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# Effects of Kangaroo Care on Procedural Pain in Preterm Infants: A Systematic Review

Alyssa M. Pagni

*The University of Akron*, [amp175@zips.uakron.edu](mailto:amp175@zips.uakron.edu)

Sophia Kellar

*The University of Akron*, [smk125@zips.uakron.edu](mailto:smk125@zips.uakron.edu)

Mary Rood

*The University of Akron*, [mtr26@zips.uakron.edu](mailto:mtr26@zips.uakron.edu)

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Effects of Kangaroo Care on Procedural Pain in Preterm Infants: A Systematic Review

Alyssa Pagni, Sophia Kellar, & Mary Rood

The University of Akron

Author Note

Alyssa Pagni, Sophia Kellar, & Mary Rood, College of Nursing, The University of Akron, This paper is in fulfillment for the course: Honors Nursing Research 8200:435:005, Due May 5<sup>th</sup>, 2017, Professor Christine Heifner Graor, PhD, MSN, APMHCNS-BC, RN

**Abstract**

Approximately 64,000 preterm infants are born annually in the United States. With preterm infants enduring between 10-16 painful procedures daily, it is important for nurses to use interventions that effectively decrease pain. Procedural pain in premature infants may result in short-term and long-term negative physical, cognitive, and emotional effects. Kangaroo care is the act of holding an infant making skin on skin contact. The purpose of this systematic review is to identify, review, and critically appraise the evidence from studies examining the effect of Kangaroo Care on procedural pain in premature infants. Literature was searched in university databases and Google Scholar for relevant studies, which were selected based on criteria of intervention studies, sampling methods, use of Kangaroo Care, and use of measurable pain scales. Studies are discussed based on the pain measurement tool, type of procedure, and specific study characteristics. The evidence was critically appraised. Limitations and gaps in knowledge are described. Recommendations for further studies and implementation of Kangaroo Care are identified.

The problem is procedural pain and discomfort in premature infants. For the purposes of this paper, preterm infants can be defined as infants born between 28 weeks and 36 weeks 6 days gestation. This problem is significant because nurses' scope of practice includes pain management of patients, and studies have shown that early exposure to pain and stress as a result of pain may have immediate and sometimes life-long effects in a preterm infant's brain. It can also have physical effects, such as an increased risk of developing an intravascular hemorrhage or hypertension (Akcan, Atıcı, & Yiğit, 2009). This early exposure to pain and stress may also lead to adverse effects such as changes in heart rate or respiratory rate (Gao et al., 2015). The problem is prevalent because approximately 14.9 million babies were born preterm worldwide in 2010 (Blencowe et al., 2012). Approximately 64,000 preterm infants weighing less than 1500 grams are born each year in the United States (Mitchell, Yates, Williams, Chang, & Hall, 2012). Nursing management of procedural pain and discomfort in premature infants is challenged because nurses are unable to communicate to infants how a procedure will feel, and the pain resulting from invasive procedures may potentially cause unstable vital signs (Gao et al., 2015).

Kangaroo Care is the intervention of interest and independent variable in this systematic review. The infant's mother, another trusted family member, or friend can perform it, as long as the infant and adult have direct skin-to-skin contact. Researchers have investigated the effects of Kangaroo Care, compared with standardized care, i.e., a control group with premedication of pain, administration of Tylenol or patient positioning during the procedure, on the outcome or dependent variable of pain before, during, or after a procedure (Johnston et al., 2008; Mitchell et al., 2012). The purpose of the review is to identify, review, and critically appraise the evidence from studies examining the effect of Kangaroo Care on procedural pain in premature infants. Research shows gaps in knowledge about the effect of Kangaroo Care in specifically preterm

infants. This review answers the following PICO question: In premature infants, how does Kangaroo Care, compared with standardized care, affect pain levels during procedures? Based on the critical appraisal of evidence, recommendations for practice and research are advanced.

### **Methods**

The literature search was conducted within a university database system. Databases were CINAHL, Medline, PsychInfo, and PubMed, as well as Google Scholar. Inclusion criteria were: Kangaroo care or skin-to-skin contact, as an intervention for procedural pain, premature infants, meaning they were born at least four weeks prior to their due date, and publications after January 2007. Keywords or phrases were premature infants, preterm infants, procedural pain, procedural pain levels, Kangaroo Care, and skin-to-skin contact. Articles were retained as potential sources based on the title of the articles as well as a brief scan of the abstract. Studies that seemed fitting were read thoroughly before being selected as sources. They were assessed based on the criteria set forth prior to being selected. Twenty studies were evaluated based on methods for choosing participants, use of Kangaroo Care as the intervention, use of the control group of standardized care, and the use of a measurable, reliable pain scale. Refer to *Appendix A* for the breakdown of searched articles.

### **Review of Literature**

Preterm infants in NICU settings endure an average of 10-16 painful procedures per day (Cong, Ludington-Hoe, & Walsh, 2011); however, few researchers have investigated the effects of procedural pain in preterm infants, indicating a gap in knowledge. Of those studying pain management in this population, researchers have consistently found that infants experience pain that has long-term cognitive effects (Akcan et al., 2009; Castral et al., 2012; Choudhary et al., 2015; Cong et al., 2011; Cong, Cusson, Hussain, & Kelly, 2012; Cong, Ludington-Hoe, McCain,

Fu, 2009; Gao et al., 2015). This shows the importance of pain management interventions, especially non-pharmacological and cost-effective ones such as Kangaroo Care. Kangaroo Care is also applicable to almost any painful procedure.

### **Types of Procedures**

Researchers have studied the effect of Kangaroo care and pain in preterm infants during various types of painful procedures (Akcan et al., 2009; Castral et al., 2012; Castral, Warnock, Leite, Haas, & Scochi, 2008; Chidambaram, Manjula, Adhisivam, & Bhat, 2013; Choudhary et al., 2015; Cong, Cusson, Hussain, et al., 2012; Cong, Cusson, Walsh, et al., 2012; Cong et al., 2009; Cong et al., 2011; de Sousa Freire, Garcia, & Lamy, 2008; Ferber & Makhoul, 2007; Gao et al., 2015; Johnston, Campbell-Yeo, & Filion, 2011; Johnston et al., 2008; Johnston et al., 2009; Kostandy et al., 2008; Lyngstad, Tandberg, Storm, Ekeberg, & Moen, 2014; Mitchell et al., 2012; Nimbalkar, Chaudhary, Gadhavi, & Phatak, 2012; Olsson, Ahlsen, & Eriksson, 2015). The most commonly studied painful procedure was heel lances, where blood samples are taken from the preterm infants' heels (Akcan et al., 2009; Castral et al., 2008; Castral et al., 2012; Chidambaram et al., 2013; Choudhary et al., 2015; Cong, Cusson, Hussain, et al., 2012; Cong, Cusson, Walsh, et al., 2012; Cong et al., 2009; Cong et al., 2011; de Sousa Freire et al., 2008; Ferber & Makhoul, 2007; Gao et al., 2015; Johnston et al., 2008; Johnston et al., 2009; Johnston et al., 2011; Kostandy et al., 2008; Nimbalkar et al., 2012; Olsson et al., 2015). A heel lance procedure generally begins when a nurse warms one heel of the infant and then uses a lancet to puncture the heel to obtain the necessary blood sample (Akcan et al., 2009). Other procedures studied by researchers were nasal suctioning (Mitchell et al., 2012) and diaper changes (Lyngstad et al., 2014). Nasal suctioning occurs when a nurse uses a bulb syringe to clear an infant's nasal passages to facilitate easier breathing in the infant (Mitchell et al., 2012). Mitchell et al. (2012)

found that nasal suctioning was a more painful procedure with a longer duration of pain, compared with heel lances. Further, diaper changes are part of daily routines in preterm infants who are at a greater risk for skin breakdown due to the sensitivity of their skin and their integumentary system not being fully developed (Lyngstad et al., 2014). Therefore, it is important to study ways to decrease pain during these frequent procedures. In general, those who have studied the effect of Kangaroo Care on pain in preterm infants during a variety of painful procedures have found Kangaroo Care to be a cost effective, nonpharmacological intervention for pain.

### **Pain Measures**

**Pain tools.** Of twenty studies, ten used the Premature Infant Pain Profile (PIPP) to measure pain (Akcan et al., 2009; Chidambaram et al., 2013; Choudhary et al., 2015; Cong, Cusson, Hussain, et al., 2012; Cong et al., 2011; de Sousa Freire et al., 2008; Johnston et al., 2008; Johnston et al., 2009; Johnston et al., 2011; Olsson et al., 2015). Higher PIPP scores indicate greater pain. For example, in a quasi-experimental study without randomized group assignment, Chidambaram et al. (2013) employed the PIPP tool to measure pain of heel lances in 100 premature infants. They found that the group in Kangaroo Care had lower PIPP scores than the control group of standardized care at both fifteen and thirty minutes of Kangaroo Care (Chidambaram et al., 2013). These findings are consistent with Akcan et al. (2009) who also used randomized group assignment and the PIPP to measure pain levels at one, two, and three minutes following the procedure. They found that preterm infants with Kangaroo Care had lower PIPP scores than the control group. Cong, Cusson, Hussain, et al. (2012) used the PIPP to measure pain in two preterm infants following heel lance as well, and found PIPP scores to be higher in the infant in incubator care compared to an infant with Kangaroo Care. As

Chidambaram et al. (2013) did not use randomized group assignment and Cong, Cusson, Hussain et al. (2012) had a small sample of two, the study by Akcan et al. (2009) provides better evidence showing that Kangaroo Care produces lower procedural pain levels as opposed to standard care. Besides pain tools, researchers also measured pain in preterm infants with pain level indicators such as heart rate and variability, cortisol levels, and cry times or behavioral cues (Castral et al., 2008; Castral et al., 2012; Choudhary et al., 2015; Cong, Cusson, Hussain, et al., 2012; Cong et al., 2009; Cong et al., 2011; de Sousa Freire et al., 2008; Ferber & Makhoul, 2007; Gao et al., 2015; Kostandy et al., 2008; Lyngstad et al., 2014; Mitchell et al., 2012; Nimbalkar et al., 2012; Olsson et al., 2015).

**Heart rate and rate variability.** Several studies measured pain with heart rate variability (Choudhary et al., 2015; Cong et al., 2009; de Sousa Freire et al., 2008; Nimbalkar et al., 2012; Olsson et al., 2015) as opposed to specific rates (Castral et al., 2008; Castral et al., 2012; Cong et al., 2012; Gao et al., 2015; Johnston et al., 2008; Lyngstad et al., 2014), with the former increasing accuracy of using heart rates as a pain level tool. In general, those who measured heart rate variability found that infants participating in Kangaroo Care had less variability in their heart rates as opposed to infants in standard care (Choudhary et al., 2015; Cong et al., 2009; de Sousa Freire et al., 2008; Nimbalkar et al., 2012; Olsson et al., 2015). Some of these researchers used crossover methods when the same preterm infants had Kangaroo care and no Kangaroo care (Choudhary et al., 2015; Cong et al., 2009; Nimbalkar et al., 2012). This may have biased findings due to infants being exposed to Kangaroo Care and then having it taken away, possibly contributing to heart rate fluctuations not only due to the painful procedure, but also due to separation anxiety. Cong, Cusson, Hussain et al. (2009) controlled this bias by splitting the infants into two groups; group A received incubator care the first day and Kangaroo Care the



second, while group B received the opposite. The researchers found that Kangaroo Care decreased heart rate variability in both groups A and B (Cong et al., 2009).

Although heart rates may be less accurate than variability, researchers have used heart rates as an objective measure of pain levels, with higher heart rates indicating higher pain levels. Those researchers have consistently found lower heart rates in preterm infants with the intervention of Kangaroo Care as compared to those with incubator care or standard care (Castral et al., 2008; Castral et al., 2012; Cong, Cusson, Hussain et al., 2012; Gao et al., 2015; Johnston et al., 2008; Lyngstad et al., 2014). In addition to finding decreased heart rates in preterm infant with Kangaroo Care, Castral et al. (2012) also found decreases in the negative effects of stress in mothers, i.e., an inverse relationship between infants' heart rates and mothers' salivary cortisol levels. Heart rate and rate variability act as additional pain management tools that aid researchers in measuring infant pain levels more accurately.

**Biomarkers.** Cortisol is another objective measure of stress, as well as pain in infants during procedures (Castral et al., 2012; Cong et al., 2011; Mitchell et al., 2012). Cong et al. (2011) compared salivary and serum cortisol levels in infants with Kangaroo Care to those with incubator care and found decreased levels in preterm infants with Kangaroo Care. This finding is inconsistent with Mitchell et al. (2012) who found no salivary cortisol level differences in infants with Kangaroo Care versus standard care, thus finding Kangaroo Care had no effect on salivary cortisol levels. However, Mitchell et al. (2012) also reported that not all cortisol levels were accurate, reducing the study validity. Although Cong et al. (2011) found cortisol levels to be affected by Kangaroo Care, contrary findings were reported by Mitchell et al. (2012) who found cortisol levels may not be as reliable as other pain measurement tools.

**Behavioral cues.** Lastly, researchers have used behavioral cues, such as cry time or muscle extension, as objective indicators of pain (Castral et al., 2008; Choudhary et al., 2015; de Sousa Freire et al., 2008; Ferber & Makhoul, 2007; Gao et al., 2015; Kostandy et al., 2008; Nimbalkar et al., 2012). Although the PIPP accounts for similar behaviors, some researchers used strictly behavioral cues as their pain measure. Kostandy et al. (2008) investigated cry times, or length of cry time, in infants during painful procedures as well as during recovery. They found that cry times were shorter in infants with Kangaroo Care both during the procedure and during recovery, compared to infants with incubator care (Kostandy et al., 2008). Similarly, Choudhary et al. (2015) found infants in Kangaroo Care had reduced mean duration of crying by 36% when compared to the control group of standard care. Ferber and Makhoul (2007) measured pain with different neurobehavioral responses, including motor disorganization and muscle extension. They found decreased behavioral responses in infants with Kangaroo Care versus those with crib care (Ferber & Makhoul, 2007). Other researchers also found decreased facial action or facial grimacing with Kangaroo Care when compared to incubator care (Castral et al., 2008; de Sousa Freire et al., 2008; Gao et al., 2015; Nimbalkar et al., 2012). Although these researchers utilized a different method of pain measurement by using behavioral cues, the results are consistent with those using PIPP to measure pain.

### **Variations of Kangaroo Care**

Across studies, researchers also examined the effects of variations of Kangaroo Care on procedural pain levels in preterm infants (Johnston et al., 2009; Johnston et al., 2011). For example, Johnston et al. (2009) compared Enhanced Kangaroo Mother Care versus Kangaroo Mother Care and found no difference in group PIPP scores. They compared their findings with those from previous studies and found that both Enhanced Kangaroo Mother Care and Kangaroo

Mother Care decreased procedural pain levels when compared to control groups of standard care (Johnston et al., 2009). Johnston et al., (2011) compared Paternal Kangaroo Care versus Maternal Kangaroo Care and found that PIPP scores of infants held by mothers were lower by thirty seconds and sixty seconds after painful procedures than infants held by fathers. However, they also found that at ninety and one hundred and twenty seconds following the procedures, PIPP scores were the same, suggesting similar effectiveness of Kangaroo Care, regardless of parent provider (Johnston et al., 2011). Overall, Kangaroo Care is effective in reducing pain levels in preterm infants, regardless of procedures and amount of time held in Kangaroo Care, regardless of if the Kangaroo Care is enhanced, and regardless of which parent provides this care.

### **Critical Appraisal of the Evidence**

The evidence found within the studies has varying levels of reliability and validity. Reliability can be addressed based on the designs of the studies and levels of evidence, the sample size, and the analysis of video recordings. Validity can be assessed based on the studies' sampling methods, use of objective data, the location of the studies, and the year it was completed. When assessing reliability and validity, limitations should also be considered. Limitations were found and assessed based on the methods used, as well as the findings. There were also limitations specific to various studies that were viewed and interpreted.

#### **Reliability**

The reliability of the methods can be graded based on their designs and level of evidence. The level of evidence with the highest reliability in the studies reviewed is level 2. Level 2 evidence is obtained from well-designed randomized controlled trials. The most reliable design is crossover as it is a repeated measure design where all subjects receive the same number of

treatments, as well as all of the treatments. Over half of the studies were crossover design with level 2 evidence (Castral et al., 2008; Cong, Cusson, Hussain et al., 2012; Cong et al., 2009; Cong et al., 2011; Johnston et al., 2011; Johnston et al., 2009; Johnston et al., 2008; Kostandy et al., 2008; Nimbalkar et al., 2012; Olsson, Ahlsen, & Eriksson, 2015). Of the crossover studies, two studies were the most reliable as they were prospective crossover because it is performed over a longer period of time; therefore, causation can be assumed and it is less prone to bias (Cong et al., 2011; Kostandy et al., 2008). Another crossover design used in one of the studies was double blind crossover, which is more reliable than single blind as both the researcher and patient do not know what treatment they have been assigned (Nimbalkar et al., 2012). Single blind, of which there were three studies, is when the researcher knows what treatment has been assigned, but the patient is not aware (Choudhary et al., 2015; Johnston et al., 2009; Johnston et al., 2008). When grading reliability, the next designs are controlled and single blind randomization, as they provide level 2 evidence. Two of the studies were control design, which is when one group receives standard care and one group receives Kangaroo Care (Akcan et al., 2009; Ferber & Makhoul, 2007; Gao et al., 2015; Mitchell et al., 2012). When the researcher is aware while the patient is not of the treatment prescribed, single blind randomization design occurs, which was utilized in one of the studies (de Sousa Freire et al., 2008). Another study was a level 2 evidence, but was a pilot design making the study less reliable (Lyngstad et al., 2014).

Sample size and the analysis of video recordings were two other determining factors of reliability. The larger the sample size the more room for preventing skewing of data from other outlying factors (Akcan et al., 2009; Castral et al., 2008; Castral et al., 2012; Chidambaram et al., 2013; Choudhary et al., 2015; Cong et al., 2011; de Sousa Freire et al., 2008; Ferber & Makhoul, 2007; Gao et al., 2015; Johnston et al., 2011; Johnston et al., 2009; Johnston et al., 2008;

Mitchell et al., 2012; Nimbalkar et al., 2012). Analysis of video recordings versus being present in the room is also a determining factor of reliability. Being present in the patient's room to perform the analysis allows the researcher to fully evaluate the infant and the infant's response to the various treatments (Castral et al., 2008; Castral et al., 2012; Chidambaram et al., 2013; Choudhary et al., 2015; Cong, Cusson, Walsh et al., 2012; Cong et al., 2009; Cong et al., 2011; de Sousa Freire et al., 2008; Ferber & Makhoul, 2007; Gao et al., 2015; Johnston et al., 2009; Johnston et al., 2008; Kostandy et al., 2008; Lyngstad et al., 2014; Mitchell et al., 2012; Olsson, Ahlsen, & Eriksson, 2015).

### **Validity**

There were various sampling methods used in the studies that speak to validity. The sampling method that increases validity of the study is randomization as it decreases the chance of selection bias and the findings may be applied to the population. This ensures that there is a balance among the variables that may skew or affect the results of the study. Most studies used randomization within the studies' design to obtain sampling groups (Akcan et al., 2009; Castral et al., 2008; Cong, Cusson, Hussain et al., 2012; Cong, Cusson, Walsh et al., 2012; Cong et al., 2009; Cong et al., 2011; de Sousa Freire et al., 2008; Ferber & Makhoul, 2007; Gao et al., 2015; Johnston et al., 2011; Johnston et al., 2009; Johnston et al., 2008; Kostandy et al., 2008; Lyngstad et al., 2014; Mitchell et al., 2012; Nimbalkar et al., 2012). The validity of the findings can be determined based on the use of objective measures as well. Objective measures that were used included PIPP scores, salivary cortisol levels, heart rates, oxygen saturation of tissues, and hemodynamic changes in the brain (Akcan et al., 2009; Castral et al., 2008; Castral et al., 2012; Chidambaram et al., 2013; Choudhary et al., 2015; Cong, Cusson, Hussain et al., 2012; Cong, Cusson, Walsh et al., 2012; Cong et al., 2009; Cong et al., 2011; de Sousa Freire et al., 2008;

Gao et al., 2015; Johnston et al., 2011; Johnston et al., 2009; Johnston et al., 2008; Lyngstad et al., 2014; Mitchell et al., 2012; Nimbalkar et al., 2012; Olsson, Ahlsen, & Eriksson, 2015).

Objective data is less prone to bias as it is quantitative as opposed to qualitative. Another factor that can judge the validity of the findings is the location, as the studies' treatments performed closer in proximity can be more easily inferred or applied to neighboring cities or states (Cong, Cusson, Hussain et al., 2012; Cong et al., 2009; Cong et al., 2011). Studies completed within the United States are more valid to base the application of Kangaroo Care as a standard treatment within the United States. The year the research study was conducted can also speak to its validity, as studies within the last five years included the most recent medical care and technology (Castral et al., 2012; Chidambaram et al., 2013; Choudhary et al., 2015; Cong, Cusson, Hussain et al., 2012; Cong, Cusson, Walsh et al., 2012; Cong et al., 2011; Gao et al., 2015; Johnston et al., 2011; Johnston et al., 2009; Lyngstad et al., 2014; Mitchell et al., 2012; Nimbalkar et al., 2012; Olsson, Ahlsen, & Eriksson, 2015).

### **Limitations**

Limitations were found in the studies analyzed that decreased their reliability. One limitation is the design of a few of the studies. Less reliable designs include descriptive design, pilot design, and case design (Castral et al., 2012; Cong, Cusson, Walsh et al., 2012; Lyngstad et al., 2014). Reliability is also decreased in a few studies due to the level of evidence used. Level 3 evidence is obtained from well-designed controlled trials without randomization. Due to the lack of randomization, these studies are less reliable (Chidambaram et al., 2013; Choudhary et al., 2015). There was one study with level 4 evidence, which is obtained from well-designed care controlled and cohort studies (Cong, Cusson, Walsh et al., 2012). Level 6 evidence is obtained from single descriptive or qualitative studies (Castral et al., 2012). Another significant limitation

found was the use of small sample sizes (Cong, Cusson, Hussain et al., 2012; Cong, Cusson, Walsh et al., 2012; Cong et al., 2009; Kostandy et al., 2008; Lyngstad et al., 2014; Olsson, Ahlsen, & Eriksson, 2015). This is significant as the smaller the sample size the less reliable it will be to produce the same results if the study was conducted again. Another limitation is the use of analysis of video recordings versus being present, which speaks to a decreased level of reliability (Akcan et al., 2009; Johnston et al., 2011; Kostandy et al., 2008; Nimbalkar et al., 2012). When analyzing video recording, the quality may be poor resulting in the researchers interpreting nonverbal or verbal cues incorrectly. For example, the microphone may have not picked up the quiet whimpering of an infant or the lighting may not have allowed the researcher to see the infant's face.

There were limitations found in the studies that decreased their level of validity. One limitation is the use of subjective data. This includes subjective responses, such as crying or grimacing and neurobehavioral responses (Castral et al., 2008; Choudhary et al., 2015; de Sousa Freire et al., 2008; Ferber & Makhoul, 2007; Gao et al., 2015; Johnston et al., 2008; Kostandy et al., 2008; Nimbalkar et al., 2012). Differences in measurement tools make it more difficult to assume the findings are similar or the same, as objective data was also used in place of subjective data in some studies. Subjective data is more prone to bias, making these studies less valid (Castral et al., 2008; Choudhary et al., 2015; de Sousa Freire et al., 2008; Ferber & Makhoul, 2007; Gao et al., 2015; Johnston et al., 2008; Kostandy et al., 2008; Nimbalkar et al., 2012). The way researchers selected their samples was also a limitation in some cases. All studies used a less valid sampling method, which is convenience sampling. Convenience sampling is less valid because the sample includes patients in the immediate setting to which the researcher has access to (Akcan et al., 2009; Castral et al., 2008; Castral et al., 2012; Chidambaram et al., 2013;

Choudhary et al., 2015; Cong, Cusson, Hussain et al., 2012; Cong, Cusson, Walsh et al., 2012; Cong et al., 2009; Cong et al., 2011; de Sousa Freire et al., 2008; Ferber & Makhoul, 2007; Gao et al., 2015; Johnston et al., 2011; Johnston et al., 2009; Johnston et al., 2008; Kostandy et al., 2008; Lyngstad et al., 2014; Mitchell et al., 2012; Nimbalkar et al., 2012; Olsson, Ahlsen, & Eriksson, 2015). Not using randomization is another significant limitation and decreases the validity further, as there is no barrier against bias and it is harder to attribute the intervention of Kangaroo Care to the relief of pain (Castral et al., 2012; Chidambaram et al., 2013; Choudhary et al., 2015; Olsson, Ahlsen, & Eriksson, 2015). A limitation that is found in most of the studies is unknown locations or conducted outside of the United States making these studies less valid for generalization to the population of the United States (Akcan et al., 2009; Castral et al., 2008; Castral et al., 2012; Chidambaram et al., 2013; Choudhary et al., 2015; Cong, Cusson, Walsh et al., 2012; de Sousa Freire et al., 2008; Ferber & Makhoul, 2007; Gao et al., 2015; Johnston et al., 2011; Johnston et al., 2009; Johnston et al., 2008; Kostandy et al., 2008; Lyngstad et al., 2014; Mitchell et al., 2012; Nimbalkar et al., 2012; Olsson, Ahlsen, & Eriksson, 2015). Another limitation is some research was completed and published prior to 2011, making it less applicable as new technologies and medical interventions may have come about after the study was completed (Akcan et al., 2009; Castral et al., 2008; Cong et al., 2009; de Sousa Freire et al., 2008; Ferber & Makhoul, 2007; Johnston et al., 2009; Johnston et al., 2008; Kostandy et al., 2008). There were a few other limitations that affected the validity of the studies including no standard care control group, a high participation refusal rate, and no baseline collected prior to the procedure (Castral et al., 2008; Gao et al., 2015; Johnston et al., 2011; Johnston et al., 2009).

There are a few studies that contain limitations specific to that study. The study performed by Yates et al. (2012) contained three limitations, which include cortisol levels were



inadequate, infants underwent a low number of procedures, and there was no attempt to perform Kangaroo Care before or during procedures. The study by Castral et al. (2012) has two limitations including that the cross-sectional design cannot determine causal relationship and there were a few mothers suffering from depression and/or anxiety. Cong et al. (2011) has a limitation of limited gestational age difference between the preterm infants studied. A different study believed that the mothers' chest expansion might have affected the grimacing scores of the infants in the group receiving Kangaroo Care (Gao et al., 2015). Another study's limitation was that the findings were only applicable to patients that showed no inflammation at stick sites (Kostandy et al., 2008). The last study contained one infant that was on continuous positive airway pressure, which may have skewed the infant's hemoglobin saturation (Olsson, Ahlsen, & Eriksson, 2015).

### **Synthesis of the Evidence**

The current state of science demonstrates that the use of Kangaroo Care for procedural pain relief in preterm infants is successful. Based on the critical appraisal of the evidence, the research studies showed that preterm infants did benefit from Kangaroo Care performed before, during or after painful procedures. The research reflected this through the following responses from the preterm infants including, decreased crying duration, increased oxygenation saturation of tissues, decreased grimacing, lower PIPP scores, lower durations of increased heart rates, decreased hemodynamic changes in the brain, decreased negative neurobehavioral responses, and decreased salivary cortisol levels.

### **Recommendations**

Recommendations for clinical practice are to utilize Kangaroo Care as a tool for procedural pain relief based on the evidence provided from these research studies. Kangaroo

Care should be used before, during, and after painful procedures.

Recommendations for future studies to advance nursing practice include a variety of topics. Studies of Kangaroo Care as a method for procedural pain relief in full term infants specifically should be completed. Further research needs to be conducted within the United States as well in order to have findings that are more applicable. Studies should also look into the use of Kangaroo Care as a positive intervention for various negative situations that affect preterm or full term infants. The bonding and attachment benefits of Kangaroo Care should also be researched.

In conclusion, the systematic review has found that preterm infants greatly benefit from the implementation of Kangaroo Care for procedural pain control. Nurses in various infant specialties should encourage families to participate in Kangaroo Care. Although there is current research available on the topic, further research needs to be conducted to strengthen the reliability and validity of the findings. There are other benefits of Kangaroo Care that should be explored and then implemented within the differing specialty areas such as, labor and delivery, postpartum, special care nurseries and N.I.C.U., and infant toddler pediatric floors.

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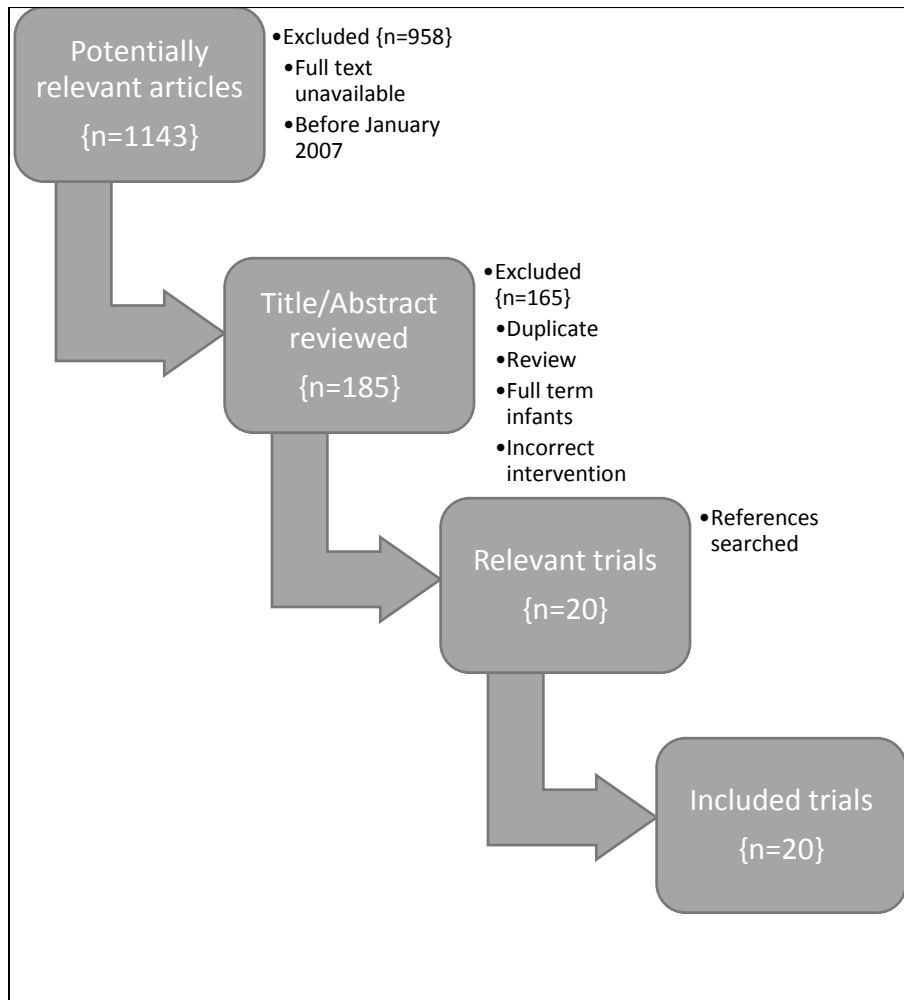
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Appendix A



## Appendix B

Systematic Review Literature Summary Table

APA formatted reference <sup>1</sup>	Background of Clinical Problem. Purpose statement. Research question <sup>2</sup> .	Clinical Practice Setting. Population, Sampling methods, sample size.	Design. Level of Evidence.	Evidence-based Findings	Practice & Research Implications	****Limitations <sup>3</sup>
1) Chidambaram, A.G., Manjula, S., Adhisivam, B., & Bhat, B.V. (2013). Effect of kangaroo mother care in reducing pain due to heel prick among preterm neonates: A crossover trial. <i>The Journal of Maternal-Fetal &amp; Neonatal Medicine</i> , 7(5), 488–49. doi: 10.3109/14767058.2013.818974  Quantitative  Primary	Background: Preterm infants are exposed to painful procedures daily and nonpharmacological interventions like KC are being used  Purpose Statement: “This trial was done to study the effect of KMC in reducing pain among preterm neonates using Premature Infant Pain Profile (PIPP).” (Pg 488)  Research question: What is the effect of Kangaroo Mother Care (KMC) in reducing pain due to	Setting: Division of Neonatology at Jawaharlal Institute of Postgraduate Medical Education and Research (JIPMER)  Population: Preterm infants who are 32–36 weeks, weigh <2.5 kg, blood pressure stable, and not on oxygen.  Sampling method: Convenience  Sample size: 100	Design: Crossover trial without randomization  Level of Evidence: 3	KMC mean PIPP score 15 minutes following heel prick: 4.3  Control mean PIPP score 15 minutes following heel prick: 5.76  KMC mean PIPP score 30 minutes following heel prick: 3.84  Control mean PIPP score 30 minutes following heel prick: 5.24  KMC infants scored lower PIPP than the	This study shows KMC is effective and should be implemented as a non-pharmacological intervention for procedural pain, specifically heel pricks.	Not randomized  Study completed outside of U.S. (India)

<sup>1</sup> Indicate if primary or secondary source and if quantitative, qualitative or mixed methods.

<sup>2</sup> Construct purpose statement and research question is not stated in article. Identify independent variables, dependent variables, and population.

<sup>3</sup> Identify independent variables, dependent variables, and population.

<sup>3</sup> List limitations related to validity and reliability of methods and applicability of findings. Consider strengths and weaknesses of study. <sup>3</sup>



	heel prick among preterm neonates?			control infants at 15 and 30 minutes.		
2) Johnston, C.C., Fillion, F., Campbell-Yeo, M., Goulet, C., Bell, L., McNaughton, K., & Byron, J. (2009). Enhanced kangaroo mother care for heel lance in preterm neonates: A crossover trial. <i>Journal of Perinatology</i> , 29, 51–56. doi: 10.1038/jp.2008.113  Quantitative  Primary	<p>Background: KMC has been shown to be effective in decreasing procedural pain levels in infants in three previous studies.</p> <p>Purpose Statement: “To test if enhancing maternal skin-to-skin contact, or Enhanced Kangaroo Mother Care (KMC) by adding rocking, singing and sucking is more efficacious than simple KMC for procedural pain in preterm neonates.” (Pg 51)</p> <p>Research question: Is enhancing maternal skin-to-skin contact through Enhanced Kangaroo Mother Care (EKMC) by adding rocking, singing, and sucking more efficacious than simple KMC for</p>	<p>Setting: Montreal Children’s Hospital, the IWK Health Centre, and Hospital Ste Justine</p> <p>Population: Preterm infants between 32 0/7 and 36 0/7 weeks’ gestational age</p> <p>Sampling Method: convenience with randomized crossover assignment</p> <p>Sample size: 90</p>	<p>Design: Single-blind randomized crossover design</p> <p>Level of Evidence: 2</p>	<p>PIPP score at 30 seconds: EKMC &gt; KMC</p> <p>PIPP score at 60 seconds: EKMC &lt; KMC</p> <p>PIPP score at 90 seconds: EKMC &lt; KMC</p> <p>PIPP score at 120 seconds: EKMC = KMC</p> <p>PIPP scores were not very different between the KMC and EKMC groups. Compared to previous studies’ control groups, KMC/EKMC had lower pain levels.</p>	<p>This study suggests mothers should not be encouraged nor discouraged from rocking, singing, or letting her baby suck her finger.</p>	<p>No standard care control group</p> <p>Participation refusal rate of 26%</p> <p>Study completed outside of U.S. (Canada)</p>

	procedural pain in preterm neonates?					
3) Castral, T., Warnock, F., Ribeiro, L., Vasconcelos, M., Leite, A., & Scochi, C. (2012). Maternal factors regulating preterm infants' responses to pain and stress while in maternal kangaroo care. <i>Latino-Am. Enfermagem</i> , 20(3), 435-43. Retrieved from <a href="http://www.eerp.usp.br/rlae">www.eerp.usp.br/rlae</a>	<p>Background: Relationship between maternal factors and response of preterm infants to pain and stress during heel puncture while in KC</p> <p>Purpose Statement: "This study's objective was to investigate the association between maternal factors (behavior, depression and/or anxiety, and stress) and the response of newborns to pain and stress when undergoing heel puncture for the neonatal screening test while held in the kangaroo position." (Pg 437 or 3)</p> <p>Research question: Is there an association between maternal factors and newborns' responses to pain and stress when</p>	<p>Setting: NICU of a university hospital in the interior of Sao Paulo, Brazil</p> <p>Population: Newborns meeting sample criteria in the NICU</p> <p>Sampling Method: Convenience</p> <p>Sample size: 42</p>	<p>Design: Descriptive study</p> <p>Level of Evidence: 6</p>	<p>Positive association: Mother's salivary cortisol levels and NFCS</p> <p>Inverse relationship: Newborns' HR and mothers' salivary cortisol levels</p> <p>Mothers' stress level effects the newborns' pain levels. Kangaroo Care encouraged self-regulation of the mothers' stress, thus leading to the decrease in newborns' pain levels.</p> <p>KMC decreased negative effect of depression and anxiety on response in infants.</p>	<p>Mothers play role in regulating pain and stress levels in their preterm infants by implementing Kangaroo Care</p>	<p>Not randomized</p> <p>Cross-sectional design cannot determine causal relationship</p> <p>Small amount of mother's suffering from depression and/or anxiety</p> <p>Study completed outside of U.S. (Brazil)</p>
Quantitative and Qualitative						
Primary						

	undergoing heel pricks?					
4) Akcan, E., Yiğit, R., & Atıcı, A. (2009). The effect of kangaroo care on pain in premature infants during invasive procedures. <i>The Turkish Journal of Pediatrics</i> , 51(1), 14-18. Retrieved from <a href="http://www.mesogeios.net">http://www.mesogeios.net</a>  Quantitative  Primary	Background: Infants in NICU have painful procedures performed on them.  Purpose Statement: “The aim of this study was to evaluate the effect of Kangaroo Mother Care (KMC), implemented by mothers, on pain in preterm infants before, during and after an invasive procedure.” (Pg 14 or 1)  Research question: How does Kangaroo Care implemented by mothers affect pain in preterm infants before, during, and after an invasive procedure?	Setting: Mersin University Research and Training Hospital  Population: Premature infants who met the sample criteria  Sampling Method: Convenience sampling with randomized group assignment  Sample size: 50	Design: Comparative, randomized, controlled study  Level of Evidence: 2	KMC PIPP score 1 minute after procedure: 7.0  Control group PIPP score 1 minute after procedure: 15.0  KMC PIPP score 2 minute after procedure: 4  Control group PIPP score 2 minute after procedure: 15.5  KMC PIPP score 3 minute after procedure: 4  Control group PIPP score 3 minute after procedure: 15.0  PIPP scores in KMC group were lower than PIPP scores in the control group at all times	KMC performed prior to and during painful procedure decreases pain responses in preterm infants. The recommendation is for KMC to be performed prior to, during, and following painful procedures.	Analysis of video recordings versus being present during KMC  Study completed outside of U.S. (Turkey)
5) Gao, H., Xu, G., Gao, H., Dong, R., Fu, H., Wang, D., Zhang, H., & Zhang, H. (2015). Effect of	Background: Infants are exposed repeatedly to painful procedures, which	Setting: Level III Neonatal Intensive Care Unit at a large teaching hospital in northeast China	Design: Randomized control trial	KMC significantly lowered preterm infants’ heart rate compared to incubator group	Doing Kangaroo Mother Care for 30 minutes reduces heel-stick pain	Baseline was not collected prior to the procedure  Mother’s chest expansion may

<p>repeated kangaroo mother care on repeated procedural pain in preterm infants: A randomized controlled trial. <i>International Journal of Nursing Studies</i>, 52, 1157-1165. Retrieved from <a href="http://dx.doi.org/10.1016/j.ijnurstu.2015.04.006">http://dx.doi.org/10.1016/j.ijnurstu.2015.04.006</a></p> <p>Quantitative Primary</p>	<p>can affect them negatively.</p> <p>Purpose Statement: "To test the effectiveness of repeated Kangaroo Mother Care on repeated heel-stick pain in preterm neonates." (Pg 1157 or 1)</p> <p>Research question: What is the effect of Kangaroo Mother Care on repeated heel-stick pain in preterm infants?</p>	<p>Population: Preterm infants less than 37 weeks gestational age</p> <p>Sampling Method: Convenience sampling with randomized group assignment</p> <p>Sample size: 80</p>	<p>Level of Evidence: 2</p>	<p>The duration of crying and facial grimacing in KMC were significantly shorter compared to the incubator group.</p>	<p>across at least three of these procedures.</p>	<p>affect grimacing scores in KMC</p> <p>Study completed outside of U.S. (China)</p>
<p>6) Choudhary, M., Dogiyal, H., Sharma, D., Gupta, B., Madabhavi, I., Choudhary, J., &amp; Choudhary, S., (2015). To study the effect of kangaroo mother care on pain response in preterm neonates and to determine the behavioral and physiological responses to painful stimuli in preterm neonates: A study from western</p>	<p>Background: Infants feel pain and it may alter their brain development</p> <p>Purpose Statement: To study the effect of Kangaroo Mother Care (KMC) on pain response in preterm infants.</p> <p>Research question: Does KMC affect the behavioral and physiological responses to pain</p>	<p>Setting: Neonatal Section of Department of Pediatrics, Umaid Hospital for Women and Child Health, India</p> <p>Population: Preterm infants &lt;37 weeks in this hospital and meeting inclusion criteria</p> <p>Sampling Method: Convenience</p> <p>Sample size: 140</p>	<p>Design: Single-blind crossover without randomization</p> <p>Level of Evidence: 3</p>	<p>KMC significantly reduced heart rate variability in preterm and very low birth weight infants</p> <p>KMC reduced mean drop in SpO<sub>2</sub> from baseline in preterm infants</p> <p>KMC reduced mean duration of cry by 36%</p> <p>KMC significantly reduced PIPP after heel lance procedure</p>	<p>KMC is an easy non-pharmacological intervention that should be implemented for treatment of procedural pain.</p>	<p>Not randomized</p> <p>Infants were used as both standard care control subjects and KMC subjects</p> <p>Study completed outside of U.S. (India)</p>

<p>Rajasthan. <i>Journal of Maternal-Fetal and Neonatal Medicine, Early Online</i>, 1-6. doi: 10.3109/14767058.2015.1020419</p> <p>Quantitative</p> <p>Primary</p>	<p>stimuli in preterm neonates?</p>					
<p>7) Mitchell, A., Yates, C., Williams, D., Chang, J., &amp; Hall, W. (2012). Does daily kangaroo care provide sustained pain and stress relief in preterm infants? <i>Journal of Neonatal-Perinatal Medicine</i>, 6, 45–52. doi:10.3233/NPM-1364212</p> <p>Quantitative</p> <p>Primary</p>	<p>Background: Many stressors, as well as painful procedures, increases infant risk for physiologic distress.</p> <p>Purpose Statement: “[To] determine whether stress in preterm infants, measured with salivary cortisol, decreases after five days of Kangaroo Mother Care (KMC) compared to five days of Standard Care (SC). 2. To determine whether kangaroo care provides sustainable pain relief beyond the period of skin-to-skin holding” (Pg 45 or 1)</p>	<p>Setting: NICU at an academic medical center</p> <p>Population: Infants &lt; 5 days old and were estimated to be 27–30 weeks gestational age weighing &lt; 1000 grams and on a form of respiratory support</p> <p>Sampling Method: Convenience sampling with randomized group assignment</p> <p>Sample size: 38</p>	<p>Design: Randomized, controlled</p> <p>Level of Evidence: 2</p>	<p>KMC had no effect on salivary cortisol levels.</p> <p>Salivary cortisol decreased from DOL 5 to 10 in KMC group and control group.</p> <p>Salivary cortisol may vary with age of infant.</p>	<p>Infants need non-pharmacological interventions, such as KMC, for painful, routine procedures, such as suctioning.</p>	<p>Cortisol levels were inadequate in some cases</p> <p>Unknown location</p>

	Research question: Does Kangaroo Care decrease stress and pain in infants during suctioning?					
8) Cong, X., Cusson, R., Hussain, N., & Kelly, S. (2012). Kangaroo care and behavioral and physiologic pain responses in very-low-birth-weight twins: A case study. <i>Pain Management Nursing</i> , 13 (3), 127-138. Retrieved from <a href="http://dx.doi.org/10.1016/j.pmn.2010.10.035">http://dx.doi.org/10.1016/j.pmn.2010.10.035</a>  Quantitative  Primary	Background: NICU preterm infants underwent 10-16 painful procedures per day.  Purpose Statement: “[To] determine effects on autonomic responses in preterm infants of longer KC and shorter KC before and during procedure compared to incubator care.” (Pg. 636 or 1)  Research question: How does longer and shorter Kangaroo Care affect the autonomic response to pain in preterm infants and how does it differ from standard incubator care?	Setting: Level III NICU in a university health center in NE US  Population: Infants born at 28 weeks 0 days to 32 weeks 6 days also were 14 days old who met inclusion criteria.  Sampling Method: convenience sampling with randomized group assignment  Sample size: 26	Design: Randomized crossover  Level of Evidence: 2	KMC 15 HR < IC HR  KMC 30 HR < IC HR  KMC 30 LF and HF < IC LF and HF	KMC should be used as a non-pharmacological intervention for painful procedures as it decreases pain responses more than IC. Longer KMC should be performed as it has larger benefits.	Data collection of 6 infants was terminated early resulting in only 20 infants completing the entire study.  True sample size < 25

<p>9) Kostandy, R., Ludington-Hoe, S., Cong, X., Abouelfetoh, A., Bronson, C., Stankus, A., &amp; Jarrell, J. (2008). Kangaroo care (skin contact) reduces crying response to pain in preterm neonates: Pilot results. <i>Pain Management Nursing</i>, 9(2), 55-65. doi: 10.1016/j.pmn.2007.11.004</p> <p>Quantitative Primary</p>	<p>Background: Crying is a common response to heel stick and can adversely affect an infant's physiologic stability</p> <p>Purpose Statement: "To test KC's effect on preterm infant's audible and inaudible crying responses to heel stick." (Pg. 55 or 1)</p> <p>Research question: Does Kangaroo Care reduce audible crying response to pain in preterm neonates?</p>	<p>Setting: Level II 13-bed NICU</p> <p>Population: Healthy mothers and healthy infants of single birth who met inclusion criteria</p> <p>Sampling Method: Convenience sampling with randomized group assignment</p> <p>Sample size: 10</p>	<p>Design: Prospective crossover w/ random assignment</p> <p>Level of Evidence: 2</p>	<p>Day 1: KMC mean 5.83 seconds &lt; IC mean 25.50 seconds during recovery</p> <p>Day 2: KMC mean 55.00 seconds &lt; IC mean 96.17 seconds during the procedure</p> <p>Cry times in KMC &lt; cry times in IC for both days.</p>	<p>Kangaroo Care has analgesic effect and NICU staff needs to educate families accordingly. KMC recommended.</p>	<p>Sample size &lt; 25</p> <p>Unable to complete blind study due to video recordings</p> <p>Results only applicable to pts that showed no inflammation at stick site.</p> <p>Unknown location</p> <p>Date prior to January 2009 (2008)</p>
<p>10) Olsson, E., Ahlsen, G., &amp; Eriksson, M. (2015). Skin-to-skin contact reduces near-infrared spectroscopy pain responses in premature infants during blood sampling. <i>Acta Paediatrica</i>, 1-5. doi:10.1111/apa.13180</p> <p>Quantitative</p>	<p>Background: Kangaroo Care is a method used in many NICUs, which can help reduce pain in neonates.</p> <p>Purpose Statement: "This study investigated if skin-to-skin contact could provide pain relief, measured with near-infrared spectroscopy (NIRS), during</p>	<p>Setting: Level III NICU</p> <p>Population: Infants 26-35 weeks gestation</p> <p>Sampling Method: Convenience</p> <p>Sample size: 10</p>	<p>Design: Crossover</p> <p>Level of Evidence: 2</p>	<p>Kangaroo Care successfully relieved pain in preterm infants during a venipuncture procedure as evidenced by lower hemodynamic changes in the infant's brain during skin-to-skin contact.</p>	<p>NICUs should implement skin-to-skin contact as a nonpharmacological pain relief method.</p>	<p>Sample size &lt; 25</p> <p>Not randomized</p> <p>One infant was on continuous positive airway pressure which may have skewed the infant's hemoglobin saturation</p> <p>Unknown location</p>

<p>Primary</p>	<p>venipuncture in premature infants.” (Pg. 1)</p> <p>Research question: Does skin-to-skin contact reduce near-infrared spectroscopy pain responses in premature infants during blood sampling?</p>					
<p>11) Cong, X., Ludington-Hoe, S., &amp; Walsh, S. (2011). Randomized crossover trial of kangaroo care to reduce biobehavioral pain responses in preterm infants: A pilot study. <i>Biological Research for Nursing</i>, 13(2), 204-216. Retrieved from <a href="http://dx.doi.org/10.1177/1099800410385839">http://dx.doi.org/10.1177/1099800410385839</a></p> <p>Quantitative</p> <p>Primary</p>	<p>Background: Infants are subjected to many painful procedures, the most common of which is heel sticks.</p> <p>Purpose Statement: “This crossover pilot tested KC effects on biobehavioral responses to heel stick in preterm infants (30–32 weeks’ gestational age, 2–9 days old) measured by Premature Infant Pain Profile (PIPP) and salivary and serum cortisol.” (Pg. 204 or 1)</p>	<p>Setting: Community-based Level II NICU in a three-city metropolis in Washington state</p> <p>Population: Preterm infants in the NICU meeting the criteria</p> <p>Sampling Method: Convenience sampling with randomized cross-over assignment</p> <p>Sample size: 28</p>	<p>Design: Prospective crossover design with permuted block randomization</p> <p>Level of Evidence: 2</p>	<p>30 minutes of Kangaroo Care was shown to relieve pain in infants by reducing the PIPP scores and biobehavioral pain indicators, which include salivary and serum cortisol levels</p>	<p>Thirty minutes of KMC before and during heel sticks are effective in reducing pain responses in infants; therefore, it is recommended.</p>	<p>Sample size &gt; 25, still small</p> <p>Insufficient power</p> <p>Limited age difference in infants of 30-32 weeks</p> <p>Infants used as standard care control subjects and KMC subjects</p>



	Research question: What effect does Kangaroo Care have on preterm infants' response when they receive a heel stick?					
12) Cong, X., Cusson, R., Walsh, S., Hussain, N., Ludington-Hoe, S., & Zhang, D. (2012). Effects of skin-to-skin contact on autonomic pain responses in preterm infants. <i>The Journal of Pain</i> , 13(7), 636-645. Retrieved from <a href="http://dx.doi.org/10.1016/j.jpain.2012.02.008">http://dx.doi.org/10.1016/j.jpain.2012.02.008</a>  Quantitative  Primary	Background: Preterm infants experience repeated heel sticks during their stay in the NICU, along with experiencing 10-16 painfully invasive procedures on average.  Purpose Statement: "The purpose of this case study was to describe pain responses in three study conditions: longer (30 minutes) Kangaroo Care (KC) before and throughout heel stick (KC30), shorter (15 minutes) KC before and throughout heel stick (KC15), and incubator care throughout heel stick (IC) in 28-week gestational age	Setting: N/A  Population: 28 and 6/7 week twins  Sampling Method: Convenience sampling with randomized group assignment  Sample size: 2	Design: Case study  Level of Evidence: 4	PIPP scores IC > PIPP scores KMC  Better autonomic nervous system balance was reported KMC versus IC	Kangaroo Care can reduce behavioral and physiological pain responses in preterm infants; therefore, it is recommended.	Sample size < 25  No description of setting provided  Unknown location  Case Study  Part of a larger randomized cross-over trial meaning that the duration of time in KMC was assigned

	twins” (Pg. 127 or 1)  Research question: What is the effect of longer and shorter Kangaroo Care on pain response?					
13) Castral, T., Warnock, F., Leite, A., Haas, V., & Scochi, C. (2008). The effects of skin-to-skin contact during acute pain in preterm infants. <i>European Journal of Pain</i> , 12, 464-471. doi:10.1016/j.ejpain.2007.07.012  Quantitative Primary	Background: Early exposure to painful experiences causes immediate and long-term changes in an infant’s brain.  Purpose Statement: “The aim of this study was to test the efficacy of mother and infant skin-to-skin contact during heel prick in premature infants” (Pg. 464 or 1)  Research question: How effective is mother and infant skin-to-skin contact in reducing pain during heel prick procedures in premature infants?	Setting: NICU of the Clinics Hospital at the Ribeirao Preto School of Medicine, University of Sao Paulo, Brazil.  Population: Infants $\geq 30$ weeks and $\leq 36$ weeks 6 days, APGAR of at least 6 at 5 minutes  Sampling Method: Convenience sampling with randomized cross over  Sample size: 59	Design: Randomized crossover  Level of Evidence: 2	Infants receiving skin-to-skin care showed lower facial action, heart rate, and crying.	Skin-to-skin is recommended to decrease procedural pain.	Duration of heel prick lasted longer for control group  HR baselines not take prior to completing procedures  Not randomized  Study completed outside of U.S. (Brazil)  Date prior to January 2009 (2008)

<p>14) Cong, X., Ludington-Hoe, S., McCain, G., &amp; Fu, P. (2009). Kangaroo care modifies preterm infant heart rate variability in response to heel stick pain: Pilot study. <i>Early Human Development</i>, 85, 561-567. doi: 10.1016/j.earlhumdev.2009.05.012</p> <p>Quantitative Primary</p>	<p>Background: Preterm infants are subjected to many painful procedures in the NICU, the most common of which is the heel stick. Painful procedures like this cause adverse effects in various organs.</p> <p>Purpose Statement: “To determine if KC results in improved balance in autonomic responses to heel stick pain than the standard method where infants remain in an incubator care (IC) for the heel stick” (Pg. 561 or 1)</p> <p>Research question: Does Kangaroo Care modify heart rate variability in infants during heel pricks?</p>	<p>Setting: Level II NICU in a non-profit community hospital in Washington state</p> <p>Population: Infants 30-32 weeks gestation, 2-9 days old, cared for in incubator, and English speaking mothers</p> <p>Sampling Method: Convenience sampling with randomized cross over</p> <p>Sample size: 14</p>	<p>Design: Randomized, crossover</p> <p>Level of Evidence: 2</p>	<p>Heart rate variability was less in infants experiencing KMC.</p>	<p>Infants’ responses to pain were more balanced in KMC versus IC; therefore, KMC is helpful in relieving pain in preterm infants.</p>	<p>Sample size &lt; 25</p> <p>Infants used as standard care control subjects and KMC subjects</p>
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<p>15) de Sousa Freire, N., Garcia, J., &amp; Lamy, Z. (2008). Evaluation of analgesic effect of skin-to-skin contact compared to oral glucose in preterm neonates. <i>Pain</i>, 139, 28-33. doi:10.1016/j.pain.2008.02.031</p> <p>Quantitative Primary</p>	<p>Background: Alternatives for pain relief such as nonpharmacological methods are important during minor procedures in preterm neonates.</p> <p>Purpose Statement: "...To assess the analgesic effect of Kangaroo Care compared to oral glucose on the response of healthy preterm neonates to a low-intensity acute painful stimulus." (Pg. 28 or 1)</p> <p>Research question: What effect does Kangaroo Care have on preterm neonates in a low-intensity acute painful stimulus compared to oral glucose?</p>	<p>Setting: N/A</p> <p>Population: Preterm neonates of both genders with a postmenstrual age of 28–36 weeks</p> <p>Sampling Method: Convenience sampling with randomized group assignment</p> <p>Sample size: 95</p>	<p>Design: Single blind randomization</p> <p>Level of Evidence: 2</p>	<p>There was a smaller variation in heart rate and oxygen saturation in KMC group</p> <p>A shorter duration of facial activity in KMC group</p> <p>A lower PIPP score was observed in KMC group</p>	<p>Ten minutes of skin-to-skin contact before the heel lancing procedure and also during the procedure produces an analgesic effect in preterm infants.</p>	<p>No description of setting provided</p> <p>Unknown location</p> <p>Date prior to January 2009 (2008)</p>
<p>16) Johnston, C., Filion, F., Campbell-Yeo, M., Goulet, C., Bell, L., McNaughton, K., Byron, J., Aita, M., Finley, G., &amp; Walker, C. (2008).</p>	<p>Background: In moderate preterm infants, skin-to-skin contact has shown to be effective in decreasing pain</p>	<p>Setting: Level 3 NICU's at the Montreal Children's Hospital, the IWK Health Centre, and Hôpital Ste. Justine in Canada</p>	<p>Design: Single-blind randomized crossover</p> <p>Level of Evidence: 2</p>	<p>Kangaroo Care was shown to be successful in relieving pain by reducing PIPP scores, recovery</p>	<p>In preterm infants between 28 and 32 weeks gestational age, maternal contact can facilitate a diminished response and also a quicker recovery</p>	<p>Study completed outside of U.S. (Canada)</p> <p>Date prior to January 2009 (2008)</p>

<p>Kangaroo mother care diminishes pain from heel lance in very preterm neonates: A crossover trial. <i>BioMed Central</i>, 8 (13), 1-9. doi:10.1186/1471-2431-8-13</p> <p>Quantitative</p> <p>Primary</p>	<p>response to heel lance.</p> <p>Purpose Statement: "The purpose of this study was to determine if Kangaroo Mother Care KMC would also be efficacious in very preterm neonates." (Pg. 1)</p> <p>Research question: Is KMC also effective in relieving pain during the heel lance in very preterm neonates?</p>	<p>Population: Infants born between 28 0/7 and 31 6/7 completed weeks post menstrual age (PMA) and met other criteria</p> <p>Sampling Method: Convenience sampling with randomized cross over assignment</p> <p>Sample size: 61</p>		<p>time, facial actions, and heart rate.</p>	<p>after a heel lance stick.</p>	
<p>17) Johnston, C., Campbell-Yeo, M., &amp; Fillion, F. (2011). Paternal vs maternal kangaroo care for procedural pain in preterm neonates. <i>Arch Pediatr Adolesc Med</i>, 165 (9), 792-796. Retrieved from <a href="http://dx.doi.org/10.1001/archpediatrics.2011.130">http://dx.doi.org/10.1001/archpediatrics.2011.130</a></p> <p>Quantitative</p> <p>Primary</p>	<p>Background: Recent reports have shown that Kangaroo Care has analgesic properties for procedural pain.</p> <p>Purpose Statement: "To test paternal Kangaroo Care (KC) vs maternal Kangaroo Care (KMC) to reduce pain from heel lance." (Pg. 792 or 1)</p> <p>Research question: Does paternal</p>	<p>Setting: Three university-affiliated level 3 NICU's</p> <p>Population: 28-36 week gestational age and met other criteria</p> <p>Sampling Method: Convenience sampling with randomized cross over assignment</p> <p>Sample size: 62</p>	<p>Design: Randomized crossover</p> <p>Level of Evidence: 2</p>	<p>30 seconds: KMC PIPP score &lt; paternal KC PIPP</p> <p>60 seconds: KMC PIPP score &lt; paternal KC PIPP</p> <p>90 and 120 seconds: no difference</p> <p>Return to HR baseline: KMC 204 seconds &lt; paternal KC 246 seconds</p>	<p>Kangaroo Care is more effective when provided by the mother compared to when provided by the father.</p>	<p>Unknown location</p> <p>Refusal rate was 22%</p> <p>Analysis was conducted based off of video recordings</p> <p>Sporadic loss of data across the session</p>

	Kangaroo Care have a different effect in reducing pain from heel lance compared to maternal Kangaroo Care?					
18) Nimbalkar, S., Chaudhary, N., Gadhavi, K., & Phatak, A. (2012). Kangaroo mother care in reducing pain in preterm neonates on heel prick. <i>Indian J Pediatr</i> , 80 (1), 6-10. doi:10.1007/s12098-012-0760-6  Quantitative  Primary	<p>Background: Increasing evidence suggests that repeated invasive surgeries such as heel pricks have long-term consequences.</p> <p>Purpose Statement: "To determine the effect of Kangaroo Mother Care (KMC) of small duration of 15 min in decreasing pain in preterm neonates between 32–36 wks 6 d on heel prick by a 26 gauge needle." (Pg. 6 or 1)</p> <p>Research question: What is the effect of KMC in decreasing pain caused by a heel stick in preterm neonates?</p>	<p>Setting: Neonatal Care Unit, Shree Krishna Hospital, Karamsad</p> <p>Population: Infants between 32 weeks and 36 weeks 6 days and who met the other criteria</p> <p>Sampling Method: Convenience sampling with randomized cross over assignment</p> <p>Sample size: 50</p>	<p>Design: Randomized controlled double masked crossover</p> <p>Level of Evidence: 2</p>	<p>HR changes during KMC were reduced significantly.</p> <p>Facial actions and behavior scores were also better in KMC condition.</p>	<p>KMC has stress reducing benefits and can reduce pain from heel stick procedures; therefore, KMC should be used to decrease the pain for a preterm receiving a heel stick.</p>	<p>Study completed outside of U.S. (India)</p> <p>Analysis of video recordings versus being present</p> <p>Infants used as standard care control subjects and KMC subjects</p>

<p>19) Ferber, S., &amp; Makhoul, I. (2007). Neurobehavioural assessment of skin-to-skin effects on reaction to pain in preterm infants: a randomized, controlled within-subject trial. <i>Acta Paediatrica</i>, 97, 171-176. doi:10.1111/j.1651-2227.2007.00607.x</p> <p>Quantitative Primary</p>	<p>Background: Preterm infants are sensitive to pain and stress and demonstrate some analgesic effects of sensory modalities, olfaction, touch and taste during painful procedures.</p> <p>Purpose Statement: "To assess the immediate and sustained effects of Kangaroo Care on reaction to pain of premature infants." (Pg. 171 or 1)</p> <p>Research question: What are the immediate and sustained effects of Kangaroo Care on premature infants' reaction to pain?</p>	<p>Setting: Large medical center in Northern Israel</p> <p>Population: Infants with gestational age of 30 weeks to 36 weeks plus 6 days and who had an Apgar score of 6 at 5 min.</p> <p>Sampling Method: Convenience sampling with randomized group assignment</p> <p>Sample size: 59</p>	<p>Design: Controlled, within-subject randomized study</p> <p>Level of Evidence: 2</p>	<p>Kangaroo Care led to a decrease in stressful neurobehavioral responses, such as motor disorganization and muscle extension, after heel lance procedures and a positive increase in attention responses.</p>	<p>Kangaroo Care lessens painful reactions due to blood tests in premature infants; therefore; it is recommended.</p>	<p>Study completed outside of U.S. (Israel)</p> <p>Date prior to January 2009 (2007)</p>
<p>20) Lyngstad, L., Tandberg, B., Storm, H., Ekeberg, B., &amp; Moen, A. (2014). Does skin-to-skin contact reduce stress during diaper change in preterm infants? <i>Early Human</i></p>	<p>Background: In preterm infants who are subjected to minor painful procedures, skin-to-skin contact can reduce pain response.</p> <p>Purpose Statement: "The purpose of this</p>	<p>Setting: NICU at Drammen Hospital in Norway</p> <p>Population: Preterm infants, gestational age between 28 and 34 weeks</p> <p>Sampling Method: Convenience</p>	<p>Design: Randomized crossover pilot</p> <p>Level of Evidence: 2</p>	<p>Kangaroo Care significantly lowers stress levels, including heart rate, oxygen saturation, and skin conductance, during diaper changes compared to diaper changes taking place</p>	<p>Skin-to-skin contact should be used when changing diapers since it lowers the stress level of the preterm baby.</p>	<p>Sample size &lt; 25</p> <p>Study completed outside of U.S. (Norway)</p>

<p><i>Development</i>, 90, 169-172. Retrieved from <a href="http://dx.doi.org/10.1016/j.earlhumdev.2014.01.01">http://dx.doi.org/10.1016/j.earlhumdev.2014.01.01</a></p> <p>Qualitative</p> <p>Primary</p>	<p>study was to investigate whether diaper change induces stress and if skin-to-skin contact could reduce such stress, measured by changes in skin conductance.” (Pg. 169 or 1)</p> <p>Research question: Can skin-to-skin contact reduce stress that could possibly occur from a diaper change?</p>	<p>sampling with randomized cross over assignment</p> <p>Sample size: 19</p>		<p>in a crib or incubator.</p>		
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