Review Article

Efficacy of 25% dextrose versus breast milk on pain and duration of cry during heel prick in neonates: A systematic review and meta-analysis

ABSTRACT

Neonates, especially admitted to neonatal intensive care unit, frequently need various medical interventions in their early days. A common procedure is the heel prick for blood sampling. Although necessary for diagnosis, this procedure can be stressful for neonates, causing pain, extended crying, and discomfort. Reducing distress in neonates during such procedures is important for the well being of neonates and the satisfaction of caregivers and healthcare providers. Therefore, this review aims to identify and compare the efficacy of 25% dextrose and breast milk on pain and duration of cry among neonates during heel-lance. As part of its review process, the article examined widely used databases, including PubMed, EMBASE, Cochrane, Academia, and Google Scholar. For the meta-analysis, the authors utilized RevMan 5.4. All eligible trials were analyzed using the Cochrane Risk of Bias Tool to assess the quality of the included studies and evaluate the risk of bias. Out of 131 studies reviewed, seven studies were included in meta-analysis of pain, and four studies were included in duration of cry. The results show that 25% dextrose is more effective to reduce pain among neonates during minor invasive procedure like heel prick ($P < 0.00001$), whereas both interventions are effective in the reduction of crying duration. This review highlights that dextrose is more effective in reducing pain in comparison to breast milk. However, additional well-designed studies with larger sample sizes and extended follow-up periods are needed to validate and build upon the current findings. Hence, this review underscores the importance of utilizing effective pain management strategies, such as 25% dextrose, to enhance neonatal care and improve the overall well-being of newborns during invasive procedures.

Keywords: Breastmilk, dextrose, duration of cry, heel prick, neonates

INTRODUCTION

According to the International Association for the Study of Pain, pain is defined as an unpleasant sensory and emotional experience associated with or resembling that associated with, actual or potential tissue damage.[1] However, for many years, neonatal pain was not taken seriously because it was believed that newborns either do not feel pain at all or do not feel it as intensely.[2] As a result, the pain experienced by newborns was often underestimated and inadequately managed.[3,4] Hospitalized newborns often undergo routine procedures early in life, such as Vitamin K injections, heel lancing, bilirubin screening, blood glucose tests, and hepatitis B vaccinations.[5-8]

A systematic review (SR) concluded that neonates in hospitals undergo 7–17 painful procedures daily, primarily heel lancing, suctioning, and venipuncture, often without pain relief (42%–100%).[9] In a Jordanian study of 150

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neonates, a total of 14,008 painful treatments were recorded, averaging 97.11 procedures per baby and 13.9 per day.[10] Another study conducted in Ethiopia involving 325 neonates found that each infant underwent a median of 4 (ranging from 3 to 7) painful procedures within the first 24 h of their neonatal intensive care units (NICU) stay. The most common procedures were heel lancing (20.7%) and venipuncture (18.41%).[11] The EPIPPAIN study of 430 neonates in Paris also highlighted frequent painful NICU procedures, with most lacking pain management.[12] In France, neonates in the NICU averaged 16 heel sticks during a 7.5-day stay, with a quarter of them undergoing over 21 heel sticks, reflecting inconsistent practices and the frequent absence of preprocedural analgesics.[13] Moreover, a study carried out in Italy reported only 25% of NICUs had written guidelines for acute pain control during invasive procedures, and 50% had protocols for chronic pain. The study found only 19% of NICUs used validated pain assessment scores, showing a significant lack of adequate analgesia.[14] Despite the availability of effective pain relief methods, many infants still experience little to no pain management during these procedures.[15]

Noxious stimuli during this critical period of brain development can result in lasting epigenetic changes, impacting neurodevelopment, pain regulation, and reactivity into adulthood.[16,17] This makes neonates particularly vulnerable to both immediate and long-term impairments in physical and psychological health, including adverse effects on brain development and sensory processing.[18-20] However, effective nonpharmacological analgesic methods provide a safer alternative to address these issues.[21]

SRs have been increasingly conducted to evaluate the effectiveness and safety of various nonpharmacological therapies for alleviating pain in newborns. These reviews are considered to provide high-quality evidence. However, due to the vast amount of information available, nurses working in NICUs may find it challenging to make rapid decisions when choosing between different analgesic therapies.[22] It is therefore necessary to compare the efficacy of two specific nonpharmacological methods for dealing with different painful stimuli in a single SR. Hence, this study was undertaken to evaluate the efficacy of the two nonpharmacological interventions (25% dextrose and breast milk) on pain and duration of cry of neonates during minor invasive procedure like heel-lance.

METHODS

The review was registered at the International Prospective Register of Systematic Review (PROSPERO) registration number CRD42023444089. The Preferred Reporting Items for Systematic Review and Meta-Analysis (PRISMA) guidelines were adopted for this SR and meta-analysis. The patient/population, intervention, comparison, and outcomes (PICO) framework was used to justify the review question.

Criteria for eligibility

Databases such as PubMed, EMBASE, Cochrane, Academia, and Google Scholar were used as major electronic databases to search literature in the English language from 2008 to 2023.

The inclusion criteria were as follows: (1) studies available in electronic databases that have been published in peer-reviewed journals, (2) randomized controlled trials and nonrandomized controlled trials exclusively in its study design, (3) neonates with 28–40 weeks of gestation irrespective of gender, region, race, and country, admitted in NICU and undergoing heel prick, (4) studies consisting of 25% dextrose and breast milk as the main intervention, (5) conducted in clinical settings (NICU), (5) regarding outcomes, articles were considered suitable if they discuss some or all of the health advantages, such as pain reduction, shorter crying duration, and enhancements in vital signs of newborns. and (6) Full-text articles in the English language.

Excluded from consideration were books, unpublished materials, databases that only contain brief abstracts, and articles in other languages.

Information sources

Databases such as PubMed, EMBASE, Cochrane, Academia, and Google Scholar were utilized using the keywords as per PICO, after that titles and abstracts were searched with the help of alternative keywords. A comprehensive investigation was done using a clear search approach for PubMed, EMBASE, Cochrane, Academia, and Google Scholar. In addition, to this, citation pearl searching was also done for relevant studies.

Search strategy

Studies were searched that assessed the efficacy of 25% dextrose and breast milk on pain and duration of cry of neonates during heel prick. The search strategy is shown in Table 1. Search databases such as PubMed, EMBASE, Cochrane, Academia, and Google Scholar were scrutinized for keywords such as "nonpharmacological," "25D," "breastmilk," "pain," "duration of cry", and "neonates."

- P – Neonates (28 + weeks of gestation)
- I – 25% dextrose
- C – Breast milk or routine care or no specific intervention
- O – Pain level and duration of cry.

Further search using additional keywords was done through major search engines such as PubMed, EMBASE, Cochrane, Academia, and Google Scholar.

Selection process and data extraction

As per the applicability of review during the screening process, all the titles as well as abstracts were searched with the help of two reviewers. The completeness of available content was reviewed following eligibility guidelines. After an independent assessment of abstract as well as full texts, any disagreements were resolved after the third reviewer's consultation.

All authors collected predefined outcome data from the studies, focusing on study characteristics. The primary outcomes for this review were pain level. The secondary outcomes were physiological parameters and the duration of cry. Data extraction involved removing duplicates and independent work by all authors, with any discrepancies resolved systematically with the inputs of authors. The characteristics of studies were tabulated to help in the extraction of data effectively. Two reviewers initially analyzed the data, with a third author assisting in resolving any discrepancies. Information related to first author, publication year, country, sample size, sample characteristics, intervention, and outcomes. If any missing data were found, then it was reverted to the original author for clarification. Two reviewers were carried out following PRISMA guidelines[23] [Figure 1]. A checklist uploaded by Cochrane was utilized for the quality assessment of studies included in this review.[24]

Table 1: Study scanning strategy

Number of scans	Term used
Scan 1	"Nonpharmacological" and pain and neonates and "duration of cry" and "heel-prick" Glucose and breast milk and pain and neonates and "heel-prick" "Nonpharmacological" and pain and "minor invasive procedures"
Scan 2	"25D" and "human milk" and pain and neonates and "heel-lance" "Nonpharmacological" and pain and neonates and infants
Scan 3	"25D" and pain and "duration of cry" and neonates Glucose and breast milk and pain neonates and "duration of cry"

The seven domains included random sequence, blinding of participants, and allocation concealment. Two reviewers assessed all included studies for risk of bias under domains of random sequence generation, allocation concealment, blinding of participants and personnel, blinding of outcome assessors, incomplete outcome data, selective reporting, and other biases. Using the Cochrane collaboration approach, each study was categorized as low, high, or unclear risk in each domain. Studies with low risk across all domains were considered good quality, and vice versa. In cases of disagreement, the 3rd and 4th reviewers scrutinized with conclusions to reach to a mutual consensus.

Data items

The study measure included the trials with the efficacy of 25% dextrose on pain and duration of cry of neonates which was

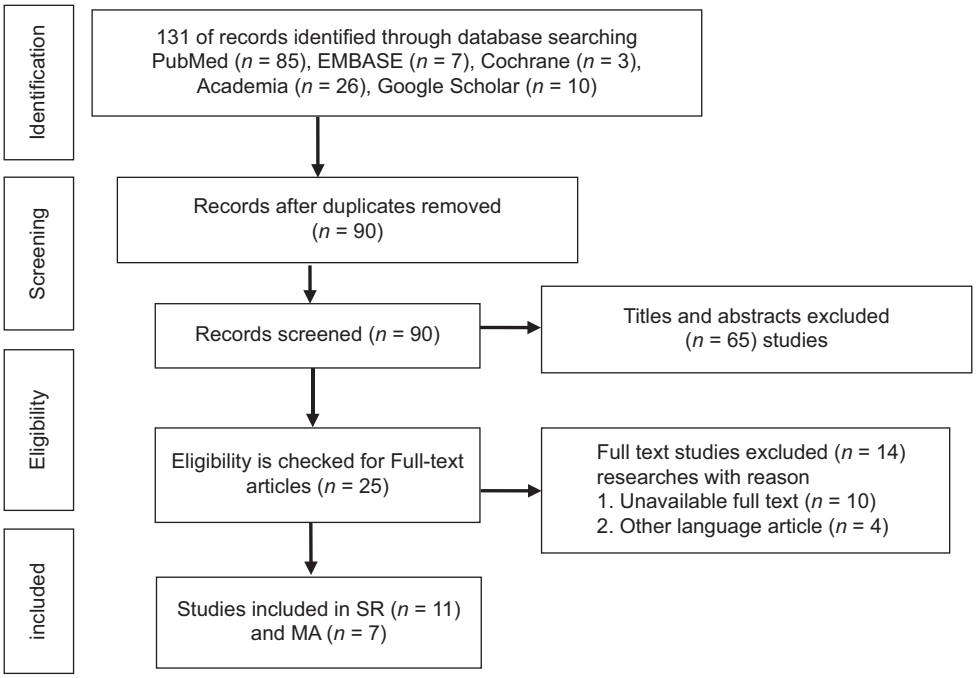

Figure 1: Preferred Reporting Items for Systematic Review and Meta-Analysis flow diagram showing the study selection process. MA: Meta-analysis, SR: Systematic review

segregated with the control group who received breast milk or sterile water or routine care during heel prick procedure. Meta-analysis was done using randomized control trials in RevMan v5.4 software (developed by Cochrane Collaboration in Norway).[25]

Statistical analysis and effect measures

The meta-analysis was done using Review Manager Software (RevMan version 5.4.1). Mean and standard deviation scores for each study were entered into the software to draw forest plots of various outcomes. Outcomes such as pain and duration of cry were continuous data and represented as standardized mean difference (SMD) with 95% confidence intervals (CIs). Heterogeneity was tested both by visual examination of a forest plot (where nonoverlapping CI shows the probability of heterogeneity) and by the use of a Chi-squared heterogeneous test. Heterogeneity was represented as I^2 (%) with 0% no heterogeneity, 25% low heterogeneity, 50% moderate heterogeneity, and 75% high heterogeneity. A weighted inverse-variance random-effects model was considered to compare between the groups. The reference value of $I^2 > 75\%$ was used to indicate substantial variability related to heterogeneity. To identify the publication bias, a funnel plot was drawn and assessed by visual inspection for its symmetry.

RESULTS

Narrative synthesis

Details of the study selection process and search results are presented in Figure 1. A total of 131 articles were found corresponding to the search strategy and based on the systematic literature search of four major databases: PubMed ($n = 85$), EMBASE ($n = 7$), COCHRANE ($n = 3$), and Academia ($n = 26$). Additional searches from other sources such as manual searches through reference lists of articles and search engines such as Google Scholar were attempted. A total of 10 articles were retrieved from Google Scholar. No new articles were found from manual tracking. After duplication removal, the title and abstract of 90 articles were screened. Twenty-five studies were eligible for full-text review. After reviewing, 14 articles were excluded due to various reasons (unavailability of full-text $n = 10$) and other language articles ($n = 4$). Finally, 11 studies[21,26-35] were included which are summarized in Table 2.

Utilizing a prepared checklist, data were manually gathered from each study that was part of the meta-analysis. This checklist's components are as follows: study design, study information, and publication, sample size, intervention, intervention group, control group, sample size, and pain measurement tool. Measured variables include pain scoring and duration of cry after painful procedures. Data extracted using the data extraction tool were tabulated and grouped. The results were presented in a narrative synthesis. The earliest study was completed in 2011 and the most recent in 2023. As a measurement tool for neonatal pain, Premature Infant Pain Profile (PIPP) Scale and Neonatal Infant Pain Rating Scale were used.

Characteristics of the included studies

Eleven studies[21,26-35] were included in this SR with 1292 participants, i.e., 638 in the intervention and 654 in the control group. The studies were published between the years 2011 and 2023. The sample sizes of the studies ranged from 63 to 400. Out of 10 included studies, seven were conducted in India,[21,27,29,30,32,34,35] and others were conducted in Iran,[31] Canada,[26] Taiwan,[28] and Pakistan.[33] The age of the neonates ranged from 0 to 28 days. Eight studies included the neonates undergoing heel prick procedure,[21,26-31,35] and three studies included the neonates undergoing venipuncture procedure.[32-34]

Among all the studies, seven studies used the PIPP Scale,[21,26-29,32-34] and the remaining three studies used Neonatal Infant Pain Scale[30,31] to assess the pain among the neonates. In addition, five studies looked for the duration of crying during the heel prick[26-28,31,35] and two studies looked over the duration of crying during venipuncture.[32,34] Duration of cry was assessed through the video camera from the baseline period to the recovery period of the neonates.

Details of 25% dextrose and control types

We included all the trials examining the efficacy of 25% dextrose and breast milk in neonates. We excluded all other invasive or noninvasive methods for relieving pain such as nonnutritive sucking, kangaroo mother care, and facilitated tucking. Breast milk or standard care or no treatment without any form of pain relief was considered the comparison group 25% dextrose was administered through various methods such as syringe[21,26-28,30,32,35] and paladai,[34] and the amount given also different, i.e., 1 mL,[35] 2 mL,[21,26,27,29,30-34] and 5 mL[28] in varying time point like 1 min,[29] 2 min,[21,26,27,32-34] 15 min,[31] 30 min,[28] and 1 h[30] before procedure.

Study risk of bias assessment and effect measures

Allocation concealment was done in five studies,[26,27,29-31] and random sequence generation was done in six studies.[26-31] Blinding of the personnel was done in six studies,[26-31] and high risk was found in one study.[35] Outcome assessors were justified in only one study,[31] and the remaining three had a higher risk for bias[27,30,35] and three had unclear risk for bias.[26,28,29] Low risk was found in five studies for attrition bias,[27-29,31,35] whereas two studies were at high risk.[26,30] Five studies had higher risk for reporting bias,[27,29-31,35] whereas two studies had lower risk.[26,28] In other risks of bias, one

Table 2: Characteristics of the included studies

Author, year, country	Study type	Participants characteristics		Sample size	Instruments	Intervention	Control	Outcome			
		Gest (weeks)	Days of life			25% dextrose	Breast milk	Pain		Others	
								Intervention	Control	Intervention	Control
Singh *et al.* (2017)[21] India	Index study (breastfeeding vs. oral dextrose)	Neonates born at 34–42	0–28 days	47/47	PIPP Scale	2 mL of 25% dextrose prior to heel lance through syringe	2 mL of prior to heel lance via syringe	Minimal=21.1 Mild/ moderate=73.7 Moderate/ severe=5.3	Minimal=89.8 Mild/ moderate=10.2 Moderate/ severe=-	-	-
Bueno *et al.* (2012)[26] Canada	Noninferiority randomized controlled trial	34–36	24–72 h	39/39	PIPP Scale	2 mL of 25% dextrose via 2 min needleless syringe 2 min before heal lance	2 mL of EBM via needleless syringe 2 min before heel lance	2.87±2.54	4.72±3.48	Duration of cry (P=0.14)	-
Chauhan *et al.* (2023)[27] India	Randomized controlled trial	28–36	0–28 days	62/63	PIPP Scale	0.2 mL/kg dextrose instilled into the mouth using a sterile syringe before heel lance	2 mL EBM was instilled into the mouth using sterile syringe before heel lance	3.15±0.41	3.02±0.09	Duration of cry=5.32±0.11	Duration of cry=4.2±3.31
Ou-yang *et al.* (2013)[28] Taiwan	Double randomized controlled trial	<37	0–7 days	39/40	PIPP Scale	5 mL of 25% dextrose before 30 min of heel lance	5 mL of EBM 30 min before heel lance	2.53±2.25	2.39±2.31	Duration of cry=2.0 (0.0–45.0)	29.5 (0.0–65.0)
Rawal *et al.* (2018)[29] India	Randomized controlled trial	34–36+6	0–7 days	21/21	PIPP Scale	2 mL of 25% dextrose orally 1 min before heel lance	2 mL of EBM orally 1 min before heel lance	2.52±1.03	3.38±1.20	Maximum HR=145.48±12.60	Maximum HR=148.19±13.33
Varghese *et al.* (2020)[30] India	Randomized controlled trial	37+	0–7 days	62/62	NIPS	2 mL of 25% dextrose 1 h before heel lance	2 mL of EBM 1 h before heel lance	1.63+0.76	3.02+1.08	Mean HR=166.57±12.25	Mean HR=144.8±12.44
Soltani *et al.* (2018)[31] Iran	Double blinded randomized controlled trial	37–42	3–5 days	40/42	NIPS	2 mL of 25% dextrose given 15 min before heel prick	Breastfeeding 15 min before heel prick	6.45±1.88	5.52±2.22	Duration of cry=1.20±0.60	Duration of cry=1.14±0.60
Jha *et al.* (2023)[32] India	Randomized controlled placebo study	>34	0–7 days	53/53	PIPP Scale	2 mL 25% dextrose 2 min prior to venepuncture	5 mL of EBM 2 min prior to venepuncture	2.94±1.41	7.42±1.69	Duration of cry=6.47±5.75	38.58±15.21
Kazmi *et al.* (2020)[33] Pakistan	Randomized controlled trial	34–37	0–28 days	200/200	PIPP	2 mL of 25% dextrose 2 min before venepuncture	2 mL of EBM 2 min before venepuncture	3.68±1.74	5.89±2.52	-	-
Sahoo *et al.* (2013)[34] India	Double blinded randomized control trial	>34	0–7 days	50/62	PIPP	2 mL via sterile paladai 2 min before venepuncture	2 mL of EBM 2 mL via sterile paladai 2 min before venepuncture	3.12 (2.4–3.8)	4.68 (3.8–5.5)	Duration of cry Median=10.0 s Maximum HR=132.6±17.0	Median=37.5 s Maximum HR=137.6±20.9
Jatana *et al.* (2003)[35] India	Randomized controlled trial	>37	0–7 days	25/25	-	1 mL via sterile syringe	1 mL of EBM obtained via sterile syringe	-	-	Duration of cry=74.80±10.96	Duration of cry=104.56±9.16

PIPP: Premature Infant Pain Profile, EBM: Expressed breast milk, HR: Heart rate, NIPS: Neonatal Infant Pain Scale

study was at low risk of bias,[28] two had a high risk of bias,[26,35] and four had unclear risk of bias[26,27,29,30] [Table 3 and Figure 2]. In the incident of any missing information from the study findings, all authors were consulted/informed, and after receiving responses from the corresponding authors of the included studies, further decisions were made with the mutual consensus of all authors of this analysis.

META-ANALYSIS RESULTS

Pain intensity

Six studies[26-31] were identified as shown in Figure 3 which evaluated the efficacy of 25% dextrose and breast milk on pain during heel prick in neonates. Among 694 neonates, (25% dextrose: 344 and breast milk: 350). Pooled results from the studies by random effect model demonstrated that there was a significant reduction in pain in 25% dextrose (experimental group) in comparison to breast milk or sterile water or routine care (SMD = 0.41; 95% CI: −0.94–−0.11; I^2 = 93%; $P < 0.00001$). Five studies[26-30] found a significant decrease in pain score in comparison to the control group.

Duration of cry

Four studies[26,27,31,35] were identified as shown in Figure 4 which evaluated the efficacy of 25% dextrose and breast milk on the duration of cry during heel prick on neonates. Among 495 neonates (25% dextrose: 247 and breast milk: 248), pooled results from the studies by random effect model demonstrated that there was a significantly lower duration of cry in the breast milk group (control group) in comparison

Table 3: Risk of bias assessment for studies included in meta-analysis

Studies	Bueno *et al.* (2012)[26]	Chauhan *et al.* (2023)[27]	Ou-yang (2013)[28]	Rawal *et al.* (2018)[29]	Varghese *et al.* (2020)[30]	Soltani *et al.* (2018)[31]	Jatana *et al.* (2003)[35]
Random sequence generation (selection bias)	+	+	+	+	+	+	−
Allocation concealment (selection bias)	+	+	−	+	+	+	−
Blinding of participants (performance bias)	+	+	+	+	+	+	−
Incomplete outcome data (attrition bias)	−	+	+	+	−	+	+
Blinding of outcome assessment (detection bias)	?	−	?	?	−	+	−
Selective reporting (reporting bias)	+	−	+	−	−	−	−
Other bias	?	?	+	?	?	−	−

+: Low Risk, −: High Risk, ?: Unclear

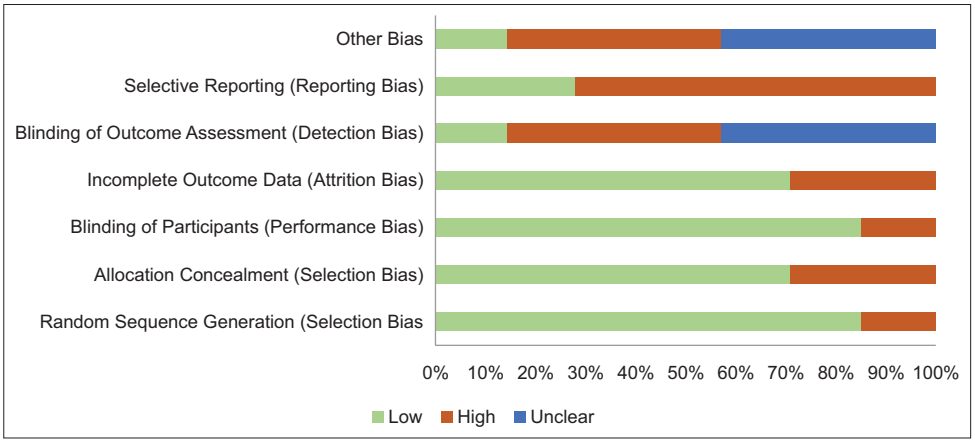

Figure 2: Graphical representation of assessment of risk of bias

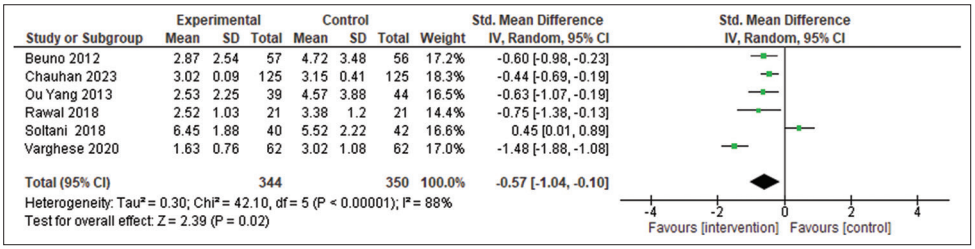

Figure 3: Forest plot of comparison: efficacy of 25% dextrose and breast milk on pain during heel prick on neonates. SD: Standard deviation, CI: Confidence interval, IV: Inverse variance

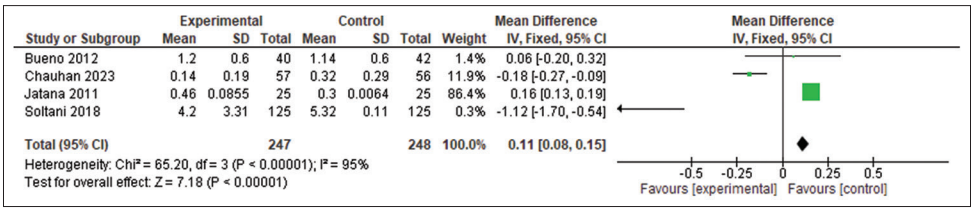

Figure 4: Forest plot of comparison: Efficacy of 25% dextrose and breast milk on duration of cry during heel prick on neonates. CI: Confidence interval, IV: Inverse variance, SD: Standard deviation

to 25% dextrose group (SMD = −0.57; 95% CI: −1.04–0.10; I^2 = 88%; P < 0.00001). Two studies[26,35] found no significant decrease in the duration of cry after the administration of 25% dextrose, whereas there was a significant decrease in the duration of cry in the control group.

Publication bias

The publication bias of pain was assessed by visual observation of funnel plots given in Figure 5. From the funnel plot distribution, scattered points mostly gathered in the middle and upper parts and moved closer to the middle. Overall, the results were slightly asymmetrical, suggesting that there may be potential publication bias in the included studies that could influence the results.

DISCUSSION

This review aimed to investigate the efficacy of 25% dextrose and breast milk on pain and duration of cry during heel prick among neonates. Doctors often recommend the administration of nonpharmacological pain management techniques as a pain relief method during noninvasive procedures in NICU. Pain can be reduced by various nonpharmacological methods such as 25% dextrose, breast milk, kangaroo-mother care, swaddling, and facilitated tucking. Among them, 25% dextrose and breast milk are those methods that are readily available, cheaper, less time-consuming, and hence can be used in every procedure. The recent study evaluated the efficacy of these solutions which were administered in various amounts through various techniques. In this regard, PIPP Scale and Neonatal Infant Pain Profile Scale were used to quantify the intensity of pain as a valid, reliable, and subjective pain assessment instrument for neonates. Furthermore, a randomized controlled trial with a suitable control group accurately reflected the effects of this treatment.

This study's findings suggest that 25% dextrose has a soothing effect on reducing pain among the neonates during heel prick. Twenty-five percent dextrose blocks the transmission of impulses to the brain by releasing endorphins to decrease pain according to gate control theory.[36] This review showed a significant difference in favor of 25% dextrose during heel prick among the neonates.

Meta-analysis of the included studies reveals that 25% dextrose reduces the pain among the neonates during heel prick. No side effects from the intervention have been reported. It is consistent with the findings of the study[37] which reported a significantly lower PIPP score for neonates receiving 24% glucose (0.2 mL) versus water (0.2 mL) but reported no differences in NIPS scores. In addition, another study[38] indicated lower pain scores with a mean difference − 3.6 ([95% CI − 4.6−−2.6]; P < 0.001; I^2 = 54%) for neonates receiving glucose compared with water or no intervention for heel lances and venipuncture. This review highlights the clinical benefits of nonpharmacological methods such as 25% dextrose and breast milk and advocates for further research. The successful outcomes point out the barriers to standard neonatal care, stressing the importance of adopting evidence-based pain management practices to improve quality care.

Our study demonstrated breast milk lowers the duration of cry in comparison to 25% dextrose while undergoing heel-lances. This is contrast to another study[39] which showed no differences in the duration of the first cry when comparing neonates receiving sucrose and water during lancing. In addition, another study[37] showed a significant reduction in the duration of crying by the administration of glucose or sucrose before immunization in infants between 1 and 12 months of age. Each meta-analysis contained a comparatively small number of infants, and in many instances, there was moderate-to-high between-study heterogeneity. Nonetheless, it is possible to regard these findings as therapeutically meaningful in favor of glucose for venipunctures and heel lances.

In some studies, both water and no intervention were compared with an experimental intervention. The findings from this review are consistent with the findings reported in the study[37,39] which showed that 25% dextrose has strong and consistent evidence for the analgesic efficacy during single procedures in healthy term and preterm infants. Consequently, researchers should consider using sweet-tasting solutions as the control intervention in future studies involving this population.

Despite extensive searching and broad selection criteria, some published papers may still have been missed. Limited

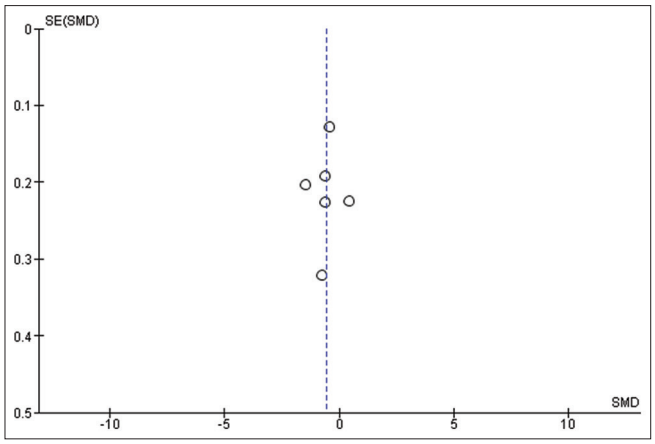

Figure 5: Funnel plot of included studies on pain. SMD: Standardized mean difference, SE: Standardized error

resources prevented separate abstract-level screening, which could have influenced the inclusion of studies. Three out of eight studies lacked sample size calculations, highlighting a notable trial weakness. Variation in amount and techniques of solution administration was observed across studies, ranging from 2 ml to 5 mL through sterile syringe and paladai. Efforts to gather additional information yielded limited responses from authors.

This study has significant implications for clinical practice and may assist medical professionals in implementing more effective strategies to alleviate pain and discomfort in neonates undergoing repeated painful procedures. Furthermore, it advises clinical practitioners to utilize a systematic, specialized, and multidisciplinary approach to pain management in neonates, emphasizing the impact of nonpharmacological interventions and recognizing potential challenges in their application.

Limitations

Our study has some limitations. First, we only included articles published in English; as a result, it is possible that some of the significant trials could have been missed from the outcomes of the present synthesis. Second, studies included in the present meta-analysis were heterogeneous and, therefore, the findings of the study need to be utilized carefully in clinical practice.

CONCLUSION

Twenty-five percent dextrose was found to be effective in pain management among the neonates during the heel prick. Overall, the data show that 25% dextrose has an additive advantage when used in place of breast milk or routine treatment. Twenty-five percent dextrose can be used as a nonpharmacological measure to manage pain among neonates during minor invasive procedures like heel prick. A substantial variability in the volumes and concentrations of glucose solutions administered and the similar outcomes in the duration of cry precluded further meta-analysis including more studies. Moreover, there is a need for more RCTs on the efficacy of nonpharmacological measures on the comfort level of neonates.

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Conflicts of interest

There are no conflicts of interest.

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