพยาบาลตามปกติ กลุ่มทดลอง ได้รับการกระตุ้นด้วยโปรแกรมการกระตุ้นประสาทหลายรูปแบบ ประเมินน้ำหนักตัวของทารกโดยการชั่งน้ำหนัก ประเมินวงจรการหลับคืน โดยใช้แบบประเมินระยะเวลาหลับคืนของ Parmelee & Stern (1972) และทดสอบทางสถิติ โดยใช้ t-test

ผลการวิจัยพบว่า เมื่อสิ้นสุดการศึกษาพบว่าทารกเกิดก่อนกำหนดในกลุ่มที่ได้รับการกระตุ้นประสาทสัมผัสหลายรูปแบบมีอัตราการเพิ่มของน้ำหนักตัว ดีกว่ากลุ่มควบคุมอย่างมีนัยสำคัญทางสถิติ ( $p < .05$ ) มีระยะเวลาหลับโดยรวมนานกว่ากลุ่มควบคุมอย่างมีนัยสำคัญทางสถิติ ( $p < .05$ ) มีปริมาณนมที่รับได้มากกว่ากลุ่มควบคุมอย่างมีนัยสำคัญทางสถิติ ( $p < .05$ ) และมีระยะเวลาการหลับลึกนานกว่ากลุ่มควบคุมอย่างไม่มีนัยสำคัญทางสถิติ ( $p > .05$ )

จากผลการวิจัยสรุปว่า โปรแกรมการกระตุ้นประสาทสัมผัสหลายรูปแบบจะช่วยในการส่งเสริมให้ทารกเกิดก่อนกำหนด มีระยะเวลาการหลับโดยรวมที่ยาวนาน รับประทานอาหารได้มากขึ้นและการเพิ่มของน้ำหนักตัวดีขึ้น ดังนั้นจึงควรมีการวางแผนในการดูแลสุขภาพ โดยการนำโปรแกรมการกระตุ้นประสาทสัมผัสหลายรูปแบบมาส่งเสริมในทารกที่เกิดก่อนกำหนด เพื่อช่วยลดระยะเวลาการอยู่โรงพยาบาลของทารก

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## CHAPTER I

### INTRODUCTION

#### **Background and rationale of the study**

Nowadays, the present technological and medical advances tremendously increase the chance of premature infants to escape death. The statistical records of Sawanpracharuk Hospital in the years 2000-2002 revealed that the numbers of premature infants delivered at the hospital were 395, 351, and 314, respectively. In general, immaturity of premature infants can lead to various organ dysfunctions or defects in bodily systems, resulting in a wide range of problems including respiration distress, apnea, ineffective thermoregulation hypoglycemia, hyperbilirubinemia, and different forms of infections. Premature infants are defined as those who are born before the pregnancy reaches its full term. Being delivered before the appropriate time, premature infants have to face with the extra uterine world, which is quite different from the environment inside a wall functioning uterine. Generally, premature infants often require a long period of hospitalization and have to deal with risks of developing iatrogenic complications from interventions to ensure their survival as well as from spending the first days of their lives staying in the intensive care nursery environment. Sources of stress in the NICU include medical and surgical procedures, pain, pathologic processes, caregiver interventions, and the physical environment of the unit itself, especially sounds and lights. It has been pointed out that neonatal stress leads to energy expenditure and disturbed sleep, which may alter physiological processes and CNS organization, influencing developmental outcomes.

Sensory stimulations are categorized into tactile stimulation, auditory stimulation, visual stimulation, and vestibular and kinesthetic stimulation that have been proved to be most appropriate and most beneficial for premature infants. Previous research studies have found that stimulation enhances neurobehavioral development to increase growth hormone and gastrointestinal hormone (Rice, 1977; Kramer & Pietpont, 1976; Beachy, 2003; Phuekvilai, 1987; Charoensri, 2002; White-Traut, 1992; Tinikul, 2000), promotes feeding and stooling (Rausch, 1981; White &

Labarba, 1976), decreases length of stay in hospital, saves cost of hospitalization (Field et al., 1986; Beachy, 2003), prolongs sleep (Banard & Bee, 1983; Rice, 1977; Banard, 1973, cited in Eiamsila et al., 1994) and promotes mother-infant interaction (Charoensri, 2002).

In Thailand, studies have been conducted to explore the effects of multi-modalities sensory stimulation programs composed of four aspects: tactile stimulation, vestibular and kinesthetic stimulation, visual stimulation, and auditory stimulation. A study by Tinikul (2000) revealed that stimulating the babies one time per day for ten days resulted in no statistically significant difference between the two groups of baby subjects when it came to their growth. However, another study indicated that the same method of multi-modalities sensory stimulation involving providing stimulation once a day for a period of one month led to statistically significant difference in the growth of the two groups of premature infants (Charoensri, 2002). Study findings have led to a conclusion that a multi-modalities sensory stimulation program involving one stimulation daily within a short duration does not lead to the differences in the growth of premature infants. In addition, studies carried out to examine the effects of a multi-modalities sensory stimulation program consisting of three types of stimulation; that is, tactile stimulation, vestibular and kinesthetic stimulation, and auditory stimulation. For this reason, the researcher was interested in investigating the effects of a multi-modalities sensory stimulation program by providing such stimulation to the clinically stable infants for two times a day from the beginning of the study until after the infants had reached the body weight of 1,800 grams. It was anticipated that the provision of stimulation would help promote sleep and growth.

### **Conceptual framework**

This research was been carried out based on the synactive theory (Als, 1982). The conceptualization of development focused on how the individual infant appeared to handle the experience of the world around him/her, including being in continual contact with his/her environment via five subsystems—the systems of autonomic, motor, state organization, attention and interaction, and regulatory (Als, 1982: 230-231; Als, 1986: 15-18; Blackburn & Vandenberg, 1993: 940-941) as follows:

1. The autonomic system is behaviorally observable in the pattern of respiration, color change, tremulousness, etc.
2. The motor system is behaviorally demonstrable through muscle tone, posture, and movement.
3. The state organization system is behaviorally observable in the kind and range of states of consciousness available to the organism.
4. The attention and interaction system is exemplified in the organism's ability to come to an alert, attentive state and to use this state to take in cognitive and social-emotional information from the environment.
5. The regulatory balancing system is behaviorally exemplified in observable strategies the organism uses to maintain a balanced, relatively stable and relaxed state of subsystem integration or to return to such a state of balance and relaxation.

The autonomic system is position of assuring the organism's baseline functioning. The motor system is unfolding from very early embryonic stages with recognizable flexor posture, limb and trunk movements, and becoming increasingly differentiated. The state organization system is the unfolding of distinct states of consciousness from a diffuse quasi-sleep to increasingly differentiated sleep, wake, and aroused bands of consciousness. The attention and interaction system goes into more and more elaborated, subtly branched, and finely tuned nuances of affective and cognitive receptivity and activity, shaping the social and inanimate world, and negotiating one's own developmental progression in the process. The within-subsystem differentiation for which each system strives depends on the other subsystems' support and relative intactness. The whole organism with its intraorganism subsystem interaction is at all stages surrounded and embedded in an environment appropriate for ontogenesis of the species. In general, premature infants are defined as those who are born before the pregnancy reaches its full term. Immaturity of premature infants means various organ and subsystem dysfunctions. As such, developmental care is a way to help premature infants continue their development. It has been found that developmental care can increase the secretion of the growth hormone and gastrointestinal hormone (Rice, 1977; Kramer & Pietpont, 1976; Beachy, 2003; Phuekvilai, 1987; Charoensri, 2002; White-Traut, 1992; Tinikul, 2000), promote feeding and stooling (Rausch, 1981; White & Labarba, 1976), decrease

length of stay in hospital, save cost of hospitalization (Field et al., 1986; Beachy, 2003), prolong sleep (Banard & Bee, 1983; Rice, 1977; Banard, 1973, cited in Eiamsila et al., 1994) and promote mother-infant interaction (Charoensri, 2002). Besides, it has been discovered that the gestational age of 32-36 weeks is the most appropriate period for stimulation with sensory inputs that promote the functions of organism and help ensure appropriate development in premature infants. In this study, the researcher was interested in investigating factors that could promote sleep, increase body weight, and promote feeding in premature infants.

Sleep is one of the basic needs of the human organism (Schiber & Fay, 1990: 285). Sleep pattern in premature infants is controlled by the central nervous system (Balsmeyer, 1990: 447). The sleep pattern of a newborn infant is a cycle, which can be divided into two states: active sleep or rapid eye movement (REM) and quiet sleep or non-rapid eye movement (NREM). Infants' sleep cycle is 50 to 60 minutes. Active sleep duration varies from 10 to 45 minutes, whereas quiet sleep lasts about 20 minutes (Catlett & Holditch-Davis, 1990: 21). As for premature infants, a sleep cycle is about 30-40 minutes. In each sleep cycle, there is more active sleep than quiet sleep. A preterm infant who is 40 weeks post connectional age does not have as well organized sleep patterns as a term newborn (Gardner & Lubchenco, 1993).

Body weight generally decreases after birth, and in the infants who do not have complications body weight begins to increase about eight or nine days after birth. After that, the body weight of premature infants will increase, with the body weight gain of about 20-30 grams per day (Avery, 1992: 174). To be more exact, the average body weight gain is 24 grams per day (GA 28-32wks), 30 grams per day (GA 32-36 wks), and 28 grams per day (GA 36-40 wks) (Babson, 1970: 11).

Feeding in preterm infants can pose several potential problems. Since neither the skeletal nor the smooth muscles of the gastrointestinal tract are as well developed in the preterm baby as in the term baby, the preterm baby sucks less vigorously and has a greater tendency toward abdominal distention (Moore, M.L., 1981). During the first week of life, infants tolerate 50-100 kcal per kg. Daily weight gain of infants should be monitored. If the rate gain is inadequate, kcal per kg must be increased by increasing volume within limits tolerated by the infant or by increasing the caloric density of feedings from the standard 20 kcal per oz of breast milk or standard infant

formula to 24 to 30 kcal per oz. (Taeusch H.W. & Yogman M.W., 1987). Schedules feedings are arranged at predetermined intervals. Some hospitals routinely feed infants every four hours, although breast-fed infants tend to be hungry every two to three hours because of the easy digestibility of the breast milk.

Developmental care concept has been divided into two different approaches. One theoretical approach views the infant in NICU as being over stimulated compared to the natural uterine environment and propose minimal handling and reduced sensory input. The other approach views the infant as being deprived of appropriate sensory inputs and additional stimulation is provided in an effect to improve outcome. (Reid & Freer, 2000: 16) The infants in the NICU are missing the chance to receive sensory stimulation from the mothers and caregivers; that is, the auditory, vestibular, tactile, and kinesthetic stimulation, tactile stimulation. A stimulation program to promote neurological functions and organ functions is thus appropriate for infants who have the risk of delayed development and are at 32-36 weeks post-conception. The researcher was interested in investigating the effectiveness of a multi-modalities sensory stimulation to increase body weight, promote sleeping period, and increase feeding intake in premature infants. A multi-modalities sensory stimulation program in this study was composed of auditory stimulation, tactile stimulation, and vestibular and kinesthetic stimulation. Each stimulation is described as follows:

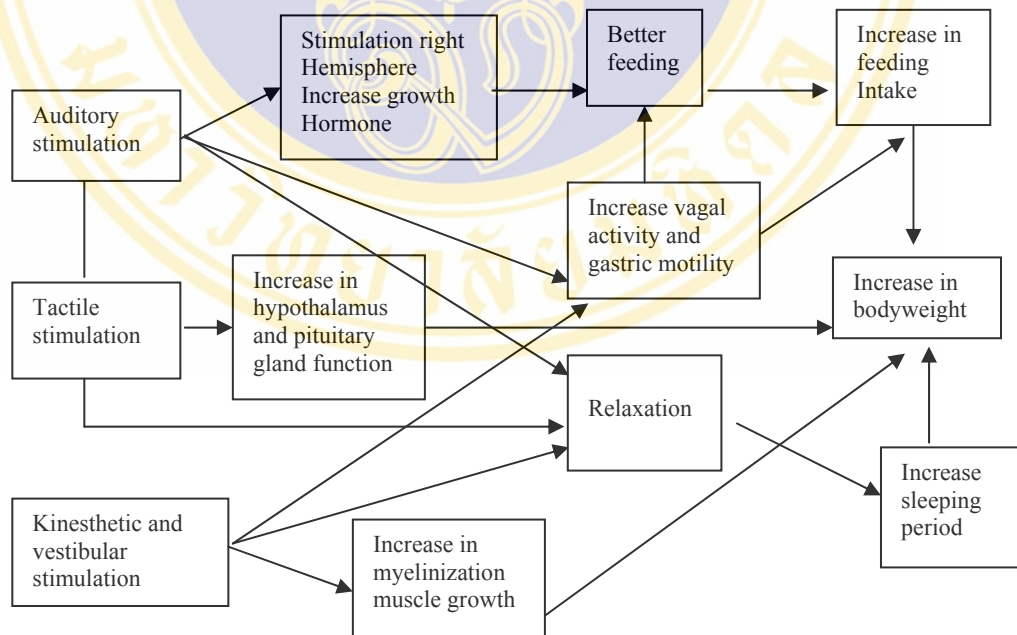
1. Auditory stimulation: Classical music stimulates the right hemisphere of the brain that is important for emotion and behavior of infants (Chaze & Ludington-Hoe, 1987: 69). Infants will relax and be calmer, with a longer duration of sleep. When sleeping, metabolism and oxygenation decrease, increasing the secretion of growth hormone and feeding (Chawarit, 1978, cited in Suksawangrote et al., 1996). This can, in turn, body weight gain (Cain, 1992, cited in Olsan, 1998; Kramer & Pierpont, 1976).

2. Tactile stimulation: Infants will relax, and this promotes quiet sleep (Rice, 1977: 71; Barnard & Bee, 1987). Increased vagal activity and the higher insulin level make food absorption more efficient. It also stimulate gastric motility, leading to better feeding tolerance (Field T, 2002: 163-167; Uvas-Moberg et al, 1987: 852; Field, 1995: 110). Also, it stimulates reticular formation to increase hypothalamus causing

the secretion of somatotrophic hormone from the pituitary gland, the maturing of tissues, and the increase in weight and strong muscles (Kuhn et al., 1991).

3. Vestibular and kinesthetic stimulation: It promotes myelinization and muscle growth. Body weight will increase. Rhythm and slow movement lead to sleep (Chaze & Ludington-Hoe, 1984: 71). At the same time, vagal activity increases, gastric motility is stimulated (Field T, 2002: 163-167), and feeding and stooling are promoted (Rausch, 1981; Beachy, 2003: 39-45).

In summary, a multi-modalities stimulation program is composed of tactile stimulation, auditory stimulation, and vestibular and kinesthetic stimulation which make infants relax, promote deeper and longer sleep, decrease metabolism, and increase secretion of growth hormone, which in turn leads to better feeding that increases body weight. For this reason, the researcher was interested in investigating the effectiveness of a multi-modalities sensory stimulation program to promote infants' total sleep, longer quiet sleep, feeding intake, and body weight gain.



**Figure 1:** Demonstrate the effect of multi- modalities stimulation program on body weight gain, sleeping period, and feeding intake in the premature infants

**Research question**

What are the effects of the multi-modalities sensory stimulation program on body weight gain, sleeping period, and feeding intake in the premature infants?

**Objectives of the study**

1. To compare the body weight gain per day between the subjects who receive a multi-modalities sensory stimulation program and those who do not.
2. To compare the total sleeping period and the quiet sleeping period of the premature infants who receive the multi-modalities sensory stimulation program and those who do not.
3. To compare the feeding intake of the premature infants who receive the multi-modalities sensory stimulation program and those who do not.

**Research hypothesis**

1. The body weight gain per day of the premature infants receiving the multi-modalities sensory stimulation program is higher than that of the premature infants who do not receive such a program.
2. The total sleeping period of the premature infants receiving the multi-modalities sensory stimulation program is longer than that of the premature infants who do not receive such a program.
3. The quiet sleeping period of the premature infants receiving the multi-modalities sensory stimulation program is longer than that of the premature infants who do not receive such a program.
4. The feeding intake of the premature infants receiving the multi-modalities sensory stimulation program is higher than that of the premature infants who do not receive such a program.

**Scope of the study**

This research study was conducted with premature infants who were admitted in the Neonatal Unit at Sawanpracharuk Hospital. The multi-modalities sensory stimulation program composes tactile stimulation, auditory stimulation, and vestibular/ kinesthetic stimulation. This program did not include visual stimulation

because that made infant awake after stimulated and this program measured sleeping period immediately outcome. The study period started when the premature infants had body weight of 1,400 to 1,700 grams and ended when the premature infants' body weight increased to 1,800 grams. Data collection was carried out from September 2004 to August 2005.

### **Expected outcomes and benefits**

1. For nursing practice, the findings of the present research can be used as a guideline in developing a multi-modalities sensory stimulation program to enhance sleep feeding intake and body weight gain of premature infants.
2. For nursing education, this research would provide a sought-after guideline in designing and implementing nursing pedagogy which enables nursing students to more effectively utilize a multi-modalities sensory stimulation program to promote sleep feeding intake and body weight gain of premature infants.
3. For nursing research, the findings of the present study can be used as a guideline for future studies investigating the effectiveness of a multi-modalities sensory stimulation program used with other groups of subjects with different demographic characteristics.

### **Assumption**

The premature infants need appropriate sensory stimulation, and sleep is one of the basic needs of the human organism. Multi-modalities sensory stimulation intervention has been proved to be safe and beneficial for stable premature infants whose gestational age is 32 weeks or more.

### **Definition of variables**

**A multi-modalities sensory stimulation program** was composed of the 15-minute per time stimulation sessions conducted twice a day with three standardized phases:

1. auditory and tactile for five minutes
2. auditory and vestibular/kinesthetic for five minutes
3. auditory and tactile for five minutes

Tinikul, (2000) has modified this program from the sensory stimulation program of White-Traut and colleagues (cited in Burns et al., 1994) and Field and colleagues (1986). The intervention was provided to the clinically stable infants twice a day by the researcher.

**Body weight gain** is defined as the changes in body weight from the beginning of the study until the end of the study divided by the number of days of the study. Research assistants assessed the body weight of premature infants every morning from 6:00 a.m. to 7:00 a.m.

**Sleeping period** meant the duration of time during which premature infants showed quiet sleep, active sleep, and total sleep. In this study, the assessment of the sleeping period was carried out using the criteria of sleep state assessment, which was modified from the sleep-wake state of premature infants developed by Parmelee & Stern (1972: 200) and subsequently adapted by Charasthong (2001). The research assistants used this assessment tool to observe the characteristics of infants' sleep every minute for one hour and 30 minutes immediately after a multi-modalities sensory stimulation program was given in the experiment group and immediately after feeding time in the control group every two days.

1. The quiet sleeping period of the premature infants was characterized by closed eyes, regular respiration, as well as abdominal movement, body movement, or startling.
2. The active sleeping period of the premature infants was characterized by closed eyes with REM, irregular respiration, and limb movement of forearms, legs, hands, feet, head, and body of premature infants.
3. The total sleeping period of the premature infants was characterized by the infants' quiet sleeping and active sleeping periods.

**Feeding intake** was defined as the volume of premature infants' formula that the premature infants could receive per day as measured in cc/kg/day.

## CHAPTER II

### LITERATURE REVIEW

In the study, related literature and existing research are reviewed in the following topics:

1. Growth of premature infants
2. Sleep-wake cycle of infants
3. Effects of light and sound levels on sleep
4. Sensory stimulation programs and effects of stimulation programs on growth and sleep

#### **1. Growth of premature infants**

1. A premature infant is defined as a live born infant that is born before the completion of 37 weeks of gestation (259 days). The causes for premature birth are still largely unknown. However, maternal complications such as bleeding, pervagina pregnancy, etc. are always found to accompany premature birth (Siripoanya, P., 1990; Wong, 1999, Usher, 1981: 230-231).

Generally, growth of premature infants is relevant to gestational age and problems during pregnancy. Assessment of growth of premature infants is done using the body weight after delivery as standard (Whaley & Wong, 1995).

#### **Body weight**

Body weights of premature infants vary along the gestational age standard of average body weight (Crosse, 1975: 2).

In general, newborns lose up to 10 percent of the birth weight by within the first three to four days of life due to loss of excessive extracellular fluid and meconium as well as limited food intake, especially in breastfeed infants (Avoa & Fischer, 1990, cited in Whaley & Wong, 1995):

A decrease in body weight of premature infants is caused by dehydration due to evaporation resulting from skin metabolism and fluid and electrolyte imbalance, resulting in insufficiency of calories (Babson, 1970: 11).

In infants that do not have any complication, body weight will begin to increase about eight or nine days after birth. After that, their body weight will increase more rapidly than that of full term infants, averaging an increase of 20-30 grams per day (Avery, 1992: 174).

Price & Kalhan (2001, cited in Jirapaet, K. & Jirapaet, V., 2005) have classified average of body weight gain in infants as follows:

Gestational age (weeks)	body weight gain
24-28	15-20 grams/kg/day
29-32	17-21 grams/kg/day
33-36	14-15 grams/kg/day
37-40	7-9 grams/kg/day
4 weeks- 3 months	30 grams/day

Gardner & Pearson (1971, cited by Yodpinij, 1993: 14) have classified growth of premature infants into four stages as follows:

The first stage: Body weight decreases very rapidly in the first two or three days after delivery. During the first three to seven days of life, body weight of premature infants decreases by 10-20 percent of birth weight. Growth delay is directly correlated with the degree of nutritional restriction (Manser, 1984).

The second stage: About half of the first week after delivery, the body weight will increase with the same growth rate as that of normal newborns. This period lasts about two to five weeks.

The third stage: The infants with the gestational age of 36-40 weeks will have even faster growth rates.

The fourth stage: During this stage, the infant's age is equivalent to the matured gestational age of 40 weeks and the growth rate of the infants will be the same as that of the normal newborns. In the infants whose growth is delayed and who are unable to catch up with the standard infants when it comes to head circumference, length, and body weight risk having slow neurological development (Manser, 1984).

## **Factors influencing growth**

### **1. Biological factors**

1.1 Hereditary: Heredity has an influence on growth. The physical and psychological features and chemical and biological substances within the body will determine the transfer of genes from the parents to their offspring. The transfer of genes is also a controlling factor of the growth rate, size, and final shape of a person. Besides, environment has a major impact in enhancing a person's development and growth to the maximum point (Whaley & Wong, 1995). In this study, only the premature infants who had similar body weights were recruited by the researcher.

1.2 Sex: On average, male infants have a slightly faster growth rate than female infants until they are about seven months old, when growth rate becomes equivalent. At the age of seven, the male growth rate will be slower than the female, and afterwards there is no difference until the children reach adolescence (Brierley, 1980). The researcher controlled this factor by selecting the proximate numbers of male and female infants in the control and the experimental groups.

1.3 Food: Food is important for growth. It is through sufficient and appropriate food substance intake that the body is enabled to receive necessary food substances for physiological growth, as well as complete physical and mental development (Rattana-path, 1991: 26). This factor was controlled by having the infants under the same nursing care and received food in the same standard.

1.4 Performance of various glands: All glands in our body play a part in physiological growth. For instance, the anterior fontanel at the pituitary gland controls the flow of hormones to ensure that the body grows properly. In case of excessive flow, the body will grow more than its ordinary size or grow less with an insufficient flow of hormones (Hurlock, 1978). In this study, the researcher controlled this factor by selecting only the infants with absence of congenital abnormalities of various glands.

1.5 Health: The infants with strong health and little sickness will grow better than the infants with frequent and severe sicknesses or with certain chronic diseases (Hurlock, 1978). In this study, the researcher selected only the infants who did not have any severe complication and made sure that all selected infants had the same complications and pathology.

## 2. Psychological and emotional factors

Infants with certain emotional effects or without clear moods resulting from not having been properly or adequately responded to in emotional needs, or from lack of love and affection, or lack of parental attention, can experience the production of too much steroids by the adrenal gland in the body, and thus, body growth will be affected (Hurlock, 1978, cited in Rattana-opath, 1991: 27).

## 3. Maternal-infant interaction

Promoting maternal-infant interaction such as by touching, speaking, or holding can stimulate the sensory organs. When applied appropriately, sensory stimuli can promote growth, development, and attachment (Chaze & Ludington-Hoe, 1984: 68). This factor was difficult to control in this study.

## **2. Sleep-wake cycle of infants**

Sleep is one of the basic needs of human organism. Sleep promotes growth, development, and metabolism by CNS that controls the sleep-wake cycle (Wong & Whaley, 1999: 129). Unlike full term infants, preterm infants have more poorly organized sleep and sleep with a shorter duration (Gardner et al., 1993: 572).

Sleep is a phenomenon that is common to all humans. It begins before birth as a part of intrauterine existence and continues until the time of death (Renand, 1996: 27).

The sleep state in infants is composed of quiet sleep state and active sleep. Active sleep is defined as having the eyes closed with rapid eye movements, frequent body, limb, or face movements, and irregular respiration. On the other hand, quiet sleep is defined as having the eyes closed without any movement, no body movements except startle, and regular respiration (Keefe, 1986: 144). During the first week of life, infants are awake every four hours and stay awake for one to two hours. The longest sustained duration of wakefulness increases slowly from two to three hours at one week to three to four hours at 16 weeks (Parmelee & Stern, 1972: 209). Generally, infants sleep for 16 to 18 hours per day (Kick, 1996: 247). The sleep cycle lasts about 50 to 60 minutes. Mostly there is more active sleep than quiet sleep (Keefe, 1986: 140). As sleeping begins, the term infants enter active rather than quiet sleep. Active sleeps lasts about 10 to 45 minutes, while quiet sleep lasts about 20 minutes. Active

sleep is lighter than quiet sleep, and the preterm infants who are 40 weeks post-conceptual age do not have as well organized sleep patterns as the term newborns. Premature infants tend to fall asleep in active sleep, and a complete sleep cycle, consisting of both active and quiet sleep, lasts from 36 to 40 minutes (Garner et al., 1993: 572). In Thailand, studies have been conducted to explore sleep patterns in premature infants' post-conceptual age of both 34-36 weeks and 37-39 weeks. It has been found that 57% of the time each sleep cycle lasts 40 to 60 minutes, with the percentage of quiet sleep being 21% and that of active sleep being 36% (Charastong, 2001). Sleep state, especially quiet sleep, helps promote growth and repair tissues that are necessary to rehabilitate health (Schiber & Fay, 1990: 285).

The assessment of the sleep-wake state of term and preterm infants is generally carried out with an observation and definition of behaviors. Examples of the assessment tools commonly used for such purpose are as follows (Holditch-Davis, 1993):

First, the Neonatal Behavioral Assessment Scale or NBAS (Brazelton, 1984) is used to assess the individuality of the infants within the interactional process consisting of six states: deep sleep, light sleep, drowsy, alert, considerable motor activity, and crying. This state system is easy to learn because the differences between the states are fairly obvious and there are only six states. However, the NBAS state scoring system is appropriate only for use with infants between 36 and 44 weeks' gestational age as the sleeping and waking states of older and younger infants will not be completely captured with this system.

Second, the Thoman State Scoring System, which was developed by Thoman, is used. It consists of ten states: alert, non-alert, waking activity, fuss, cry, daze, drowse sleep-wake transition, active sleep, active-quiet transitional sleep, and quiet sleep. This system has been used with preterm infants and with infants older than one month after term. However, the ten-state system is somewhat more difficult to learn and to obtain training for its accurate use.

Third, the Assessment of Preterm Infant Behavior or APIB was modified from the NBAS to make it more appropriate for use with premature infants. It consists of altogether 13 states: very still deep sleep, deep sleep, light sleep, "noisy" light sleep, drowsy with more activity, drowsy, awake and quiet, bright alert, hyper alert, active,

considerable activity, crying, and lusty crying. The persons who perform the assessment need training from NIDCAP.

Finally, the Anderson Behavior State Scale or ABSS was developed by Anderson to assess premature infants. It consists of 12 states: very quiet sleep, quiet sleep with irregular respirations, restless sleep, very restless sleep, drowsy, alert inactivity, quiet awake, restless awake, very restless awake, fussing, crying, and hard crying. The ABSS may also be difficult to learn because of the small number of research using it as well as the complexity when as many as 12 states is involved. In this study, the measurement developed by Parmelee & Stern (1972) was used. This was a practical decision based on the fact that the tool has been used over a wide age range, including the fetus and premature infants. It is also easy to use because it assesses behaviors of preterm and term infants by observing the whether their eyes are closed or open as well as whether there is any other body activity (Parmelee & Stern, 1972: 200).

Different states measured by this assessment are as follows:

1. Quiet sleep: This state is important because mechanisms are maturing at all levels of the CNS during infancy (Parmelee & Stern, 1972: 213-214). Quiet sleep is characterized by closed eyes, regular respiration and abdomen movement body movement or startled.

2. Active sleep: If external stimuli occur when Infants are in this state, they may remain in this state, return to deep sleep, or become used to drowsiness. This state is characterized by closed eyes with REM, irregular respiration, and limb movements of forearms, legs, hands, feet, head, and body.

3. Drowsy: Premature infants may be unable to engage in eye-to-eye contact with the parents or may be able to sustain it only for a short period of time (Gardner, Garland, Merenstein & Lubchenco, 1993: 583). This state is characterized by half-open or closed eyes, irregular respiration, and quiet or some movements of the body.

4. Quiet alert: Infants who spend more time in this state are likely to receive more social stimulation and have a slight advantage in cognitive development (Berk, 1996: 159). They also tend to have a bright alert look with attention focused (Medoff-Cooper, McCrath & Bilker, 2000: 64-70). This state is characterized by fixed and

closed eyes, regular respiration, and slow movement of forearms, legs, hands, feet, or head, or no movement at all.

5. Active alert: The infants' activity increases in the active alert state. During this state, the body is unable to focus attention and has a decreased tolerance for continuous stimulation. If we continue to speak to the body or try to make eye contact, the infants may escalate to crying; if we lower our voice or discontinue the interactions, then they may return to the quiet alert state (Zaichkin, 1996: 59). This state is characterized by open eyes, irregular respiration, and movement of forearms, legs, hands, feet, and body, or total body movement.

6. Crying: Crying is the first way used by infants to communicate. Infants seem to have some fussy periods when they are difficult to console (Berk, 1996: 160). This state is characterized by closed or open eyes, irregular respiration, movement of the trunk, body movement, and strained muscle.

### **Factors affecting the sleep-wake state in premature infants**

1. Age: Older infants or those with 30 - 33 weeks postconceptual age more often expressed fussiness and cry than younger infants. In this study, the researcher chose premature infants whose gestational ages were not different.

2. Temperature: Infants who are in a neutral environment will have a longer period of deep sleep than those in a cold or hot environment (Hack, 1992). The incubators are capable of maintaining the infants' body temperature when covered (Nelson, Thomas & Stein, 1992).

3. Positioning: The supine position will increase active sleep, and infants can be more startled than when they are in the prone position (Mastertan, Zucker & Schulze, 1987). In this study, the researcher provided infant with the prone positioning and assessed the sleep-wake state when the infants were in the incubator.

4. Environment in the NICU

#### 4.1 Light

Continuous exposure to light can result in endocrine changes, changes in biological rhythm, and sleep deprivation (Catlett & Holditch-Davis, 1990: 23).

## 4.2 Sound

Sound in the NICU can be highly arousing for premature infants and ill term neonates, causing agitation and crying (Long et al., 1980: 143-145).

In this study, it was difficult to control the light and sound levels.

5. Handling: Premature infants in the NICU are always handled by doctors, nurses, and other healthcare staff (Wolke, 1987), as well as by their parents who are allowed to visit, touch, and hold them (Haut, Peddicar & Brien, 1994). Handling has an influence on sleep in premature infants as it can decrease the duration of sleep. As a result, it affects their growth because while premature infants sleep, growth hormone will be released to promote growth (Oswal, 1970, cited in Craft & Dencthy, 1990). In this study, during the observation of the sleep-wake state, premature infants were not disturbed.

6. Feeding time: Feeding time and hunger are known to have a great influence on the pattern of sleep and wakefulness in newborn infants. The quiet wakefulness condition is most often found after feeding (Karch et al., 1982: 40). In this study, the researcher compared the duration of long sleep premature infants had.

7. Drug: 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 management of sleep pattern disturbances. Choralhydrate is a useful sedative because it facilitates relaxation and eases sleep stage transitions with minimal effects on REM sleep (Schibler, 1990: 291). In this study, the researcher recruited only the premature infants who did not receive any drug that influenced their sleep pattern.

## 3. Effects of light and sound levels on sleep

### 3.1 Light level

Light is harmful for premature infants. Too much bright light is believed to be harmful for premature infants though the reason is not yet clearly understood. However, it is generally assumed that too much bright light will damage eyes structure and infants' immature retinas (Diloksakulchai, 2005). The American Academy of Pediatric (1992) recommends the light level of 60 foot-candles in the NICU.

According to the AAP Committee's 1992 Guidelines for Perinatal Care, 60 foot-candles is recommended in the NICU for adequate observation, and 100 foot-candles is recommended for procedures (Jack, 2000: 16; Shogan & Schumann, 1993: 7). Also, the AAP recommends that illumination maximum of 650 lux for observation and 1080 lux for procedure (Fielder & Moseley, 2000: 292). Studies which investigated the effects of dimmed or cycled lighting revealed that infants experiencing reduced light levels for a portion of the 24-hour period had significantly lower activity levels and heart rates during the periods when the lights were off and also a longer period of quiet sleep (Blackburn & Patterson, 1991; Mann et al., 1986). In addition, Mann et al. (1986) conducted a study on the effects of night and day on premature infants staying in a newborn nursery. In this study, a randomized trial was employed with 41 subjects, 20 in the experimental group and 21 in the control group. The duration of the experimental process was 19 days. In this study, the experimental group received dimmed light from 7:00 a.m. to 7:00 p.m. The results showed an increase in weight gain, a longer period of sleep, and a decrease in feeding time in the experimental group. As too much bright light is believed to be harmful for premature infants, the nursing care should decrease bright light with the use of incubator covers, installation of dimmer light, and establishment of a night and day pattern, and lights should be turned off when not used (Lotas, 1992, cited in Young, 1996).

### **3.2 Sound Level**

The loud sound is believed to damage infants' auditory structure. Infants who hear loud sound will experience decreased oxygen saturation (Long, Lucey & Philips, 1980). According to the American Academy of Pediatric (1992), the sound level in the NICU should not exceed 58 decibels. Sources of sound in the NICU are incubators, infusion pumps, monitor alarms, respirators, etc. (Lotas, 1992, cited in Young, 1996; Oecher, 1993; Weibley, 1989). The AAP Committee on Environmental Hazards (1974) recommends that the sound levels in incubators and in the NICU should be reduced below 58 decibels sound came from the staffs or equipment or since noise that comes from many different sources at unexpected time, it is almost impossible to reduce the noise level beyond certain level without advance installation and equipment (Gottfried & Hodgman, 1984: 292-293; Thoman, 1989: 249). It is also recommended to decrease sound levels in the NICU by encouraging staff to speak

more quietly, turning down the alarm volume of equipment, providing quiet time in infants, and turning down the telephone and radio to the lowest audible settings. Strauch et al. (1993) conducted a study to examine the effects of implementation of a quiet hour on noise level and infant sleep states. In this study, the noise levels were controlled and monitored in five locations in the room. The results indicated that noise levels decreased significantly on two of the three shifts. Moreover, they found that fewer infants were crying during the quiet hour than in the control period and more had deep and light sleep.

#### **4. Sensory stimulation programs and effects of stimulation programs on growth and sleep**

##### **Tactile sensory stimulation**

Weiss (1999) has described the language of touch with six tactile symbols as its components as follows:

1. Duration of touch refers to the length of time in touching from initiation of the contact to cessation. Preterm infants may not tolerate a long duration of touching. The length of duration should depend on the infants' responses, signs, and the developmental maturity.
2. Location of touch refers to the body contacted. Different parts of the body carry different sensitivity and socio-cultural meaning.
3. Action is the rate of approach to a body surface with the attendant amount of physical energy. Preterm infants usually need gradual and rhythmic action of touch.
4. Intensity refers to the extent of indentation applied to the body surface by the pressure of touch. Different degrees of intensity in a touch can result in different states of hyper excitability in the cortex.
5. Frequency of touch refers to the overall amount of touching persons experience in everyday life. Frequency of touch can stabilize relationships and facilitate interactions between individuals and may correlate with self-actualization.

6. Sensation refers to the immediate comfort or discomfort reaction of the skin to the touch. It defines the tactile stimulation as pleasurable or not to the body surface.

#### Examples of studies on tactile stimulation

Kramer et al. (1975) studied the effects of tactile stimulation on premature infants with body weight less than 1,800 gram. They used 14 cases, with six in the control group and eight in the experimental group. Those in the experimental group received tactile stimulation before and after feeding for one to eight minutes per day for the duration of two weeks. The subjects' neuro-social development was assessed at six weeks and three months after leaving from the incubator. The study findings indicated that the premature infants in the experimental group had better social development than those in the control group.

Tanomsri Umsila (1983) investigated the effects of tactile stimulation on growth of premature infants. The sample was composed of 20 AGA premature infants with gestational age between 28 and 32 weeks and weight between 1,000 and 1,500 grams. Ten were assigned to the experimental group, while the other ten the control group. The subjects were matched pairs in sex, birth weight, and gestational age. In this study, the experimental group received tactile stimulation for 15 minutes once a day before feeding for two weeks, whereas the control group received only routine nursing care. The findings revealed that the mean weight gain in the control group was 18.21 grams per day and that of the experiment group was 24.64 grams per day. There was also a statistically significant difference in body weight, head circumference, and body length between the experimental and control groups.

#### **Tactile and kinesthetic stimulation**

Rice (1977) conducted a study to examine the effects of tactile and kinesthetic stimulation from the mothers by stroking from head to feet for ten minutes, reading for five minutes, and maintaining the en-face position while rocking the infants. Such tactile and kinesthetic stimulation was given four times for 30 days. When the infants were four months old, it was found that the experimental infants made significant gains in neurological development ( $p < .001$ ), and weight gain in the experimental group averaged 5.863 grams, while the average weight gain of the control group was 5.345 grams. Thus, the results indicated significantly greater weight gains for the

experimental group ( $p < .04$ ). However, no statistically significant differences were found in both groups on length and head circumference gains.

Field and colleagues (1986) explored the effects of tactile and kinesthetic stimulation on preterm neonates. In their study, the experimental group received tactile-kinesthetic stimulation for three 15-minute periods at the start of 3 consecutive hours each day for 10 days. They found that the stimulated neonates averaged a 47 percent greater weight gain per day, were more active and alert during the sleep/wake behavior observations, and showed more mature habituation, orientation, motor, and range of state behavior on the Brazelton scale than the control infants. Furthermore, their hospital stay was six days shorter, yielding an estimated \$3,000 cost savings of each infant.

Rausch (1981) carried out a study to determine the effects of tactile and kinesthetic stimulation on premature infants. In this study, the treatment group received a 15-minute period of tactile and kinesthetic stimulation once daily on days 1-10 postpartum, whereas the control group received routine care. The findings showed that the treated infants had increased stooling frequency on days 5 to 10, and increased feeding intake on days 6 to 10. The treated infants gained increasingly more weight each day, but these differences were not statistically significant.

Thumtamara Somsri (1988) studied the effect of tactile and kinesthetic stimulation on body weight and response to stimulated behavior in premature infants with gestational age less than 32 weeks, body weight between 1,500 and 2,000 grams, and postconceptual age of 72 to 96 hours. The total number of subjects was 16, with eight in the experimental group and eight in the control group. The treatment group received tactile and kinesthetic stimulation once a day, 15 minutes per time, for 10 days. It was found that the treatment and control groups had increased weight gain, but their responses to stimulation were not different.

Beachy (2003) studied the effects of massage on premature infants in the NICU. The subjects, premature infants in the NICU, received stimulation for six minutes that was divided into massage and kinesthetic stimulation by flexion and extension one to two times a day. The findings suggested that such stimulations could improve sleep, lead to better feeding tolerance, and result in significant weight gain.

In the present study, the researcher chose the tactile and kinesthetic stimulation suggested by Field et al. (1986) which included gentle strokes, body flexing, and extending arms and legs for 15 minutes because it was considered safe, easy, and practical. Also, it could be performed while the infants were in the incubator.

### **Auditory sensory stimulation**

Infants with at least 28 weeks of gestational age are able to respond to sound. In the first few weeks after birth, infants become interested in the sound in their environment as evidenced by the fact that they will stop crying and become quiet when they hear their mother's voice. It is also believed that music helps stimulate the right brain, which is important to infants' emotional development. White noise will make infant sleep for a long time as well (Spencer et al., 1991: 136) and music will increase in growth hormone better feeding and growth. (Chawarit, 1978, cited in Suksawangrote et al., 1996)

#### **Examples of studies on auditory sensory stimulation**

Chapman and Molloy studied the effects of auditory stimulation on premature infants with gestational age 25-33 weeks at five days after birth. The total number of subjects was 153, and they were divided into three groups. Group 1 consisted of 50 infants who listened to Brahms's lullaby. Group 2 consisted of 51 subjects who listened to their mother's voice for five minutes per time, six times per day. Group 3 consisted of 52 subjects who were in the control group. The study continued until the subjects had body weight of 1,800 grams. It was found that the infants who listened to Brahms's lullaby had the fastest body weight gain than those in other groups (cited in Harrison, 1985: 74-75).

Standley & Moore (1995) studied the effects of music and the mother's voice on premature infants. The subjects consisted of 20 cases, 10 listened to lullabies while the other 10 cases listened to the mother's voice for 20 minute for three days, with the noise level of 65 or 70 decibels. It was found that on day 1, the infants listening to music had significantly higher oxygen saturation levels. On days 2 and 3, the infants hearing music had significantly depressed oxygen saturation levels during the posttest intervals after the music was terminated. Infants hearing music had significantly

lower occurrences of oximeter alarms during auditory stimuli than listening to the mother's voice.

Manee Pekwilai (1986) studied the effect of music on growth of premature infants with 30 to 32 weeks gestational age at 10 days after birth. The infants in the treatment group received stimulation by music at 70-85 decibels twice per day, 15 minutes per time during feeding for 3 weeks, while those in the control group received routine nursing care. Their growth was assessed at 1, 2, and 3 weeks, respectively. It was found that the average body weight in the treatment group was higher than that of the control group. However, the average length of body and head circumference of the subjects in the control and treatment groups was not different.

Poonsin Charoensri (2002) investigated the effects of a multi-modalities sensory stimulation program on the growth of premature infants and maternal-infant attachment. The subjects in the experimental group were stimulated by music with the sound level at 60-65 decibels. According to the study findings, the growth rate of the premature infants in the experimental group was significantly higher than that of the subjects in the control group ( $p < .05$ ).

In this study, the researcher chose to use taped music with the noise level at 60 to 65 dB twice a day, 15 minutes per time, based on the belief that music is the universal language and it helps stimulate the central nervous system of premature infants (Cook, 1981).

### **Auditory and kinesthetic stimulation**

Had premature infants remained in the uterus of their mothers, they would have received vestibular and kinesthetic stimulation when the mothers moved, and from the amniotic fluid, the walls of the uterus, etc. Thus, premature infants missed these beneficial experiences in their early days and weeks to a large extent. Rather, they have to lie in the incubator or on the open-bed under radiant warmer, often attached to one or more pieces of equipment such as heart rate monitors, respiratory support equipment, the monitor probes, and a variety of other devices.

### Examples of studies on the effects of vestibular and kinesthetic stimulation

Kramer & Pierpent (1976) conducted a study to determine the effects of the use of rocking waterbeds and auditory stimuli to enhance growth of preterm infants. The subjects in the experimental group of the study received a special program two through seven days after birth lasting for the duration of stay in the incubator. The program included placement of infants on a waterbed, with mechanical rocking of the waterbed one hour prior to each feeding and uses of a taped stimulated heartbeat and a woman's voice at 74 to 84 dB during the rocking period. The results showed that the stimulated group suckled sooner, ate better, and were more active than the control group. Stimulated infants on the waterbeds gained weight significantly ( $p < 0.01$ ), with more weight gain each week ( $211 + 30$  grams/week) than did the control infants ( $165 + 35$  grams/week). Moreover, increases in the head circumference were noted to be significantly larger ( $p < 0.01$ ) for stimulated infants than for the control infants. However, the two groups were not significantly different when it came to growth of the A-P diameter of the head.

Barnard (1972) studied the influence of kinesthetic and auditory stimulation on the premature infants' sleep-wake behavior. A rocker bed provided the kinesthetic stimulation and recording of a heartbeat offered auditory stimulation. The results indicated that there were more and larger periods of quiet sleep, accompanied by larger weight gains and more rapid neurological development although there was no statistical difference in gains between the control and experimental infants (cited in Rice, 1977).

Banard & Bee (1983) explored the impact of temporally patterned stimulation on the development of preterm infants. The control subjects received regular hospital care, the fixed interval subjects received 15 minutes of rocking/heartbeat stimulation each hour, the self-activating subjects received rocking stimulation for 15 minutes after every 90 seconds of inactivity, and the quasi-self-activating subjects received 15 minutes of rocking/heartbeat when inactive for 90 seconds, but only for one stimulation period per hour. The findings of this study confirmed the impact of the rocking bed and heartbeat stimulation on the development of preterm infants. In both cases, the immediate effect of the stimulation was reduction in activity, or an increase in quietness in the infants. At 24 months, the experimental infants scored significantly

higher on the Mental Development Index of the Bayley Scales, and few differences were found in parent-infant interaction patterns.

In this study, the researcher chose to investigate the tactile and kinesthetic stimulation in premature infants (Field et al., 1986) including gentle strokes, body flexing, and extending arms and legs for 15 minutes because it is safe, easy, and practical. It can also be done while the infants are in the incubator. Besides, when used with other forms of stimulation, it can promote growth in premature infants.

### **Multi-modalities sensory stimulation**

The multi-modalities sensory stimulation is generally composed of auditory stimulation, visual stimulation, tactile stimulation, and vestibular and kinesthetic stimulation that greatly benefit premature infants (White-Traut et al. 1992).

Examples of studies on the effects of multi-modalities sensory stimulation

White-Traut (1997) studied the responses of unimodal stimulation and multi-modalities sensory stimulation and found that the infants who received stimulation in the form of soft voice had increased quiet sleep. The results also indicated that the infants receiving only auditory intervention responded with an increase in quiet sleep (11.8% quiet sleep at baseline to 29% quiet sleep) and ATVV (auditory stimulation, visual stimulation, vestibular and kinesthetic stimulation, and tactile stimulation). Also, increasing alertness was sustained over the 30-minute post intervention. In addition, tactile and ATV (auditory stimulation, visual stimulation, and tactile stimulation) resulted in an increase in alert states during intervention. It also increased body weight.

Sirinat Tinikul (2000) carried out a comparative study on the growth and development of premature infants using the multi-modalities sensory stimulation program. The selected sample consisted of 44 premature infants who were assigned to the experimental group and the control group. The results showed that the development of the infants in the experimental group was more advanced than that of the infants in the control group. At the end of the study, the mean increased body weight of the subjects in the control group was 293.68 grams whereas that of the subjects in the experimental group was 296.4 grams. However, the growth rates of the two groups of subjects were not statistically significantly different. There was also no

statistically significant difference between the two groups when it came to physiological changes such as heart rate, respiration rate, and oxygen saturation.

Poonsin Charoensri (2002) examined the effects of a multi-modalities sensory stimulation program on the growth of premature infants and maternal-infant attachment. The subjects in the experimental group were stimulated one time per day for 15 minutes per time. After hospital discharge, the mothers continued to stimulate the infants at least four times a week. The results showed that body weight of the subjects in the experimental group was above the 50<sup>th</sup> percentile range of the growth chart, whereas that of the subjects in the control group was below the 50<sup>th</sup> percentile range of the growth chart. Moreover, at one month after delivery, the growth of premature infants in the experimental group was significantly higher than that of the subjects in the control group ( $p < .05$ ). Finally, the mean score of maternal-infant attachment of the subjects in the experimental group was significantly higher than that of the subjects in the control group ( $p < .05$ ).

Based on the review of related literature and existing research, the researcher was interested in investigating the use of a multi-modalities program including auditory stimulation, tactile stimulation, and vestibular and kinesthetic stimulation to determine its effectiveness on promotion of sleep feeding and growth in premature infants.

## CHAPTER III

### MATERIAL AND METHOD

This study employed a quasi-experimental research design, aiming to compare the body weight gain the sleeping period and feeding intake of the premature infants in the experimental group who received a multi-modalities sensory stimulation program and those of the premature infants in the control group who did not receive such a program and received only routine nursing care.

#### **Population and sampling**

##### **Population**

The population in this study consisted of premature infants in the Neonatal Unit at Sawanpracharuk Hospital between September 2004 and August 2005.

The subjects in the study were selected by means of purposive sampling based on the inclusion criteria as follows:

##### **Inclusion criteria**

1. their gestational age was between 32 and 36 weeks and AGA;
2. they had body weight of 1,400 to 1,700 grams;
3. they were seven days old or older;
4. they were clinically stable;
5. they did not receive oxygen therapy or intravenous replacement therapy;
6. they did not have any congenital abnormalities or severe complications such as infection, necrotizing enterocolitis, bronchopulmonary dysplasia, and seizure disorder, as confirmed by physicians' diagnosis; and,
7. they did not receive any drug which had an effect on their sleep cycle.

##### **Exclusion criteria**

1. Premature infants who had sepsis or who received respirator or oxygen therapy during the study period.
2. The infants' respiration rate was higher than 20 times per minute of baseline or apnea episode.

3. The infants' heart rate was less than 100 times per minute, or higher than 200 times per minute, or 20 times per minute of baseline.

4. The infants' oxygen saturation was less than 86 percent.

### **Sample size**

The researcher estimated the sample size based on the recommendation of Polit & Hungler (1983: 426). In a quasi-experimental design, it is generally recommended that a sample size of at least 10, preferably 20 to 30, be used for every subdivision of the data or cell of the design or the number of study variables. In this study, the sample size was 40 subjects. These 40 subjects were then randomly divided into two groups—20 in the control group and 20 in the experimental group. Practically, when the sample serves the criteria, it needs to be divided into the control and experimental group. In this study, when doing this, the first person had the basic weight, while the next had the related weight, so the first belonged to the first group. Then, the next person who had a different weight from the first was assigned to the second group. This continued until 20 pairs of subjects (40 cases) were obtained by this method.

### **Research setting**

In the Neonatal Unit of Sawanpracharuk Hospital, special care and nursing services were provided to sick infants. The physicians' round took place from 9:00 to 10:00 a.m. The feeding was conducted every three hours starting at 3:00 a.m. and lasting until 0:00 p.m. each day. The parents were encouraged to pay their infants a visit any time of the day. Furthermore, parents were also encouraged to touch, hold, and talk to their infants. In general, premature infants were discharged from the hospital when their weight was at least 1,800 grams and after they were healthy enough to suck their mother's breast milk.

### **Protection of human subjects**

The researcher explained the research objectives, the data collection process, and benefits of the study to the parents of the would-be subjects. They were informed of their rights to refuse to participate in the study, and they were assured that their refusal would not affect the treatment their infants would receive in any way. Those who agreed to participate in the study would be asked to sign the informed consent

form after receiving information from the researcher. Also, they were ensured that the data collected from their infants would be kept strictly confidential and would be reported only as group data. They were told that they could request for information about the procedure in this study from the researcher at any time as well.

### **Research instruments**

1. A stop watch which had been tested for accuracy with the standard time.
2. A music tape which was used to play classical music with the noise level of 60 – 65 dB and which had been tested for the level of sound by the Auditory Research and Study Unit, Ramathibodi Hospital, to stimulate the infants' auditory system.
3. Growth measuring instruments including an infant weight scale in grams, which had been tested for accuracy and validity with a one-kilogram weight pendulum before weighing the infants to measure the infants' growth throughout the duration of the study.
4. A sound level meter model to be measured in decibel and a digital level meter model to be measured in lux whose validity had been confirmed by the National Institute of Metrology, Ministry of Technology and Environment.
5. A pulse oximeter to measure the heart rate and oxygen saturation, which had been tested for validity weekly by comparing with another one with an equal value.
6. A demographic data record form which was used to elicit information regarding sex, gestational age, feeding intake, complications after birth, diagnosis, medication, body weight, Apgar scores, and body temperature of the premature infants (Appendix D).
7. A daily data record form which was used to record information regarding the body weight and feeding intake of the subjects since the beginning of the participation in the program until the end of their participation (the day their weight reached 1,800 grams), as well as the sound and light level record forms which were completed once every two days throughout the duration of the study (Appendixes E and F).
8. A sleep-wake state record form, which was used once every two days throughout the duration of the study. The criteria of sleep state assessment was modified from the Sleep-Wake State of Premature Infants developed by Parmelee &

Stern (1972: 200) and adapted by Charasthong (2001). It divided the sleep-wake state into six categories: quiet sleep, active sleep, drowsy sleep, quiet alert, active alert, and crying. The objective of this record form was to explore the sleep pattern of premature infants. This form had been revised based on the experts' comments and recommendations before actual use and their inter-rater reliability was equal to 0.9.

In this study, the researcher examined only the quiet sleep, active sleep, and total sleep of premature infants by using this record form. This form was used to observe and record the sleep-wake state of premature infants every one-minute for one hour and 30 minutes. The researcher and five research assistants then observed the sleep-wake patterns and recorded the details in the observation record to assess the sleep-wake patterns of premature babies minute by minute. The inter-rater reliability was equal to 0.91. The research assistant counted and identified the various states and wrote down the appropriate symbols accordingly (QS, AS, DS, QA, AA, and Cry) in the time slot (Appendix G).

### **A multi-modalities sensory stimulation program**

The researcher asked for permission to use the multi-modalities sensory stimulation program that Tinikul (2000) modified from the multi-modalities sensory stimulation program of White-Traut and colleagues (cited in Burns et al., 1994) and Field and colleagues (1986). The program involved two steps, each of which lasted 15 minutes, and it was carried out twice a day.

Step 1: Playing a classical music tape (Smart Symphonies Classical Music cassette tapes) to premature infants for 15 minutes. In this study, the smart symphonies tape of Mead Johnson was used.

#### **Step 2: Multi-modalities sensory stimulation**

This step included two activities within ten minutes:

2.1 During the first five minutes, tactile stimulation was provided with gentle strokes through the areas of neck, upper back, both legs, both arms, and head for a second at each area, approximately five seconds per stroke.

The activities included the following steps:

- From the area of the neck x 12 strokes
- From the neck to the waist x 12 strokes

- From the thighs to the toes on both legs x 12 strokes
- From the shoulders to the hand on both arms x 12 strokes
- From the forehead to both ears x 12 strokes

2.2 During the second five minutes, vestibular and kinesthetic stimulation was provided by slowly flexing and extending both legs and arms for approximately five seconds per time.

The activities included the following steps:

- Flexing and extending the right arm x 12 times
- Flexing and extending the left arm x 12 times
- Flexing and extending the right leg x 12 times
- Flexing and extending the left leg x 12 times
- Flexing and extending both legs x 12 times

Step 2: Re-providing tactile stimulation for five minutes

Note: 1. To avoid hypothermia, the infants were in the incubators while receiving the multi-modalities sensory stimulation program.

2. The multi-modalities sensory stimulation program was provided to the infants 60 minutes after feeding and when the infants were in the alert state.

### **Data collection**

#### **Preparatory phase**

1. An introduction letter issued by the Faculty of Graduate Studies, Mahidol University, was sent to the Director of Sawanpracharuk Hospital, asking for cooperation in data collection.

2. The Documentary Proof of Ethical Clearance Committee on Human Rights to Research Involving Human Subjects issued by Mahidol University was submitted to the Director of the Hospital to ask for permission to collect data.

3. The researcher met the supervisor nurse and the head nurse of Neonatal Unit to explain the research objectives and the data collection procedures. The researcher also trained the research assistants on how to identify and count the sleep-wake State of premature infants.

4. The research assistants observed the sleep-wake state by using the blind technique.

### **Implementing phase**

1. The researcher selected the subjects who met the inclusion criteria and were able to participate in the study from the medical records of premature infants in Neonatal Unit.

2. The researcher approached the mothers of premature infants, introduced herself, and explained the research objectives to them, with a request for their participation. When they agreed to participate in the study, the researcher informed them of human rights protection and asked them to sign the informed consent form.

3. On the first day of the study, the baby subjects were weighed during 6:00-7:00 a.m., and their body weight was measured and their feeding intake was recorded daily by the research assistants.

### **Experimental phase**

In the experimental group

1. The subjects in the experimental group received the multi-modalities sensory stimulation from the researcher twice a day. The provision of stimulation was done approximately one hour after feeding time at 9:00 a.m. in the morning and at 3:00 p.m. in the afternoon.

2. The assessment of the sleep-wake state was carried out immediately after the subjects had received the multi-modalities sensory stimulation. The sleep-wake state was observed and recorded every one minute for one hour and 30 minutes every two days by the research assistants.

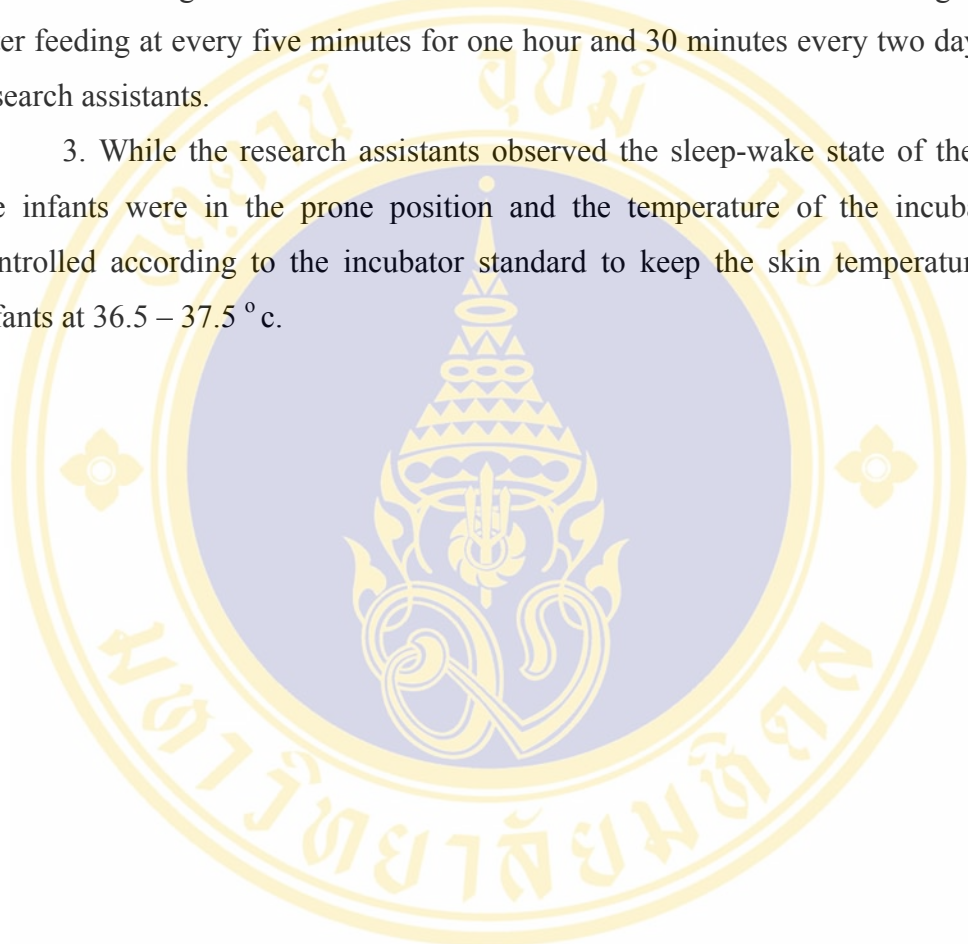
3. The light and sound levels after the implementation of the multi-modalities sensory stimulation program were observed and recorded immediately after the subjects had received the multi-modalities sensory stimulation. The observation and recording were done every five minutes for one hour and 30 minutes every two days by the research assistants.

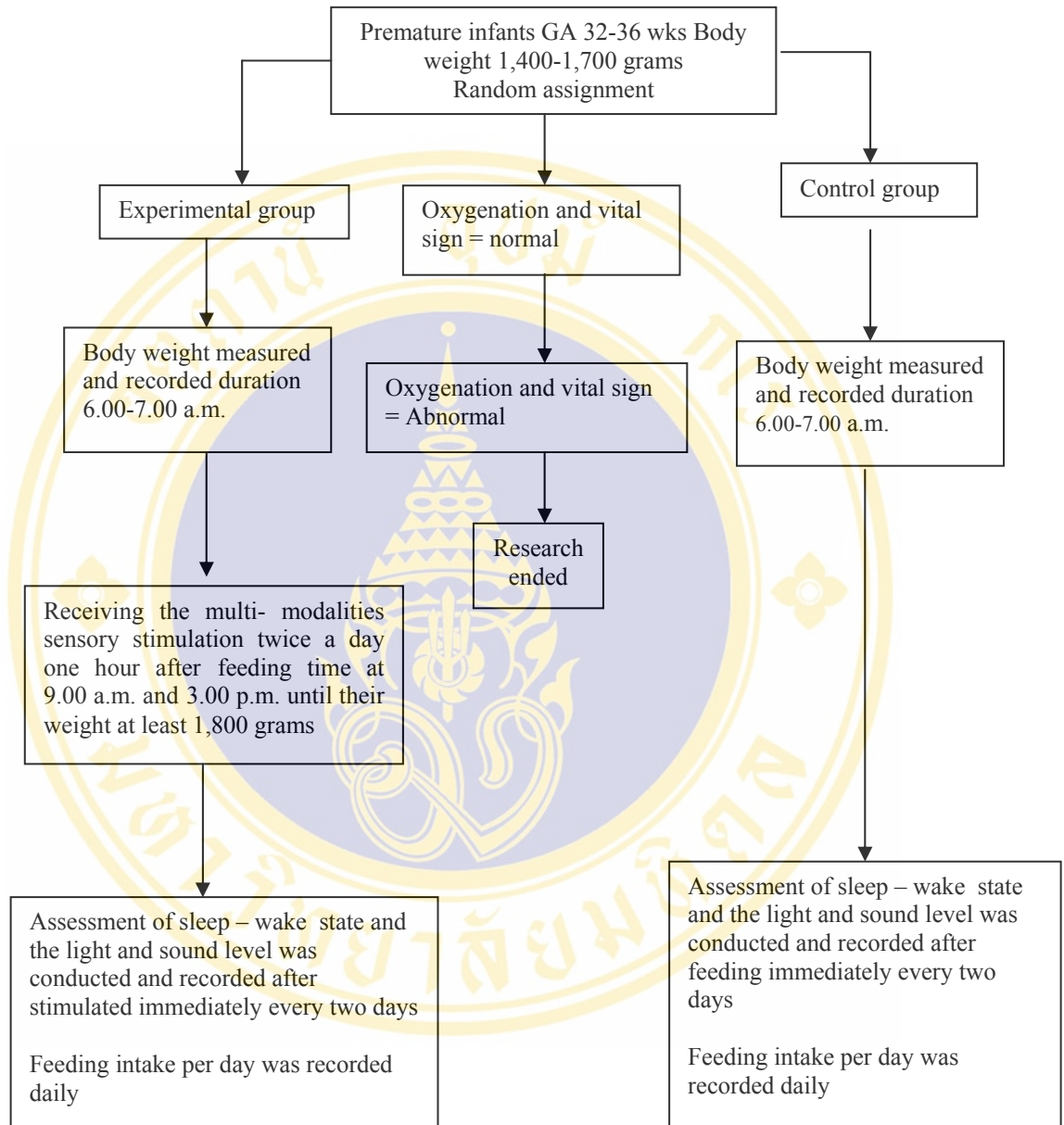
In the control group

1. The sleep-wake state was observed and recorded starting one hour after feeding at every one minute for one hour and 30 minutes every two days by the research assistants.

2. The light and sound levels were observed and recorded starting one hour after feeding at every five minutes for one hour and 30 minutes every two days by the research assistants.

3. While the research assistants observed the sleep-wake state of the infants, the infants were in the prone position and the temperature of the incubator was controlled according to the incubator standard to keep the skin temperature of the infants at 36.5 – 37.5 °c.





**Figure 2: Steps in data collection**

### **Data analysis**

Data analysis was conducted using the statistical package for social science (SPSS) program as follows:

1. The Chi-square test and Mann-Whitney U test were used to compare the data regarding the demographic characteristics of the subjects in the experimental and control groups, while the t-test was used to indicate the differences between the demographic characteristics and environmental factor in both groups.
2. T-test was calculated to determine the differences in the rate of body weight gains between the subjects in both groups.
3. A graph was plotted to depict the body weight gain in each day between the subjects in both groups.
4. The t-test was employed to compare the differences in the total sleeping period between the subjects in both groups.
5. The t-test was also used to identify the differences in the quiet sleeping period between the subjects in both groups.
6. The t-test was used to identify the differences of the total feeding intake between the subjects in both groups.

## CHAPTER IV

### RESULTS

This chapter describes the findings of the present study which was quasi-experimental research aiming at investigating the effectiveness of a multi-modalities sensory stimulation program on body weight gain, the sleeping period, and feeding intake of premature infants. The findings are presented in two parts: demographic characteristics of the subjects and the results of the hypothesis testing.

#### **Demographic characteristics of the subjects**

The subjects in this study were 40 premature infants, composed of 15 males and 25 females in the Newborn Unit at Sawanpracharuk Hospital. They were divided into two groups—the experimental group and the control group, with 20 subjects in each group. The results of the Chi-square test on gender of the subjects showed that there was no statistically significant difference between the two groups ( $p > .05$ ). When the t-test and Mann–Whitney U test was performed to compare the demographic characteristics of the two groups of subjects regarding gestational age, baseline body weight, Apgar score at five minutes since the beginning of the data collection until the day when the subjects' body weight was at least 1,800 grams, it was discovered that there was no statistically significant difference between the two groups, as illustrated in Table 1.

**Table 1: Demographic characteristics of the subjects in the experimental group and the control group using t-test, Chi-square test, and Mann–Whitney U test (n = 40)**

Characteristics	Control group ( n = 20 )			Experimental group ( n = 20 )			
	min-max	Mean	SD	min-max	Mean	SD	
Gastational age (weeks)	27 – 36	32.8	2.12	28 – 36	32.4	1.91	t = 0.63 <sup>ns</sup>
Baseline body weight (grams)	1,450 – 1,700	1,617	82.34	1,430 – 1,700	1,662	72.81	t = -0.20 <sup>ns</sup>
Apgar score at 5 mins.	2 – 10	8.85	2.16	5 – 10	8.70	1.60	U = 163 <sup>ns</sup>
Male	10			5			X <sup>2</sup> = 2.67 <sup>ns</sup>
Female	10			15			
%	33.33			66.67			

<sup>ns</sup> p > .05

\* p < .05

The environmental factors that affected sleeping periods were light level, sound level, and temperature. In this study, the light and sound levels were not controlled. However, they were recorded by the researcher assistants during the observation of the sleep-wake state. It was found that the control groups the maximum and minimum of the light and sound levels were different, but there was no statistically significant difference between the two groups (p>.05). When the t-test was performed to compare the environmental factors of the two groups of subjects regarding light level, sound level, and temperature since the beginning of the data collection until the day when the subjects' body weight was at least 1,800 grams, it was discovered that there was no statistically significant difference between the two groups, as illustrated in Table 2.

**Table 2: Environmental factors during the study period of the subjects in the experimental group and the control group using t-test**

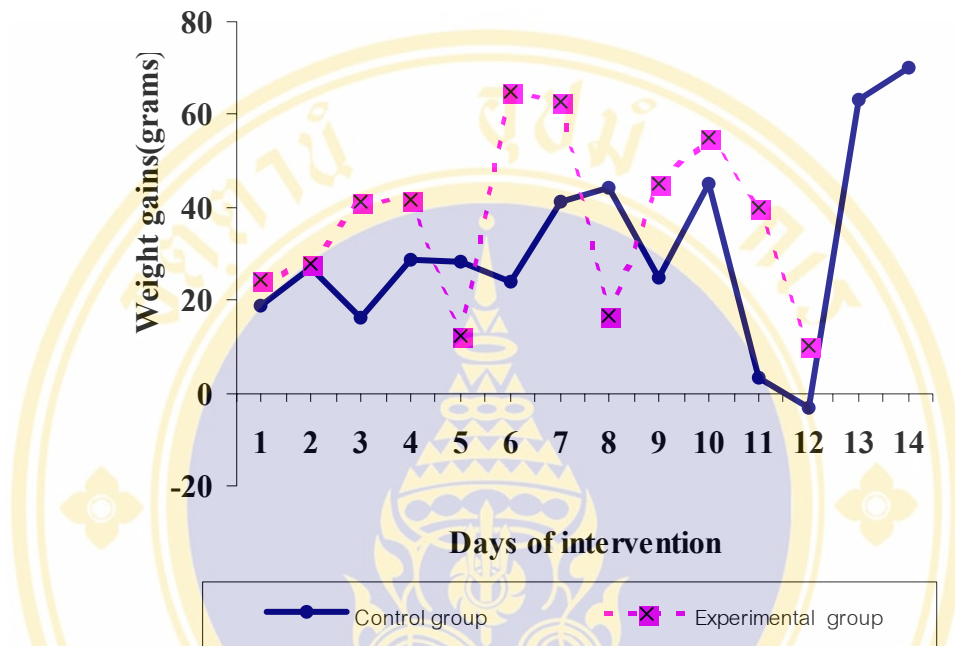
Characteristics	Control group ( n = 20 )			Experimental group( n = 20 )			t
	min – max	Mean	SD	min – max	Mean	SD	
Light level (lux)	12.35 – 66.89	25.79	15.53	9.64 – 26.76	18.95	6.36	1.82 <sup>ns</sup>
Sound level (decibel)	21.55 – 84.50	64.55	14.31	62.92 – 74.52	67.96	2.93	-1.04 <sup>ns</sup>
Temperature (°C)	36.9 – 37.2	37.00	0.11	36.8 – 37.4	36.97	0.16	0.58 <sup>ns</sup>

<sup>ns</sup> p > .05

\* p &lt; .05

As for the body weight gain in each day in the experimental group and the control group, it could be seen from the study findings that the weight gain of the subjects in the control group was as follows: 19 grams on the first day, 27 grams on the second day, 16 grams on the third day, 28.25 grams on the fourth day, 28.13 grams on the fifth day, 24.17 grams on the sixth day, 41.11 grams on the seventh day, 44.29 grams on the eighth day, 25 grams on the ninth day, 45 grams on the tenth day, 3.3 grams on the 11<sup>th</sup> day, 63.3 grams on the 13<sup>th</sup> day, and 70 grams on the 14<sup>th</sup> day. It was noteworthy that on the 12<sup>th</sup> day, instead of gaining weight, the subjects lost 3.3 grams of weight. As for the subjects in the experimental group, the weight gain was as follows: 24.5 grams on the first day, 28 grams on the second day, 41.11 grams on the third day, 41.76 grams on the fourth day, 12.5 grams on the fifth day, 65 grams on the sixth day, 62.86 grams on the seventh day, 16.67 grams on the eighth day, 45 grams on the ninth day, 55 grams on the 10<sup>th</sup> day, 40 grams on the 11<sup>th</sup> day, and 10 grams on the 12<sup>th</sup> day. It is evident that most of the body weight gains were more than 20 grams and the infants in the experimental group gained more weight than those in the control group. It is worth noting that although the subjects in the experimental group gained less than 20 grams on some of the days, this may have resulted from the inconsistency

of the measurement as it was done by different research assistants, as illustrated in Figure 3.



**Figure 3: The body weight gain in each day of the subjects in the experimental group and the control group**

**Results of hypothesis testing**

**Hypothesis I:** The body weight gain per day of the premature infants receiving the multi-modalities sensory stimulation program is higher than that of the premature infants who do not receive such a program.

According to the study findings, the body weight gain per day of the subjects in the experimental group increased more than that of the subjects in the control group. The outcome of the statistical analysis indicated that there was a statistically significant difference between the body weight gains of the subjects in the two groups ( $p < .05$ ) as depicted in Table 3.

**Hypothesis II:** The total sleeping period of the premature infants receiving the multi-modalities sensory stimulation program is longer than that of the premature infants who do not receive such a program.

The findings of the study revealed that the sleeping period of the subjects in the experimental group was longer than that of the subjects in the control group. The outcome of the statistical analysis showed that there was a statistically significant difference between the sleeping periods of the two groups of subjects ( $p < .05$ ) as shown in Table 3.

**Hypothesis III:** The quiet sleeping period of the premature infants receiving the multi-modalities sensory stimulation program is longer than that of the premature infants who do not receive such a program.

The results of the study showed that the quiet sleeping period of the subjects in the experimental group increased more than that of the subjects in the control group. The outcome of the statistical analysis indicated that there was no statistically significant difference between the two groups of subjects ( $p > .05$ ) as depicted in Table 3.

**Hypothesis IV:** The feeding intake of the premature infants receiving the multi-modalities sensory stimulation program is higher than that of the premature infants who do not receive such a program.

According to the study findings, the feeding intake of the subjects in the experimental group was higher than that of the subjects in the control group. The outcome of the statistical analysis showed that there was a statistically significant difference between the feeding intakes of the subjects in both groups ( $p < .05$ ) as shown in Table 3.

**Table 3: Comparison of the mean of increase in body weight gain, sleeping period and feeding intake of the subjects in the experimental group and the control group using independent t-test**

Characteristics	Control group ( n = 20 )			Experimental group ( n = 20 )			t
	min – max	Mean	SD	min – max	Mean	SD	
Body weight Gain (grams/day)	17.50 – 41.43	28.18	6.80	11.42 – 76.67	39.23	15.23	-2.96*
Total sleeping period (minutes)	21.00 – 87.33	61.39	17.60	52.00 – 87.00	69.32	10.62	-1.72*
Quiet sleeping period (minutes)	5.00 – 47.33	20.98	11.92	2.50 – 41.00	25.11	11.22	-1.13 <sup>ns</sup>
Feeding intake (cc/kg/day)	119.59 – 204.48	155.63	18.11	138.21 – 287.50	173.33	32.81	-2.11*

<sup>ns</sup> p > .05

\* p < .05

## CHAPTER V

### DISCUSSION

**Hypothesis I:** The body weight gain of the premature infants receiving the multi-modalities sensory stimulation program is higher than that of the premature infants who do not receive such a program.

The research findings showed that the premature infants in the experimental group had higher body weight gain when compared to those in the control group with statistical significance ( $p < .05$ ) (Table 3). In this study the researcher provided the multi-modalities program to the infants in the experimental group who were stimulated twice a day until their weight was at least 1,800 grams, which was equal to 12 days, while the subjects in the control group needed 14 days to grow up to 1,800 grams. The average body weight gain of the premature infants in the control group was 28.18 grams/day, while that of the premature infants in the experimental group was 39.23 grams/day. In other words, it took the subjects in the control group longer than it took the subjects in the experimental group to grow and reach the weight of 1,800 grams, although there was no statistically significant difference between the two groups of subjects ( $P > .05$ ). The demographic characteristics data included the basic factors that may have influenced body weight gain such as sex, body weight at the start of the study, etc., all of which were tested by the Chi-square test, and the Apgar score, which was tested by the Mann Whitney U test. It was found that that there was no statistically significant difference between both groups ( $P > .05$ ) as shown in Table 1

It may be explained that stimulation may lead to the release of food absorption hormones, such as insulin and gastrin, as well as an increase in vagal activity. The resulting higher insulin level makes food absorption more efficient and enables the infants to grow faster (Uvnas-Moborg, K., et al., 1987: 852; Field, 1995: 110; Field, T., 2002: 163-167). It also increases hypothalamus causing secretion of somatotrophic hormone from the pituitary gland, hence the maturing of tissues and the increase of weights (Kuhn et al., 1991). The findings of this study were consistent with those of previous studies. For instance, Rice (1977) found that tactile and kinesthetic

stimulation by stroking the infants from head to feet for ten minutes, reading to the infants for five minutes, maintaining in the en-face position while rocking the infants for four times a day for 30 days when the infant were four months old could result in significant weight gain. Rausch (1981) studied the effects of tactile and kinesthetic stimulation on premature infants. The infants in the experimental group received a 15-minute period of tactile and kinesthetic stimulation once daily on days 1 to 10. It was discovered that the infants who received treatment gained more weight each day, though with no statistical significance. In addition, Field and associates (1986) found that the premature infants who received tactile/kinesthetic stimulation which consisted of body stroking and passive movement of the limbs for three 15-minute periods per day for ten days had averaged a 47% greater weight gain per day than the control infants. Moreover, in White & Labarba's (1976) study, a group of premature infants that were stimulated by nursing staff with four 15-minute periods of tactile and kinesthetic stimulation daily for ten days had significant weight gain over the ten-day treatment period when compared to those in the control group.

In Thailand, Tanomsri Umsila (1983) studied the effects of tactile stimulation on growth of premature infants. The experimental group received tactile stimulation for 15 minutes once a day before feeding for two weeks, whereas the control group received only routine nursing care. The findings revealed statistically significant difference in body weight. Furthermore, Sirinat Tinikul (2000) carried out a comparative study on the growth and development of premature infants with the infants in the experimental group receiving a multi-modalities stimulation program one time per day for ten days. However, it was discovered that the growth rates were not statistically significantly different. Finally, Poonsin (2002) investigated the effect of a multi-modalities sensory stimulation program on the growth of premature infants and maternal-infant attachment. In this study, the multi-modalities sensory stimulation program was provided by the researcher and the mothers. The findings suggested that the premature infants who were continuously stimulated for 15 minutes once a day until they were one month old had a significantly higher weight gain than those in the control group ( $P < 0.5$ ). The findings of this study were consistent with those of previous studies although the types of stimulation used were different. From the previous studies, it was found that most of infant stimulations were tactile and

kinesthetic stimulation lasting 15 minutes per time, one to four times a day, for ten to 30 days, which proved to be an effective mean to increase the infant's body weight. Thus, in this study, the infants were stimulated for 15 minutes twice a day until their weight was at least 1,800 gram, which took about 12 days, for 15 minutes per time when they were clinically stable in the incubator. The premature infants in the experimental group who received the multi-modalities sensory stimulation program gained more body weight when compared to those in the control group with statistical significance.

Therefore, it could be concluded that the multi-modalities sensory stimulation program in this study could help increase infants' body weight gain, so it is suitable for use with premature infants who are clinically stable. For this reason, Hypothesis I was supported.

**Hypothesis II:** The total sleeping period of the premature infants receiving the multi-modalities sensory stimulation program is longer than that of the premature infants who do not receive such a program.

The research results indicated that the premature infants in the experimental group had a longer sleeping period than that of the subjects in the control group with statistical significance ( $p < .05$ ) (Table 3). The environmental factors that may have influenced the sleep period such as temperature, light level, and sound level were compared between both groups by using the Chi-square test and the Mann-Whitney U test which revealed that there was no statistically significant difference between both groups ( $p > .05$ ) as shown in Table 2. The findings showed that the mean total sleeping period of the premature infants in the control group was 61.39 minutes, whereas that of the subjects in the experimental group was 69.32 minutes. There were statistically significant differences between both groups ( $P < .05$ ) as shown in Table 3

The multi-modalities sensory stimulation program provides stimuli that enhance the neonatal development of the infants—physiology, motor, state, self-regulatory, and interaction system (Als, 1982), while making them in continual contact with their environment. The infants will be relaxed and clam with a longer duration of sleep (Cain, 1992, cited in Olsan, 1998; Rice, 1997:71; Barnard & Bee, 1987; Chaze Ludington-Hoe, 1984: 71). The findings of this study were consistent with the results

of previous studies. For example, Beachy (2003) used massage to promote sleep in the premature infants in the NICU for six minutes, one to two times a day. It was found that massage helped improve sleep. However, in this study, another form of stimulation was used. It was composed of tactile, vestibular and kinesthetic, and auditory stimulation for 15 minutes twice a day, which could also promote sleep just like massage. In summary, the multi-modalities sensory stimulation program could relax and make infants sleep for a longer period of time.

**Hypothesis III:** The quiet sleeping period of premature infants receiving the multi-modalities sensory stimulation program is longer than that of the premature infants who do not receive such a program.

In this study, the quiet sleeping period of premature infants who received the multi-modalities sensory stimulation program was longer than that of the premature infants who did not receive such a program. The results of this study indicated that there was no statistically significant difference between the two groups of subjects ( $P > .05$ ) as illustrated in Table 3. The results of this study showed that on average the minimum sound level during observation in the experimental group was 62.92 dB and the maximum was 74.52 dB, with a mean of 67.79 dB and a median of 67.96 dB. On the other hand, in the control group, the minimum was 21.55 dB whereas the maximum was 84.50 dB, with the mean of 64.55 dB and the median of 67.82 dB. One plausible explanation for such findings is that the maximum and minimum sound levels in the setting where premature infants were observed were different, although there were no statistically significant differences between the two groups of subjects ( $P > .05$ ). In addition, the environmental factors may have occurred unnoticed such as the sound that was uncontrolled. These sounds came from the staff or the equipment and others. Since noises came from many different sources at an unexpected time, it was almost impossible to reduce the noise level beyond a certain level without advance installation of equipment (Gottfried & Hodgman, 1984: 292-293; Thomas, 1989: 249). The American Academy of Pediatric (AAP): Committee on Environmental Hazards (1974) recommends that the sound level inside incubators and in the NICU should be reduced to below 58 dB. In addition, as for the average light level during observation in the experimental group, the minimum was 9.64 lux and the

maximum was 26.76 lux, with the mean of 18.95 lux and the median of 22.29 lux. In the control group, the minimum was 12.35 lux and the maximum was 66.89 lux, with the mean of 25.79 lux and the median of 24.04 lux. Most of the light levels in the experimental and control groups were less than 650 lux. The American Academy of Pediatrics for Guideline for Perinatal Care in 1992 recommends the maximum illumination of 650 lux for observation and 1080 lux for procedure (Fielder & Moseley, 2000: 292). Although the light levels were not statistically significantly different between the two groups, the light levels were uncontrolled. Peak light exposure for the infants was found to be associated with additional light sources such as extensive direct window exposure, supplementary artificial lighting, and turned on light, all of which may have varied as there were different light sources. This could lead to differences in the quiet sleeping period between the premature infants who received the multi-modalities stimulation and those who did not.

As such, the environmental factors that may have an effect on quiet sleep should be controlled as this had been found to result in a statistically significant difference between the premature infants who received stimulation and those who did not when it came to quiet sleep.

**Hypothesis IV:** The feeding intake of the premature infants receiving the multi-modalities sensory stimulation program is higher than that of the premature infants who do not receive such a program.

The research results indicated that the premature infants in the experimental group had higher feeding intake than that of the subject in the control group with statistical significance ( $p < .05$ ) (Table 3). In this study the researcher provided the multi-modalities program to the infants in the experimental group by stimulating them twice a day for 15 minutes per time when they were clinically stable in the incubator until their weight was at least 1,800 grams. The demographic characteristic data included the basic factors that may have influenced the feeding intake such as body weight at the start of the data collection. The researcher compared demographic characteristic data from both groups by using the t-test which revealed that there was no statistically significant difference between both groups ( $p > .05$ ) as shown in Table

1. The average feeding intake of the subjects in the control group was 155.63 cc/kg/day, while that of the subjects in the experimental group was 173.33 cc/kg/day.

Thus, Hypothesis IV was supported by the study findings. According to Field (2002: 163-167), increased vagal activity also stimulates gastric motility, which can contribute to more efficient absorption of food, hence increased growth hormone and better feeding (Chawarit, 1978, cited in Suksawangrote et al., 1996). The findings of this study were consistent with the results of previous studies. For instance, a six-minute massage given one to two times per day to premature infants in the NICU led to better feeding tolerance (Beachy, 2003). Moreover, Rausch (1981) studied the effects of tactile and kinesthetic stimulation on premature infants by giving 15 minutes of tactile and kinesthetic stimulation once daily on days one to ten postpartum to the subjects in the experimental group. It was found that the experimental subjects showed increased feeding intake when compared to the control subjects who received only routine nursing care. Thus, it could be concluded that different stimulations as given in the multi-modalities sensory stimulation program that was composed of tactile, vestibular and kinesthetic, and auditory stimulation used in this study could help the experimental group to have higher feeding intake than that of the subjects in the control group.

Thus, it can be concluded that a multi-modalities sensory stimulation program can effectively enhance the total sleeping period, the feeding intake, and the body weight gain of premature infants.

## CHAPTER VI

### CONCLUSION

#### Conclusion

The present study was quasi-experimental research aiming to compare the body weight gain the sleeping period and the feeding intake of premature infants to determine the effectiveness of a multi-modalities sensory stimulation program.

The study sample consisted of 40 premature infants in the Neonatal Unit at Sawanpracharuk Hospital who were selected based on the inclusion criteria previously set and who were randomly assigned to the experimental and control groups. Data collection took place from September 2004 to August 2005.

In determining the effectiveness of a multi-modalities sensory stimulation program, the sleep-wake cycle was evaluated by using the scanning form of sleep-wake state of Parmelee & Stern (1972).

Five research assistants took part in the data collection. They were specially trained to assess and record the sleep-wake state of infants. In this study, the subjects in the control group received only the standard routine nursing activities. On the other hand, the subjects in the experimental group received the multi-modalities sensory stimulation program given by the researcher from the first day until the day their body weight reached 1,800 grams.

#### Summary of the findings

1. The body weight gain of the premature infants receiving the multi-modalities sensory stimulation program was higher than that of the premature infants who did not receive such a program with a statistically significant difference ( $p < .05$ ).
2. The total sleeping period of the premature infants receiving the multi-modalities sensory stimulation program was longer than that of the premature infants who did not receive such a program with a statistically significant difference ( $p < .05$ ).
3. The quiet sleeping period of the premature infants receiving the multi-modalities sensory stimulation program was longer than that of the premature infants

who did not receive such a program with no statistically significant difference ( $p > .05$ ).

4. The feeding intake of the premature infants receiving the multi-modalities sensory stimulation program was higher than that of the premature infants who did not receive such a program with a statistically significant difference ( $p < .05$ ).

### **Limitations of the research**

1. In this study, it was not possible to control the extraneous factors such as light levels, sound levels that may have affected the sleeping period of premature infants.

2. While the multi-stimulation program was given, auditory stimulation might not have been provided in a suitable environment such as in a quiet room.

### **Recommendations**

The results of this study have revealed that the multi-modalities sensory stimulation program was beneficial to the premature infants as it led to better weight gain (Field et al., 1986; White & Labarba, 1976) and promoted sleep (Beachy, 2003). Based on the study findings, the following recommendations could be made:

1. Healthcare team members should recognize the importance and benefits of The multi-modalities sensory stimulation program was composed of auditory stimulation, tactile stimulation, and vestibular and kinesthetic stimulation that promotes sleep of premature infants. The program should be included as part of the healthcare plan and it should also be adapted to meet each premature infant's clinical needs by stimulating premature infants while they are still in the incubator for 15 minutes twice a day.

2. Further studies should measure the infants' body weight on the day that the multi-modalities sensory stimulation program starts. The infants' body weight should be about 1,400-1,500 grams. This should help shed more light on the effectiveness of the multi-modalities sensory stimulation program to promote sleeping period and body weight gain of premature infants.

3. After premature infants' hospital discharge, they may live with their mother that should have participation of the mothers in the program is crucial to the success of

the program, and the mothers should receive training multi- modalities program by before their premature infants' hospital discharge so as to enable them to provide beneficial stimulation to their infants at home. This can also help strengthen the maternal-infant attachment between the mothers and their premature infants.



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ในกรณีที่ผู้ยินยอมคนให้ทำการวิจัยไม่สามารถอ่านและเขียนหนังสือได้ จะต้องได้รับการยินยอมในขณะที่ยังมีสติสัมปชัญญะ และระบุข้อความไว้ตามนี้ ข้าพเจ้าไม่สามารถอ่านหนังสือได้ แต่ผู้วิจัยได้อ่านข้อความในใบยินยอมนี้ให้ข้าพเจ้าฟังจนเข้าใจดีแล้ว ข้าพเจ้าจึงลงนาม หรือประทับลายนิ้วหัวแม่มือของข้าพเจ้าในใบยินยอมนี้ด้วยความเต็มใจ

ลงนาม..... ผู้ยินยอม

(หรือประทับลายนิ้วหัวแม่มือ)

ลงนาม..... พยาน

ลงนาม..... พยาน

ในกรณีที่ผู้ยินยอมคนให้ทำการวิจัยยังไม่บรรลุนิติภาวะ จะต้องได้รับการยินยอมจากผู้ปกครองหรือผู้อุปการะโดยชอบด้วยกฎหมาย

ลงนาม..... ผู้ปกครอง/ผู้อุปการะ

โดยชอบด้วยกฎหมาย

ลงนาม..... พยาน

ลงนาม..... พยาน

## เอกสารแนะนำโครงการวิจัย

ดิฉัน นางสาว กุลวรา เพียรจริง นักศึกษาพยาบาลปริญญาโท สาขาวิชาการพยาบาล  
เด็กภาควิชาพยาบาลศาสตร์ คณะแพทยศาสตร์ โรงพยาบาลรามาธิบดี มหาวิทยาลัยมหิดล  
มีความสนใจที่จะศึกษาวิจัยเรื่อง ผลของโปรแกรมการกระตุ้นประสาทสัมผัสหลายรูปแบบต่อ  
น้ำหนักร่างกายและระยะเวลาการหลับของทารกเกิดก่อนกำหนด โดยมีวัตถุประสงค์เพื่อเปรียบเทียบ  
ความแตกต่างของอัตราการเพิ่มของน้ำหนักตัว เปรียบเทียบความแตกต่างของระยะเวลาการหลับ  
ของทารก เปรียบเทียบความแตกต่างของปริมาณนมที่รับได้ระหว่างกลุ่มที่ได้รับการกระตุ้น  
ประสาทสัมผัสหลายรูปแบบและกลุ่มควบคุม ซึ่งการเก็บรวบรวมข้อมูลกลุ่มทดลองจะได้รับการ  
กระตุ้นประสาทสัมผัสหลายรูปแบบวันละ 2 ครั้ง ครั้งละ 15 นาที ตั้งแต่วันที่เริ่มทำการศึกษจนถึง  
วันที่น้ำหนักตัวทารกเพิ่มขึ้นถึง 1,800 กรัมและได้รับการพยาบาลตามปกติ กลุ่มควบคุมจะได้รับการ  
พยาบาลตามปกติ ทั้ง 2 กลุ่ม จะได้รับการชั่งน้ำหนักทุกวันตั้งแต่วันที่เริ่มทำการศึกษจนถึงวันที่  
สิ้นสุดการศึกษา จะได้รับการสังเกตระยะเวลาการหลับคืน ร่วมกับการสังเกตระดับแสง ระดับเสียง  
ภายในตู้อบ ทุกวันเว้นวันตั้งแต่วันที่เริ่มทำการศึกษาและวันที่สิ้นสุดการศึกษา ข้อมูลที่ได้จากการ  
วิจัยนี้จะนำไปวิเคราะห์และแปลผลในภาพรวม เพื่อเป็นแนวทางในการจัดโปรแกรมการกระตุ้น  
ประสาทสัมผัสหลายรูปแบบร่วมกับการปฏิบัติการพยาบาลเพื่อส่งเสริมการหลับและการ  
เจริญเติบโตในทารกเกิดก่อนกำหนด โดยที่บุตรของท่านจะได้รับการดูแลจากแพทย์และพยาบาล  
ตามปกติ

จึงเรียนมาเพื่อขอความร่วมมือและอนุญาตให้บุตรของท่านเข้าร่วมการวิจัย ท่านสามารถ  
ยกเลิกการอนุญาตและให้บุตรของท่านออกจากกรวิจัยครั้งนี้ โดยไม่มีผลต่อการรักษาพยาบาล  
ที่ท่านได้รับแต่อย่างใด หากท่านอนุญาตให้บุตรเข้าร่วมการศึกษาวินิจฉัย กรุณาลงชื่อยินยอมเข้า  
ร่วมการศึกษาด้วย

ขอบคุณในความร่วมมือ  
นางสาวกุลวรา เพียรจริง

## APPENDIX B

### INTER-RATER RELIABILITY TEST OF SLEEP-WAKE CYCLE

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

The inter-rater reliability factor was analyzed by using a formula that suggested by Polit, and Hungler(1999)

Inter-rater reliability test at 1<sup>st</sup> = 0.91

Inter-rater reliability test at 2<sup>nd</sup> = 0.91

In this study, Inter-rater reliability of assessing sleep-wake state minute by minute = 0.91

## APPENDIX C

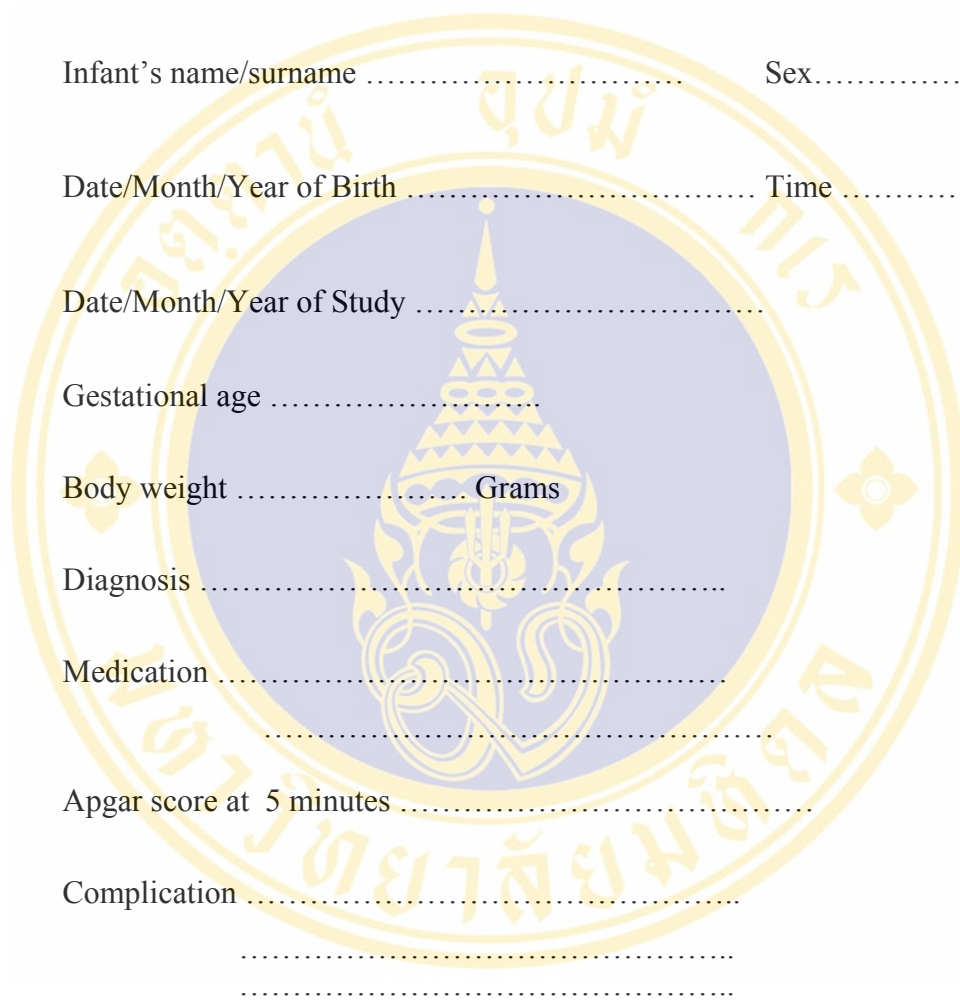
List of expert consultant on tested for level of sound of music tape in multi-modalities stimulation program is as follows:

- Associate professor Kriisna Lertsukprasert  
Department of Otolaryngology  
Faculty of Medicine, Ramathibodi Hospital, Mahidol University



## APPENDIX D

### Demographic Data From



Infant's name/surname ..... Sex.....

Date/Month/Year of Birth ..... Time .....

Date/Month/Year of Study .....

Gestational age .....

Body weight ..... Grams

Diagnosis .....

Medication .....

Apgar score at 5 minutes .....

Complication .....

.....

.....

### APPENDIX E

#### Light and sound level record form

Infant's name/surname .....

Date/Month/Year ..... Time .....

Duration (minutes)	Light level (lux)	Sound level (decibel)	Note
5			
10			
15			
20			
25			
30			
...			
...			
...			
90			

## APPENDIX F

### Body weight and feeding intake record form

Infant's name/surname .....

Date/Month/Year ..... Time .....

DAY	BODY WEIGHT (grams)	FEEDING INTAKE (CC)
1		
2		
3		
4		
5		
...		
...		
...		
...		
...		
...		
...		
...		
...		

## APPENDIX G

### Sleep-wake cycle record form

Infant's name/surname..... Temperature.....

Date/Month/Year..... Incubator's temperature.....







- = quiet sleep (QS)      ——— = active sleep (AS)      ~~~~~ = drowsy sleep (DS)
- - - -● = quiet alert (QA)      - - - - - = active alert (AA)      ~~~~~ = crying (Cry)

Time at start..... minute

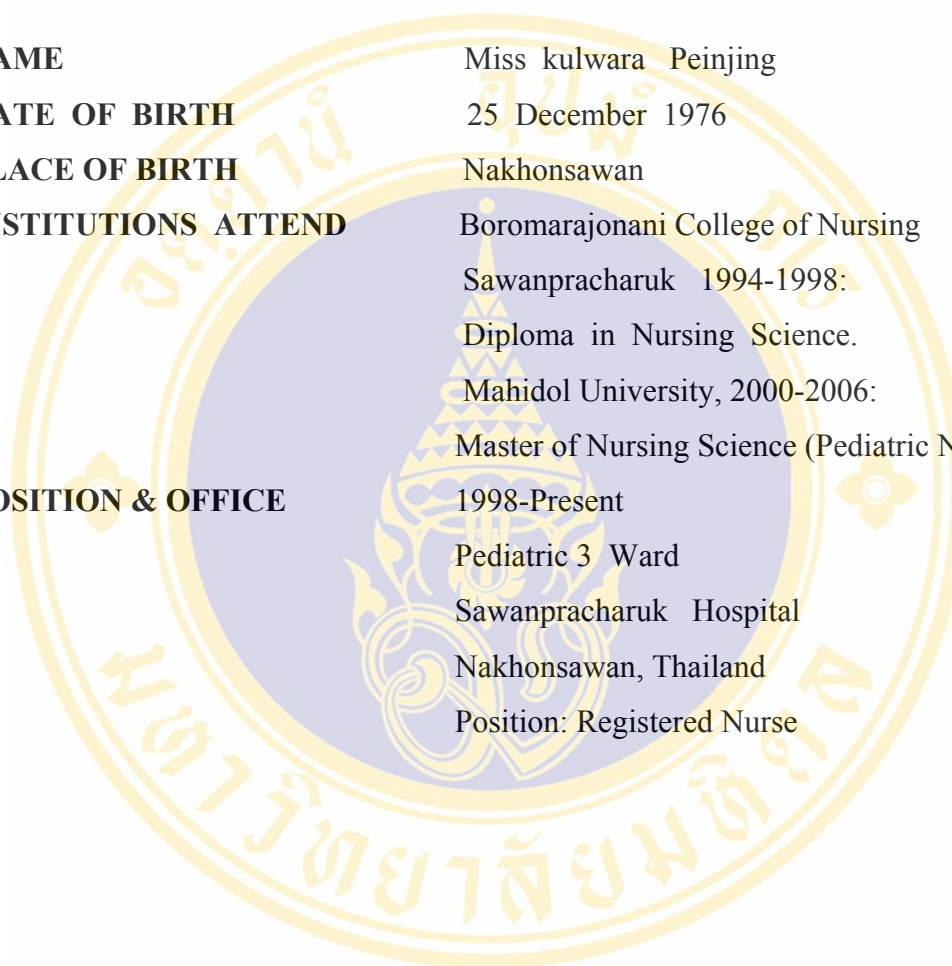
0	1	2	3	4	5	6	7	8	9	10
10	11	12	13	14	15	16	17	18	19	20
20	21	22	23	24	25	26	27	28	29	30
30	31	32	33	34	35	36	37	38	39	40
40	41	42	43	44	45	46	47	48	49	50
50	51	52	53	54	55	56	57	58	59	60
60	61	62	63	64	65	66	67	68	69	70
70	71	72	73	74	75	76	77	78	79	80
80	81	82	83	84	85	86	87	88	89	90

Total time.....minutes    Quiet sleep.....minutes    Active sleep.....minutes  
 Drowsy sleep.....minutes    Quiet alert.....minutes  
 Active alert.....minutes    Crying.....minutes  
 Total sleep..... minutes

เกณฑ์การประเมินสถานะการหลับตื่นของทารกเกิดก่อนกำหนด  
 การประเมินสถานะการหลับตื่นของทารกเกิดก่อนกำหนด สังกัดจากการปิดเปิดเปลือกตา การเคลื่อนไหวร่างกายและลักษณะการหายใจ

สถานะการหลับตื่น (Sleep-wake state)	สัญลักษณ์	การเปิด-ปิดของตา	ลักษณะการหายใจ	การเคลื่อนไหวของร่างกาย
ระยะหลับลึก (Quiet sleep)		ตาปิด	หายใจสม่ำเสมอและใช้กล้ามเนื้อหน้าท้องเคลื่อนไหว	ไม่มีการเคลื่อนไหวหรือมีการเคลื่อนไหวเล็กน้อยจากบกระตุ่ง
ระยะหลับตื่น (Active sleep)		ตาปิด มี REM	หายใจไม่สม่ำเสมอและใช้กล้ามเนื้อตัวโครงเคลื่อนไหว	มีการเคลื่อนไหวของแขน ขา, มือ, เท้า, ศีรษะและลำตัว หรือทั้งร่างกาย
ระยะง่วงซึม (Drowsy sleep)		ตาหนัก ตาปิดหรือเปิดครึ่งตา	หายใจไม่สม่ำเสมอ	มีหรือไม่มี การเคลื่อนไหวร่างกาย
ระยะตื่นสงบ (Quiet alert)		ตาเปิด จ้องมองนิ่ง	หายใจสม่ำเสมอ	มีการเคลื่อนไหวเล็กน้อยของแขน, ขา, มือ, เท้า, ศีรษะ เป็นบางส่วน หรือไม่มี การเคลื่อนไหว
ระยะตื่นเต็มที่ (Active alert)		ตาเปิดเต็มที่	หายใจไม่สม่ำเสมอ	มีการเคลื่อนไหวไหวทั้งแขน, ขา, หน้า, ศีรษะ, ลำตัว หรือทั้งร่างกาย
ระยะร้อง (Crying)		ตาเปิดหรือปิด	หายใจไม่สม่ำเสมอ มีการเคลื่อนไหวไหวรวดเร็วขึ้น	มีการเคลื่อนไหวไหวทั้งร่างกาย มีการดึงตัวของกล้ามเนื้อ

## BIOGRAPHY



<b>NAME</b>	Miss kulwara Peinjing
<b>DATE OF BIRTH</b>	25 December 1976
<b>PLACE OF BIRTH</b>	Nakhonsawan
<b>INSTITUTIONS ATTEND</b>	Boromarajonani College of Nursing Sawanpracharuk 1994-1998: Diploma in Nursing Science. Mahidol University, 2000-2006: Master of Nursing Science (Pediatric Nursing)
<b>POSITION &amp; OFFICE</b>	1998-Present Pediatric 3 Ward Sawanpracharuk Hospital Nakhonsawan, Thailand Position: Registered Nurse