A COMPARATIVE STUDY IN THE GROWTH AND DEVELOPMENT OF PREMATURE INFANTS BETWEEN THE GROUPS OF CONTROL AND TREATMENT UNDER THE MULTI-MODALITIES SENSORY STIMULATION PROGRAM

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SIRINAT TINIKUL: A COMPARATIVE STUDY IN THE GROWTH AND DEVELOPMENT OF PREMATURE INFANTS BETWEEN THE GROUPS OF CONTROL AND TREATMENT UNDER THE MULTI-MODALITIES SENSORY STIMULATION PROGRAM.THESIS ADVISORS:JARIYA WITTAYASOOPORN,D.N.S., NITTAYA KOTCHABHAKDI, M.D., LAMYONG RUSMEEMALA, M.Ed., 146 p. ISBN 974-664-924-8

The purpose of this quasi-experimental research was to compare the growth and development of premature infants in the control group and the treatment group under the multi-modalities sensory stimulation program based on conceptual framework of the synactive theory of development. The selective sampling were 44 premature infants in the Premature Infant Unit at Queen Sirikit National Institute of Child Health, and Special Care Nursery at Ramathibodi Hospital. Out of the total, 19 formed the control group who received only standard routine care, 25 formed the treatment group who received both standard routine care and multi-modalities sensory stimulation program. Neonatal Behavioral Assessment Scale (NBAS) was used for evaluating the development of premature infants. Statistical analysis and t-test was used at the end of study.

The results showed three main outcomes. Firstly, the development of infants in the treatment group was more advanced than the control group particularly in social interaction, motor system, state organization, state regulation, autonomic system and supplementary items. Secondly, for the growth rate, there was no significant difference showed by statistics between the two groups. Thirdly, there was no significant statistical difference between the two groups is physiological changes such as heart rate, respiration rate and oxygen saturation. Thus, this program should be provided regularly to premature infants because it enhances the development and positive response to the environment of infants.

4036685 RAPN/M : สาขาวิชา :การพยาบาลเด็ก; พย.ม. (การพยาบาลเด็ก)

ศิรินาฏ ตินิกุล : การศึกษาเปรียบเทียบอัตราการเจริญเติบโตและพัฒนาการของทารกคลอดก่อนกำหนดระหว่างกลุ่มควบคุมกับกลุ่มทดลองที่ได้รับโปรแกรมกระตุ้นการรับความรู้สึกหลายรูปแบบ (A COMPARATIVE STUDY IN THE GROWTH AND DEVELOPMENT OF PREMATURE INFANTS BETWEEN THE GROUPS OF CONTROL AND TREATMENT UNDER THE MULTI-MODALITIES SENSORY STIMULATION PROGRAM) คณะกรรมการควบคุมวิทยานิพนธ์: จริยา วิทยะศุภร พ.ย.ด.,นิตยา คชภักดี พ.บ., ลำยอง รัศมีมาลา ค.ม. 146 หน้า. ISBN 974-664-924-8

การศึกษาครั้งนี้เป็นการวิจัยกึ่งทดลองโดยมีวัตถุประสงค์เพื่อศึกษาเปรียบเทียบการเจริญเติบโตและพัฒนาการของทารกคลอดก่อนกำหนดระหว่างกลุ่มควบคุมกับกลุ่มทดลองที่ได้รับโปรแกรมกระตุ้นการรับความรู้สึกหลายรูปแบบภายใต้กรอบแนวคิด the synactive theory กลุ่มตัวอย่างจำนวน 44 คน เป็นทารกคลอดก่อนกำหนดในสถาบันสุขภาพเด็กแห่งชาติมหาราชินีและหน่วยอภิบาลทารกแรกเกิดของโรงพยาบาลรามาธิบดี โดยแบ่งออกเป็น 2 กลุ่ม คือ กลุ่มควบคุมจำนวน 19 คน ซึ่งได้รับการดูแลตามปกติ และกลุ่มทดลองจำนวน 25 คน ซึ่งได้รับการดูแลตามปกติและโปรแกรมกระตุ้นการรับความรู้สึกหลายรูปแบบ สำหรับเครื่องมือที่ใช้ในการประเมินพฤติกรรมของทารกทั้งสองกลุ่มคือแบบประเมินพฤติกรรมทารกแรกเกิดของบราเซลตัน (NBAS) และการทดสอบทางสถิติโดยใช้ t-test

ผลการวิจัยใน 3 ประเด็นหลักพบว่า 1) เมื่อสิ้นสุดการศึกษา ทารกในกลุ่มทดลองมีพัฒนาการโดยรวมสูงกว่ากลุ่มควบคุมอย่างมีนัยสำคัญทางสถิติ โดยเฉพาะด้านการมีปฏิสัมพันธ์ทางสังคม (social interaction) ด้านมอเตอร์ (motor system) ด้านการควบคุมภาวะพฤติกรรม (state organization) ด้านการปรับตัว (state regulation) ด้านออโตโนมิค (autonomic system) และความสามารถของทารกที่แสดงออกทางพฤติกรรม (supplementary items) 2) อัตราการเจริญเติบโตของทารกทั้งสองกลุ่มไม่มีความแตกต่างอย่างมีนัยสำคัญทางสถิติ และ 3) อัตราการเต้นของหัวใจ อัตราการหายใจ และค่าความอิ่มตัวของออกซิเจนในกระแสเลือดของทารกทั้งสองกลุ่มไม่มีความแตกต่างอย่างมีนัยสำคัญทางสถิติ ดังนั้นจึงควรนำโปรแกรมนี้มาใช้ในการดูแลทารกคลอดก่อนกำหนด เพราะทำให้ทารกมีพัฒนาการดีขึ้นและมีพฤติกรรมตอบสนองเชิงบวกต่อสิ่งแวดล้อมอย่างเห็นได้ชัด

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CHAPTER I

INTRODUCTION

Background and rationale

Over the past two decades the survival of premature infants, especially those under 1,500 grams and less than 30 gestational weeks, has shown a marked increase resulting from the development of technology. Although this has been a challenge to the capacity of the health profession, there has been significant progress and success of medical science and management for these premature infants. However, many premature infants are still considered to be a high risk for developmental outcomes, because of their immature organ system in both their anatomic and functional system. The central nervous system (CNS) organization, which was the key factor for the growth and development of infants, has been particularly affected. (Cole, 1985: 471; Bauchner, 1988: 1,207; Merenstein, 1994:890; Lotas, 1996: 681; Vohr & Msall, 1997:202) .

In terms of the growth and development of premature infants during the first year of survival, there was a delay of approximately 21-24 percent, as compared to full-term infants (Bauchner, 1988: 1,210, 1,214: Brooten, et al., 1989: 316). Faced with the extrauterine world, which is quite different from the environment inside a well functioning uterine, it is inevitable for infants to feel stress. To survive, they must adjust the balance within their organ system based on the function of their nervous system. This would be complete and effective only when receiving appropriate sensory stimulation (Gorski, et al., 1990: 103).

According to the study of Barnard and Bee (1983 cited by Harrison, 1985: 69), the negative behavioral reactions and inability to organize physiological changes of premature infants occurred by inappropriate sensory stimulation, rather than insufficient stimulation. It was also the consequence of medical treatment which emphasized securing the survival of the infant but neglected the long-term health and development of infants. Inappropriate stimulation such as loud noise, bright light and treatment and emergency nursing caused complications and may have both short-term and long-term effects on development (Lester & Tronick, 1990: xvii). Short-term effects include changes of the infant's physiological function such as respiration, heart rate, blood pressure and oxygen saturation. These will have an effect on the infant's sleeping and waking behavior as well as on their interactive environment. Long-term effects cause the high rate of failure to thrive, neurologic abnormalities, and neurosensory deficits affected 45 percent of the children. (Cohen, 1987: 23; Vanden Berg, 1995 cited by Lotas, 1996: 681) There is a high risk of mental retardation as well (Graven, et al., 1992: 165).

Regarding the study of Gennaro and colleague (1991: 29), it was found that 27 percent of premature infants that were rehospitalized had the central nervous system problems. Though the intellectual development and capacity of premature infants were at the normal level after ten years of survival, the number of infants who had problems with literacy, slow development of learning and cognition, and deficit sensory and motor skills were about 25-50 percent. Those problems stay until adolescence. The impact on the family showed that 48 percent of these mothers faced difficulties in care giving. Therefore, premature infants should receive appropriate sensory stimulation for the greatest benefit of brain development and the effectiveness of growth and development. This helps the infant in his abilities to adjust and response to stimulus (Als, et al., 1986: 1,131).

In the past it was originally believed that premature infants could not respond to or interact with their environment because they lacked the neuronal maturation needed to receive and process information. Contemporary clinical interpretation is quite different. Rather than a lack of responsiveness, premature infants are now believed to be oversensitive and over responsive to environment stimuli (Yecco, 1993: 56). It was also found that the regular sensory stimulation covering tactile, vestibular, kinesthetic and auditory stimulation within the uterus were the main factors for the development and interactive capacity of the fetus. Stimulation within a warm, dim aqueous environment in the uterus consisted of rhythmic noise of the mother's circulation and breathing, intermittent bowel sounds, voices, and extraneous sounds from her surrounding. (Linn, et al., 1985: 408, White-Traut, 1988: 285; Graven, et al., 1992: 166). It is presumed that the fetus is comfortable, and free of pain in this environment.

After birth, there is a dramatic change in the environment in the incubator for the premature infant. The child is no longer experiences the diurnal fluctuations in intensity of motion, touch, sound, and temperature that occurred before birth. Exposure to odors and pain at birth, inappropriate stimulation (in some cases over-stimulation, in others, under stimulation), decrease of vestibular stimulation, increase of visual, auditory and tactile stimulation (loud noises, bright lights, alarms of the equipment), treatment, and emergency nursing, provided the worst effect to sleep-wake cycles of infants. Because of metabolic processes while they are awake, premature infants need more oxygen and must adapt in order to survive (Anderson, 1986: 21; Gorski, 1991: 1,474; Kathy deLestard & Lennox, 1995: 24).

Applicable stimulation proved to be the best and the most benefit for premature infants, as it completely supports organic functions of neurobehavioral to increase growth hormone and gastrointestinal hormone. The growth in anatomy and organic function of premature infants could be seen as the gradual increase of weight and head circumference, the absence of apnea episodes, the appropriate ability of feeding, adapting, responding and interaction to environment, the reduction of infection and complications such as intraventricular hemorrhage, bronchopulmonary dysplasia, a younger age of discharge, shorter hospital stay and decrease of hospital costs (Masi, 1979; Chaze & Lundington – Hoe, 1984; Leib, et al., 1980; Rausch, 1981; Barnard & Bee, 1983; Cole & Frappier, 1985; Harrison, 1985; Field, et al., 1986; Uvnas – Moberg, et al., 1987; White-Traut & Goldman, 1988; Gorski, 1991; White-Traut,et al., 1993, 1994, 1997; Lotas & Walden, 1996). Through appropriate stimulation, an estimated cost of each infant is saved US$ 90,000 yearly (Als & Gilkerson, 1997: 181).

The evaluation of family functions found the positive progress of maternal-infant interaction in families without maternal stress and anxiety. The growth and development of premature infants were not only to encouraged and inspired by the frequency of visiting by the mother, but also made recognition and understanding (Rosenfield, et al., 1977). Thus, it was true that appropriate stimulation was the root of long-term development of premature infants (Fields, 1986). While inapplicable stimulation would provide the worst experiences, and stop the growth and development of premature infants. The problems of complication and reinfection of infants caused a higher age at discharge, longer hospital stay, and increased hospital costs. It was also caused the troubles of maternal-infant relationship, as the mother ignored the child and felt bored to take care of infant. Premature infants that are not properly cared for , therefore, have a poor quality of life and will be the social problem in the future.

According to information found through CD-ROM on CINAHL during the year of 1982-1998, and the duration of 1995-1998 on MEDLINE, there were two modalities of sensory stimulation. The first was a single modality, and the second was multi-modalities. Early studies in the past stated on a single stimulation rather than multi-stimulation based on the belief that the structure and organ functions of premature infants were not mature enough to receive various modalities of stimulation. Multi-modalities stimulation may be more stressful to the infants rather than a single modality stimulation (Lester & Tronic, 1990: xvi). Premature infants should obtain only a unimodal of stimulation either tactile, vestibular or auditory stimulation. Laster, many researchers conducted such research on the topic of multi-modalities stimulation. The results insisted that multi-modalities stimulation were most appropriate for premature infants (Mueller, 1996; White-Traut, et al., 1997). It caused no negative effect to heart rate, respiration, blood pressure and oxygen saturation of infants (Thoman & Graham, 1986: 855).

Those reasons influenced and inspired researcher to conduct a study on the topic of sensory stimulation programs for premature infants. The preliminary study on the growth and development of premature infants at Special Care Nursery of Ramathibodi Hospital in Bangkok City was done by modifying two models of sensory stimulation: First, the multi-modalities stimulation program of White-Traut and colleague (1993) which were composed of auditory, tactile, vestibular/kinesthetic and visual stimulation. Second, the tactile and kinesthetic stimulation program of Fields and colleague (1986) which were easier and more practical, particularly the process of tactile stimulation when compared with the complex and difficulty of tactile stimulation procession of White-Traut. Thus, the tactile modality stimulation of Fields was used in this research.

The outcomes of preliminary study showed that after receiving a sensory stimulation program, premature infants showed an increase in weight gain and feeding, and had positive interaction to their environment. However, it is not a truth conclusion due to the small number of samples and a short period of study. Thus, researcher conducted further study on the topic of "A comparative study in the growth and development of premature infants between groups of control and treatment under the multi-modalities sensory stimulation program".

Conceptual Framework

The synactive theory of development (Als, 1982; Als, 1986 cited by Blackburn & Vanden Berg, 1993) provides a model through which one can specify the degree of differentiation of behavior and the ability of infants to organize and control their behavior. The focus is not on assessment of skills, but on the unique way each individual infant deals with the world around him or her. The synactive theory of development specifies the range of neonatal behavior on the infant matures as well as the ability of the infant to regulate behavior. This model is based on the assumption that the infants's primary route of communicating both functional stability and the limits for stress is through behavior.

Infants are seen as being in continual interaction with their environment via five subsystems including the systems of autonomic, motor, state-organization, attention and interaction, and regulatory. The autonomic system is observable via the pattern of respiration, color changes, tremulousness, and visceral signals such as bowel movements, gagging, hiccoughing, etc. The motor system is observable in the posture, tone, and movements of organism. The state-organization system is observable in the kind and range of states of consciousness available to the organism, from asleep to aroused states, and in the pattern of state transitions exhibited. The attention and interaction system is exemplified in the organism's ability to come to alters, attentive state and to utilize this state to take in cognitive and social-emotional information from the environment and in turn elicit and modify the inputs from the environment. The regulatory system is exemplified in the observable strategies the organism utilizes to maintain a balanced, relatively stable and relaxed state of subsystems integration or to turn to such a state of balance and relaxation.

These subsystems are interdependent and interrelated. For example, physiologic stability provides the foundation for motor and state control; the infants cannot respond socially to caregivers until motor and state control is achieved. The loss of integrity in one subsystem can influence the organization of other subsystems in response to environmental demands. In the case of premature infants, the deficits and discontinuity function of five subsystems due to the immature nervous system were due to premature birth. Infants exposed to an extrauterine world which was quite different from the environment inside a well-functioning uterine and received inappropriate stimulation, failed to manage this situation. Premature infants should be provided with the suitable environment particularly the similarity sensory stimulation obtained in uterine for the progressive of well functioning of the five subsystems.

Sensory stimulation is one environment that is important and benefits the growth and development of premature infants (Masi, 1979; Chaze & Ludington-hoe, 1984; Anderson, 1986; Muller, 1996; White-Traut, et al., 1994, 1997). Because sensory systems begin to function before their structures have completely matured (McGraw, 1946 cited by Korner 1990: 175). Gottlieb (1971 cited by Korner, 1990: 175), in reviewing the ontogeny of sensory function of birds and mammals, including man, it clearly demonstrates an invariant sequence of development of sensory system becoming functional, beginning with cutaneous responsibility in the oral or snout region and progressing to vestibular, auditory, and visual responsibility.

The studies of Neal (1969), Barnard and Bee (1983) firmly stated that stimulation on one sensory system can include the function of sensory systems that are about to develop. When premature infants are provided with vestibular-proprioceptive stimulation, they begin to function better in the auditory and visual spheres than did controls. The physiological theory of the central nervous system of Moffett (1993) based on the assumption that under normal situations the nervous system will function when stimulated, tells us that sensory receptors will transfer data in the form of nerve impulses to the spinal cord and primary sensory cortex through cortical association areas which have various sensory receptors, particularly auditory, visual, tactlie, vestibular and kinesthetic receptors.

Multi-modalities stimulation were the best appropriate methods for infants because all functions of nervous system were stimulated at the same time (Muller, 1996). The supportive outcomes research of Field (1986), Barnard and Bee (1983) supported firmly the belief in the previous findings that the stress of infants did not occur by obtaining multi-modalities stimulation. In fact, the infants would feel calm because the stimulation mimicked a similar stimulation and environment that in utero. Resulting from the effectiveness and continuity of all functions, infants could adjust and control their behavior in a suitable way which would lead to the growth and development of ages of infants.

Sensory stimulation program provided to premature infants was as follows:

1.Auditory stimulation by using a musical toy instrument with noise level at 60-65 dB for 10 minutes (White-Traut, et al.,1994). This method benefits for the development and maturity of the right brain, the intellectual and emotional behavior of infants, and the improvement of general body tonus(Chaze & Ludington-Hoe, 1984: 69). Infants will feel relaxed and calm with the longer period of sleep. While sleeping, the metabolism rate and oxygen was decreased, but growth hormones were increased. Those caused the increase in infants' weight, feeding quantity, early discharge from hospital, and the gradual development (Kramer & Pierpont, 1976; Chapman & Molloy, 1979 cited by Harrison, 1985; Puakvilai, 1986).

2. Tactile stimulation is provided to infants with the belief that cutaneous tissues is the most sensitive (Moore, 1981:223). Skin-to-skin stroking given in a head-to toe direction over the infant's entire body surface for 10 minutes a day (Field, et al., 1986) will stimulate reticular formation to increase hypothalamus causing the somatotrophic hormone from pituitary gland, the maturing of tissues, the increase of weight and strong muscles (Kuhn et, al.,1991) and positive interaction between mothers and infants. Eye to eye contact of caregivers and infants with strokes of love and kindness will build a feeling of warmth and trust which is good for the development of learning and social interactions of infants. It should be best to alternately provide infants with tactile stimulation and vestibular/kinesthetic for 5 minutes of each, then reprovide tactile stimulation again. This way will not only protect infants' hypothemia, but does not provide overstimulation as considering from the infants' physiologic response and oxygen saturation which a bit change from baseline mean but still be normal and acceptable.

3. Vestibular and kinesthetic stimulation by flexing and extension of extremities for 5 minutes (Field, et al., 1986) caused the increase of body movement and muscle tone. Having received two sensory stimulations, tactile and

vestibular/kinesthetic stimulation, greater development of myelinization of nerve fibers effecting to the development of memorial capacity of infants occurred (Chaze & Ludington-Hoe, 1984: 71). It also reduced the incidence of apnea and oxygen (Tuck, et al., 1982). and created regular respiration, digestion, and metabolism, body weight gain (White & Labarba, 1979: 66). Without receiving vestibular stimulation, the existence of abnormal behavior, the high risk of apnea, slow weight gain and illness will appear (Moore, 1981).

4. Visual stimulation by holding infants in the "en face" position for 1 minute (White-Traut, et al., 1994) will promote attachment (Moore, 1981: 225) as infants can clearly see shapes within the visual range of 8-12 inches (Dixon, 1992: 68; Kenner & MacLaren, 1993: 44). This method will also develop the readiness of the visual receptor, the conjuction of head and eyes movement under the cortically controlled visual system, and promote attention, perception, the ability to learn and recognition (Brazelton, 1981: 338).

The above four modalities of sensory stimulation will take nerve impulses to the cortical of the brain and produce a fruitfulness of cortical improvement during the period of brain development (Als, et al., 1986; Buehler, et al., 1995). Due to the continuity and dependence of these stimulation, the procession must start with auditory stimulation to make infants calm and ready to receive other modalities, followed by the stimulation of tactile, vestibular and kinesthetic which provide alertness and functions of the organs for adapting. Then infants should receive visual stimulation which promotes the readiness of environmental interaction. These stimulation will support the healthy function of the nervous system, and provide the fruitfulness of short-term and long-term growth and development of infants. The minimal changes in respiration, heart rate and oxygen saturation were acceptable (White-Traut & Goldman, 1988; White-Traut, et al., 1993).

Sensory stimulation to premature infants should be done within an appropriate period particularly after 4 days or after a critical period for the betterment of infants' growth and development (Korner , 1990). Due to the stability of balance, infants can easily maintain caloric intake during the period of the first 3 weeks (Manser, 1984). According to the study of Korner (1990) on sensory stimulation of low-risk premature infants by using waterbeds, it was found that there was a decrease of apnea episode. But it was not effective in cases of severe illness groups because of the imbalance of their organ system. In the adaptation period infants lost more energy which is observable through the changes of physiology such as heart rate, respiration pattern, and oxygen saturation.

Researcher do realize the importance and benefit of sensory stimulation programs for premature infants. The programs provide various types of positive progress of growth, development and physiological change such as the growth of brain, nerve cells and tissue proportion, the increase of weight, positive environment interaction, normal changing of heart rate, respiration rate, and oxygen saturation which cause harmless to infants (White-Traut, et al, 1993). So, this study will focus on the growth and development of premature infants between groups of control and treatment under the multi-modalities sensory stimulation program. The outcomes will be of use for the development and progress of nursing care, and the promotion of growth and development of premature infants as well as stated in chart I.

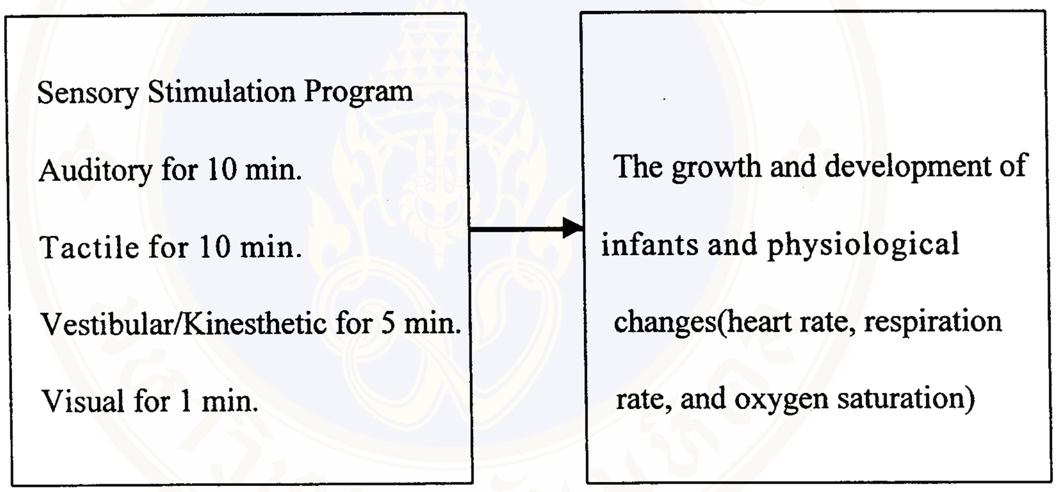

Chart I: showing the related of independent and dependent variable

Research question

What is the effectiveness of the multi-modalities sensory stimulation program for premature infants?

Objectives

1. To study and compare the growth of body weight, body length, head circumference, and chest circumference of premature infants between the groups of control and treatment.

2. To study and compare the development between the groups of control and treatment.

3. To study and compare the changes of heart rate, respiration rate and oxygen saturation between the groups of control and treatment.

Research Hypothesis

1. The growth rate of body weight, body length, head circumference and chest circumference of the treatment group will higher than the control group.

2. The development of the treatment group will have more maturity than the control group.

3. Physiological changes of heart rate, respiration rate and oxygen saturation of the treatment group will similar to the control group.

Research Limitation and Scope

Sampling population for a comparative study in the growth and development of premature infants between the groups of control and treatment under the multi-modalities sensory stimulation program, focuses on 44 premature infants from Premature Infant Unit at Queen Sirikit National Institute of Child Health, and Special Care Nursery at Ramathibodi Hospital from May to September, 1999. 19 out of the total is the control group, and the rest (25 infants) is the treatment group.

Usefulness of the Study

1.To promote the gradual development and growth of premature infants which should be done continuously as it is the first step of development.

2. The outcomes of study will be of use for the effectiveness and appropriation of planning and organizing the multi-modalities sensory stimulation program for premature infants.

Assumption

This research is based on the assumption that each premature infant had continuous and linear development but the different level of development depended on sensory stimulation.

Definition of Variables

Multi-modalities sensory stimulation program means activities that nurses provide to premature infants at age of 4 days by modifying the sensory stimulation program of White-Traut and colleague, Field and colleague. Those are composed of auditory stimulation for 10 minutes, tactile stimulation for 10 minutes, vestibular/kinesthetic stimulation for 5 minutes and visual stimulation for 1 minute.

Premature infants means a survival infant at postconceptual age of 32-36 weeks with body weight 1,400-1,800 grams by using assessment of gestational age of Ballard.

The growth rate means the changes of physiology, the increase of bodyweight and size proportion of body length, head circumference and chest circumference could be considered from the following indicators.

Body weight means the weight of infant without clothes, to be measured in grams by using infant's bodyweight scale. The increase of body weight at the end of study means positive changing.

Body length means length from the head to heel, to be measured in centimeters by place a tape measure from the top of the head to the base of the heels.

The increase of body length at the end of study means the development of infant's health.

Head circumference means the length from the forehead to the occiput, to be measured in centimeters by place a tape measure securely around the fullest part of the caput, from the middle of the forehead to the midline of the back of the skull. The increase of head circumference at the end of study means the development of infant's health.

Chest circumference means the measurement of the chest, to be measured in centimeters by place a tape measure around the chest at the nipples. The increase of chest circumference at the end of study means the development of infant's health.

Development means premature infant's ability to interact with the environment and by his/her capacity to deal selectively with environmental stimuli. This is the result of the maturation and well functioning of the central nervous systems which can be measured by Brazelton Neonatal Behavioral Assessment Scale that are composed of:

- 28 behavioral repertoire items, each item scored on a 9-point scale.
- 18 reflex items on neurological status, identify gross neurologic abnormalities, each item scored on a 4-point scale.

- 7 supplementary items, adding in with an attempt to better capture the range and quality of the behavior of premature infants, each item scored on a 9-point scale.

Physiological change of heart rate means at the beginning, during, and after receiving multi-modality sensory stimulation program, range of heart rate of premature infant is 140-160 beat/ minute.

Respiration rate means at the beginning, during, and after receiving multi-modality sensory stimulation program, range of respiration rate of premature infant is 40-60 beat/ minute.

Oxygen saturation means at the beginning, during, and after receiving multi-modality sensory stimulation program, range of saturation level of premature infant is 95-98 percent.

CHAPTER II

LITERATURE REVIEW

The concerned literature to be reviewed respectively in this chapter are composed of: 1) the definition and characteristics of premature infants, 2) the growth and development of premature infants, 3) the environment factors for the growth and development of premature infants, and 4) sensory stimulation program provided to premature infants.

1. The definition and characteristics of premature infants

The definition of premature infants

Premature infants are infants under 2,500 grams with less than 37 weeks gestation who are considered to be a high risk of mortality rate during the first two years of survival (Siripun, 1996:66; Pillitteri, 1995: 746).

Types of premature infants

There are 3 groups of premature infants, comprising the groups of low birth weight , very low birth weight and extremely low birth weight as the following details (Peteree & Warshaw, 1999: 185; Msall & Tremont, 2000:381).

Firstly, the group of low birth weight (LBW) means infants with a birth weight of less than 2,500 grams. The maturity of physical function and nervous system of infants are similar to full-term infants. Survival rate of infants are at 90 to 95 percent.

Secondly, the group of very low birth weight (VLBW) means infants with a birth weight of less than 1,500 grams. Effective caring with modern tools during the first two months, increase the survival rate of infants to 93 percent up though they are physical immature.

Thirdly, the group of extremely low birth weight (ELBW) means infants with a birth weight of 751 to 1,000 grams. They need specific caring due to the immature physical function and nervous system. Survival rate of infants are at 85 percent.

Characteristics of premature infants

The characteristics of each premature infant vary with the gestation age. They are most marked in the infants with the shortest gestational age and become less distinctive as the gestational age increases (Cross, 1975: 1). According to Cross (1975: 1-10) and Siripun (1996: 66), the characteristics of a premature infant are as follows:

1. Infant has a large head in proportion to the size of its body. The chest is relatively small while the abdomen is relatively large.

2. The skin is red and shiny, and little subcutaneous fat is present in infants up to 28 weeks; but after this the skin becomes paler and subcutaneous fat begins to appear. Infant has little vernix caseosa.

3. The nipples are flat pigmented area and it is only after 36 weeks gestation that they rise above the surrounding skin. Engorgement of the breast is rare.

4. Lanugo is plentiful up to 28 weeks, then becomes less in amount; the back, the face and extensor surfaces of the limbs begin most commonly affected. Hair is short and scanty and eyebrows are often absent.

5. The cartilage of the ear is immature and allows the pinna to fall forward. The ears appear large in relation to the head.

6. The extremities do not flex the body well but remain in an extended position due to the weakness of muscles. The

movement of extremities occur spontaneously with jerky movements.

7. The nails are shorter and softer than at term. They have few or no creases on the soles of the feet.

8. In the female, the labia minora are not covered by the labia majora until almost at term. In the male, the testicles may be in the abdomen, inguinal canal or scrotum, according to gestational age, but they may be found in the scrotum as early as 28 weeks' gestation. There is a special tendency to inguinal hernia.

9. Respiration is largely diaphragmatic and tends to be irregular in rhythm and depth. There are often periods of apnea due to weak respiratory muscles, yielding thoracic cage and poorly developed respiratory center. The development of the lung depends on the length of gestation.

10. The body temperature tends to be subnormal because of the poor heat production and increased heat loss. Loss of heat is increased because of the relatively greater body surface and the lack of subcutaneous fat, particularly brown fat.

11. Because of the low level of gamma globulin at the first 4 to 6 weeks of life, it contributes to the poor response to infection.

12. Anemia may occur afterward because of the limitation of iron storage.

13. The stomach shows little folding of the mucosal surface and poor development of the secretory glands and muscle fibers. It is easy to digest and absorb proteins and carbohydrates but it is hard to absorb fat.

14. The liver is relatively large but its function is poorly developed. The immaturity of the liver predisposes to jaundice by reason of the inability of the liver to conjugate and excrete bilirubin .

15. Urination is scanty and infrequent for a few days after birth due to the small amount of fluid taken. A premature infant has relatively more extracellular fluid and less ability to concentrate urine. Their inability to excrete sodium and chloride and the consequent retention of water are due to the poor development of kidneys. Edema and dehydration may occur because of the imbalance of water intake and output.

16. The immaturity of reflection issuing on coughing, swallowing and sucking may cause poor feeding and aspiration. Regurgitation is common.

The health problems of premature infants during the neonatal period are composed of birth asphyxia, respiratory distress syndrome, hypothermia, hypoglycemia, apnea of prematurity, hyperbilirubinemia, sepsis, anemia, and intraventricular hemorrhage. Infants, therefore, need intensive care immediately and longer hospital stay which will impact to the health of infants after discharging. There are 6 main health problems of infants.

Firstly, the handicap of childrearing counted to 22-35 percent (Hack & Fanaroff, 1988: 784). This problem is the result of the severe complication and longer hospital stay which effected the growth and development of infants. The separation from mothers after birth interferes with the normal maternal-infant attachment process. Mothers find it difficult to take care of infants and the lack of confidence in their roles lead to an insufficient response to the needs of infants. It is also due to the inability of infants to communicate their needs as the full-term infants do. The behavior of infants which is difficult for interpretation comprise of :

1. Behavior of sleep and wake (Brazelton & Nugent, 1995) which is classified into 6 periods of deep sleep, drowsy, light sleep, alert, eye open, and crying.

2. Behavior of crying, is a sign of discomfort and unhappiness, one of the infant's major mode of communication, classified into 5 indicative feeling of hunger, angry, pain, frustration, and interest requirement (Kasemsan, 1993: 172).

3. Behavior of feeding, a reflex to outsides and inside stimulants, can be seen through the poor sucking and swallowing of infants. This is due to the immaturity of the central nervous system and the weakness of muscles around the infants' mouth, causing the slow and frequent feeding during the first 1 to 2 months of life. This behavior makes the mother confuses as to whether she is providing sufficiency feeding to the infants or not.

Secondly, vision problem, the number of infants who received uncontrolled oxygen and exposure to 300 FTC for 12 to 72 hours faced with the retinopathy of prematurity and visual impairment counted to 23-57 percent (Avery & Glass, 1988: 924; Dusick, 1997: 173). There are 10 percent of infants under 750 grams who are the blind.

Thirdly, hearing problem, infants with conductive hearing loss are at 14-42 percent. A group of infants weighing less than 1,000 grams who have sensorineural hearing loss has been reported up to 9.2 percent due to hypoxia, intracranial hemorrhage; side effects of ototoxic drugs. The research finding of Leslie and colleague (1995 cited by Dusick, 1997: 172) found the following factors related to an increased risk of sensorinueral hearing loss : > 90 days of oxygen use, maximum 90 percent of oxygen concentration.

Fourthly, respiratory problem, the percentage of infants faced with bronchopulmonary dysplasia ranged from 15 to 47 percent resulting from having received more oxygen and a prolonged use of the ventilator.

Fifthly, gastrointestinal problem; it was found the necrotizing enterocolitis of infants due to the hypoxia intestine and invasiveness of bacteria in tissues caused the abdominal distension, vomitting and stool occult blood of infants.

Sixthly, infection problem; there is a growing trend of infants who have infection due to the immaturity of preventive function of the immune system. This is due to the factor of the sudden decrease of IgG received from the mother and the lower level of production of IgG inside the body. During the first year of life, 25-50% of premature infants were readmitted to hospital, compared with an estimated of 8 to 10 percent of full-term infants who were readmitted (Blackburn, 1995: 44).

It could be concluded that health problems of premature infants depended on 2 factors. Firstly, the immaturity of physical state that caused the high risk of illness. Secondly, the caring method under nursing and medical treatment in the neonatal period which provides the important environment for infants. Infants who receive appropriate nursing activities and sensory stimulation, and stay in the optimal environment composed of overhead and indirect lighting and minimal extraneous noise, will have normal growth and development. Without the appropriate nursing activities and optimal environment many health problems are occurred. Thus, the principal of child-rearing is not only aimed at the survival of infants but also focuses on the wealth of health and the success of preventive sequelae of infants that will benefit the normal growth and gradual development of infants.

2. Growth and development of premature infants

Growth of infants can be seen through physical changing, increasing cell number (hyperplasia) and increasing cell size (hypertrophy) of infants (Manser, 1984: 20; Khotchapakdee, 1993: 1). The growth of fetus, particularly the structure and function of organs has changed dramatically in each trimester of pregnancy. Increasing cell number for the development of organs during the embryogenesis will appear in the first trimester (Srisupab, 1997: 271), the critical growth period. The second trimester is the period where an increase in number and size of cells occurs.

Interference with growth during the period of hyperplasia will result in a permanent decrease in cell number, in organ size, and potentially in organ function. In the third trimester, the cell still grow full term but the number of cells will decrease. If delivery occurs at any period of pregnancy, infants will be faced with many problems resulting from immature organs. Besides, there are many influencing factors of growth process comprising of genetic factors or environment factors that will cause the deviation of growth.

The growths of premature infants depend on gestational age, birth weight, duration and severity of neonatal illness. Growth assessment of premature infants is evaluated from body weight, length and head circumference. Normally, phase of growth in premature infants is evaluated from the last 3 months of pregnancy to the first year of life, which can be classified into 4 phases (Manser, 1984: 22-25).

Phase I is the period of growth delay. This phase follows birth and corresponds to the sick, the percentage of growth delay of premature infants is 58 (Hack, et al., 1984: 370). Initial dynamic changes occur in body water and electrolyte distributions that are reflected by decreases in weight. Normally, during the first 3 days of life, the body weight of premature infants decreases by 10-20 percent of birth weight due to immature organs, bad functioning of the kidney and the existence of extracellular fluid count to 85 percent, loss of fluid occurs through evaporation of skin, inspiration, and metabolism. Moreover, dehydration and restricted nutrition are the factors of fluid loss which is obvious in 28-30 weeks of gestation age of premature infants.

Phase II is the period of transition. With achievement of fluid and electrolyte homeostasis, and improvement of medical status, maintenance caloric intake becomes easier to achieve 1-3 weeks after birth. As caloric intake exceeds the infant's needs for maintenance, and catabolic needs from disease states diminish, slow growth begins, marking the transition from the phase of growth delay to the phase of catch-up growth. There is initially a slow increase in head circumference paralleled by a slow increase in length.

Phase III is the period of catch-up growth which is characterized by increases in head circumference, length, and weight of infants particularly those at 6-9 months of age. The growth rate of premature infants at 2-8 years of age increase rapidly at the normal level of full-term infants if they receive enriched nutrition and appropriate stimulation (Kitchen, et al., 1980 cited by Hack, et al., 1984: 374, Ross, et al., 1990 cited by Blackman, 1991: 1504).

Phase IV is the period of homeorrhesis when the growth rate of premature infants and full-term infants are closely parallel. The growth rate of premature infants who experienced the longest period of initial growth delay without management will be in the lowest percentiles or below standard growth charts. These infants appear to be at the highest risk for subsequent neurodevelopment handicap.

The length of each phase may vary from days to weeks depending upon several factors such as genetic, nutrition, infection, hypoxia and chronic illness.

According to the research of Bernbaum and colleague (1987: 45), growth of premature infants varies in two categories.

First, growth rate of each infant is different. The growth rate of delivered infants at 27-33 weeks of gestation who have no severity and complication of illness will be at normal level when they reach 36-44 weeks and are at 10-90 percentile in the first year of life. The comparison of size and appropriateness for gestational age showed an average body weight of premature infants varies from 3-25 percentile when they are at 3 years while an average of length is in the 25-50 percent. But there are less than the 5 percent of premature infants at less than 1,000 grams who have an average of body weight and length at 15 and 20 percent respectively (Manser, 1984).

Second, individual infants demonstrate differences between the growth velocity of their head circumference, length, and weight. Concerning the measurements for the growth of premature infants, it should be better to assess by measuring the head circumference which represents the growth of brain rather than the measurement of length and body weight (Ballard & Bernbaum, 1996: 261). Research finding of Gross and Eckerman (1983: 948) showed an average brain growth of premature infants during the first 3 weeks are 0.49, 0.78 and 0.95 centimeter respectively. Because of the wide range of growth that is considered within normal limits, it is necessary to assess premature infants growth by analyzing trends in growth rather than by making assumptions based on only one set of measurements.

Three main factors for growth assessment of premature infants are composed of history of illness and medical treatment, growth parameter comprising the head circumference, body weight and length, and data analysis by using growth chart records. It should be better to assess infants of 4-6 weeks in order to follow up changing growth because this method will easily point to abnormal occurances.

Indicators of the normal growth rate of premature infants are as follow (Bauchner, et, al., 1988: 1208):

Body weight: during 28 weeks gestation to the first 6 months of life, an average increase of body weight in each week is 208 grams.

Body length: during 28 to 40 weeks' gestation, an average increase of length in each week is 1.1 centimeters. At birth to the first 3 months of life, an average increase in each week is 0.75 centimeter. After the first 3 months, an average increase in each week is 0.5 centimeter.

Head circumference: In the last 3 months of pregnancy, an average increase of head circumference in each week is 0.75 centimeter. During the first 3 months of life, an average increase in each week is 0.5 centimeter. After the first 3 months of life, an average increase in each week is 0.25 centimeter.

Development is an ongoing process of increasing integration and complexity. The development of organs and functional cells since conception to maturity are based on genetic and environmental factors (Gardner, et al., 1989: 629). Steps of development of each infant are similar but the level of development is different. The direction of development begins from the head to the feet, from gross to specific. Primary reflexes can be seen before the true movement. However, development can not be value as the growth (Weerawan, 1997: 36) as it covers all development such as the growth of cells to become organs' tissues, and the neurological development.

Neurologic development is the mature development of nerve cells and brain that will lead to the readiness for active behavior of infants. Infants' behavior are various and different, and can be assessed by using Brazelton Neonatal Behavioral Assessment Scale (NBAS) and Als Assessment Premature Infant Behavior (APIB).

Brain growth of infants can be classified into 2 periods (Gardner, et al., 1989: 632).

Firstly, the human cortex begins development around the 6th week of gestation (Als & Gilkerson, 1997: 179), followed with an increase and continuity of brain development in 10 to 18 weeks of pregnancy. Then development will go on continuously until the neonatal period. However, the interruption of brain growth and development will occur if the growth of the fetus is interfered by factors such as malnutrition, maternal drugs, and infection.

Secondly, nerve cells develop continuously during the first 20 weeks of gestation and the third trimester of pregnancy which causes an enlargement of the brain. Behaviors of fetus such as movement of the extremities, sleep and wake period will occur continuously till delivery. Normally, the highest development of brain will begin when infants are at 2 to 5 years of age , and will slow down at the 18th year of life. Assessment of central nervous system can be done after birth by measuring reflection, responding capacity to stimulants, psychosocial interaction, and neurobehavioral.

Neurobehavioral is one of the infants' development assessments. Having faced various of physical and social environments (Als, 1982), infants must adapt their neurobehavioral system. The continuity and balance depend on the function and maturation of the central nervous system (Als & Duffy, 1989 cited by Miller & Quinn-Hurst, 1994: 506). In cases of premature infants, appropriate adjustment can not occur due to the immaturity of the central nervous system, which can be seen through the physiological and behavioral changes. An improvement of neurobehavioral organization can be evaluated from the decrease of severity of health problems, shorter hospitalization, the improvement of developmental outcomes, and the progress of parent-infant interaction (Miller & Quinn-Hurst, 1994: 512).

There are 2 types of neurobehavioral assessment.

The first is the Brazelton Neonatal Behavioral Assessment Scale (NBAS), measuring the responding behavior of 1) full-term, 2) premature infants, 3) infants whose mother are alcoholics and drug addicts. The NBAS is based on the assumption that newborn infants are both competent and complexly organized; they have the ability to interact with the environment by his/her capacity to deal selectively with environmental stimuli. The goal of the NBAS was to identify and describe individual differences in neonatal behavior. The scale describe the current status of the individual infants's autonomic, motor, state and social-attentional system as they interact with each other and become integrated during the neonatal period. Over the first ten days of life or until 1 month of age (Tedder, 1991: 26), repeated examination was conducted.

The contents of NBAS is composed of 5 packages as follows.

1. The Habituation Package which includes the Response Decrement items which are designed to evaluate the infant's capacity to "shut out" negative stimuli.

2. The Motor-Oral Package which includes the reflexes of the feet and rooting sucking and glabella items.

3. The Truncal Package which includes undressing and handling, the Tonic Deviation of head and eyes.

4. The Vestibular Package which includes the Defensive Movement, Tonic Neck Reflex and Moro Reflex.

5. The Social-Interactive Package which includes all the orientation items in both animate and inanimate stimuli.

Those are consisted of 28 behavioral items that look at the infant's intervention with his or her environment. Each score on a 9-point scale, with 18 elicited items or neurological reflexes of which each score on a 4-point scale. Supplementary item is added in an attempt to better capture the range and quality of the behavior of infants. These seven items attempt to summarize the quality of the infants' responsiveness and the amount of input they need from the examiners to organize their response. All details are mentioned in appendix C (NBAS Scoring Form).

The second is the Als Assessment Premature Infant Behavior (APIB), adapting from Brazelton NBAS, it is based on the synactive theory of development, particularly useful for the premature and full-term high-risk infant from birth to 44 weeks' postconceptual age. The propose of this assessment is to determine how infants cope with the intense environment of the NICU and the degree of organization of the central nervous system.

Outcomes of the study indicate that the development of premature infants began since they were fetus depending on the control of biorhythmic balance of maternal physiologic system. Faced with the imbalance of the new environment after birth, all systems of the infant are interrupted. Infants, therefore, need to adapt for the continuity of biorhythmic balance and the highest development of central nerve system maturing that are the supportive factors for the normal growth and development of infants.

The study of Gardner and colleague (1989) pointed that development of premature infants is based on the relationship of endowment and environment. Endowment means genetic inheritance from parents to infants beginning when they are in utero. Unchangeable genetic inheritance such as physical characteristics and intelligent level of parents ensures that the characteristics of each infant are different.

There are 3 main environments explained in the following details.

Firstly, prenatal environment means maternal health during pregnancy that effects the early development of infants. The development of infants is based on and depends on the nutrition, protective caring, and sensory stimulation received under the control of maternal physiologic system.

Secondly, there are two intrapartal environment comprised of maternal and neonatal environment. On maternal environment, the physiologic changes of labor produce stress in the mother. The feeling of fear, loneliness, and anxiety produce ACTH (Adenocorticotropic hormone) and oxytocin hormones that will effect the birth process. On neonatal environment, birth is a major transition from physiologic dependence to physiologic independence, an unfamiliar experience that causes stress in infants.

Thirdly, postnatal environment means nursery or NICU environment (physical and social environment) including family and home where infants live after being discharged from hospital. The 2 most important things done to promote the development of physical, psychosocial and nervous system of premature infants are environment management and nursing care adjustment. As the family system is considered to be a normalized environment for human development, caregivers should provide information and knowledge to parents for better understanding of

Infants' behavior and demands in each period, thus improving the capacity of parents to organize suitable environments for developmental care of infants.

Als and colleague (1986) found that after birth caregivers should adjust their roles and activities in providing nursing activities to individual premature infants who are faced with bronchopulmonary dysplasia. Those activities will improve cortical development and, thus, better motor and mental functioning. This can be measured with behavioral functioning and brain electrical activities mapping. The results of activities adjustment of caregivers also give positive results for improvement of medical treatment evaluated from shorter stays on the respirator, earlier success in complete bottle or breast feeding, the progressive relation between infants and parents, and saving costs.

The report of KathydeLestard and Lennox (1995) mentioned the neonatal individualized developmental care and assessment program (NIDCAP) in the Women's College Hospital in Toronto (Canada) where 2 policies are experimentally implemented. The first controlled noxious and over stimulation environment by dim overhead lights and reduced noise levels at all times. The second changed the caregivers' behavior to promote maximum comfort for the infants, gently flexed position, and reduced the frequency of handling. The outcomes are very satisfactory due to the survival and development of infants, and the enhancement relationship of parents and infants. Therefore, such programs on developmental care which is a new concept must be conducted.

The research study of Thomas and Chess (1980 cited by Rice & Feeg, 1985: 30) mentioned the development of premature infants as biopsychosocial models of development based on 3 main factors. First, the biologic factors influencing development include structure and function of the brain in addition to genetic inheritance. Second, the psychological factor includes perception, cognition, and learning ability. Third, the social factors include family and other social interaction. The continuity and appropriation of infants' development are under the control of those 3 main factors.

The conclusion is that the changes of growth and development of premature infants related to and depended on endowment, physical and social environment, and psychological development of each individual. Those are factors for the infants' maturity. In my research study, growth assessment evaluated from body weight, length, head and chest circumference, while the assessment of development is based on Brazelton Neonatal Behavioral Assessment Scale (NBAS). In fact, even though, I am very interested in Als APIB, which is the most appropriate neurobehavioral assessment of premature infants, but the problem is that there is no expert on Als APIB in Thailand. Therefore, I select to use Brazelton NBAS as the tool in my comparative study because it is an accurate tool for premature infants. All information of Brazelton NBAS will be mentioned in Chapter III .

3. Environment factors for the growth and development of premature infants

Though the survival rate of 3 groups of premature infants, comprising the extremely very low birth weight, very low birth weight and low birth weight groups, are going to increase, but after birth the percentage of development delay and neurosensory deficits of infants are at 25 and 45 in respective (Gardner, et al., 1989: 663). Other problems resulting from surrounding environment (Gottfried & Gaiter, 1985, Gardner, et al., 1989: 630) are failure to thrive, child abuse and neglect, learning disabilities, visual-motor impairment, speech problems, emotional disturbance, difficulties with self-esteem, and school performance deficits, the severe problem (Als, 1997: 964). Those problems interrupt the development of immature central nervous system and the growth and development of infants and also cause health deviations (Schanberg & Field, 1987: 1431).

The fetus receives the supportive environment that benefits the growth and development. Naturally, they also receive the sensory stimulation continuously (Blackburn & Vanden Berg, 1993: 1101). In the third trimester of pregnancy, the fetus receive significant auditory stimulation through the rhythmic noise of his /her mother's circulation, bowel sound, and extraneous sounds. They also receive tactile, vestibular and kinesthetic stimulation from the movement of mothers and fetus. Those sensory stimulation develop the central nervous system.

Having been exposed to a new unfamiliar environment, it is difficult for premature infants to manage surrounding environments particularly in neonatal intensive care units (NICU) (Blackburn & Vanden Berg, 1993: 1101, White-Traut, et al., 1993: 393, Premji & Chapman, 1997: 107, Kurdahi Zahr, 1998: 29). Outcomes of study stated that NICU environment is the factor of infants' abnormal development. The study of Gottfried and colleagues (Gottfried, et al., 1984, Gottfried & Cornell, 1976 cited by Blackburn & Vanden Berg, 1993) indicated the effect of NICU environment to premature infants as follows:

1. sensory stimulation such as tactile, vestibular, kinesthetic and auditory is not provided to infants.

2. Infants receive inappropriate sensory stimulation.

3. The rush hours and activities in NICU make infants stress and provide overload sensory stimulation. Stress affects hypothalamus function, causing adverse effects on growth, heat production, and neurologic mechanisms (Gunderson & Kenner, 1987 cited by Wong, 1995: 382).

According to Blackburn & Vanden Berg (1993), there are 2 categories of NICU environment. The first is physical or inanimate environment, the second is social or animate environment. The 2 main components of physical or inanimate environment are light and sound, while the nurse is the only component of social or animate environment.

Light is a danger to the health of premature infants particularly in NICU where they frequently have continuous 24 hour exposure to fluorescent or cool-white light. The study of Gottfried (1985 cited by Sweeney, 1993: 14) indicated an average illumination level in NICU to be 530 lumen/m2, peaking during the midafternoon. Glass and colleague (1985) reported a 5-to 10-fold or 60-80 foot-candles increase in light intensity in hospitals and may be as high as 400 foot-candles. It is found that a significant increase in retinopathy occurred in premature infants at less than 1,000 grams who were continuously exposed to high illumination (Fielder, et al., 1992). Ambient-light exposure also causes an increase in free radicals (Reynold, et al., 1998: 1976). Light will harm the sleep state and biorhythms in infants (Glass 1985;Becker, et al., 1993). Bright light was associated with significantly greater amounts of active-REM sleep. Active-REM is regarded as a relatively destabilized state with fluctuations in heart rate, blood pressure, brain metabolism, and oxygen saturation. In animal models, altered endocrine function, delayed gonad development, chromosomal breakage, hypocalcemia, cellular transformations were attributed to the bright lights (Blackburn & Vanden Berg, et al., 1993: 1,103; Sweeney, 1993: 15). It is found a significant reduction in the occurrence of patent ductus arteriosus among premature infants whose chests were shielded from exposure to phototherapy light (Rosenfeld, et al., 1986).

Regarding the study of Mann and colleague (1986) on the topic of "Effect of night and day on preterm infants in a newborn nursery: randomized trial", there were 41 samples of which 20 infants were in the experimental group and 21 infants were in the control group. The duration of experimental process was 19 days. From 7 p.m. to 7 a.m. the experimental group received dimmed light. The outcomes showed an increase in weight gain, a longer period of sleep and decreased feeding time in the experimental group. The study of Wilcox (1995) and Becker and colleague (1991, 1993) support the previous finding stating that the decreased level of light in NICU is not only causing an increase of weight gain, a longer sleep period, and improvement of feeding ability, but also minimizes stress of infants and increases appropriate behavior, resulting from the capacity of infants to manage for the balance.

Realizing the importance of light in NICU will benefit the normal development of premature infants. According to Wilcox (1995:50), Graven and colleague (1992: 169) there are 3 protocols of implementation:

1.light was reduced between 7 p.m. and 7 a.m. with the installation of dimmer lights creating a night and day pattern;

2. Incubator covers were also used to adjust lighting;

3.Modify the intensity of lighting to mimic natural day-night cycles during nursing activities.

Regarding **sound**, high levels of noise harm the cochlea in the ear canal causing loss of hearing, and the change of physical and behaviors of infants. It also disturbs the period of sleep, causing a chronic illness, an increase of intracranial pressure and blood pressure, a decrease of oxygen saturation, apnea, negative interaction between caregivers and infants, and effects the hearing and development of infants afterwards (Kurdahi Zahr, 1995: 180, 1998: 29). The study of Long and colleague (1980) showed the supportive outcomes and found that if infants received level of noise at 80 dB for 7 days long, the period of sleep will be disturbed, causing an increase of intracranial pressure and heart rate. The study outcomes of Abramowich and colleague (1979) also stated that a noise level at 80 dB not only caused hearing loss premature infants at 24-28 weeks gestational age but it is also effected the hearing of adults as well.

McCarthy and colleague (1991 cited by Pope, 1995: 292) cited excess noise as a stress for premature infants. Noise was shown to cause a stress response that increased serum adrenaline, cortisol and ACTH, and decreased growth hormone. Noise suppressed the lymphocyte function and altered inflammatory response (Collins & Kuch, 1990 cited by Pope, 1995: 292). In 1974 the United States Environmental Protection Agency imposed the standard value of noise in hospital at 40-45 dB during daytime and less than 35 dB at nighttime.

Many studies on the noise level in hospitals found that normally the level of noise in hospital at daytime and nighttime averages at 50-80 dB or is as high as 118 dB with low frequencies. The level of noise increases sharply in the critical period of infants. In 1994, the American Academy of Pediatrics, in 1994, controlled and imposed noise levels in NICU not exceed 58 dB. Naturally, the level of noise from nursing activities surpassed 52 dB resulting from the following implementation (De Paul & Chambers, 1995: 74).

Activity	**dB**
Full bottle of formula placed on bedside table	75.3
Storage drawer closed	69.8
Orogastric package opened	71.3
Empty feeding syringes tossed in plastic waste can	55.8
Chair moved across floor	62.0

Activity	**dB**
Running water	54.2
Medication drawer closed	58.9
Medication pump sounding an alarm	57.5
Oxygen disconnected from wall	55.0
Ringing telephone	49.7
Cardiac monitor sounding an alarm at 70% volume	65.8
Cardiac monitor sounding an alarm at 30% volume	55.4

Thus, minimizing noise at the standard level in NICU is very important to premature infants. The study of Kurdahi Zahr and Traversay (1995) on premature infant responses to noise reduction by using earmuffs, (infants were at 480-1,860 grams and 23-36 weeks gestational age) found that earmuffs reduced the intensity of noise by 7-12 dB. When infants wore the earmuffs, they had significantly higher mean oxygen saturation levels and less fluctuation in oxygen saturation. Furthermore, these infants had less frequent behavioral state changes, and spent more time in the quiet sleep state.

Data mentioned above indicates that protocol of noise level reduction in NICU is most beneficial to premature infants. Those activities (Graven et al., 1992: 167; Sweeney, 1993: 17; Wilcox, 1995 : 50) include :

1. Encouraging staff to speak more quietly and away from the bedside during rounds;
2. Removing radio and centrifuge from infants. Turn down telephone to the lowest audible settings;
3. Turning down the alarm volume of equipment;
4. Providing knowledge for protecting infants from harm to caregivers and parents;
5. Providing quiet time hours to infants.

The study of Gray and colleague (1998: 35) found that it would be better to provide quiet time hours to premature infants 3 times a day. Quiet time was defined as a 2 hour period during each 8 hours shift. Quiet time hours were 12 noon to 2 p.m. (day shift), 8.30 p.m. to 10.30 p.m. (evening shift), and 3 a.m. to 5 a.m. (night shift). Having received quiet time hours, premature infants show progressive and rapid development, and shorter days on mechanical ventilation and hospital stay.

The **social environment** is the caring methods of premature infants under the administration of nurses as most of infants or 81-94 percent are treated by nurses activities and medical treatment. Browne (1992 cited by White-Traut, et al., 1994: 398) reported the amount of time per day that infants hospitalized more than 60 days in an intermediate care nursery spend interacting with people. 70 percent of the day's total interactions were spent with nurses, 8.1 percent with parents, 4.5 percent with physicians, 6.5 percent with respiratory therapists, and 0.4 percent with physical or occupational therapists.

Normally, the frequency of physical handing of infants in neonatal intensive care during a typical 24-hour day has been documented at 130 times (Wolk, 1987: 987; Sweeney, 1993: 17) or 2 fold of nursing activities provided to premature infants who are at an early recovery from illness. An estimate of time when infants received activities under nursing care are 18-30 minutes at time (Gottfried, 1984: 293) compared with the period of 4.6-19.2 minute a time without nursing care (Wolke, 1987: 987). Gorski and colleague (1983) also found that after completing an intervention, the nurse still stays with the infant for a while. Nurses spend a mean of 85 seconds in the immediate infants care area for ill infants and a mean of 45 seconds for intermediate grower infants. Those activities interfered with the adaptation of infants (Blackburn & Vanden Berg, 1993: 1,104) and changed their state of behavior. The percentage of oxygen saturation, cardiac, apnea are 83, 93 and 38 respectively (Murdoch, 1984). Moreover, during that time infants also received various inappropriate visual, auditory and tactile stimulation.

The outcomes of Gottfried and colleague (1984) mentioned on 2 main topics which are composed of:

1) **premature infants stimulation**, most of infants are under routine care which causes them pain and stress. Those activities include suctioning,

diapering, changing positions, bathing, inserting nasogastric tubes and feeding (McGrath & Conliffe - Torrese, 1996: 375). High and Gorski (1985 cited by Dixon, 1992: 98) also discovered an absence of temporal contingency between the sleep or awake state of infants in an NICU and the onset of either medical or custodial care.

2) **nursing activities;** 30 percent of the total nursing activities included rocking, embracing, touching and talking with infants, and while 50 percent of the total nursing activities involved talking and comforting infants without touching. Anderson (1986: 21) believed infants who received tactile stimulation from blood test, injection, intravenous tubes, and other procedures will feel pain rather than satisfaction.

Routine nursing activities implemented by medical models less responsive to infants' need, aiming for the survival of infants rather than attention to the afterward growth and development of infants (Gorski, et al., 1990: 104), enhance the increased tension of infants (Wilson & Broome, 1989: 277). Infants, therefore, must adapt and organize neurobehavioral to be in balance in order to respond to stimulants.

Vanden Berg (1990 cited by Yecco, 1993: 61) identified the following 3 objectives for the implementation of developmental appropriate nursing activities:

1.to alter the environmental, treatment, and caregiving events that cause stress and interfere with physiologic homeostasis;

2.to promote neurobehavioral organization by identifying and enhancing stable behaviors and reducing the incidence of stressful behaviors to support the emergence of maturation, energy conservation, and eventual recovery from acute illness; and

3.to promote parental understanding of infant behavior and to give parents a role with their infant even at very early stages of development.

Thus, nurses should manage and organize a new nursing system and implementation by providing appropriate activities to each infant rather than stated on medical models. Be careful to provide a quiet time period and adjust individual environment to suit the infant without the extra sensory stimulation to promote infants' self regulatory management.

The conclusion is NICU component both in physical and social environment are the utmost influential factors for the growth and development of premature infants. Caregivers, therefore, must organize appropriate and the best environment to infants. Those environment will reduce infants' stress, support the very early recover from illness without any complication or sequelae (Beckman, 1997: 56), and promote the mature function of the central nervous system that benefits the normal growth and gradual development of premature infants (Als, et, al., 1994: 853). Vanden Berg (1990 cited by Yecco, 1993: 63) outlined 10 commandments for stress avoidance in the NICU that can be used as a guide by nurses and parents for the behavioral and developmental support of the premature infants:

1. Protect infants from the environment by reducing light, noise, and activity around the bedside;

2. Position infant to avoid supine posture and to promote prone, tucked postures;

3. Handle in ways that allow recovery to calm state after each segment of caregiving event;

4. Handle in ways to avoid stressful reactions such as flailing, arching, fluctuating heart, respiratory rates, and Tcpo2;

5. Wrap body; hold hands or feet alone if body is not wrapped. Provide suck and grasping opportunities;

6. Provide stable, consistent routine that all caregivers implement in a similar way;

7. Provide consistent caregiver for familiarity and predictability of handing, positioning, touch, or other sensory experiences;

8. Contain infant with hands or wrapping or placing rolled blankets around his or her body; maintain containment during procedures and caregiving events;

9. Adjust daily routines so that they are offered at the best time for the infant and in conjunction with appropriate state changes;

10. Be aware and responsive to subtle cues that indicate readiness, impending disorganization, or stability.

4.Sensory stimulation program

In the past premature infants received careful nursing in the incubator with the principal idea being to provide infants with protection from infection, to keep warm, and fewer disruption for long periods of sleep. But animals studied found that those procedures do not stimulate the central nervous system and also causes abnormal behavior compared with an orderly progression of structure and function in animals that received sensory stimulation (Parmelee & Sigman, 1983 cited by Thomas, 1990)

The study of Gottlieb (1971, 1976 cited by Korner, 1990: 175) found that genes give rise to structural maturation processes, but sensory stimulation enhances the functional maturity of the nerve system. It is of interest that stimulation on one sensory system can include the function of sensory systems that are about to develop. Schultz (1965 cited by Thomas, 1990: 261) stated that infants will have positive interaction having received appropriate stimulation.

Als (1982) found the supportive outcomes confirm that premature infants can adjust their self-control system if they receive the suitable sensory stimulation from the environment. It can be seen through behaviors such as regular respiration under the control temperature of the incubator. Als also mentioned that the environment management ability of infants is based on the relative function of 5 subsystems which are composed of the autonomic system, motor system, state-organizational system, attention and interaction system, and regulatory system. Those subsystems work completely in full-term infants, but premature infants represent a major and abrupt disruption of this process. The limitation in sending and retrieving data of axon and dendrite slowdowns the central nervous system function and causes the deficit of 5 subsystems.

Many studies found that the organization of sensory stimulation by providing a similar environment premature infant received when they were a fetus (comprising of auditory, tactile, vestibular/kinesthetic and visual) is the best and most effective method for the promotion and well-functioning of the 5 subsystems to mature as full-term infants. Premature infants, therefore, can manage and adjust themselves for the growth and development (Masi, 1979; Harrison, 1985; Linn, et al., 1985; Field, et al., 1986; Korner, 1990; Gorski, 1991, Mueller, 1996; White-Traut, et al., 1994, 1997; Feldman, 1998).

Auditory Sensory Stimulation, The human auditory apparatus is structurally complete and physiologically functional at 24 weeks' gestation. Fetal movement responding to auditory stimuli begin as early as 26 weeks' gestation (Aristotle, 1983: 339). The study of Monod and Garma (1971, cited by Aristotle, 1983: 339) supports that cortical evoked auditory responses have been documented from 25 weeks' gestation. With increasing age the complexity of the wave responses increase as mesured by the brainstem auditory evoked response monitor. Responses of infants at 30-31 weeks gestational age can be seen through behaviors such as motor response (29%), eyes blinking response (5%), and increase of heart rate.

Naturally, in utero, sounds that the fetus received can be conducted through fluid or bone (Aristotle, 1983: 339) at an average level of 85 dB with low frequency. Murooka (1974 cited by Linn, et al., 1985: 408) stated that intrauterine sound environment makes the fetus calm especially the mothers' voice that the fetus can remember well. But extrauterine sound environment with the high level of sound makes the infants stressed. Each infant has different behaviors in responding. Regarding the study on behaviors responding to sound, it was found that infants will open eyes, move their heads and increase their heart rate, if they received a long period with low frequency of sound. According to the study of Bazelton (1994: 294), a series of 2 regular steps of the neonate's behavioral response to an appropriate sound are respectively composed of step I) an increase of heart rate with extremities movement; step 2) brighten face, heart rate decrease, slow breathing and searching for the source of the sound. Those 2 steps expressed the infants' capacity to organize central and autonomic nervous systems.

Objectives of auditory sensory stimulation aim for the relaxation, calm, and sufficient rest of infants. Many procedures of auditory stimulation such as voices of parents and nurses, lullabies, classical songs and music can be done without limitation, but be aware about the level of sound causing stress to infants. According to Robeck (1978: 156), soft, low-pitched lullabies and particularly the human heart tones produce decreased activity and decreased crying in the infants. Infants will be calm if they are stimulated by various rhythms of voices that they have learned to listen since they were a fetus (Kenner & McLaren, 1993: 344).

Kramer and Pierpont (1976: 299) found that auditory stimuli consists of low-pitched, variable sounds (85-95 dB) that originate from the maternal cardiovascular and digestive systems. The outcomes of study of 20 premature infants at less than 34 weeks gestation who received appropriate auditory stimulation showed the increase of weight gain and head circumference. Puakvilai (1986) studied the topic " Effect of musical stimulation to the growth of 24 premature infants at 30-32 weeks' gestation". Throughout the 3 weeks, musical tape recording were played to Infants 2 times a day (15 minutes per time). Evaluation at each week found the average body weight of the experimental group higher than a group of control.

Fifer and Moon (1994) studied the topic of "The role of mothers' voice in the organization of brain function in the newborn". They played a recording of the mother's voice to infants. Newborn infants prefer the sound of the maternal voice, they showed heart rate deceleration in response to speech sounds. The study of Katz (1971) randomly assigned 6 premature infants from 28-32 weeks' gestation to either an experimental or control group. Infants in the experimental group who were exposed to taped recording of their mothers' voice for stimulus, 6 times a day until 36 weeks postconceptual age, had better response to visual and auditory stimuli compared with the control group.

Segall (1972 cited by Harrison, 1985) employed the same intervention with 60 premature infants (28-32 weeks gestational age). At 36 weeks postconceptual age the infants demonstrated greater responsiveness to auditory stimulus, and greater decrease in heart rate when exposed to their mothers' voices. Chapman and Molloy (1979 cited by Harrison, 1985) reported on two different aspects of a study in which a total of 153 premature infants (from 26-33 weeks' gestation) were exposed to two different types of auditory stimulation. Infants in the first experimental group were exposed to a taped recording of Brahm's lullaby for 5 minutes, 6 times a day. Infants in the second group were exposed to tapes of their mother's voice for 5 minutes, 6 times a day. Infants in a control group were exposed only to the usual noise in the NICU environment. The study of the three groups started when the infants were 5 days old and continued until they reached a weight of 1,800 grams. The results showed infants in the first group gained weight faster than infants in the other groups. Molloy followed the infants until they were 9 months old, and reported that infants in both experimental groups were discharged 6-9 days earlier, and had higher scores on the Bayley test at 9 months than infants in the control group.

Chaze and Ludington-Hoe (1984: 70) stated that the parents' voice stimulated the function of the left hemisphere of the brain on skill and language of the infants, while music stimulated the work of right hemisphere of the brain on intellectual and emotional behavior of infants. Moreover, calling infants by name enhanced recognition of self, and capture their attention.

In this study, I prefer to use a musical toy instrument with the noise level at 60-65 dB based on the belief that a musical toy instrument not only stimulates the central nervous system of premature infants but also controls the autonomic nervous system (Rodbun, 1975: 2). The previous study found that music effects to blood circulation, decreases oxygen, metabolism, and anxiety (Cook, 1981), and stops infants' crying.

Lind (1980) stated that music influences the fetus. When mothers listened to music using headphones, the heart rate of the fetus increased in 2 minutes. When placing the sound box on the mothers' abdomen directly to utero, the fetus movement and heart rate increases in 5 seconds. Music also effects the growth of other animates such as trees which grow rapidly. Thus, auditory stimulation by music is the best way due because music is the universal language, and good for feeling expression.

Tactile Sensory Stimulation, tactile or touch is a human basic need, the first sense to mature and be developmentally relevant (Morris, 1994: 286). Infants have received tactile sensitivity since they were a fetuses. A response to touch around the mouth occurs in the fetus as early as 2 months after conception and provides the first evidence. This response is a precursor to the rooting reflex (Haith, 1986: 158). Touch is one such universal and basic component, and has been described as the first and most fundamental means of communication (Barnett, 1972) delivering the simplest and most straight forward of all messages. According to Jay (1982), touch is the utmost necessity for the learning of infants. Tactile stimulation is the first to complete myelinization in the infants, followed by the auditory and visual senses (Kolb, 1959 cited by Weiss, 1979: 77). Cusler (1965 cited by Weiss, 1979) found that infants who received an extra 20 minutes of handling each day demonstrated a greater visual attention than those not handled for that 20 minutes.

Regarding the mechanics of the central nervous system, having been stimulated with tactiles, the nerve pathways, comprising of nerve cells, myeline, and synaptic structure (Weiss, 1979: 76), transmitted the nerve impulse to stimulate reticular formation of brainstem and hypothalamus (Ratanaopas, 1988). Pituitary glands that produce somatotrophic hormones was also stimulated, making and enlarging numberical tissues which is the main factor of infants' weight gain.

According to the study of Alasmi, Pickens, and Hoath (1997) on the "Effect of tactile stimulation on serum lactate in the newborn rat", 250 rats (postnatal 0-7) were exposed to a standard of stroking the dorsum with a soft camel hair brush for 30 strokes every minute for 10 minutes. The measurement of serum lactate was shown to increase the lactate level at 207 percent in newborn rats. Thus, tactile stimulation, causing the increase of lactate, an important metabolic fuel for the developing brain, is the most necessary for the growth and development of infants.

The study of Kuhn and colleague (1991) entitled "Tactile-kinesthetic stimulation effects on sympathetic and adrenocortical function in preterm infants", included 40 premature infants (mean gestational age 30 weeks, mean birth weight 1,176 grams) of which the control group was comprised of 14 female and 6 male. The experimental group consisted of 11 female and 9 male infants who received tactile-kinesthetic stimulation for three 15-minute periods at the start of 3 consecutive hours each day for 10 days. Urine test for norepinephrine, epinephrine, dopamine, cortisol, and cretinine was showed as significant increase of norepinephrine and epinephrine values only in the stimulated infants. Tactile-kinesthetic stimulation that enhances weight gain and development in premature infants has specific effects on maturation and/or activity of the sympathetic nervous systems, and also facilitates the normal developmental rise in catecholamine excretion.

The study of Field and colleague (1986), who conducted similar research to Kuhn, found that infants in the experimental group can receive quantities of milk. 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 control infants. Their hospital stay was 6 days shorter, yielding an estimated $3,000 cost savings of each infant . This data suggests that tactile-kinesthetic stimulation is a cost effective way of facilitating growth and behavioral organization even in very small premature infants. The research outcomes of Rausch (1981) supported that tactile-kinesthetic stimulation improves feeding ability through vagal stimulation that promotes peristalsis and expulsion of waste products, thereby decreasing gastric retention and abdominal distention.

According to the study of Weiss (1979), Harrison and Woods (1991), appropriate tactile stimulation should be concentrated on the following issues.

1. **Duration of touch** is the temporal length of the touch from initiation of interbody contact by one individual to cessation. Shorter or longer durations of touching will have harmful effects. Infants feel calm when they are tounched 2-3 time periods at an early period, but having received more than 5 periods of touching, the sensory stimulation was evoked resulting in the muscle relaxation of infants. Jay (1982) who evaluated the effects of gentle human touch on 13 premature infants between 28-32 weeks' gestation mentioned that it may take several minutes for a premature infant to integrate a tactile stimulus.

2. **Location of touch** is the areas of the body contacted by the person who is touched and encompassed three dimensions as follows:

2.1 **Threshold** is an individual's sensitivity to touch, which varies according to part of the body touched. For example, infants are generally more sensitive or have a lower threshold to touch on the right than the left side of the body. Also the face is heavily innervated and thus is extremely sensitive, but the arms are less sensitive.

2.2 **Extent** is the number of areas of one's body, which are touched in relation to the number of areas available to be touched over the entire body surface. An individual who receives body contact from others over most body areas, in contrast to only a few areas, generally feels greater attraction, to other persons and possesses an accurate perception of the form and shape of his/ her body.

2.3 **Centripetality** is the degree to which the trunk of the body is touched rather than the limbs.

3. **Action of touch** is the rate of approach to a body surface with the attendant amount of physical energy exerted in the onset of a tactile act. An abrupt approach to one's body causes an actual muscular resistance, encouraging a different degree of discrimination in neural representation than is found in gradual action. The study of

Weiss (1992) comprising of 24 full-term infants in their first 6 months of life, hospitalized for congenital heart disease howed that gentle and gradual stroking help to produce muscle relaxation and comfort. The heart rate and systolic blood pressure decrease. It all has positive affects on the psychophysiology and behaviors.

4. **Intensity of touch** is the extent of indentation applied to the body surface by the pressure of the touch. Rice (1985 cited by Harrison & Woods, 1991: 300) recommended preliminary light tactile stimulation of premature infants in the area of the body where a procedure would be performed.

5. **Frequency of touch** is the overall amount of touching which an individual experiences. Frequency of touch affects the metabolism; intestinal motility; and glandular, biochemical, and muscular changes. High frequency of touch promotes the positive value for linking of self, awareness of one's body, a sense of closeness with others, increased cognitive and emotive ability.

6. **Sensation of touch** is the immediate comfort or discomfort reaction of the skin to a touch, with specialized reception and transmission of these sensory impressions to the brain. Painful tactile stimuli or

discomfort sensation distort the body image by preventing adequate functioning of the body's perceptual system, while pleasurable tactile interaction allows for maximal discrimination, providing vital information for development of a positive and stable cathexis of one's body as a worthwhile and valuable part of the self.

The conclusion is that the perception and response of infants to tactile stimulation is based on the ability of the skin sensation and central nervous system of each individual. Touching at the areas with afferent sensory fibers should be better and will produce better perception. It is true that tactile stimulation is the most important for the growth and development of premature infants.

There are various patterns of tactile stimulation. The best pattern that I select to use in this study is the pattern of Field and colleague (1986) which is easier and more practical. The details of tactile stimulation will be mentioned on chapter III.

Vestibular and Kinesthetic Stimulation, Harrison (1985) collected research study related to vestibular and kinesthetic stimulation of premature infants, those were composed of the study of Neal (1969), Korner and colleague (1975, 1978, 1983), Jone (1981), Tuck and colleague (1982).

Neal provided vestibular stimulation, an oscillating hammock, to 31 premature infants for 30-minute periods three times a day, beginning after birth and continuing until the infants were 36 weeks postconceptual age. The results showed that the experimental infants had greater weight gain, greater motor and general maturity, and greater visual and auditory responsiveness at the end of the intervention period when compared with the group of control.

The study of Korner and colleague, examining the effect of an oscillating water bed, found that exposure to an oscillating water bed resulted in decrease apnea and improved orientation and motor maturity. Moreover, the study of Jones, found that treatment on the non-oscillating waterbed was associated with less apnea.

Deiriggi (1990), conducting the research on the "Effect of waterbed flotation on indicators of energy expenditure in preterm infants" of which subjects were 22 healthy premature infants in NICU who had 31-35 weeks postconceptional age and whose average weight was 1,482 grams at onset of the study, found that nonoscillating waterbed flotation is a simple, cost -effective intervention that reduces energy expenditure.

Tuck and colleague who exposed 12 premature infants with apnea to periods of bed rocking, found that all infants had decreased apnea, bradycardia, and hypoxia when the bed was rocking.

From the supportive data mentioned above, there are many patterns of vestibular and kinesthetic stimulation such as placing infants on a water bed, changing position, flexion and extension of extremities, knees and hips. This helps regulate respiratory function, encourages memory development, enhances grasp reflex, promotes self-stimulation of bringing objects within visual field. Exercising increases myelination and muscle growth and control (Chaze & Ludington-Hoe, 1984: 71). It is clear that vestibular and kinesthetic stimulation is the most important to premature infants.

In this study, vestibular and kinesthetic stimulation is done by flexing and extending of extremities for 5 minutes according to the patterns of Field and colleague (1986). Due to the ease of practice without any cost, the successful results are at the same level of other patterns do vestibular and kinesthetic stimulation .

Visual Stimulation. Anatomically, all the neurons of the visual cortex are present by 25 to 26 weeks' gestation (Aristotle, 1983: 338). Infants can see faces and objects when they are presented in a range of his/her best focal distance, 8 to 12 inches (Dixon, 1992: 68; Kenner & MacLaren, 1993:44), especially geometric shapes such as squares, rectangles, or circles roughly 3 inches in diameter. Black and white images hold the neonates' gaze longer that color images. Incomplete muscle control of ocular movements for the first 4 weeks after birth sometimes causes transient strabismus. Visual acuity improves quickly; by age 6 months, adult level visual acuity is achieved.

Sigman and colleague (1973 cited by Brazelton, 1994: 294) who conducted a long- term study on the visual behavior of infants, found that visual behavior may be one of the best predicators of an intact CNS in the neonate. Tronick and Clanton (1971 cited by Brazelton, 1981: 337) demonstrated the relationship of head and eye movements and found that when infants were in an upright position both head and eyes became aimed at the target. When infants moved his/her line of sight from one target to another, the eyes typically moved first, with a rapid saccadic shift, followed by a slower head movement. Thus, there are the relational function of head and eyes under the cortically controlled visual system since after birth. However, in the group of full-term infants the function is better than premature infants.

Sigman and Parmelee (1973) found that premature infants spent more time looking at visual stimuli than full-term infants. Friedman (1981 cited by Aristotle, 1983:339) found that premature infants look longer to fixate on a stimulus and also longer to decrease their response. An early state of visual stimulation organization, therefore, is best for the functional development of vision.

Many objects that can stimulate the visual function are composed of mobiles, pictures, fabric, posters, light pastels, and colors. Those should be the moving objects with light placed within visual range and en face position as infants lie prone (Chaze & Ludington-Hoe, 1984: 68). If the moving object can be moved slowly parallel to the natural, lateral movements of the eyes, it is more likely to capture the baby's interest (Brazelton, 1981: 338).

In the past, most of the research study on visual stimulation was always conducted with other stimulations such as tactile, vestibular and auditory stimulation. It still leaves several unanswered questions whether providing only visual stimulation is enough for premature infants. Regarding neonatal behavioral assessment scale (Brazelton, 1995), in case of infants who received visual stimuli with a bright light, it was found that when a bright light is flashed into a neonate's eyes, not only do his/her pupil constrict, but he/she also blinks, his/her eyelids and whole face contract, and he/she withdraws his/her head by arching his/her whole body, often setting off a complete startle as he/she withdraws. Visual stimulation is one of the most important stimulation for premature infants. Having received such stimulation, infants have much more attention and interest. Moreover, holding infants face to parents strongly reinforces parent-infant bonding (Moore, 1981: 225). Thus, in this study, I prefer the en face position for 1-2 minutes, range at 8-12 inches.

Apart from the above stimulation, another stimulation is done in the form of **Nonnutritive Sucking,** a natural activity of premature infants. According to Freud Psychoanalytic Theory, sucking of infant is not only for eating, but also the way to express his/her emotion and behavior (Pilliterri, 1981: 65). Many researches on nonnutritive sucking mentioned that sucking and swallowing accelerated the maturation of the sucking reflex, comprising the increase of well functioning of salivary gland, and facilitating a more rapid transition from gavage to oral feeding, the decrease of intestinal transition time, the rapid increase of weight gain and a shorter hospital stay (Field, et al., 1982; Bernbaum, et al., 1983; Field, 1986; Gill, et al., 1988; Pickler, et al., 1996).

Apatirapong (1990) conducted a research on the effect of nonnutritive sucking during tube feeding in premature infants of which 20 premature infants (< 34 weeks with < 1700 grams) at Maharat Nakhonrajsima Hospital are separated to 2 groups of treatment and control. Results showed that the treatment group who received nonnutritive sucking during tube feeding for 10 days increases their weight gain and have the maturation of the sucking reflex. The percentage of gastric contents is less than the control group.

In Thailand, the study in such topic is limited due to the policy of Ministry of Public Health stating on the promotion and campaign on breast feeding. Thus, the maternal-child friendly hospitals under the government ban the use of pacifier in neonatal. Also in my study, the use of pacifier is not included in sensory stimulation program.

Realizing the most important of all sensory stimulation which are composed of auditory, tactile, vestibular/kinesthetic, and visual stimulation, and due to the conclusion that multi-modalities sensory stimulation program are more suitable for premature infants rather than a single sensory stimulation, I, therefore, plan to provide such multi-modalities sensory stimulation program to premature infants who are the sample in my research study entitled a comparative study in the growth and development of premature infants between groups of control and treatment under the multi-modalities sensory stimulation program.

CHAPTER III

METHODOLOGY

This research study was a quasi-experimental research, aiming to compare the growth and development of premature infants between the control group and the treatment group under the multi-modalities sensory stimulation program.

Population and sampling

Population

The population in this study were premature infants in the Premature Infant Unit at Queen Sirikit National Institute of Child Health, and Special Care Nursery at Ramathibodi Hospital.

Sampling criteria

Due to the purposive sampling, the qualification of premature infants in the **inclusion criteria** were composed of:

1.postconceptual age of 32-36 weeks;

2. body weight at 1,400-1,800 grams;

3. age of 4 days up and clinically stable;

4. not receiving oxygen therapy or intravenous replacement therapy;

5. absent of congenital anomalies and severe complication such as infection, necrotizing enterocolitis, respiratory distress and seizure disorder as confirmed by physician diagnosis;

6. no contraindication to stimuli;

7.mothers gave informed written consent for their infants' participation.

Under the **exclusion criteria** were infants who sepsis during the period of study or those under treatment by receiving respirator or oxygen therapy.

Duration of study

The period of study was from May to September, 1999. There were 40 samples due to the principal of Polit and Hungler (1983: 426-427) that the sample size should be at least 20-30 cases. For the case of comparison, the number of sampling in each group should not be less than 10 cases depending on research design. In this study, the sample size was calculated from the group number X variable X constant (10) = 2 X 2 X 10 = 40. The population was divided into 2 groups, of which 20 were the control group, and 20 were the treatment group.

Based on nursery statistics of Queen Sirikit National Institute of Child Health, and Special Care Nursery at Ramathibodi Hospital, the daily average of premature infants in the inclusion criteria were 5-7, and 3-4 respectively. 56 cases of premature infants were collected during the 5 months of study. 12 cases (Control group=9, Treatment group= 3) were dropped from the study because of infection and other complications. Those were composed of 4 cases of each necrotizing enterocolitis, ileus, early hydrocephalus, and conjunctivitis (MRSA), 2 cases of reintubation and on respirator, 3 cases of pneumonia, 3 cases of R/O sepsis. Thus, 44 cases were divided into 2 groups by the blind random sampling technique. Of which 19 (Premature Infant Unit at Queen Sirikit National Institute of Child Health = 14, Special Care Nursery at Ramathibodi Hospital = 5) formed the control group and 25 (Premature Infant Unit at Queen Sirikit National Institute of Child Health = 21, Special Care Nursery at Ramathibodi Hospital = 4) formed the treatment group.

Place of study

Two places of study with similarity of internal environment and nursing activities were composed of:

1) Premature Infant Unit at Queen Sirikit National Institute of Child Health that provided nursing care to 30 infants weighing less than 2000 grams at birth in the incubators. Open visiting hours was encouraged to facilitate parental visiting for an hour a day. When infants were in the incubators, mothers could touch them. After they were in the cribs, mothers could hold and feed their infants. Infants were

discharged from the hospital at minimum weights of 1800 grams after having demonstrated an ability to feed and gained weight adequately.

2) Special Care Nursery at Ramathibodi Hospital provided nursing care to 30 high risk infants which similar to the operational regulation as Premature Infant Unit at Queen Sirikit National Institute of Child Health.

Intervention Protocol

Multi-modalities sensory stimulation program, covering 5 steps for 15 minutes a day, modified from the sensory stimulation program of White-Traut and colleague, and Field and colleague, will be provided to the treatment group for 10 days. The 5 steps were as follows:

- Step I, playing melodeon musical toy instrument to premature infants for 10 minutes.

-Step II, providing tactile stimulation by gentle strokes through the areas of neck, upper back, both legs and arms, and head for a second at each area.

All activities in step 2 will be completed in 5 minutes including the following steps:

- from the area of the neck (12 strokes at approximately 5 seconds per stroke)
- from the neck to the waist (12 strokes at approximately 5 seconds per stroke)

- from the thigh to toe on both legs(12 strokes at approximately 5 seconds per stroke)
- from the shoulder to the hand on both arms (12 strokes at approximately 5 seconds per stroke)
- from the forehead to both ears(12 strokes at approximately 5 seconds per stroke)

- Step III, providing vestibular and kinesthetic stimulation by slowly flexing and extending both legs and arms. All activities will be completed in 5 minutes including the following steps:

- flex and extend the right arm(12times at approximately 5 seconds per time)
- flex and extend the left arm (12 times at approximately 5 seconds per time)
- flex and extend the right leg (12 times at approximately 5 seconds per time)
- flex and extend the left leg (12 times at approximately 5 seconds per time)
- flex and extend both legs (12 times at approximately 5 seconds per time)

- Step IV, providing visual stimulation by holding infants "en face" position, talking and making eye contact with infants for 1 minutes. This step will be done when infants are at alert state. If infants are crying, it has to wait till they stop crying.

- Step V, reproviding tactile stimulation similar to the second step.

Notes: 1) To avoid hypothermia, infants should be in the incubators while receiving sensory stimulation program.

2) The multi-modalities sensory stimulation program should be provided to infants for 30-60 minutes after feeding.

3) The record of heart rate, respiration rate and oxygen saturation should be done for 5 minutes before providing sensory stimulation program to infants, and keep on monitoring the record till finish the program.

4) All activities must be stopped in cases of:

4.1 infants' respiration rate is higher than 20 times per minutes of baseline, or apnea episode.

4.2 infants' heart rate less than 100 times per minutes, or higher than 200 times per minute, or 20 times per minute of baseline.

4.3 infants' oxygen saturation is less than 86 percent.

Tools of study

1. A stop watch which had been tested for validity with standard time.

2. A musical toy instrument with noise level at 60 or 65 dB, having been tested for level of sound by auditory research and study unit in Ramathibodi Hospital, was used to stimulate infants' auditory system. It must be placed respectively about 1 meter from infants' ears.

3. Growth measuring instruments including weigh scale in grams and measuring tape in millimeter for measuring body length, head and chest circumferences. The two scales will be used for measurement of infants growth throughout the duration of study.

4. Pulse oximetry of Nelcor, no.503 to measure heart rate and oxygen saturation, having been tested for reliability weekly by comparing with another one at equal value, will be used in this study.

5. Demographic data record form obtaining information on sex, gestational age, time-day of delivery, birth weight, body length, head circumference, chest circumference, age during the study, and age at the end of the study.

6.Daily data record form obtaining information on population sampling such as body weight, feeding, heart rate, respiration rate, and oxygen saturation from the first day of study until the end of the study.

7. Brazelton neonatal behavioral assessment scale was used for the evaluation by using such equipment as light, rattle, bell, heel-stick, and diaper.

Regarding the quality of Brazelton NBAS, it is the best tool to evaluate the infants' behavior. The use of NBAS is increasing in 38 countries in the region of Asia, Europe, Central and South American, and Africa. The NBAS is 2 part of assessment. Firstly, the infant's behavioral repertoire on 28 items, each scored on a 9-point scale. High score means the maturity and stability of infants. Secondly, the infant's neurological status on 18 reflex items, each scored on a 4-point scale. 2 point means normal response.

Those 2 assessments indicated the coping capacity and adaptive strategies of the infant, which become apparent as she/he recovers from the stress of labor and delivery and begins to adjust to the demands of the extrauterine environment during the first week of life. The score changes daily depending on how the infant manages the environment. Due to the fluctuation of the score, it is impossible to determine the validity-reliability of the score. However, measuring the behavior of the infant many times can increase the validate-reliability of the score.

Thus, it can be said that this tool is of quality and reliable for neonatal behavioral assessment. There are 2 major phases in the reliability training of examiners using the NBAS: (a) the training phase, and (b) the reliability phase.

Aiming for the fruitfulness of using the NBAS in this research study, first of all, researcher has to be trained by expert from Child Development Unit of Ramathibodi Hospital which affiliates to Brazelton Center for Infants and Parents in order to study the scoring criteria in the manual, and view the training film of Brazelton neonatal behavioral assessment, then attended an orientation session at Post-Partum Ward 2 in Ramathibodi Hospital. After acquiring skills to handle techniques for administering the scale, researcher tested this scale with 20-25 infants, then demonstrated the inter-observers reliability of assessment with expert trainers until receiving 90 percent level of agreement.

According to Brazelton neonatal behavioral assessment scale (NBAS), the first assessment in the infant's state is to find out what period of sleep (deep or light) and awake (drowsy, alert, eyes open or crying) that infant is in. After that the following assessment must be conducted:

1. The Habituation Package

- response decrement to light
- response decrement to sound (rattle)
- response decrement to sound (bell)

- uncover
- response decrement to tactile stimulation of the foot.

2. The Motor-Oral Package

- plantar grasp
- babinski response
- ankle clonus
- passive tone in legs
- passive tone in arms
- rooting reflex
- sucking reflex
- glabella reflex

3. The Truncal Package

- palmar grasp
- pull-to-sit
- placing reflex
- standing reflex
- stepping or walking reflex
- crawling reflex
- incurvation
- tonic deviation of head and eyes, and nysagmus
- cuddliness

4. The vestibular Package

- defensive movement
- tonic neck reflex
- moro reflex

5. The Social Interactive Package

- inanimate visual orientation-red ball
- inanimate auditory orientation
- inanimate visual and auditory orientation
- animate visual orientation
- animate auditory orientation
- animate visual and auditory orientation
- consolability

Apart from the 5 packages mentioned above, all details are indicated in Appendix C (NBAS Scoring Form).

Method of research and data collection

Data collection started after permission was secured from the Faculty of Graduate Studies, Mahidol University, according to the following steps:

1. Asking for permission to collect data by submitting the document from the Faculty of Graduate Studies, Mahidol University, to the Dean of Medicine Faculty, Ramathibodi Hospital, and the Director of Nursing at Queen Sirikit National Institute of Child Health.

2. To contact and ask for permission from the head nurse of Special Care Unit, Ramathibodi Hospital, and the head nurse of Premature Infant Unit, Queen Sirikit National Institute of Child Health, and to inform staff nurses on the research procedure.

3. Providing orientation and training on sensory stimulation program and data collection technique to 3 assistant researchers (1 at Special Care Nursery, Ramathibodi Hospital, and 2 at Premature Infant Unit, Queen Sirikit National Institute of Child Health). After that each assistant researcher will receive the intervention protocol and has to practice this program not less than 2 times. Observant evaluation was done by researcher.

4. Selecting the samples from medical record.

5. To protect the rights of samples by meeting with parents to inform objectives of the research and asking for their participation.

6. 44 samples were divided into 2 groups by the blind random sampling technique. 60 pieces of paper inside the closed envelope were picked by assistant researchers. 30 pieces of No.1 formed the treatment group, and 30 pieces of No.2 formed the control group. There was no bias in this research because researcher did not know which group each infant belong to.

7. Assistant researchers filled in a form of record on general data of samples, including data on the body weight, and the amount of feeding from the beginning to the end of the study.

8. Assistant researchers will take care of the 2 groups of samples. Only standard routine nursing activities such as bathing, feeding, diapering, weight measurement, temperature record, position changing, and sucking will be provided to the control group for 10 days. But the treatment group will receive both standard routine nursing activities and sensory stimulation program as mentioned earlier for 10 days. During the study, they also recorded the heart rate, respiration rate, and oxygen saturation of samples from the beginning to the end.

9. The evaluation of the growth assessment by measuring the body weight, body length, head circumference, and chest circumference of samples will be done by assistant researchers. The evaluation of the development assessment by using Brazelton NBAS will be done by researchers on the 11^{th} day of study .

10. During the first visit by the mother, researcher will build a good relationship with her and ask her to allow me for including her baby to the program. After the end of study, the researcher will demonstrate sensory stimulation program

to mothers of both groups and train each mother until she can do those activities by herself.

11. Statistic data analysis is the last thing to be done.

Data Analysis

Computerized data analysis by using SPSS/FW (Statistical Package for the Social Science for Window) were as follows:

1. To compare the characteristic of samples by t-test and chi-square.

2. To compare the increase of physical growth of samples at the end of study by using t-test.

3. Scores on mean and standard deviation of samples, resulting from using Brazelton NBAS, will be analyzed by using t-test statistic at the end of the study .

4. To compare mean and standard deviation in heart rate, respiration rate and oxygen saturation of samples at the 3 period of time (before, during and after receiving sensory stimulation program) by using t-test statistics.

5. Before analyze statistic data by t-test, the means of growth, development, and physiological change must be tested by Kolmogorov-Smirnov to find out the normal distribution.

CHAPTER IV

RESULTS

The results of data and statistical analysis of a comparative study in the growth and development of premature infants between the groups of control and treatment under the multi-modalities sensory stimulation program, a quasi-experimental research, are divided into 2 main parts. There are composed of the demographic data of the samples and the hypothesis testing results.

Characteristic of the samples

Samples were the 44 premature infants composed of 21 males (47.73%) and 23 female (52.27%) in the Premature Infant Unit at Queen Sirikit National Institute of Child Health, and Special Care Nursery at Ramathibodi Hospital. They were divided into 2 groups. The groups of control and treatment were composed of 19 and 25 premature infants respectively. The results of Chi-square test on sex showed there was no significant difference of statistic between the 2 groups ($p > .05$). When compared the characteristic of 2 groups on gestational age at birth, gestational age at study, age at study, body weight, head and chest circumference, body length, and quantity of feeding by t-test, it showed no significant difference of statistic as stated in Table 1.

Table 1: Comparison characteristic of 2 sampling groups by t-test

Demographic data of samples	Control Group(n=19)			Treatment Group(n=25)			
	Range	X	SD	Range	X	SD	t
Gestational age at birth (week)	(30-35)	32.53	1.47	(30-35)	33.08	1.38	1.28^{ns}
Gestational age at study (week)	(32-36)	33.79	1.23	(32-36)	34.28	1.28	1.28^{ns}
Age at study (day)	(4-15)	9.74	4.05	(4-15)	9.24	4.06	$.40^{ns}$
Body weight (g)	(1240-1800)	1573.68	149.67	(1200-1750)	1567.60	137.43	$.14^{ns}$
Head circumference (centimeter)	(25.5-31)	28.50	1.36	(26-31)	28.92	1.46	$.97^{ns}$
Chest circumference (centimeter)	(23-39)	24.82	1.43	(22-39)	25.32	1.87	$.98^{ns}$
Body length (centimeter)	(39-45)	40.50	1.52	(38-43)	40.46	1.47	$.09^{ns}$
Feeding quantity (c.c./Kg/day)	(15-42)	272.52	27.40	(15-45)	273.39	33.02	$.09^{ns}$
Sex	number	percentage		number	percentage		X^2
Male	9	47.4		12	48		$.76^{ns}$
Female	10	52.6		13	52		

^{ns} $p > .05$

Hypothesis testing results

Hypothesis I : The growth rate on body weight, body length, head circumference and chest circumference of the treatment group will higher than the control group.

The results of study showed that the body weight of the treatment group increased higher than the control group. But the body length, head circumference, and chest circumference of the treatment group increased at the lower rate when compared with the increase of body weight. Therefore, means of body length, head circumference, and chest circumference of the treatment group was lower than the control group. However, the outcomes of statistical analysis showed that there was no significant different of statistic between the 2 groups ($p>.05$) as stated in Table 2.

Table 2: Comparison the increase of physical growth of the 2 groups at the end of study by using independent t-test

Samples	Control Group (n=19)		Treatment Group (n=25)		t
	d	SDd	d	SDd	
Body weight (g)	293.68	78.19	296.40	62.58	0.03 ^{ns}
Head circumference (cms.)	1.92	1.00	1.54	0.79	1.75 ^{ns}
Chest circumference (cms.)	1.92	1.26	1.80	0.89	0.37 ^{ns}
Body length (cms.)	0.66	0.80	0.62	0.85	0.05 ^{ns}

^{ns} $p > .05$

Hypothesis II: The development of the treatment group will have more maturity than the control group.

The results of study showed that the mean score of 6 parts, covering social-interaction, motor system, state organization, state regulation, automatic system, supplementary items, in responding behavior of the treatment group was higher than the control group ($p<.05$, $p<.01$, and $p<.001$). But the mean score in part of habituation and reflex items between the 2 groups was not significant different ($p>.05$) as stated in Table 3.

Table 3 : Comparison mean of responding behavior of infants between the groups of control and treatment at the end of study by using independent t-test

Samples	Control Group		Treatment Group		t
	X	SD	X	SD	
Habituation	21.58	4.21	23.28	1.80	1.65^{ns}
Social Interaction	25.68	7.08	32.04	6.78	3.46***
Motor System	17.42	2.67	20.72	4.22	3.16*
State Organization	14.11	1.05	16.24	1.65	5.15***
State Regulation	13.00	2.77	15.92	3.98	2.73**
Autonomic System	11.00	1.05	12.24	1.48	3.10**
Supplementary items	30.68	1.63	33.60	2.61	4.53***
Reflex Items	30.16	1.61	30.96	1.84	1.51^{ns}

^{ns} p > .05 * p < .05 ** p < .01 *** p < .001

1. Habituation evaluates the infants' adaptation and capacity to shut out negative stimuli during the sleeping state. From this study, the ability to response decrement to bell of the treatment group was higher than the control group ($p<.05$) as stated in Table 4. However, statistical analysis outcome showed that there was no significant difference of statistic between 2 groups ($p > .05$).

Table 4 : Comparison mean of habituation item of infants between the groups of control and treatment.

Samples	Control Group		Treatment Group		t
	X	SD	X	SD	
Response Dec.- light	5.00	1.29	5.44	1.08	1.23^{ns}
Response Dec.- rattle	5.79	1.27	5.92	1.04	0.36^{ns}
Response Dec.- bell	5.79	1.36	6.56	0.82	2.19*
Response Dec.- foot	5.13	1.07	5.36	0.70	0.76^{ns}
Total	**21.58**	**4.21**	**23.28**	**1.80**	**1.65^{ns}**

^{ns} $p > .05$ * $p < .05$

2. Social-Interaction evaluates the ability of infants in responding and interacting to social and environment. The results of this study showed that the total mean of the treatment group was higher than the control group (p<.001), especially the ability in responding to animate auditory and to animate visual and auditory as stated in Table 5. Statistical analysis outcome showed that there was the significant difference of statistic between 2 groups (p<.001).

Table 5 : Comparison mean of social interaction item of infants between the groups of control and treatment.

Samples	Control Group		Treatment Group		t
	X	SD	X	SD	
Animate Visual	3.26.	0.99	4.36	1.25	3.14**
Animate Vis.+Aud.	4.05	1.13	5.48	1.45	3.55***
Inanimate Visual	3.37	1.01	4.08	0.95	2.39*
Inanimate Vis.+Aud	3.08	0.91	3.32	1.00	0.82*
Animate Auditory	4.58	1.22	5.68	0.56	3.67***
Inanimate Auditory	3.74	0.99	4.88	0.73	4.42**
Alertness	3.58	0.90	4.24	0.88	2.44*
Total	**25.68**	**7.08**	**32.04**	**6.78**	**3.46*** **

* p < .05 ** p < .01 *** p < .001

3. Motor System evaluates the movement and responding ability of infants. The results of this study showed that the total mean of the treatment group was higher than the control group ($p < .05$). But there was significant different mean between the 2 groups in part of the motor maturity. While the mean of general tone and pull-to-sit of both groups was not significant difference ($p > .05$) as stated in Table 6.

Table 6 : Comparison mean of motor system item of infants between the groups of control and treatment.

Samples	Control Group		Treatment Group		t
	X	SD	X	SD	
General tone	3.53.	0.77	3.88	0.97	1.30^{ns}
Motor maturity	4.16	0.69	5.04	0.74	4.05***
Pull-to -Sit	2.74	0.87	3.32	1.18	1.86^{ns}
Defensive	2.84	1.02	3.92	1.41	2.82**
Activity level	4.16	0.38	4.56	0.71	2.23*
Total	**17.42**	**2.67**	**20.72**	**4.22**	**3.16***

^{ns} $p > .05$ * $p < .05$ ** $p < .01$ *** $p < .001$

4. State Organization evaluates the infants' state performance ability. The results of this study showed that the mean of the peak of excitement, the rapidity of build-up, the irritability and the lability of state of the treatment group was higher than the control group ($p<.01$). Statistical analysis outcome showed that there was the significant difference of statistic between 2 groups ($p < .001$) as stated in Table 7.

Table 7 : Comparison mean of state organization item of infants between the groups of control and treatment.

Samples	Control Group		Treatment Group		t
	X	SD	X	SD	
Peak of excitement	3.84	0.50	4.36	0.64	2.92**
Rapidity of build-up	4.21	0.71	4.92	0.81	3.02**
Irritability	4.00	0.33	4.52	0.65	3.17**
Lability of states	2.05	0.23	2.44	0.50	3.09**
Total	**14.11**	**1.05**	**16.24**	**1.69**	**5.15*** **

** $p < .01$ *** $p < .001$

5. State Regulation evaluates the self-control ability of infants. It was found that there was the significant difference of statistic between 2 groups in part of cuddliness and consolability ($p < .01$). But there was not different between 2 groups in part of self-quieting and hand to mouth ($p>.05$). However, the total mean of the treatment group was higher than the control group ($p<.01$) as stated in Table 8.

Table 8 : Comparison mean of state regulation item of infants between the groups of control and treatment.

Samples	**Control Group**		**Treatment Group**		**t**
	X	**SD**	**X**	**SD**	
Cuddliness	3.58	1.02	4.88	1.45	3.36**
Consolability	3.79	0.98	4.96	1.80	2.57**
Self-quieting	4.26	0.73	4.72	1.06	1.61^{ns}
Hand-to-mouth	1.36	1.17	1.36	1.04	0.03^{ns}
Total	**13.00**	**2.77**	**15.92**	**3.98**	**2.73****

^{ns} $p > .05$ * $p < .05$ ** $p < .01$

6. Autonomic System evaluate the central nervous system function of the premature infants by examining from the ability of infants' physiological performance, covering tremulousness startles and lability of skin color. It was found that there was significant difference between 2 groups in part of tremulousness ($p<.01$). But there was no significant difference in part of startles and lability of skin color ($p>.05$). However, the total mean of treatment group was higher than the control group ($p<.01$) as stated in table 9.

Table 9 : Comparison mean of autonomic system item of infants between the groups of control and treatment.

Samples	**Control Group**		**Treatment Group**		**t**
	X	**SD**	**X**	**SD**	
Tremulousness	2.74	0.87	3.76	1.30	2.96**
Startles	3.42	0.51	3.54	0.51	0.77^{ns}
Lability of skin color	4.84	0.37	4.96	0.35	1.07^{ns}
Total	**11.00**	**1.05**	**12.24**	**1.48**	**3.10****

^{ns} $p > .05$ ** $p < .01$

7. Supplementary Items evaluates the infants' performance and subtle sign of state over the course of the examination that may not be captured by the standard scale items. From the study, it was found that the total mean of the treatment group was higher than the control group ($p < .001$), particularly examiner facilitation and state regulation. But in part of general irritability, there was no significant difference between 2 groups as stated in table 10.

Table 10 : Comparison mean of supplementary item of infants between the groups of control and treatment.

Samples	Control Group		Treatment Group		t
	X	SD	X	SD	
Quality of alertness	4.26	0.56	4.64	0.57	2.19*
Cost of attention	4.63	0.50	5.00	0.50	2.43*
Examiner facilitation	4.16	0.38	4.64	0.49	3.57***
General irritability	4.95	0.23	4.96	0.20	0.20^{ns}
Robustness/endurance	4.16	0.38	4.52	0.51	2.60*
State regulation	4.37	0.60	5.16	0.55	4.54***
E's Emotional Resp.	4.16	0.50	4.68	0.69	2.78**
Total	**30.68**	**1.63**	**33.60**	**2.61**	**4.53*** **

^{ns} $p > .05$ * $p < .05$ ** $p < .01$ *** $p < .001$

8. Reflex Items evaluates the function of the central nervous system of infants in order to find out the abnormal by using NBAS tool. The results of study showed that the mean of the treatment group was similar to the control group. However, statistical analysis outcomes showed no significant difference of statistic between the 2 groups ($p > .05$). This was based on the equality of primitive reflex of infants as stated in table 11.

Table 11 : Comparison mean of reflex item of infants between the groups of control and treatment.

Samples	Control Group		Treatment Group		t
	X	SD	X	SD	
Plantar grasp	2.00	0.00	2.00	0.00	-
Babinski	2.00	0.00	2.00	0.00	-
Ankle clonus	1.63	0.50	1.92	0.28	2.45*
Rooting	1.58	0.51	1.52	0.51	0.38^{ns}
Sucking	1.79	0.42	1.80	0.41	0.84^{ns}
Glabella	1.90	0.32	2.00	0.00	1.68^{ns}
Passive resist.-legs	1.90	0.32	1.92	0.28	0.28^{ns}
Passive resist.-arms	1.90	0.32	1.76	0.44	1.14^{ns}
Palmar grasp	2.00	0.00	2.00	0.00	-
Placing	2.00	0.00	1.92	0.28	1.26^{ns}
Standing	1.74	0.45	1.80	0.41	0.49^{ns}
Walking	1.16	0.37	1.28	0.46	0.95^{ns}
Crawling	1.32	0.48	1.28	0.46	0.25^{ns}
Incurvation	1.89	0.32	1.96	0.20	0.84^{ns}
Tonic Dev. Head/Eyes	1.32	0.48	1.56	0.51	1.62^{ns}
Nystagmus	1.11	0.32	1.24	0.44	1.14^{ns}
TNR	1.00	0.00	1.04	0.20	0.87^{ns}
Moro	1.95	0.23	1.96	0.20	0.20^{ns}
Total	**30.16**	**1.61**	**30.96**	**1.84**	$\mathbf{1.51^{ns}}$

^{ns} $p > .05$ * $p < .05$

Hypothesis III: Physiological changes on heart rate, respiration rate, and oxygen saturation of the treatment group will similar to the control group.

The outcomes of study showed that the means of heart rate, respiration rate, and oxygen saturation of the treatment group at the beginning till the end of study were similar to the control group (Table 12). In this study, the evaluation of heart rate, respiration rate, and oxygen saturation was done for 5 minutes before providing the program to infants, and keep on monitoring for 15 minutes when infants received the program. It was found that the changes of heart rate, respiration rate, and oxygen saturation was occurred occasionally but at the normal rate. Thus, the program can be done continuously and no case was stopped. Statistical analysis outcomes showed no significant difference of statistic between 2 groups ($p > 0.5$) as stated in Table 13.

Table 12 : Comparison means, standard deviation of heart rate, respiration rate, and oxygen saturation of the 2 groups at the beginning, during, and at the end of study.

Samples	Control Group(n=19)			Treatment Group(n=25)		
	Min-Max	X	SD	Min-Max	X	SD
At the beginning of study						
Heart rate (beat/minute)	142.73-159-09	149.58	4.54	144.91-159.27	149.82	4.40
Respiration rate (beat/minute)	45.27 - 54.36	47.69	2.50	44.18 – 54.00	47.69	2.02
Oxygen Saturation (%)	95.91 - 97.45	96.84	0.45	95.10- 98.45	97.22	0.72
During the study						
Heart rate (beat/minute)	141.45-160.73	148.95	5.13	143.82.-158.91	149.33	4.36
Respiration rate (beat/minute)	44.36- 54.55	46.97	2.78	44.18 – 53.27	46.85	2.10
Oxygen Saturation (%)	96.82-98.64	97.52	0.14	95.82- 98.64	97.73	0.72
At the end of study						
Heart rate (beat/minute)	142.36-159.09	149.37	4.51	143.64-159.82	149.48	4.29
Respiration rate (beat/minute)	45.27 - 54.91	47.70	2.58	42.27 – 52.91	47.22	2.20
Oxygen Saturation (%)	96.82-97.91	97.39	0.24	96.27- 98.45	97.80	0.57

Table 13: Comparison means of heart rate, respiration rate, and oxygen saturation of the 2 groups at the beginning, during, and at the end of study.

Samples	Control Group (n=19)		Treatment Group (n=25)		t
	d	SDd	d	SDd	
At the beginning- during of study (0-5 minutes)					
Heart rate (beat/minute)	1.01	0.54	0.76	0.71	1.31^{ns}
Respiration rate (beat/minute)	0.77	0.62	0.93	0.57	0.92^{ns}
Oxygen Saturation (%)	0.68	0.41	0.66	0.39	0.19^{ns}
During – the end of study (15 minutes)					
Heart rate (beat/minute)	0.90	0.48	0.69	0.71	1.12^{ns}
Respiration rate (beat/minute)	0.56	0.36	0.79	0.74	1.21^{ns}
Oxygen Saturation (%)	0.31	0.25	0.48	0.38	1.72^{ns}
At the beginning- the end of study (15 minutes)					
Heart rate (beat/minute)	0.46	0.35	0.74	0.57	1.92^{ns}
Respiration rate (beat/minute)	0.44	0.30	0.76	0.73	1.80^{ns}
Oxygen Saturation (%)	0.55	0.32	0.59	0.40	0.31^{ns}

^{ns} $p > .05$

CHAPTER V

DISCUSSION

Hypothesis I: The growth rate of body weight, body length, head circumference, and chest circumference of the treatment group will higher than the control group.

In this study, the growth assessment of premature infants evaluates from body weight, head circumference, chest circumference, and body length.

At the beginning of study, characteristic of the treatment and the control groups were similar. They were at age of 4 days up (the average age of the group was 9 days), 32-36 weeks gestational age (the average age of the group was 33-34 weeks) and there was no significant difference of statistic between the 2 groups (Table 1). But at the end of study (10 days completed), the body weight of the treatment group increased 296.40 grams or 29.64 grams/day which higher than the control group (293.68 grams or 29.36 grams/day). This result was similar to the standard mean of Bauchner (1988) of which the body weight of infants will increase 208 grams in each week or 29.7 grams/day. However, statistical analysis showed that there was no significant difference of statistic between the 2 groups (Table 2).

Concerning the mean of body weight of the treatment group in this study which higher than the control group and there was no significant difference of statistic mean of the body weight between the 2 groups, this issue can be explained into 2 reasons. Firstly, it was the result of phototherapy curing. The outcome of this study showed that the hyperbilirubinemia was occurred in the treatment group rather than the control group (treatment group = 17, control group = 1). Secondly, it was the result of uncontrollable external factors. Because it was impossible to control external factors such as bright lights, loud noises and nursing activities which effected to the growth of infants.

Thus, it can be concluded that the similarity of body weight of 2 groups were resulted from: 1) Infants were at the second phase of the changing period. At this time (1-5 weeks after birth), the growth of infants will be slowed (Gairdner & Pearson, 1971). 2) Multi-modalities sensory stimulation program cause the increase of body weight in the treatment group through it does not appear clearly due to the short period of study. This result repeated the research finding of Leib, Benfield & Guidubaldi (1980) entitled "Effects of Early Intervention and Stimulation on the Preterm Infant" and the study of White-Traut & Tubeszewski (1986) in the topic of " Multi-modal Stimulation of the Premature Infant". 3) The small number of samples were hindrances in the interpretation of data.

Regarding the increased means of head circumference, chest circumference, and body length of both groups, in this study, the comparison showed no significant difference between the 2 groups (Table 2). However, there was a trend to be increased continuously. From this study, the increase of head circumference, chest circumference and body length of infants in the treatment group was not proportional to the increase of body weight (Table 2). This results may based on the fact that the evaluation design was not good enough. Therefore, the errors of measurement may occur unnoticed. If the measurement of head circumference, chest circumference and body length of the infants was done while the infants were flailing, it was possible to get the wrong figure. Thus, the measurement should be done only when the infants feel calm. It is also needed the professional who has very well skill on measurement. With these the outcomes of evaluation will be correct and believable.

However, there is a trend that the significant difference of the growth rate between the 2 groups will clearly appear if the number of sample is big and infants are at the third phase of growth period with controlled environment factors.

Hypothesis II: The development of the treatment group will have more maturity than the control group.

In this study, development of premature infants means the ability to interact with the environment and to deal selectively with the environmental stimuli, resulting from the maturation and well functioning of the central nervous systems which can be measured by Brazelton Neonatal Behavioral Assessment Scale (NBAS). The results of study showed that there was no significant difference of statistic on habituation and reflex items between the 2 groups. But statistical analysis outcomes of social interaction, motor system, state organization, state regulation, autonomic system, and supplementary items between the 2 groups were obviously different (Table 3).

The following details focused on the 2 main topics of the similarity statistic on habituation and reflex items between the 2 groups.

1. **Habituation,** evaluation was done after the end of study. It was found that infants in both groups were at the sleeping or in a transitional drowsy states. They had equally capacity to decrease responses to repeated disturbing stimuli. The treatment group had more ability to response decrement to bell rather than the control group. This results from the fact the treatment group had stimulated by musical toy, So, they had more ability to response to bell. This outcomes repeated the fact finding from the research of Leib, Benfield & Guidubaldi (1980).

2. **Reflex Items,** evaluation was done to assess the function of the central nervous system of premature infants in order to find out the abnormal. Based on the equality of primitive reflex of infants, there was no significant difference of statistic between the groups of control and treatment.

Though there was no significant difference of statistic on habituation and reflex items between the groups of control and treatment. But the evaluation must be done because it was the first step to assess not only the ability of premature infants to deal with environment, and also the well functioning of the central nervous system.

Regarding the difference of statistic on social interaction, motor system, state organization, state regulation, autonomic system, and supplementary items between the 2 groups, it can be explained as follows:

1. **Social Interaction,** multi-modalities sensory stimulation program support the social interactive development of infants. The treatment group had more response to animate visual and auditory rather than the control group. Because they had stimulated with talking and en-face position. This study repeated the study outcomes of Leib, Benfield & Guidubaldi (1980), and Katz (1971) which indicated that the treatment group who received multi-modalities sensory stimulation program have more responding of vision and auditory rather than the control group.

2. **Motor System** , stimulation by flexing and extension of extremities under multi-modalities sensory stimulation program caused the increase of body movement and muscle tone. Thus, the treatment group in this study who received appropriated flexing and extension of extremities can move their arms and legs in all directions when compared with the control group.

3. **State Organization,** from this study, the treatment group had ability to control state performance. The treatment group will not cry unless they were disturbed to change position as Pull-to-Sit or being undressed. From observation the level of alertness and eye-opening ability of the treatment group was better than the control group. There was 3-5 state changes of the treatment group. But most of infants in the control group were at the state of drowsiness rather than alertness. Thus, researcher had to stimulate them by rocking for many times.

4. **State Regulation,** from this study, the treatment group had self-control ability which can be noticed easily. They stopped crying as soon as they got consolation in form of gentle holding or rocking. This showed the capacity of infants in dealing with stimuli. During evaluation, researcher found the significant difference of self-control capacity of the 2 groups. The treatment group could stop crying in the short time when getting consolation just by gentle holding or rocking for 1-2 times. But the control group still kept on crying until they got swaddling consolation. Sometimes researcher had to let them sucking her index finger for a minute. Concerning the self-control by hand to mouth, it was rarely found in both groups. Some infants have the ability just to move their hands to mouths but not insert to. While the full-term infant has the ability to bring his/her hand to mouth.

5. **Autonomic System,** from this study, the treatment group had ability to control physiological changes better than the control group. As the infants become alert and active the tremulousness should be overcome with smooth.

6. **Supplementary Items,** from this study, the evaluation showed that mean of supplementary system of the treatment group was higher than the control group, mainly in part of examiner facilitation and state regulation. This was resulted from the treatment group used to receive this program before. Thus, the treatment group was ready for evaluation rather than the control group and did not need help from examiner. The outcomes of study in seven sub-items were as follows:

6.1 Quality of alertness evaluates the infants' alertness level. From the study, most of infants in the treatment group were alert all the time when compared with the control group who paid attention to stimuli just for a while. Thus, researcher made an effort to gain attention from the control group.

6.2 Cost of attention evaluates physiological changes of infants as a result of stress. In this study, physiological changes of infants in the treatment group appeared in form of mottling, slightly paling, yawning, sneezing, and crying. But the control group had an obvious changes in form of rapid breathing, extreme paling, hiccuping, yawning, crying, and flailing. Though, those sign causing from stress interrupted the examination in some times, but examination can be completed.

6.3 Examiner facilitation evaluates the score of the amount of help necessary from the examiner to facilitate the infants' optimal performance. In this study, holding, rocking, and swaddling were provided to the control group rather than the treatment group.

6.4 General irritability evaluates the responsive action of infants to the mildly and moderately aversive stimulus situation. From the study, the infants in the treatment group who were crying or flailing while received stimulation will be calm as soon as they got consolation in form of holding or speaking softly. But it took a long time for the control group.

6.5 Robustness and endurance evaluates the robustness and endurance of infants. In this study, the treatment group and the control group had the same level of robustness and endurance. Both groups had a limited energy resource. Most of them were exhausted and need short breaks.

6.6 State regulation, the outcomes of examination showed that the treatment group had well-organized state better than the control group.

6.7 Examiner's emotional response reflects the feeling of examiner to infants as administering the examination. The reflex of examiner will indicate the characteristic of infants whether they have positive behavior or negative behavior. From this study, the mean of the treatment group was higher than the control group. Due to the fact that the rewarding and aversive behavior of the treatment group during the examination are equal. But the control group had a brief period of rewarding behavior.

Thus, it can be summarized that multi-modalities sensory stimulation program is very useful program to premature infants. It also promotes positive responding behavior to stimuli. The different of growth development between the groups of control and treatment appear clearly.

Hypothesis III: Physiological changes of heart rate, respiration rate, and oxygen saturation of the treatment group will similar to the control group.

In this study, the outcomes of study showed that the means of heart rate, respiration rate, and oxygen saturation of the treatment group at the beginning, during, and the end of study were similar to the control group. Statistical analysis outcomes showed no significant difference of statistic between the 2 groups.

There were 2 main reasonable outcomes supporting hypothesis.

Firstly, multi-modalities sensory stimulation program caused no stress and harmless to infants. The treatment group could adapt themselves and had more endurance for each step of stimulation. Though there was some changes of heart rate (143-158 beat/minute), respiration rate (44-53 beat/minute), and oxygen saturation (95-98%) when infants in the treatment group received this program, but it was occurred less than 15 seconds. This was generally accepted as normal range (Table 12).

The outcomes of this study repeated what has been said in the study of White-Traut (1993, 1997), entitled " Patterns of physiological and behavioral response of intermediate care preterm infants to intervention", that there was some changes of heart rate (149-155 beat/minute), respiration rate (30-60 beat/minute), and oxygen saturation (96-97%) in the group of treatment. But the outcomes of statistical analysis showed no significant difference between the 2 groups.

Secondly, this program is the most usefulness to premature infants. The treatment group felt relax and calm while listening to a musical toy, and being hold "en face" position. This program also promoted the positive of blood circulation (10-30%) and muscles relaxation of infants when receiving tactile and vestibular stimulation (Jay, 1982). The central nervous system of premature infants in the treatment group functioned well at the same level of the full-term infants.

CHAPTER VI

CONCLUSION AND RECOMMENDATION

Conclusion

This research study was a quasi-experimental research, aiming to compare the growth and development of premature infants between the groups of control and treatment under the multi-modalities sensory stimulation program.

44 Selected samples were premature infants in the Premature Infant Unit at Queen Sirikit National Institute of Child Health, and the Special Care Nursery at Ramathibodi Hospital. They were divided to 2 groups. The period of study was from May to September 1999.

Research protocol was multi-modalities sensory stimulation program. The development of infants was evaluated by using the scoring form of Brazelton Neonatal Behavioral Assessment Scale (NBAS).

Research steps were composed of the selection of samples under the setting criteria, the training of the multi-modalities sensory stimulation program using for 3 assistant researchers.44 samples were divided to 2 groups using the blind random sampling technique by assistant researchers. The control group received only the standard routine nursing activities. The treatment group received both the standard routine nursing activities and the multi-modalities sensory stimulation program from assistant researchers for 10 days. Data record was done by assistant researchers. After the end of study, I, a researcher of this study, evaluated the responding behavior to stimuli of samples by using NBAS scoring form.

The outcomes of study showed that:

1. The development of infants in treatment group were more maturity and stability rather than the control group. There was a significant difference of statistic in part of social interaction, motor system, state organization, state regulation, autonomic system and supplementary items, excluded the habituation and reflex items.

2. There was no significant difference statistic in part of growth between the two groups.

3. Physiological changes of heart rate, respiration rate and oxygen saturation of infants was at normal rate and can be accepted.

Research limitation

1. In this study, it was impossible to control the external factors such as bright lights, loud noises, and nursing activities that effected to the growth of infants.

2. During the evaluation by using Barzelton's NBAS, it was impossible to organized the suitable environment such as a quiet, semi-darkened room with a temperature of 22-27 c.

Recommendation

From this study, it was found that the multi-modalities sensory stimulation program are truly benefited and caused harmless to premature infants. Though there was no significant difference of the growth rate between the groups of treatment and control, but at the end of study there were the increased body weight of the treatment group, infants had capacity to deal with environment stimuli, and the good relationship between mother, caregiver and infants. Suggestion of this study was as follows:

1. Health officer should recognize to the important and the benefit of the multi-modalities sensory stimulation program that promote the growth and

development of premature infants. This program should be obtained in nursing care plan and adapted for the benefit of each infant.

2. The participation of mother to this program should be encouraged continuously. As soon as infant recovery from illness, mother should begin to take care her infant in order to create and strengthen the stable bonding of mother and infant. The participation of mother will make a good understanding and positive responding to infant's behavior. This can be evaluated from the interaction between parents and infants.

Recommendations for further study

1. Further study on this topic should be conducted with not less than 60 samples. The duration of evaluation issue on the body weight of infants should be extended till infants are at the third phase (catch-up growth). Evaluation for growth rate (body weight, body length, head circumference and chest circumference) should be done by the same person. in Moreover, external factors must be in controlled. This will benefit to data interpretation.

2. Mother should be acted as nurse who provide multi-modalities sensory stimulation program to infants for the benefit of bonding between mothers and infants.

3. Other stimulation such as using non nutritive sucking should be added for evaluation the ability in sucking and swallowing of premature infants.

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APPENDIX

Appendix A

Consent to Participate in Research Study

My name is Miss Sirinat Tinikul. I am a graduate nursing student in Nursing Department at the Faculty of Medicine, Ramathibodi Hospital, Mahidol University. I have an interest to conduct a research study on the topic of A Comparative Study in the Growth and Development of Premature Infants between the Groups of Control and Treatment under the Multi-Modality Sensory Stimulation Program with 3 main objectives. Firstly, to study and compare the growth of body weight, body length, head circumference, and chest circumferençe of infants in the groups of control and treatment. Secondly, to study and compare the development of the 2 groups. Thirdly, to study and compare the changes of heart rate, respiration rate and oxygen saturation of the 2 groups.

Based on the fact that there are now many premature infants who are suffered either from neglect or illness, therefore, any study that will directly benefit to infants should be supported. I hope that you will understand and realize the most usefulness of this study that will not only benefit to infants but also to promote the effective and appropriate planning and organizing of the multi-modalities sensory stimulation program to premature infants. You can contribute and give valuable help by just allow me to include your infant to the program. And you can stop at any time with no effect to asking for nursing service at this place. May I thank you in anticipation for your consideration. For your kind assistance, please sign your name below.

Thank you very much.

Miss Sirinat Tinikul

Mother name:--

Appendix B

Research Tool

Demographic Data

Infant's name/surname…………………Sex………Gestational age…………………..

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

Birth weight……………………..(grams) Body length………………………..(cms.)

Head circumference……………(cms.) Chest circumference……………..(cms.)

Age at study……………………..(days) Age at the end……………………..(days)

Mother's name/surname……………………………………………………………

Daily Data Record Form

Date Of Study	Items											Note
	B.W	F	H.R.			R.R.			O_2 Sat			
			Pr	D	Po	Pr	D	Po	Pr	D	Po	
1												
11												

F = Feeding
Pr = At the beginning of study
D = During
Po = At the end of study

Appendix C

NBAS Scoring Form*

Name: Date of examination:
Gestational age: Body weight: Body length:
Head circumference: Chest circumference:

Habituation	Infant Behavior 9	8	7	6	5	4	3	2	1	Comments
Response Dec.-Light										
Response Dec.-Rattle										
Response Dec.-Bell										
Response Dec.-Foot										
Social-Interactive										
Animate Visual										
Animate Vis. +Aud.										
Inanimate Visual										
Inanimate Vis. + Aud.										
Animate Auditory										
Inanimate Auditory										
Alertness										
Motor System										
General Tone										
Motor Maturity										
Pull-to-Sit										
Defensive										
Activity Level										
State Organization										
Peak of Excitement										
Rapidity of Build-up										
Irritability										
Lability of States										
State Regulation										
Cuddliness										
Consolability										
Self-Quieting										
Hand-to-Mouth										

Infant Behavior

Autonomic System	9	8	7	6	5	4	3	2	1	Comments
Tremulousness										
Startles										
Lability of Skin Color										
Supplementary Items										
Quality of Alertness										
Cost of attention										
Examiner Facilitation										
General Irritability										
Robustness/Endurance										
State Regulation										
E's Emotional Resp.										

Reflexes	0	1	2	3	Asym	Comments
Plantar Grasp						
Babinski						
Ankle Clonus						
Rooting						
Sucking						
Glabella						
Passive Resist.-Legs						
Passive Resist.-Arms						
Palmar Grasp						
Placing						
Standing						
Walking						
Crawling						
Incurvation						
Tonic Dev.Head/Eyes						
Nystagmus						
TNR						
Moro						

Summary: Infant

Strengths Concerns

Summary: Parent(s)

Strengths Concerns

* From Brazelton, 1995

Biography

NAME	Miss Sirinat Tinikul
DATE OF BIRTH	16 November 1960
PLACE OF BIRTH	Uthaithani, Thailand
INSTITUTIONS ATTEND	Sawanpracharak College of Nursing,1979-1982:
	Diploma of Nursing Science.
	Mahidol University, 1997-2000:
	Master of Nursing Science (Pediatric Nursing)
POSITION & OFFICE	Head Nurse
	Pediatric Ward
	Uthaithani Hospital