



EFFECTIVENESS OF ICE PACK APPLICATION ON PAIN DURING INTRAVENOUS INSERTION PROCEDURES IN PRESCHOOL-AGED CHILDREN

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ABSTRACT

Intravenous (IV) cannulation in preschool-aged children often causes pain, which can affect their comfort and overall experience in hospital. Various pain reduction techniques, such as deep-breathing and distraction, are commonly used but are not always effective in directly minimising pain. One non-pharmacological method to reduce pain is the application of ice packs or cold compresses. This article review aims to evaluate the effect of ice pack application on pain in preschool-aged children undergoing IV cannulation. This literature review utilised five databases: Google Scholar, ScienceDirect, ResearchGate, PubMed, and Portal Garuda. The keywords used included “use of ice pack in preschool children”, “effectiveness of ice compress”, and “IV cannulation”. Of the 138 articles published between 2015 and 2025 prospective articles identified, only 13 met the inclusion criteria. The quality of the articles was assessed using the 2020 CASP instrument. Based on data extraction, the authors found that the use of ice packs is effective as a non-invasive intervention and can reduce pain during IV insertion. Conclusion: Paediatric nurses are advised to consider the use of ice packs as part of atraumatic care in order to minimise procedural pain in children.

Keywords: IV cannulation; children; ice pack; pain; procedure

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INTRODUCTION

Preschool-aged children are those between 3 and 6 years of age. Children under six years old have limited ability to understand events, are not yet able to determine appropriate behaviours to cope with new situations, and possess only a limited understanding of the experiences they undergo. One of the standard procedures for hospitalised children is the insertion of an intravenous (IV) line and blood sampling (Wandini & Resandi, 2020). The purposes of IV line insertion include the administration or replacement of electrolytes, blood transfusions, nutrition, medications, and chemotherapy. Blood sampling and IV insertion can cause pain at the needle puncture site (Wandini & Resandi, 2020). Nurses must be able to provide atraumatic care to reduce pain in children. Atraumatic care is a form of therapeutic healthcare in paediatric settings that aims to minimise the physical and psychological stress experienced by children and their parents (Supartini, 2004).

A preliminary study conducted in the paediatric ward of Gunung Jati Regional General Hospital (RSUD Gunung Jati) Cirebon, West Java Province, found that over the last three months, from July to September 2024, 607 preschool-aged children were hospitalised, and based on the percentage within the ward, this age group ranked third, accounting for 26%. In this hospital, pain management in children generally consists of therapeutic communication and distraction techniques, such as deep-breathing exercises and gentle stroking of the back. However, these techniques do not directly inhibit pain transmission in nerve cells.

Ice packs or cold compresses are an appropriate non-pharmacological therapy and can be applied prior to IV insertion. Cold compresses induce a sensation of numbness before the onset of pain. They create a local anaesthetic effect at the needle insertion site during IV cannulation (Potter &

Perry, 2013). Cold compresses slow the conduction of peripheral nerve fibres and reduce the release of inflammatory mediators and nociceptors, thereby producing a relatively rapid anaesthetic effect on the skin (Waterhouse, 2013).

The paediatric ward at RSUD Gunung Jati Cirebon has not yet implemented the use of ice packs as a method to reduce pain during IV insertion. Therefore, a literature review is needed to evaluate the effectiveness of ice packs in reducing pain during this procedure. The findings of this review are expected to provide a basis for hospital management to consider incorporating ice pack application into the standard operating procedures for pain management in paediatric patients. In line with this, the aim of this review article is to determine the effectiveness of ice packs in reducing pain during IV insertion in preschool-aged children.

METHOD

This study employed a systematic review approach structured according to the PICO framework (Population, Intervention, Comparison, Outcome). The Population (P) in this review consists of preschool-aged children undergoing intravenous infusion cannulation procedures. The Intervention (I) examined is the use of ice compresses (ice packs or cool packs) during or prior to the IV insertion procedure. The Comparison (C) includes groups that did not receive ice compresses as well as other control groups that were not given any cold intervention. The Outcome (O) assessed is the level of procedural pain, measured using standardised pain assessment instruments.

The literature search was conducted systematically across several relevant national and international databases, namely Google Scholar, ResearchGate, ScienceDirect, PubMed, and Portal Garuda. The search strategy utilised keywords tailored to the population, intervention, and outcome, and combined using Boolean operators. For Google Scholar, the following keywords were used: “Ice Pack” AND “Nyeri” AND “Infus” AND “Prasekolah”. On ResearchGate and ScienceDirect, the keywords were: “Ice Pack” AND “Skor Nyeri” AND “Infus” AND “Prasekolah”. The search in PubMed used the keywords: “Ice Pack” AND “Pain” AND “Preschool”, while in Portal Garuda the combination “Ice Pack” AND “Nyeri” was applied. In addition, a manual search was carried out using the keywords “Ice Pack AND nyeri prasekolah AND prosedur infus” by screening the reference lists of relevant articles.

Inclusion criteria were clearly defined prior to the commencement of the search process. Articles included in the review were: (a) national and international articles published between 2015 and 2024; (b) available in open-access format with full text; (c) original research articles (not editorials or narrative reviews); (d) studies that used ice compresses as an intervention to reduce pain during intravenous infusion cannulation; and (e) studies employing a randomised controlled trial (RCT) design or quasi-experimental design with a control group.

Exclusion criteria comprised: (a) articles that were not accessible in full-text form; (b) studies that did not use ice compresses as the primary intervention for pain management during infusion procedures; and (c) research that did not clearly report pain level outcomes. Study selection was conducted in stages, beginning with title identification, followed by screening based on titles and abstracts, eligibility assessment through full-text review, and finally the determination of studies that met the inclusion criteria to be incorporated into the systematic review a total of 13 articles published between 2015 and 2025 were analyzed. This selection process may be illustrated using a flow diagram in accordance with PRISMA guidelines.

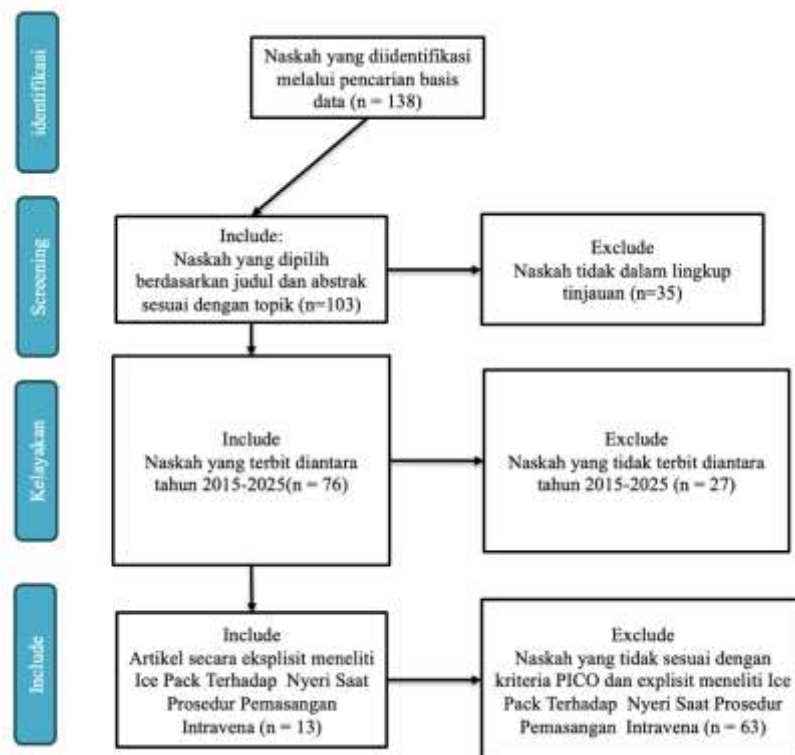


Figure 1. PRISMA flow diagram for article selection

Based on Figure 1, there are several stages of article selection carried out systematically to ensure that only studies meeting the relevant and methodological criteria are included in the review. From a total of 138 articles identified through various databases and manual searching, 13 articles met the inclusion criteria and subsequently underwent methodological quality assessment. A summary of the findings and the quality appraisal of each article is presented in Table 1.

Table 1.

Quality assessment of RCT articles

No	Questions	Article												
		1	2	3	4	5	6	7	8	9	10	11	12	13
1	Was true randomization used for assignment of participants to treatment groups?	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
2	Was allocation to treatment groups concealed?	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
3	Were treatment groups similar at the baseline?	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
4	Were participants blind to treatment assignment?	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
5	Were those delivering the treatment blind to treatment assignment?	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
6	Were treatment groups treated identically other than the intervention of interest?	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
7	Were outcome assessors blind to treatment assignment?	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
8	Were outcomes measured in the same way for treatment groups?	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
9	Were outcomes measured in a reliable way	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y

No	Questions	Article												
		1	2	3	4	5	6	7	8	9	10	11	12	13
10	<i>Was follow up complete and if not, were differences between groups in terms of their follow up adequately described and analysed?</i>	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
11	<i>Were participants analysed in the groups to which they were randomized?</i>	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
12	<i>Was appropriate statistical analysis used?</i>	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
13	<i>Was the trial design appropriate and any deviations from the standard RCT design (individual randomization, parallel groups) accounted for in the conduct and analysis of the trial?</i>	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Percentage		100	100	100	100	100	100	100	100	100	100	100	100	100%
Result		inc	inc	inc	inc	inc	inc	inc	inc	inc	inc	inc	inc	inc

*Yes (Y), No (N), Unclear (U), Not Applicable (NA)

* 1 (Artikel 1), 2 (Artikel 2)

* inc (include)

Table 1 presents the appraisal of the methodological quality of the thirteen randomised controlled trial (RCT) articles reviewed. All articles met the thirteen quality assessment criteria, as indicated by a “Yes” (Y) response for each item, resulting in an eligibility score of 100% for every study. This includes the use of valid randomisation procedures for allocating participants to intervention groups, appropriate allocation concealment, comparability of baseline characteristics between groups, and the implementation of blinding for participants, care providers/interventionists, and outcome assessors. In addition, all studies applied identical treatment conditions to the comparison groups apart from the main intervention under investigation, measured outcomes in a consistent and reliable manner across groups, reported follow-up data completely or provided an adequate explanation for any discrepancies, and analysed participants according to their original randomisation groups. The statistical analyses used were deemed appropriate, and the clinical trial designs, along with any deviations from the standard RCT framework, were sufficiently considered in both implementation and analysis. Accordingly, all thirteen articles were classified as included and deemed suitable to be used as references in this review and for further evidence synthesis.

RESULT

Based on the analysis presented in Table 1, the findings consistently indicate that the application of cold compresses/ice packs is an effective non-pharmacological intervention for reducing procedural pain in children, including those of preschool age. Various quasi-experimental and experimental studies (Akriansyah & Surahmat, 2021; Nuraeni et al., 2020; Wilandika et al., 2025) have reported a significant reduction in pain scores in groups receiving cold compresses compared with control groups, as measured using the FLACC scale, Numerical Rating Scale, CHEOPS, and Wong-Baker FACES. These findings are further supported by the experimental study of Alalo et al. (2018) in school-aged children, as well as Sayed et al. (2020), who specifically demonstrated that cryotherapy at the venipuncture site significantly reduces pain intensity in preschool-aged children. Thus, in terms of effectiveness, the available evidence consistently supports the role of ice compresses/ice

packs as a simple local analgesic capable of reducing sharp pain caused by invasive procedures such as IV cannulation and venipuncture.

With regard to the preschool population and the specific context of IV cannulation, several studies are highly relevant to the aim of this review. The study by Wonginchan et al. (2017) in children aged 3–5 years receiving intravenous fluid infusions showed that the application of cold alcohol compresses prior to cannulation significantly reduced pain scores compared with controls, indicating that the principle of cold application is effective in providing a local anaesthetic effect in preschoolers. Oommen and Shetty (2022) likewise found that local cold application prior to IV procedures reduced pain and behavioural distress, with the majority of their sample being between 3 and 5.9 years of age. The strongest evidence in the Indonesian context and for preschool-aged children is provided by Wilandika et al. (2025), who involved 98 children aged 3–6 years in a quasi-experimental study with block randomisation, and reported that administering a cold pack 2 minutes before IV cannulation significantly reduced FLACC scores and shifted the proportion of pain from the moderate to the mild category. Meanwhile, practice reports and case studies (Pushpasanthi et al., 2024) offer clinical illustrations that cold compresses are also beneficial for children with specific conditions (dengue haemorrhagic fever, typhoid, leukaemia), although in the case of leukaemia, pain reduction did not reach the mild category, thereby indicating the need for combination with other interventions.

The analysis also highlights a number of limitations that constitute important research gaps regarding the effectiveness of ice compresses during IV insertion in preschool-aged children. Many studies remain focused on school-aged children or on other procedures (venipuncture, booster immunisation), resulting in relatively limited and fragmented evidence specific to IV cannulation in the preschool group. Most study designs are single-centre quasi-experiments with small to moderate sample sizes and minimal analysis of psychological factors such as child anxiety, parental support, and prior procedural experiences. In addition, variation in the form of cold interventions (ice pack, cool pack, ice gel, cold alcohol) and differences in cultural contexts and healthcare systems underscore the need for more structured research in order to draw conclusions that are more specific and applicable to nursing practice in Indonesia.

Table 2.
Results of Data Analysis

No.	Title	Authors & Study Setting	Aim of the Study	Design / Methods	Main Findings	Implications & Gaps
1	Analysis of Clinical Nursing Practice Using an Innovative Cold Compress (Cool Pack) Intervention to Reduce Pain During IV Insertion in Dengue Fever Patients in the Emergency Department	Efita Latifah et al., Aji Muhamm ad Parikesit Regional General Hospital, Kutai Kartaneg ara, Indonesia	To analyse the effect of an innovative cold compress (cool pack) intervention on pain levels during IV insertion in children with dengue fever in the emergency department.	Clinical practice / case analysis using the FLACC pain scale (face, legs, activity, cry, consolability) to assess changes in pain before and after the cool pack intervention.	The cool pack intervention was associated with a reduction in pain scores during IV insertion.	Implication: Supports the use of cool packs as a non-pharmacological intervention in the emergency department to reduce procedural pain in children with dengue fever. Gap: Practice-based/case report design, no control group, small and non-random sample; limited generalisability and not specific to preschool-aged children only.

No.	Title	Authors & Study Setting	Aim of the Study	Design / Methods	Main Findings	Implications & Gaps
2	Effect of Cold Compresses (Cool Packs) on Pain During IV Insertion in Hospitalised Children	Mareta Akriansyah, Raden Surahmat, RSUD Palembang, Indonesia	To examine the effect of cold compresses on pain intensity during IV insertion in children.	Quasi-experimental, two-group post-test design; 15 children in the intervention group and 15 in the control group; cold compress applied before IV insertion; pain measured using FLACC; independent t-test used for analysis.	Mean pain score in the cold-compress group was 3.93 (SD 1.033) versus 7.40 (SD 1.242) in the control group (p = 0.000), indicating a statistically significant reduction in pain.	Implication: Provides strong justification for incorporating cold compresses/cool packs into standard IV insertion procedures in paediatric wards. Gap: Focuses on children in general rather than preschool-aged specifically; only immediate post-procedure pain assessed; anxiety, parental comfort, and longer-term procedural experience were not evaluated.
3	Cold Compresses to Reduce Pain Level During IV Infusion in Paediatric Typhoid Patients	Renny Triwijayanti et al., Muhammadiyah Hospital, Palembang, Indonesia	To describe the use of cold packs to reduce pain during IV insertion in children with typhoid fever in the emergency department.	Descriptive case-based approach using observation, interviews, and pain assessment over two days in two paediatric patients.	After application of the cool pack, the first child had a pain score of 5 and the second a score of 4, indicating a reduction compared with initial pain.	Implication: Provides preliminary clinical illustration that cold compresses can help reduce IV-related pain in children with specific medical conditions (typhoid) in emergency care. Gap: Very small sample (two cases), no comparison group, no statistical analysis; no specific focus on preschool-aged children or psychological factors such as anxiety.
4	Nursing Care Analysis of Cold Compress (Cool Pack) Application on Pain During IV Insertion in Preschool Children with Leukaemia	Novia Putri, Riau Roslita, Arifin Achmad Regional General Hospital, Pekanbaru, Indonesia	To determine whether cold compress application reduces pain scores during IV insertion in preschool children with leukaemia.	Evidence-Based Nursing Practice (EBNP) using PICOT: preschool children undergoing IV insertion; intervention: cool pack applied 5–10 minutes before insertion; comparison: no cool pack; outcome: reduction in pain level; time: pre-procedural application.	In the intervention case, pain score was 7 (severe pain), while in the control case it was 10 (severe pain); the difference between the two children was small and not clearly clinically significant.	Implication: In complex conditions such as leukaemia, cold compress alone may be insufficient to reduce pain to a mild level; combined non-pharmacological strategies may be required. Gap: Only two cases, no statistical analysis; minimal difference in pain; larger experimental studies are needed, particularly in preschool children with chronic/oncological conditions.
5	Pain Intensity After Application of Ice Compress Before Venipuncture	Fadeelah M.A. Alalo et al., King Fahd University	To determine pain intensity after ice compress application prior to	Experimental study; 50 children aged 6–12 years randomly allocated to a	Mean self-reported pain was significantly lower in the ice-compress	Implication: Supports pre-procedural ice compress as an effective non-pharmacological analgesic for venipuncture; recommended as part of

No.	Title	Authors & Study Setting	Aim of the Study	Design / Methods	Main Findings	Implications & Gaps
	in School-Aged Children: An Experimental Study	y Hospital, Al-Khobar, Saudi Arabia	venipuncture in school-aged children.	study group (ice compress for 3 minutes before venipuncture) and a control group (routine care); pain measured with Wong-Baker FACES; vital signs recorded.	group (1.92 ± 0.316) than in the control group (4.40 ± 0.490), $p < 0.001$; pain was lower in older school-aged children and higher in boys.	routine care for school-aged children. Gap: Restricted to school-aged children (6–12 years); different cultural and service context (Saudi Arabia); no comparison with other non-pharmacological techniques; anxiety and family satisfaction not assessed.
6	Effectiveness of Cold Compresses in Reducing Pain Before IV Insertion or Blood Sampling in School-Aged Children	Junita Lusty et al., Harapan Kita Women and Children's Hospital, Jakarta, Indonesia	To determine the effect of cold compresses on pain during IV insertion or blood sampling in school-aged children.	Quasi-experimental, two-group post-test design; pain measured using the Numerical Rating Scale; intervention vs control compared.	In the intervention group, 90% of children had mild pain (score 1–3), whereas in the control group 100% had severe pain (score 7–10); $p = 0.000$ ($p < 0.05$).	Implication: Confirms that cold compresses reduce procedural pain (IV insertion and blood sampling) and can be integrated into standard paediatric procedures. Gap: Focuses on school-aged children, not preschoolers; no pre-test data; psychological variables such as fear of needles and previous experiences were not explored.
7	Differences in the Effectiveness of Ice-Gel Compresses and Distraction Therapy Using Ice Cubes on Pain Scale in Children Undergoing IV Insertion at Ungaran Regional Hospital	Asti Nuraeni, Tunik Saptawati, RSUD Ungaran, Semarang, Indonesia	To compare the effectiveness of ice-gel compress therapy and distraction by holding ice cubes on the pain scale of children undergoing IV insertion.	Quasi-experimental two-group design; 44 children divided into 22 in the ice-gel compress group and 22 in the distraction-with-ice group; purposive sampling; Mann-Whitney test for analysis.	There was a statistically significant difference in mean pain scores between the two groups ($p = 0.000$), indicating different levels of effectiveness between ice-gel compresses and distraction by holding ice cubes.	Implication: Shows that different cold-based techniques (ice-gel compress vs distraction with ice cubes) can be used by nurses to reduce IV-related pain and selected according to child needs. Gap: Age categories (preschool vs school-aged) not clearly specified; combination of both techniques not evaluated; single-centre quasi-experimental design multi-centre RCTs are needed.
8	Effect of Cold Compresses on Reducing Pain Scale During IV Insertion in School-Aged Children	Sri Enawati et al., DKT Slamet RSPAD Riyadi, Surakarta, Indonesia	To determine whether cold compresses influence pain reduction during IV insertion in children.	Quantitative quasi-experimental design; non-parametric tests used to analyse differences in pain scores between groups.	Non-parametric test result $p = 0.003$ (< 0.05); cold compresses significantly reduced pain scale during IV insertion in school-aged children.	Implication: Supports adoption of cold compresses as part of standard paediatric nursing interventions for IV-related pain in Indonesian facilities. Gap: Focus on school-aged children only; absence of true randomisation; other factors such as anxiety, previous procedures and parental support not examined.
9	Differences in the	Martina Sulasmia	To determine the	Quasi-experimental	Mann-Whitney test	Implication: Indicates that both cold packs and deep

No.	Title	Authors & Study Setting	Aim of the Study	Design / Methods	Main Findings	Implications & Gaps
	Effectiveness of Cold Pack Compresses and Deep Breathing Relaxation Techniques on Pain in School-Aged Children After Td Booster Immunisation	i et al., Bandung, West Java, Indonesia	effectiveness of cold pack compresses and deep breathing relaxation techniques on pain following Td booster immunisation in school-aged children.	post-test-only design with non-equivalent control group; 34 children divided into a cold-pack group (n = 17) and a deep breathing group (n = 17); pain measured using the Visual Analogue Scale.	showed no significant difference in pain levels between cold pack and deep breathing relaxation; both techniques helped manage pain.	breathing may be used as alternative pain management strategies during immunisation, and that family support plays an important role in reducing perceived pain. Gap: No “no-intervention” control group, making it difficult to isolate the pure effect of each technique; focuses on booster immunisation in school-aged children, not IV procedures or preschoolers; combination of cold and relaxation techniques not assessed.
10	Effect of Cryotherapy at Venipuncture Site on Pain Intensity Among Children Undergoing Blood Sampling	Yahia M. Sayed et al., Paediatric Medical Unit, Minia University Hospital, Egypt	To evaluate the effect of cryotherapy (cold compress/ice pack) at the venipuncture site on pain intensity in preschool children undergoing blood sampling.	Quasi-experimental one-group pre-post design; 60 preschool children; cryotherapy applied at venipuncture site before blood sampling; pain measured using Wong-Baker Faces Pain Scale and CHEOPS.	Pain scores on both Wong-Baker and CHEOPS decreased significantly after cryotherapy (p < 0.001); cryotherapy was concluded to be effective in reducing venipuncture pain in preschoolers.	Implication: Cryotherapy/ice pack can be used as a routine non-pharmacological intervention to reduce venipuncture pain in preschool children. Gap: Single-group design without control; focused on blood sampling, not specifically IV cannulation; RCTs with control groups and studies in other countries (e.g. Indonesia) are needed.
11	Effects of Cold Alcohol Compression on Pain of Preschoolers Receiving Intravenous Fluid Infusion	Atchariya Wonginc han et al., hospital in Thailand providing IV fluid infusion to preschoolers	To determine the effect of cold alcohol compression on pain in children aged 3–5 years receiving intravenous fluid infusion.	Quasi-experimental four-group design; preschoolers aged 3–5 years assigned to intervention (cold alcohol compression 1 minute before IV insertion) and control groups; pain measured using CHEOPS.	Children receiving cold alcohol compression had significantly lower pain scores than controls; brief pre-procedural cold application reduced sharp pain at needle insertion.	Implication: Demonstrates that cold compression (including ice/cold packs) is appropriate to provide local anaesthetic effect prior to IV infusion in preschoolers. Gap: Uses cold alcohol rather than pure ice pack; single setting in Thailand; combination with distraction techniques (e.g. music, parental presence) not evaluated.
12	Effectiveness of Local Cold Application on Pain and Behavioural Distress During Invasive Intravenous Procedures –	Sushma Oommen, Asha P. Shetty, paediatric hospital in India	To assess the effectiveness of local cold application in reducing pain and behavioural distress during invasive IV	Experimental post-test-only control group design; 24 children aged 3–12 years (12 intervention, 12 control); local cold application (ice pack)	Most participants were aged 3–5.9 years. Children in the cold-application group had significantly lower pain	Implication: Ice pack application a few minutes before IV insertion can be implemented independently by nurses as a simple, safe, low-cost non-pharmacological technique. Gap: Small sample (pilot study) and wide age range; preschool-specific analysis

No.	Title	Authors & Study Setting	Aim of the Study	Design / Methods	Main Findings	Implications & Gaps
	A Pilot Study		procedures (IV cannulation).	before IV procedure; pain measured with the Revised Faces Pain Scale, distress with the Behavioural Distress Scale.	and behavioural distress scores than controls, indicating the effectiveness of local cold application.	not reported; parental anxiety and satisfaction not measured.
13	A Non-Pharmacological Approach to Pain Management in Paediatrics: Cold Pack Therapy During Intravenous Cannulation	Angga Wilandika et al., RSUD Bandung Kiwari & Universitas 'Aisyiyah Bandung, Indonesia	To evaluate the effectiveness of cold pack therapy in reducing pain during IV cannulation in paediatric patients, particularly those aged 3–6 years.	Quasi-experimental study with block randomisation; 98 children aged 3–6 years; intervention group (n = 49) received cold pack 2 minutes before IV cannulation, control group (n = 49) received standard care; pain measured using FLACC; Mann–Whitney U test used for analysis.	Mean pain score in the cold-pack group was 3.31 ± 1.63 versus 4.33 ± 1.56 in the control group ($p = 0.002$). In the intervention group, 46.9% experienced only mild pain, whereas 57.1% in the control group experienced moderate pain. Cold pack therapy was concluded to be effective and simple.	Implication: Provides recent and highly relevant evidence from Indonesia for preschoolers (3–6 years), showing that a 2-minute cold pack application before IV cannulation significantly reduces FLACC pain scores. Gap: Although block randomisation was used, the design remains single-centre quasi-experimental; no comparison with other non-pharmacological methods (e.g. Buzzy, play, music); long-term outcomes such as procedural trauma or cooperation with future procedures were not evaluated.

DISCUSSION

Age and Pain in Intravenous Cannulation Procedures

Based on the analysis, it is evident that the child's age plays an important role in the perception and expression of pain during invasive procedures such as intravenous cannulation and venepuncture. In the pre-school age group (± 3 –6 years), several studies (Oommen & Shetty, 2022; Pushpasanthi et al., 2024) indicate that children within this age range are still able to demonstrate clear differences in pain intensity before and after the application of cold compresses, even though their verbal ability to describe pain remains limited. This is reflected in the reduction of pain scores on observational scales such as FLACC and CHEOPS, accompanied by decreased crying, restlessness, and physical resistance when the cannulation procedure is performed following the application of a cold compress.

Conversely, among school-age children (6–12 years), pain assessment generally shows reductions that are more readily captured through self-report scales such as the Wong-Baker Faces Pain Rating Scale, the Numerical Rating Scale, and the Visual Analogue Scale. Studies (Alalo et al., 2018; Dais et al., 2025) consistently report statistically significant decreases in pain scores following the application of ice compresses prior to venepuncture or intravenous cannulation. School-age children tend to have more mature cognitive and language abilities, enabling them to identify and communicate their pain intensity with greater accuracy. Specifically, in pre-school children with severe or chronic medical conditions, such as those with leukaemia, findings by Cozzi et al. (2021)

show that although cold compresses are administered before intravenous cannulation, the reduction in pain does not reach the mild category (scores remain within the severe pain range). This illustrates that beyond age, disease condition, frequency of prior procedural exposure, and psychological burden may also influence pain perception (Neshat et al., 2020). Therefore, the relationship between age and pain in the context of ice compress interventions is complex: cold compresses are effective across different age groups, but the response may be modulated by developmental maturity, clinical condition, and the child's procedural experience.

Cold Compress Interventions in Alleviating Pain: Mechanisms and Effectiveness

The analysis indicates that ice compresses (ice packs/cool packs) constitute an effective non-pharmacological intervention for reducing procedural pain in children, including those of pre-school age. Quasi-experimental studies with control groups (Dais et al., 2025; Wilandika et al., 2025) demonstrate significant reductions in pain scores in groups receiving cold compresses compared with groups without cold interventions. In the study by Wilandika et al., for example, the application of a cold pack for 2 minutes before intravenous cannulation in children aged 3–6 years significantly reduced FLACC scores and shifted the proportion of pain from the moderate to the mild category. Similarly, Sayed et al. (2020) report a marked reduction in Wong-Baker and CHEOPS scores following cryotherapy at the venepuncture site in pre-school children.

Based on physiological perspective, the mechanism of cold compresses in alleviating pain can be explained through several main pathways. First, exposure to low temperatures induces local vasoconstriction, thereby reducing blood flow to the innervated area and decreasing the release of inflammatory mediators and nociceptor sensitisation (Bourdier et al., 2021; Perumal et al., 2025). Second, cold temperatures reduce the conduction velocity of impulses in pain fibres (C and A-delta fibres), so that the transmission of pain signals to the central nervous system becomes slower. Third, in line with gate control theory, non-nociceptive sensory stimulation (such as cold sensation transmitted via A-beta fibres) may “close the gate” at the dorsal horn of the spinal cord, thereby inhibiting the incoming pain impulses (Haghani & Reza, 2021). The combination of these effects leads to a reduction in both subjective pain intensity and observable pain-related behaviours in children.

Based on clinical practice standpoint, cold compress interventions have also been shown to reduce behavioural distress, such as crying, struggling, and muscle tension during procedures (Taam & Lim, 2023). Consistent with this, Friedrichsdorf and García (2020) report that children receiving local cold application before intravenous procedures not only exhibit reduced pain scores but also significantly lower behavioural distress scores. Consequently, it can be concluded that ice compresses act not only on the physiological pain pathways but also contribute to emotional comfort and the child's adaptation during invasive procedures.

Advantages and Disadvantages of Various Forms of Cold Compress Interventions

Various forms of cold interventions used in the reviewed studies such as ice packs/gel cool packs, cold alcohol compresses, distraction by holding ice cubes, and combinations with relaxation breathing techniques each have their advantages and limitations. Ice packs or gel cool packs have the advantages of ease of use, the ability to maintain a more stable cold temperature, non-dripping properties, and relative safety for the skin if wrapped in a thin cloth (Small et al., 2021). This form is highly practical for intravenous cannulation procedures because it can be placed directly on the puncture area without interfering with the procedural field (Ahmad et al., 2022).

In contrast to cool packs, cold alcohol compresses offer the advantage of a rapid cooling effect combined with the antiseptic properties of alcohol, thus simultaneously assisting skin antisepsis (Yilmaz & Canbulat Sahiner, 2023). However, their disadvantages include the potential for skin irritation or dryness, particularly in children with sensitive skin, and an odour that may be

unpleasant to children. Distraction by holding ice cubes combines the cold effect with sensorimotor distraction, thereby diverting the child's attention away from the procedure. Its drawback is that this intervention requires the child's active cooperation; in very anxious or uncooperative pre-school children, holding ice cubes may instead increase discomfort (Cozzi et al., 2021).

Relaxation breathing techniques in the study by Sulasmiati et al. (2017) do not provide a direct cooling effect but act through regulation of the autonomic nervous system and reduction of anxiety. Their advantages include not requiring additional equipment and being teachable to children and parents (Mansour et al., 2016). However, these techniques demand a certain level of cognitive ability to follow breathing instructions and are therefore more suitable for school-age children than pre-schoolers. In addition, the study by Şermet et al. (2021) reports no significant differences between cold compresses and relaxation techniques, indicating that both approaches can be beneficial, but their relative effectiveness may be influenced by the individual characteristics of the child and the clinical context.

Based on perspective of applicability in pre-school children, ice compresses/ice packs or cool packs applied directly at the procedural site appear to be the most realistic and consistently effective in reducing pain, as they do not depend heavily on the child's verbal cooperation (Mansour et al., 2016). However, in the context of chronic disease or very frequent procedures, such as in children with leukaemia, cold compresses tend to need to be combined with other techniques (for example, visual distraction, parental presence, or simple relaxation techniques) to achieve more optimal reductions in pain and anxiety.

Instruments for Assessing Pain Intensity: Strengths and Limitations

The studies in the table employ various pain assessment instruments which can broadly be categorised into behavioural observational scales and self-report scales. The FLACC scale (Face, Legs, Activity, Cry, Consolability) is widely used in studies in Indonesia and is highly appropriate for pre-school children and those who are not yet able to verbally report pain (Akriansyah & Surahmat, 2021). The strength of FLACC lies in its ability to capture pain expression through five behavioural domains, which makes it particularly useful in children who are uncooperative or have limited communication abilities. However, its main limitation is its subjective nature and the potential for inter-rater variation; reliability is highly dependent on observer training and consistency (Z. Zhou et al., 2025).

The CHEOPS and Behaviour Distress Scale are also observational scales that focus on pain-related behaviours and distress during procedures. Their advantages include sensitivity in capturing children's motor and vocal responses to invasive pain (Sayed et al., 2020). Nonetheless, similar to FLACC, these scales require time, training, and consistency in scoring, and can be influenced by other factors such as the child's baseline temperament or situational anxiety, which are not solely attributable to physical pain. In the context of school-age children, self-report instruments such as the Wong-Baker Faces Pain Rating Scale, the Numerical Rating Scale (NRS), and the Visual Analogue Scale (VAS) are commonly used (Alalo et al., 2018). The primary advantage of facial and numerical scales is that they allow children to directly express their subjective pain experience, enabling the detection of subtle changes that may not be evident in behaviour (Silverberg et al., 2020). However, these scales require a certain level of cognitive ability to understand numerical concepts, ordering, or abstract facial expressions, making them less ideal for younger pre-schoolers or children with developmental delays (Mao et al., 2020).

Therefore, in evaluating the effectiveness of ice compresses on pain during intravenous cannulation in pre-school children, observational instruments such as FLACC and CHEOPS are the most appropriate choice, as they do not depend on verbal reporting and have been shown to be sensitive to changes in pain following cold compress interventions (X. Zhou et al., 2020). Facial scales may be used as an additional tool in pre-school children who are sufficiently mature cognitively and able

to select facial expressions that match the pain they experience. Hence, an appropriate combination of pain assessment instruments and standardised cold compress interventions will enhance the validity of findings and support evidence-based clinical implementation in pre-school age groups.

CONCLUSION

Based on the analysis, it can be concluded that the application of ice compresses (ice packs/cool packs) is an effective non-pharmacological intervention for reducing procedural pain in children, including pre-schoolers undergoing intravenous cannulation. The majority of studies demonstrate significant reductions in pain scores in groups receiving cold compresses compared with control groups, whether assessed using observational instruments (FLACC, CHEOPS, Behaviour Distress Scale) or self-report scales (Wong-Baker Faces, NRS). Consistently, the administration of ice compresses several minutes before intravenous cannulation or venepuncture is able to transform sharp pain sensations into milder, more tolerable pain for the child.

Available evidence also indicates variability in pain responses related to age, underlying clinical condition, and type of procedure. In pre-school children with acute illness without severe comorbidities, ice compresses tend to produce more marked reductions in pain, whereas in children with chronic or oncological conditions, the effect is not always sufficient to reduce pain to a mild category and may therefore require combination with other interventions. In addition, a number of studies still focus predominantly on school-age children and employ quasi-experimental designs in single healthcare facilities, meaning that the generalisability of findings specifically for intravenous cannulation procedures in pre-school children requires further strengthening through larger-scale controlled clinical trials.

These findings have important implications for paediatric nursing practice, particularly in the application of atraumatic care principles in paediatric units. As a simple, low-cost, and relatively safe technique, ice compresses should be considered for integration into standard operating procedures (SOPs) for procedural pain management, especially in intravenous cannulation for pre-school children. The implementation of this intervention should be accompanied by nurse training on correct application procedures (duration, site, and skin protection), appropriate age-specific pain instrument selection, and education for parents to support the use of non-pharmacological strategies in the hospital environment.

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