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Effectiveness of parental education about pain in the neonatal period on knowledge, attitudes, and practices: A systematic review and meta-analysis

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ABSTRACT

Background: Despite the availability of effective, safe, and feasible pain management strategies, infant pain remains undertreated. Parents can play a key role in advocating for or delivering pain management strategies if they are educated. To date, a quantitative synthesis of the effectiveness of parental education about pain management in the neonatal period has not been performed.

Objective: To systematically review the effectiveness of parental education during the neonatal period on pain management in infancy.

Methods: MEDLINE, EMBASE, PsycInfo, CINAHL, and the Cochrane Library were searched for relevant randomized controlled trials (RCTs) and non-randomized trials (NRTs) that evaluated parental education with respect to pain management during the neonatal period in any setting from inception to February 2021. Screening of article titles and abstracts and data extraction were performed in duplicate. The risk of bias was assessed using the Cochrane Risk Bias Tool 2.0 and the Risk of Bias in Non-randomized Studies of Interventions for RCTs and NRTs, respectively. As per the GRADE methodology, critically important and important outcomes were identified. Critically important outcomes included utilization of pain management strategies and infant pain. Important outcomes included parental knowledge about pain mitigation strategies, parental attitudes, compliance with painful procedures, procedure outcomes, and safety. Data were combined and presented as relative risk (RR) or mean or standardized mean difference (MD or SMD) with 95% confidence interval (CI).

Results: Of the six studies eligible for inclusion, four studies were RCTs and two studies were NRTs. Written information and/or video were used to deliver parental education during the neonatal period in hospital settings in all studies. Four studies (two RCTs and two NRTs) reported on critically important outcomes. The risk of bias was low for the two RCTs and moderate to serious for the two NRTs. Utilization of pain management strategies was assessed for heel lance in the first 48 hours of life in two studies and for vaccine injection at 2 to 6 months of life in two studies. Higher utilization rate for pain management strategies was reported in the pain education group in three studies (RR 1.15, 95% CI 1.04, 1.26; N=2712). There was no difference in the mean number of pain management strategies used in one NRT tracking utilization tracking utilization as continuous data (MD 0.20, 95% CI –0.01, 0.41; N=178). Parent-reported infant pain scores were lower in the pain education group in one RCT (MD –0.16, 95% CI –0.27, –0.06; N=1615). The quality of evidence for the outcome of utilization of pain management strategies was very low while for the outcome of infant pain the quality of evidence was moderate. Five studies (3 RCTs and 2 NRTs) reported on important

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outcomes. The risk of bias was low for two RCTs and high for one RCT and moderate to serious for the two NRTs. Parental knowledge about pain management strategies (SMD 0.54, 95% CI 0.26, 0.82), parental confidence in their ability to manage pain (SMD 0.24, 95% CI 0.14, 0.34), parental satisfaction with education (MD 1.18, 95% CI 0.84, 1.52) and parental satisfaction with pain management (RR 1.05. 95% CI 1.01, 1.08) were increased in the pain education group. None of the included studies reported on procedural outcomes. No adverse events with the pain education nor the use of pain management interventions were reported in one study.

Conclusions: Parental education in the neonatal period was effective in increasing utilization of pain management strategies during painful procedures. Reduction of pain in infants is based on one study of moderate quality. Furthermore, parental education increased parental knowledge about pain management strategies, confidence in their ability to manage infant pain, and satisfaction with the education and pain management. Parental pain education should be incorporated into postnatal care.

Keywords: Infant; Knowledge; Pain management; Parental education; Systematic review.

Healthy neonates may be subjected to several painful procedures as part of their care in the first 24 to 48 hours of life, including intramuscular injection of vitamin K, heel lancing for newborn screening, bilirubin assessment, and glucose monitoring (1,2). Furthermore, thousands of infants are admitted to neonatal intensive care units (NICUs) in Canada and around the globe (3). On average, hospitalized neonates endure 7 to 17 painful medical procedures per day as part of routine care (2,4,5). It is recommended that all infants receive multiple intramuscular immunizations during the first year of life (1,2). These procedures result in considerable pain and suffering for infants. Early and repeated exposure to untreated pain is associated with sub-optimal brain development, including reduced cortical grey matter, white matter and thalamic volume loss, alterations in pain responsivity, and motor and cognitive functioning (6–14). Therefore, it is clinically important to prevent and treat pain.

Procedural pain management in infants involves the use of pharmacological and non-pharmacological strategies. However, due to the potential for serious adverse effects, pharmacological strategies are reserved for moderate to severely painful procedures (15). For minor tissue-damaging needle pain, such as heel lance and intramuscular injection, non-pharmacological strategies are recommended (16). Breastfeeding, sucrose, and skin-to-skin care are regarded as the most effective non-pharmacological strategies, while other strategies, such as non-nutritive sucking (NNS), holding, pacifier, and swaddling are considered adjunct strategies and their effectiveness have been demonstrated in several Cochrane reviews (17–19). Despite the effectiveness of various pharmacological and non-pharmacological strategies, recent studies show that they are underutilized around the world, and that somewhere between 50% and 80% of infants do not routinely receive evidence-based pain management (2,20–23).

Pain management practices are typically overseen by health care professionals (HCPs). Evidence-based pain guidelines have long advocated for parents to be involved in infant pain management (24,25). In addition, the model of care espoused globally is 'family-centred care' (26), which is consistent with parents being key participants in their infant's care, including pain management. A meta-synthesis evaluating factors influencing parental participation in their infant's pain management found that infant pain was a source of parental psychological stress and anxiety (27). Parents desired knowledge about infant pain and pain management strategies (27). Separately, it has been demonstrated that parents would like to be involved in providing comfort to their infants during painful procedures (28,29). Lack of parental knowledge about effective pain mitigation strategies is one of the barriers to parents participating in or advocating for their infant's pain management (30–33).

A published systematic review of parent education on a variety of topics (e.g., infant care and safety, infant behaviour, sleep, breastfeeding) in the postnatal period reported improvements in parental knowledge and confidence, and diminished stress and anxiety (34). Education was delivered using a variety of formats, including verbal, written, or video either individually or in a group setting. With regard to pain management in childhood (0 to 18 years), there have been one scoping and two systematic reviews of the effectiveness of parent education (35–37). Together, these reviews showed that parental education improved knowledge, self-efficacy, increased involvement in pain management, and reduced parental stress during painful procedures (35–37). Parents accepted a variety of educational formats, including videos, booklets, pamphlets, and power point presentations (36).

Currently, there is no systematic review and meta-analysis of the effectiveness of parental education relating to pain management in the neonatal period specifically. The objective was to synthesize the results from studies evaluating the effectiveness of parental education about infant pain on (i) parental knowledge, attitudes, and practices and (ii) infant pain.

METHODS

The framework for this systematic review and meta-analysis followed the Grading of Assessments, Recommendations, Development and Evaluation (GRADE) (38) and Cochrane methodologies (39). The protocol was registered with PROSPERO (registration # CRD42021222944), the international prospective register for systematic reviews (https://www.crd.york.ac.uk/prospero/). The Preferred Reporting Items for Systematic Reviews and Meta-analysis (PRISMA) guide was used for reporting the results (40).

Inclusion and exclusion criteria

We included published reports of randomized and non-randomized controlled clinical trials (RCT and NRTs) that evaluated parental education regarding pain management during the neonatal period. We excluded conference proceedings or abstracts, review articles, surveys, letters, commentaries, and editorials. Parents of newly born neonates could receive education in any setting (e.g., postnatal hospital ward, NICU), and with any format (e.g., pamphlet, face to face [individually or group settings], video, computer, social media). Education could

be delivered either passively (information given to parents to read/watch or included in information packages routinely given to parents without drawing any attention to the information) or actively (bringing attention to the education information or by providing information and engaging parents in a formal teaching session). Comparators included no education or education related to neonatal care other than pain (e.g., postnatal discharge information, neonatal intensive care package).

Outcomes of interest

Consistent with the GRADE framework, the authors selected (i) critically important and (ii) important outcomes from the perspective of parents, infants undergoing painful procedures, and HCPs performing these procedures based on the methodology used in our knowledge synthesis of vaccination pain management (41). Critically important outcomes included (1) utilization of pain management strategies (overall utilization of any pain management strategy and utilization of individual pain management strategies [e.g., breastfeeding, topical anesthetic] during a painful procedure [e.g., heel lance, vaccine injection]) and (2) infant pain intensity using a behavioural or physiological measure or assessed using accepted approaches (e.g., numerical rating scale [0 to 10]) (42). Important outcomes included (1) parental knowledge about pain mitigation strategies; (2) parental attitudes, including (a) confidence in their ability to manage procedural pain (e.g., heel lance pain, vaccine injection pain), (b) satisfaction with pain education, (c) satisfaction with pain management in their infant, (d) stress associated with pain education (e.g., watching the video, reading the pamphlet), and (e) stress watching the painful procedure; (3) compliance with painful procedures (e.g., vaccination); (4) procedure outcomes (duration of procedure, success rate of procedure); and (5) safety (any adverse events associated with pain interventions).

Search strategy

The search strategy was designed in conjunction with an information specialist (E.U.). The following databases were searched: MEDLINE (Medline-in-Process, Medline Epub Ahead of Print), EMBASE, APA PsycInfo (OvidSP); CINAHL (EBSCOHost); and Cochrane (Wiley) from inception to February 2021. We used both subject headings and text word terms in a two-pronged approach to the topic. Part one was to search for articles on pain AND specific interventions AND parental education AND infants AND study designs and was limited to English and French articles given the large body of literature. Part two was to search for articles on pain AND specific technology OR knowledge translation (KT) AND infants without study design search terms. Target search words included 'parents', 'pain', 'pain management', 'education', 'social media', 'immunization', 'heel lance', 'procedure', 'infant', and 'neonatal intensive care'. No language restrictions were applied. The specifics of the search terms used are available in Supplementary Appendix 1.

Study selection and data extraction

The titles and abstracts of retrieved citations were imported into an EndNote library (X9.1, 2018) and screened by two reviewers (C.M., N.C.). Full-text review was conducted for articles that potentially met the inclusion criteria. Reference lists of included articles were screened to identify additional articles. Discrepancies were resolved by involving a third team member (V.S.). Data extraction was performed independently by two reviewers (C.M., N.C.) on a pre-specified data collection form and included author, country, year of publication, study design, patient characteristics, inclusion and exclusion criteria, details of interventions and comparators, and any of the critically important or important outcome measures mentioned above. For utilization of pain strategies, analyses included use of any evidence-based strategies as well as individual strategies (e.g., breastfeeding, skin-to-skin contact). Summary statistics (e.g., means, standard deviation, proportion) and sample sizes were extracted for the critically important and important outcomes. If a study provided multiple arms for >1 analysis, the sample size for the control group was divided so as not to double-count participants within the analysis. The extracted data were verified by a third reviewer (V.S.) and any discrepancies were resolved by consensus.

Unique identifiers were assigned to the included studies for use in tables and the software programs (RevMan, GRADEprofiler [GRADEpro]) using the following notations: First Author, Year of Publication (e.g., Taddio 2014). If studies contributed to multiple analysis then (#) was added to enable their discernment (e.g., Taddio 2014(1)). If the same author published >1 study in the same year, then a lowercase letter was added for subsequent articles (e.g., Taddio 2014a(1)).

Assessment of risk of bias

Two reviewers (VS, NC) assessed the methodological quality of included studies. The Cochrane Risk of Bias Tool Version 2.0 (https://methods.cochrane.org/risk-bias-2) and Risk of Bias for Non-randomized Studies of Interventions-I (https://methods.cochrane.org/methods-cochrane/robins-i-tool) were used for RCTs and NRTs, respectively (43,44). For RCTs, the risk of bias was assessed under the following five domains: randomization process, deviations from the intended interventions, missing outcome data, measurement of the outcome, and selection of the reported results. Each domain was categorized as low/high/some concerns for risk of bias. Then an overall risk of bias judgement with similar categorization was made based on the domain with the worst score. For NRTs, the risk of bias was assessed in the following domains: confounders, selection of participants in the study, classification of interventions, deviations from intended interventions, missing data, measurement of outcomes, and selection of the reported result. Each of the domains was scored as low/moderate/serious/critical/no information and then an overall risk of bias judgement was made using the worst score in any of the domains.

Data synthesis and statistical analysis

Continuous data were combined using the mean difference (MD) and standardized mean difference (SMD) with 95% confidence interval (CI) while dichotomous data were combined using relative risk (RR) and 95% CI from studies eligible for meta-analysis. The risk difference (RD) and 95% CI were also calculated for dichotomous outcomes with significant results. A random-effects model was used for all comparisons of interest. Continuous data with different scales for a particular outcome were converted from 0 to 10. All analyses were performed using Review Manager Version 5.3 (Cochrane Collaboration,

Copenhagen, Denmark). Clinical heterogeneity was assessed by taking note of the differences among studies in regard to the following variables: age group (participants), type of educational format (e.g., verbal, pamphlet, video), delivery of intervention (e.g., in person (active), part of the discharge package (passive) and comparator group, type of procedure (e.g., heel lance, vaccine injection pain), lag time between education and the procedure (e.g., hours, weeks, months), outcome assessment methods, and any other study-specific design features. Statistical heterogeneity was assessed using the χ^2 and I^2 statistics. For the I^2, the following categorization was used: 0% to 40% may not be important, 30% to 60% may be moderate, 50% to 90% may be substantial, and 75% to 100% may be considerable (39). If there were >10 studies for comparison for any outcome, a funnel plot was generated to assess publication bias. Additional analyses were carried out based on the quality of the study (e.g., type of study design or removal of data from a study with serious methodological weaknesses).

The quality of evidence from outcomes across studies was assessed as per the GRADE methodology. The assessment was based on five factors: risk of bias, inconsistency, indirectness, imprecision, and publication bias for RCTs and large effect, dose-response and all plausible confounding and bias for NRTs. The quality of evidence was assigned into one of four categories: high, moderate, low, and very low. The GRADEpro software was used to generate evidence profiles and a summary of the findings table. Judgements pertaining to the evaluation of the quality of evidence were recorded for the critically important outcomes of utilization of pain management strategies and infant pain intensity.

RESULTS

The search yielded 11,080 references of which 4668 were duplicates. Full texts were reviewed for 83 of the remaining 6412 references of which six met inclusion criteria (Figure 1).

Characteristics of the included studies are reported in Table 1. Four of the six evaluated the impact of hospital-based parental education coupled with a skin-breaking procedure (42,45–47) on parental knowledge and utilization of pain strategies, while two studies evaluated the impact of hospital-based parental education on knowledge and attitudes only (48,49). Four of the included studies were RCTs (42,46,48,49), one was a controlled before and after study (47), and one was a NRT (45). In five studies, parental education was provided on the postnatal ward (mother–baby unit) (42,45–47,49), while in one study education was provided in the NICU (48). Only one study (42) evaluated the impact of parental education on infant pain intensity.

Parents were shown the 'Be Sweet to Babies' video by a research assistant in the studies by Korki de Candido et al. (NRT) and Lavin Venegas et al. (RCT) (45,46). In both studies, heel lance was performed within 24 to 48 hours of the education. The 'Be Sweet to Babies' video contained information on the use and effectiveness of breastfeeding, skin-to-skin care, and sweet-tasting solution (e.g., sucrose or glucose). In addition, in the NRT by Korki de Candido et al. (45), mothers received a companion pamphlet with identical information about pain management as in the video. In the RCT by Lavin Venegas et al. (46), participants (both groups) received usual care in accordance with the hospital pain assessment and management and sucrose administration policy. In two of the three included studies conducted by Taddio et al. (47,49), educational information was based on the 3P's describing pharmacological (topical anesthetics, sucrose), physical (breastfeeding, holding, pacifier), and psychological interventions (deep breathing for parent, distraction technique) pamphlet. In the first study, parental education was provided passively (inclusion of 'The 3P's of Helping Your Baby during Vaccination' pamphlet in the postnatal information package at discharge without drawing attention to the parents) (47) using a pre- and post-implementation study

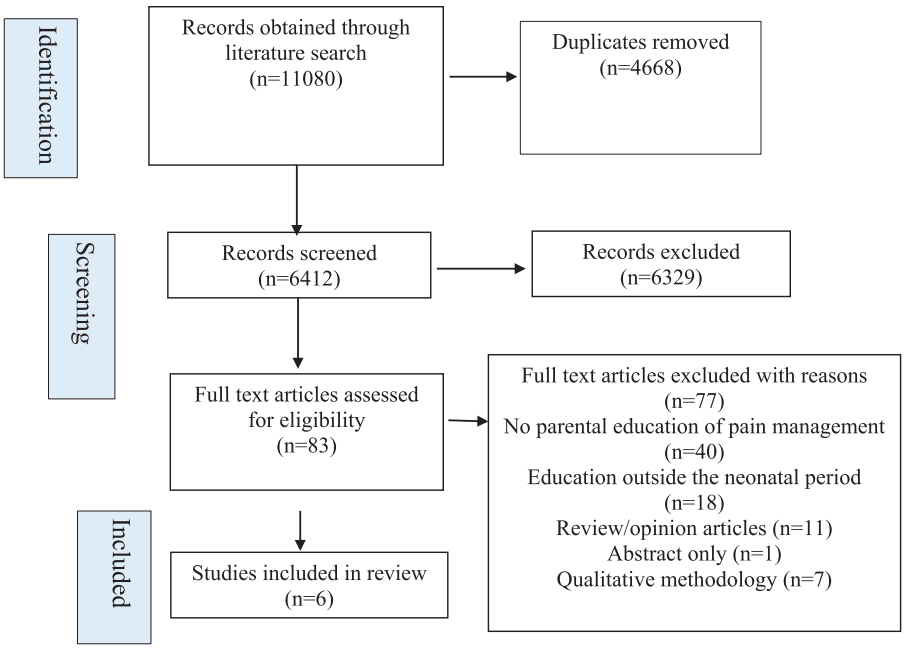

Figure 1. Flow diagram of study identification and selection.

Table 1. Characteristics of included studies

First author, year, and country	Population design, setting	Intervention	Outcomes
Does parental education on pain management in the neonatal period coupled with a skin-breaking procedure impact on knowledge, attitudes, and practices in infancy?			
Korki de Candido, 2020 (45), Brazil	N=73; mothers >16 years; NR between-group design; single centre; hospital	Information pamphlet on effective pain-relieving strategies included in the video+watching the "'Be Sweet to Babies" video (n = 35) or The information pamphlet alone (n = 38)	Utilization of pain management strategies for heel lance
Lavin Venegas, 2019 (46), Canada	N=100; parents of eligible infants; between-group design; single centre; hospital	'Be Sweet to Babies' video (n=51) or Control (usual care in accordance with hospital policy on pain assessment, management, and sucrose administration) (n=49)	Utilization of pain management strategies for heel lance
Taddio, 2014a (47), Canada	N=354; mothers; controlled before and after design; multicentre; hospital	Standard care package with information on selected topics of infant care+pain management pamphlet (n=92) or Standard care package with information on selected topics of infant care (n=88) *Data from only one centre where parents received pain management pamphlet	Utilization and parental knowledge of pain management strategies for vaccination injection pain
Taddio, 2018 (42), Canada	N=3420; mothers; between-group design; single centre, hospital	Pain management pamphlet 'Reducing the Pain of Vaccination in Babies'+general immunization video (n=1140) or 'Reducing the Pain of Vaccination in Babies' pamphlet and video (n=1140) or Control (pamphlet and video on immunization in general with some information about comforting infants) (n=1140)	Utilization and knowledge of pain management strategies Parent-reported infant pain: NRS Parental confidence: NRS Parental satisfaction: NRS
Does parental education on pain management in the neonatal period impact on parental knowledge and attitudes?			
Franck, 2011 (48), UK	N=169; parents; between-group design, multicentre, hospital	Parent Information Guide (booklet on NICU infant care)+Comforting Your Infant in Intensive Care (booklet about pain and comforting infants)+two visits by a research nurse providing education on how to apply the comforting techniques (n=84) or Parent Information Guide (booklet on NICU infant care) (n=85)	Parental satisfaction: Scale of 1–6
Taddio, 2014b (49)	N=120; mothers; between-group design; single centre; hospital	Pretest about pain management strategies followed by pain management pamphlet (n=30) or Pain management pamphlet without the pretest (n=30) or Pretest about pain management strategies and pamphlet on normal infant growth (n=30) or Pamphlet on infant growth (n=30)	Parental knowledge of pain management strategies

NICU neonatal intensive care unit; NR not reported; NRS numerical rating scale.
*If the same author published >1 study in the same year, then a lower case letter was added after the first article in the same year by the same author (e.g., Taddio 2014a(1))

design. In the second study, parents were randomized to receive either the same pamphlet or normal infant growth pamphlet which they reviewed independently (49). In the third Taddio et al.'s study (42), participants were randomized into three groups: (i) provided with a pamphlet titled 'Reducing the Pain of Vaccination in Babies: A Guide for parents' and a general immunization video, (ii) the same pamphlet plus a video containing the same information on 'Reducing the Pain of Vaccination in Babies', and (iii) a control group which received a pamphlet and video produced by the Public Health Agency of Canada on the topic of general immunization. The general immunization pamphlet and video contained some information about comforting infants (e.g., mothers to relax, cuddle including breastfeeding and distraction). The written information was provided by a research assistant who started the video for parents to watch (42). In all three studies by Taddio et al., education was provided in the postnatal period with outcomes assessed at subsequent vaccine injections at 2 to 6 months of age (42,47,49).

In the final study by Franck et al. (48), parents were randomized to receive a booklet titled 'Comforting Your Infant in Intensive Care' which contained evidence-based information about pain and comforting infants in the NICU and two visits of ~ 45 minutes each by a research nurse who taught them how to apply the comforting techniques described in the booklet. Outcomes were assessed after completion of the intervention and again at 3 months following discharge. All parents also received the 'Parent Information Guide' booklet detailing general information about NICU care (48).

Quality of studies and risk of bias

Tables 2 and 3 show the results of risk of bias assessment for included studies. Of the RCTs, three studies were of low risk of bias (42,46,49) and one was of high risk of bias due to lack of blinding of outcome assessors (48). The overall risk of bias for NRTs was moderate in one study due to missing outcome data (47) and serious in the other study as all mothers in both groups received a pamphlet containing the same evidence-based information about pain management strategies as in the video (education intervention), resulting in contamination (45). In addition, the baseline characteristics were different between the intervention and control groups (45).

Outcomes

Critically important outcomes.

The results for utilization of pain management strategies were mixed (Table 4). In a meta-analysis of two RCTs and one NRT with dichotomous outcomes (42,45,46) including 2712 participants, there was an increased utilization of any pain management strategy (RR 1.15 [95% CI 1.04, 1.26]) in the parental education group (Table 4). The RD (95% CI) was 0.08 (0.04, 0.13). Excluding the data from the NRT with serious risk of bias (45), the RR (95% CI) was 1.1 (1.03, 1.25). There was no statistical heterogeneity for this outcome (P=0.24). Subgroup analysis of individual pain management strategies showed statistically significantly higher utilization of breastfeeding and topical anesthetics but not sucrose solution or skin-to-skin care compared with control (Figure 2). The quality of evidence for this outcome was very low. In one NRT study including 178 participants (47), the mean number of pain management strategies used did not differ between groups (MD 0.20 [95% CI –0.01, 0.41]) (Table 4), however, only 21% of the mothers read the pamphlet on pain education. The quality of evidence was very low for this outcome. Parental education was associated with a reduction in parent-reported infant pain in one study including 1615 participants (MD –0.16 [95% CI –0.27, –0.06]) (42). The quality of evidence was moderate.

Important outcomes.

Three studies (two RCTs and one NRT) (42,47,49) including 2809 participants reported on parental knowledge about pain mitigation strategies. Parental education was associated with a statistically significant increase in parental knowledge (Table 4). Parental confidence in their ability to manage infant pain (n=2525) (42) and satisfaction both with pain education (n=169) (48) and pain management in infants (n=2535) (42) was significantly higher in the group that received parent education based on data from single studies for each outcome (Table 4). No study reported on parental stress related to pain education or watching a painful procedure being performed in

Table 2. Assessment of risk of bias of randomized controlled studies

Author	Randomization process	Deviations from the intended interventions	Missing data	Outcome measurement	Selection of the reported result	Overall risk
Does parental education on pain management coupled with a skin-breaking procedure impact on knowledge, attitudes, and practices in neonates?						
Taddio et al., 2014b (49)	Low	Low	Low	Low	Low	Low
Taddio et al., 2018 (42)	Low	Low	Low	Low	Low	Low
Lavin Venegas, 2018 (46)	Low	Low	Low	Low	Low	Low
Does parental education on pain management impact on knowledge and attitudes in neonates?						
Franck, 2011 (48)	Low	Low	Some concerns	High	Low	High

Table 3. Assessment of risk of bias of non-randomized studies

Author	Confounding	Selection of participants	Classification of intervention	Deviations from intended interventions	Missing data	Measurement outcomes	Selection of reported results	Overall risk
Does parental education on pain management coupled with a skin-breaking procedure impact on knowledge, attitudes, and practices in neonates?								
Korki de Candido, 2020 (45)	Moderate	Low	Moderate	Serious	Low	Moderate	Moderate	Serious
Taddio et al., 2014a (47)	Low	Low	Low	Low	Moderate	Low	Low	Moderate

Table 4. Results of critically important and important outcomes

Outcomes	Study author and year	Number of studies	Effect size (95% confidence interval)
Critical outcomes			
Overall utilization of any pain management strategy*	Korki de Candido, 2020 (45) Lavin Venegas, 2019 (46) Taddio, 2018 (42)	3	1.15 (1.04, 1.26)
Overall utilization of any pain management strategy†	Taddio, 2014a (47)	1	0.20 (–0.01, 0.41)
Infant pain†	Taddio, 2018 (42)	1	–0.16 (–0.27, –0.06)
Important outcomes			
Parental knowledge about pain management strategies†	Taddio et al., 2014a (47) Taddio et al., 2014b (49) Taddio, 2018 (42)	3	0.54 (0.26, 0.82)
Parental confidence in their ability to manage pain†	Taddio, 2018 (42)	1	0.24 (0.14, 0.34)
Parental satisfaction with education†	Franck, 2011 (48)	1	1.18 (0.84, 1.52)
Parent satisfaction with pain management*	Taddio 2018 (42)	1	1.05 (1.01, 1,08)
Parental stress with pain education			NR
Parental stress watching a painful procedure			NR
Compliance with vaccination†	Taddio, 2018 (42)	1	2.50 (–1.74, 6.74)
Procedure outcomes			NR
Adverse events	Korki de Candido, 2020 (40)	1	0 (0, 0)

CI confidence interval; NR not reported.
*Results are presented as relative risk along with 95% CI.
†Results are presented as mean difference or standardized mean difference along with 95% CI

infants. There was no difference in compliance with vaccination (assessed using mean infant age at vaccination) in one study that evaluated compliance with procedures (42) (Table 4). None of the studies reported on procedure outcomes (duration of procedure, success rate of procedure). Adverse outcomes were only assessed in one study with none attributed to the education (video) nor the use of analgesic strategies (45) (Table 4). There was no clinical heterogeneity as all studies included parents of newly born infants in hospital settings and the intervention was delivered either using pamphlet and/or video.

DISCUSSION

In this systematic review and meta-analysis, we examined the effectiveness of parental education about infant pain management during the neonatal period. Provision of parental education increased utilization of pain management strategies during painful procedures in infants. The absolute increase in utilization rate was 8%, which is equivalent to, on average, education of 13 parents to increase utilization of pain management strategies in one infant. In addition, education reduced infant pain intensity, although this finding was based on a single study of moderate quality. Parental education increased parental knowledge, confidence in managing their infant's pain, and satisfaction with both education and pain management. There were no adverse effects associated with the parental education nor with the use of any pain management strategies (45). None of the included studies reported on stress associated with the procedure or procedure outcomes.

Breastfeeding was the most frequently used pain management strategy. It is a simple and cost-neutral intervention that can be adopted in any setting (e.g., hospital, outpatient clinics) and HCPs play an important role in its promotion (19,50,51). Systematic reviews support breastfeeding as a primary analgesic strategy for needle pain in infants (19,50) and this review revealed that parental education can improve its utilization.

Utilization of topical anesthetics was increased with parental education; however, the overall rate of use remained low. Use of topical anesthetics in clinical practice is associated with logistic challenges, including its accessibility (needs to be purchased from a pharmacy for outpatient use), feasibility (application time of 20 to 60 minutes before the procedure), and cost.

There is also potential for systemic toxicity (e.g., methemoglobinemia, arrhythmia) with inappropriate application methods (52). With education, parents can plan for and advocate the use of topical anesthetics as part of standard care (51,53).

Sweet-tasting solutions (e.g., sucrose, glucose) are the most widely used pain management strategy in clinical practice and recommended by several professional organizations (24,25). Even though there was increased use of sucrose in one included study by Taddio et al. (42), overall there was no difference in utilization in the meta-analysis. This may be because existing hospital guidelines already include use of sucrose (e.g., by Lavin Venegas et al. (46)). Another potential factor influencing uptake may be lack of materials (e.g., sugar sachet) to prepare the sucrose solution for outpatient settings (commercially available products are not typically available outside of hospitals).

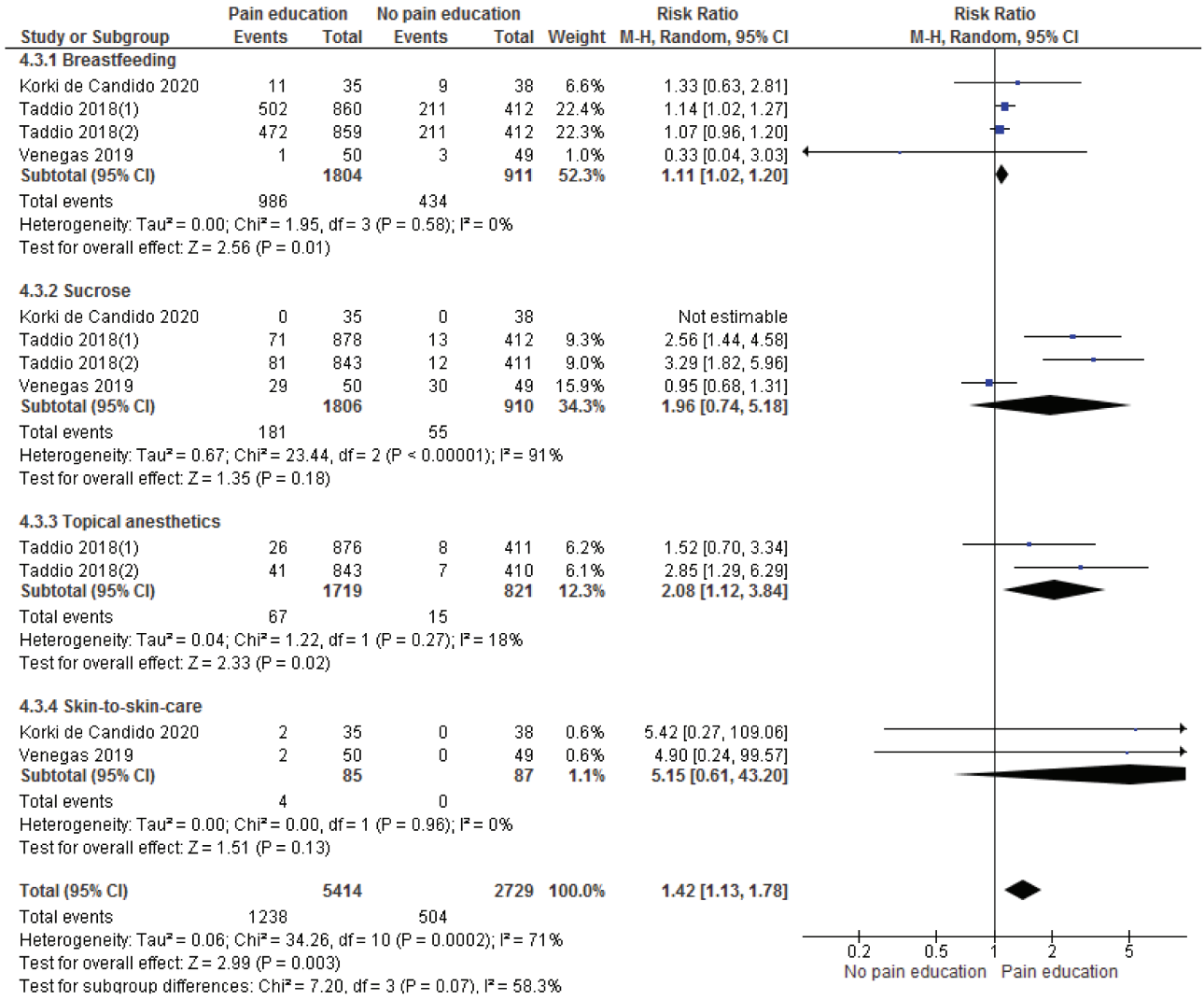

Figure 2. Utilization of individual pain management strategies.

Importantly, one included study (42) assessed the effectiveness of parent education on infant pain intensity and demonstrated lower infant pain scores as reported by parents on a scale of 0 to 10. The results of this study suggest that parents are able to use pain interventions with fidelity in the real world and reduce infant pain experience. Future studies could confirm this finding in both community and hospital settings.

Our findings are consistent with previous systematic reviews on parent-targeted education and knowledge beyond the neonatal period, which showed that parents appreciate the education they received and were able to acquire knowledge. Furthermore, we demonstrated that parental education resulted in their infant receiving more interventions during procedures. None of the included studies evaluated parental preferences regarding the format and the mode of delivery. We expect that different people would prefer different formats (33,36,54,55). In three included studies, information was provided actively by an individual (42,45,46), while in one study the information was provided passively as part of the discharge package where parents were expected to read on their own accord (47). However, when the information was provided passively, only 21% of parents reported reading the pamphlet (47), suggesting that bringing attention to the education or providing interactive classes is likely more effective for knowledge uptake.

Recently, social media (56,57) and newer technologies (smartphone applications, web-based interventions) (58–61) have been used to educate parents. Recent studies have shown that despite the availability of various technologies, parents prefer written material (31,48,61) or in-person education (59). In the only included study (42) comparing pamphlet versus pamphlet+video, no difference in the utilization of pain management strategies was reported. Future studies should incorporate and evaluate various methods available to educate parents and determine optimal modalities for different parents.

Parents are only one stakeholder group involved in infant pain management practices. Another key stakeholder group is HCPs. Korki de Candido et al. (45) identified that HCP recommendation was the only significant factor increasing the utilization of pain management strategies. However, in one included study by Lavin Venegas et al. (46), despite parents' intention to use/advocate for pain management strategies, 40% of infants received no pain management (46). It is not clear what factors influenced the observed results but may include potential conflict between parental and HCPs' preferences as there was an institutional policy

of pain management in place, including the use of sucrose and other non-pharmacological interventions. Furthermore, of the 60% of infants in that study who received pain management, only 38% received the pain management strategy that their parents requested (46). Despite breastfeeding and skin-to-skin care being the preferred parental strategy, 22% of infants received sucrose (46), suggesting that hospital policy and/or behaviour of HCPs may have superseded parental preference. Similarly, in two studies by Taddio et al. (47,49), some parents were blocked by the clinician and HCPs from using the pain management strategies of their choice. Therefore, the collaboration between parents and HCPs is required to achieve optimal uptake of analgesic strategies. In the study by Franck et al. (48), parents who received the education reported a positive change in HCPs' behaviour, suggesting parents can motivate staff. Parental presence during painful procedures has previously been shown to impact HCPs use of pain mitigation strategies (1,2). These findings underscore the need for concurrent up-to-date evidence-based education for both parents and HCPs so that parents are guided and supported in their choices and decision making (27,31,62).

The major strength of this review is the comprehensive search of literature, detailed analytic approach that included both the GRADE and Cochrane methodologies, and inclusion of well-defined and relevant outcomes. The results are limited by the small number of available studies for inclusion in this review. Furthermore, data were not available for some of the a priori clinically relevant outcomes. Despite the heterogeneous nature of the formats used for education, the majority of the studies provided education in the hospital (postnatal ward) and all the studies provided education in the postnatal period. The findings of this review are generalizable as we demonstrated increased utilization of pain management strategies and reduced infant pain intensity across the studies and with the various formats used. Future studies should be conducted including the NICU setting, as the evidence in that setting was limited to only one study. Furthermore, future studies evaluating the sustained impact of parental education during the neonatal period on procedural pain management in infancy/childhood are warranted.

Recommendations for future research include conducting studies that: (1) compare different formats of education, setting of education (e.g., postnatal floor versus NICU setting), and the mode of delivery (passive versus active), (2) determine impact and sustainability of education provided in the postnatal period and impact on utilization longitudinally beyond the first 6 months (e.g., vaccine hesitancy in the context of repeated immunizations), (3) confirm the impact on infant acute pain responses using validated pain tools, and (4) evaluate the effectiveness of educating both HCPs and parents to align with family-centred/integrated care and assess its impact. These studies should not only assess the outcomes listed in this review but also seek to understand and accommodate factors that influence parental preferences, such as parental, HCPs, and contextual factors.

In summary, parental education in the neonatal period can impact utilization of pain management strategies and infant pain. Parental education should be incorporated into postnatal care. Future studies targeting both parents and HCPs and evaluating different modalities of educational formats should be conducted to improve pain management in infants.

SUPPLEMENTARY DATA

Supplementary data are available at *Paediatrics & Child Health* Online by searching for pxac050.

POTENTIAL CONFLICTS OF INTEREST

All authors: No reported conflicts of interest. All authors have submitted the ICMJE Form for Disclosure of Potential Conflicts of Interest. Conflicts that the editors consider relevant to the content of the manuscript have been disclosed.

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