

Is Kangaroo Care an Effective Intervention to Reduce Heel Stick Pain Response in Preterm Infants?

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Abstract

Background: Approximately 15 million babies are born prematurely each year. Preterm infants admitted to the NICU undergo painful procedures (a heel stick for blood monitoring is most common). Experiences of pain or stress in very early life are associated with negative effects that may endure throughout the lifespan. Pharmacological interventions (e.g., opioids, topical analgesics) have shown limited effectiveness against procedural pain in preterm infants; therefore, it is important to investigate non-pharmacological approaches to pain relief.

Objective: To evaluate the effectiveness of Kangaroo Mother Care (KMC) in reducing heel stick pain response in preterm infants.

Methods: We conducted a structured literature review of the databases PubMed and SCOPUS using the keywords: kangaroo mother care, skin-to-skin contact, procedural pain response, pain, heel prick and preterm infants. Exclusion criteria: non-English language studies, systematic reviews, meta-analyses, and studies including term infants, infants with additional conditions, and KMC as an adjunctive therapy.

Results: Out of nine relevant studies, four studied Premature Infant Pain Profile (PIPP) scores and found significantly reduced heel stick pain responses in infants receiving KMC. Four other studies focused primarily on duration of cry (DOC), and found that DOC was significantly shorter with KMC intervention. One study analyzed both measures and found that KMC was associated with significant decreases in PIPP scores and DOC.

Conclusion: The evidence supports the use of KMC to reduce heel stick pain responses in preterm infants. Further research is needed to evaluate effectiveness of KMC for other acute pain procedures, and infants with additional conditions.

Background

An infant is considered premature when born at 37 weeks gestation or less, very premature if born before 32 weeks, and extremely premature if born before 28 weeks (Jepsen, 2006, p. 1). The pain response in neonates is extremely important to consider, since it has been well documented that infants experiencing repeated, unrelieved pain can be at risk for serious consequences (Kenner, 2004, 199). Short-term consequences include decreased oxygen saturation and increased heart rate (which puts a dangerous amount of stress on the cardiovascular system). Long-term consequences include decreased sensitivity to pain in childhood, numerous physical complaints, and structural changes in the central nervous system, most notably the brain and spinal cord (Kenner, 2004, p. 199). Immediately after birth, most infants typically undergo a few painful routine procedures, but premature or acutely ill infants experience significantly more painful procedures (e.g. endotracheal suctioning, intubation, insertion of a venous catheter, and heel sticks) (Kenner, 2004, p. 199-200). A 1995 study found a negative correlation between gestational age and number of painful procedures, meaning that the youngest babies in the most critical condition were most likely to be exposed to repeated pain, with some experiencing hundreds of painful procedures during their hospital stay (Kenner, 2004, p. 200).

As a result, pain relief for neonates (particularly premature neonates) has become a growing focus of study. Pharmacological methods have demonstrated limited success, however non-pharmacological interventions, such as kangaroo mother care, have demonstrated greater success (Twycross, 2008a, p. 78). Kangaroo mother care involves placing the infant (wearing just a diaper and hat) upright or diagonally on the bare chest of either parent, with the parent and child covered in a blanket or shawl (Lumsden, 2010, 97).

Standardized measurements of neonatal pain responses are crucial in order to evaluate and compare effectiveness of pain management techniques. The two most accepted methods of measuring pain response in premature neonates are duration of cry, and the Premature Infant Pain Profile (PIPP). In just a one-minute assessment, PIPP evaluates the sum of observed expressions of various physiological, behavioural, and contextual indicators, each on a four-point scale (0, 1, 2, 3) (Twycross, 2008b, p. 101). PIPP

includes gestational age, behavioural state, heart rate, oxygen saturation, and facial activity (brow bulge, eye squeeze, and nasolabial furrow); a score of 6 or less indicates minimal to no pain, while scores greater than 12 indicate moderate to severe pain (Twycross, 2008b, p. 101).



Figure 1: PRISMA Flowchart for Study Inclusion

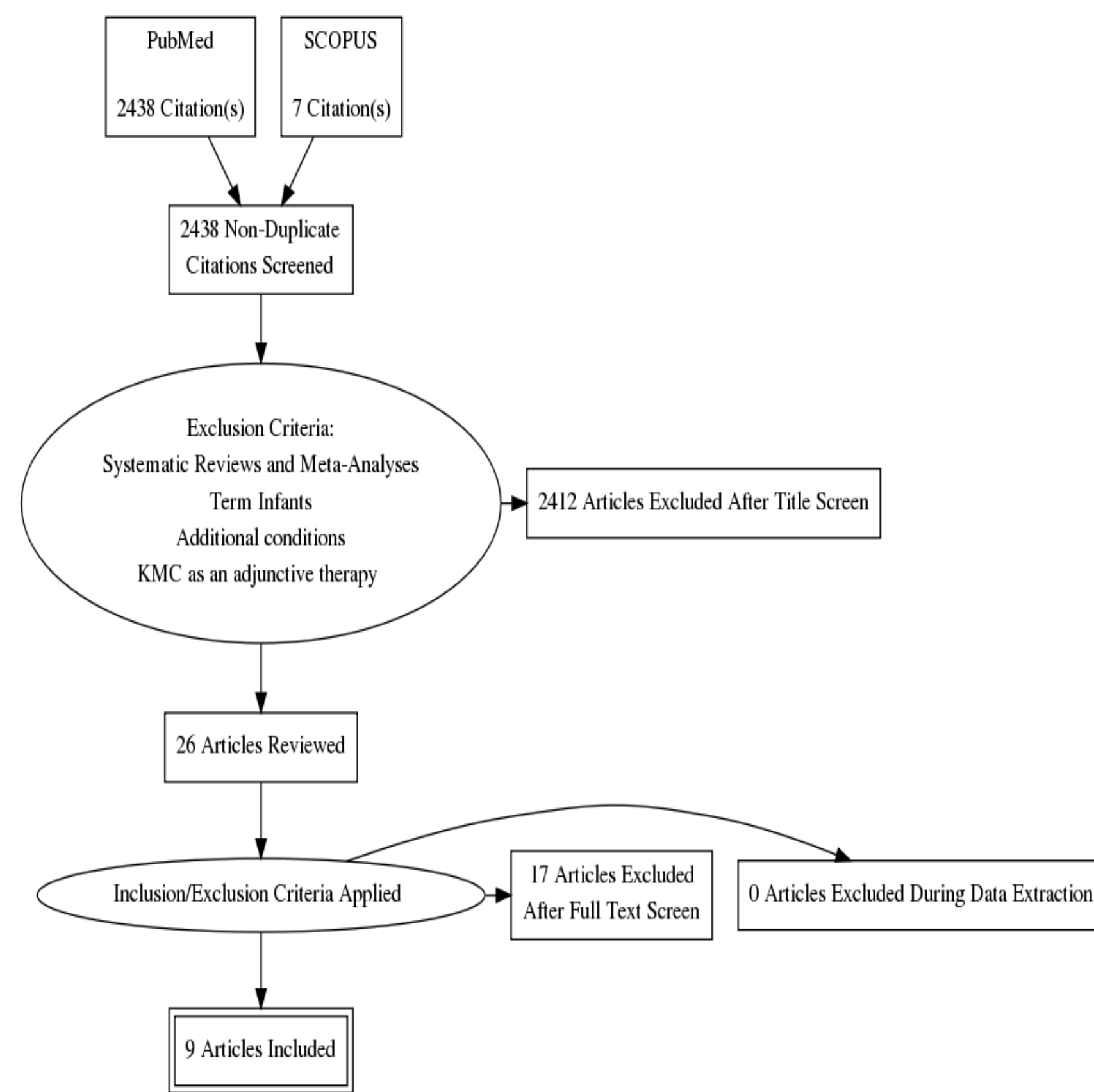


Figure 2: Results of Literature Review

Study	Population	Intervention	Comparison	Outcomes
Effect of repeated Kangaroo Mother Care on repeated procedural pain in preterm infants: A randomized controlled trial.	n= 75 preterm infants	Randomly assigned to incubator or KMC Incubator group infants were placed in the incubator at 30-40 degree incline to resemble the KMC position 30 minutes before heel prick blood collection and remained in the incubator during recovery period KMC infants were given KC for 30 minutes before heel prick, during heel prick and in the recovery period	Duration of crying across the blood collection phase and recovery phase Duration of grimacing during the blood collection and recovery phase Change in heart rate	ANOVA results showed statistically significant lower heart rate in the KMC babies during blood collection and recovery (p<0.0001) ANOVA results also showed statistically significant shorter duration of crying and facial grimacing in the KMC infants (p<0.0001)
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 Rajasthan.	n=140 preterm infants	infants were given a heel prick under aseptic conditions After a 24 hour period during which KMC was given, the infant was given another After a 7 day period during which KMC was given, the infant was again separated from its mother and given a heel prick	Premature Infant Pain Profile (PIPP), Duration of Cry	Paired- t-test showed KMC resulted in significantly lower PIPP scores at 60 seconds after heel prick (p<0.01) but not at 120 seconds after heel prick, compared to without KMC According to paired t-test, KMC resulted in statistically significant reduction in duration of cry for infants with a gestational age of 30-34 weeks and a birth weight of 1.5-2.5 kg (p<0.01) Effect of 7 days of KMC on duration of cry was statistically insignificant in all neonates
Effect of Kangaroo mother care in reducing pain due to heel prick among preterm neonates: a crossover trial	n= 100 preterm neonates	Control group: PIPP assessment was taken 15 minutes before heel prick, and repeated 15 and 30 minutes after KMC: Heel prick was scheduled 15 minutes after the initiation of KMC and PIPP was measured as with control group	PIPP	Mean PIPP scores were significantly less in KMC infants, at 15 and 30 minute post heel prick, compared to controls (p=0.001) Mean PIPP difference between baseline and 30 minutes was significantly lower in KMC (p=0.04) Mean HR was not significantly different between 2 groups
The effect of kangaroo care on pain in premature infants during invasive procedures	n = 50 preterm infants	Randomly assigned to incubator or KMC KMC group: vein/heel blood sample taken at 30th minute in KMC position. (KMC babies continued to be held in KMC position for 10 additional minutes) Incubator group had samples taken when quiet in their incubator	PIPP Behavioural responses to pain recorded with video camera	PIPP scores for KMC infants were significantly lower at each measurement at 1, 2, and 3 minutes following the painful procedure (p<0.001, p=0.001, p=0.047). PIPP scores soon after the invasive procedure were significantly lower in the KC group compared to the control group (p<0.001 and p=0.023 respectively).
The effects of skin-to-skin contact during acute pain in preterm newborns	n = 59 preterm infants	Randomly assigned to skin-to-skin group or regular crib/incubator care. 4 measures collected in seven data collection time points: baseline, treatment, heel cleaning, heel squeeze, wound compression, and recovery.	Four Measures: NFCS (Change in Facial Action) Sleep-wake (Behavioural State) Infant cry Heart rate	Babies in skin-to-skin group had significantly lower NFCS scores for heel prick (p = 0.023) and heel squeeze (p = 0.001), a more stable sleep-wake cycle (with 71.0% of treatment infants and 21.4% of control infants in deep sleep), a shorter duration of cry (p = 0.024, reduction of 37.41%), and lower mean HR values (but with no statistically significant differences between the 2 groups during the 7 phases).
Kangaroo Care (Skin Contact) Reduces Crying Response to Pain in Preterm Neonates: Pilot Results	n = 10 preterm infants	Randomly assigned to two sequences: SEQUENCE A Day 1: heel stick after 30 minutes in KMC, and Day 2: heel stick in incubator. SEQUENCE B Opposite of Sequence A Videotapes assessed at: baseline, heel warming, heel stick and recovery phases	Audible crying time Inaudible crying time	Crying time was less in KMC condition during the heel stick (p = 0.001) and recovery (p = 0.01) phases, regardless of sequence.
Skin-to-Skin Contact Analgesia for Preterm Infant Heel Stick	n = 24 preterm infants	Randomly assigned to one of two groups. SEQUENCE A 3 hours of skin-to-skin contact with a heel stick in skin-to-skin; followed by 3 hours in an incubator with a heel stick in the incubator. SEQUENCE B Opposite of Sequence A.	Heart rate Respiratory rate, Oxygen saturation, Cry duration Behavioural state	Heart rate (p = 0.042) and crying responses (p = 0.01) to pain were significantly reduced in skin-to-skin contact and skin-to-skin heel stick group; skin-to-skin infants slept more deeply during skin-to-skin contact during baseline (p ≤ 0.04) and during post-stick phase (p ≤ 0.05).
Kangaroo care is effective in diminishing pain response in preterm neonates	n=74 preterm infants	Randomly assigned to incubator or KMC commencing 30 minutes before the heel prick	PIPP	PIPP scores were significantly lower across the first 90 seconds after the heel prick (0.002<p<0.4)
Kangaroo mother care diminishes pain from heel lance in very preterm neonates: a crossover trial	n=61 preterm infants	Randomly assigned to KMC or incubator KMC was commenced 15 minutes before heel prick and continued throughout	PIPP Time to return to baseline (heart rate return to baseline)	PIPP scores at 90 seconds post lance were significantly lower in the KC condition (p<0.001) but not at 30, 60 or 120 seconds post lance Time to return to baseline heart rate following the prick was significantly lower in KC condition (p<0.000)

Methods:

A structured literature of the databases PubMed and SCOPUS was conducted using the following search strategy: Kangaroo care OR skin to skin AND preterm OR premature AND pain OR heel lance. This strategy yielded 2438 PubMed results and 7 SCOPUS results. After removing 7 duplicates, 2438 articles were screened based on their titles. Exclusion Criteria included: systematic reviews, meta-analyses and studies looking at term infants, infants with additional conditions (besides prematurity) and KMC as an adjunctive therapy. After the title screen, 26 articles were reviewed. Of the articles reviewed, 17 were excluded because they were systematic reviews (n=4), used KMC as an adjunctive therapy (n=2), looked at an intervention other than KMC (n=4), looked at outcome measures other than pain response (n=2), looked at a procedure other than a heel prick (n=1), looked at maternal outcomes (n=1) or looked at term babies (n=3). The remaining 9 studies were included in analyses.

Summary of Results:

In the studies that looked at behavioural pain responses (crying, facial actions, sleep patterns):

- All 4 found a statistically significant effect with KMC compared to controls.

In the studies that looked at physiological pain responses (HR, time to return to baseline):

- 2 found a statistically significant difference in HR between KMC and controls and 1 found a significant difference in the time to return to baseline
- 2 found that was no statistical difference in HR between KMC and controls

In studies looking at PIPP (a composite behavioural and physiological score):

- All 5 found a significant difference between KMC groups and controls

Discussion

Results:

In every study that looked at behavioural responses to heel prick pain, kangaroo mother care was found to have a significant effect on reducing experienced pain. In the five studies that looked at physiological response, it was found that kangaroo mother care had a significant effect in three of the studies, compared to two studies that found no effect. It is therefore possible that kangaroo mother care has more of an effect on behavioural pain responses than physiological pain responses.

Strength of the Studies included:

Of the nine studies included in the analysis, six utilized a crossover design, which was an appropriate design for the intervention. The same infants received two heel pricks in both the standard and kangaroo mother care condition, and the pain responses from each condition were compared. As a result, the infants acted as their own controls, preventing baseline differences between intervention and control groups. The remaining studies were case-control studies and randomly assigned infants to either the control or intervention group. Of these studies, two found no significant baseline differences between the two groups, which means that differences in pain responses could more reliably be attributed to KMC treatment.

Limitations of the studies included:

Of the studies included, 2 were pilot studies and therefore results are only preliminary. One of these studies required 26 subjects to detect moderate difference in crying time, but funding only permitted 10 subjects. These small sample sizes limit generalizability of results, and increase the probability that results are due to chance. One of the case-control studies found that the KMC group had significantly lower APGAR scores at baseline and that the duration of heel stick was significantly longer in the control group. These are potential confounders that could have affected the results. In addition, there was a lack of consistency in pain assessment measures between some of the studies; some used a complete PIPP assessment, others used a partial PIPP assessment, and others focused on solely duration of cry.

Limitations of our own work:

Our literature review only included two databases and restricted the search to only studies written in English. It is therefore possible that relevant literature was missed. In studies that looked separately at the component measures of PIPP scores (such as oxygen saturation) in addition to the composite PIPP scores, we only included the overall PIPP scores in our analysis. It is therefore possible that the individual component scores were not statistically significant although the overall PIPP score was.

Conclusion

Kangaroo mother care is a simple, inexpensive, non-pharmacological intervention to reduce heel prick pain responses in preterm infants. Since there are many negative and enduring effects of untreated pain in neonates, it should be used more frequently in clinical settings. More research is warranted to investigate the effectiveness of kangaroo mother care as an intervention for other procedural pain, for sustained rather than acute pain, and in infants with other conditions.

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