EFFECTS OF MOZART'S MUSIC ON VITAL SIGNS, OXYGEN SATURATION, AND SLEEP DURATION OF PRETERM INFANTS

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Thesis
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EFFECTS OF MOZART'S MUSIC ON VITAL SIGNS, OXYGEN SATURATION, AND SLEEP DURATION OF PRETERM INFANTS

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ABSTRACT

For this study, cross-over experimental design research was used to compare the heart rate, respiratory rate, oxygen saturation, and total sleeping duration while listening to Mozart's music and when not listening to Mozart's music in preterm infants from 32 to 36 weeks of gestation who were admitted in the Sick Newborn Unit of Nopparat Rajathanee Hospital from September, 2010 to January, 2011. Fifteen eligible participants were recruited for the purposive sampling. The sample in this study was divided into two experiments: the first experiment - listening to Mozart's music for one day before not listening to Mozart music for one day (Mozart/none) and the second experiment - not listening to Mozart's music for one day before listening to Mozart's music for one day (none/Mozart) for 40 minutes each day. The video recorder observed the sleeping duration among the preterm infants. The evaluation was also conducted using infants' sleep-wake record form and sleep-wake behavior evaluation guideline for preterm infants. The data was analyzed using descriptive statistics including frequency, percentile, mean, standard deviation, and paired t-test.

The findings indicated that the mean heart rate and respiratory rate among preterm infants while listening to Mozart's music decreased more than those who were not listening to Mozart's music with a .01 level of statistical significance. The mean of oxygen saturation levels among preterm infants while listening to Mozart's music increased more than those who were not listening to Mozart's music with a .05 level of statistical significance. The mean of the total sleeping duration during listening to Mozart music was longer than those who were not listening to Mozart music with a .001 level of statistical significance. The results from this study can be used as fundamental information for nursing practice to promote sleep among preterm infants.

KEY WORDS: PRETERM INFANTS / MOZART'S MUSIC / VITAL SIGNS / OXYGEN SATURATION / SLEEP DURATION

93 pages

ผลของเสียงเพลงโมสาร์ทต่อสัญญาณชีพ ค่าความอิ่มตัวของออกซิเจนในเลือด และระยะเวลาการนอนหลับในทารกเกิดก่อนกำหนด

EFFECTS OF MOZART'S MUSIC ON VITAL SIGNS, OXYGEN SATURATION, AND SLEEP DURATION OF PRETERM INFANTS

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คณะกรรมการที่ปรึกษาวิทยานิพนธ์: ทิพวัลย์ ดารามาศ, พย.ด., เรณู พุกบุญมี, พย.ด.

บทคัดย่อ

การวิจัยนี้เป็นการวิจัยกึ่งทดลองแบบข้ามสลับ (Cross-over design) เพื่อเปรียบเทียบอัตราการเต้นของหัวใจ อัตราการหายใจ ค่าความ อิ่มตัวของออกซิเจนในเลือด และระยะเวลาการนอนหลับในทารกเกิดก่อนกำหนดขณะที่ได้รับฟังเพลงโมสาร์ทแ ละขณะที่ไม่ได้รับฟังเพลงโมสาร์ท ศึกษาในทารกที่มีอายุครรภ์ 32-36 สัปดาห์ และได้รับการรักษาในหอผู้ป่วยทารกแรกเกิดป่วย โรงพยาบาลนพรัตนราชธานี ระหว่างเดือนกันยายน 2553-มกราคม 2554 เลือกกลุ่มตัวอย่างแบบ เฉพาะเจาะจง จำนวน 15 คน กลุ่มตัวอย่างถูกสุ่มทำการทดลอง 2 สถานการณ์ คือ สถานการณ์ที่ 1 ให้ฟังเสียงเพลงโมสาร์ทก่อนแล้วจึงตามด้วยไม่ได้ฟังเสียงเพลงโมสาร์ท และสถานการณ์ที่ 2 ไม่ได้รับฟังเสียงเพลงโมสาร์ทก่อนแล้วจึงตามด้วยให้ฟังเสียงเพลงโม สาร์ท เป็นเวลา 40 นาที และบันทึกระยะการหลับของทารก ด้วยกล้องวีดิทัศน์ ประเมิน การหลับตื่น โดยใช้แบบบันทึกการหลับตื่นของทารกเกิดก่อนกำหนด และคู่มือการประเมินพฤติกรรมการหลับตื่นของทารกเกิดก่อนกำหนด วิเคราะห์ข้อมูล โดยใช้สถิติบรรยาย และสถิติทดสอบที (Paired t-test)

ผลการศึกษา พบว่า ค่าเฉลี่ยอัตราการเต้นของหัวใจและอัตราการหายใจใ นทารกเกิดก่อนกำหนดขณะที่ได้รับฟังเพลงโมสาร์ทมีค่าน้อยกว่าขณะที่ไม่ได้รับฟังเพลงโมสาร์ท อย่างมีนัยสำคัญทางสถิติที่ระดับ .01 ค่าความอิ่มตัวของออกซิเจนในเลือดในทารกเกิดก่อนกำหนดขณะที่ได้รับฟั งเพลงโมสาร์ทมีค่ามากกว่าขณะที่ไม่ได้รับฟังเพลงโมสาร์ท อย่างมีนัยสำคัญทางสถิติที่ระดับ .05 และค่าเฉลี่ยระยะเวลาการนอนหลับทั้งหมดในทารกเกิดก่อนกำหนดขณะที่ได้รับฟังเพลงโมสาร์ทนานกว่าขณะที่ไม่ได้รับฟังเพลงโมสาร์ท อย่างมีนัยสำคัญทางสถิติที่ระดับ .001 ผลการศึกษา ครั้งนี้สามารถ นำไป ใช้เป็นแนวทางในการปฏิบัติการพยาบาล เพื่อส่งเสริมการนอนหลับในทารกเกิดก่อนกำหนดได้

93 หน้า

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CHAPTER I
INTRODUCTION

Background and significance of the problem

Today, in developed countries high technologies in health care services and better medications have resulted in an increase in the average life expectancy of preterm infants. However, because of incomplete body functions they are often not ready to cope with the external environment. The birth rate of preterm infants in the United States of America increased from 12.5% to 12.8% (Plains, 2007 cited in Srichalerm, 2010). Health expenditure is also increasing for the care of preterm infants (Schmitt, Sneed, & Phibbs, 2006 cited in Poore & Barlow, 2009). There is no record of the rate of premature baby rates in Thailand. However, the incidence rates of preterm infant weights less than 2,500 g. from 2003 to 2008 this increased from 8.99% to 10.8% (Ministry of Public Health, 2009). Also, premature labor incidence rates at the Nopparat Rajathanee Hospital, Bangkok, (NRH) from 2006 to 2008 increased from 8.8% to 12.0% and 15.7%, respectively (Labor Room Records, Nopparat Rajathanee Hospital, 2008). The premature labor at NRH are the major cause of death among newborn.

Preterm infants staying in hospital for a duration of time are cared for in an intensive care unit environment or newborn ward environment that is significantly different that of the mother's womb. The womb is a warm, calm, safe, and quiet environment which is most appropriate for fetal development (Glass, 2005). While the environment in the patient's room is suitable for medical and physiological care it can cause excess stimulation for the newborn. For example, the lights are turned on all day and night, sound from both of the medical equipment, speech from staff, and the nurse's touch all serve to abnormally stimulate the preterm infant. There is some evidence to suggest that this stimuli may cause damage to the preterm infant's neurons and affect central nervous system development. This is especially true if it affects the

sleep control of the infants (Blackburn & Loper, 1992; Blackburn & Vandenberg, 1993 cited in Nakklinkool, 2003). The preterm infant is more easily woken and caused to cry, restless, and be hyperactive which causes an increase in energy expenditure, heart rate, respiratory rate, and blood pressure (Thomas & Uran, 2007). This can also lead to an increase in intracranial pressure and the risk of intracranial hemorrhage, decreased oxygen saturated, and to cease breathing (Perlman, 2001; Holditch-Davis, Blackburn, & Vandenberg, 2003; Brown, 2009). The result from prospective studies indicate that preterm infants who were admitted to intensive care units later developed abnormal learning, abnormal movement and touch (American Academy of Pediatrics, 1995). Evidence also suggests that the preterm infants develop abnormal brain development, delayed growth development, problems with hearing, speaking, reading, and language skills (Buehler, Als, Duffy, McAnulty, & Liederman, 1995).

Sleep is vitally important to preterm infants because it is the key factor for growth development. The full term newborn needs to sleep for 16-19 hours a day, while preterm infants need much more hours; almost all day and night. They have sleep cycle for 30 - 40 minutes. (Hack, 1992; Gardner & Lubchenco, 1998; Hassakunachai, 2008). During deep sleep, preterm infants will synthesize energy for cell division as well as synthesis and secrete growth hormones for growth development. Therefore, preterm infants gain weight and grow. In addition, decreasing cortisol and adrenaline levels serve to reduces stress in preterm infants (Fosters, Hunsberger, & Anderson, 1989; Hodgson, 1991; Glass, 1994). Studies suggest that preterm infants who sleep well and long enough leads to improved brain development, increases weight, improves the immune system, and encourages early rehabilitation (Bertelle, Sevestre, Laou-Hap, Nagahapitiye, & Sizun, 2007; Hinds, Hockenberry, Rai, Zhang, Razzouk, & McCarthy, 2007; Vandenberg, 2007). Accordingly, nurse should strive to promote high quality sleep in preterm infants for improved growth and development.

Some evidence suggests that listening to Mozart’s music lets the preterm infant relax, sleep better, and reduces crying. Furthermore, they have a decreased heart and respiratory rate, and increased oxygen saturation. Much of Mozart’s music has regular musical notes which appear to cause preterm infants to focus on the music and relax. Hence, Mozart’s music may be helpful in improving brain and emotional

development rather than other kinds of music. In addition, the regular speed of rhythm of the music may make the preterm infant feel relaxed, reduce stress, reduce and regulate the heart and respiration rate, increase oxygen saturation, decrease energy expenditure at resting duration which in turn will lead to weight gain (Lemmer, 2008; Lubetzky et al., 2009). Many studies found that preterm infants who listen to the Mozart's music reduce stress, feel more relaxed and comfort including reduced heart rate, increase oxygen saturation, and reduced energy expenditure at the resting duration resulted in increased weight (Lemmer, 2008; Cassidy, 2009; Lubetzky, Mimouni, Dollberg, Reifen, Ashbel & Mandel, 2009).

The literature review failed to identify any studies in Thailand on the effect of Mozart's music on sleeping duration in preterm infants . Overseas there have been a number of studies on the effect of Mozart's music aimed at increasing the weight of the preterm infants (Lubetzky et al., 2009), and reducing heart rate and increasing oxygen saturation (Cassidy, 2009). However, there appeared to be no studies on the effect of Mozart's music on sleeping duration in preterm infants. In short, listening to Mozart's music among infants seem to present positive outcomes as well as been harmless among preterm infants. Therefore, this study explores the effects of the Mozart's music to vital signs and sleeping duration among preterm infants. The findings should result in the development of guidelines as to the use of music in improving normal vital signs and longer sleeping duration among preterm infants.

Conceptual Framework of the Study

The conceptual framework for this study was derived from Als's (1982) Synactive Theory of Development, and Hearing Physiology (Updike, 1990; Braun & Anderson, 2007). Als's Synactive theory of development stated the infant's adaptation to homeostasis and relationship between infants and environment was through five subsystems: 1) The autonomic system related to vital systems that control the basic conditioning systems including respiratory rate, heart rate, skin color, and internal impulses (regurgitation, cough, and intestinal movements). 2) The motor system related to muscle tone that express by upper and lower limb movements and the newborn's general behavior. 3) The state-organizational system illustrated by

consciousness levels of the preterm infant classified into 6 states which include quiet sleep or non rapid eye movement, active sleep or rapid eye movement, quiet awake or alert, active awake or alert, crying, and drowsy. Whether the newborn presents with a confused facial expression, tetany, looking eyes, hawk, discomfort, and, difficult to induce sleep. 4) The attention and interaction system, an adapted preterm infant's with homeostasis and social and environmental alertness, readyness to learn. 5) The self-regulation system, preterm infants who keep self homeostasis such as the presence of sucking behavior, placing the hands near their mouth, and sleeping in a fetal position.

There are relationships among five physiological systems. The beginning starts with the effective autonomic nervous system that will be followed by normal functions, including motor function, and movement, sleeping and waking, alertness and reaction, including self-adaptation. If there is an imbalance of the autonomic nervous system, such as low level of oxygen saturation, the preterm infants could not reach the complete level of motor functioning and movement. Mozart's music appears to make the preterm infant relax and improve homeostasis and other physiological functions including heart rate, respiratory rate, and oxygen saturation, and improved sleeping .

The conceptual framework of the physiological studies related to hearing address to the important hearing structure; the cochlear. Hearing is performed primarily by the auditory vibrations and are detected by the hair cells in the cochlear and transduced into nerve impulses that are perceived by the auditory nerve within the brain (Braun & Anderson, 2007). The nerve impulses pass to thalamus that is the sensory conducting pathway and then to limbic system (emotional center, sensation, and touch) in hypothalamus. The capacity reduction of the neurotransmitter causes discomfort and reduces eyes movements. Increasing serotonin secretion creates relaxation and improved sleeping. Moreover, listening to the music of Mozart appears to stimulate the pituitary gland to secrete endorphin that induces a sense of happiness, pain reduction Decreased sympathetic nerve responses lead to a reduction in body responses, heart and respiratory rates, and oxygen saturation which are more regular and constant (Updike, 1990). When the preterm infant is relaxed, their muscles

become less tightened, skeletal muscles would be more comfortable leading to more efficient sleep-rest states, and better and longer sleep.

This study the researcher compared heart rate, respiratory rate, oxygen saturation, and sleeping duration among preterm infants while listening to Mozart's music and not listening to Mozart's music. This is illustrated in the conceptual framework below:

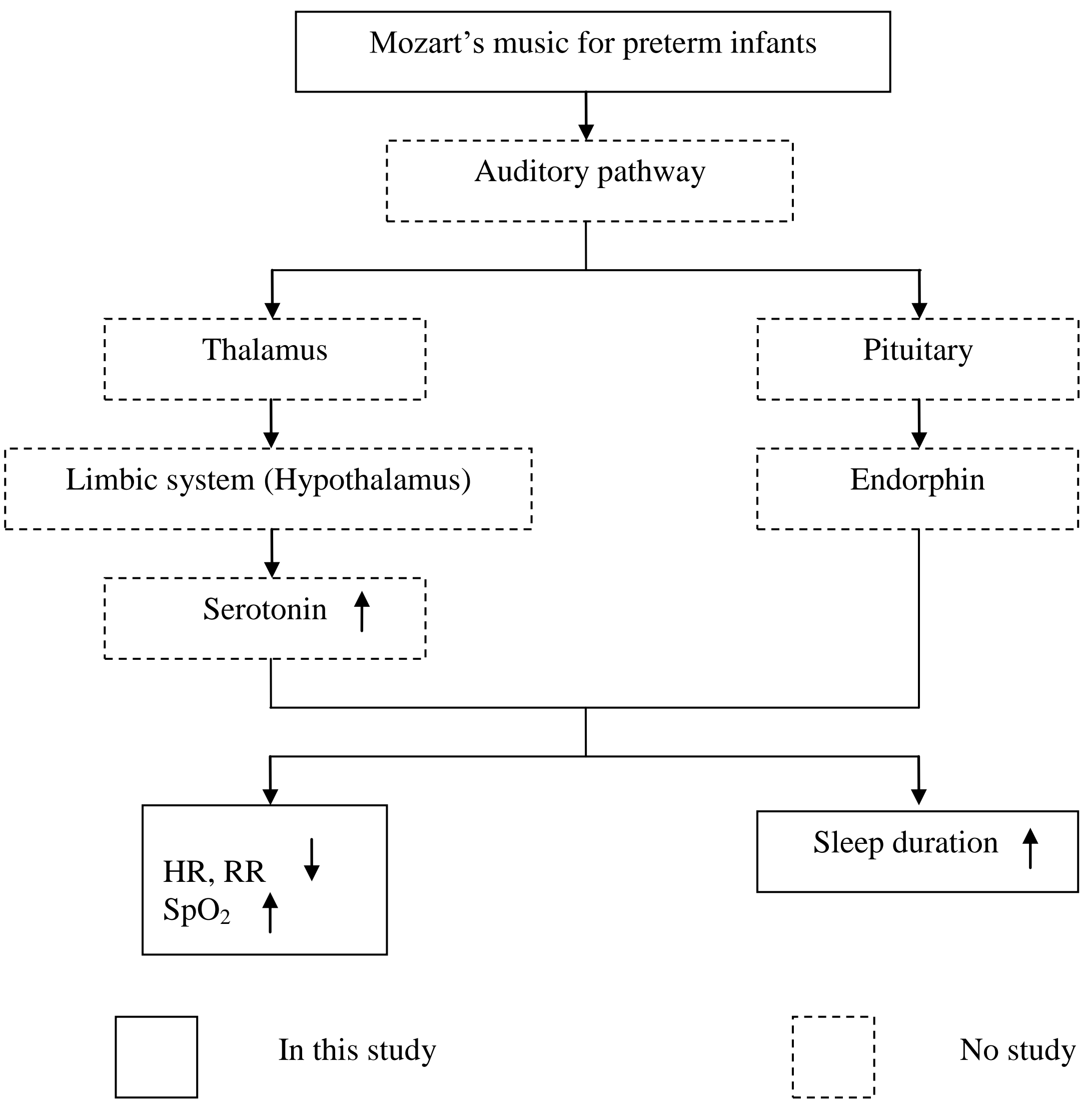


Figure 1.1 Conceptual Framework of the Study

Research Questions

The study poses the following research questions:

Are the heart rates, respiratory rates, oxygen saturation, and sleep duration among preterm infants improved while listening to Mozart's music and are the physiological indicators different from the preterm infants not listening to Mozart's music?

Purposes of the study

The purpose of the study is threefold:

1. To examine the effect of Mozart's music to the heart rate, respiratory rate, and oxygen saturation among preterm infants.
2. To examine the effect of Mozart's music on sleeping duration among preterm infants.
3. To compare the heart rate, respiratory rate, oxygen saturation and total sleeping duration among preterm infants while listening to Mozart's music and during not listening to Mozart's music.

Research Hypotheses

The study poses 3 hypotheses:

1. The heart rate and respiratory rate among preterm infants during listening to Mozart's music decreases more than those preterm infants not listening.
2. The oxygen saturation among preterm infants during listening to Mozart's music increases more than those preterm infants not listening.
3. That the total sleeping duration among preterm infants during listening to Mozart's music is longer than duration of non listening preterm infants.

Operational Definition of Terms

The terms used in this study are defined as follows:

Mozart's music in this study refer to pattern of sound produced to relaxed, Mozart's music emphasized violin with low frequency with repeated note and regular rhythm (Campbell, 2002).

Vistal signs refers to the heart rate and respiratory rate.

Heart rate refers to the number of heartbeats per minute in preterm infants with normal rate set at 120 to 160 beats per minute.

Respiratory rate refers to the number of chest movement, respiration per minute in preterm infants with normal rate set at 40 – 60 beats per minute.

Oxygen saturation refers to the percentage concentration of the oxygen bound with hemoglobin assessed by pulse oximetry (SpO_2), in preterm infants the normal value is taken as 92 – 95 %

Quiet sleep (Non Rapid eye movement/ NREM) duration refers to the duration that preterm infants express normal stage of sleep characterized by closing eyes and eyelids, regular heart rate and respiratory rate related to abdominal movement and diaphragm movements. There is usually little or no eye movement and body movement (head, face, upper and lower limbs or trunk) during this stage

Active sleep (Rapid eye movement/ REM) duration refers to the duration that preterm infants' visible normal stage of sleep characterized by closing eyes and eyelids, irregular heart rate and respiratory rate related to intercostal muscle and diaphragm movements, no or slight body movement. Criteria for REM sleep not only includes rapid eye movement, but also low muscle tone.

Total sleeping duration refers to the duration that preterm infants express normal stage of sleep characterized by both quiet and active sleeping durations. Sleeping duration ends with the preterm infants' expression of drowsiness or wake up evaluated by sleeping and awake evaluation manual and record form for preterm infants using the Thai version of this sleep evaluation instrument (Charastong, 2001). This evaluation manual modified from The Sleeping and Awake Evaluation Form of Pamaelee and Stern (Pamaelee & Stern, 1972).

CHAPTER II
LITERATURE REVIEW

The purposes of this study are to compare the heart rate, respiratory rate, oxygen saturation, sleep duration and quality of sleep among preterm infants while listening and non listening to Mozart's music. The researcher reviewed the literature focusing on the following topics:

1. Preterm infants
   - Definition, category, and characteristics
   - Central nervous system development among preterm infant
   - Hearing development among preterm infant
2. Sleeping duration
   - Sleep-wake period development of preterm infant
   - Factors affecting to Sleep-wake of preterm infant
   - Sleep-wake evaluation of preterm infant
3. Quiet hours management
   - Factors affect to quiet hours management
   - Nursing guideline to quiet hour management
4. Music therapy
   - The effect of Mozart music to vital signs and sleeping duration among preterm infants

Preterm infants

Definition of preterm infants

The term "preterm infant" refers to a newborn baby born before 37 weeks or 259 days from the mother's last menstrual day and without prior to an increase in body weight. (American Academy of Pediatrics, 2000 cited in Srichalerm, 2010 ; Littleton & Engebretson, 2002; Lertthumtawee, 2009)

Categories of preterm infants

Preterm infants were divided into three groups based on body weight (Kohn et al., 2000; Siriboonpipathana & Tunlert, 2001; Thaithumyanon, 2001).

These are:

1. Low birth-weight infant: LBW refers to preterm infants who have lower weight than 2,500 grams

2. Very low birth-weight infant: VLBW refers to preterm infants who have lower weight than 1,500 grams

3. Extremely low birth-weight infant: ELBW refers to preterm infants who have lower weight than 1,000 grams

Characteristics of preterm infants

The preterm infants that was born from mother in the early gestation phase had incomplete organ than those who was born from mother in late gestation phase (Supapunchat, 1997; Thaithumyanon, 2001; Pilliteri, 2007; Lertthumtawee, 2009). The characteristics of preterm infants depends on the length of gestation as follows:

1. General characteristics: Preterm infants are small, underweight, and have a body length dependent on the length of gestation. They weigh less than 2,500 grams, always sleepy, light crying, irregular respiration, and have a subnormal temperature.

2. Head and hair: Head is bigger than trunk, less hair, abnormal distribution of lanugo, soft skull large length of suture and fontanel, head circumference less than 33 centimeters.

3. Skin: thin, less subcutaneous fat make clearly visible cutaneous capillaries and pink skin, little vernix caseosa, a lot of lanugo, especially, forehead, shoulder, back, and proximal arm.

4. Eyelids: swelling and protrude making them continually closed.

5. Pinna: soft and smooth sheet, flexible when it was fold or free, immature growth of cartilage structure.

6. Breast: flat nipple.

7. Upper and lower limbs: short when compared with trunk, straight, not flexible, poor muscle tone, little and smooth finger prints, and soft finger nails.

8. Finger nails of the hand and foot are short and soft, grow unevenly on each finger.

9. Foot prints are few on front of foot.

10. Male and female genital organ: small size, testis develop in the abdomen not in the scrotal sac with a few fissure at the scrotal sac in male, and obvious minor cam and clitoris in females.

11. Posture is extended in the upper and lower limbs with poor muscle tone.

12. Reflexes such as sucking, swallowing, sneezing, coughing, and little or no neuro-response including little sucking pads.

13. The thorax is soft, incomplete lung tissue growth according to gestation phase, incomplete function of respiratory center and incomplete function of respiratory muscles, respiration using diaphragm often creating periodic breathing with little ventilation.

14. Incomplete organ function leads to a poor heat regulation center leading to a subnormal temperature, limited renal function, low immune resistance leading to a high risk for infections.

Central nervous system development among preterm infant

This section discusses the central nervous system development in preterm infants from the period of conception to the postnatal phase. These developmental stages are divided into six periods. The first three periods will be completed in the first 16 weeks and the last three periods will continue development until full term gestation (Blackburn, 1993; Polin & Fox, 1998; Holditch-Davis, Blackburn, & Vandenberg, 2003). These periods are briefly summarized below.

The first period: development is the hind brain (dorsal induction) cover brain and the spinal cord occurs when the embryo is aged 18 days and completed development 32 days after fertilization.

The second period: This is the development of the forebrain (ventral induction) cover brain and ventricles development in the gestation phase of eight weeks.

The third period is neuronal proliferation in this period of neurons develop as well as supporting cells (glial cells) during the gestation phase of 8 - 16 weeks. Supporting cells in ventricle and subventricular layer, called the germinal layer, is the beginning point of the neurons and meningeal development.

The fourth period: Neuronal migration is the period of neuron and supporting cell transportation from germinal layer to gray matter of cerebral cortex and cerebellum. Transportation occurs in the gestation phase of 12 weeks and completed in 34 - 36 weeks of gestation. There is a lot of blood circulation supply in the germinal layer; however, these blood vessels are not tough and break easily. Therefore, when the preterm infants feel stress, a brain hemorrhage can easily occur (Holditch-Davis, Blackburn, & Vandenberg, 2003)

The fifth period: Neuron organization phase create connection of neuron that makes coordination throughout the whole system. Neuron organizations occur from 24 weeks of gestation phase till one year after delivery and continue development until adult age. Growth development and connection of neuron (Synapse) lead to the brain development that related to more advance and complex behavior. Neuron development is also the neuron reduction process. Neuron or ineffective cell will be damage and the left cell with appropriate number will be more effective function (Squier, 2001). Neuron capacities in structural and functional change called brain plasticity occur during relationships between newborn and environment. Appropriate environmental stimulation in this period creates strong synaptic neuron. Oppositely, inappropriate environmental stimulation cause weak synaptic neuron that affect brain development among newborn. (Chatkoop, 1999; Holditch-Davis., et al., 2003). Moreover, neuron organization is important to neuron synapse and Sleep-Wake among preterm infant. However, external environment interfere affect Sleep-Wake among preterm infants as well (Als, 1982; Blackburn, et al., 1992; Blackburn, 1998)

The sixth period: Myelinization, the thicker the myelin sheath, the faster the synaptic neuron occur. Myelinization is like a insulating sheath. It consists of supporting cell of the nervous system lipoprotein that creates myelin sheath cover axon. This step occur in the second trimester of gestation phase (20 weeks) and continue development until mature. However, the most development occur in between of the 32 weeks gestation phase to one year newborn.

Brain development is important, especially in the preterm infants otherwise there is incomplete central nervous system development and a need to continue treatment in an intensive care unit or preterm infants ward. The external environment in patient's ward, such as light, sound, and touch may interfere with the central nervous system development process and cause negative effects to the brain development among newborns. The nurse should closely observe these negative effects in preterm infants from the five subsystems outlined in Als's Synactive Theory of Development. These subsystems include the autonomic system, the motor system, the state-organizational system, the attention and interaction system, and the self-regulation system. This study will focus mainly on the state-organizational subsystem in preterm infants.

Hearing development among preterm infant

Hearing in preterm infants develops in the first three to six weeks of gestation. The major organs of hearing develop in the 23 - 25 week after gestation and are characterized by pinna and cochlear development. These organ complete development over the first 28 weeks of gestation. They respond to loud sounds by displaying fright and blinking. They also present with other complicated behaviors, such as stopping motor functions, changing respiratory patterns, opening their mouth, and opened yes widely (Graven, 2000; Liu, Gujjula, Thanigai & Kuo, 2008; Volpe, 2008). Preterm infants present the highest response to sound after 28 - 34 weeks of gestation, especially the mother's sound. They can differentiate several sounds, especially, different rhythms and levels of sound (Neal et al., 2008). Hearing development among preterm infants continues to develop until the child is approximately three years old (James, 1998).

Hearing sounds among preterm infants begin when the sound waves pass through ear canal and major structures in the internal ear. In turn the cochlea stimulates the hair cells. Different frequencies and levels of sound will change into energy and electric current to the auditory nerve (Braun et al., 2007) to temporal lobe that is located in the lateral sides of the brain and is the area to interpret the meaning of sound (Al-Mana, Ceranic, Djahanbakhch & Luxon, 2008). The intensity and level of sound for the normal person range from 0 - 120 dB. The sound with higher intensity

than 90 dB cause hearing harm or injury. The preterm infants have different hearing capacity. The preterm infants can accept sound with intensity range from 40 - 65 dB, while the full term newborn can accept the sound with intensity range upwards of 20 dB (American Academy of Pediatrics, 1997; Young, 1996; Perlman, 2001; Glass, 2005). However, the intensity of sound that is safe to the newborn should not be higher than 58 dB (American Academy of Pediatrics, 1974). Sounds with high intensity irritate sleeping among preterm infants that make them wake up early and stress. Therefore, repetitive monotone sound with low intensity clam and lead them into sleeping phase (Gardner et al., 1998).

Preterm infants can express their response behavior to highest intensity sound since 28 weeks of gestation. The appropriate intensity of sound that makes newborn sleep well should be not louder than 58 dB. Therefore, the researcher choose to study in preterm infants within 32 - 36 weeks of gestation with a sound setting under the intensity of 58 dB for the purposes of this study.

Sleeping duration

There were several definitions of sleep In the present study the definition provided by Rojanakitti, (2001) will be used. Specifically, that sleep refers to a basic physiological process that is relevant to biological rhythms, including changes in internal and external organs in the body and causes relaxation in the person.

Reduction of conscious levels and stimuli response cause clam down behavior that temporarily can be stimulated by appropriate stimuli (Srapaudom, 2003). Sleeping also refers to physiological processes related to changing of body organs that create a reduction in consciousness, stimuli response, motor function, and relaxation (Carskadon & Dement, 1994).

Sleeping refers to repetition of the reduction of response behaviors and reaction to the environment that occurs from the prenatal phase until death (Wong, 2005; Santrock, 2007).

In short, sleeping is a vital and complex physiological process occurring from the prenatal period throughout life. Sleep is a response to physiological changes

that induce relaxation and reduction of conscious, stimuli responses, and motor function.

Sleep-wake period development of preterm infant

The sleep-wake cycle is a natural process of all human beings. Sleeping develops in the fetus in the 6 - 7 month of gestation (Wong, 2005; Santrock, 2007; Hassakunachai, 2008). Sleeping in preterm infants is a vital process because there are many things happening during sleeping. For example it is a time to accumulate energy, repair the body, create neurons, and a time for rehabilitation. These processes create proper growth and good physical, mental, emotional, and social development including brain development and functioning of body organs that are necessary for learning (Hongsanguansri, 2004). Developments of the pattern of the sleep-wake in each phase depend on completeness of brain since this system is controlled by the central nervous system (Wong & Whaley, 1999). Central nervous system development in preterm infants is not complete, therefore, the sleep-wake cycle among preterm infants is not as good as full term infants.

There are studies of the sleep-wake cycle using ultrasound during 8 - 12 weeks and using electric wave in the 21 weeks of gestation phase (Hack, 1992; Peirano, Algarin, & Uaury, 2003). Their findings showed that there is slight body movement in the early periods of inter-uterine development with short period relaxation. The cycle and rhythm, including inconsistent resting period during body movements, and activities that could be recorded in the 20 weeks of gestation. Also, the encephalogram recordings during sleep apparently found even at 24 weeks of gestation (Hack, 1992; Sheldon, 2002). Sleeping cycle occur during 24 - 26 weeks of gestation phase although it could not apparently differential separate. The sleep-wake among preterm infants was continuously developed to have a clearly active sleeping cycle in the 28 - 30 weeks of gestation. The electroencephalogram could be detected incontinuously during sleep in this period and presented the relationship between behavior and the sleep-wake. For example, rapid eyes movement, body movement, irregular heart and respiratory rate. However, there is poor functional coordination during 28 - 31 weeks of gestation (Blackburn & Patterson, 1991; Hack, 1992; Peirano et al., 2003). Preterm infants begin to have quiet sleep periods after 32 weeks of

gestation, including presenting different behaviors of quiet sleep, active sleep, and wake up periods. They present apparently different behaviors according to quiet sleep, active sleep, and wake up period during 34 - 36 weeks of gestation phase. It is gradually increase until 40 weeks of gestation phase, while active sleeping cycle were well developed during 34 - 36 weeks of gestation phase (Hack, 1992; Sheldon, 2002).

Preterm infants use most of the time in active sleeping 60 - 70 % of the whole sleep, while the full term newborn fall in active sleep only 50%. Fall in quiet sleep for just a few moments among preterm infants they fall asleep for the whole day or much more time than full term newborn make them meet body need. Each sleep cycle takes 30 - 40 minutes per cycle. Sleeping duration during night time similar to day time that related to hungry and full among newborn (Hack, 1992; Gardner et al., 1998; Hansakunachai, 2008), while the sleeping duration among full term newborn takes 50 - 60 minutes (Glass, 1994; Herman & Steinberg, 1997). The study of sleeping pattern among preterm infants with 34 - 36 weeks of gestation phase found that take 40 - 60 minutes for each cycle (Charastong, 2001).

Hence, observation of sleeping behavior during quiet sleep, active sleep, and wake each time of sleep cycle under 40 minutes among preterm infants should conduct in 32 - 36 weeks of gestation phase. Therefore, the researcher selected to study in newborn with 32 - 36 weeks of gestation phase and record sleeping duration for 40 minutes according to sleeping cycle among the preterm infants in this study.

Sleep-wake periods among preterm infants are divided into 6 periods that differ from full term newborn because of the incomplete development of nervous system and muscles. It is difficult to separate behavior in the sleep or wake period unless using close observation. Sleep-wake periods among preterm infants categorized using opened and closed behaviors and eyelids movement, respiratory characteristics, facial and body movement (Brazelton, 1994; Brazelton & Nugent, 1995; Herman et al., 1997; Lowdermilk & Perry, 2006; Feigelman, 2007) that address details as following:

1. Quiet sleep or deep sleep: During this stage newborns present characteristics including closing eyes, non rapid eyes movement/NREM, regular respiration and heart rate, respiration related to deep and slow rhythm of abdominal movement, regular rhythmic sucking, no intentional facial and body movement, unless

there is something frightening them. They might be present frighten, fear, or slightly myoclonic movements.

Quiet sleep is significant and benefits a newborn's development. This phase needs complete neuronal coordination much more than any other phases (Peirano et al., 2003), a low level of oxygen when they fall in quiet sleep (Kooptanon & Puetipun, 2006), synthesized energy from nutrition to use for cell division and serotonin hypersecretion to stimulate growth hormones, decreases secretion of glucocorticoid, glucagon, and catecholamine that reduces energy catalysis resulting in weight gain among preterm infants. Moreover, during quiet sleep, there is hyposecretion of cortisol and adrenaline (Glass, 1994) that reduce stress among newborns.

2. Active sleep or lighter sleep: The newborn present characteristics including lagophthalmos, closing eyelids with rapid eye movement: REM 10 second per time, irregular respiratory pattern and heart rate, using thoracic wall in breathing, and irregular respiratory rhythm. They may have peristaltic waves, body spasm or straight and facial expression including frowning, smiling, moving lips, and sucking, however, there is occasionally only slight facial movements.

Active sleep is the most sleep among newborns, especially preterm infants, (Davis, Parker, & Montgomery, 2004). They fall into dreams during this phase and may be related to learning, memory, and a meditation process (Siripoon, 1993; Long, Lucey, & Phillips, 1980 cited in Naklinkool, 2003; Davis et al., 2004).

3. Drowsy or semi-dozing: This phase the newborn almost all fall asleep or half-asleep (semiconscious). They present the characteristics including drowsiness, heavy eyelids, inconsistency of closing and opened eyelids, or stagnant eyes, stupor, regular respiratory pattern but rather fast and shallow than normal respiration, irregular heart rate (fast rate), slightly facial movement. The newborn might be smile, crumple up, and occasionally move the lip. This phase the newborn have slow response to stimuli and might be fussy.

4. Quiet awake or active alert: The newborn in this phase will present with bright and sparkling eyes or turn to the source of sound (Feigelman, 2007). Preterm infants in this phase received physical and mental needs response. Therefore, the preterm infants feel happy. The newborn access information well in this phase,

therefore, it is appropriate for parents or caregivers to create a relationship with the newborn to promote development.

5. Active awake or considerable motor activity: The newborn present behavior similar to quiet awake. However, they will present much more body movement, light crying all time, irregular respiratory pattern, and might change skin color. If preterm infants does not meet the physical and mental need, such as hungry, wet or pain, they might change into crying phase.

6. Crying: The newborn in this phase communicate unsatisfaction, much more body movement, crying all time, regular respiratory pattern, and might be changing of skin color. The newborns do not meet their need or feel uncomfortable including pain.

Factors affecting to Sleep-wake of preterm infant

Preterm infants need to be admitted into an intensive care unit for newborns or preterm infants for a long time have to face the external environment before developmentally ready. It is at this stage they should not over exposed to nervous stimuli, such as loud sounds from medical equipment around them, conversational sound, and 24 hours of artificial light because these factors affect body system development (Thomas, 2007).

Sound

The sound that the fetus hears during in the natal period are sounds from the rhythm of heart rate, digestive system, circulatory system, and the maternal intrauterus that are the soft sounds that make them relax (Stanley et al., 1992). It's differ from the sound in the intensive care unit for newborn or preterm infants that are over sound levels for them (Thomas, 1989).

The pattern of sound in intensive care unit for the newborn or preterm infants is the irritating sound that have 2 characteristics as follow (Thomas, 1989; DePaul & Chambers, 1995; Standley, 2002).

1. Ambient sound or background sound which there are several levels of sound as described below (Bremmer, Byers, & Kiehl, 2003; Brandon, Ryan, & Barnes, 2007; Thomas & Uran, 2007)

Silent room	58 - 62 dB

Working sound of incubator	50 - 60 dB
Bird Respiration sound	63 - 75 dB
High frequency sound from bird respiration	85 - 110 dB
Sound from the oxygen pipeline	55 dB
Sound from the cardiac functional evaluation machine at 70% level of sound	65.8 dB
Sound from the cardiac functional evaluation machine at 30% level of sound	55.4 dB

2. Peak sound at several levels of sound as following (Brandon., et al., 2007; Bremmer., et al., 2003; Thomas et al., 2007)

Alarm sound from monitor machines	55 - 92 dB
Radio and television	55 - 92 dB
Opened and closed sound of incubator	92 - 124 dB
Conversation	58 - 64 dB
Sound to push milk bottom down on bedside cupboard	75.5 dB
Sound to push milk bottom down on incubator	96 - 117 dB
Closed and opened sound of the cupboard	69.8 dB
Opened sound of NG tube feeding	71.3 dB
Syringe pushing sound in the plastic plate	55.8 dB
Dragging sound of the chair on floor	62 dB
Turn on and turn off sound of the water tapping	66 - 67 dB
Rinsing sound of water	54.2 dB
Drawer Opened sound of the nursing care craft	58.9 dB
Sound of the turn on monitor machine	57.5 dB
Telephone sound	49.7 dB
Laughing sound of the personals	60 - 80 dB
Conversation sound among personals	58 - 64 dB
Whispering sounds	20 - 30 dB

Most of the preterm infants with low birth weights need to stay in an incubator. The levels of sound in an incubator range from 50 - 60 dB, while levels of the sound of the opened and closing door of the incubator range from 92 - 124 dB. The safety level of sound for newborn should not be over 58 dB (American Academy of

Pediatrics, 1974). The sounds of higher levels at 60 dB reduce blood oxygen saturation, increase intracranial pressure causing ventricular hemorrhage (Gray, Dostal, Ternull-Retta, & Armstrong, 1998). Moreover, the level of sound over than 60 dB makes negative effects such as increasing the secretion of cortisol (secreted during stress). Cortisol damages the cerebral cortex that is responsible to thinking and talent, while hippocampus is responsible to emotion, memory, and alert stimuli that interfere sleeping duration of the newborn (Chatkoop, 1999; Graven, 2000; Witt, 2008).

Nakklinkool (2003) compared the state of organizational system among 20 preterm infants in the resting and normal environment during 34 - 37 weeks of gestation phase. The newborn were the sample for both of experimental group (resting environment) and control group (normal environment). The resting environment were set two hours a day during 9.30 - 11.30 a.m. There was no touching sample during quiet hours and control sound not over than 58 dB. Sleeping evaluation among preterm infants were conducted using Brazelton's Neonatal Assessment Behavioral Scale (NABS). The results showed that preterm infants who were in the resting environment and control sound present more periods of quiet sleep than those who were in normal environment (Nakklinkool, 2003).

Light

Over lighting in the intensive care unit for the newborn or preterm infants waken them and reduce period of quiet sleep, while dim lights make them fall into quiet sleep longer, low oxygen use, decrease body movement and heart rate create increasing weight (Kooptanon & Puetipun, 2006; Glass, 2005). Light is the wave that is measured in Lux or Lumens/m^2 or Ftc that Lux is 10 times more value than Ftc (Holditch-Davis et al., 2003), such as light with 500 Lux is equal to 50 Ftc.

The America Academy of Pediatrics and American college of Obstetricians & Gynecologist recommended that the appropriate light intensity in the intensive care unit for newborn or preterm infants should be 60 Ftc. This level of light intensity is appropriate to observe newborn behavior. The average light intensity was between 60 - 80 Ftc in the intensive care unit that turn on the light 24 hours (Blackburn & VendenBerg, 1993). The intensity of light over 100 Ftc might damage eye structure and cause Retinopathy of Prematurity (ROP). Moreover, too much light

intensity reduces oxygen saturation, increases body movement, and prevents sleeping among newborns (Gardner & Lubchenco, 1998; Warorarn, 2006).

Blackburn and Patherson (1991) studied the cycle of light management among preterm infants. The findings showed that the newborn created a reduction of heart rate and low body movement while they stayed in the low intensity light (Blackburn & Patherson, 1991), this is similar to the findings of Rivkees and his colleagues. They studied the effect of light to sleep-wake cycle among 62 preterm infants who were less than 32 weeks of gestation. The preterm infants were divided into control groups, stay with dimly light all time and experimental group, stay in the room with day and night time. The Sleep-wake cycle and body movement evaluation among both groups of preterm infants using Actiwatches (Minimitler) were conducted. The findings indicated that the preterm infants who stay in the dimly room all time created much more sleeping development and lesser body movement than those who were in the room with day and night time. (Rivkees, Mayes, Jacobs, & Gross, 2004)

Sleep-wake evaluation of preterm infant

The central nervous system controls the sleep-wake cycle of the newborn. The sleep-wake control among preterm infants are not as good as adults because of the incomplete function of nervous system. This may be the reason that makes them difficulty to maintain sleep-wake status. Sleeping duration evaluation among preterm infants could be conducted from respiratory behavior, encephalogram, eyes movement, and muscle tone (Carskadon & Rechtschaffen, 1989 cited in Thanacharoenpipat, 2001). However, it is not reliable to use only one method (encephalogram or behavioral observation) to evaluate sleeping duration because of the incomplete development of nervous system and body function. Therefore, it should be used several methods to evaluate sleeping duration among preterm infants including physiological behavior observations and specific behavioral expressions (Holditch-Davis et al., 2003).

There are five common sleep-wake evaluations (Holditch-Davis et al., 2003) as follow:

1. Brazelton's State Scoring System: Brazelton was a pediatrician. In 1984, he and his colleagues created a behavior evaluation among newborn called

Neonatal Behavioral Assessment Scale (NBAS). This instrument is used to evaluate each newborn characteristic during sleep-wake changing process. The instrument is divided into six phases: 1) quiet or quiet sleep, 2) active or active sleep, 3) drowsy or semi-dozying, 4) quiet awake or active alert, 5) active awake or considerable motor activity, and finally crying.

Brazelton's State Scoring System is a widely used and simple assessment instrument that is clearly defined in each phase so that it creates a simple evaluation of sleep-wake period among newborns. However, this instrument divided into too few phase of the sleep-wake cycle. Therefore, this instrument could not separate the differences in behavior between normal newborns and newborns that have complications during the labor process. This evaluation form was appropriate to the newborn within 36 - 44 weeks of gestation. Also, this evaluation form was not appropriate to those who had gestation period less than or more than 36 - 44 weeks (Brazelton, 1994; Brazelton et al., 1995).

2. Thoman's State Scoring System was developed in 1975 to assess sleep-wake periods. This instrument is divided into 10 phases: 1) quiet sleep, 2) active quiet transition sleep, 3) active sleep, 4) Sleep-Wake transition, 5) drowsy, 6) daze, 7) alert, 8) non-alert waking activity, 9) fussy, and the final phase, crying.

Thoman's State Scoring System is reliable and simple to use, especially after using the more complex Brazelton's State Scoring System. This instrument could be used to separate the differences between behavior of the normal newborns and those who had complications during the labor process. This instrument was practical to evaluate sleep-wake cycle among preterm infants and full term newborn until one month of age. In addition, the researchers can merge some phases together if they think that it was too difficult to study. Therefore, this instrument was not as used worldwide as the Brazelton's State Scoring System. The researcher who collects the data should be trained before using it (Thoman, Holditch-Davis, Graham, Scholz, & Rowe cited in Holditch-Davis et al., 1993)

3. Als' State Scoring System is modified from Brazelton's State Scoring System, but is much more detailed. Als' instrument, the Assessment of Preterm Infants' Behavior (APIB), can evaluate sleep-wake behavior, including reaction evaluations, and stress of the newborn to environment among fetus with 36 – 44 weeks

of gestation. The instrument has 13 phases: 1) very still quiet sleep, 2) quiet sleep, 3) active sleep, 4) noisy active sleep, 5) drowsy with more activity, 6) drowsy, 7) awake and quiet, 8) hyper-alert, 9) bright alert, 10) phase was active, 11) considerable activity, 12) crying. And final phase was lusty crying. Each phase was different among preterm infants and full term newborn and related to the encephalogram. In addition, this evaluation could be use as basic data for development evaluation planning in each newborn (Neonatal Individualized Developmental Care and Assessment Program: NIDCAP)

As noted above, Als' State Scoring System explained the details of the sleep-wake cycle in preterm infants into 13 phases. However, this evaluation was not practical to use since there were too many phases to evaluate (Holditch-Davis et al., 1993; Holditch-Davis et al., 2003)

4. Anderson's State Scoring System is a behavioral evaluation used on newborns and is called the Anderson Behavioral State Scale (ABSS). This instrument was use to evaluate newborn behavior with Parmalee and Stern. There are 12 measures in this instrument: 1) very quit sleep, 2) quite sleep with irregular respirations, 3) restless sleep, 4) very restless sleep, 5) drowsy, 6) quite awake, 7) alert inactivity, 8) restless awake, 9) very restless awake, 10) fussing, 11) crying, 12) hard crying. Each phase was measured against heart rate and energy metabolism.

Anderson's State Scoring System was not used because there was no reported reliability and validity measures. The instrument was used on preterm infants and never used in full term newborns or over term new borns. Moreover, this instrument was more complex with its 12 phases when compared with other evaluations. Therefore, it is not appropriate to use (Holditch-Davis et al., 2003)

5. Pamaelee & Stern's Sleep-Wake Evaluation Form (Pamaelee et al., 1972) is the sleep-wake evaluation form among preterm infants. This instrument was developed for assessing sleep-wake phases among newborns by observing opened-closed eyes and total body movement and identify score for each phase without the need for encephalogram measurements. A live fetus observation was used as a criteria for each phase of the evaluation (Parmalee & Stern, 1972**;** cited in Charastong, 2001). The evaluation was divided into four phases: 1) quiet sleep, 2) awake and quiet, 3)

bright alert, and finally, crying. The details of how to score was addressed as (Michaelis, Parmelee, Stern, & Haber, 1973).

0 Closed eyes and no body movement
1 Closed eyes and facial movement
2 Closed eyes with upper and lower limbs movement
3 Closed eyes with whole body movement
4 Opening and closing eyes with or no body movement
5 Opened eyes with no body movement
6 Opened eyes with facial movement
7 Opened eyes with upper and lower limbs movement
8 Opened eyes with whole body movement
9 Cry with opened or closed eyes

Accordingly, the Pamaelee and Stern's sleep-wake evaluation form will be used in this study because it is a distinct evaluation form and divided the evaluation period into four simple phases.

The present study will use the sleep-wake record of the preterm infants and sleep-wake evaluation manual for preterm infants. These measures was translated into Thai and modified from Pamaelee and Stern's sleep-wake evaluation (Pamaelee & Stern; 1972) by Charastong (Charastong, 2001). The reason to select this instrument for preterm infants because of its simplicity of use it is not complicated to identify each sleeping duration in minute, and finally assign to the appropriate group division. This instrument separates the sleep-wake period into six phases: the first phase is the quiet sleep, the second phase is the active sleep, the third phase is the drowsy sleep, the fourth phase is the quiet alert, the fifth phase is the active alert, and finally, the crying. The preterm infants present behavior as illustrated as follow:

1. Quiet sleep refers to closed eyes, no eyelids movement, regular respiration, and movement of abdominal movement with no or slightly body movement, sometimes frighten startled

2. Active sleep refers to closed eyes, eyelids movement, irregular respiration with intercostal muscle movement, with body movement including upper and lower limbs, head, and trunk movement or the whole body movement

3. Drowsy sleep refers to heavy eyes, closed eyes, or half opened half closed eyes, irregular respiration, and have or no body movement

4. Quiet alert refers to opened eyes, gazing eyes, regular respiration, with some parts of body movement including upper and lower limbs, head, and trunk movement or no body movement

5. Active alert refers to fully opened eyes, irregular respiration, rapid thorax movement with whole body movement and muscle tone

6. Crying refers to opened or closed eyes, irregular respiration, rapid thorax movement with whole body movement and muscle tone

Quiet hours management

Quiet hours management refer to period of time during which the environment of both of the sound and light levels in the unit have been adjusted to lower than normal (Glass, 2005; Sudsaneha, 2005; Wannakhow, 2010) to let the patient rest. The Quiet hours management also refer to reduce unnecessary touching, tender and fast nursing care, bother the patient as less as possible, and finally appropriated sleeping position (Holditch-Davis et al., 2003; Thanacharoenpipat, 2001).

Factors affect to quiet hours management

Overly loud sounds always bother the sleep-wake cycle of preterm infants, especially sudden loud sounds or bothersome sounds caused by medical equipment and other sounds occurred in the patient unit. These sounds make the newborn infants wake up and easily cry. The body with higher activities using much more energy will reduce blood oxygen and negative effect to body and interfere with sleep duration among newborn infants (Thomas, 2007).

Light

Over lighting annoy the state of organizational system among preterm infant (White, Martin, & Graven, 1999). Over lighting or all time lighting reduce sleeping duration that make negative effect to body. Dim lightening create long quiet sleep among preterm infant including lower body movement, decrease respiratory and heart rate, increase blood oxygen saturation and body weight (Glass, 2005).

Touching

Most of the touching among preterm infant related to treatment or nursing care procedure that make uncomfortable and pain feeling. These response reactions effect to changing in respiration, heart rate, blood oxygen saturation, and sleeping among preterm infants (Intrapun, 2001), especially, in those who were touch by medical doctor and nurse over than 150 times per day. Frequently touching interfere sleep and make frequent wake up including short and incontinuous sleeping duration (Holditch-Davis et al., 2003; Glass, 2005) that could be effect growth and development among newborn infant.

Nursing care

Nursing care following the medical treatment, such as blood withdrawing, postural drainage, and other medical activities may be cause uncomfortable and pain in newborn infant. Nursing care activities also effect to the increasing respiratory and heart rate, decrease blood oxygen saturation (Young, 1996), and interfere sleep that are the negative effect to growth and development among newborn infant.

Sleeping position management

Preterm infants who sleep in supine position are shudder easier than those sleep in lean or lie prone that similar to newborn posture in natal period. The lean posture simply decreasing of the shudder among preterm infants because the newborn infants support themselves by put their hand in their mouth, while they lie prone on the soft surface make them feel warm, relax, and increase quiet sleeping duration. Therefore, semi-supine or posterior posture in sleeping promote the preterm infants to resting period, stable body function, and effective sleep (Young, 1996).

Nursing guideline to quiet hour management (Altimier, 2003; Saunders, 1995; Strauch et al., 1993) are details as follow:

1. Using incubator cloth cover to reduce friction between surface above incubator and other equipments

2. Avoid to put equipment or nurses note and medical treatment on the incubator

3. Do not cause louder sound using tender open and close of the room door, cupboard, and incubator opening

4. Should conversation with a voice that light and away from sleeping area of the newborn infant

5. Response to preterm infants crying, warning sound as quickly as possible to reduce hearing time period of the louder sound

6. Detect the sound level of the equipment in patient unit regularly

7. Move the telephone and radio far from the newborn sleeping area

8. Modify the warning sound of the control machine to the lowest level as hearing capacity

9. Limit number of the nurse, care giver, and relatives to reduce conversation sound

10. Select equipment with less than 40 decibel of the sound level using in NICU and SNB

11. Place the air conditioner far from the preterm infants sleeping area

12. Using soundproofed walls in the preterm infants sleeping area

13. Using carpet or vinyl material floor

14. Using lighting or shaking warning sound to blinking light or shaking pattern

According to the study of quiet hour management, Strauch and colleague (1993) studied the effect of the quiet hour management to the sound level in NICU. The findings showed that quiet hour period under average sound level of 52.2 decibel (S.D. = 5.0) using equally average sound level in the morning shift and evening shift and slightly louder sound in the afternoon shift. However, the comparison among the normal status of the NICU in the morning, afternoon, and evening shift indicated average sound level of 58.3 decibel (S.D. = 7.1). The average sound level in the evening shift, morning shift, and afternoon shift presented the highest to the lowest sound level, respectively. Also, the mid-week period showed higher average sound level than weekend period of 64 decibel to 52 decibel, respectively.

Saunders (1995) studied the comparison of the using and non-using incubator cloth cover to reduce sound level. The results showed that sound level during using incubator cloth cover lower than those of the non-using incubator cloth cover with statistically significant at level .05. Moreover, there was the studied of the quiet hour management to promote sleep among preterm infants by Strauch and

colleague (Strauch et al., 1993). They studied the effect of quiet hour management to sleeping duration among preterm infant. They found that active sleeping duration were decrease and quiet sleeping duration were increase from 33.9% to 84.5% during quiet hour management among preterm infants (Strauch et al., 1993) that relevant to the studies of Nakklinkul and Sudsanaha (Nakklinkul, 2003; Sudsanaha, 2005). They studied about the quiet hour management among preterm infant. The finding indicated that preterm infants who received quiet hour management had longer quiet sleeping duration than active sleeping duration. Also, the total sleeping duration was longer than those who was not received quiet hour management with statistically significant at level .05.

Music therapy

Music has a great impact on the human mind since it is able to effect our emotions which include enjoyment, depression, sadness, and anger in a brief period of time. The most attractive aspect of music is related to its ability to decrease sadness and stress. At the same time, music also induces happiness, body relaxation, adaptation into homeostasis, and finally, relief of pain among other health problems.

Music rhythms effect the human mind and stimulates humans' imagination. The cranial nerves expand and activate when they hear sound (Chareonsook, 2006.) The appropriated high-low level of pitch enhances personal concentration. When the ear receives musical sound in patterns of sound waves, the sensory receptor of hearing, (the tympanic membrane, ear oscines, and the organ of corti,) change the sound waves to electrical signals and cross the synapse to the neuron. Finally, the sound signals arrive at the deep (autonomic) processes to create the emotion of tempo and beat that are very important to the human body. The same speed level of pitch and heart rate make the body more relaxed, a more comfortable respiration-rate, and more stable and balanced blood-circulation. The melody enhances creative thinking and harmony on the imagination that has a lot of effects on the emotions. Synchronized harmony creates calmer emotions, better muscle relaxation better motivation (Poosiri, 2000; Pumduang, 2005). The infants who listen to the soft and slow music with low and middle sound level, (between 40-60 dB,) may feel

relaxed and sleep (Mukdasirikul, 2006), low electro encephalogram, creative thinking, imagination, perception, and a good emotional enviroment have a direct effect on the good emotional development of the infant. (Nuansuwan, 2004). Her study found that when we listen to favorable music, we feel happy and joyful because the music's sound stimulates the endorphin secretions that make us feel happy. Also, music increases interleukkin-1 level, (a significant substance to stimulate brain functions,) reduces cortisone secretion, (a stress inducing substance,) and reduces testosterone level, (an aggressive inducing hormone.) Music affects encephalogram development, promotes a stable and regular heart rate, and promotes good body locomotion (Nakphet, 2005).

The effect of Mozart music to vital signs and sleeping duration among preterm infants

Music has been used in the medical service since ancient era to body strengthens, reduce pain and suffer, cry management, and development stimulation among newborn. There was reliable evidence that the newborn who listen to the good-night song or classic song for 30 minutes to one hour and a half under control of 58 dB presented sleep with calm and without crying sound. In addition, good-night song assist longer sleep, growth development, and good brain development resulted in reducing day of hospital admission (Almerud & Peterson, 2003; Nakklinkool, 2003; Sidebotham, 2003; Kemper & Danhauer, 2005; Sudsaneha, 2005). There is trying to relief pain, relaxing, and promoting growth development using music and song among preterm infants to reach the goal of healthiness (Keith, Russell, & Weaver, 2009). Classical music, especially Mozart music was use in medicine because of the belief that specific music rhythm of Mozart music imitates some biological rhythm cycles in the brain among human being (Campbell, 2002).

There were studies related to the effect of Mozart music among preterm infant. The findings showed that music passed into the ear canal and changed into energy and electric current to the brain and emotional center, somethetic (sensory) area, and sensory of touch caused functional reduction of synapse, emotional response, and slow eyes movement (Updike, 1990; Braun & Anderson, 2007;). The newborn feel relax and easily fall in sleeping cycle much longer. Moreover, Mozart music

stimulates more serotonin and endorphin secretion than normal status. Music also relief pain, reduce sympathetic nervous system function, and low body response. Mozart music is a classical music with consistency and regular repetition that create imagination in the brain of the newborn and listening concentration attractive follow until the end of the music. Therefore, classical music is more appropriate to brain and emotional development than other kinds of music. Consistency speed of the music make the newborn relaxes, reduce stress and heart rate, decrease and regular respiration rate, increase oxygen saturation, decrease energy consumption during rest create weight gain (Lemmer, 2008; Lubetzky et al., 2009).

Lubetzky and colleague (2009) studied the effect of Mozart music to energy use during growth development among preterm infant. The purpose of their studied was evaluating weight gain among preterm infants after listening to the Mozart music. Their research design was prospective and sample size was the 20 healthy preterm infants that had appropriate weight related to gestation phase and received nasogastric tube feeding. Categorized sample using randomized technique to listen to the Mozart music for 30 minutes or control group who did not listening to the Mozart music. The intervention was conducted once a day for two days one hour after milk feeding (12 a.m.). The environment within incubator was also set with no less than 45 dB of miscellaneous sound and no less than 75 dB of the Mozart music. The pretest group of the newborn listened to the music for 10 minutes and measure energy metabolized for 30 minutes using indirect measure by calories consumption per kilogram per day using Deltatrac II Metabolic monitor. This monitor measures the oxygen consumption and carbon dioxide production of the newborn. The results showed that resting energy consumption nearly the same during first 10 minutes of both groups. Ten minutes later, the results showed that the group of preterm infants who listened to the Mozart music had resting energy consumption less than the group of preterm infants who did not listen to the Mozart music and decreased of energy consumption during last 10 minutes equally both groups with statistically significant ($p = .028$ and $p = .03$) respectively. The effect of the Mozart music to energy consumption among preterm infants during rest reduce for 10 - 13 % of basic value and effect in 10 - 30 minutes. Therefore, listening to the Mozart music reduced resting energy consumption among healthy preterm infants (Lubetzky et al., 2009).

Cassidy (2009) studied the effect of music to physiological responses and head circumstance in 62 preterm infants with gestation phase between 28 - 33 weeks. There were 31 preterm infants in experimental group listened to good-night song 20 minutes for 2 days, then listened to Mozart string music 20 minutes for 2 days. At the same time, another group with 31 preterm infants listened to the Mozart string music before good-night song. The sample had been divided into 4 subgroups that first three subgroups listened to different levels of song including 65 dB, 70 dB, and 75 dB, and final group that is the control group (did not listen to any song). Head circumstance was measured four times: 1) after signed parent permission, 2) the beginning day of listening to the music (one week after permission), 3) final day of listening to the music and finally, one week later. Measuring of physiological responses including heart rate, respiratory rate, and oxygen saturation every 2 minutes were conducted 14 times (four minutes prior to listening to the music and continue measures until the end of the music, and four minutes after listening to the music). The findings showed increasing head circumstances with statistically significant ($p < .001$), and might not be related to listening to because the increasing of head circumstance similar to those group who did not listen to the music. Physiological response of heart rate reduced statistically significance ($p = .002$) (Cassidy, 2009).

Therefore, this study presented that listening to the Mozart music increased average head circumstance and reduced resting energy consumption that resulted in weight gain. Moreover, Mozart music affected not only growth development but also physiological responses by reduced heart rate and increased oxygen saturation. These events made preterm infants fall in good sleeping duration that created positive effects to brain development and good development in the future. In addition, recent literature review showed that there was no study about the effect of the Mozart music to sleeping duration among preterm infants in Thailand and in abroad. There were only studies about the effect of the Mozart music to weight gain, reduced heart rate, and increased oxygen saturation among preterm infants. Therefore, the researcher interested to study the effect of the Mozart music to sleeping duration among preterm infant. The results from this study should be use as a guideline to promote sleeping pattern among preterm infants.

CHAPTER III
MATERIALS AND METHODS

A Cross-over experimental research design was used to compare heart rate, respiration rate, oxygen saturation and total sleeping hours in preterm infants during listening to Mozart music and not listening to Mozart music. This study conducted in one sample group that each preterm infant was a self control and randomized control as well. The researcher was an observer and recorder the sleeping duration of the sample group.

Population and Sampling

The study population comprised of preterm infants who were admitted in preterm infants' ward of Nopparat Rajathanee Hospital during September, 2010-January, 2011. Eligible participants were also recruited according to the purposive sampling following these inclusion criteria:

1. Preterm infants with 32-36 weeks of gestation duration with appropriate for gestational age: AGA or body weight between percentile 10 - 90

2. Normal hearing determined by the personnel of the Nopparat Rajathanee Hospital

3. No oxygen administration, stable condition, and not in crisis status according to medical doctor's investigation (normal physical temperature, heart rate, respiration rate, and oxygen saturation including there was no respiratory arrest)

4. Having no congenital anomaly or perinatal complications, such as infection, inflammatory bowel disease, lung complication, and epilepsy that were investigated by a physician

5. Receiving no drug affecting sleeping pattern, such as Phenobarbital, chloral hydrate, or a antihistamine

6. Parents of the preterm infants were willing to participate in this study including those who were illiterate and were able to communicate in the Thai language

7. Permission from a physician to undertake the study

Exclusion Criteria:

Stop the intervention in case of the preterm infants cry and could not stop crying by themselves or the amount of the oxygen saturation less than 90 % and cannot adapt to normal value

Sample size calculation

The sample size in this study was computed using the Glass's formula (Glass, McGaw, & Smith, 1981) at the statistically significance level .05 and power of test = .80, effect size value = .83 (Standley, 2002), and effect size of the Pearson (r) = 0.44 (Flowers, McCain, & Hillker, 1999). The value of the effect size was retrieved from the literature review of 10 studies of Stanley about the effect of the music therapy in preterm infants. The sample size value of the sample group, calculated from the formula, was 13.9 participants, therefore, the researcher used 15 participants to prevent loss of information from participant attrition.

Formula

$$d = \frac{\sqrt{N-2}}{N}\left(\frac{2r}{\sqrt{1-r^2}}\right)$$

d = effect size .83

r = effect size of the Pearson .4383 (~.44)

Research Setting

This study was conducted in Sick Newborn Care Unit, Nopparat Rajathanee Hospital. This unit cares for preterm and full term infants. The unit cares for babies born at Nopparat Rajathanee Hospital or referred from other hospitals. There are 36 beds in the unit. There were 5 rooms: 1) first room is the isolation room

for those refer from other hospitals, or preterm infant who was not born in Nopparat Rajathanee Hospital, or preterm infant who were recover and had no need for intensive care, 2) second room for the preterm infant with chronic illness, or preterm infants who was not born in Nopparat Rajathanee Hospital, or preterm infant who were waiting for discharge, 3) the third room was for preterm infants who have jaundice or preterm infant who waiting for injection, 4-5) fourth and fifth room for those who were preterm infant , or preterm infant who need intensive care, or preterm infant who were in the duration of growing up. The preterm infant or underweight infant with less than 1,800 gram will stay in the incubator. They receive nursing care follow the appropriate time and 3-hour milk feeding. There is no quiet hour because the light will be turned on all day and all night. The infants were probably also irritated from medical equipments, air conditioning, telephone noise, and personnel's voice. The eligible preterm infant recruited from the preterm infants who admitted in the fourth or fifth room.

Protection of Human Subjects and Confidentiality Consent Statement

After this statement/consent form and instrument for the research study were approved by the Faculty of Medicine, Ramathibodi Human Research Review Committee, the investigator introduced oneself to the parents of the potential participants. This study followed the Helsinki Protocol; participating parents were informed about the details of the study including objectives, methods, benefits and risks, participants' rights, and identification protection. The parents of the preterm infants were also informed that the preterm infant in this study will listen to Mozart's music and measure the vital signs and sleeping duration. There trend to be positive effect to the preterm infant and there is no risk or harm to them. Also, they will have an intensive care during the study. The participants' parents had the right to decline participation or withdrawal from the study at any time without affecting the childs' treatment. Participants' identification was protected using code numbers on the data sheets and password protection on computer files. Confidentiality was assured by placing the master list of subjects' names and code numbers in a locked cabinet in a secured place. All data presented in summary form of study reports. Their names and

addresses were not being attached to the data. The participants' parents who are willing to participate in this study need to sign their names in a consent form.

Research Instruments

The instruments in this study divided into two kinds including instrument for intervention and instrument for data collection. The details of each instrument were as follows:

1. Instruments for intervention

1.1 The Mozart music in the album series of the Mozart Effect Music for Babies Volume II Nighty Night with music code Larghetto, II, from the Clarinet in A Major, K. 581 (Campbell, 2002) for eight minutes per round. It consists of five rounds; therefore, total time is 40 minutes in memo record of MP3 under Sony brand and turn on with 58 decibel (American Academy of Pediatrics, 1974).

1.2 The instrument for measuring heart rate and blood oxygen saturation using masimo that pass the instrument qualification by the medical instrument inspection company once a year and maintenance twice a year, or according to the lifetime. The accuracy among measurements as following: heart rate ±5%, oxygen saturation ±2% with sensor probe and 1-inch elastic for sensor probe that using the same machine throughout the study.

1.3 Sound level instrument using Sound Level Meter Digicon DS 40 in decibel and last pass calibrate the accuracy from the NEEDISS SUPPLY AND SERVICE CO., LTD. on 10th August 2010.

1.4 Light intensity instrument using LUX METER TM-201 in lux and pass calibrate the accuracy from the TENMARS ELECTRONICS CO., LTD. on 14th July 2010.

1.5 MP3-Samsung player and loudspeaker for 40 minutes Mozart music recording that pass the instrument qualification and use the same machine throughout the study.

1.6 Hearing instrument using TEOAE, GN otometrics, Model AccuScreen, Serial No. 31845 that pass the instrument qualification by the medical instrument inspection once a year and maintenance twice a year or according to the

lifetime. This instrument was inspected by the personnel of Nopparat Rajathanee Hospital every time before use with each newborn infant.

1.7 Dark-Video recorder using Sanyo VPC-TH 1 to inspect the quality before using and use the same machine throughout the study.

2. Instruments for data collection:

2.1 General data recording included gender, birth method, gestation duration, birth weight, date of the study, diagnosis, treatment, and present medication

2.2 The sleep-wake record form for preterm infants, (Charastong, 2001) that record sleeping pattern of the preterm infant using video recorder. Then, the researcher observe the sleeping behavior of the preterm infant from the video and record sleeping of the infant in recording form every one minute for 40 minutes

2.3 The sleep-wake evaluation manual for preterm infant that modified from Pamaelee & Stern's sleep-wake evaluation (Pamaelee & Stern, 1972) translated into Thai by Charastong (Charastong, 2001). The manual divided into six durations as follows:

Quiet sleeping duration refers to closed eyes, no eyelids movement, regular respiration, and movement of abdominal movement with no or slightly body movement, sometimes frighten startled that recorded using symbol as follow:

Active sleeping duration refers to closed eyes, eyelids movement, irregular respiration using intercostal muscle movement, with body movement including upper and lower limbs, head, and trunk movement or the whole body movement that recorded using symbol as follow:

Drowsy sleeping duration refers to heavy eyes, closed eyes, or half opened half closed eyes, irregular respiration, and have or no body movement that recorded using symbol as follow:

Quiet alert duration refers to opened eyes, gazing eyes, regular respiration, with some parts of body movement including upper and lower limbs, head, and trunk movement or no body movement that recorded using symbol as follow:

Active alert duration refers to fully opened eyes, irregular respiration, rapid thorax movement with whole body movement and muscle tone that recorded using symbol as follow:

Crying duration refers to opened or closed eyes, irregular respiration, and rapid thorax / movement with whole body movement and muscle tone that recorded using symbol as follow:

The result from the record, interpretation from video after record of deep sleep, light sleep, drowsy, quiet awake, active awake, crying. The video was interpreted after collecting data for a week to prevent bias.

2.4 Light and sound intensity was recorded five minutes before the experiment and the twenty minutes during experiment to control light for not more than 600 Lux and sound for not louder than 58 decibels.

2.5 Heart rate and oxygen saturation record form that was recorded every minute and respiration rate every 10 minutes.

The Mozart music recording

Mozart music record using Samsung MP3 player to record in the memory card for 40 minutes

Instrument qualification

The preterm infant and sleep-wake evaluation manual for preterm infant (Charastong, 2001) that translated into Thai and modified from Pamaelee & Stern's sleep-wake evaluation (Pamaelee & Stern, 1972) were conducted for content validity and reliability as below:

1. Content validity

The researcher used the Sleep-wake record form for preterm infants and evaluation manual for the sleep-wake of the preterm infant developed by Pamaelee & Stern (Pamaelee & Stern, 1972) and modified by Charastong (Charastong, 2001). This evaluation manual was translated into Thai language and was verified by five experts who met the criteria of expertise for evaluation of instrument including two nursing instructors in the ward for newborn and preterm infants, one medical doctor who was an expert in newborn infants, one nurse who had an experience in preterm infants, and one nurse who had an experience about the intensive care newborn.

2. Reliability

The researcher and the experts were observed and evaluated sleep behavior among preterm infant and then recorded details of each sleeping duration in the recording form minute to minute for 10 cases. The reliability was conducted before study using the formula of Polit & Hungler (1999).

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

The calculated value should be sought 0.90 or better for new instrument.

In this study the reliability = .90

Data collection

After sample recruitment, the collection process was conducted using the process as follow:

1. The researcher presented the proposal and instruments of the study to the Human Research Board for the Ethic of the Faculty of Medicine, Ramathibodi Hospital, Mahidol University and the Human Research Board of the Nopparat Rajathanee Hospital for reviewed.

2. After Ethic approval, the researcher contacted the Director of the Nopparat rajathni hospital for data collection via sending the document both of the approval from the Human Research Board for Ethics from Mahidol University and executive summary of the proposal.

3. After obtaining the approval from the Director of the Nopparat Rajathanee Hospital for the researcher to approach the potential participants and head of the ward for preterm infant patients to inform about the details and data collection; including preparing the setting for the study.

4. The researcher listed the name and history of the preterm infant including the mother's history from obstetric form at ward of the preterm infant patients, Nopparat Rajathanee Hospital.

5. Purposive sampling was conducted by the researcher on patients meeting the inclusion criteria.

6. Hearing test among the sample group using the instrument of TEOAE, GN otometrics, Model Accu Screen, Serial No. 31845 was conducted by the health personnel of the Nopparat Rajathanee Hospital. The sample who was not passed the hearing test were excluded from the study.

7. The researcher informed the parents of the sample group after self introduction for relationship creation. Then the researcher provided information about the purposes and method of this study to encourage them to participate during data collection. Potential guardian were informed and obtained the consent form. After completing the consent form. The researcher conducted the procedure follow the below step.

8. Recorded data were conducted as general information record

9. Divided the experimental into two situation equally and sampling them using two labels with details as follow: 1) listening to the Mozart's music before none listening to the Mozart's music (mozart/none) and 2) non listening to the Mozart's music before listening to the Mozart's music (none/Mozart). Every preterm infant will be exposed the same treatment but sampling different time, by anybody who not involve. The preterm infants who listened to Mozart's music were in the experimental duration of the study and the preterm infants who did not listened to Mozart's music were in the control for the duration of the study.

10. Each preterm infant received two experiment studies for 40 minutes for each time for two days. The experimental study will be conducted once a day during 4 - 6 p.m. or 7 - 10 p.m. since there was no medical or nursing procedures during this time. The experimental study will be conducted another time in the same interval for the next day to let the preterm infant rest and received the routine nursing care. Also, to prevent the effects of the first experimental to the next experimental study.

Preparation duration

The researcher conducted as following:

1. Equipment preparation for the study including blood oxygen saturation and heart rate measurement, sound level measurement, light intensity measurement, MP3 player, loud speaker, the Mozart music, video, and video standing

2. Incubator preparation to set the appropriate temperature for the newborn infant, next preparing for infant to sleep, and incubation cover used for light reducing

3. Oxygen saturation and heart rate machine setting at the one foot of the infant to observe the infant during the study. The researcher adapted the most lighting, sound level, and oxygen saturation to reduce the interfering sound. If there were abnormal oxygen saturation or heart rate, the intervention was stopped, conducted the nursing care and medical record.

4. The researcher tests the MP 3 player for Mozart's music recording and set the loud sound at the level not more than 58 decibel when measure nears the ear. The sound at this level does not cause any harm to newborn infant. Therefore, the

researcher has to set the level of sound at 58 decibel and test the level of sound every time before conduct the experimental study.

5. Set the video recorder to record the sleep-wake behavior among preterm infants

6. Reduce the interfering sound and sound control in the experimental area, especially in the incubator which should be less than 58 decibel of the sound level

7. Reduce light and light control in the experimental area, especially in incubator should be less than 600 Lux of the light intensity

8. Milk feeding following the treatment should be conduct 30 minutes before intervention to prevent vomiting and aspiration during experiment. To conveniently behavior observation and listening to the music of the newborn infant, the preterm infants should be set to lie in the nest made from the cloth that circle around the infants creating an environment similar to the uterus.

9. Elimination administration and long-lasing pamper changing before beginning the experimental to reduce the interfering cause from elimination during study

Experimental duration (listening to Mozart's music)

The research was conducted as follows:

1. Measure the sound and light intensity 5 minutes before experimental study and at the 20 minutes during experiment and record the actual value in the sound and the light intensity recording form

2. Turn on Mozart's music from MP3 player at the sound level not more than 58 decibels and begin to record using the video recorder to observe sleeping behavior.

3. During the experimental study, the researcher recorded heart rate and oxygen saturation every one minute and respiration rate every 10 minutes for 40 minutes in the recording form for heart rate, oxygen saturation, and respiration rate. The sleep-wake behavior was studied to observe and interpret sleep-wake duration minute by minute from the video and recorded in the sleep-wake recording form

4. Stop the experiment in case of the preterm infant cannot stop crying by themselves or the oxygen saturation value is less than 90% and cannot return to the normal status. The study would be stopped immediately and abnormality was reported to the doctor. In such a case the infants were helped and excluded from the study.

Control duration (Non listening to Mozart's music)

The researcher treated on control duration both preparation and experimental duration, except experimental step that did not turn on Mozart's music, recorded and observed the infants' sleeping behavior

The experimental method can be summarized as following:

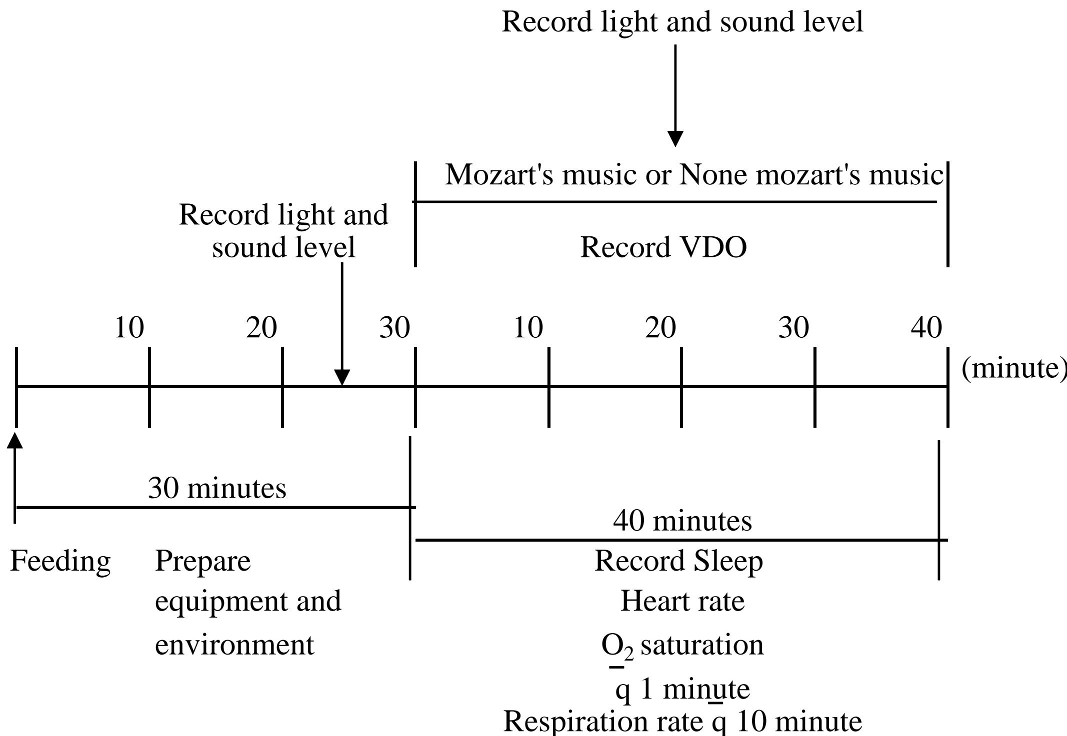


Figure 3.1 Overview of the intervention procedure

Data Analysis

The data was analyzed using a Statistical Software package after a week in order to reduce storage bias sequentially as follow:

1. Descriptive statistical analysis for general information of the samples was also conducted, such as frequency, percentage of responses, mean, and standard deviations.

2. Descriptive statistical analysis for light and quiet sleeping duration interpretation and total sleep time in each duration were also conducted in minute and percentage in each sleeping duration

3. Paired t-test was use to compare the mean change among the heart rate, respiration rate, oxygen saturation, quiet sleeping duration, active sleeping duration, and total sleeping duration while listening to the music and non listening to the music

CHAPTER IV
RESULTS

This study has presented the effects of Mozart's music on the vital signs, oxygen saturation and sleeping duration of preterm infants. It was a Cross-over experimental design research study to compare the heart rate, respiratory rate, oxygen saturation, and sleeping duration among preterm infants during listening to Mozart's music and during not listening to Mozart's music in the same 15 participants. Every preterm infant was the control group by themselves. The results from the study are presented in the table with the details divided into three parts as follows:

Part I: Demographic characteristics of the sample group

Part II: The heart rate, respiratory rate, oxygen saturation and sleeping duration of 15 preterm infants while listening to Mozart's music and non listening to Mozart's music.

Part III: Hypothesis testing

Part I: Demographic characteristics of the sample group

The information about gender, gestation duration, age at the time of the experiment, birth-weight, means of childbirth, (natural or ceasarian section,) using descriptive statistics presented frequency, percentage, maximum-minimum, mean, and standard deviation as illustrated in table 4.1.

Table 4.1: Demographic characteristics of the number, percentile, minimum-maximum, mean and standard deviation of the study sample. (n = 15)

Characteristics	Number	Percentage	Min – Max	Mean	S.D.
Gender					
Male	6	40			
Female	9	60			
Gestation duration (weeks)					
32-34	4	27	33-36	34.80	.94
>34-36	11	73			
Birth age (days)					
< 1-2	0	0	3-4	3.20	.41
3-4	15	100			
Birth weight (grams)					
1,500-1,999	2	13	1,910-2,410	2,187.33	150.16
2,000-2,499	13	87			
Childbirth					
Normal labor	6	40			
Cesarean section	9	60			

Table 4.1 presented data analysis of the 15 studied samples including 9 female (60%) and six males (40%). Most of the sample had pregnancies of more than 34 weeks of gestation duration, but not more than 36 weeks with a mean gestation duration of 34.8 weeks (S.D. = .94), minimum gestation duration 33 weeks, maximum gestation duration 36 weeks, age since birth- three to four days, mean age 3.20 days, (S.D. = .41). The minimum age was three days, maximum was four days, and weight between 2,000 - 2,499 gram for 13 cases (87%) with mean weight 2,187.33 gram (S.D. = 150.16), minimum weight 1,910 gram, maximum weight 2,410 gram. Most of the sample were delivered by cesarean section- nine cases, and natural delivery for six cases.

Part II: The heart rate, respiratory rate, oxygen saturation and sleeping duration among preterm infants while listening to Mozart's music and non listening to Mozart's music.

The data about the heart rate, respiratory rate, oxygen saturation, quiet sleep, active sleep, and total sleep were collected every minute for 40 minutes, in the following tables- Table 4.2 to Table 4.6.

Table 4.2: Descriptive data of the heart rate, respiratory rate, and oxygen saturation during listening and non listening to Mozart's music. (n = 15)

Vital Signs	Mozart's music			None Mozart's music		
	Min-Max	Mean	S.D.	Min-Max	Mean	S.D.
HR	123-149	133.40	7.44	124-149	134.53	7.16
RR	31-44	37.47	3.38	34-46	38.87	3.42
SpO_2	97.50-100	99.13	0.64	95.50-100	98.47	1.22

Table 4.2 The data analysis of the heart rate and the respiratory rate while listening to Mozart's music were of less value than those of the non listening to Mozart's music as illustrated by the following: the heart rate during listening to Mozart's music presented a mean value of 133.40 beats per minute (S.D. = 7.44.) The minimum value was 123 beats per minute and the maximum value was 149 beats per minute. The heart rate during non listening to Mozart's music presented a mean value of 134.53 beats per minute (S.D. = 7.16) and a minimum value of 124 beats per minute. This clearly shows an average decrease of 1.13 beats per minute while listening to Mozart's music. The maximum value was 149 beats per minute. The mean value of the respiratory rate while listening to Mozart's music was 37.47 breaths per minute (S.D. = 3.38), and the minimum value was 31 breaths per minute. The maximum value was 44 breaths per minute. The respiratory rate during non listening to Mozart's music was 38.87 breaths per minute (S.D. = 3.42,) -1.4 respirations per minute more than during the music. The minimum value was 34 breaths per minute and the maximum value was 46 breaths per minute. Interestingly, the oxygen

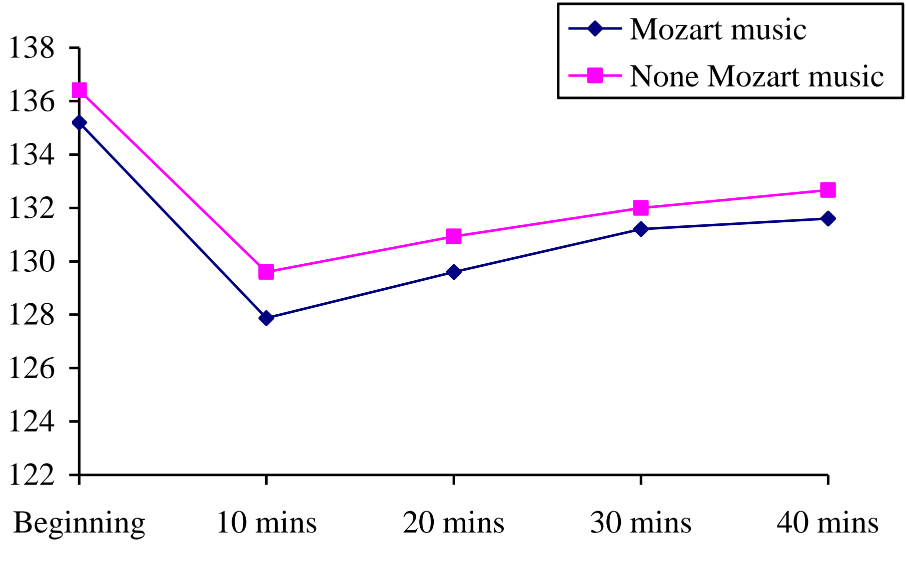
saturation while listening to Mozart's music was more than the oxygen saturation during the non listening to Mozart's music period. The mean value of the oxygen saturation while listening to Mozart's music was 99.13% (S.D. = 0.64), with the minimum value being 97.50%, and the maximum value was 100%. While the mean value of the oxygen saturation during non listening to Mozart's music was 98.47%, (S.D. = 1.22,) - an increase of 0.66% during listening to the music. The minimum value was 95.50 % and the maximum value was 100%.

Table 4.3: Comparison of the mean value of the heart rate over time during listening to Mozart's music and non listening to Mozart's music. (n = 15)

Heart rate over time	Mean		S.D.		$\bar{D}$	$S_{\bar{d}}$	t	p-value (one-tailed)
	M	NM	M	NM				
Beginning	135.20	136.40	9.38	9.30	1.20	1.47	3.154	.004
10 mins	127.87	129.60	9.30	7.94	1.73	2.92	2.303	.019
20 mins	129.60	130.93	9.95	9.65	1.33	2.35	2.197	.023
30 mins	131.20	132.00	11.13	10.64	0.80	1.82	1.702	.056
40 mins	131.60	132.67	8.15	7.12	1.07	2.71	1.524	.075

M = Mozart's music

NM = None Mozart's music



Time intervals

Figure 4.1 Mean of heart rate over time

Table 4.3 presents the data analysis of the mean value, standard deviation, and mean difference of heart rate over time among preterm infants while listening to Mozart's music and non listening to Mozart's music. The mean heart rate and standard deviation while listening to Mozart's music at the beginning, and at 10, 20, 30, and 40 minutes-on were 135.20 beats per minute (S.D. = 9.38); 127.87 beats per minute (S.D. = 9.30); 129.60 beats per minute (S.D. = 9.95); 131.20 beats per minute (S.D. = 11.13); and 131.60 beats per minute (S.D. = 8.15) respectively. The mean heart rate and standard deviation during the non listening to Mozart's music periods were at the beginning, 10, 20, 30, and 40 minutes-on were 136.40 beats per minute (S.D. = 9.30); 129.60 beats per minute (S.D. = 7.94); 130.93 beats per minute (S.D. = 9.65); 132 beats per minute (S.D. = 10.64); and 132.67 beats per minute (S.D. = 7.12) respectively. Finally, the comparison of the mean difference of heart rate over time during listening to Mozart's music and non listening to Mozart's music using Paired t-test statistical method, (α = .05,) found that the mean of the heart rate over time at the beginning, 10, and 20 was statistically significant different ($p < .05$, $p < .01$) and at the 30 and 40 minute, the heart rate were not statistically significant different ($p > .05$).

Table 4.4: Comparison of the mean value of the respiratory rate over time during listening to Mozart's music and non listening to Mozart's music. (n = 15)

Respiratory rate over time	Mean		S.D.		$\bar{D}$	$S_{\bar{d}}$	t	p-value (one-tailed)
	M	NM	M	NM				
Beginning	39.60	40	4.79	4.41	4.00	1.35	1.146	.136
10 mins	36.27	39.33	4.46	6.13	3.07	2.92	4.075	.001
20 mins	35.20	38.80	3.99	4.65	3.60	5.25	2.657	.009
30 mins	34.67	37.60	4.12	5.91	2.93	4.83	2.351	.017
40 mins	35.33	37.73	3.44	3.77	2.40	3.40	2.736	.008

M = Mozart's music

NM = None Mozart's music

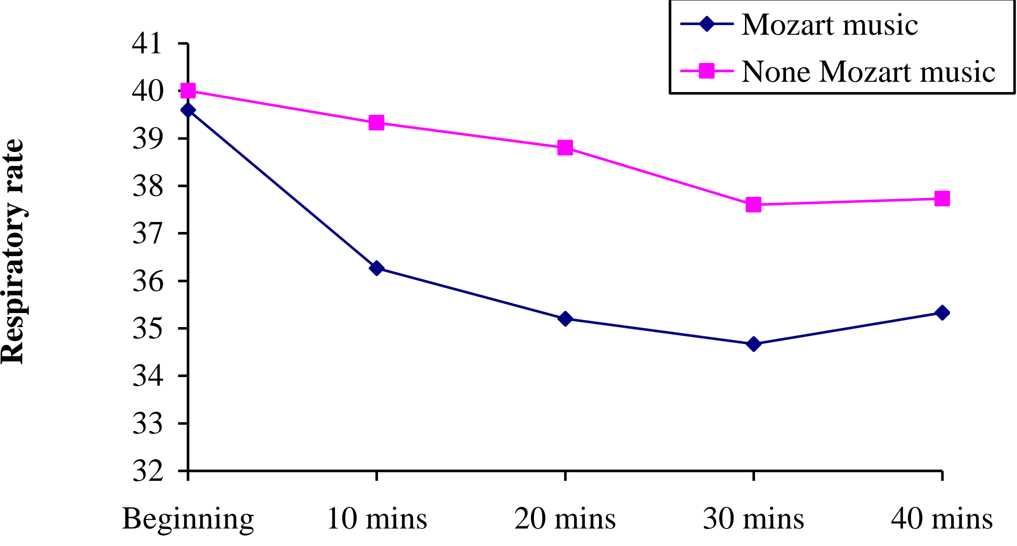


Figure 4.2 Mean of respiratory rate over time

Table 4.4 presented the data analysis of the mean value, standard deviation, and mean difference of the respiratory rate over time among preterm infants while listening to Mozart's music and non listening to Mozart's music. The mean respiratory rate and standard deviation while listening to Mozart's music at the beginning, 10, 20, 30, and 40 were 39.60 breaths per minute (S.D. = 4.79); 36.27 breaths per minute (S.D. = 4.46); 35.20 breaths per minute (S.D. = 3.99); 34.67 breaths per minute (S.D. = 4.12); and 35.33 breaths per minute (S.D. = 3.44) respectively. The mean respiratory rate and standard deviation during non listening to Mozart's music at the beginning, 10, 20, 30, and 40 minutes were 40 breaths per minute (S.D. = 4.41); 39.33 breaths per minute (S.D. = 6.13); 38.80 breaths per minute (S.D. = 4.65); 37.60 breaths per minute (S.D. = 5.91); and 37.73 breaths per minute (S.D. = 3.77) respectively. Finally, the comparison of the mean difference of respiratory rate over time while listening to Mozart's music and non listening to Mozart's music using Paired t-test statistical method ($\alpha = .05$) found that the mean of the respiratory rate over time at the 10, 20, 30, and 40 minute was statistically significant different ($p < .001$, $p < .01$, $p < .05$) and at the beginning was not statistically significant different ($p > .05$).

Table 4.5: Comparison of the mean value of the oxygen saturation over time during listening to Mozart's music and non listening to Mozart's music. (n = 15)

Oxygen saturation over time	Mean		S.D.		$\bar{D}$	$S_{\bar{d}}$	t	p-value (one-tailed)
	M	NM	M	NM				
Beginning	98.87	98.07	1.06	1.49	0.80	1.32	2.347	.017
10 mins	99.60	99.00	0.63	0.85	0.60	0.91	2.553	.012
20 mins	99.47	98.67	0.74	1.05	0.80	1.21	2.567	.011
30 mins	99.27	99.00	0.59	0.76	0.27	0.46	2.256	.021
40 mins	99.40	98.87	0.63	1.13	0.53	1.13	1.835	.044

M = Mozart's music

NM = None Mozart's music

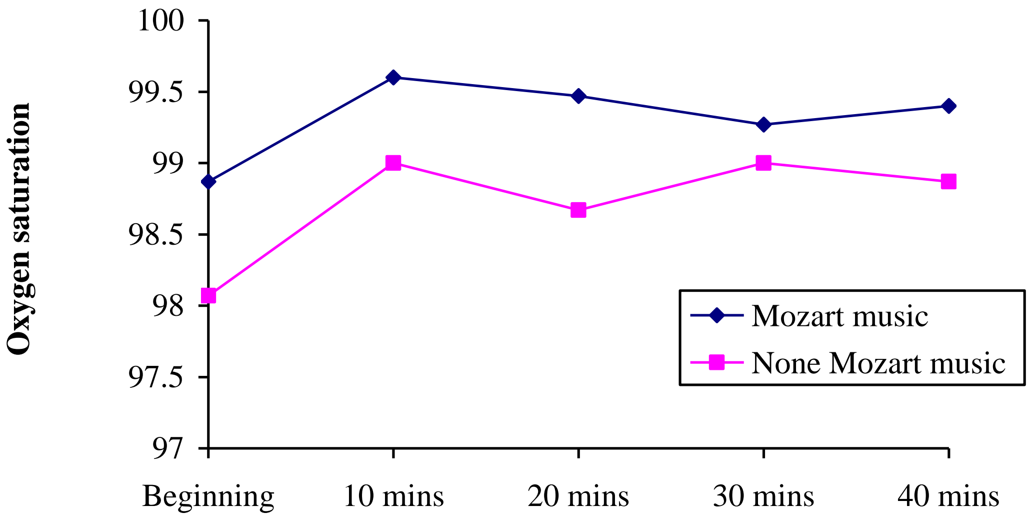


Figure 4.3 Mean of oxygen saturation over time

Table 4.5 presents the data analysis of the mean, standard deviation, and mean difference of oxygen saturation over time among preterm infants while listening to Mozart's music and non listening to Mozart's music. The mean of oxygen saturation and standard deviation while listening to Mozart's music at the beginning, 10, 20, 30, and 40 minutes were 98.87 % (S.D. = 1.06); 99.60 % (S.D. = 0.63); 99.47 % (S.D. = 0.74); 99.27 % (S.D. = 0.59); and 99.40 % (S.D. = 0.63) respectively. The mean oxygen saturation and standard deviation during non listening to Mozart's music at the beginning, 10, 20, 30, and 40 minutes on were 98.07 % (S.D. = 1.49); 99 % (S.D. = 0.85); 98.67 % (S.D. = 1.05); 99 % (S.D. = 0.76); and 98.87 % (S.D. = 1.13) respectively. Finally, the comparison of the mean difference of oxygen saturation over time while listening to Mozart's music and non listening to Mozart's music using the paired t-test statistical method, ($\alpha = .05$,) found that the mean of oxygen saturation over time at the beginning, 10, 20, 30, and 40 minutes was statistically significant different ($p < .05$).

Table 4.6: Minimum-maximum value, mean, and standard deviation of each sleeping duration during listening and non listening to Mozart's music. (n = 15)

Sleeping duration (minutes)	Min-Max		Mean		S.D.		Percentage	
	M	NM	M	NM	M	NM	M	NM
Total sleep	30-40	28-40	37.97	35.70	2.86	4.25	94.93	89.25
Quiet sleep	14-24	10-15	19.63	13.33	3.59	1.70	49.08	33.33
Active sleep	15-21.50	17.50-25	18.33	22.37	2.01	2.83	45.83	55.93

M = Mozart's music

NM = None Mozart's music

Table 4.6 shows the data analysis of the total sleeping duration, (quiet and active sleeping duration,) while listening to Mozart's music as much higher value than those who were non listening to Mozart's music. The mean value of the total sleeping duration while listening to Mozart's music was 37.97 minutes (S.D. = 2.86); with a minimum of 30 minutes and a maximum of 40 minutes and was 94.93% of the total

sleeping duration. At the same time, the mean value of the total sleeping duration during non listening to Mozart's music was 35.70 minutes, (S.D. = 4.25,) with a minimum value of 28 minutes and a maximum value of 40 minutes, and was 89.25% of the total sleeping duration.

Significantly, the mean value of the quiet sleeping duration was more than the mean value of the active sleeping duration- when separating total sleeping duration into quiet and active sleeping duration. The mean value of the quiet sleeping duration while listening to Mozart's music was 19.63 minutes (S.D. = 3.59,) with a minimum value of 14 minutes and a maximum value of 24 minutes, and was 49.08% of the total sleeping duration. At the same time, the mean value of the quiet sleeping duration while non listening to Mozart's music was 13.33 minutes, (S.D. = 1.70,) with a minimum value of 10 minutes and a maximum value of 15 minutes, and was 33.33% of the total sleeping duration. The mean value of the active sleeping duration while listening to Mozart's music was 18.33 minutes (S.D. = 2.01) with a minimum value of 15 minutes and a maximum value of 21.50 minutes, and was 45.83% of the total sleeping duration. At the same time, the mean value of the active sleeping duration during non listening to Mozart's music was 22.37 minutes (S.D. = 2.83), with a minimum value of 17.50 minutes and a maximum value of 25 minutes, and was 55.93% of the total sleeping duration.

Part III: Hypothesis testing

Comparison data of the heart rate, respiratory rate, oxygen saturation and total sleeping duration among premature newborn while listening and non listening to Mozart's music was conducted. Paired t-test presented the mean differences among the independent population. The comparison of the data of the heart rate, respiratory rate, oxygen saturation, and sleeping behavior collected by observation from the same preterm infant two times was examined. Each of the preterm infants, by themselves, were the control group. The experimental study consisted of one independent variable- the presence or absence of Mozart's music. The dependent variables consist of their individual heart rate; respiratory rate, oxygen saturation, and total sleeping duration- that were measured in a ratio scale. The data from the experimental study presented a

normal distribution following the statistic assumption of Paired t-test (Rojanaplakorn-G & Luecha, 2006) as shown in table 7 to table 8.

The first hypothesis: The heart rate and respiratory rate among preterm infants during listening to Mozart's music decreases more than those preterm infants not listening.

The Second hypothesis: The oxygen saturation among preterm infants during listening to the Mozart's music increases more than those preterm infants not listening.

Table 4.7: Comparison of the mean value of the heart rate, respiratory rate, and oxygen saturation among preterm infants during listening to Mozart's music and non listening to Mozart's music using paired t-test. (n = 15)

Vital Signs	Mean		S.D.		$\bar{D}$	$S_{\bar{d}}$	t	p-value (one-tailed)
	M	NM	M	NM				
HR	133.40	134.53	7.44	7.16	-1.13	1.36	-3.238	.006
RR	37.47	38.87	3.38	3.42	-1.40	1.80	-3.004	.009
SpO_2	99.13	98.47	0.64	1.22	0.67	0.98	2.646	.019

M = Mozart's music

NM = None Mozart's music

Table 4.7 presents the data analysis of the mean difference of heart rate among preterm infants during listening to Mozart's music and non listening to Mozart's music. The findings showed that the mean heart rate among preterm infants while listening to Mozart's music and non listening to Mozart's music were 133.40 beats per minute (S.D. = 7.44) and 134.53 beats per minute (S.D. = 7.16), respectively. The mean value of the heart-rate difference between preterm infants while listening to Mozart's music and non listening to Mozart's music was -1.13 with standard deviation 1.36. Finally, the comparison of the mean value of heart rate among preterm infants while listening to Mozart's music and non listening to Mozart's music using Paired

t-test statistical method, ($\alpha = .05$), was statistically significant different ($t = -3.238$, $p < .01$).

Table 4.7 also shows the data analysis of the mean difference of the respiratory rate among preterm infants while listening to Mozart's music and non listening to Mozart's music. The findings showed that the mean respiratory rate among preterm infant while listening to Mozart's music and non listening to Mozart's music were 37.47 breaths per minute (S.D. = 3.38) and 38.87 breaths per minute (S.D. = 3.42), respectively. The mean value of the respiratory rate difference between preterm infants while listening to Mozart's music and non listening to Mozart's music was -1.40, with a standard deviation of 1.80. Finally, the comparison of the mean value of the respiratory rate difference among preterm infants while listening to Mozart's music and non listening to Mozart's music using Paired t-test statistical method, ($\alpha = .05$,) was statistically significant different ($t = -3.004$, $p < .01$).

The data analysis of the mean difference of oxygen-saturation among preterm infants while listening to Mozart's music and non listening to Mozart's music is also shown in Table 7. The findings showed that mean of oxygen saturation among preterm infant while listening to Mozart's music and non listening to Mozart's music was 99.13%, (S.D. = 0.64) and 98.47% (S.D. = 1.22), respectively. The mean value of oxygen saturation difference between preterm infants while listening to Mozart's music and non listening to Mozart's music was 0.67 with a standard deviation of 0.98. Finally, the comparison of the mean value of oxygen saturation difference among preterm infants while listening to Mozart's music and non listening to Mozart's music using the paired t-test statistical method, ($\alpha = .05$,) was statistically significant different ($t = 2.646$, $p < .05$).

The Third hypothesis: The total sleeping duration among preterm infants during listening to Mozart's music is longer than duration of non listening preterm infants.

Table 4.8: Comparison of the mean value of the total sleeping duration among preterm infants during listening to Mozart's music and non listening to Mozart's music using paired t-test. (n = 15)

Sleep duration	Mean		S.D.		$\bar{D}$	$S_{\bar{d}}$	t	p-value (one-tailed)
	M	NM	M	NM				
Total sleep	37.97	35.70	2.88	4.25	2.27	2.09	4.208	.0005
Quiet sleep	19.63	13.33	3.59	1.70	6.30	2.49	9.794	< .001
Active sleep	18.33	22.37	2.01	2.83	-4.03	3.96	-3.943	.0005

M = Mozart's music

NM = None Mozart's music

Table 4.8 presents the data analysis of the mean difference of the total sleeping duration among preterm infants while listening to Mozart's music and non listening to Mozart's music. The findings showed that the mean of the total sleeping duration among preterm infants while listening to Mozart's music and non listening to Mozart's music was 37.97 minutes, (S.D. = 2.88,) and 35.70 minutes, (S.D. = 4.25,) respectively. The mean value of the total sleeping duration difference between preterm infants while listening to Mozart's music and non listening to Mozart's music was 2.27 with a standard deviation of 2.09 minutes. Interestingly, the comparison of the mean value of the total sleeping duration difference among preterm infants while listening to Mozart's music and non listening to Mozart's music using the paired t-test statistical method, ($\alpha = .05$,) was statistically significant different ($t = 4.208$, $p < .001$).

Table 4.8 also shows the data analysis of the mean difference of the quiet sleeping duration among preterm infants while they listened to Mozart's music and while they didn't listen to Mozart's music. The findings show that the mean of the quiet sleeping duration among preterm infants during the listening of Mozart's music

and the non- listening of Mozart's music were 19.63 minutes (S.D. = 3.59); and 13.33 minutes (S.D. = 1.70), respectively. The mean value of the quiet sleeping duration difference between preterm infants while listening to Mozart's music and non listening to Mozart's music was 6.30 minutes with a standard deviation of 2.49. Finally, the comparison of the mean value of the quiet sleeping duration difference among preterm infants while listening to Mozart's music and non listening to Mozart's music using the paired t-test statistical method, (α = .05,) was statistically significant different (t = 9.794, $p < .001$).

The data analysis of the mean difference of the active sleeping duration among preterm infants while listening to Mozart's music and non listening to Mozart's music. The findings showed that mean of the active sleeping duration among preterm infants while listening to Mozart's music and non listening to Mozart's music was 18.33 minutes (S.D. = 2.01) and 22.37 minutes (S.D. = 2.83), respectively. The mean value of the active sleeping duration difference between preterm infants while listening to Mozart's music and non listening to Mozart's music was -4.03 minutes with a standard deviation of 3.96. However, the comparison of the mean value of the active sleeping duration difference among preterm infants while listening to Mozart's music and non listening to Mozart's music using the paired t-test statistical method, (α = .05,) was statistically significant different (t = -3.943, $p < .001$).

CHAPTER V
DISCUSSION

This research was conducted to compare the heart rate, respiratory rate, oxygen saturation, and total sleeping duration of preterm infants while listening to Mozart music and while not listening to Mozart music using a sample of 15 preterm infants. Every preterm infant was also a control group by themselves. All samples were preterm infants who had been admitted to the Sick Newborn Unit of Nopparat Rajathanee Hospital. The sample was set in a sound and light controlled environment. The experimental period was listening to Mozart music and the control period was not listening to Mozart music. The discussion was conducted according to the purposes and hypothesis of the research study as follow:

Sample Characteristics

The fifteen preterm infants consisted of females, 60%, and males, 40%. Most of them had a gestational age over than 34 weeks, but less than 36 weeks with a mean gestation phase of 34.80 weeks. The age after birth was 3-4 days with a mean age of 3.20 days. The weight was between 2,000 - 2,499 grams with mean weight of 2,187.33 grams. The majority of the samples were cesarean section births (60%,) and the minority were normal labor delivery (40%).

The first hypothesis: The heart rate and respiratory rate among preterm infants while listening to Mozart's music decreases more than those preterm infants not listening.

The second hypothesis: The oxygen saturation among preterm infants while listening to Mozart's music increases more than those preterm infants not listening.

In this study, the preterm infants were listening to Mozart's music with consistency of both phase and speed for 40 minutes to complete the sleeping cycle of the infant (Gardner & Lubchenco, 1998; Charastong, 2001.) The sound level was not over 58 decibels so as to not be injurious to the infant (American Academy of Pediatrics, 1974.) The preterm infants were settled in an environment similar to the mother's womb. The preterm infants were in the isolation room and were lying in the incubator in a light-controled room using dim lighting and in a cloth-covered incubator throughout the duration of the experiment. The mean light level was 30.31 lux and mean sound level was 57.94 decibels during playing Mozart's music. The setting environment in the control duration, (no Mozart,) was different from the experimental duration, (Mozart's music,) by not playing the Mozart music for the preterm infants. The mean light level was 30.30 lux, while the mean sound level was 50.54 decibels.

To compare of the mean change of heart rate and respiratory rate over time of preterm infants between while listening to Mozart's music and non listening to Mozart's music (Table 4.2, 4.3, and 4.4), the results showed that the mean difference of heart rate over time at the beginning, 10, and 20 minutes, among preterm infants while listening to Mozart's music had decreased more than those who were non-listening to Mozart's music with statistical significance ($p < .01$, $p < .05$) The mean difference of the respiratory rate over time at the minute-mark of 10, 20, 30, and 40 among preterm infants listening to Mozart's music were less than those who were non listening to Mozart's music with statistical significance ($p < .001$, $p < .01$, $p < .05$). The mean change of heart rate and respiratory rate of preterm infants between listening to Mozart's music and non listening to Mozart's music (Table 4.7), showed that the mean value of the heart rate and respiratory rate among preterm infants while listening to Mozart's music were decreased more than those who were not listening to the Mozart music with statistical significance ($p < .01$). The mean values while listening to Mozart's music are presented as follows: heart rate = 133.40 times per minute and respiratory rate = 37.47 times per minute. The mean values while non listening to Mozart's music are presented as follows: heart rate = 134.53 times per minute and respiratory rate = 38.87 times per minute. The result from this study was relevant to the study of Butt and Kisilevsky in 2000. They studied about the effects of

music to behavior and physiological responses among preterm infants during heel puncture. The findings indicated that the preterm infants who were listening to the music sound presented facial expression in the lowest level, a lower respiratory rate and were more stable than those who were not listening to the music. The results from this study can also indicate that the Mozart music made the preterm infants feel more relaxed and comfortable. It also indicates that the preterm infants can achieve a quiet sleeping duration faster and longer than normal. The parasympathetic nervous system increases its function during quiet sleep. There was also a stable, lowered-level metabolic state (Wasiknanon, 2002). That made the lowered, stable, regular respiration rate consistent with the results from the study of Cassidy who studied the effect of music sound to physiological responses. The first group of the preterm infants was listening to the Mozart string music, while the second group of the preterm infants was listening to the '*Cradlesong*,' after listening to the Mozart string music. The results from the study stated that the heart rate of the preterm infants in both groups decreased at statistically significant levels .01 (Cassidy, 1995).

To compare the mean change of oxygen saturation over time of preterm infants between while they were listening to Mozart's music and while they were not listening to Mozart's music (Table 4.2 and 4.5), the results showed that the mean difference of oxygen saturation over time at the beginning, 10, 20, 30, and 40 minute-marks, among preterm infants while listening to Mozart's music were increased more than those who were not listening to Mozart's music with statistical significance ($p < .05$). The mean change of oxygen saturation of preterm infants while listening to Mozart's music and non listening to Mozart's music (Table 4.7), showed that the mean value of the oxygen saturation among preterm infants during listening the Mozart music was increase more than those who were not listening to the Mozart music at a statistically significant level of .05. The mean value during listening to the Mozart music of the oxygen saturation was 99.13%, while the mean value during non-listening to Mozart music of the oxygen saturation was 98.47%. The result from this study could be explained by the music sound making the preterm infants feel more relaxed. The preterm infants feel more relaxed, calmer, and sleep longer when they listen to the Mozart music which is the soft and slow music that plays repeated notes

regularly and consistently with a sound level no louder than 58 decibels (Cassidy, 1995; Charoensuk, 2006; Lemmer, 2008.) The preterm infants move their bodies more slowly in the stage of quiet sleep, including minor energy expenditures, and have less oxygen consumption (Brown, 2009.) It means that there would be an increased and stable oxygen saturation level that is consistent with the research study of Wannakhow (Wannakhow, 2010). She studied the difference between preterm infants that were listening to heart-rhythms and non listening to heart-rhythms. The results showed that the oxygen saturation value in preterm infants that were listening to heart rhythms were much higher in their oxygen saturation values than in the preterm infants who were not listening to heart-rhythms at a statistically significant level of .05. This may be explained by the fact that heart-rhythms are similar to music sound- as both are slow, repeated, and regular in rhythm that made preterm infants relax and have a decreased oxygen consumption rate.

The third hypothesis: The total sleeping duration among preterm infants while listening to Mozart's music was longer than the duration of non listening preterm infants.

To compare of the mean change of total sleeping duration of preterm infants that were listening to Mozart's music and those that were non listening to Mozart's music (Table 4.8), the results showed that the mean total sleeping duration among premature infants who were listening to Mozart's music (37.97 minutes) was longer than those who were not listening to Mozart's music (35.70 minutes) at a statistically significant level of .001. The preterm infants response to music sound is evident even while they are unborn, therefore, the mother who listens to the playing music will stimulate development among preterm infants (Chinpong and Sunkasophon, 2005 cited in Prakodchue, 2011.) The infants who listen to music during sleep falls asleep faster and improves their sleeping quality (Singsawat, 2009 cited Prakodchue, 2011). Therefore, this study explains that Mozart's music is a music sound with the characteristics of soft, slow, repeated notes that made the infants calm down, relax, and fall into their sleeping phase more quickly (Lemmer, 2008; Lubetzky et al., 2009). Mozart's music also contributed to a longer quiet sleeping duration. This

physiological reaction reflects good development of the central nervous system (Schmidt et al., 1980) which means that the infant will have a good growing period and appropriate development in the future. The results from this study were relevant to the study of Prakodchue (Prakodchue, 2011). She studied the effects of Thai song music to infants, and found that the infants who listened to Thai music during sleep stayed in their sleeping phase longer than those who listened before and after sleep at a statistically significant level of .05. The result from this study also indicated that the preterm infants who listened to the playing music, such as the Mozart music, will fall in longer sleep and have the beneficial physical, mental, and emotional effects in the future.

To compare of the mean change of the quiet sleeping duration of preterm infants between those that listened to Mozart's music and those that didn't listen to Mozart's music (Table 4.8), the results showed that the mean quiet sleeping duration among premature infants who listened to Mozart's music (19.63 minutes) was longer than those who did not listen to Mozart's music (13.33 minutes) at a statistically significant level of .001. This indicates that Mozart's music that made infants sleep well and longer because Mozart's music is a soft and tender playing music with regularly repeating notes (Lemmer, 2008; Lubetzky et al., 2009). The Mozart music changes into the energy and electric current and send as a wave to the auditory nerve when the music passes the ear ossicles and the cochlear in the ears (Braun & Anderson, 2007) and then affects the thalamus and the limbic system that is the emotional, sensory, and behavior center. The limbic system functions cooperatively with the hypothalamus and the cerebral cortex to reduce neurotransmitter levels and decreases the sympathetic nervous system stimulation which finally reduces the secretion of epinephrine and norepinephrine. These physiological changes result in relaxed muscles and decreased heart rate, respiratory rate, and blood pressure. In addition, the limbic system functions cooperatively with the cerebral cortex to stimulate the secretion of endorphins- the happiness and relaxant substance (Duangboobpa, Hanucharoenkul, and Boonsri, 2008). Therefore, premature infants fall into their sleeping phase faster, more well and longer.

To compare of the mean change of active sleeping duration of preterm infants between those that listened to Mozart's music and those that didn't listen to Mozart's music (Table 4.6 and 4.8), the results showed that the mean active sleeping duration among premature infants who listened to Mozart's music (18.33 minutes, 45.83% of the total sleeping duration,) was shorter than those who did not listening to the Mozart music (22.37 minutes, 55.93% of the total sleeping duration,) at a statistically significant level of .001. Moreover, the mean value of drowsy, quiet awake, and active awake phases during listening to the Mozart music (1.43, 0.47, 0.13 minutes, respectively) were lower than those who were not listening to the Mozart music (2.93, 1.0, 0.37 minute, respectively). However, there was no mean value of crying phase while listening and non listening to Mozart music. Usually, active-sleep phase should be about 80% of total sleeping duration among premature infants because of the incomplete development of central nervous system and poor sleep-wake control (Gardner & Lubchenco, 1998; Papalia, Olds, & Feldman, 1999; Peirano et al., 2003). The results from this study indicate that the Mozart music made preterm infants calm down, relax, and more comfortable with a decreased and stable heart rate and respiratory-rate (Cassidy, 1995; Lemmer, 2008; Lubetzky et al., 2009)

In summary, this study found that Mozart's music can reduce and stabilize the heart rate and respiratory rate and increase oxygen saturation. Also Mozart's music creates shorter active sleep, and a longer duration of both quiet and total sleeping.

CHAPTER VI
CONCLUSION AND RECOMMENDATIONS

A Cross-over experimental research design was used to compare heart rate, respiration rate, oxygen saturation and total sleeping hours in preterm infants while listening to Mozart music and non listening to Mozart music. This study was conducted having one sample group where each preterm infant was a self control and randomized control as well. The samples in this study were the preterm infants who were admitted in Nopparat Rajathanee Hospital during September, 2010 - January, 2011. Eligible participants were also recruited according to the purposive sampling following these inclusion criteria, (i.e. preterm infants with 32 - 36 weeks of gestation duration with appropriate for gestational age: AGA, normal hearing, no oxygen administration, stable condition, and not in crisis status according to medical doctor's investigation (normal physical temperature, heart rate, respiration rate, and oxygen saturation including no respiratory arrest). Also, having no congenital anomaly or perinatal, receiving no drug to affect their sleeping pattern, parents of the preterm infants were willing to participate in this study including those who were illiterate and were able to communicate in the Thai language, and finally, permission from a physician to undertake the study.

After proposal and instrumental approval from the Human Research Board for the Ethics of the Faculty of Medicine, Ramathibodi Hospital, Mahidol University including the Human Research Board of the Nopparat Rajathanee Hospital, the researcher contacted the director of the Nopparat Rajathnee Hospital and the head of the ward for preterm infant patients to prepare the setting for the study and inform them of the details including data collection, recruited purposive samples from the listed names and history of the preterm infant including mother's history from the obstetric form and conducted the samples' hearing inspection. The researcher directly contacted samples' parents to build the relationship, informed purposes and steps of the research study including data collection participation.

The researcher began to record data following the general data recording by dividing the research experimental into two phases including experimental phase, (listening to Mozart music) and the control phase, (non listening to Mozart music). The eligible samples received both phases of the experiment. The first group was randomized to listening to Mozart music before non listening to Mozart music and the second group was randomized to non listening to Mozart music before listening to Mozart music. All preterm infants were lying in the nest made from clothes folded into circles that cover around them similar to the fetal position and put in the incubator with a cover in the isolated room. It was also sound controlled to less than 58 decibels and light intensity was kept less than 600 Lux. The oxygen saturation and heart rate measurement machine was attached to either foot of the preterm infants modifying the lowest sound of the oxygen saturation measurement's machine to reduce sound interference. The researcher observed the sleep-wake pattern and recorded the data for 40 minutes. The heart rate, respiratory rate and oxygen saturation were also recorded every minute for 40 minutes. The experimental study stopped when abnormal oxygen saturation or heart rate occurred and then notified the medical doctor and the preterm infants' assistant.

There were two kinds of experimental instruments in this study: 1) the experimental instruments including the Mozart music, heart rate and blood oxygen saturation measurement equipment, sound level measurement equipment, intensive light measurement equipment, MP 3 player, and the Mozart music recorder amplifier for 40 minutes. Also, a video camera, and 2) data collection instruments including general data recorder, preterm infants sleep-wake record form, Charasthong's sleep-wake evaluation guideline for preterm infants (Charasthong, 2001) that was already translated into the Thai language and modified from Pamaelee and Stern' sleep-wake evaluation form (Pamaelee & Stern, 1972). This sleep-wake evaluation guideline was conducted with the content validity of a panel of five experts and the reliability coefficient between the researcher and the expert was .90. In addition, the researchers evaluated sleep-wake behavior among preterm infants one week after data collection to prevent data bias. The collected data was analyzed using the Statistical Software for descriptive statistic and Paired t-test.

The results from the study indicated the following:

1. The average heart rate and respiratory rate among preterm infants while listening to Mozart's music was less than those who were not listening to Mozart's music with a statistical significance level of .01.

2. The average oxygen saturation value among preterm infants while listening to Mozart's music was more than those who were not listening to Mozart's music with a statistical significance level of .05.

3. The average total sleeping duration among preterm infants while listening to Mozart's music was longer than those who were not listening to Mozart's music with a statistical significance level of .001.

Limitation of the study

This research aimed to study the effects of Mozart's music on vital signs, oxygen saturation and sleeping duration among 15 preterm infants who were admitted in the preterm infants' ward of Nopparat Rajathanee Hospital, Department of Medicine, Ministry of Public Health. The results from the study could be compared only to the study with a similar environmental setting Sick Newborn Care Unit and listening to Mozart's music. Moreover, 32 weeks gestation preterm infants could not be recruited to be samples in this study because they did not pass the hearing inspection. The abnormal hearing might be caused by incomplete hearing development. The hearing organ development is normally completed in 30 weeks of gestation, while the hearing sensation still continues development until three years old (James, 1998; cited in Naklinkul, 2003).

Recommendation and guideline for valuable usage

Nursing practice

Nurses can apply the results from this study to preterm infants' nursing care for normal vital signs. Moreover, nurses can promote sleep among preterm

infants, specially promote a longer sleeping phase for growth and better development in the future.

Nursing Education

Nursing Education should merge the resultant indications to promote a longer sleeping phase among preterm infants using Mozart's music and setting the environment similar to the mother's womb to maximize all the health benefits to the infants. Also, nurses can be trained in these nursing care procedures to correctly promote sleeping advantages among preterm infants.

Nursing administration

This research could be presented to the nursing administrator for nursing care plan administration. The environment in the Sick Newborn Unit and Neonatal Intensive Care Unit were set similar to status in the womb and the preterm infants listened to Mozart's music for more rapid growth and development.

The recommendations for further research

1. There should be further studies about the effects of other sounds to sleep patterns among preterm infants, such as mother's sound, and Thai classical music.

2. There should be studies in other populations with different characteristics.

3. There should be an increased sample size of the preterm infants for more accurate results.

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APPENDICES

APPENDIX A

คณะแพทยศาสตร์ โรงพยาบาลรามาธิบดี มหาวิทยาลัยมหิดล
ถนนพระราม 6 กทม. 10400
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Documentary Proof of Ethical Clearance
Committee on Human Rights Related to Research Involving Human Subjects
Faculty of Medicine Ramathibodi Hospital, Mahidol University

No. MURA2010/362

Title of Project	Effects of the Mozart Music on Vital Signs and Sleep Duration of Preterm Infants
Protocol Number	ID 08 – 53 – 17
Principal Investigator	Miss Siriluk Srisawet
Education Address	Department of Nursing Faculty of Medicine Ramathibodi Hospital Mahidol University

The aforementioned project has been reviewed and approved by the Committee on Human Rights Related to Research Involving Human Subjects, based on the Declaration of Helsinki.

Signature of Secretary **Committee on Human Rights Related to Research Involving Human Subjects**	.... Prof. Duangrurdee Wattanasirichaigoon, M.D.
Signature of Chairman **Committee on Human Rights Related to Research Involving Human Subjects**	.... Prof. Boonsong Ongphiphadhanakul, M.D.
Date of Approval	September 17, 2010

คณะแพทยศาสตร์ โรงพยาบาลรามาธิบดี มหาวิทยาลัยมหิดล
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เอกสารรับรองโดยคณะกรรมการจริยธรรมการวิจัยในคน
คณะแพทยศาสตร์โรงพยาบาลรามาธิบดี
มหาวิทยาลัยมหิดล

เลขที่ ๒๕๕๓/๓๖๒

ชื่อโครงการ	ผลของเสียงเพลงโมสาร์ทต่อสัญญาณชีพและระยะเวลาการนอนหลับในทารกเกิดก่อนกำหนด
เลขที่โครงการ/รหัส	ID ๐๘ – ๕๓ – ๑๗ ว
ชื่อหัวหน้าโครงการ	นางสาวสิริลักษณ์ ศรีเศวต
สถานที่ศึกษา	ภาควิชาพยาบาลศาสตร์ คณะแพทยศาสตร์โรงพยาบาลรามาธิบดี มหาวิทยาลัยมหิดล

ขอรับรองว่าโครงการดังกล่าวข้างต้นได้ผ่านการพิจารณาเห็นชอบโดยสอดคล้องกับแนวปฏิญญาเฮลซิงกิ จากคณะกรรมการจริยธรรมการวิจัยในคน คณะแพทยศาสตร์โรงพยาบาลรามาธิบดี

ลงนาม ....
กรรมการและเลขานุการจริยธรรมการวิจัยในคน (ศาสตราจารย์ แพทย์หญิงดวงฤดี วัฒนศิริชัยกุล)

ลงนาม ....
ประธานกรรมการจริยธรรมการวิจัยในคน (ศาสตราจารย์ นายแพทย์บุญส่ง องค์พิพัฒนกุล)

วันที่รับรอง ๑๗ กันยายน ๒๕๕๓

คณะแพทยศาสตร์ โรงพยาบาลรามาธิบดี มหาวิทยาลัยมหิดล
ถนนพระราม 6 กทม. 10400
โทร. (662) 354-7275, 201-1296 โทรสาร (662) 354-7233

Faculty of Medicine, Ramathibodi Hospital, Mahidol University
Rama VI Road, Bangkok 10400, Thailand
Tel. (662) 354-7275, 201-1296 Fax (662) 354-7233

ที่ จวค ๑๗๗/๒๕๕๓ คณะกรรมการจริยธรรมการวิจัยในคน

วันที่ ๒๔ กันยายน ๒๕๕๓

เรื่อง แจ้งผลการพิจารณาของคณะกรรมการจริยธรรมการวิจัยในคน

เรียน นางสาวสิริลักษณ์ ศรีเศวต

อ้างถึงโครงการวิจัยเรื่อง ผลของเสียงเพลงโมสาร์ทต่อสัญญาณชีพและระยะเวลาการนอนหลับในทารกเกิดก่อนกำหนด
หมายเลขโครงการวิจัย ID ๐๘ - ๕๓ – ๑๗ ว

ในนามของคณะกรรมการจริยธรรมการวิจัยในคน ผมขอแสดงความยินดีที่โครงการวิจัยดังกล่าวข้างต้นของท่านได้ผ่านความเห็นชอบจากคณะกรรมการฯแล้ว

เพื่อให้สอดคล้องกับระเบียบปฏิบัติคณะแพทยศาสตร์โรงพยาบาลรามาธิบดี ว่าด้วยการศึกษาวิจัยและการทดลองในมนุษย์ พ.ศ. ๒๕๔๔ คณะกรรมการฯ ขอให้ท่านถือปฏิบัติโดยเป็นไปตามข้อแนะนำดังต่อไปนี้

๑. การดำเนินการวิจัยจะต้องเป็นไปตามโครงร่างวิจัยล่าสุดที่ผ่านการพิจารณาจากคณะกรรมการจริยธรรมการวิจัยในคนแล้ว
๒. การดำเนินการวิรัยจะต้องไม่เบี่ยงเบนไปจากโครงร่างวิจัยหรือมีการเปลี่ยนโครงร่างการวิจัยก่อนที่การ แก้ไขเพิ่มเติมโครงร่างวิจัยนั้นจะได้รับการอนุมัติและเห็นชอบจากคณะกรรมการจริยธรรมการวิจัยในคนก่อน ยกเว้นในกรณีจำเป็นที่จะต้องกระทำไปก่อนเพื่อขจัดอันตรายเฉพาะหน้าที่เกิดขึ้นกับผู้ยินยอมตนให้ทำวิจัย
๓. ในกรณีที่มีการเปลี่ยนแปลงชื่อโครงการไปจากชื่อเดิมที่เสนอไว้ ต่อคณะกรรมการฯ ต้องแจ้งชื่อมายังคณะกรรมการฯ เพื่อออกหนังสือรับรองให้เสมอ
๔. ผู้ยินยอมตนให้ทำวิจัยจะต้องได้รับเอกสารชี้แจงข้อมูล/คำแนะนำแก่ผู้ยินยอมตนให้ทำวิจัย (Patient/Participant Information Sheet) และลงนามในหนังสือยินยอมโดยได้รับการบอกกล่าวและเต็มใจ (Informed Consent Form) ก่อนเริ่มดำเนินการวิจัย
๕. ในเอกสารชี้แจงข้อมูล/คำแนะนำแก่ผู้ยินยอมตนให้ทำวิจัย (Patient's Information Sheet) จะต้องพิมพ์ข้อความดังต่อไปนี้ไว้ด้วยทุกครั้ง

"ถ้าท่านมีข้อข้องใจหรือมีความกังวลใจเกี่ยวกับวิธีดำเนินการวิจัยของโครงการวิจัยนี้ ท่านสามารถติดต่อได้ที่ ประธานกรรมการ จริยธรรมการวิจัยในคน คณะแพทยศาสตร์โรงพยาบาลรามาธิบดี หน่วยจริยธรรมการวิจัยในคน สำนักงานวิจัยคณะฯ อาคารวิจัยและสวัสดิการ ชั้น ๓ (ห้อง ๓) โทรศัพท์ ๐๒–๒๐๑ ๑๕๔๔ ในเวลาราชการ"

๖. ความลับของผู้ยินยอมตนให้ทำวิจัย จะต้องถูกปกปิดไว้ตลอดเวลา ยกเว้นถ้าเป็นคำสั่งตามกฎหมาย

สุดท้ายนี้ ขอให้โครงการวิจัยของท่านประสบผลสำเร็จตามความมุ่งหมายอันจะนำมาซึ่งความเจริญก้าวหน้าทางวิชาการ และเพื่อประโยชน์ของมนุษยชาติสืบต่อไป

ขอแสดงความนับถือ

(ศาสตราจารย์บุญส่ง องค์พิพัฒนกุล)
ประธานกรรมการจริยธรรมการวิจัยในคน

คณะกรรมการวิจัยและจริยธรรมวิจัย
โรงพยาบาลนพรัตนราชธานี

ใบรับรองโครงการวิจัยผ่านการพิจารณาจากคณะกรรมการวิจัยและจริยธรรมวิจัย
โรงพยาบาลนพรัตนราชธานี

ชื่อโครงการ(ไทย) **ผลของเสียงเพลงโมสาร์ทต่อสัญญาณชีพและระยะเวลาการนอนหลับในทารกเกิดก่อนกำหนด**

ชื่อโครงการ(อังกฤษ) **EFFECTS OF THE MOZART MUSIC ON VITAL SIGNS AND SLEEP DURATION OF PRETERM INFANTS**

ชื่อผู้วิจัย : **นางสาวสิริลักษณ์ ศรีเศวต**

เลขที่ใบรับรอง : 30/2553 **รหัสโครงการวิจัย :** 53-2-040-0

หน่วยงานที่สังกัด : **ภาควิชาพยาบาลศาสตร์ คณะแพทยศาสตร์ โรงพยาบาลรามาธิบดี**

ประเภทโครงการวิจัย ☐ **โครงการวิจัยภายใน** ☑ **โครงการวิจัยภายนอก**

ผลการพิจารณาของคณะกรรมการวิจัย :

คณะกรรมการจริยธรรมการวิจัยได้พิจารณารายละเอียดโครงการวิจัย เรื่องดังกล่าวข้างต้นแล้ว ในประเด็นที่เกี่ยวกับ

1) การเคารพในศักดิ์ศรี และสิทธิของมนุษย์ที่เป็นกลุ่มตัวอย่างในโครงการวิจัย
2) วิธีการวิจัยที่เหมาะสมและได้รับความยินยอมจากกลุ่มตัวอย่างก่อนเข้าร่วมโครงการวิจัย (Informed consent) รวมทั้งการปกป้องสิทธิประโยชน์ และรักษาความลับของกลุ่มตัวอย่างในโครงการวิจัย
3) การดำเนินงานวิจัยเหมาะสม ไม่ก่อความเสียหายต่อกลุ่มตัวอย่างของการศึกษาวิจัย

วันที่ให้การรับรอง 24 **เดือน** สิงหาคม **พ.ศ.** 2553

เอกสารนี้ให้ไว้เพื่อแสดงว่าโครงการวิจัยนี้ ได้ผ่านการตรวจสอบและมีมติจากคณะกรรมการวิจัยและจริยธรรมวิจัยของโรงพยาบาลนพรัตนราชธานี ให้ดำเนินการเก็บข้อมูลในโรงพยาบาลนพรัตนราชธานีได้ ตามเงื่อนไขและแนวทางที่เจ้าของโครงการเสนอมา

ลงนาม นงนุช สุธีเชษฐ
(แพทย์หญิงนงนุช สุธีเชษฐ)
ประธานคณะกรรมการวิจัยและจริยธรรมวิจัย

APPENDIX B

เอกสารแนะนำโครงการวิจัย

ดิฉัน นางสาวสิริลักษณ์ ศรีเศวต นักศึกษาปริญญาโท ภาควิชาพยาบาลศาสตร์ คณะแพทยศาสตร์ โรงพยาบาลรามาธิบดี มหาวิทยาลัยมหิดล มีความสนใจที่จะศึกษาวิจัยเรื่อง ผลของเสียงเพลงโมสาร์ทต่อสัญญาณชีพและระยะเวลาการนอนหลับในทารกเกิดก่อนกำหนด มีแนวโน้มว่าจะเป็นผลดีต่อทารกเกิดก่อนกำหนด และไม่พบว่าจะมีอันตรายใดๆ ต่อทารก และบุตรของท่านได้รับเลือกเป็นกลุ่มตัวอย่างในการศึกษาวิจัย เนื่องจากมีอาการคงที่ และรักษาตัวอยู่ในโรงพยาบาลในช่วงเวลานี้ วัตถุประสงค์ ของศึกษา เพื่อศึกษาสัญญาณชีพและ ระยะเวลาการ นอนหลับในทารกเกิดก่อนกำหนดขณะที่ได้รับฟังเพลงโมสาร์ทและขณะที่ไม่ได้รับฟังเพลงโมสาร์ท และเพื่อเปรียบเทียบสัญญาณชีพและ ระยะเวลาการ นอนหลับในทารกเกิดก่อนกำหนด ขณะที่ได้รับฟังเพลงโมสาร์ทและขณะที่ไม่ได้รับ ฟังเพลงโมสาร์ท ซึ่งการเก็บรวบรวมข้อมูลจะใช้กลุ่ มตัวอย่างกลุ่มเดียว เป็นทั้งกลุ่มควบคุมและกลุ่มทดลอง จำนวน 15 ราย โดยจะบันทึกภาพวิดีทัศน์พฤติกรรมและระยะเวลาการนอนหลับ ขณะทารกได้รับฟังเสียงเพลงโมสาร์ทที่อัดจากเทป และขณะไม่ได้รับฟังโมสาร์ท เป็นเวลา 40 นาทีในห้องแยกที่ไม่มีแสงและเสียงรบกวน ช่วงเวลา 16.00-18.00 น.และ 19.00-22.00 น. เป็นเวลา 2 วัน ทารกจะได้รับการสุ่มวิธีทดลองว่าทารกจะได้รับการฟังเสียงโมสาร์ทหรือไม่ได้รับฟังก่อน ข้อมูลที่ได้จากการวิจัยนี้จะนำไปวิเคราะห์และแปรผลในภาพรวม เพื่อเป็นแนวทางในการจัดการส่งเสริมการนอนหลับในทารกเกิดก่อนกำหนดต่อไป การรักษาและการบริการจากแพทย์และพยาบาลในด้านอื่นๆ ยังคงเป็นไปตามปกติ

จึงเรียนมาเพื่อขอความร่วมมือและอนุญาตให้บุตรของท่านเข้าร่วมการวิจัย ท่านสามารถยกเลิกการอนุญาตและให้บุตรของท่านออกจากการวิจัยครั้งนี้ โดยไม่มีผลต่ อการรักษาพยาบาลที่ท่านได้รับแต่อย่างใด หากท่านอนุญาตให้บุตรเข้าร่วมการวิจัยครั้งนี้ กรุณาลงชื่อยินยอมเข้าร่วมการวิจัยด้วย

ขอขอบคุณในความร่วมมือ

นางสาวสิริลักษณ์ ศรีเศวต
นักศึกษาปริญญาโท

หนังสือยินยอมโดยได้รับการบอกกล่าวและเต็มใจ

(Informed Consent Form)

ชื่อโครงการ ผลของเสียงเพลงโมสาร์ทต่อสัญญาณชีพและระยะเวลาการนอนหลับในทารกเกิดก่อนกำหนด

ชื่อผู้วิจัย นางสาวสิริลักษณ์ ศรีเศวต

*ชื่อผู้เข้าร่วมการวิจัย...

อายุ........................... เลขที่เวชระเบียน...........................

คำยินยอมของผู้มีอำนาจกระทำการแทนผู้เข้าร่วมการวิจัย

ข้าพเจ้านาย /นาง/นางสาว ....ซึ่งเป็นผู้มีอำนาจกระทำการแทน ด.ช./ด.ญ. .... ในฐานะ.......................... ได้ทราบรายละเอียดของโครงการวิจัยตลอดจน ประโยชน์ และข้อเสี่ยงที่จะเกิดขึ้นต่อ ผู้เข้าร่วมการวิจัย จากผู้วิจัยแล้วอย่างชัดเจน ไม่มีสิ่งใดปิดบังซ่อนเร้นและยินยอมให้ทำการวิจัยในโครงการที่มีชื่อข้างต้น และข้าพเจ้ารู้ว่าถ้ามีปัญหาหรือข้อสงสัยเกิดขึ้นข้าพเจ้าสามารถสอบถามผู้วิจัยได้ และข้าพเจ้าสามารถไม่ให้ผู้เข้าร่วมการวิจัยเข้าร่วมโครงการวิจัยนี้เมื่อใดก็ได้ โดยไม่มีผลกระทบต่อ การรักษาที่ผู้เข้าร่วมการวิจัยได้รับ นอกจากนี้ ผู้วิจัยจะเก็บข้อมูลเฉพาะเกี่ยวกับ ตัวผู้เข้าร่วมการวิจัย เป็นความลับ และจะเปิดเผยได้เฉพาะในรูปที่เป็นสรุปผลการวิจัย การเปิดเผยข้อมูลเกี่ยวกับตัว ผู้เข้าร่วมการวิจัยต่อหน่วยงานต่างๆ ที่เกี่ยวข้อง กระทำได้เฉพาะกรณีจำเป็นด้วยเหตุผลทางวิชาการเท่านั้น

ลงชื่อ ....(บิดา/มารดาของผู้เข้าร่วมวิจัย)

.... (พยาน)

.... (พยาน)

วันที่............./....................../.................

คำอธิบายของผู้วิจัย

ข้าพเจ้าได้อธิบายรายละเอียดของโครงการ ตลอดจนประโยชน์ของการวิจัย รวมทั้งข้อเสี่ยงที่อาจจะเกิดขึ้นแก่ผู้เข้าร่วมการวิจัยทราบแล้วอย่างชัดเจนโดยไม่มีสิ่งใดปิดบังซ่อนเร้น

ลงชื่อ...(ผู้วิจัย)

(นางสาวสิริลักษณ์ ศรีเศวต)

วันที่ ..../...................../................

หมายเหตุ: * ผู้เข้าร่วมการวิจัย หมายถึง ผู้ยินยอมตนให้ทำวิจัย

APPENDIX C

เครื่องมือที่ใช้ในการเก็บรวบรวมข้อมูล

ส่วนที่ 1 แบบบันทึกข้อมูลทั่วไป

ลำดับที่..............

วันที่...................

ชื่อ.......................................นามสกุล..เพศ..........................

อายุครรภ์..............................สัปดาห์ อายุหลังเกิด............................วัน

น้ำหนักแรกเกิด................................กรัม วิธีคลอด..

การวินิจฉัยโรค..

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การรักษาที่ได้รับ..

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ยาที่ได้รับ...

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ส่วนที่ 2 แบบบันทึกการหลับตื่นของทารกเกิดก่อนกำหนด

ลำดับที่....................................

วันที่..

ชื่อ/นามสกุล..

●——● = Quiet sleep (QS) ——— = Active sleep (AS) ∿ = Drowsy sleep (DS)

●- - - -● = Quiet alert (QA) - - - - - - - = Active alert (AA) ⋁⋁⋁ = Crying (Cry)

เวลาที่เริ่ม ....

0–1	2	3	4	5	6	7	8	9	10

11	12	13	14	15	16	17	18	19	20

21	22	23	24	25	26	27	28	29	30

31	32	33	34	35	36	37	38	39	40

รวม Quiet sleep ....นาที

Active sleep ....นาที

Drowsy sleep ....นาที

Quiet alert ....นาที

Active alert ....นาที

Crying ....นาที

ส่วนที่ 3 คู่มือการประเมินพฤติกรรมการหลับตื่นของทารกเกิดก่อนกำหนด การประเมินสภาวะการหลับตื่นของทารกเกิดก่อนกำหนด สังเกตจากการปิดเปิดเปลือกตา การเคลื่อนไหวร่างกายและลักษณะการหายใจ

สภาวะการหลับตื่น (Sleep-wake state)	**สัญลักษณ์**	**การเปิด-ปิดของตา**	**ลักษณะการหายใจ**	**การเคลื่อนไหวของร่างกาย**
ระยะหลับลึก (Quiet sleep)		ตาปิด (NREM)	หายใจสม่ำเสมอและใช้กล้ามเนื้อหน้าท้องเคลื่อนไหว	ไม่มีการเคลื่อนไหวหรือมีการ เคลื่อนไหวเล็กน้อยอาจพบสะดุ้ง
ระยะหลับตื้น (Active sleep)		ตาปิด มีการเคลื่อนไหวของลูกตา (REM)	หายใจไม่สม่ำเสมอและใช้กล้ามเนื้อซี่โครงเคลื่อนไหว	มีการเคลื่อนไหวของแขน ขา มือเท้า ศีรษะและลำตัว หรือทั้งร่างกาย
ระยะง่วงซึม (Drowsy sleep)		ตาหนัก ตาปิด หรือเปิดครึ่งตา	หายใจไม่สม่ำเสมอ	มีหรือไม่มีการเคลื่อนไหวร่างกาย
ระยะตื่นสงบ (Quiet alert)		ตาเปิด จ้องมองนิ่ง	หายใจสม่ำเสมอ	มีการเคลื่อนไหวเล็กน้อยของแขนขา มือ เท้า ศีรษะ เป็นบางส่วนหรือไม่มีการเคลื่อนไหว
ระยะตื่นเต็มที่ (Active alert)		ตาเปิดเต็มที่	หายใจไม่สม่ำเสมอ	มีการเคลื่อนไหวทั้งแขน ขา หน้าศีรษะ ลำตัว หรือทั้งร่างกาย
ระยะร้อง (Crying)		ตาเปิดหรือปิด	หายใจไม่สม่ำเสมอ มีการเคลื่อนไหวทรวงอกเร็วขึ้น	มีการเคลื่อนไหวทั้งร่างกาย มีการตึงตัวของกล้ามเนื้อ

ส่วนที่ 4 แบบบันทึกค่าความเข้มแสงและเสียง

ลำดับที่..............

วันที่...................

ชื่อ..นามสกุล...

เวลา	ความเข้มแสง (Lux)	ความดังของเสียง (dB)
นาทีที่ 25 ก่อนการทดลอง		
นาทีที่ 20 ระหว่างการทดลอง		

ส่วนที่ 5 แบบบันทึกอัตราการเต้นของหัวใจ ค่าความอิ่มตัวของออกซิเจนและอัตราการหายใจ

ลำดับที่..............

วันที่...................

ชื่อ...นามสกุล...

0	1	2	3	4	5	6	7	8	9	10
HR										
O_2										
RR										

	11	12	13	14	15	16	17	18	19	20
HR										
O_2										
RR										

	21	22	23	24	25	26	27	28	29	30
HR										
O_2										
RR										

	31	32	33	34	35	36	37	38	39	40
HR										
O_2										
RR										

APPENDIX D

NEEDISS SUPPLY AND SERVICE CO., LTD.
536 Soi Bangkhae 7 Bangkhae Bangkok 10160 Thailand
Tel:0-2802-3980-2 Fax:0-2802-3988 e-mail:info@neediss.com website:www.neediss.com

Calibration Test Report

Report No.: SM-530458
Calibrated Date: 10 August 2010
Reference Job No.: ET5300014

Calibrated for: คุณสิริลักษณ์ ศรีเศวต
Equipment: Sound Level Meter
Manufacturer: DIGICON
Model: DS-40
Serial or ID No. M114235

Environment: Temperature 26.5 °C Humidity: 50 %RH

Reference Standard: Sound Calibrator Class 1 Model QC10, Quest/USA
Serial No.QIA090069
Date of Calibration :Nov.18, 2009

Result of Calibration

Reference Standard (dB)	INSTRUMENT READING (dB)	ERROR (dB)	ADJUST
113.9	103.8	10.1	113.9

Calibrated By: (Napaporn Nuipuak)
Date: 10/8/53

Approve By: (Sarawut Keawsrinual)
Date: 10/8/53

NEEDISS SUPPLY AND SERVICES CO.,LTD

This report shall not be reproduced except infull,without the written approval of Needis Supply and Services Co.,Ltd.

Request No. FE. 048/53 **MTC No.** EEL.BP. 73/1052

CALIBRATION CERTIFICATE

Submitted by : Neediss Supply and Service Co., Ltd.

Address : 72/40 M.1 Soi Bangbon 12, Sukapiban 1 Rd., Bangkhae, Bangkok 10160.

Calibrated at : Electrical and Electronic Standards Laboratory, Industrial Metrology and Testing Service Center Soi 1, Bangpoo Industrial Estate, Sukhumvit Rd., Muang, Samutprakan 10280.

Instrument Calibrated :

Description : Calibrator
Manufacturer : Quest Technologies
Model : QC-10
Serial No. : QIA090069

Ambient Environment :

Temperature : $(23 \pm 3)^{\circ}C$
Relative humidity : (55 ± 15) %
Ambient Pressure : (1008 ± 5) hPa

Standards Used :

1. Digital Function Synthesizer NF Electronic DF-193A S/N 122037 193A024.
2. Measuring Amplifier Bruel&Kjaer 2636 S/N 1537484.
3. Programmable Attenuator Tamagawa TPA-303A S/N OF 2214.
4. Digital Multimeter Fluke 8520A S/N 4985007.
5. VHF Switch Hewlett-Packard 59307 S/N 3002A08302.
6. Pressure Transmitter Vaisala PTB202AD S/N T0650001.
7. Audio Analyzer Panasonic VP-7722A S/N 041477D122.
8. Condenser Microphone Tokyo Riko MR-103 S/N 9008.

Calibration Procedure : CP.SC.01(By determination of the absolute value of the calibrator or pistonphone output using a calibrated microphone and the insert voltage method.)

This instrument has been calibrated against standards maintained at Electrical and Electronic Standards Laboratory (EEL), which are traceable to the International System of Unit through

- National Institute of Metrology (Thailand)

Date of Receipt : 21 Oct. 2009

Date of Calibration : 18 Nov. 2009

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1/2

The above results are valid exclusively for the tested ... as ... in this report/certificate. Advertise the Report/Certificate and ... of the results, except ... unless written permission is obtained from the governor of TISTR

Request No. EE 048/53 **MTC No.** EEL.BP. 73/1052

The information on actual reading is attached herewith and the uncertainty limits quoted refer to the measured values only.

The reported expanded uncertainty is based upon a standard uncertainty multiplied by a coverage factor k = 2, providing a level of confidence of approximately 95%.

Nominal Output of Unit Under Test = 114 dB re 20μPa at 1 kHz

Acoustic Output in dB re 20μPa , Corrected to Reference Conditions

Standard Microphone Type	Acoustic Output dB re 20 μPa		Frequency		Distortion	
	Sound Pressure Level(dB)	Uncertainty (dB)	Reading (Hz)	Uncertainty (Hz)	Reading (%)	Uncertainty (%)
1 inch MR-103 (Pressure-field)	113.84	± 0.18	999.28	± 1.00	0.46	± 0.40

Note : 1. No adjustment.

2. The result was not corrected with the correction of microphone type .

Calibrated by : **Approved by :**

(Mr. Tawikiat Iamsamran) (Ms. Wadee Wachaidit)

Acting Director

Electrical and Electronic Standards Laboratory

Industrial Metrology and Testing Service Center

Date of Calibration : 18 Nov. 2009

Date of Issue : 20 Nov. 2009

Ref [illegible]02702766001

2/2

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THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR) FM.BL.MTC.002 Rev

INDUSTRIAL METROLOGY AND TESTING SERVICE CENTRE

TENMARS ELECTRONICS CO., LTD.

SALES OFFICE:6F 586 RUI GUANG ROAD, NEIHU, TAIPEI, TAIWAN, R.O.C.
TEL: +886-2-2658-5770 FAX: +886-2-2658-5075 E-mail: services@tenmars.com
WEBSITE:http://www.tenmars.com

CALIBRATION & TEST CERTIFICATE

No.09907022 Date of Issue: 2010-07-14

To whom it my concern:
We hereby certify that the instrument under mentioned has been certainly calibrated according to our calibration standard and the testing result in the calibration procedure has been good enough within the tolerance regulated in our specification.

Name of Model : LUX / FC LIGHT METER
Model Number :TM –201
Serial Number : 100601557
Test Data : as under

Temperature : 22.5℃
Humidity : 61.2%
Date of Calibration: 2010-07-14
Inspector : CARY

Range		Indication	Calibration Point	Tolerance	Result
LUX	200	150.3	150LUX	145.5LUX～154.5LUX	Pass
	2000	1503	1500LUX	1455LUX～1545LUX	Pass
	20000	300 X0	3000LUX	291 X0LU～309×0LUX	Pass
	200000	30 X00	3000LUX	29X00LUX～31X00LUX	Pass
FC	20	13.96	13.94 FC	13.53 FC～14.36FC	Pass
	200	139.7	139.4 FC	135.3 FC～143.6FC	Pass
	2000	280	279 FC	271 FC～287FC	Pass
	20000	28 X0	28 X0 FC	27×0 FC～29×0FC	Pass

Calibrators used for calibration and testing:

Name of Model	Model Number	Serial Number	Final Calibrated Date
Standard ILLUMINANC EMETER	YOKOGAWA 51002	090139	Feb.09, 2011

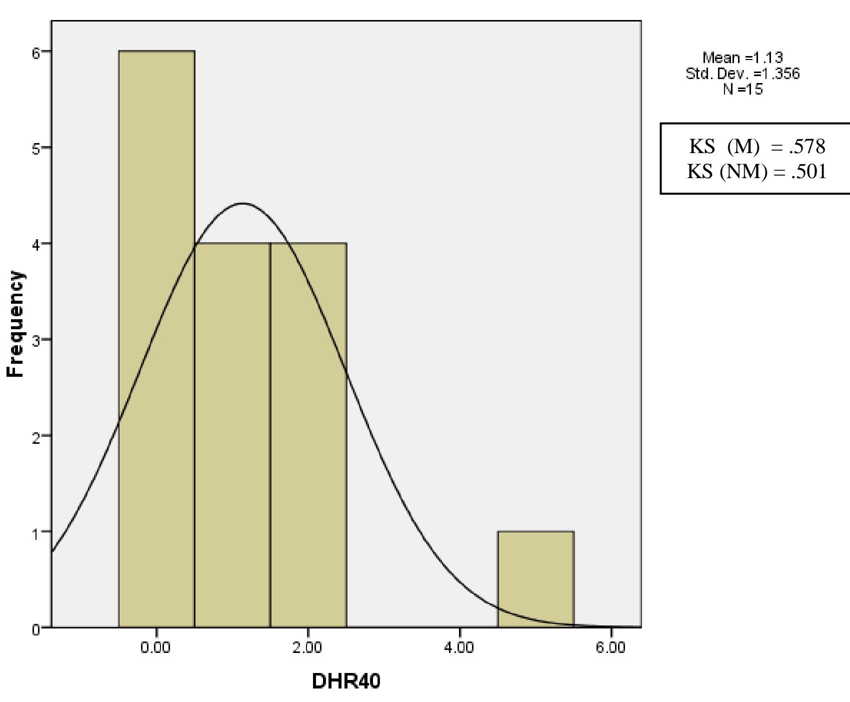
(The standard generators used for calibration procedure are proofed once a year and can be traceable to the standard authorized by public organization.)

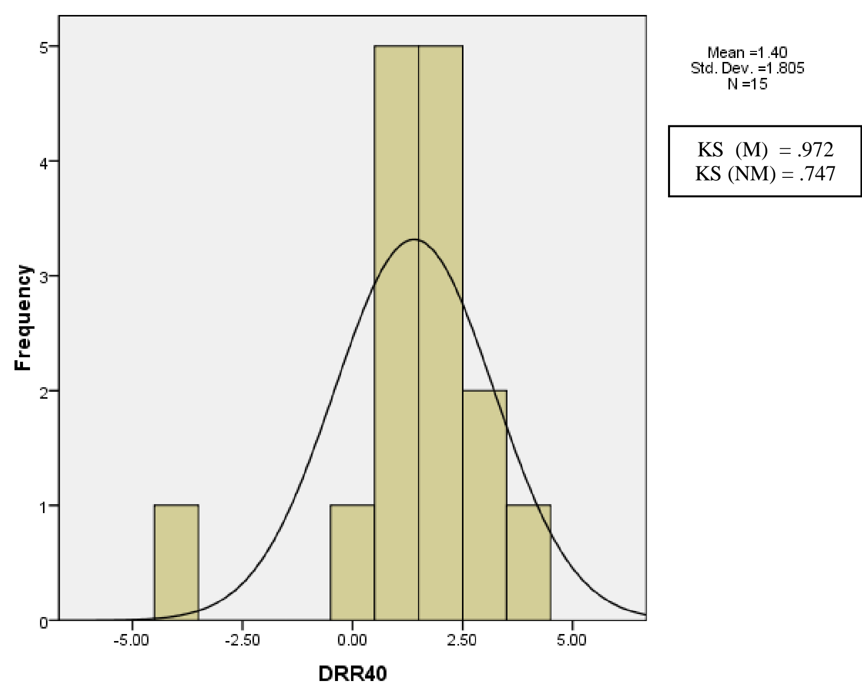
TENMARS ELECTRONICS CO., LTD.

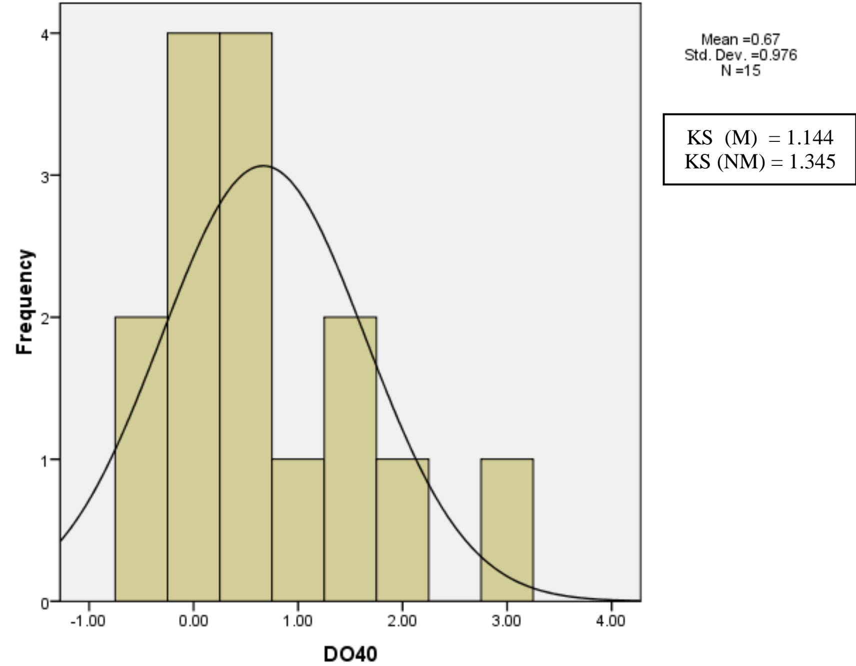
Jia Ming Wu

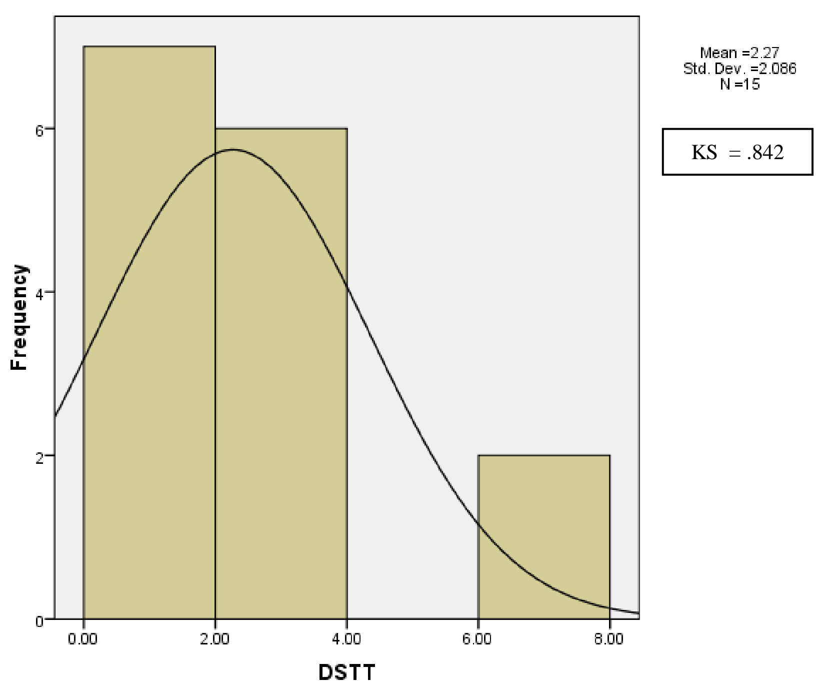
Manager, Quality Control Dept.

APPENDIX E






Mean =0.67
Std. Dev. =0.976
N =15
KS (M) = 1.144
KS (NM) = 1.345
Frequency
0
1
2
3
4
-1.00
0.00
1.00
2.00
3.00
4.00
DO40


Mean =2.27
Std. Dev. =2.086
N =15
KS = .842
Frequency
0
2
4
6
0.00
2.00
4.00
6.00
8.00
DSTT

BIOGRAPHY

NAME	Miss.Siriluk Srisawet
DATE OF BIRTH	27th August 1982
PLACE OF BIRTH	Nakhonratchasima, Thailand
INSTITUTIONS ATTENDED	Boromarajonani College of Nursing Nopparat Vajira (Kasetsart University), 2001 - 2005 : Bachelor of Nursing Mahidol University, 2008 - 2012 : Master of Nursing (Pediatric Nursing)
POSITION & OFFICE	681 Boromarajonani College of Nursing Nopparat Vajira, Bangkok, Thailand Position: Registered Nurse