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Review Article

Cold Compress to Reduce Pain During Invasive Procedures: Systematic Review

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ABSTRACT

Pain is one of the common effects experienced by children during invasive procedures, such as infusion, injection, blood sampling, and others. Cold compresses are a non-pharmacological method believed to be effective in reducing pain in children prior to invasive procedures. The purpose this systematic review aims to evaluate the effectiveness of cold compresses in reducing pain in children during invasive procedures. The study adopts a systematic review approach following the PRISMA guidelines. The synthesized articles were selected based on Randomized Controlled Trials (RCT) designs and met the inclusion criteria, namely children aged 0–18 years undergoing invasive procedures. Articles were sourced from PubMed, Cochrane, and ProQuest. The collected data included population, intervention, comparison, and outcomes measured using the Visual Analog Scale (VAS) and FLACC. A review of three articles showed that cold compresses significantly reduced pain intensity in children before invasive procedures. Data analysis using a random-effects model of secondary trial data revealed a mean difference in pain intensity of 0.34 (95% confidence interval: [-0.76, -0.33]), assessed using VAS and FLACC scores. Cold compresses are proven effective in reducing pain intensity in children before invasive procedures. Further studies are needed to explore the influence of other variables, such as the type of procedure and the duration of application

INTRODUCTION

According to Carla, (2017), In the United States, 3-10% of children undergo hospitalization which includes various age groups, such as toddlers (1-3 years old), preschoolers (3-5 years old), and school-age children (6-12 years old). Meanwhile, in Germany, hospitalization occurs in 3-7% of toddlers and 5-10% of preschoolers. Nationally, based on data from the 2020 Health Statistics Profile, 43.69% of children aged 0-4 years who had undergone hospitalization were reportedly treated in private hospitals, while 30.81% were treated in government hospitals (Kemenkes RI, 2021). During the hospitalization process, children often undergo invasive procedures, such as IV insertion, which can cause pain (Anonymous et al., 2024). These procedures are particularly challenging for preschool children who do not have a mature understanding of body integrity (Inan & Inal, 2019).

Pain is a feeling of discomfort caused by tissue damage or potential tissue damage (Ashkenazy & Ganz, 2019). While the International Association for the Study of Pain (IASP) defines it as an unpleasant sensory and emotional experience, related to potential or existing tissue damage (Raja et al., 2020). One of the causes of tissue damage is invasive procedures, such as blood draws, IV insertion, and drug administration, which can cause significant pain in children (Handayani et al., 2020). Some people will not feel comfortable if their body feels a feeling of pain (Rachmawati & Budiawan, 2024). Smith et al., (2022) stated that pain from invasive procedures in children is often overlooked, even though it can have a long-term impact on children's development and their medical experience. Therefore, it is important to find effective and safe pain management methods.

One of the methods that can be used to reduce pain is nonpharmacological methods (Putra et al., 2024), including cold compresses (Kia et al., 2021). Nonpharmacologic techniques are known to have positive effects in managing pain in children (Checa-Penalver et al., 2024). Some methods that can be used are distraction techniques (Wardah et al., 2020). In addition, another method that can be used is cold compresses (Fatriansari, 2019).

Cold compress is a pain relief measure using cold water 10-15 degrees Celsius (Sutiyono et al., 2024). Giving cold compresses can minimize pain by inhibiting impulses of small myelin fibers and nonmyelin C fibers, so as to reduce the increase in the number of nocicepto stimuli (Makkaraeng et al., 2024), selain itu cold compresses can have an analgesic effect. This can provide relaxation to tense muscles and joint stiffness (Hidayatin et al., 2020).

Although the application of cold compresses in pain reduction in children has not been fully confirmed, this method is starting to be applied in various healthcare facilities. Given the high problem of pain caused by invasive procedures, this study aims to evaluate the effectiveness of cold compresses in reducing pain in children during invasive procedures. This study is expected to contribute to better pain management efforts for children during invasive medical procedures.

METHOD

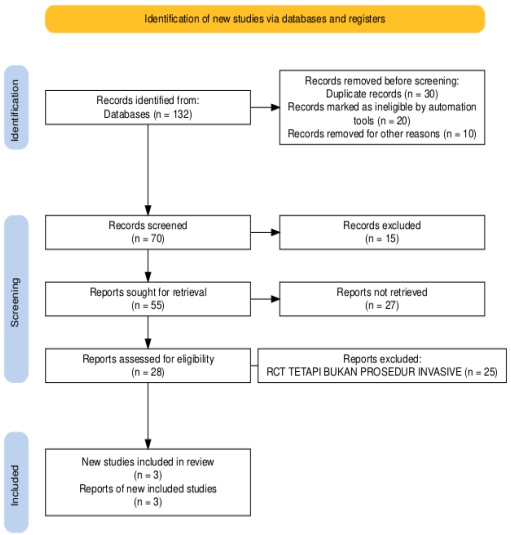
The method applied in this review was a Systematic Review approach using PICO (Population, Intervention, Comparing, and Outcome) guidelines in developing research questions and the basis for article selection. The initial stage involved

searching for articles in three electronic databases, such as PubMed, Cochrane, and ProQuest. Articles that met the inclusion criteria had to contain research related to the mirror therapy intervention in one of the treatment groups, published between 2014 and 2024, and available in full text in English.
Other criteria included the type of study, which was a randomized clinical trial (RCT). In the context of research participants, the inclusion criteria for articles included pediatric patients aged 0-18 years with the inclusion criteria of children undergoing hospitalization and invasive measures. Exclusion criteria were children with hypersensitivity to cold, worsening skin disorders, and circulatory disorders. The keywords used were "child," "cold compress," "ice therapy," "invasive," "infusion," "injection," "RCT". The keywords used in the article search have been determined using Medical Subject Headings (MesH) and then the author conducted a search strategy using the "AND" and "OR" methods as Boolean Operators.
Two independent reviewers (SA and EM) will evaluate the title, abstract, and full text based on the established inclusion criteria. Any disagreements that arise will be resolved through discussion, or if necessary, by involving a third reviewer (AY). In addition, this selection process will follow the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines to provide a visual representation of the number of articles found, selected, and included in the study.
Data analysis will be conducted systematically, starting with a quality assessment of each article using the Joanna Briggs Institute (JBI) checklist. An overall methodological quality assessment will be conducted using the Cochrane Risk of Bias in Randomized Trials (ROB 2.0). The data extraction process will include collecting information from the selected studies, including author names, year of publication, study design, participant demographics, details of the mirror therapy intervention, comparison group characteristics, and relevant statistical results, along with the effect size of each study.

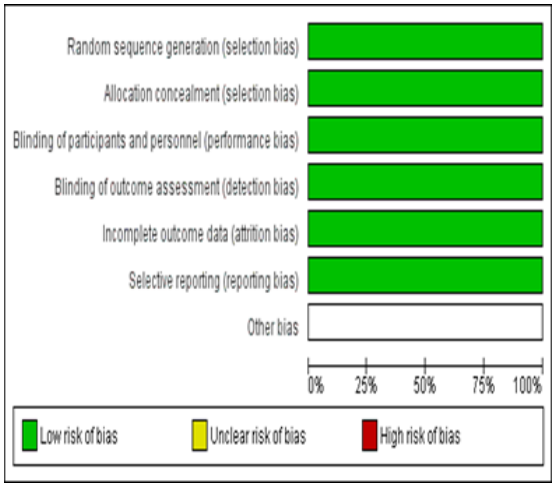
RESULTS

At this stage, the author conducted an article search. In the identification stage, a total of 132 articles were successfully obtained from such as PubMed, Cochrane, and ProQuest. Prior to the screening process, 30 articles were removed due to duplication, 20 articles were marked as ineligible by automated tools, and 10 articles were removed for other reasons, leaving 70 records to be screened. At the screening stage, 15 articles were excluded, leaving 55 articles searched for retrieval, of which 2 were inaccessible. Next, 28 articles were assessed for eligibility, but 25 report articles were excluded on the grounds of "RCTs but not invasive procedures." Finally, only 3 articles made it through and were included in the systematic review, with 3 articles from those studies included.

Bagan 1: Search Diagram Using the PRIMSA Method



From the three articles obtained, the authors conducted a risk of bias assessment using the Cochrane Risk of Bias in Randomized Trials (ROB 2.0) tool and visually depicted using Revman software through the risk of bias graph (Figure 1) and risk of bias summary (Figure 2) as follows:



Picture 1. Risk of bias graph

Picture 2. Risk of bias graph summary

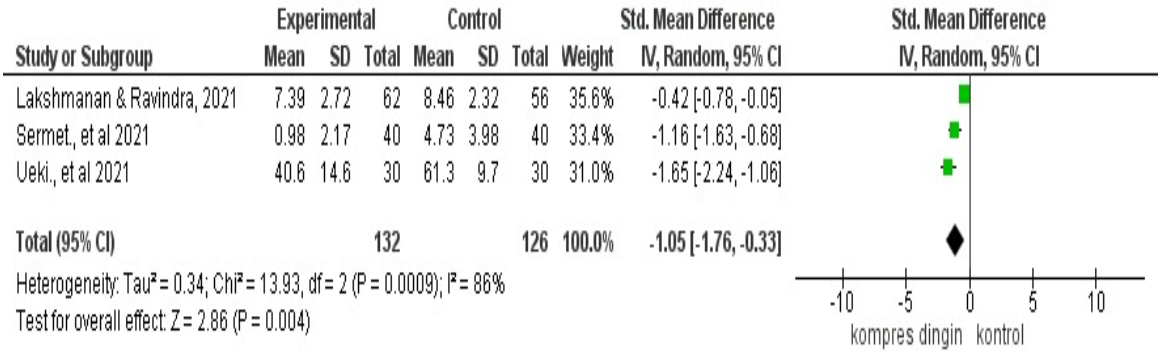
In the next stage, the authors conducted a quality assessment for each article using the Joanna Briggs Institute (JBI) checklist. Overall methodological quality assessment will be carried out using the Cochrane Risk of Bias in Randomized Trials (ROB 2.0).

Table 1. Penilaian Kualitas Artikel

Joanna brigs Institute: Randomised Controlled Trial	Lakshmanan & Ravindran, 2021	Şermet., et al 2021	Ueki., 2021
Was the randomization used for sample selection done correctly?	Yes	Yes	Yes
Was the assignment to treatment groups hidden?	Not	Not	Yes
Does the treatment group have similar characteristics to the control group?	Yes	Yes	Yes
Were participants blinded to group assignment?	Not	Not	Not
Are the blinded outcome assessors unaware of the group assignments?	Yes	Yes	Yes
Were the intervention and control groups given the same treatment other than the intervention?	Yes	Yes	Yes
Were the participants randomly analyzed in the division of groups?	Not	Not	Yes
Are outcomes measured in the same way in the treatment group?	Yes	Yes	Yes
Are the results measured in a reliable way?	Yes	Yes	Yes
Is the statistical analysis used appropriate?	Yes	Yes	Yes
Is the RCT design appropriate for the topic and are there differences in the methods and analyses from standardized RCTs?	Yes	Yes	Yes

Tabel 2. Sintesis Artikel

NO	ARTICLE TITLE	AUTHOR AND YEAR	RESEARCH METHODS	POPULATION	INTERVENTIONS	COMPARISON	RESULT
1	Efficacy of Cryotherapy Application on the Pain Perception during Intraoral Injection: A Randomized Controlled Trial	Lakshimi Lakshmanan dan Vignesh Ravindran, 2021	Randomized Controlled Trial (split-mouth design)	30 pediatric patients aged 7-10 years who required bilateral buccal infiltration anesthesia for dental procedures	Cryotherapy (ice pack application on the buccal mucosa for 2 minutes)	Topical anesthetic 20% benzocaine gel (1 minute application)	Cryotherapy significantly decreased pain scores on the VAS scale (40.66 ± 14.60) compared with benzocaine (61.33 ± 9.73). On the SEM scale, cryotherapy showed lower scores (1.2 ± 0.1) than benzocaine (1.6 ± 0.1), although not statistically significant.
2	The Effect of Cold Application on Relieving Drug Infusion-Related Pain in Children: A Randomized Controlled Experimental Trial in Turkey	Müzeyyen Beste Şermet, Nurcan Özyazıcıoğlu, Sibel Ergün, 2021	Randomized Controlled Trial	120 children aged 6-18 years old who were hospitalized in pediatric hospitals in Turkey	Application of cold pack (stored in refrigerator) over the intravenous catheter area before infusion	Cold pack application at room temperature (placebo) and no application (control)	Cold pack application from the refrigerator significantly reduced the mean VAS score at the 5th minute (0.98 ± 2.17) compared to the placebo (3.95 ± 4.08) and control (4.73 ± 3.89) groups with $p<0.001$. There was no significant difference at the 10th minute, but at the 15th minute the control group showed higher scores than the placebo group ($p=0.026$).
3	The Effectiveness of Vibratory Stimulation in Reducing Pain in Children Receiving Vaccine Injection: A Randomized Controlled Trial	Shingo Ueki, Eriko Matsunaka, Kenji Takao, Mika Kitao, Minae Fukui, Yuichi Fujita, 2021	Single-blind Randomized Controlled Trial	118 children aged ≥6 years who received vaccinations in Japan	Application of BUZZY® device (vibration + ice pack) at the injection site for 1-2 minutes before vaccination	BUZZY® placed without power on (control)	Researcher assessment using the FLACC scale showed no significant difference (mean score 6.98 vs 7.63; $p=0.25$). Parents' assessment using the FPS-R scale showed a significant difference (7.39 vs 8.46; $p=0.02$).



Gambar 3. Meta-analysis of all studies to see the effectiveness of cold compresses on pain before invasive procedures in children

DISCUSSION

Cold compress/cryotherapy has been widely investigated as a non-pharmacological method to reduce pain arising from medical procedures in children. Three studies were analyzed showing the application of this method to intraoral injection, intravenous infusion, and vaccination procedures to evaluate its effectiveness in reducing pain perception. The research method used was a randomized controlled trial. The sample size of the studies varied, with participants ranging from 30 to 120 children, reflecting a wide enough population to analyze.

In the first study by Lakshmanan & Ravindran, (2021), the study involved 30 children aged 7-10 years who underwent dental procedures under bilateral buccal anesthesia. Topical cryotherapy using ice packs compared to benzocaine showed a significant reduction in pain scores on the VAS scale (40.66 ± 14.60) compared to benzocaine (61.33 ± 9.73) with $p < 0.05$. However, on the SEM scale, the difference between cryotherapy (1.2 ± 0.1) and benzocaine (1.6 ± 0.1) was not statistically significant ($p > 0.05$). This suggests that cryotherapy may be a promising alternative in procedural pain management.

The second study by Şermet et al., (2021) involved 120 children aged 6-18 years who underwent intravenous infusion at a hospital in Turkey. Refrigerated cold pack application compared to placebo and control showed significant results in reducing pain at the 5th minute after infusion. The mean VAS score at the 5th minute showed a significant decrease in the cold application group (0.98 ± 2.17) compared to the placebo group (3.95 ± 4.08). The results showed that at the 5th minute, the group receiving cold therapy had a lower pain score (3.89 ± 4.73) compared to the control group (4.73 ± 3.89) with a p value <0.001. However, there was no significant difference at the 10th minute ($p > 0.05$). At the 15th minute, the control group showed a higher pain score than the placebo group with a p value = 0.026. This finding indicates that the analgesic effect of cold therapy is more effective in the short term, but tends to decrease over time, so additional interventions may be needed to achieve more lasting results.

On the other hand, a third study by Ueki et al., (2021) involved 118 children aged ≥6 years in Japan who received vaccinations. The effectiveness of vibrational stimulation using the BUZZY® device was evaluated through two pain assessment methods: the researcher-rated FLACC scale and the parent-rated FPS-R scale. Results showed that the mean FLACC score showed no significant difference

between the intervention and control groups (6.98 vs. 7.63; p = 0.25). However, on the parent-rated FPS-R scale, there was a significant difference in pain perception, where the group using the BUZZY® tool reported lower scores (7.39 vs 8.46) with a p value = 0.02. This difference between the two assessment methods suggests that pain perception is subjective and dependent on the evaluation method used, so the results of this study warrant further study.

This study is supported by research results Ekawaty & Oktarina (2020), the results showed that the pain level in the control group mostly experienced 68.8% more pain. The pain level in the intervention group mostly experienced a slight pain of 43.8%. The difference in pain level was known to be lower than the control group's pain level 1.50 compared to the control group. Mann Withney Test results obtained p value of 0,000 means that there are significant differences between children who get icepack before venous puncture and children who do not get aice pack before venous puncture.

Overall, these three studies show that cryotherapy and vibration stimulation methods can help reduce pain from medical procedures in children, with effectiveness varying depending on the type of procedure, duration of application, and pain assessment method used. The experimental group's research sample of 132 children provided a fairly good picture.

Results from the meta-analysis showed that the use of cold compresses was effective in reducing pain before invasive procedures in children. Three studies were analyzed, namely Lakshmanan & Ravindra (2021), Sermet et al. (2021), and Ueki et al. (2021), showed standardized mean differences (SMD) of -0.42, -1.16, and -1.65, respectively, with 95% confidence intervals (CI) indicating a significant effect. Overall, the combined results showed an SMD of -1.05 (95% CI: -1.76 to -0.33) with a Z value = 2.86 and P = 0.004, indicating that these results were statistically significant. The total sample size in the experimental group was 132 children, while the control group consisted of 126 children. However, the heterogeneity between studies was high (I^2 = 86%), indicating that there was variation in the results. Nonetheless, these findings support that cold compresses can be an effective method to reduce pain before invasive procedures in children.

CONCLUSION

Cold compress is effective in reducing pain before invasive procedures in children. The results were statistically significant, but the high heterogeneity showed variation between studies. Nonetheless, cold compress can be considered as an effective non-pharmacological method for pain management.

RECOMMENDATION

The application of cold compresses in healthcare is very positive, especially in improving pediatric patient comfort during invasive procedures. It is easy to apply, cost-effective, and has minimal risk of side effects, making it a practical solution for pain management. With proper education to healthcare workers, cold compresses can be integrated as part of standard procedures in various healthcare facilities. The long-term impact of pain reduction in children includes a more positive medical experience, reduced risk of psychological trauma, and improved patient compliance with follow-up care. Further research is needed to explore factors that influence the effectiveness of cold compresses, such as duration of

application and optimal temperature, to maximize its benefits.

REFERENCES

Ashkenazy, S., & Ganz, F. D. (2019). The Differentiation Between Pain and Discomfort: A Concept Analysis of Discomfort. *Pain Manag Nurs.*, *20*(6), 556–562. https://doi.org/https://doi.org/10.1016/j.pmn.2019.05.003

Carla, N. (2017). Pengaruh penerapan atraumatic care: Medical play terhadap respon kecemasan anak usia prasekolah yang hospitalisasi di ruang rawat inap anak RSUD dr. M. Zein Painan tahun 2017 (Doctoral dissertation, Universitas Andalas). *Universitas Andalas*.

Checa-Penalver, A., Lirio-Romero, C., Ferreira, E. A. L., Hernandes-Iglesias, S., Garcia-Valdivieso, I., Perez-Pozuelo, J., & Gomez-Cantarino, S. (2024). Effectiveness of Non-Pharmacological Interventions in the Management of Pediatric Chronic Pain: A Systematic Review. *MDPI Journals*, *11*(12). https://doi.org/https://www.mdpi.com/2227-9067/11/12/1420#

Ekawaty, F., & Oktarina, Y. (2020). The Effectiveness of Ice pack to Reduce Pain in School Age Children with Venous Functioning. *Advances in Health Sciences Research*, *25*.

Fatriansari, A. (2019). Pengaruh kompres dingin terhadap penurunan skala nyeri pemasangan infus pada anak pra sekolah. *Jurnal Ilmiah Multi Science Kesehatan*, *11*(1).

Handayani, L., Rahayu, U., & Platini, H. (2020). Kualitas Tidur Pada Pasien Gagal Jantung. *Medika Cendikia*, *7*(1), 35–39.

Hidayatin, N., A, A. D., & Prawitasi, E. (2020). The Effect of a Cold Compress on Pain During the First Stage of Childbirth at BPM. *Jurnal Ners*, *15*(2), 473–475. https://doi.org/http://dx.doi.org/10.20473/jn.v15i2(si).20514

Inan, G., & Inal, S. (2019). The impact of 3 different distraction techniques on the pain and anxiety levels of children during venipuncture. *Clinical Journal of Pain*, *35*(2), 140.

Kemenkes RI. (2021). *Profil Kesehatan Indonesia 2020*. Kementerian Kesehatan Republik Indonesia.

Kia, Z., Allahbakhshian, M., Ilkhani, M., Nasiri, M., & Allahbakhshian, A. (2021). Nurses' use of non-pharmacological pain management methods in intensive care units: A descriptive cross-sectional study. *Complementary Therapies in Medicine*, *58*, 1–5. https://doi.org/https://doi.org/10.1016/j.ctim.2021.102705

Lakshmanan, L., & Ravindran, V. (2021). Efficacy of cryotherapy application on the pain perception during intraoral injection: A randomized controlled trial. *Journal of Dental Anesthesia and Pain Medicine*, *21*(2), 97–103.

Makkaraeng, M. Y., Maruapey, F., Huwae, L. B. ., & Aagkejaya, O. W. (2024). Pengaruh Kompres Dingin Terhadap Perubahan Tanda Dan Skor Nyeri Pada Tindakan Pungsi Vena Pediatrik. *Jurnal Ners*, *8*(2), 1584–1592.

Putra, F. A., Widiyono, Suwarni, A., & Abdillah, Y. (2024). Analgesic Effect Of Cuping Therapy To Reducing Pain Cephalgia Patients. *Healthcare Nursing Journal*, *6*(2276–283).

Rachmawati, A. S., & Budiawan, H. (2024). Effect of Application of Benson Relaxation on Pain Reduction in Postoperative Patients with Benigna Prostate Hyperplasia at Dr. Soekardjo

Hospital. *Healthcare Nursing Journal*, 6(2), 384–389. https://doi.org/10.35568/healthcare.v6i2.5128

Raja, S. N., Carr, D. B., Cohen, M., Finnerup, N. B., Flor, H., Gibson, S., Keefe, F., Mogil, J., Ringkamp, M., Sluka, K. A., Song, X.-J., Stevens, B., Sullivan, M., Tutelman, P., & Ushida, T. (2020). The Revised IASP definition of pain: concepts, challenges, and compromises. *HHS Public Access*, *161*(19), 1976–1982. https://doi.org/10.1097/j.pain.0000000000001939

Şermet, M. B., Özyazıcıoğlu, N., & Ergün, S. (2021). The effect of cold application on relieving drug infusion-related pain in children: A randomized controlled experimental trial in Turkey. *Journal of Pediatric Nursing*, *61*, 38–45.

Smith, H., James, B., Kritina, B., Peter, J., Vijay, E., Brenda, G., Aaron, G., Larkin, A., Chritina, A., Christine, B., Jenny, B., Michael, C., Mihaela, D., Mary, D., James, F., Kimberly, F., Frances, G., Mary, G., Joy, H., … John, B. (2022). Society of Critical Care Medicine Clinical Practice Guidelines on Prevention and Management of Pain, Agitation, Neuromuscular Blockade, and Delirium in Critically Ill Pediatric Patients With Consideration of the ICU Environment and Early Mobility. *The Society of Critical Care Medicine and the World Federation of Pediatric Intensive and Critical Care Societies*, *23*(2), e74–e110. https://doi.org/: 10.1097/PCC.0000000000002873

Sutiyono, Riniasih, W., & Sari, E. puspikha. (2024). Perbandingan Intervensi Kompres Hangat Dan Kompres Dingin Pada Nyeri Sendi Pasien : Studi Kasus Keperawatan Pada Pasien Asam Urat. *Journal of TSCNers*, *9*(1), 22–32.

Ueki, S., Matsunaka, E., Takao, K., Kitao, M., Fukui, M., & Fujita, Y. (2021). The effectiveness of vibratory stimulation in reducing pain in children receiving vaccine injection: A randomized controlled trial. *Vaccine*, *39*(14), 2080–2087. https://doi.org/https://doi.org/10.1016/j.vaccine.2021.03.013

Wardah, G. N., Purwanto, S., & Adhisty, K. (2020). Pengaruh Teknik Distraksi Audio terhadap Penurunan Skala Nyeri pada Proses Pemasangan Intravena Fluid Drip. *Citra Delima: Jurnal Ilmiah STIKES Citra Delima Bangka Belitung*, *3*(2), 82–88.