Comparing physiological and behavioral responses of preterm infants exposed to heel stick using the PIPP and PAT

Monica Slattman
Medical College of Ohio

Follow this and additional works at: http://utdr.utoledo.edu/graduate-projects
Graduate School
Knowledge Begins with Research

FINAL APPROVAL OF SCHOLARLY PROJECT
Master of Science in Nursing

Comparing Physiological and Behavioral Responses of Preterm Infants Exposed to a Heel Stick Using the PIPP and PAT

Submitted by

Monica Slattman

In partial fulfillment of the requirements for the degree of
Master of Science in Nursing

Academic Advisory Committee

Jane Evans, Ph.D., R.N.
(Major Advisor)

Catherine Kleiner, Ph.D., R.N.

Signature

[Signatures]

Interim Associate Dean, Graduate Nursing Programs
Judith Anderson, Ph.D., APRN-BC

Dean, School of Nursing
Jeri Ann Milshead, Ph.D., R.N., FAAN

Dean, Graduate School
Keith K. Schlender, Ph.D.

Date of Presentation: April 22, 2005
Comparing Physiological and Behavioral Responses of Preterm Infants Exposed to Heel Stick Using the PIPP and PAT

Monica Slattman

Medical College of Ohio

2005
ABSTRACT

The purpose of this study was to determine if a correlation existed between 2 pain assessment tools, the PIPP (Premature Infant Pain Profile) and PAT (Pain Assessment Tool). This comparative correlational study used a secondary analysis of a larger study conducted by Evans et al. 2002. A sample of 19 infants, ranging in age from 34 through 36 weeks gestation in a Level III NICU, were videotaped during a heel stick procedure. Physiological and behavioral responses of the preterm infants were coded using the PAT. The Pearson’s Product Moment Correlation was used to determine a correlation between the PAT and PIPP that was used in the original study. The correlation coefficient was r=.60 (p < .001), which indicated a significant positive correlation.
DEDICATION

I dedicate this to one of my best friends, Black, who has been there for me everyday over the last 18 years. You have always been supportive of me no matter what I was doing!

I also dedicate this to my amazing husband, Jason, who has chosen to support me with all of life’s adventures.
ACKNOWLEDGMENTS

I want to thank my advisory committee, Dr. Jane Evans and Dr. Cathy Kleiner. Their encouragement and dedication to helping me complete this project was exemplary! I would not have succeeded without their trust and guidance.

I would also like to thank Dr. Deb Buchman who helped with my statistics. She patiently assisted me with the appropriate statistical tests and accurate interpretation of the results.

I would also like to thank my mom and dad, Sandy and Al Horstman. They have always supported, guided, and encouraged me to follow my dreams, even if it meant taking the long way!
# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>ABSTRACT</td>
<td>2</td>
</tr>
<tr>
<td>DEDICATION</td>
<td>3</td>
</tr>
<tr>
<td>ACKNOWLEDGEMENTS</td>
<td>4</td>
</tr>
<tr>
<td>TABLE OF CONTENTS</td>
<td>5</td>
</tr>
<tr>
<td>LIST OF FIGURES AND TABLES</td>
<td>7</td>
</tr>
<tr>
<td>CHAPTER 1  Introduction</td>
<td>8</td>
</tr>
<tr>
<td>Statement of Problem</td>
<td>9</td>
</tr>
<tr>
<td>Statement of Purpose</td>
<td>10</td>
</tr>
<tr>
<td>Conceptual Framework</td>
<td>10</td>
</tr>
<tr>
<td>Research Question</td>
<td>12</td>
</tr>
<tr>
<td>Hypothesis</td>
<td>12</td>
</tr>
<tr>
<td>Definition of Terms</td>
<td>12</td>
</tr>
<tr>
<td>Significance</td>
<td>14</td>
</tr>
<tr>
<td>Assumptions</td>
<td>15</td>
</tr>
<tr>
<td>Limitations</td>
<td>15</td>
</tr>
<tr>
<td>Summary</td>
<td>16</td>
</tr>
<tr>
<td>CHAPTER II  Literature</td>
<td>17</td>
</tr>
<tr>
<td>Conceptual Framework</td>
<td>17</td>
</tr>
<tr>
<td>Review of Research</td>
<td>23</td>
</tr>
<tr>
<td>Summary</td>
<td>35</td>
</tr>
<tr>
<td>CHAPTER III  Method</td>
<td>36</td>
</tr>
<tr>
<td>Design</td>
<td>36</td>
</tr>
<tr>
<td>Subjects</td>
<td>36</td>
</tr>
</tbody>
</table>
LIST OF FIGURES AND TABLES

Figure 1  Conceptual Framework......................................................... 22
Figure 2  Scatterplot of PIPP and modified PAT......................... 46
Table 1  Sample Characteristics.............................................................. 47
Myrtle McGraw (1941) concluded from her research that neonates could not feel or identify pain because of their body’s immaturity. McGraw’s research provided a basis of care consisting of painful procedures and no analgesics for the neonates. It was not until after almost 40 years of countless painful procedures performed with minimal analgesics that other researchers began to question whether it could be possible for neonates to experience and feel pain. Several studies (Anand, 1999; Lilley, Craig, & Grunau, 1997; Abu-Saad, 1998) since the 1990s concluded that neonates could feel pain.

Craig, Korol, and Pillai (2002) stated that some neonates experienced pain to such a high degree that the effects of pain reactivity were measured weeks, months, and years later. Grunau, Holst, Whitfield, and Ling (2000) concluded that some of these effects included learning disabilities, cognitive impairments, attention deficits, and learning disabilities. Years later, these effects included impulsiveness and poor adaptive capabilities (Grunau et al., 2000).

Several researchers have shown McGraw’s conclusion false. Brooks (1999) concluded that pain receptors are found in practically every tissue of the body and may be aroused by a variety of stimuli. Premature neonates have all the
Comparing Responses 9

requirements for pain perception, both anatomically and physiologically. Marceau (2003) noted that even the most premature of newborns feel pain. Puchalski and Hummel (2002) also supported this finding with a study involving the infant’s withdrawal response to painful procedures of an extremity as with a heel stick.

Anand and Craig (1996) concluded from their study that the full anatomical pathways necessary for nociception are in place at 20 weeks gestation. Neonates and premature neonates aged 24 through 28 weeks gestation do experience pain. The Joint Commission on Accreditation of Healthcare Organization (JCAHO, 2001) took this new found research information and developed new standards to ensure appropriate assessments and treatments of pain were performed.

Neonates do not possess the ability to verbalize pain, which makes it difficult to determine how much pain is experienced. Preterm infants express pain physiologically and behaviorally, which must be assessed by nurses to determine the extent of the pain (Hodgkinson, Bear, Thorn, & Van Blaricum, 1994; Stevens, Johnston, Petryshen, & Taddio, 1996).

Statement of Problem

The preterm infant is born into a world that brings with it numerous uncomfortable and painful medical procedures. Stevens, Johnston, Petryshen, Jack, Stremler, and Platt (1999) stated
Comparing Responses 10

that in the first two weeks of life premature infants underwent an average of 134 painful procedures, many of which contained tissue-damaging stimuli. The consequences of these procedures have been shown to trigger physiological and behavioral effects. Behavioral indicators of pain in the neonate include facial activity, cry, gross motor movement, sweating, and restlessness (Stevens & Franck, 2001). Facial activity can include brow bulge, eye squeeze, nasolabial furrow, chin quiver, and tongue protrusion (Warnock, 2004). Proper assessment and pain alleviation in preterm infants is an important issue. Currently many pain assessment tools are available. Limited research comparing and evaluating these pain assessment tools exists.

Statement of Purpose

The purpose of this study is to compare the existing procedural pain measurement tool, the PIPP (Premature Infant Pain Profile) to the PAT (Pain Assessment Tool). The tools will be compared to determine if a correlation exists between the scores. Correlations between the tools would increase the validity of the tools.

Conceptual Framework

Levine’s Conservation Model of Nursing (1991) was chosen as the conceptual foundation for this study. Levine’s model focuses on individuals responding to internal and external environmental stimuli. If individuals are not able to adapt to
the internal and external stimuli, they seek nursing care. It then becomes the nurse’s responsibility to promote adaptation and maintain wholeness. Using the conservation principles, the nurse can identify specific interventions for the individual.

In premature infants, pain occurs during the heel stick procedure. In application to Levine’s Model (1991), pain occurs when the energy supply is unable to meet the energy demand. Pain affects the physiological and behavioral responses of the infant, even in preterm infants. (Evans, 2001; Glover and Fisk, 2000)

Using the integrities identified by Levine (1991) the preterm infant experiencing pain could manifest:

a) Energy conservation, which includes changes in heart rate, oxygen saturation, and respiratory rate,

b) Structural integrity, including tissue damage from noxious stimuli such as a heel stick,

c) Personal integrity, including depressed state of health due to prematurity,

d) Social integrity, which includes the preterm infant’s inability to socialize as a healthy full-term infant can.

Marceau (2003) conducted a study with 30 ventilated neonates with a mean gestational age of 28 weeks. Marceau (2003) concluded that factors other than cry, such as body movement, respiratory rate, facial expressions, and skin
color needed to be assessed since neonates on a ventilator cannot cry.

Specifically, this study will focus on energy conservation and structural integrity.

Research Question

The research question for this study is: Is there a correlation between two measures of pain, the PIPP (Premature Infant Pain Profile) and the PAT (Pain Assessment Tool), on preterm infants in the NICU who experience a heel stick?

Hypothesis

A correlation will be found between the PIPP and PAT tools showing levels of pain. It is also hypothesized that the tools will differ in specificity of each tool due to the difference in behavioral and physiological aspects measured by each tool.

Conceptual Definitions

1. **Pain** is defined by the International Association for the Study of Pain (2005) as an unpleasant sensory and emotional experience associated with actual or potential tissue damage. It also notes that pain is always subjective.

2. **Preterm infant** is defined by Pillitteri (2003) as an infant born before term (less than the full 37th week gestation).
3. **Heel stick** is a procedure for collecting capillary blood in which the infant’s heel is warmed, cleaned with alcohol, and pierced with a lancing device. Blood from the skin puncture is collected in a tube (Meehan, 1998).

4. **Premature Infant Pain Profile (PIPP)** is a tool used for assessing preterm infants physiological and behavioral responses to pain. Physiologically, the PIPP assesses heart rate and oxygen saturation. Behaviorally, the PIPP assesses eye squeeze, brow bulge, and nasolabial furrow (Stevens et al. 1996).

5. **Pain Assessment Tool (PAT)** is a tool used for assessing infants’ physiological and behavioral responses to pain. Physiologically, the PAT assesses for heart rate, blood pressure, oxygen saturation, respiratory rate, and color. Behaviorally, the PAT assesses for tone, extended or flexed, and facial expressions, frown or grimace (Hodgkinson et al., 1994).

**Operational Definitions**

1. **Pain** for this study is indicated by PIPP and PAT scores. Scores on the PIPP of 6 or less indicate no pain while scores of greater than 12 indicate severe pain (Stevens et al., 1996). PAT scores of 5 through 9 indicate moderate while PAT scores of 10 or greater indicate severe pain (Hodgkinson et al., 1994).
2. **Preterm infant** for this study includes neonates with a gestational age of 34 through 36 weeks.

3. **Heel stick** is defined as a procedure performed by a caregiver that is recorded on videotape and coded in the database.

4. **Premature Infant Pain Profile (PIPP)** - In this study, the pain response was reported in a database (Evans, Lawhorn, & McCartney, 2002).

5. **Pain Assessment Tool (PAT)** - For this study, the pain response of the preterm infant is measured by the score on the PAT.

**Significance**

Nurses use tools, such as the PIPP and PAT, without having the opportunity to compare clinical equivalence and sensitivity in detecting pain associated with routine caregiving procedures among preterm infants of varying gestational ages. Carefully assessing behavioral and physiological responses expressed by preterm infants during painful procedures will assist in ensuring that appropriate actions, such as administering pain medications, are performed.

Preterm infants are a vulnerable population. Not only are preterm infants exposed to numerous painful procedures, they also lack the ability to verbally state pain. Accurate assessment and treatment of pain could reduce the possibility of
long term effects. Grunau et al. (2000) stated that cognitive impairments, learning disabilities, and attention deficits can develop from untreated pain. Accurate assessment and early treatment of pain could decrease subsequent health care costs, morbidity, and mortality rates.

Limited research exists comparing pain assessment tools in preterm infants. The proposed research will help establish concurrent validity for the PAT by comparing the scores to the PIPP, which has construct validity and intrarater and interrater reliability (Ballantyne, 1999).

Assumptions

1. Preterm infants experience pain from heel sticks.
2. Infants should not experience an excess of painful procedures due to possible long-term effects.
3. Infants respond physiologically and behaviorally to painful procedures.

Limitations of the Research

1. Different caregivers use different techniques in performing a heel stick, which can cause a different reaction among the infants.
2. This study uses a convenience sample.
3. This study has a small sample size of 19 preterm infants. Correlations can be detected, however, making a
generalization of the results to a larger population is limited.

4. The study uses a modified PAT scale, which does not include two measures, blood pressure and nurse’s perception.

**Summary**

Pain in the preterm infant is difficult to assess because infants cannot verbalize their feelings. To assess an infant’s reaction to pain, caregivers must analyze the subjective data obtained from physiological and behavioral responses. This study will focus on comparing physiological and behavioral responses of preterm infants to heel sticks using the PIPP and PAT tools.

The theoretical framework using Levine’s Conservation of Energy Model was introduced. The problem, research questions, and hypothesis were stated. Definitions of terms were provided. Significance, assumptions, and limitations were discussed.
The purpose of this study is to assess the physiological and behavioral responses to a heel stick and to determine if a correlation exists between the PIPP (Premature Infant Pain Profile) and PAT (Pain Assessment Tool). This chapter will be divided into two sections. The first section will discuss the conceptual framework used for this study. The second section will contain a review of literature discussing the physiology of preterm infants, assessment of preterm infants, the PIPP, and the PAT assessment tools.

Conceptual Framework

Levine’s Model of Energy Conservation (1991) was used as a basis for the development of this study. Levine formulated a conceptual model of nursing that focuses on energy and the conservation of the patient's wholeness (Levine, 1989). Levine’s (1969) model focuses on an individual’s ability to maintain their wholeness or integrity through the process of adaptation to their internal and external environments. Wholeness is characterized by a person as an integration of its parts system and is described as an “Organism is dependent upon the interrelatedness of it’s component system. In fact, the organism is a system of systems” (Levine, 1973, pp. 8-9).
All of life's processes are fundamentally dependent on the production and expenditure of energy (Levine, 1989). Therefore, the ability of any individual to function is based on his or her energy potential and the specific patterns of energy exchange that are available to that person (Levine, 1989).

Levine added that energy resources needed to be conserved directly by nursing intervention in order to ensure the maintenance of individual integrity (Levine, 1989). The nurse's role within the conservation model is an integral part and instrumental person for the preservation of energy. The nurse's responsibility is to promote conservation of a person's energy, structural, personal, and social integrities.

Levine's (1989) model discusses energy in terms of measurable qualities (consumption, expenditure, etc.) and energy resources arise from this causal model in which nurses can control or aid the individual in attaining and utilizing energy (Levine, 1989).

Levine's (1989) model structures nursing intervention according to four conservation principles, which are conservation of energy, structural integrity, personal integrity and social integrity (Levine, 1989). These principles are defined in the following manner:

1. Conservation of Energy is a natural law found to hold everywhere in the universe for all animate and inanimate
Comparing Responses 19

entities. Nursing intervention is based on balancing the individual's energy input with energy output.

2. Conservation of Structural Integrity focuses attention on healing. Healing is the body's attempt to maintain wholeness (Levine, 1989). Nursing intervention is based on limiting the amount of tissue involvement in infection and disease.

3. Conservation of Personal Integrity focuses attention on the patient as a person. Nursing intervention is based on helping the individual to preserve his or her identity and selfhood.

4. Conservation of Social Integrity focuses attention on the individual's place in his or her family, community, and society. Nursing intervention is based on helping the individual to preserve his or her place in a family, community, and society (Levine, 1989).

Levine's (1989) model describes the internal environment as the integration of bodily functions that resembles a stabilized flow (homeorrhesis) rather than a static state (homeostasis) and is subject to challenges presented by the external environment, which always takes the form of energy (Levine, 1991). The internal environment refers to the physiological and pathophysiologic aspects of the patient with which the nurse deals. In this study, the internal environment is within the preterm infant. Evans (2001) stated that the peripheral nervous system is mature and functions fully in preterm infants. Since
Comparing Responses 20

preterm infants have a functioning immune system and the ability to replace damaged tissue, they have the capacity to adapt and maintain homeostasis.

Levine divided the external environment into perceptual, operational, and conceptual environments (Levine, 1989). The perceptual environment in Levine's (1989) model refers to that portion of the external environment, in this study the NICU, in which people respond to through their sense organs and includes light, sound, touch, temperature, chemical change that is smelled or tasted, and position, sense and balance (Levine, 1989). The operational environment in Levine's (1989) model includes the presence of stimuli, in this study the heel stick, and the efforts to manage stimuli. This study will use the PIPP and PAT assessment tools to measure how the preterm infants are responding, behaviorally and physiologically, to the heel stick procedure.

In order to maintain the body as a whole, the preterm infant must adapt. According to Levine (1989), adaptation is the product of the person’s interaction with the environment, which serves to maintain individual integrity. The inability to adapt to pain can cause long-term side effects. Franck, Greenberg, and Stevens (2000) stated that pain can lead to anorexia, impaired mobility, and delayed wound healing. If left
untreated, pain can cause significant morbidity and an increase in mortality.

Levine's conservation principles all suggest cause-and-effect relationships (Levine, 1989). The first principle of Levine's (1989) model refers to the fact that the ability of any person to function is predicated on that individual's energy potential and the specific patterns of energy exchange that are available. These factors combine to form a pragmatic framework within which to view neonates staying the NICU environment. Only two of Levine’s principles are applied within the nursing conceptual framework for this research study (Levine, 1989).

The concepts within this study have been applied to Levine’s (1989) Conservation of Energy Model. This framework shows the relationship between preterm infants who struggle to function within their own internal environment and external environment in the NICU. The relationships among these concepts are presented in a schematic map (See Figure 1).
Schematic Map: Levine’s Conservation of Energy Model for the Preterm Infant

Levine’s Conservation Principles

Energy Conservation

Structural Integrity

Nursing Care/Interventions
(Heel Stick)

Physical/Behavioral Response
(Video Observation)

PIPP Score

PAT Score

Comparison of Scales
Review of Research

A review of the literature explaining the preterm infant’s behavioral and physiological response to pain will be presented. The review will begin with a discussion of the physiology of the preterm infant including the ability to express pain. Several studies will be discussed representing preterm infant’s behavioral and physiological response to painful procedures, such as a heel stick. Two pain assessment tools, the PIPP and PAT, will be presented in terms of validity and reliability as they apply to this study. The review will end with a summary of findings pertaining to the available literature.

Physiology in Preterm Infants

Being able to sense and react to pain is necessary for survival. Several studies have been done in order to show that preterm infants can actually feel and perceive pain. Glover and Fisk (2000) stated that in order for the fetus to feel pain, the nociceptive pathways must be developed.

Glover and Fisk (2000) determined that the full anatomical pathways for nociception are in place at 24 to 28 weeks gestation. Puchalski and Hummel (2002) further evidenced that an infant’s response to painful procedures is withdrawal of an extremity.

Puchalski and Hummel (2002) provided a timeline for fetal nociception. The timeline suggested that sensory nerve endings
begin developing in the perioral area during the seventh week of gestation. At eleven weeks sensory nerve endings on the face, palms and soles of feet are formed. By twelve weeks, the start of the neural pathway connecting the peripheral nociceptive nerve endings and the spinal dorsal horn cells are present. At fifteen weeks, sensory nerve endings develop on the trunk and proximal extremities. The twentieth week marks when sensory nerve endings develop on mucous membranes and remaining cutaneous areas. This is followed by the completion of the thalamic track at 24 weeks. At thirty weeks, the brain stem and thalamic track are myelinated. At thirty-seven weeks the nociceptive track is completely myelinized (Puchalski and Hummel, 2002).

Myelinization is important because it increases the speed at which an axon can transmit a signal. In the past, it has been a belief that unmyelinated axons transmit signals slower. This provided support to the ideas that neonates were either not affected by pain or less affected by pain. Puchalski and Hummel (2002) stated that impulses travel quite well along unmyelinated nerve tracts and that even some mature nerve fibers remain unmyelinated (C-polymodal fibers), or only thinly myelinated (A delta fibers) into adulthood. Brooks (1999) also noted that these A and C fibers are responsible for transmitting pain impulses to the central nervous system.
Evans (2001) describes the functioning physiology of a preterm infant’s response to acute pain. In the preterm infant, the peripheral nervous system, supraspinal modulation and integration, and spinal cord processing are mature and work to the full extent (Evans, 2001). Painful procedures such as a heel stick result in tissue injury. Hummel and Puchalski (2002) describe the pain pathway in terms of noxious stimuli that excite afferent fibers, which transmit information from the periphery to the dorsal horn of the spinal cord. Tissue injury is noted by supraspinal modulation.

The thalamus, reticular formation, periaqueductal gray area, midbrain, and limbic system and cortex within the supraspinal modulation and integration component receive the initial pain impulse. After receiving the pain impulse, the supraspinal modulation and integration component interprets the pain and determines how to protect the body from the pain (Evans, 2001).

According to Evans (2001), tissue injury caused by heel sticks causes chemical mediators to be released in the body. Chemical mediators perform two main functions. First, these chemical mediators stimulate pain impulses to transport the pain impulse to the spinal cord. Second, chemical mediators trigger inflammation where the heel stick tissue injury occurred.
Franck et al. (2000) provided an example that demonstrated the role of chemical mediators. In the example, tissue injury caused the release of inflammatory mediators (e.g., potassium, bradykinin, prostaglandins, cytokines, nerve growth factors, catecholamines, and substance P) that sensitize the A-delta and C fibers and recruit other neurons (silent nociceptors) resulting in hyperalgesia. In a healthy infant, these effects can be detrimental. However, in preterm neonates, these effects prove an immediate threat on their ability to thrive (Franck et al., 2000).

Anand and Craig (1996) concluded that preterm infants as early as 20 weeks gestation have cortical capacity to interpret painful stimuli, but lack inhibitory mechanisms necessary to regulate pain impulses. Evans (2001) expanded this conclusion by adding that preterm infants lack the neurotransmitters, dopamine and norepinephrine, which regulate pain. Serotonin is not present at birth and may take up to 8 weeks following birth to be released. Not only do these factors restrict a preterm infant from regulating pain, they also can result in increasing the intensity of the pain.

Behavioral and physiological responses to pain in the preterm infant are observable. Mature, ascending pathways in the preterm infant result in increased heart and respiratory rates. The ascending pathways are also responsible for the
preterm infant’s behavioral response. This response includes facial activity, such as brow bulge and eye squeeze (Evans, 2001).

Physiological signs of painful stimuli are present in neonates, whether there is a behavioral response or not. Painful stimuli solicit responses from the autonomic nervous system such as increased respirations, increased ventilation, increased heart rate, increased systolic and diastolic blood pressure, pupil dilation, and palmar sweat (Brooks, 1999; Franck & Miakowski, 1997).

These physiological and behavioral responses are expressed by preterm infants in response to pain. As nurses, the task of assessing and determining what these responses means is imperative to the health of this vulnerable population. Accurate assessment can help ensure that pain is identified early. Upon identification of pain, specific treatments for the determined cause of pain can be initiated. It is hopeful that research in this area will lead to a widespread understanding and acceptance of neonatal pain and necessary measures which need to be taken to reduce pain and stress.

Assessment of Preterm Infants

Currently, there is not one widely used and accepted tool for assessing pain in the preterm infant. Assessment techniques for pain involve self-reports, which is limited in infants
because they cannot verbally express pain. Observation of behavioral and physiological responses of preterm infants is necessary to assess their pain. Assessments involve using unidimensional or multidimensional tools, such as the PIPP and PAT. Franck et al. (2000) stated that using multidimensional tools that assess behavioral and physiological measures across different aspects of the pain experience, such as intensity, pattern, and meaning, could result in a more accurate rating of the preterm infant’s pain response.

Johnston, Stevens, Yang, and Horton (1995) conducted a multidimensional assessment of preterm infant responses to real and sham heel sticks. The study consisted of 48 infants between 26 and 31 weeks gestational age. The purpose of the study was to use the real or sham heel stick with preterm infants and focus on behavioral and physiological aspects that are present, which may discriminate between real and sham heel stick procedures. The heel stick procedure consisted of heel warming, lancing of the heel, and heel squeezing until an adequate blood sample was obtained. The sham heel stick was identical to the real heel stick, except that the heel was not lanced. Instead of lancing the heel, the nurse touched and squeezed the heel no longer than two minutes, which could be painful.

From this study, it was concluded that young very low birth weight infants are capable of experiencing a multidimensional
Comparing Responses 29
differential response to pain. The infants responded
differently to the sham and real heel stick procedures. The
real heel stick created a greater response. The infant’s
responses increased throughout the procedure, with increased
heart rate and brow bulge becoming the most expressed. Older
gestational age preterm infants showed a greater response than
younger gestational age infants.

Lindh, Wiklung, Sandman, and Hakansson (1997) conducted a
study of 10 preterm infants, ranging in age from 27-35 weeks,
who had a heel stick procedure performed. Similar to Johnston
et al. (1995), this study concluded that all infants responded
with facial expression, such as brow bulge and had an increase
in heart rate. Blood sampling causes distress in the preterm
infants, which was expressed by the facial activity in all of
the participants. In comparison to Johnston et al. (1995),
Lindh et al. (1997) concluded the most premature infants did not
respond as robustly to the pain compared to older infants. This
study had a limited number of participants making definitive
conclusions difficult.

Hadjistavropoulos, Craig, Grunau, and Whitfield (1997)
conducted a study consisting of 56 preterm infants ranging in
gestational age from 25 to 41 weeks. The study focused on
facial and body activity. This study identified a specific
order to the infant’s response to pain. Pain ratings occurred in
an orderly fashion starting with facial expressions and proceeding to body movements. Similar to Lindh et al. (1997) and Johnston et al. (1995), Hadjistavropoulos et al. (1997) concluded that infants older in gestational age showed a more pronounced effect to the heel stick. These infants were judged to be experiencing the most pain as evidenced by facial activity, which was the most observed variable. The study also concluded 71% of the variance in pain ratings could be predicted using facial activity alone.

Johnston, Stevens, Franck, Jack, Stremler, and Platt (1999) conducted a study consisting of 120 preterm infants with an average gestational age of 28 weeks. The purpose of the study was to use the PIPP scale and medical records to determine what might cause a lack of response to a heel stick procedure. In contrast to Lindh et al. (1997), not all of the participants responded to the heel stick. Only 80% of the participants responded. In contrast to Lindh et al. (1997), Johnston et al. (1995), and Hadjistavropoulos et al. (1997), Johnston et al. (1999) could not rule the possibility that some infants may not perceive pain. With available research stating that pain can be felt by preterm infants, this is a unlikely conclusion. A better explanation could be that the preterm infant felt the pain, but was unable to express it because no energy was left (Johnston et al., 1999).
Comparing Responses 31

Premature Infant Pain Profile (PIPP)

Realizing that inadequate assessment of pain, especially in the preterm infants, was a serious clinical problem, Stevens et al. (1996) developed the PIPP. The PIPP is a multi-dimensional tool that was initially used to measure procedural pain in preterm and full-term infants. The PIPP contains a seven-indicator measure, which includes behavioral, physiological, and contextual aspects of infant responses to pain.

Behaviorally the PIPP assesses eye squeeze, brow bulge, and nasolabial furrow. Physiologically the PIPP assesses heart rate and oxygen saturation. Currently the PIPP has content validity, criterion validity, interrater reliability, and internal consistency. It is also the only tool that has clinical utility. (Stevens et al., 1996)

The initial study to test the reliability and validity of the PIPP with four data sets was conducted (Stevens et al., 1996). Data set 1 had a sample size of 124 infants with gestational ages between 32 through 34 weeks. Data set 2 included 39 infants with gestational ages ranging from 32-34 weeks. Data set 3 contained 47 infants with gestational ages ranging from 28 through 30 weeks gestation. Data set 4 contained 27 male infants ranging in age from 37 through 40 weeks gestation. Data sets 1 and 2 compared heel sticks. Data set 3 compared heel sticks with sham heel sticks. Data set 4
compared baseline circumcision to Gomeo clamp application. Data
sets were chosen to represent different ranges of gestational
ages, painful procedures, and various settings (Stevens et al.,
1996).

Construct validity was determined by analyzing the heel
stick procedure versus a sham heel stick procedure for infants
in data set 2. Infants in data set 3 were younger than those in
data set 2 who had the heel stick and sham heel stick performed.
Similar to Stevens et al. (1996), Lindh et al. (1997), and
Hadjistavropoulos et al. (1997), the study concluded that
infants of lower gestational age in data set 3 scored lower than
the infants in data set 2 who were older. Two possible reasons
were identified for the conclusion. First, the younger
gestational age infants experience less pain. Second, the
measure does not compensate for expressive limitations. Both
conclusions stress the importance of not comparing scores
between infants of varying gestational ages (Stevens et al.,
1996).

Initially the PIPP was used to determine procedural pain in
the preterm infant. Since its development in 1996, the PIPP has
taken on other roles. The PIPP also has validation for use in
evaluating postoperative pain (Franck et al., 2000) as well as
determining the efficiency of nonpharmacological interventions
(Craig et al., 2002) in preterm infants.
Pain Assessment Tool (PAT)

Hodgkinson et al. (1994) developed the PAT in an attempt to measure pain in neonates and provide a tool that was easy to use and understand. Initially the PAT was developed by a group of neonatal nurses to assess a neonate’s pain response postoperatively. The pilot study included 20 postoperative neonates ranging in age from 27 weeks gestation to full-term and 3 days to 42 days after full-term delivery. The purpose of the study was to determine what interventions to take with a specific score. The study concluded that scores greater than five and greater than ten were indicative of specific interventions, such as analgesia, repositioning, decreasing environmental stressors, and touch (Hodgkinson et al., 1994).

Limitations were noted in this study. A major limitation was that the data collectors were seldom the nurse caring for the patients whose data they were collecting. Different interpretations of pain levels could have resulted between the different caregivers. Another limitation is that the study consisted of 20 infants, which makes it difficult to make generalizations of the whole population. Since this was a pilot study, more studies with larger populations are necessary to test the PAT’s validity (Hodgkinson et al. 1994).

The PAT is a multidimensional tool that includes behavioral and physiological parameters. Behaviorally the PAT assesses
facial expressions and body tone. Physiologically, the PAT assesses heart rate, oxygen saturation, respiratory rate, and skin color of the infant (Hodgkinson et al. 1994).

Abu-Saad (1998) concluded that somatic testing is necessary in order to determine construct validity and reliability within the PAT. In an attempt to determine construct validity, Marceau (2003) conducted a study, which combined the PAT and the Clinical Distress Scale for Ventilated Newborn Infants (DSVNI). Thirty ventilated, preterm infants ranging in age from 25 to 36 were included in the study. The study concluded the NNICUPAT had a significant degree of concurrent validity when compared to the Visual Analogue Scale (VAS). Marceau (2003) noted that further research is needed to determine the interrater reliability and validity of the PAT and NNICUPAT.

Currently, no research is available comparing the PAT assessment tool with any of the other assessment tools for neonates. By comparing the PAT with the well-tested PIPP, this study will examine correlations between the PAT and the PIPP.

The PIPP and PAT are both multi-dimensional tools. A correlation and relationship to each other will provide a greater understanding of how to accurately measure preterm infants pain. Accurate measurement of pain can provide a way to improve the quality of life for this susceptible population.
Because of the extensive research done using and testing the PIPP, it was determined to be the gold standard for the purpose of this study. The PAT scores will be compared to the original researchers PIPP to establish concurrent validity. The comparison will also allow us to examine the relationship between these two scales and their attempts to quantify the multidimensional experience that pain is.

Summary

Glover and Fisk (2000) and Evans (2001) stated that preterm infants have the necessary nociceptors needed to feel pain. Pain responses can be identified in preterm infants at early ages. Painful procedures such as heel sticks cause preterm infants to respond physiologically and behaviorally to pain. Preterm infants’ responses to pain are assessed using tools such as the PIPP and PAT.

Little research comparing the assessment tools against each other exists. This study is an attempt to compare the PIPP and PAT tools and use the comparison to check the reliability and validity of the PAT to the PIPP. Evaluating preterm infants’ behavioral and physiological responses to a heel stick using the PIPP and PAT tools will aid in the attempt to narrow the gap between how effective one pain assessment tool is to another in the treatment of pain for preterm infants.
CHAPTER III

METHOD

The purpose of this study is to compare existing procedural pain measurement tools to determine correlation among scores. The correlation will determine the equivalency of pain levels across tools, such as the PIPP (Premature Infant Pain Profile) and PAT (Pain Assessment Tool). The chapter begins with a description of the study design. The setting for the study and sample will be identified. Materials, data collection methods, and data analysis will be presented. The chapter concludes with a summary.

Design

This study will use a comparative correlational design. This design was selected because the purpose of the study was to compare the PIPP and the PAT scores for heel stick procedures. This study will involve a secondary analysis of data collected in a NIH funded study conducted by Evans et al. 2002. The original study was designed to observe behavioral and physiological responses of 81 preterm infants during painful and nonpainful procedures (Evans et al., 2002).

Subjects

The setting for the original study was a 60 bed, Level III NICU in a large metropolitan hospital. Eighty-one preterm infants who ranged in age from 23 through 36 weeks gestation
were eligible for the original study. The preterm infants were divided into 4 groups according to gestational age: Group 1 (less than 28 weeks gestation), Group 2 (28 through 30 weeks gestation), Group 3 (31 through 33 weeks gestation), and Group 4 (34 through 36 weeks gestation). Each infant was assigned an identification number by an external source. The preterm infants were videotaped during the heel stick procedure.

For the current study, the setting will be the research office of the principal investigator (Jane Evans) at MCO. A convenience sample using the same 20 preterm infants used by Evans et al. (2002) as Group 4, preterm infants ranging in age from 34 through 36 weeks gestation, will be selected. This selection was based on the need to provide support for the review of literature, in which, Hadjistavropoulos et al. (1997) concluded that older infants such as those in Group 4 showed a pronounced effect to the heel stick.

**Inclusion/Exclusion Criteria**

Inclusion criteria for this study includes preterm infants with a gestational age of 34 through 36 weeks gestation who had an observed heel stick.

Exclusion criteria for the original study were: known cardiovascular or central nervous system anomalies, evidence of sepsis, documented intraventricular hemorrhage, and infants who received tranquilizers, opioid analgesics, or neuromuscular
blocking agents. Exclusion criteria for the current study included Groups 1 through 3, which contained infants less than 34 weeks gestation. Also excluded for this study is personal identification information about the preterm infants or any hospital staff included in the care. This exclusion limits the researcher’s knowledge on how many heel sticks each preterm infant had performed.

Material

Stevens et al. (1996) developed the Premature Infant Pain Profile (PIPP) as a multidimensional pain measure for premature infants. (See Appendix A) In the original study conducted by Evans et al. (2002), the PIPP was used to assess behavioral and physiological responses to preterm infant’s pain. The score each preterm infant received on the PIPP was recorded in a computerized database.

Hodgkinson et al. (1994) developed the Pain Assessment Tool (PAT) in an attempt to measure pain in neonates and provide a tool that was easy to use and understand. (See Appendix B) The purpose of developing the PAT was to determine what interventions to take with a specific score. Only a pilot study was conducted during the development of the PAT. More studies with larger populations are necessary to test the validity of the PAT. Current research lacks any further information on testing the PAT.
The PAT is a multidimensional tool that includes behavioral and physiological parameters. The PAT consists of 10 indicators, which are scored on a scale ranging from 0 through 2. The 10 indicators are: body posture/tone, sleep pattern, facial expression, skin color, cry, respirations, heart rate, oxygen saturation, blood pressure, and the nurse’s perception on whether he/she thinks the baby is in pain (Hodgkinson et al., 1994). For the current study, two indicators were not recorded. A modified PAT that has eliminated blood pressure and nurse’s perception of preterm infant pain will be used.

Total scores on the PAT indicate the level of pain a preterm infant is experiencing. Scores of 0 through 4 indicate no pain. Scores of 5 through 9 indicate moderate pain. Scores of 10 or higher indicate the preterm infant is experiencing severe pain. With moderate pain levels (5-9), nurses should use comfort measures, such as holding to decrease pain levels. With severe pain levels (10 and greater), nurses should administer analgesia (Hodgkinson et al., 1994).

Ballantyne et al. (1999) established concurrent validity and reliability in the clinical setting for the PIPP. Comparing the PAT scores to the original researchers PIPP scores will establish concurrent validity.
Data Collection

The original study conducted by Evans et al. (2002) recruited 81 preterm infants who were admitted in a Level III NICU. Of the 81 preterm infants, 50 were male and 31 were female. The sample was divided into 4 groups according to gestational age: Group 1 (less than 28 weeks gestation), Group 2 (28 through 30 weeks gestation), Group 3 (31 through 33 weeks gestation), and Group 4 (34 through 36 weeks gestation). A convenience sample of the 20 infants in Group 4 will be used for this study.

Approval for the original study (Evans et al., 2002) was obtained from the Institutional Review Board (IRB) of the Medical College of Ohio as well as the hospital participating in the study. Protection of human rights procedures for the current study was approved by the IRB at the Medical College of Ohio and the hospital participating in the study. Confidentiality of the participants was insured by assigning an identification number to each infant. No names of the participants or the staff providing care are on the videotapes.

In the original study, Evans et al. (2002) assessed the preterm infants’ responses to a heel stick using the PIPP. The scores on the PIPP were recorded in a computerized database. In the current study, the preterm infants’ responses to the heel stick procedure will be measured with the PAT by observing the
responses on the videotapes. The scores from the PAT will be recorded in a computerized database so they can be compared to the original study scores of the PIPP.

Assumptions

1. The PIPP and PAT are reliable instruments.
2. The coding of the physiological and behavioral responses recorded in the original study are accurate.

Limitations

1. Different nurses provided care and performed the heel stick procedures, which could cause a difference in an infant’s response to pain.
2. The number and timing of painful procedures performed on infants while in the NICU could affect the preterm infants’ responses to pain. It is unknown how many procedures were performed or the amount of time between procedures.
3. The study uses a convenience sample.
4. The study uses a modified PAT tool which eliminates two measures, blood pressure and nurse’ perception.

Data Analysis

The data will be analyzed using descriptive parametric statistical methods. The purpose of the study was to compare the physiological and behavioral responses of preterm infants using the PIPP and PAT tools. The Pearson Product Moment
Correlation was used to determine correlations among the PIPP and PAT tools.

The research question for the study was: Is there a correlation between two measures of pain, the PIPP (Premature Infant Pain Profile) and the PAT (Pain Assessment Tool), on preterm infants in the NICU who experience a heel stick? To answer the question, data will be analyzed using the Pearson Product Moment Correlation.

The use of the Pearson Product Moment Correlation requires that the following assumptions are met: 1) Interval measurement of both variables, 2) Normal distribution of at least one variable, 3) Independence of observational pairs, and 4) Homoscedasticity, equally dispersed around the line of best fit (Burns & Grove, 2001).

Summary

This chapter contained a description of the comparative correlational design used for the study of preterm infants’ responses to a heel stick procedure. This research involved a secondary analysis of a larger study. Physiological and behavioral responses of the preterm infants were assessed using the PAT. These responses were recorded in a database so they could be compared to those of the PIPP used in the original study.
The setting for the original and present study was discussed. The sample and the criteria for the selection of the sample were described. The instrument used to measure pain response, the PAT (Pain Assessment Tool) was explained. The reliability and validity of the PAT and PIPP was addressed. The chapter concluded with a description of the methods of data collection and analysis.
CHAPTER IV

RESULTS

The research study was designed to determine correlations among different pain scales used with preterm infants. Observing and scoring behavioral and physiological responses of preterm infants ranging in age from 34 through 36 weeks gestation using the PIPP and PAT tools was implemented. It was hypothesized that a correlation will be found between the PIPP and PAT tools showing levels of pain.

The chapter begins with a description of the demographic characteristics of the sample. The research question, appropriate statistical analysis, and findings will be presented. The chapter will conclude with a summary.

Sample

The sample for the current study consisted of 19 preterm infants ranging in age from 34 through 36 weeks gestation. (See Table 1) The sample contained 14 males and 5 females. There were 7 infants born at 34 weeks gestation, 7 at 35 weeks, and 5 at 36 weeks gestation. The ethnic background of the 19 preterm infants chosen for this study included: 14 Caucasian, 4 African American, and 1 Asian/Pacific Islander. The mean birthweight for the sample was 2241 grams with a standard deviation of 236 grams.
In the original study conducted by Evans et al. (2002), the goal for minority representation was 25 percent. The sample for this study contained a minority representation of 26 percent. This study sample contained a sufficient minority representation of the target population.

Table 1

<table>
<thead>
<tr>
<th>Sample Characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Gestational Age</strong></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td><strong>Gender</strong></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td><strong>Ethnic Group</strong></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td><strong>Birthweight</strong></td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>

Findings

The research question for the study was: Is there a correlation between two measures of pain, the PIPP (Premature Infant Pain Profile) score and the PAT (Pain Assessment Tool), on preterm infants in the NICU who experience a heel stick? To answer the question, data were analyzed using the Pearson Product Moment Correlation.

Descriptive means of the PIPP and modified PAT were used to compare the preterm infants’ responses to the heel stick procedure. The PIPP score was calculated two minutes after the skin puncture phase of the heel stick procedure. The baseline parameters were obtained for 2 minutes. For the 49 observed
heel sticks in the present study, the mean PIPP score was 9.00 with a standard deviation of 4.4. The minimum and maximum PIPP scores were 2 and 17.

The modified PAT score was calculated immediately following the skin puncture phase of the heel stick procedure. In comparison to the PIPP, the mean modified PAT score was 9.85 with a standard deviation of 5.1. The minimum and maximum modified PAT scores were 0 and 15.

The Pearson Product Moment Correlation was computed for the PIPP and modified PAT tools. The correlation coefficient between the PIPP and the modified PAT scores was $r=.60$ ($p < .001$). The results suggest that there is a significant positive correlation between the PIPP and PAT tools. The scatterplot (See Figure 2) for the PIPP and modified PAT indicated that the two variables are linearly related, as the PIPP score increased the modified PAT score increased.
Summary

This chapter contained a statistical analysis between the PIPP and modified PAT tools. Preterm infants’ behavioral and physiological responses to a heel stick procedure were measured. A determination was made that a significant correlation \( r = 0.60 \) (\( p < .001 \)), exists between the PIPP and modified PAT tools. The results suggest that there is a significant positive correlation between the PIPP and PAT. Higher pain scores on the PIPP indicate higher pain scores on the PAT.

The sample characteristics of the present study were described. The research question and appropriate statistical tests for the sample data was presented. The chapter concluded with the results of the present study.
CHAPTER V
DISCUSSION

The purpose of this study was to determine if a correlation existed between the PIPP (Premature Infant Pain Profile) and PAT (Pain Assessment Tool). Observing and scoring behavioral and physiological responses of preterm infants expressed following a heel stick procedure were necessary. This chapter begins with a discussion the findings of the research study. Conclusions, limitations, and implications for nursing will be addressed. Recommendations for further research will be presented. The chapter will conclude with a summary of the research study.

Findings

The research question for the study was: What is the correlation between two measures of pain, the PIPP (Premature Infant Pain Profile) score and the PAT (Pain Assessment Tool), on preterm infants in the NICU who experience a heel stick? For the current study, preterm infants expressed behavioral and physiological responses to a heel stick procedure. This finding is similar to the research presented in the review of literature (Glover et al., 2000; Puchalski et al., 2002; Evans, 2001; Lindh et al., 1997; Johnston et al., 1995), which concluded that preterm infants have the ability to feel and express pain in response to painful stimuli.
Originally, Hodgkinson et al. (1994) developed the PAT for use in post-surgery preterm infants. Upon arrival to the hospital unit, the preterm infants were assessed for pain and coded hourly using the PAT tool. For the current study, the modified PAT score was calculated immediately following the skin puncture phase of the heel stick procedure. The modified PAT score coding continued to the end of the heel stick procedure when the bandage was applied. In comparison, the PIPP (Stevens et al., 1996) score was calculated two minutes after the stick portion of the heel stick procedure. Baseline data was determined for 2 minutes prior to the nurse touch of the infant.

Scores on the PIPP of 6 or less indicated no pain while scores of greater than 12 indicated severe pain (Stevens et al., 1996). The mean PIPP score for the current study was 9.00, which indicated moderate pain. Scores on the modified PAT of less than 5 indicated no pain. Scores greater than 5 and less than 10 on the modified PAT indicate moderate pain and call for nursing comfort measures, such as holding the infant. Scores greater than 10 indicate severe pain and call for analgesia administration (Hodgkinson et al., 1994).

This research study supports Levine’s Energy of Conservation Model (1969), which focuses on the conservation of energy, structural integrity, personal integrity, and social integrity. The current study specifically focuses on the
Comparing Responses 50

conservation of energy and structural integrity principles. Behavioral and physiological responses expressed by preterm infants to a heel stick are indicative of an organism responding to the environment. The heel stick procedure breached the structural integrity of the organism, which caused the behavioral and physiological responses to be expressed. Increase in heart rate and decrease in oxygen saturation diminish energy stores in the preterm infant.

Conclusions

This study supports many previous research studies that preterm infants can feel and express behavioral and physiological responses to painful stimuli (Glover & Fisk, 2000; Puchalski et al., 2002; Evans, 2001; Lindh et al., 1997; Johnston et al., 1995; Anand, 1999). The results of the research study are as follows:

- Heel sticks are painful for preterm infants between 34 through 36 weeks gestation.
- The PIPP and PAT are reliable and valid tools used to determine the level of pain a preterm infant is experiencing.
- A positive correlation $r = .60$ ($p < .001$), exists between the PIPP and modified PAT scores. As the score on the PIPP increases, the score on the PAT increases.
It was hypothesized that a correlation would be found between the PIPP and PAT showing levels of pain. A positive correlation $r=.60$ ($p < .001$), supports the hypothesis.

**Limitations**

The current study had several limitations. A small sample size limits the ability to make generalizations applying to the whole population. Each infant had a varied number of heel stick procedures performed by different caregivers using different techniques, which may have caused different reactions among the infants.

Another limitation of the study was the preterm infant’s inability to verbally communicate pain. Levels of pain needed to be determined by observing the infant’s behavioral and physiological responses to the heel stick procedure.

Factors such as length of stay in the NICU, number of invasive procedures, and severity of illness could have also affected the preterm infant’s behavioral and physiological response to pain. Some infants were intubated at the time of the heel stick, which affected the interpretation of facial expressions. The PAT scoring for the research study was also limited. Blood pressure readings were not recorded, which may have skewed the total pain score by 2 points. Nurse’s perception of whether or not the infant appeared to be experiencing pain was not recorded, which may have skewed the
Comparing Responses 52

total pain score by 2 points. A modified PAT was used for the current study, which adjusted for the missing blood pressure and nurse’s perception variables.

Implications

The current research study has implications for nursing practice, education, and administration. Preterm infants’ pain is not only detrimental to their overall well-being, but it is also costly to hospitals that have to pay for lengthy stays.

Nurses are responsible for providing care to preterm infants who cannot verbally state how much pain is experienced. Providing care means being able to accurately assess the preterm infant and carry out comfort and pain-reducing measures, such as analgesia. In order to achieve this mark, nurses must understand the cause of preterm infants’ behavioral and physiological responses and how to reduce pain depending on its level of intensity.

Educating nurses about the physiology of pain and how to accurately assess pain is crucial. Nursing instructors need to educate BSN students about preterm infant pain. Additional time in undergraduate coursework needs to be spent on explaining the physiology of pain, especially in the preterm infant who cannot verbally state a pain rating. Educating nursing students about how the body perceives and processes pain will aid in more accurate assessments obtained from objective data.
Educating nurses how to use pain assessment tools at the bedside assists in assuring that this vulnerable population will obtain the comfort and pain reducing measures needed. In order to obtain more accurate assessments a multi-dimensional pain assessment tool such as the PAT should be used. Using the PAT provides an easy way to observe various physiological and behavioral responses the infants express during painful procedures at the bedside. Providing nurses with the checklist PAT tool can save time and help this vulnerable population receive necessary comfort and pain reducing measures.

Nursing administrators face the challenge of how to educate their staff, ensure accurate assessments and treatments are provided to patients, and keep down financial costs. Many pain assessment tools are available for use. Nursing administrators need to work with their staff in order to find the best assessment tool. Increasing staff awareness of accurate assessments and the long-term effects of pain in preterm infants is essential to successful care.

Recommendations for Further Research

Further research studies are needed to address some of the questions brought up by the current research study. This study used 2 pain assessment tools, the PIPP and modified PAT, to determine the extent of pain experienced by preterm infants. Several more tools are available to measure preterm infant pain.
Future research should address other tools and compare the ease of use and scoring methods. Are there correlations between any other pain assessment tools other than the PIPP and PAT?

Further research should also address what comfort measures are performed at specific pain levels. Observing just a few minutes of a heel stick procedure, it is difficult to know when the last time any pain medications or other nursing interventions were performed. Did the infants who received pain medication score lower on the PIPP and PAT? Do preterm infants who have lower scores have an inability to express the pain they are experiencing?

**Summary**

A significant correlation exists between the PIPP and modified PAT, $r=.60$ ($p < .001$). Higher pain scores on the PIPP indicate higher pain scores on the modified PAT. Pain scores on the PIPP ranging from 6 through 10 indicate moderate pain while scores of 12 and greater indicate severe pain. In comparison, pain scores on the PAT ranging from greater than 5 and less than 10 on the modified PAT indicate moderate pain while scores greater than 10 indicate severe pain.

The current study involved a secondary analysis of a larger study and had several limitations. A small sample size containing preterm infants who cannot verbally communicate pain may have influenced the results. Factors such as length of stay...
in the NICU, number of invasive procedures, and severity of illness could have also affected the preterm infants’ behavioral and physiological responses to pain. Some infants were intubated at the time of the heel stick, which affected the interpretation of facial expressions.

Educating nursing students and nurses who work on the floor to use the PAT for pain scoring is essential. Understanding the physiology of preterm infant pain and accurately assessing pain levels is crucial to their health and survival. Accurate assessments may also limit the number of days spent in the hospital and decrease the cost of care.

This chapter presented a discussion of the study results. Conclusions and limitations were presented. Implications for nursing practice, education, and administration were addressed.
REFERENCES


Evans, J. (2001). Physiology of acute pain in preterm infants. *Newborn and Infant Nursing Reviews, 1*, 75-84.


### APPENDIX A

**Premature Infant Pain Profile (PIPP)**

**Infant ID Number**

**Date/Time**

**Event**

<table>
<thead>
<tr>
<th>PROCESS</th>
<th>INDICATOR</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>SCORE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chart</td>
<td>Gestational Age</td>
<td>36 weeks and more</td>
<td>32-35 weeks, 6 days</td>
<td>28-31 weeks, 6 days</td>
<td>Less than 28 weeks</td>
<td></td>
</tr>
<tr>
<td>Observe infant 15 seconds Heart rate</td>
<td>Behavioral State</td>
<td>Active/awake Eyes open Facial movements</td>
<td>Quiet/awake Eyes open No facial movements</td>
<td>Active/sleep Eyes closed Facial movements</td>
<td>Quiet/sleep Eyes closed No Facial movements</td>
<td></td>
</tr>
<tr>
<td>Oxygen Saturation</td>
<td>Heart Rate Max</td>
<td>0-4 beats/min increase</td>
<td>5-14 beats/min increase</td>
<td>15-24 beats/min increase</td>
<td>25 beats/min or more increase</td>
<td></td>
</tr>
<tr>
<td>Observe infant 30 seconds</td>
<td>Oxygen Saturation Min</td>
<td>0-2.4% decrease</td>
<td>2.5-4.9% decrease</td>
<td>5.0-7.4% decrease</td>
<td>7.5% or more decrease</td>
<td></td>
</tr>
<tr>
<td>Brow Bulge</td>
<td>None</td>
<td>0-9% of time</td>
<td>Minimum 10-39% of time</td>
<td>Moderate 40-69% of time</td>
<td>Maximum 70% of time or more</td>
<td></td>
</tr>
<tr>
<td>Eye Squeeze</td>
<td>None</td>
<td>0-9% of time</td>
<td>Minimum 10-39% of time</td>
<td>Moderate 40-69% of time</td>
<td>Maximum 70% of time or more</td>
<td></td>
</tr>
<tr>
<td>Nasolabial Furrow</td>
<td>None</td>
<td>0-9% of time</td>
<td>Minimum 10-39% of time</td>
<td>Moderate 40-69% of time</td>
<td>Maximum 70% of time or more</td>
<td></td>
</tr>
</tbody>
</table>

**TOTAL SCORE**
Scoring Method for the PIPP

1. Familiarize yourself with each indicator and how it is to be scored by looking at the measure.

2. Score gestational age from the chart before you begin.

3. Score behavioral state by observing the infant 15 seconds immediately before the event.

4. Record baseline heart rate and oxygen saturation.

5. Observe the infant for 30 seconds immediately following the event. You will have to look back and forth from the monitor to the baby’s face. Score physiological and facial action changes seen during that time and record immediately following the observation period.

6. Calculate the final score.

## APPENDIX B

### Pain Assessment Tool (PAT)

<table>
<thead>
<tr>
<th>INDICATOR</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>SCORE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Posture/Tone</td>
<td>EXTENDED</td>
<td>FLEXED/TENSED</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>*Digits widespread</td>
<td>*Fists clenched</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>*Trunk rigid</td>
<td>*Trunk guarding</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>*Limbs drawn out</td>
<td>*Limbs drawn to midline</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>*Shoulders raised off bed</td>
<td>*Head &amp; shoulders resist posturing</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sleep Pattern</td>
<td>RELAXED</td>
<td>AGITATED/DEMENTED</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>*Wakes with startle</td>
<td>*Easily woken</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>*Restless</td>
<td>*Squirming</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>*No clear sleep/wake pattern</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Expression</td>
<td>FROWN</td>
<td>GRIMACE</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>*Shallow furrow</td>
<td>*Deep furrow</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>*Eyes lightly closed</td>
<td>*Eyes tightly closed</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>*Pupils dilated</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Color</td>
<td>PINK, WELL PERFUSED</td>
<td>PALE/DUSKY/FLUSH</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>*Palmar sweating</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cry</td>
<td>NO</td>
<td>YES</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>*When disturbed</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>*Doesn’t settle after handling</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>*Loud</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>*Whimpering</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>*Whining</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Respirations</td>
<td>TACHYPNEA</td>
<td>APNEA</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Heart Rate</td>
<td>TACHYCARDIA</td>
<td>FLUCTUATING</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>*Spontaneous or at rest</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Oxygen Saturation</td>
<td>NORMAL</td>
<td>DESATURATION</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Blood Pressure</td>
<td>NORMAL</td>
<td>HYPO/ HYPERTENSION AT REST</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nurse’s Perception</td>
<td>NO</td>
<td>YES</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**TOTAL SCORE**