

A comparative study of preterm infant pain tools during a common NICU procedure

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FINAL APPROVAL OF SCHOLARLY PROJECT
Master of Science in Nursing

A Comparison Study of the Preterm Infant Pain Scale During a Common Heel Stick Procedure

Submitted by

Beth Szymanski

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

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CHAPTER I

INTRODUCTION

Hospitalized infants undergo repeated invasive procedures beginning minutes after they are born. The controversy of whether a neonate even “feels” pain, the issues of pain assessment and pain management, and the understanding of the very basics of the nature of pain in the neonate remain significant problems (Blauer & Gerstmann 1998). Many of these procedures are being performed repeatedly without the use of analgesics. Inadequate assessment of pain in premature infants is an unresolved clinical problem. The need for a valid measure that is clinically useful persists (Stevens, Johnson, & Grunau 1996).

For the past several years, multiple studies have been done using various assessment tools, none of which are currently being utilized at the bedside. It has been thought that infants do not feel pain or are unable to remember the experience. As a result, the issue of pain management in neonates has long been overlooked. Owens stated in 1984 “even if we have no facts, observations, or theories to suggest that infants feel pain, we have nothing to lose by assuming that they do” (Blauer & Gerstmann, 1998). Recent research has tested previous beliefs about pain in neonates and has found that neonates not only feel pain, but that the pain may cause physiological changes that could affect them for the rest of their lives.

The Joint Commission on Accreditation of Health Care Organizations requires healthcare providers to assess and treat pain in neonates

(JCAHO,2002). The difficulty with this requirement is that neonates are unable to verbalize their pain. Therefore, we need to look at physiological and behavioral changes in the neonate to establish a standard protocol for pain assessment.

Several assessment tools are currently available but they are generally used in research and not in healthcare facilities. Research allowing comparison of these tools is currently lacking. Only four studies have done comparative analyses of these tools (Blauer & Gerstmann, 1998; Guinsburg, Almeida, Peres, Shinzato, & Kopelman, 2003; Patel, Cxerniawski, Grey & Lui, 2003; Sizun, Ansquer, Browne, Tordjman & Morin, 2002). In order to allow comparison of the many available tools more research must be done comparing these tools.

Studies indicate a lack of awareness among healthcare professionals regarding pain perception, assessment, and management of neonates. The current study proposes to perform a comparative analysis of the Premature Infant Pain Scale (PIPP) and the Neonatal Infant Pain Scale (NIPS) in a population of 20 neonates ranging in age from <28 weeks to 36 weeks gestation who have received heel sticks (see Appendix A).

Statement of Problem

The problem with adequate or accurate pain assessment in neonates is complicated by issues related to the nature, consistency, and variability of the infant's physiological or behavioral responses and contextual factor such as the severity of illness (Abu-Saad, 1998). Stevens et al., (1996) demonstrated that in the first two weeks of life premature infants underwent an average of 134 painful

procedures. A lack of adequate guidelines leads to inadequate assessment and subsequent inappropriate pain management (Brooks, 1999).

Statement of Purpose

The purpose of this study was to establish a correlation between scores on the Premature Infant Pain Profile and scores on the Neonatal Infant Pain Scale. This correlation allowed the researchers to determine if the scores for each of these scales were, in fact, comparable. This made pain ratings on each of these scales transcend the confines of the scale, and allowed for the application of scores established using these different tools.

Identification of Nursing Conceptual/Theoretical Framework

Nursing scholars have primarily employed the concept of energy conservation within a natural science perspective, particularly in regard to physics (Lerdal, 1998). Levine (1989), who formulated her theory of energy conservation in 1969, often refers to the first law of thermodynamics and how it relates to the energy in a closed system. This law states that energy cannot be created or destroyed, but can only be transformed from one state of matter to another. Levine, in addition, draws from physics the definition of energy as the "capacity to do work" (Lerdal, p. 3). However, as Lerdal's research progressed, another definition emerged that is more applicable to the needs of nursing research. This definition states, "Energy is the individual's potential to perform physical and mental activity" (Lerdal, p. 4). Levine's assessment of the necessity for energy conservation in the carative environment relates directly to an individuals capacity for healing. Fatigue has been studied and understood as a

condition of low energy (Lerdal, p.4). According to Lerdal, Levine states that: “The energy required by alteration in physiological function during illness represents an additional demand on the energy producing systems, and the fatigue so often experienced with illness is the very empirical measure of that additional demand for energy” (p. 4). In conjunction with Levine's assessment, the Conservation of Energy Model reflects the belief that the exertion of energy (in this case in response to painful stimuli) can cause a negative impact on the healing process for neonates.

Research Questions

1. Is there a correlation between the original PIPP scores obtained by the researcher for each heel-stick and scores for the same heel-sticks using the NIPS tool on preterm infants in the NICU ranging in age <28 weeks to 37 weeks gestation?
2. What are the physiological and behavioral responses to a heel-stick that signify pain in the preterm infant?

Definition of Terms

Pain

Conceptual definition – The International Association for the Study of Pain defines pain as an unpleasant sensory and emotional experience associated with actual or potential tissue damage, or described in terms of such damage (Merskey & Bogduk, 1994). Physiological responses to pain include increased heart rate, respiratory rate, blood pressure, palmer sweating, intracranial pressure, and cortisol levels along with decreases in vagal tone, pO₂ levels, and

transcutaneous oxygen saturation levels (Stevens, Johnston, & Grunau, 1995). Behavioral responses include facial expressions, cry (frequency, peak, duration, and latency), and body movements (Stevens et al., 1995).

Operational definition – the neonate’s response to a heel stick procedure as evidenced by scores on the Neonatal Infant Pain Scale (NIPS).

Preterm Infants

Conceptual definition - an infant born prior to 37 weeks of gestation.

Operational definition – infants observed in the NICU ranging in age from <28 weeks to 37 weeks gestation.

Neonatal Infant Pain Scale (NIPS)

Conceptual definition - This tool is designed to assess facial expression, cry, breathing patterns, movements of arms and legs, and state of arousal using a two and three point scale per category.

Operational definition – assessing and assigning point values to all five categories following a heel-stick (Appendix B).

Premature Infant Pain Profile (PIPP)

Conceptual definition – measures the neonate’s response to pain by observing behavioral responses such as eye squeeze, brow bulge, nasolabial furrow, and state of arousal, and physiological response, as evidenced by changes in heart rate and oxygen saturation (Stevens et al 1996).

Operational definition – comparing the PIPP results obtained from previous research with infants in the NICU that received heel-sticks that are recorded in the database. (Appendix C).

Heel-stick procedure

Conceptual definition – The heel-stick is a procedure routinely performed in a NICU for the collection of capillary blood for some predetermined lab test. The skin is cleaned with alcohol then punctured with some lancing device, and if necessary, the heel is squeezed to obtain an adequate blood sample amount for the prescribed test.

Operational definition – The heel-stick procedure on the videotape used in the original research study to assess the neonate's pain response.

Research Hypothesis

A correlation will be found between the Premature Infant Pain Profile and the Neonatal Infant Pain Scale.

Significance

The preterm infant experiences many painful procedures while in the NICU. Unfortunately, there is not one assessment tool that is commonly used for assessing pain. This study compared the PIPP scores calculated from a number of infants in the NICU with the scores to be obtained using the NIPS scale to determine if a correlation existed between the two scales. The results will help researchers determine an appropriate pain scale to use in the hospital setting.

Without an appropriate way to evaluate pain of preterm infants, procedures and operations will continue to be done without the appropriate interventions necessary to manage the painful experience. Inadequate pain management leads to unnecessary energy expenditure by the infant, which in turn may potentially lead to higher rates of morbidity and mortality. When a pain

assessment tool is established, the preterm infant will benefit from the overall outcome. Both morbidity and mortality rates will decrease as well as the cost to the hospitals that is accrued by sick infants.

Finding a standard of care for assessing pain in the preterm infant will also improve nursing practice. With the understanding of physiological and behavioral responses to pain, nurses will be able to properly treat preterm infants experiencing pain.

Assumptions

In this study, it was assumed that neonates do experience pain during procedures such as the heel-stick, that scores on the PIPP and NIPS will correlate and, with proper pain assessment, better pain management will follow.

Limitations

This study included only a small number of infants, a total of 20, five infants from four gestational age groups ranging less than 28 weeks to 37 weeks. Past operations and procedures were unknown in the group of infants involved in this study, which is also a limitation.

Summary

Research allowing comparison of pain assessment tools for preterm infants is currently lacking. The purpose of this study was to establish a correlation between scores on the Premature Infant Pain Profile and scores on the Neonatal Infant Pain Scale. This will aid in finding a tool that is adequate to use in the NICU for preterm infants undergoing common procedures. Levine's conceptual model was discussed as the theoretical framework for this study.

Conservation of energy for an infant is imperative, essential to growth, and when this is altered, so is the growth process. Conceptual and operational definitions were stated for a better understanding of the research questions. Concluding the chapter was the assumption that infants do feel and that a having a small sample size for the study is a limitation.

CHAPTER II

THEORETICAL FRAMEWORK

This chapter focused on two main conceptual areas. First is a description of the conceptual/theoretical framework. Secondly, the literature review gives pertinent information regarding the pain response in neonates, assessment, and management.

Nursing Conceptual/Theoretical Framework

Levine's Conservation of Energy Model provides a nursing framework for which this research is based (Levine, 1969, 1989). Levine (1969) formulated a conceptual model of nursing that focuses on energy and the conservation of the patient's wholeness. 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. However, while Levine alluded to a holistic view of human beings, it should be noted that her concept of energy was a mechanistic one (Levine, 1989). Wholeness is characterized by a person as an integration of its parts system and is described as an "Organism is dependent upon the inter relatedness of its component system. In fact, the organism is a system of systems" (Levine, 1973, pp. 8-9). While Levine affirmed that humans could be explained according to physical laws, she strongly asserted, unlike Rogers, that there is no mystery attached to the phenomenon of energy (Levine, 1989). All of life's processes are fundamentally dependent on the production and expenditure of energy (Todaro-Franceschi, 2001). 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 (Todaro-Franceschi).

Levine cited that energy resources need to be conserved and directed by nursing intervention in order to ensure the maintenance of individual integrity (Todaro-Franceschi, 2001). The nurse's role within the conservation model is an integral part as an instrumental person for the preservation of energy. The nurse's responsibility is to promote conservation of the person's energy, structural, personal, and social integrity. Consequently, Levine's model discusses energy in terms of measurable qualities (consumption, expenditure, etc.) and energy resources that arise from this causal model in which nurses can control or aid the individual in attaining and utilizing energy (Todaro-Franceschi).

The internal environment in Levine's model was described as the "integration of bodily functions that resembles a stabilized flow (homeorrhexis) rather than a static state (homeostasis) and is subject to challenges presented by the external environment which always takes the form of energy" (Fawcett, 2002, p. 5). This is subject to challenges presented by the external environment that always takes the form of energy (Fawcett). In other words, the internal environment refers to the "physiological and pathophysiologic aspects of the patient with which the nurse deals" (Fawcett, Brophy, Rather & Roos, 1997). According to Fawcett, the external environment is divided by Levine into the "perceptual, operational and conceptual environments" (p. 5). The perceptual environment, in Levine's model, refers to that portion of the external environment which people respond to via their sense organs and includes "light, sound, touch,

temperature, chemical change that is smelled or tasted, and position, sense and balance" (Fawcett, p.5). The operational environment in Levine's model includes the presence of stimuli and the efforts to manage stimuli. Levine's model structures nursing intervention according to four conservation principles, which are conservation of energy, structural integrity, personal integrity and social integrity (Fawcett). 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 entities. Nursing intervention is based on balancing the individual's energy input with energy output.
2. Conservation of Structural Integrity focuses attention on healing. 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 (Fawcett).

Levine's conservation principles all suggest cause-and-effect relationships (Todaro-Franceschi, 2001). The first principle of Levine's 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 available. These factors

combine to form a pragmatic framework within which to view neonates within the NICU environment. Only two of Levine's principals are applied within the nursing conceptual framework for this research study, see (Appendix A). Schematic Map: Levine's Energy of Conservation Model for Neonatal Infant.

This conceptual model offers a unique approach to applying theoretical evidenced based research that allows for incorporation of both qualitative and quantitative approaches under on nursing framework (Levine, 1991). For this study, a quantitative approach is applied to Levine's model.

Review of Literature

The infant is born into a world that brings with it numerous medical procedures that at best are uncomfortable and at worst very painful. It is now well proven that preterm neonates react to pain and there is concern about the long-term effects of early pain experiences on personality development and psychological outcome (Brooks, 1999). Stevens et al. in 1996, demonstrated that in the first two weeks of life premature infants underwent an average of 134 painful procedures (as cited in Coleman, Solarin, & Smith, 2002). Some of the procedures noted include heel-sticks, intubations, frequent position changes, chest tube insertion, feedings and immunizations. The consequences of these procedures have been shown to cause physiological and behavioral alterations. Assessment and alleviation of pain and/or distress in very preterm infants is, therefore, an important issue that warrant further study (McVey, 1998). This review of the literature will demonstrate the need for pain assessment and management for the preterm infant.

Pain receptors are found in practically every tissue of the body and may be aroused by a variety of stimuli (Brooks, 1999). Marceau (2003) notes that even the most premature of newborns can feel pain. Premature neonates have all the requirements for pain perception, both anatomically and physiologically (Brooks, 1999). Glover and Fisk (2000) actually determined that the full anatomical pathways necessary for nociception are actually in place at 24–28 weeks gestation. This is further evidenced by Puchalski and Hummel's (2002) observation that the infant's response to painful procedures is withdrawal of an extremity. Therefore, it should be noted that significant research has been done in this area, and that recent studies have shown that infants are as able to feel pain as any fully developed, healthy human.

Behavioral indicators of pain in the neonate include facial activity, cry, gross motor movement, sweating, restlessness, posturing, and changes in behavioral state and functions, e.g. sleeping and feeding patterns (Stevens & Franck, 2001). It has been noted by Gibbins and Stevens (2001) that behavioral responses have been found to be significantly greater in painful situations than nonpainful or stressful situations and may be more specific in defining pain.

McVey (1998) asserts that the most typical response to pain in neonates is crying. Grunau, Johnston, and Craig (1990) discusses varying domains of cries with the parameters being time, frequency, and intensity. Owens and Todt (1984) demonstrated this in their study where 100% of the neonates cried in response to the heel-stick. Because of studies such as these, crying has become a large part of current pain assessment. In some institutions, a cry may

be the only way to assess pain. However, preterm or acutely ill infants often are too immature to elicit a response cry, or may be unable to elicit a cry because of mechanical interference such as the presence of an endotracheal tube through their glottis. Although a cry can provide valuable information when it occurs, its absence cannot discount pain; therefore, it is not a reliable indicator of infant pain (Gibbens & Stevens 2001).

Due to the neonates inability to verbalize their pain, they depend on others to recognize, assess and manage their pain. Owens and Todt, (1984) noted that it is possible to measure physical changes in a clinical setting with measurement systems such as electrocardiogram and the human ear. Grunau et al., (1990) concluded the major challenge for adults attempting to identify and alleviate pain in the newborn is interpreting the significance of the infant's behavior.

Facial expressions can also provide a source of information to acute noxious intervention in neonates (Grunau et al., 1990). Facial activity can include brow bulge, eye squeeze, naso-labial furrow, open lips, vertical stretch mouth, chin quiver, taut tongue, and tongue protrusion (Grunau et al.). Distinct facial expressions are associated with pleasure, pain, sadness, and surprise. Facial expressions are important pain indicators as they are relatively free of learning bias and represent an infant's natural response to noxious events (Abu-Saad, 1998).

Even in those neonates who are unable to mount a full behavioral response, physiological signs are present. Physiological pain stimuli solicit stress responses from the autonomic nervous system such as increased

respirations, increased ventilation, increased heart rate, increased systolic and diastolic blood pressure, pupil dilation, inhibition of gastrointestinal motility, decreased oxygen saturation, and hyperglycemia (Brooks, 1999). In the research study done by Owens and Todt (1984) 95% of the infants observed had an increase in heart rate in response to a heel-stick procedure. Pain stimulates the release of glucocorticoids. The release of glucocorticoids is naturally catabolic and inhibits cell division and growth, protein synthesis, and neuronal myelination (Puchalski & Hummel, 2002). In a healthy infant, these effects would be detrimental. However, in an at-risk neonate, there would be an immediate threat on his or her ability to thrive.

Glover and Fisk (2000) describes evidence to suggest that these early painful or stressful experiences can have long-term effects. Coleman suggests the possibility that newborn pain actually alters neuronal adaptation, structural, and functional organization of the developing brain and nervous system, or both is currently a provocative area of research (Coleman et al., 2002). Puchalski and Hummel (2002) further support this with their findings that over-stimulation of one neural pathway (e.g. the nociceptive pathway) can lead to under stimulation and underdevelopment of another pathway, e.g. the non-pain pathway.

The result of pain in neonates is therefore a very real concern. According to Bishop (2003), only 86% of hospitals that participated in his or her survey use a pain scale in the assessment of neonatal pain. Franck, Greenberg, and Stevens (2000) acknowledges that after twenty years, we still do not have standard pain assessment scales that guide treatment of infant pain. Bishop also

noted that assessment inaccuracies in using a scale and pain assessment and management were considered a low priority.

The goal of pain assessment is early recognition of pain and provision of appropriate data so that interventions to reduce the immediate and long-term effects of pain can be implemented (Gibbens & Stevens, 2001). Therefore, assessment tools must be used accurately and consistently. Dodds (2003) states that an appropriate pain assessment tool needs to be introduced along with education about its importance and how to use it. The necessity for the development and validation of neonatal pain assessment scales that are easily applicable in the clinical setting is a very real concern. Over the past several years, many pain scales have been created to assess various nonverbal pain indicators. However, no one scale has emerged as the gold standard. Thus, research into the applicability and validity of the currently available tools is necessary in order to establish standards of care for the assessment and subsequent treatment of pain in neonates.

Physiology of Pain

Despite differences between adults and infants in their response to pain, research suggests that newborn infants, even the extremely premature, are anatomically and physiologically equipped to perceive, react to, and have some understanding of pain (Puchalski & Hummel, 2002). Pain receptors are found in virtually every tissue of the body and may be aroused by a variety of stimuli (Brooks, 1999). Premature neonates have all the requirements for pain perception, both anatomically and physiologically (Brooks). They are able to

detect painful stimuli at the periphery and transmit messages throughout the central nervous system (Gibbins & Stevens, 2001). Anand, (as cited in Gibbins & Stevens, 2001), suggests that the density of nerve endings in the skin of newborns is similar to or greater than that in adult skin.

Puchalski and Hummel (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. Next, neurotransmitters in the spinal cord amplify the pain information from the periphery, which reaches the thalamus and is distributed throughout the brain (Puchalski & Hummel).

Jorgensen (1999) describes nociceptors as the pain receptors or free-nerve endings that detect and transmit general physical and chemical tissue damage. Humphrey, Valman, and Pearson (as cited in Stevens, Johnston, & Grunau, 1995), assert that peripheral nociceptive, or pain-sensing pathways begin developing in the fetus at about seven-weeks gestation with sensory nerve endings and are complete by the twentieth week.

Puchalski and Hummel (2002) provide a timeline for fetal nociception. This timeline suggests that sensory nerve endings begin developing in the peripheral area during the seventh-week of gestation. Sensory nerve endings on the face, palms and soles of feet develop at eleven-weeks; followed at twelve-weeks by the start of the neural pathway connecting the peripheral nociceptive nerve endings and the spinal dorsal horn cells. 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. At 24-weeks the thalamic track is complete, at thirty weeks, the brain stem and thalamic track are myelinated; and finally, at thirty-seven weeks the nociceptive track is completely myelinated (Puchalski & Hummel).

Myelination is important because it increases the speed at which an axon can transmit a signal. Because 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. However, Anand and Hickey (as cited in Stevens et al., 1995) note that the slower conduction caused by unmyelination is offset by the shorter distances traveled by the impulses. This is further supported by Puchalski and Hummel (2002), who state 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. These A and C fibers are responsible for transmitting pain impulses to the CNS (Brooks, 1999)

In addition to the afferent and efferent pain pathways discussed here, there are chemical mediators that play a role in the neonates' experience of pain. Pain stimulates the release of glucocorticoids. The release of glucocorticoids is naturally catabolic and inhibits cell division and growth, protein synthesis, and neuronal myelination (Puchalski & Hummel, 2002). Jorgensen (1999) supports this idea by indicating that pain leads to the release of stress hormones such as cortisol and catecholamines. This can affect a newborn's growth pattern and wound healing and may contribute to an increase in complications and a longer hospital stay. Franck et al., (2000) provide an example that demonstrates the

role of chemical mediators. In the example, tissue injury causes release of inflammatory mediators (e.g., potassium, bradykinin, prostaglandins, cytokines, nerve growth factors, catecholamines, and substance *P*). These mediators sensitize the A-delta and C fibers and recruit other neurons (silent nociceptors) resulting in hyperalgesia (Franck et al., 2000). In a healthy infant, these affects can be detrimental. However, in a preterm neonate, they could prove an immediate threat on their ability to thrive.

Physiological signs of painful stimuli are present in neonates, whether there is a behavioral response or not. Painful stimuli solicit stress responses from the autonomic nervous system such as increased respirations, increased ventilation, increased heart rate, increased systolic and diastolic blood pressure, pupil dilation, inhibition of gastrointestinal motility, decreased oxygen saturation, hyperglycemia, changes in transcutaneous oxygen and carbon dioxide levels, intracranial pressure, measures of vagal tone, skin blood flow, and palmar sweat (Brooks, 1999; Franck & Miaskowski, 1997).

Current research is investigating the long-term effects of neonatal pain. Glover and Fisk (2000) describe evidence to suggest that early painful or stressful experiences can have long-term effects. Reynolds and Fitzgerald, (as cited in Evans, 2001), suggest that tissue damage in the early neonatal period causes hyperinnervation to that area that can last into adulthood. Merskey (as cited in Evans, 2001), suggests that repeated tissue damage may extend into adjacent uninjured tissue and cause pain sensations (allodynia) from stimuli that normally would not invoke a pain response. Puchalski and Hummel (2002) found

that over-stimulation of one pathway (e.g. the nociceptive pathway) can lead to under-stimulation and underdevelopment of another pathway (e.g. the non-pain pathway). Anand (2000) hypothesized that the plasticity of the developing pain system in neonates provides a critical window for producing long-term changes in subsequent behavior, responses to stress, and susceptibility to psychosomatic complaints and psychiatric disorders in later life. Stevens et al., (1995) note that the structures needed for the long-term memory are well developed in the newborn period; therefore, painful experiences during that period have the potential to affect long-term outcomes. It is also noted that although pain may not specifically be remembered, stress related to the event may mediate altered response later in life (Stevens et al., 1995). It is hopeful that research in this area will lead to a widespread understanding and acceptance of the reality of neonatal pain and the need to take measures at reducing pain and stress in this population.

Assessment of Pain in Preterm Infants

Currently, there is not one widely used and accepted tool for assessing pain in the preterm infant. Assessment techniques involve 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 a preterm infants pain.

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. From this study, it was concluded that young very low birth weight infants are capable of experiencing a multidimensional 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 did.

Lindh, Wiklung, Sandman, & 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. As pointed out by Johnston et al., the most premature infants had a more robust response to the pain compared to older infants. This study had a limited number of participants making definitive conclusions difficult.

Hadjistavropoulos, Craig, Grunau and Whitfiel (1997) proposed 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 concluded a specific order to the infant's response to pain. Pain ratings occurred in an orderly fashion starting with facial expressions and proceeded to body movements. Similar to Lindh et al., (1997) and Johnston et al., (1995), Hadjistavropoulos et al., 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 et al. Lindh (1997), not all of the participants responded to the heel-stick. Only 80% of the participants responded. In contrast to Lindh et al., 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 infant, this is an unlikely conclusion. A better explanation could be that the preterm infant felt the pain, but was unable to express it.

Preterm Infant Pain Profile (PIPP)

The PIPP was developed by a group of researchers in an attempt to create a pain scale that was designed exclusively for preterm neonates (Johnson et al., 1995). Their initial review of literature sparked a new thinking process in the field of pain scale research. Although several pain scales were currently in use, no one tool encompassed all dimensions of the pain phenomenon. They decided that since pain itself was multidimensional, the tools used to rate pain should also be multidimensional. Therefore, they began by reviewing symptoms of pain. Their initial findings were as follows:

Physiological indicators (heart rate, vagal tone, respiratory rate, blood pressure, oxygen saturation, intracranial pressure, catecholamine levels, corticosteroid levels, growth hormone levels, glucagons levels), and behavioral indicators, facial activity (brow bulge, eye squeeze, nasolabial furrow, open lips, vertical and horizontal mouth stretch, and taut tongue), crying (acoustical characteristics, temporal characteristics, peak spectral energy, harmonic structure, and duration), body activity and movements (arms, legs, torso), modifying factors (behavioral state, health status, and gestational age).

Their list was quite extensive. However, they knew that not all of these factors could be included in one scale if it was to ever be used clinically. Their

next step was to determine which indicators were critical and available for use in the clinical and research setting. Several measures were discarded because of the unavailability of equipment to measure them. Others were eliminated because of lack of use in the setting and for their high correlation to the disease state. Biochemical and hormonal indicators were discarded because of the required invasive procedure needed to procure their results. Many other similar decisions had to be made on other indicators.

With their indicators chosen, they went to a group of experts in pain from several disciplines. They asked these experts to examine their list of indicators. The experts agreed that these indicators were a good representation of pain in infants.

The next step was pilot testing. They used four existing data sets for their initial tests. The initial test helped them to remove a few more indicators because of lack of specificity and/or sensitivity. The indicators that remained were brow bulge, eye squeeze, nasolabial furrow, heart rate, oxygen saturation, behavioral state, and gestational age. Once the indicators had been determined, they needed a way to rate the indicators on a number scale. Therefore, they determined categories for all the indicators and gave them a number score.

With the number, ratings in place they could start to test the consistency and validity of the scores. They found that generally scores of six or less were non-pain scores, while scores of 12 were related to moderate to severe pain. As with adults and verbal pain scales they found that it was not the score

necessarily that could determine pain, but that the difference between the pre and post procedure scores was much more effective at determining pain.

The results of the tests on the four pilot groups revealed moderate Cronbach's alpha coefficients ranging from 0.76 of eye squeeze to 0.59 for behavioral state. However, in order for these results to be confirmed as anything other than a correlation between behavioral, physiological, or contextual factors, they needed another test. The standardized alpha confirmed their results with a score of 0.71, which suggested internal consistency.

With these results they were able to continue with a test of construct validity. Their method was to test two opposite situations. They would use the PIPP to score one painful situation, a heel-stick, and one non-painful situation, handling similar to heel-stick procedure but without the actual heel-stick. The mean PIPP score for the painful situation was 10.3 (*SD* 4.5) and the non-painful situation PIPP score was 6.3 (*SD* 3.2). The difference of the scores was significant ($t = 2.4$, two-tailed $p < 0.02$). They also performed similar tests on full-term neonates and had the same results (Stevens et al., 1996). Now that the scale had been statistically validated, all that was needed was to test the tool clinically.

Ballantyne, Stevens, McAllister, Dionne, and Jack (1999) performed research to test the PIPP clinically. The design for this study included using the PIPP to measure pain in three situations after separating the infants into gestational age groups. The first was referred to as a baseline event and included no contact with the infant. The second situation was diapering. The

final situation in this study was a tissue-damaging event, heel-lance, venous blood draw, or intravenous insertion.

While the procedures were being performed two nurses observed and rated the infants on the PIPP. Nurse 1 was the individual caring for the patient. This individual varied depending on the day and the patient. The second nurse was an expert rater and was present for all the procedures. The procedures were also videotaped and reviewed by two expert raters at a later time.

The scores ranged from 9.1 to 13.3 with a mean of 11.0 ($SD = 1.3$) for the pain event. The scores for the non-pain event ranged from 7.8 to 10.9 with a mean of 9.0 ($SD = 0.8$). Scores from the baseline event ranged from 2.5 to 6.6 with a mean of 4.9 (± 1.0). RM ANOVA gave statistical significance to the PIPP by establishing that it was able to statistically differentiate between pain and non-pain events ($F = 48, p = 0.0001$). These results were further stabilized by the fact that no significant effects were found between gestational groups ($F = 0.10, p = 0.96$) or between raters ($F = 0.73, p = 0.534$) (Ballantyne 1999). The PIPP now had construct validity along with intra- and interrater reliability and was ready for the clinical arena.

Because of the extensive research done using and testing the PIPP, it was determined to be the gold standard for the purposes of this study. The NIPS scores will therefore be compared to the original researchers PIPP for the sake of establishing 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 is pain.

Neonatal Infant Pain Scale (NIPS)

This pain scale created by Lawrence, McGrath, Kay, MacMurray, and Dulberg in 1993 is a modification from a pediatric pain scale developed at the Children's Hospital of Eastern Ontario (CHEO). The CHEO pain scale was developed to measure pain responses in children from ages one to seven. This pediatric pain assessment tool included cry, facial, child verbal, torso, touch and legs in six categories. Each category included a brief definition of behavioral responses with a number value assigned to them. The highest score possible on the CHEO was thirteen with a score greater than four indicating a painful response.

Neonatal Infant Pain Scale, however, is specifically formatted for newborns and is based on five behavioral and one physiological indicator. Lawrence et al. (1993) omits the child verbal, torso, and touch items and includes one physiological response of breathing pattern. Assessed in the NIPS tool are facial expression, cry, movements of arms and legs, state of arousal and breathing patterns. Each category has two or three gradations. An explanation of each possible score is given in easy-to-use descriptive statements. Facial Expression has two descriptions relaxed/grimace, cry has three no cry/whimper/vigorous, arms and legs are both described as flexion or extension, state of arousal including sleeping/awake and fussy, and breathing patterns is noted as relaxed or change in breathing pattern. The total score ranges from 0-8 (Lawrence et al., 1993). The scale had been established for reliability and validity but had not found widespread use in neonatal intensive care.

The initial study on the NIPS assessment was done by Lawrence to determine the reliability of the tool. In this study the objectives were to 1) develop a behavioral assessment tool for the measurement of pain in the preterm and full-term neonate, 2) establish the construct and concurrent validity, interrater reliability, and internal consistency of the tool, and 3) examine the relationship between the pain scores and infant characteristics. Thirty-eight infants contributed to the 90 procedures videotaped for the study (Lawrence et al., 1993). The NIPS was used to score behavioral responses before, during and after each intrusive procedure.

The significant difference in NIPS scores over time indicates that the scale provides a measurement of intensity of infant responses to intrusive procedures. Concurrent validity was established by correlations, ranging from .53 to .84, between NIPS scores at each minute of observation and scores on the Visual Analogue Scale. Interrater reliability was high. Pearson correlations range from .92 to .97 across successive minutes of observation. The six component scores of the NIPS had a high internal consistency: Cronbach's alphas were .95, .87, and .88 for before, during, and after the procedures, respectively. Although gestational age and five minute Apgars were positively associated with NIPS scores over time, there was no association between these factors and responsiveness to pain, as measured by change in NIPS scores from before to during the procedure. Results were discussed in terms of the use of the NIPS in clinical trial and its clinical application in a neonatal intensive care unit (Lawrence et al., 1993).

Summary

There is a need for pain assessment and management for preterm infants. Currently there is not one specific tool that is being utilized at the bedside and painful procedures may continue to be performed with detrimental consequences. Pain may trigger both physiological and behavioral responses. The response of preterm infants experiencing pain will help guide the practicing nurse using an assessment tool better manage pain. This research study will determine if the PIPP and NIPS tools are a reliable indicator of infant pain. Both the PIPP and NIPS tools use physiological and behavioral responses to assess the infants.

The theoretical framework used was Levine's Energy Conservation Theory. Levine's model describes how conservation of energy is essential for growth, especially in the preterm infants. Hopefully, this study will aid in standardizing a specific tool that is both reliable and valid for assessing pain.

CHAPTER III

METHOD

The purpose of this study was to determine a correlation between the PIPP and NIPS tool. Included in the text is a description of the subjects and materials used. Data collection and analysis are also included in this chapter.

Design

This study was a descriptive comparative design using secondary analysis of videotapes collected in a National Institutes of Health funded study entitled "Stability of Infant Responses to Painful Procedures" (Evans, McCartney, & Lawhon, 2002). The researcher reviewed the videotapes from the original study and coded pain responses to heel-sticks using the NIPS. The scores obtained using the NIPS was then compared to the PIPP used in the original study.

Subjects

The setting for this study was in the research office of a school of nursing at the Medical College of Ohio. Televisions and VCR's were set up in the provided space to review the tapes on file.

The target population contained 81 preterm infants that had been previously recruited for the original study from one Neonatal Intensive Care Unit. The infants had been grouped into four categories by gestational age at birth, Group 1 (less than 28 weeks gestation age), Group 2 (28-30 weeks gestational age), Group 3 (31-33 weeks, gestational age), and Group 4 (34-36 weeks gestational age). For the purpose of this study five infants were selected randomly from each gestational age group totaling 20 infants. No names were

attached to any of the tapes or to the previous statistical analysis. There was no way to identify the infants in this population because no birth weights, birth dates, or other identifying information was kept in the database.

The subjects were randomly selected by numbers that were placed in a hat; five were drawn from each group. The only identifiers that were recorded included the identification number of the infant and the time and date of the heel-stick. There was no ongoing or follow-up contact with the original subjects.

Material

The NIPS is multi-dimensional, measuring a combination of physiological and behavioral indicators of pain. This tool is designed to assess facial expression, cry, breathing patterns, movements of arms and legs, and state of arousal using a two and three point scale per category (Lawrence et al., 1993). The PIPP measures the neonate's response to pain by observing behavioral responses such as eye squeeze, brow bulge, nasolabial furrow, and state of arousal, and physiological response, as evidenced by changes in heart rate and oxygen saturation (Stevens et al., 1996).

Also used were televisions and VCR's that were set up in the researchers' office. The videotapes were from the original study. A database was also used in entering, coding, and analyzing data.

Data Collection

Videotapes were watched of five infants from each of the four gestational age groups. There was protection of human rights because there was no way of identifying the subjects being used in this study. A pain score was completed

using the NIPS. This information was then entered into the computerized summative database for analysis and comparison.

The researcher assumed that the data were properly coded for the subjects during the original study. In addition, the researcher assumed that the equipment being used to review the tapes was in proper condition.

Data Analysis

Is there a correlation between the original PIPP scores obtained by principal researcher for each heel-stick and scores for the same heel-sticks using the NIPS on preterm infants in the NICU ranging in age <28 weeks to 36 weeks gestation? To answer this research question descriptive statistics on scores for the NIPS and PIPP and Pearson's Product Moment Correlations were conducted between the two tools.

Summary

This chapter outlined the method of the study. This is a secondary analysis researching a correlation between the PIPP and NIPS tools. The subjects, material used, data collection, and data analysis were all discussed. The setting is in the primary researchers' office and the Pearson Product Moment Correlation will be used to determine the statistical significance.

CHAPTER IV

RESULTS

In this chapter, the correlation of the PIPP and NIPS are described and illustrated. Data to support or reject the research hypothesis is acknowledged. Tables and graphs are also included to further describe the appropriate statistics and variables.

Sample

This study included twenty neonates. The total sample of infants was comprised of fourteen males ($n = 14$) and six females ($n = 6$). Five African American infants, fourteen Caucasian infants and one "Other" infant compile the sample. The breakdown in gestational age groups that were included in the study were five from each of the following groups, Group 1 (less than 28 weeks gestation age), Group 2 (28-30 weeks gestational age), Group 3 (31-33 weeks, gestational age), and Group 4 (34-36 weeks gestational age), totally twenty.

A total of 72 heel-sticks were reviewed. The mean score obtained for the PIPP was 9.29 with a standard deviation of 4.023 (Figure 1). The mean score using the NIPS was 4.6 with a standard deviation of 2.06 (Figure 2).

The heel-sticks were then further divided into each gestation age group showing minimum scores, maximum scores, means and standard deviations (Table 1). For the infants less than 28 weeks, the PIPP minimum score was 3 and the maximum score was 18. For the NIPS, the minimum score was 1 and maximum was 8. The mean and standard deviation for the PIPP was 8.36, $SD=3.57$. Using the NIPS, the mean was 4.16, $SD= 1.93$.

Figure 1

Mean Scores of the Preterm Infant Pain Profile

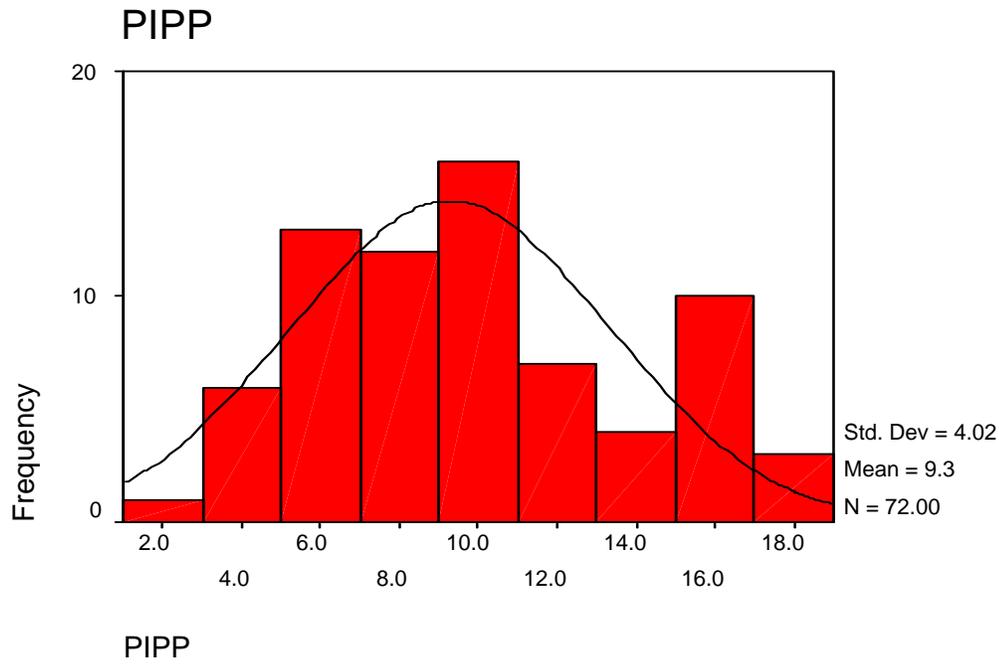


Figure 2

Frequency of the Preterm Infant Pain Profile

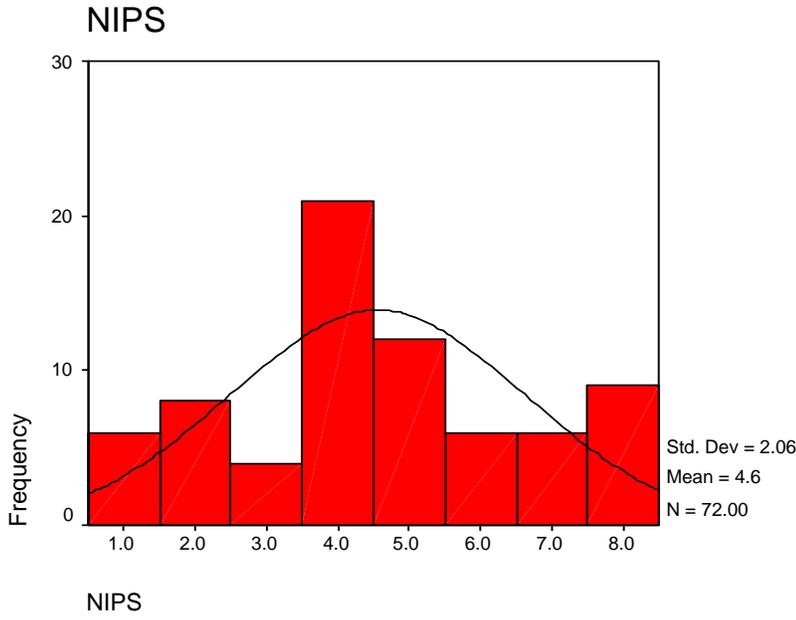


Table 1

Descriptive Statistics of each Gestational Age Group

		Heel-stick (#)	Minimum Score	Maximum Score	Mean	Standard Deviation
Group 1 < 28 wks	PIPP	25	3	18	8.36	3.57
	NIPS	25	1	8	4.16	1.93
Group 2 28-30 wks	PIPP	16	3	10	6.81	1.94
	NIPS	16	1	5	3.50	1.21
Group 3 31-33 wks	PIPP	19	3	17	11.79	3.78
	NIPS	19	4	8	5.84	1.53
Group 4 34-36 wks	PIPP	12	2	17	10.58	4.96
	NIPS	12	1	8	4.75	2.93

The second age group was 28-30 weeks gestation. The minimum score for the PIPP was 3, NIPS was 1, maximum for the PIPP was 10, and NIPS was 5. The mean score using the PIPP was 6.81, SD= 1.94. Coding with the NIPS, the mean score was 3.5, SD= 1.21.

Group 3, 31-33 weeks gestation, had a minimum score of 3 and a maximum of 17 using the PIPP. When coded with the NIPS, the minimum score was 4 and the maximum score was 8. The mean score of group 3 was 11.79 for the PIPP, SD= 3.78, and for the NIPS the mean was 5.84, SD= 1.54.

The last group, 34-36 gestation, had a minimum score of 2 and maximum of 17 when coded with the PIPP. The NIPS minimum score was 1 and the maximum score was 8. The PIPP mean was 10.58 (SD= 4.96), while the NIPS mean was 4.75 (SD= 2.93).

Findings

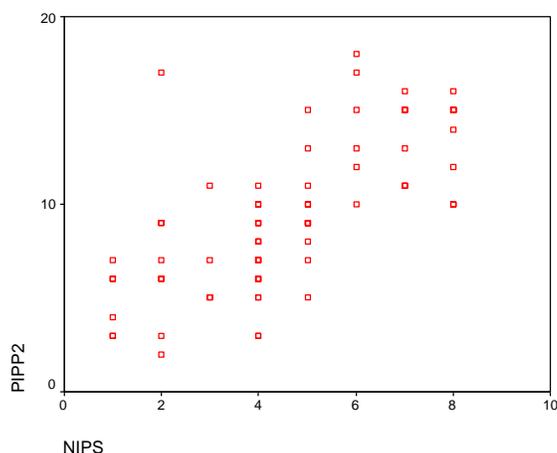
Research Question #1

Is there a correlation between the original PIPP scores obtained by the principal researcher for each heel-stick and scores for the same heel-sticks using the NIPS on preterm infants in the NICU ranging in age <28 weeks to 36 weeks gestation?

A significant correlation, $r = 0.699$, $p = 0.01$ was found between the PIPP and NIPS. This correlation is also demonstrated in the scatter plot (Figure 3). It appears on the scatter plot that very few infants did not have a painful response when receiving a heel-stick. On the PIPP, a score greater than six signifies pain (Stevens et al., 1996). Using the NIPS zero signifies no pain and eight equals severe pain (Lawrence et al., 1993)

Figure 3

Frequency of the Neonatal Infant Pain Scale



Group 1 had a significant correlation of 0.651, $p = 0.01$, which indicates a moderately strong relationship (Table 2). For Group 2, a very weak and not

significant correlation was found at 0.099, $p= 0.71$. When correlating the PIPP and NIPS for Group 3, a strong positive relationship was found at 0.835, $p= 0.01$. Group 4, 34-36 weeks gestations, had a significant correlation of 0.612, $p= 0.035$ which indicated a moderately strong relationship.

Table 2

Pearson Product Moment Correlations between the PIPP and NIPS for all Groups

	All Groups Combined	Group 1 <28 wks gestation	Group 2 28-30 wks gestation	Group 3 31-33 wks gestation	Group 4 34-36 wks gestation
Pearson Correlation	$r= 0.699$ $p=0.01$	$r = 0.651$ $p=0.01$	$r = 0.099$ $p=0.71$	$r = 0.835$ $p=0.01$	$r = 0.612$ $p=0.035$

Research Question #2

What are the physiological and behavioral responses to a heel stick that signify pain in the neonate?

Although this question was not specifically addressed in the research, physiological and behavioral changes were observed and scored using each tool. When the infant was being scored using the NIPS tool, pain responses included the arms and legs being flexed or extended as a response to the painful stimuli. Facial expression being relaxed or grimaced, a whimper cry or a vigorous cry is also indicative of pain. A change in breathing patterns and state of arousal may also imply a reaction to painful stimuli.

Summary

In this chapter, the sample characteristics were described including age, race, and sex. Descriptive statistics were outlined in tables for each gestational age group. The findings of the study support the research question that there was a significant correlation between the Preterm Infant Pain Profile and the Neonatal Infant Pain Scale, $r=0.699$, $p=0.01$. Physiological and behavioral responses to pain when scoring with the NIPS were identified.

CHAPTER V

DISCUSSION

The purpose of the study was to establish whether there was a correlation between the Preterm Infant Pain Profile and Neonatal Infant Pain Scale based on the same NICU heel stick procedure. The following chapter includes the findings of the present study. Limitations and implications about the study are specified. Recommendations for further research will also be made.

Findings

The findings from the present study support the literature that neonates do feel pain when undergoing routine procedures (Marceau, 2003).

Research Question #1

Is there a correlation between the original PIPP scores obtained by Evans, McCartney, and Lawhon (2001) study for each heel stick and scores for the same heel stick using the NIPS tool on preterm infants in the NICU ranging in age from less than 28 weeks to 36 weeks gestation?

A significant positive correlation $r= 0.699$, $p=0.001$, was found between the PIPP and NIPS. This demonstrates that the Neonatal Infant Pain Scale and the Preterm Infant Pain Profile are both assessment tools that would be appropriate to use in the clinical setting for preterm infants.

Correlations were conducted on each gestational group. Group 3 had a strong significant correlation $r= 0.835$, $p= 0.01$. Groups 1 $r=0.651$, $p=0.01$ and Group 4 $r=0.612$, $p= 0.035$ both had a moderate significant correlations, and Group 2 had a very weak correlation $r= 0.099$, $p= 0.71$. The findings of statistical

significance for three of the four groups support the hypothesis that there is a correlation between the two tools.

Research Question #2

What are the physiological and behavioral responses to a heel stick that signify pain in the preterm infant?

Physiological responses that are affected by pain included breathing patterns and state of arousal. Behavioral responses in this sample included grimacing facial expressions, whimper or vigorous cries, and flexion or extension of extremities. Using the NIPS, the mean score was 4.6, which signifies a painful response in neonates.

Mean scores among each individual gestational age group ranged from 3.5 – 5.84, all of which were indicative of pain. Mean scores using the PIPP ranged from 6.81 - 11.79. The scores calculated using both of the scales demonstrate the infants physiological and behavioral responses to pain.

Conclusion

Tapes of the behaviors of 20 infants during a heel-stick were observed. Significant correlations between the PIPP and NIPS were found for three of the four groups studied. Behavioral observations indicated that neonates do feel pain associated with the heel-stick procedure. Both tools were deemed appropriate to use for assessment of preterm infants.

Limitations

The present study included 20 infants in total, five from each gestational age group. This may be seen as a small sample, although 72 heel sticks

comprised the study. As stated previously, 11 heel sticks were eliminated because UV masks were worn by some of the infants while trying to score facial expression. Intubation was also a limitation in the study because assessing the infant's cry was difficult. Another limitation was the lack of knowledge of previous procedures or operations the infants underwent.

Implications

A lack of adequate guidelines will lead to inadequate assessment and subsequent inappropriate pain management (Brooks, 1999). Pain scales should be implemented in the NICU so that neonates undergoing common procedure are cared for in the appropriate manner. This present study suggests that both the PIPP and the NIPS are adequate for assessing such pain. Using a clinically reliable assessment tool will allow for the nurse to carry out adequate interventions, either using comfort measures or medication.

Education of preterm infant pain is also imperative for healthcare providers assessing those patients who are nonverbal. Physiological changes as well as behavioral changes of the infant need to be taught so that the nurse is able to monitor pain. In addition, instruction in the utilization of the PIPP and NIPS in the clinical setting would be of great help to the practicing nurse and inevitably to the infant.

Nursing administration of neonatal units should take the initiative to implement staff use of a valid and reliable infant pain assessment tool. An evidence based practice protocol should be established. The infant pain

assessment tool selected would need to be mandated in assessing preterm infants during common procedures in the NICU, including heel-sticks.

An understanding of Levine's Conservation of Energy Theory, used as the framework for this study, would allow healthcare providers to recognize and respond to painful stimuli associated with common procedures in the NICU. The preterm infant both expends and conserves energy. Having the understanding of the need for preterm infants to conserve energy necessary for growth and the ability to assess the infants experiencing pain is essential. Having both this knowledge and utilization of an appropriate infant pain assessment tool would make this possible.

Recommendations for Further Research

A further comparison could be done using both the PIPP and NIPS with a larger number of infants, more from each gestational age group. A study comparing gender differences as well as racial groups is also recommended for future research.

Summary

Much of the literature reviewed notes that neonates do feel pain. This study concluded that common NICU procedures, specifically the heel-stick, are painful. Both the Preterm Infant Pain Profile and the Neonatal Infant Pain Scale were found in the study to be appropriate to use in the NICU.

Implications addressing the necessity of a preterm infant pain assessment tool in the clinical setting and for nursing education on preterm infant pain responses were identified. Suggestions for nursing administrations to mandate

specific protocol for preterm infant pain assessment and the need for an understanding of the conservation of energy were made. Further research recommendations including sampling larger preterm infant populations and possibly comparing gender and ethnic differences were suggested.

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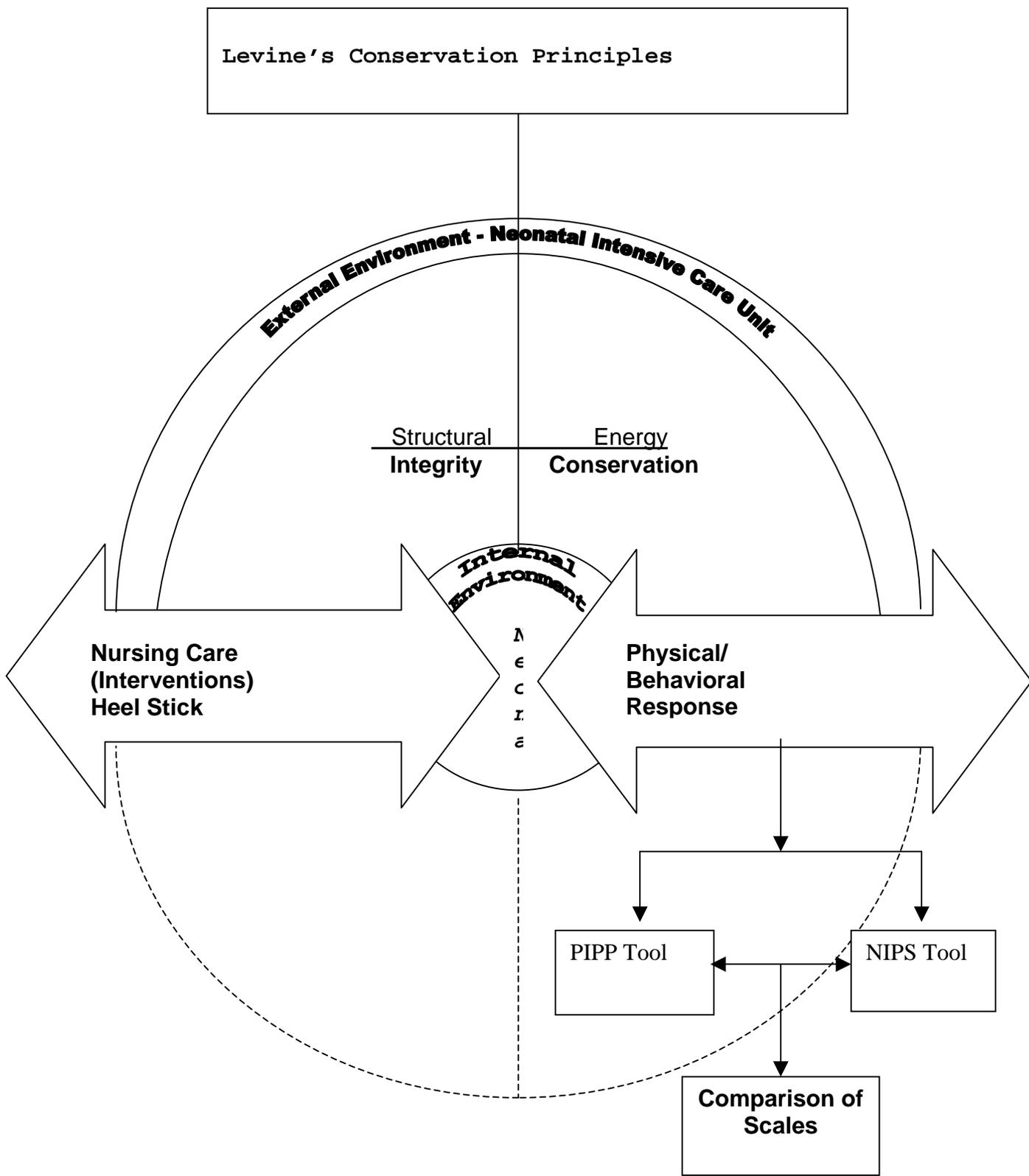
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Abstract

Pain assessment is an essential part of nursing care today. In order to make patients comfortable, nurses need to be consistently assessing their pain. This research was done to show a correlation between two pain assessment tools for neonates. The Preterm Infant Pain Profile (PIPP) has often been used in the clinical setting. The findings of this research show that the correlation of $r=0.0699$, $p=0.01$, between the PIPP and the Neonatal Infant Pain Scale (NIPS) means both tools are appropriate for use. This correlation between the two scales demonstrates that healthcare workers can now be confident that these tools are appropriate for assessing pain in preterm infants.

Appendix A.
Schematic Map: Levine's (1989) Conservation of Energy Model for the Preterm Infant



Appendix B

Neonatal Infant Pain Scale

Facial expression:	1 relaxed	2 grimace	
Cry:	0 no cry	1 whimper	2 vigorous
Breathing patterns:	0 relaxed	1 changed in breathing	
Arms:	0 relaxed	1 flexed/extended	
Legs:	0 relaxed	1 flexed/extended	
State of arousal:	0 sleeping/awake	1 fussy	

Total _____

Appendix C

Premature Infant Pain Profile Scoring Sheet

Process	Indicator	0	1	2	3	Score
Chart	Gestational Age	36 wks and more	32-35 wks, 6 days	38-31 wks, 6 days	Less than 28 wks	
Observe Infant 15 Seconds	Behavioral state	Active / awake	Quite / awake	Active / sleep	Quite / sleep	
Heart rate		Eyes open	Eyes open	Eyes closed	Eyes closed	
Oxygen Saturation		Facial movements	No facial movements	Facial movements	No facial movements	
Observe infant 30 seconds	Heart rate	0-4 beats/min increase	5-14 beats/min increase	15-24 beats / min increase	25 beats/min or more increase	
	Oxygen saturation min	0-2.4 % decrease	2.5-4.9% decrease	5.0-7.4% decrease	7.5% or more increase	
	Brow bulge	None 0-9 % of time	Minimum 10-39% of time	Moderate 40-69% of time	Maximum 70% of time or more	
	Eye squeeze	None 0-9 % of time	Minimum 10-39% of time	Moderate 40-69% of time	Maximum 70% of time or more	
	Nasolabial Furrow	None 0-9 % of time	Minimum 10-39% of time	Moderate 40-69% of time	Maximum 70% of time or more	
Total Score						

