



# Factors Explaining Procedural Pain Management in Newborn Intensive Care Unit: A Cross- Sectional Study

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## Abstract

Introduction: Recent research has highlighted the significant impact of procedural pain on critically ill neonates. However, effective pain management strategies to mitigate long-term negative consequences are still underutilized. Objective: To determine the effect of nurse factors on procedural pain management in neonates performed by neonatal nurses, when controlling organizational context factors and infant factors. Method: This study was cross-sectional correlation design. The participants consisted of 118 Thai NICU nurses. The Data collecting used by a self-report questionnaire. The descriptive statistics and hierarchical multiple regression analysis are used to analyze the data. Result: The findings showed that organizational supportive resources and nurse-physician collaboration had significantly positive effects on pain management in neonates ( $\beta$  = .349, p < .001, and  $\beta$  = .362, p < .001). Gestational age had a significant negative effect on pain management in neonates ( $\beta$  = -.414, p < .001). Knowledge, attitude, and nurses' experience of infant care had significant positive effects on pain management in neonates ( $\beta$  = .435, p < .001,  $\beta$  = .257, p < .01, and  $\beta$  = .236, p < .01, respectively). When controlling for the organizational context factors and the infant factor, nurse factors still predicted procedural pain management in neonates. Together, the predictor variables explained 54.8% of the total variance of nurses' pain management in neonates. It can conclude that nurse factors are important predictors of procedural pain management in neonates. Conclusion: Thus, there is a need for nurse empowerment and enhanced knowledge about neonatal pain assessment and management among NICU nurses.

Keywords:

Pain, Procedural Pain Management, Newborn, NICU

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# INTRODUCTION

Most critically ill neonates are admitted to the NICU. During their hospitalization, they are exposed to various invasive procedures for diagnosis and treatment that cause pain (Luo et al., 2023; Wang et al., 2020). It is well known that neonates, especially premature infants, not only feel pain, but are also hypersensitive to pain because of their immaturely developed nervous systems (Grunau, 2013; McPherson et al., 2020).

Repeated and untreated pain lead to poor short and long-term consequences. The short-term effects are detected by changes in both physical and behavioral responses, such as increased heart rate, increased blood pressure and decreased oxygen saturation. Moreover, the long-term effects are present in the form of neurodevelopment aberration and emotional and learning disability (Grunau, 2013; McPherson et al., 2020). Pain management is therefore important for the purpose of reducing neonatal pain during painful procedures, since effective pain management can reduce the negative consequences of repeated and poorly treated pain.

Pain management in neonates involves both and nonpharmacological pharmacological intervention. In terms of non-pharmacological intervention, nurses play an importance role in using non-pharmacological methods to relief pain. Swaddling, touching, positioning, breastfeeding, oral sucrose administration and non-nutritive sucking have been confirmed as effective approaches to pain relief in neonates (Assefa et al., 2022; Muteteli et al., 2019; Popowicz et al., 2022). However, nurses are free to prescription. apply, without doctor's nonpharmacological pain-relief methods, since pain relief in critically neonates is still underutilized (Carlsen Misic et al., 2021; Muteteli et al., 2019; Popowicz et al., 2021; Tarjoman et al., 2019; Wari et al., 2021). This study explores the factors involved in explaining pain management practice in hospitalized neonates to nurses. The aim of this study was to support the development of a program of intervention to improve nursing skills in pain management and to promote a better quality of pain care.

The pain management practices of nurses in neonates involve various factors. According to previous studies, there were several factors that impact pain management practice for hospitalized neonates (Neshat et al., 2023; Popowicz et al., 2022; Priscah & Martina, 2018). Latimer (2010) proposed the Knowledge Use in Pain Care conceptual model, which provides a theoretical framework to evaluate the factors that affect evidence-based pain management outcomes in hospitalized neonates. These factors include organizational expertise, nursing characteristics, child or patient characteristics and socio-political factors.

Organizational context is important in the delivery of quality and safe patient care. The role that organizations play in enhancing the quality of patient

care occurs within a context that facilitates the use of pain knowledge (Latimer et al., 2010). Organizational context factors, such as organizational supportive resources and collaboration between nurses and physicians, have an impact on pain management in Nurse-physician neonates. collaboration has frequently been reported as a key in meeting the challenge of providing effective pain care for neonates (Carlsen Misic et al., 2021; Mala et al., 2023; Mehrnoush et al., 2018; Neshat et al., 2022; Neshat et al., 2023). Organizational resources are needed to solve such problems as lack of time resulting from workload (Mala et al., 2023; Neshat et al., 2022; Neshat et al., 2023) and inadequate educational programs, as well as to provide opportunities to access courses and conferences and to improve knowledge and skills in neonatal pain management, which have been claimed to optimize neonatal pain care (Abed & ALdoori, 2022; Kebede et al., 2024; Mala et al., 2023;Neshat et al., 2023;Popowicz et al., 2021)

Nurse characteristics, such as knowledge about the area of neonatal pain care, attitude regarding pain management and years of experience in neonatal care can result in better neonatal pain care (Priscah & Martina, 2018; Tassaneeyarat et al., 2022). Knowledge and beliefs have had a significant influence on the effectiveness of pain management (Wari et al., 2022). Inadequate professional knowledge and lacking time to update knowledge and improve clinical practices have been obstacles to the effective practice of neonatal pain (Mala et al., 2023; Neshat et al., 2022; Wari et al., 2021).

Infant/patient characteristics include the fact that infants at the lowest gestational age with very low birth weights are exposed to a high number of painful procedures (Luo et al., 2023, Wang et al., 2020). Infants are guite limited in their ability to express their pain symptoms, since they are nonverbal and impaired in their ability to display the pain they are experiencing, especially hospitalized infants who are obstructed by the imposition of support devices and other medical equipment. The level of pain care may be mediated by the nurses' ability to assess pain expression in younger, more acutely ill infants. Thus, it was important to include infant characteristics in this study, while factors such as age were used for testing purposes to determine their influence on pain care practices.

The socio-political factors comprised policy statements, accreditation guidelines, and professional associations. Latimer (2010) proposed that factors incorporated in socio-political views have the potential to change both working life conditions and patient outcomes. In several studies, it was thought that the pain management guidelines in their units were unclear, and that pain assessment was not being routinely implemented in their units. This limitation prevented the use of pain assessment in the daily work (Carlsen Misic et al., 2021; Priscah & Martina, 2018; Wari et al., 2021).

The pain-management issues are complex, since the characteristics of the nurses and infants,

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together with organizational contextual factors, must be integrated together in order to facilitate the translation of knowledge into clinical practice. The aim of this study was to determine the effect of nurse factors on the procedural pain management in neonates being performed by neonatal nurses, when using both infant factors and organizational context factors as control variables.

The conceptual framework (Figure 1) of this study was guided by use of the Knowledge Used in Pain Care (KUPC) Model (Latimer et al., 2010) and a literature review. However, the components of this model used in this study consisted of the organizational component, the nurse-characteristic component and the infant-characteristic component. The socio-political component was not examined because of the study context, in which some NICUs had no written guideline or pain care standard for their unit on neonatal pain management.

# METHOD

## 1. Design

A cross-sectional correlation study was designed to determine which set of Independent Variables (IVs) in a hierarchical structure can predict procedural pain management in hospitalized neonates performed by neonatal nurses was better than any other set of IVs.

2. Sample

The study was conducted in the neonatal intensive care units (NICUs) of general hospitals overseen by the Ministry of Public Health, Thailand, and the Thai Red Cross. These general hospitals were situated in provincial capitals or major districts and had capacities ranging from 200 to 500 beds. The multi-stage sampling method was implemented to select participants from four regions of Thailand (86 general hospitals), namely the Western Region (2 hospitals), the Northeastern Region (2 hospitals), the Central Region (2 hospitals) and the Southern Region (2 hospitals). Thus, there were eight general hospitals that participated in this study. The participant inclusion criteria were follows: (a) working as a registered nurse with current work in an NICU; (b) discharging the responsibility of providing direct care for newborns in an NICU; (c) having had at least one year of experience caring for newborns in NICU. The head nurse of each NICU referred potential participants to the researcher. The sample size was calculated by using Green's (1991) formula: N ≥ 104+M (where M is the number of IVs). In this current study, the number of IVs was six. Thus, the minimum number of participants was at least 110 cases. An additional ten percent was added to cover attrition from the sample; thus, 120 NICU nursing staff were recruited into the study.

# 3. Instruments

Data Collection Instruments seven selfreported questionnaires were used for data collection in this study: 1) The Nurse Demographic Data Questionnaire (NDDQ): This instrument was developed by the researcher to collect demographic and professional information. It gathered data on age, position (head nurse or general registered nurse), years of experience in neonatal care, educational background (graduate degree or Bachelor of Nursing Science), pain management training/education, and number of working hours per day. 2) The Infant Demographic Data Record (IDDR): This questionnaire was developed by the researchers to collect information related to the infants under the care of neonatal nurses. It included items on the gestational age (GA) of the infants most frequently cared for in the neonatal intensive care unit (NICU) and the types of painful procedures most commonly performed by neonatal nurses. 3)The Nurses' Pain Management Practice Questionnaire (NPMP): This questionnaire consisted of 31 items developed by the researchers based on a literature review. The content validity index for the scale (S-CVI) was 0.91, as evaluated by a panel of five experts. The total score was calculated by summing the responses across the 31 items, yielding a possible range of 31 to 155. Higher scores indicated more comprehensive neonatal pain management practices. The internal consistency of the scale was supported by a Cronbach's alpha coefficient of 0.80. 4)The Nurses' Knowledge Regarding Pain Management in Newborns Questionnaire (NKPM): This guestionnaire was modified by the researcher based on published literature. It comprised 20 true/false items, with higher scores indicating greater knowledge. The content validity index for the scale (S-CVI) was 0.92, as assessed by a panel of five experts. The score range was 0 to 20, with correct answers receiving a score of 1 and incorrect answers a score of 0. The internal consistency of the questionnaire was demonstrated by a KR-20 value of 0.70. 5)The Neonatal Nurses' Attitude Survey Regarding Pain (NNAS): This instrument was also modified by the researcher based on a literature review. It included 17 items measuring both positive and negative attitudes toward neonatal pain management. The content validity index for the scale (S-CVI) was 0.98, as evaluated by a panel of five experts. The total score was calculated by summing the responses across the 17 items, ranging from 17 to 54, with higher scores reflecting more positive attitudes toward pain management. The internal consistency was supported by a Cronbach's alpha coefficient of 0.72. 6)The Nurses' Perception of Organizational Supportive Resources Questionnaire (NPOR): This guestionnaire was modified by the researcher based on published literature. It contained 13 items covering three dimensions: opportunities (3 items), resources (5 items), and support (4 items). Responses were measured on a 5-point Likert scale ranging from "Strongly Agree" (5) to "Strongly Disagree" (1). Total scores ranged from 13 to 65, with higher scores indicating a greater perception of organizational support. The content validity index for the scale (S-CVI) was 0.97, and the internal consistency was demonstrated by a Cronbach's alpha coefficient of 0.80. 7) The Nurse-Physician Collaboration for Pain Management Questionnaire (NPCP): This instrument was modified by the researcher based on published literature. It included 13 items, scored on a 5-point Likert scale. The total score was calculated by summing the responses across the 13 items, ranging from 13 to 65, with higher scores indicating greater collaboration between nurses and physicians. The content validity index for the scale (S-CVI) was 0.98, and the internal consistency was supported by a Cronbach's alpha coefficient of 0.94.

4. Data collection

Arrangements for the study were made through coordination between the investigator and head nurse of each NICU to address the status of neonatal nurses. All neonatal nurses who had at least one year of experience in caring for an infant in a NICU were invited to the study. Interested participants were assured that their information would be anonymous. and those willing to participate signed consent forms. The questionnaires were printed and prepared in a sealed package. Participants were asked to complete all questionnaires during their own private time and to return then within the following two weeks. The initial number of neonatal nurses was 120 from eight general hospitals. Two nurses did not complete their questionnaires, because they were on postpartum leave. Therefore, there were a total of 118 subjects providing information for data analysis.

5. Data analysis

Descriptive statistics, such as frequency, mean and standard deviation, were used to analyze participant characteristics. A hierarchical regression analysis was used to analyze the effect of nurse factors on procedural pain management in neonates, while taking into account both infant factors and organizational context factors.

6. Ethical considerations

Approval was obtained by the Institutional Review Board of the Faculty of Nursing, Burapha University (No. 02-02-2562), and the directors of eight hospitals.

## RESULT

#### 1. Desciptive data

One hundred and twenty NICU nurses were recruited into the study, and 118 returned their completed questionnaires, for a response rate of 98.33%. The findings obtained indicated that a majority of the participants were staff nurses (92.4%), with ages ranging from 22 to 58 years (mean = 37.13, SD = 9.05), and had graduated with a bachelor's degree in nursing science (91.5%).

The average number of years of experience working in a neonatal unit was  $14.26 \pm 7.53$  years, ranging from 1 to 30 years (Figure 2). Half (55.9%) of the participants had more than 10 years' experience in caring for hospitalized infants. Half (55.08%) of the participants had received at least one year of training on neonatal pain management. Among the people who participated in pain management training, the specialty nursing program for neonatal critical care nursing practitioners was cited as the most attended (47.62%, see figure 3).

2. Factors explaining procedural pain management as performed by NICU nurses

To examine the effect of the nurse factors (knowledge regarding pain management in newborns, attitudes regarding pain management in newborns and experience in infant care) on nursing painmanagement care of neonates, a hierarchical multiple regression analysis was utilized. A control variable such as infant gestational age was entered in Step 1. Next, control variables, such as the perception of nurses toward organizational supportive resources and nurse-physician collaboration were added in Step 2. Subsequently, the knowledge, attitudes and experience of the nurses pertaining to infant care were entered in Step 3. The three-step model of hierarchical regression is presented in Table 1.



Figure 2. Nurse's Experience in Neonatal Care



Figure 3. Pain Management Training Experience

**Table 1.** Hierarchical multiple regression analysis for pain management in neonates performed by nurses when using for organizational context factors and infant factors as control variables (N = 118)

Predictors	Model 1 β (t)	Model 2 β (t)	Model 3 β (t)
Infant factor			
Gestational age	-0.414(-4.904)	-0.286 (-3.860)	-0.175 (-2.534)
Organizational contextual factors			
Organizational supportive resources		0.314(4.102)	0.237 (3.380)
Nurse-physician collaboration		0.309(3.991)	0.194 (2.658)
Nurse factors			
Knowledge of nurses regarding pa management in neonates	iin		0.305(4.248)
Attitude of nurses regarding pa management in neonates	lin		0.151(2.094)
Experience of infant care			0.156(2.285)
Constant	5.101	3.185	0.983
R	0.414	0.644	0.740
R <sup>2</sup>	0.172	0.414	0.548
$\Delta R^2$	0.172	0.243	0.134
S.E. E	0.401	0.339	0.302
F	24.045	26.898	22.429
$\Delta F$	24.045	23.633	10.931
Sig ∆F	0.000	0.000	0.000

\*(t) = t value

As presented in Table 1, the results indicate that model 1: gestational age significantly fits to the regression model ( $\beta$  = -0.414, p < 0.001) and explains 17.2 % of the total variance in nursing pain management in neonates, with standard errors of estimation of 0.401 (F (2,115) = 24.045, p < 0.001).

In model 2, organizational context factors were added. The resulting regression model accounted for 41.4% of the total variance in nursing pain management in neonates, which exhibited a total variance of change = 24.3% (S.E.E = 0.339,  $\Delta F(1,114) = 23.633$ , p < 0.001). Gestational ages still emerged as significant predictors of pain management neonates (ß in -0.286, p < 0.001). When organizational supportive resources and nurse-physician collaboration were added, these were also shown to be significant predictors of pain management in neonates performed by nurses ( $\beta = 0.314$ , p < 0.001, ( $\beta = 0.309$ , p < 0.001).

In Model 3, when all 6 predictive variables were included in step 3 of the regression model, all variables were found to be significant indicators: gestational age, for which ß -0.175, p < 0.001; organizational supportive resources, for which  $\beta = 0.237$ , p < 0.001; nursephysician collaboration, for which  $\beta = 0.194$ , p < 0.001; knowledge of nurses regarding pain management in newborns, for which  $\beta = 0.305$ , p < attitudes of nurses regarding pain 0.001; management in newborns, for which  $\beta = 0.151$ , p < 0.001; and experience in infant care, for which  $\beta$  = 0.156, p < 0.001, respectively. These variables explained 54.8% of the total variance of pain management in neonates performed by nurses, which exhibited a total variance of change 13.4 % (S.E.E = 0.302, ∆F(3,111) = 10.931, p < 0.001).

# DISCUSSION

The results of this study indicated that nurse factors (knowledge of nurses regarding pain management in newborns, attitudes of nurses regarding pain management in newborns and experience in infant care) contributed significantly to pain management in neonates performed by the nurses, when using organizational context factors and infant factors as control variables.

1. Infant factors

In this study, the infant factor of interest was the gestational age at which neonatal nurses most frequently provided care for neonatal infants in the NICU. Gestational age had a significantly negative effect on nursing pain management in neonates ( $\beta$  = -0.414). It was also shown to be a significant predictor of nursing pain management in neonates performed by nurses in Model 2 ( $\beta$  = -0.286) and Model 3 ( $\beta$  = -0.175). It can thus be concluded that gestational age can predict pain management in neonates performed by a nurse. This result indicates that infants who were

born at a lower gestational age are more likely to receive higher levels of neonatal pain management performed by nurses. This finding could be explained by the fact that infants born at less than 37 weeks of gestational age are premature babies. Most premature babies, especially younger preterm infants, are admitted to the NICU. They are exposed to a number of painful procedures (Luo et al., 2023; Wang et al., 2020). Often, behavioral indicators of pain response that might have been detected, such as by viewing the baby's face, are obstructed by supportive devices and other medical equipment. This fact makes it difficult for neonatal nurses to assess the magnitude of newborn pain responses (Assefa et al., 2022).

# 2. Organizational contextual factors

Our study has shown that organizational contextual factors, including organizational supportive resources and nurse-physician collaboration, have a significantly positive effect on nursing pain management in neonates, and together had a significant effect on pain management in neonates in all three models. As a result, nurse-physician collaboration appears to be a significant predictor of greater pain management in neonates performed by nurses. It means that a neonatal nurse who has good collaboration with physicians was more likely to provide higher-quality pain care. This finding was consistent with previous studies in which nursephysician collaborative activities can predict effective pain management in neonates. It was found from our study that having more open and ongoing communication within the treatment team facilitates effective neonatal pain care, while inadequate communication within the health-care team resulted in less optimal outcomes (Mehrnoush et al., 2018; Neshat et al., 2023; Priscah & Martina, 2018). Furthermore, our study found that organizational support resources, opportunities to gain knowledge and skills in the area of treating neonatal pain, receiving advice from knowledgeable superiors or specialists and having the needed materials, supplies, equipment and the time necessary to exercise appropriate pain management significantly helped us to predict the pain management practice in neonates being performed by the nurses. This result is consistent with the previous findings that continuous education or training based on scientific evidence helps neonatal nurses to adopt effective and safe measures to control pain (Muteteli et al., 2019; Tarjoman et al., 2019; Wari et al., 2021). The remaining unsolved issues regarding working hours, appropriate staffing ratios and having enough nurses with expertise are barriers to effective pain management in neonates. Insufficient time to enter some notes and remarks into the medical records also appeared in this study (Mehrnoush et al., 2018; Neshat et al., 2023). The professional should feel motivated and value his/her work by always registering it. However, it is worth mentioning that because of the lack of knowledge regarding the

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subject, the record is frail, since the management of pain has not been established as a subject of recognized care (Neshat et al., 2023). This record is part of the health information system and enables the ethical and legal support of the assistant workers in auditing and developing instruments for teaching and research in the nursing area. The scientific deficiency in relation to pain leaves the professionals in this area feeling insecure and unmotivated and can be a leading factor underlying still other problems.

## 3. Nurse factors

The study findings revealed that nurse factors consisting of knowledge regarding pain management in neonates, attitude regarding pain management in neonates, and experience of infant care were significantly positive effect on nurses' pain management in neonates. These predictors together did significantly effect on pain management performed by nurses, when using organizational context factors and infant factors as control variables.

Among all predictors, knowledge regarding pain management in neonates was highlighted as a significantly stronger predictor of higher pain management in neonates ( $\beta = 0.305$ ). This finding was consistent with the previous studies, in which it was found that a high level of knowledge in the area of pain care was correlated with better pain care (Wari et al., 2021). On the other hand, knowledge deficiency was likely to lead to inaccurate neonatal pain assessment by neonatal nurses and under-treatment of pain management for neonates (Carlsen Misic et al., 2021; Muteteli et al., 2019; Popowicz et al., 2021; Popowicz et al., 2022) Also, it was found that a positive attitude can facilitate better pain management in neonates (Muteteli et al., 2019).

Experience in infant care was shown to be a predictor of pain management ability in the treatment of neonates in this present study. This finding was in alignment with previous studies conducted on this same subject. For infants not capable of pain expression, pain care may be administered by the nurses relying on their own knowledge and experience (Priscah & Martina, 2018). In the absence of pain expression, an infant who is diagnosed with a severe illness may correctly be "assumed" to be in pain, and expert nurses may then administer the appropriate care6. Nurses with more experience are typically assigned to medically unstable infants with need of a higher level of nursing care; nurses with more expertise were found to be more confident in their pain-care decisions and were more inclined to administer analgesics to children (Priscah & Martina, 2018).

The limitations of this study were considered when interpreting the results and considering the generalizability of the findings. Our study utilized questionnaires, which may be susceptible to bias, potentially leading nurses to over-report their pain management and assessment practices. Additionally, the medium effect size used in this study was a general value, possibly resulting in insufficient sample size to detect significance in the effect of nurse factors on neonatal pain management practices. Consequently, the researchers found only minor significance in the areas of pain knowledge, experience in infant care and neonatal pain management practices among nurses.

# CONCLUSION

Exposure of neonates to painful procedures has been shown to contribute to long-term adverse effects. Effective pain management in neonates can help mitigate these negative impacts. Based on the results of this study, it can be concluded that individual nursing characteristics, particularly knowledge, play a significant role in care decisions. Factors such as the nurses' experience, beliefs and education may therefore contribute to their ability to provide optimal pain care.

# **Conflict of Interest**

No conflict of interest to declare.

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