



Case Report

NON-NUTRITIVE SUCKING FOR PROCEDURAL PAIN RELIEF IN A PRETERM NEONATE IN THE NEONATAL INTENSIVE CARE UNIT: A NURSING CASE REPORT



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Abstract

Premature infants admitted to the neonatal intensive care unit are frequently subjected to repeated invasive procedures, placing them at high risk for procedural pain that can adversely affect neurological development if not properly managed. This case report describes the nursing care provided to a premature infant born at 27 weeks of gestation with a birth weight of 1,100 grams. Assessment revealed that the infant exhibited acute pain responses during invasive procedures, including peripheral intravenous catheter placement and venous blood sampling, characterized by grimacing, high-pitched crying, increased limb movements, and irregular breathing patterns, with a Neonatal Infant Pain Scale score of 7, indicating severe pain. The primary nursing diagnosis established was acute pain related to invasive procedural stimuli, supported by physiological and behavioral pain indicators. The nursing care plan incorporated non-nutritive sucking as the primary non-pharmacological pain intervention, administered consistently two minutes before, throughout, and two minutes after each invasive procedure over a 25-day observation period, while nesting positioning and environmental modification were maintained as pre-existing components of routine developmental care. Pain reassessment using the Neonatal Infant Pain Scale across five follow-up time points throughout the entire observation period. Following intervention, the Neonatal Infant Pain Scale score decreased from 7 (severe pain) to 1 (minimal or clinically insignificant pain), accompanied by reduced crying duration, a calmer behavioral state, and stable physiological parameters. This case demonstrates that the Non-Nutritive Sucking technique is a simple, safe, cost-effective, and scientifically supported nursing intervention for reducing procedural pain in preterm infants in an intensive care setting; therefore, its integration into standard neonatal pain management protocols should be considered.

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Keywords: Intensive Care Units, Neonatal Pain, Neonate, Non-Nutritive Sucking, Pain Management, Premature Infant



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Introduction

Preterm neonates admitted to the neonatal intensive care unit are frequently exposed to repeated painful invasive procedures, including venipuncture, heel puncture, intravenous catheter insertion, suctioning, and endotracheal procedures (Weng et al., 2024). Evidence indicates that neonates in intensive care settings undergo an average of 7.38 painful procedures daily, with only 27% receiving adequate analgesia (Bueno et al., 2024). Unmanaged pain exposure in this population is associated with altered neurodevelopmental outcomes at 12 months corrected age, highlighting the critical importance of adequate pain management to reduce the risk of poor outcomes in these vulnerable patients (Giordano et al., 2023). Premature infants are particularly susceptible due to immature neurological systems and limited capacity for self-regulation (Giordano et al., 2023; Lv et al., 2025; T. Zhao et al., 2022). Pain assessment in neonates presents significant clinical challenges, as these patients are unable to verbally communicate discomfort. Healthcare professionals therefore rely on physiological and behavioral indicators (Ten Barge et al., 2024). Validated tools such as the Neonatal Infant Pain Scale assess behavioral reactions to painful procedures in preterm and full-term newborns and have demonstrated high interrater reliability and internal consistency (Sarkaria & Gruszfeld, 2022). The assessment and management of neonatal pain is considered crucial for the development and wellbeing of vulnerable infants, with neonates reported to experience a median of 10 painful procedures daily during hospitalization (Llerena et al., 2022). Effective neonatal pain management requires a multidisciplinary and evidence-based approach integrating both pharmacological and non-pharmacological strategies (Weng et al., 2024). Non-nutritive sucking is among the most widely studied non-pharmacological interventions, involving sucking activity using a pacifier or gloved finger without nutritional intake, thereby stimulating orotactile receptors and endogenous analgesic pathways to promote comfort and self-regulation (Popowicz et al., 2026).

Multiple high-quality systematic reviews and meta-analyses have consistently confirmed the effectiveness of non-nutritive sucking in reducing procedural pain in neonatal intensive care unit settings, with evidence showing significant reductions in pain scores when non-nutritive sucking is applied alone or in combination with

oral sucrose during invasive procedures, while also supporting oral feeding progression and physiological maturation in preterm infants (Q. Li et al., 2022; Weng et al., 2024; S. Zhao et al., 2024). Although the effectiveness of non-nutritive sucking has been widely reported in clinical trials and systematic reviews, evidence describing its implementation within structured nursing care processes in Indonesian neonatal intensive care unit settings remains limited. This case report therefore aims to describe the implementation and effectiveness of non-nutritive sucking in reducing procedural pain in a preterm neonate treated in the neonatal intensive care unit.

Presentation of the Case

a. Patient Information

Baby R is a de-identified female preterm neonate born on 2 January 2026 at 27 weeks of gestation via emergency caesarean section, with a birth weight of 1,100 grams and body length of 39 cm. She is the third child (G3P1A1) with premature rupture of membranes as the primary obstetric complication. No maternal history of chronic illness, allergies, or infectious risk factors was identified. Apgar scores were 6 and 8 at five and ten minutes respectively. Active diagnoses included respiratory failure, hyaline membrane disease grade I, metabolic acidosis, very low birth weight with extreme prematurity, hyponatremia, hypocalcemia, neonatal jaundice, hyperbilirubinemia, anemia, and impending cardiorespiratory decompensation. Nutritional support was delivered via orogastric tube (20–25 mL/feed, 12 feeds/day) and parenteral IV fluids, though nutritional status remained poor per the Fenton growth curve.

The primary nursing concern was acute procedural pain during repeated invasive procedures (peripheral IV insertion and venous blood sampling), with a NIPS score of 7 indicating severe pain, accompanied by grimacing, high-pitched crying, and irregular breathing. Additional nursing diagnoses included ineffective breathing pattern, nutritional deficit secondary to gastrointestinal immaturity, and infection risk related to prolonged hospitalization and

invasive device use. From a psychosocial standpoint, no social risk factors or parental capacity concerns were identified. The mother was actively involved in care, received counseling on breastfeeding and kangaroo mother care, and no genetic conditions or relevant familial medical history were documented.

b. Clinical Findings

On initial admission to the NICU on 2 January 2026, Baby R was a female preterm neonate born at 27 weeks of gestation with a birth weight of 1,100 g and a body length of 39 cm, head circumference of 24 cm, and chest circumference of 25 cm. The neonate exhibited characteristics of extreme prematurity, including thin fragile skin, lanugo, absent plantar creases, poorly formed ear cartilage, and a weak sucking reflex. Skin color appeared mildly icteric with warm acral perfusion, and capillary refill time was less than two seconds, indicating adequate peripheral perfusion. Primitive neonatal reflexes, including rooting and grasp reflexes, were present but diminished, consistent with extreme prematurity. Significant respiratory distress necessitated immediate endotracheal intubation and mechanical ventilation (PC-SIMV mode).

c. Timeline

Table 1

Daily Clinical Progress of Patient

Date	Clinical Status
2 January 2026	Born at 27 weeks gestation via emergency caesarean section; birth weight 1,100 g, length 39 cm; Apgar score 5'/10' = 6/8; Down score 8; intubated and placed on mechanical ventilation (PC-SIMV mode). Orogastric tube (OGT) and peripherally inserted central catheter (PICC line) were inserted.
2-16 January 2026	Mechanical ventilation (PC-SIMV) maintained for 14 days; Weight 1,200 g.
17 January 2026	Successfully extubated; transitioned to CPAP-B support.
19-26 January 2026	Transitioned to low-flow nasal oxygen (0.5 – 0.3 L/min), weight 1,340 g. NIPS score was 7 without NNS intervention. NIPS score 4-3 with NNS.
27 January – 10 February 2026	Transitioned to low-flow nasal oxygen (0.3 – 0.1 L/min), weight 1,400 g. NIPS score 2-1.
10-13 February 2026	The infant was relatively stable, breathing independently without supplemental oxygen support, and was transferred to the neonatal ward with a weight of 1,630 g.

d. Diagnostic Assessment

Diagnostic evaluation included physical examination, laboratory assessment, radiologic imaging, and neonatal pain

Vital signs on admission were heart rate 121 beats/minute, respiratory rate 54 breaths/minute, temperature 36.8°C, and SpO₂ 98% under ventilatory support, with Apgar scores of 6 and 8 at five and ten minutes respectively, indicating initial compromise followed by clinical improvement.

Respiratory examination showed minimal retractions and nasal flaring without wheezing or crackles. Chest auscultation revealed bilateral vesicular breath sounds. Cardiovascular examination showed regular heart sounds without murmur. Abdominal examination revealed no distention, normal bowel sounds, and oral gastric tube placement.

During invasive procedures, peripheral intravenous catheter insertion and venous blood sampling, the neonate consistently demonstrated behavioral and physiological pain indicators including facial grimacing, high-pitched crying, increased extremity movement, and irregular breathing, with a Neonatal Infant Pain Scale (NIPS) score of 7, indicating significant pain.

assessment. Chest radiography demonstrated hyaline membrane disease grade I. Laboratory examination revealed elevated monocyte count and increased

bilirubin levels, while culture results remained sterile.

The infant was diagnosed medically with respiratory failure improvement, metabolic acidosis, hyaline membrane disease grade I, very low birth weight preterm infant, hyperbilirubinemia, anemia, hyponatremia, hypocalcemia, and impending decompensation.

Nursing assessment identified several nursing diagnoses, including ineffective breathing pattern related to lung immaturity, imbalanced nutrition less than body requirements related to inability to absorb nutrients, acute pain related to invasive procedures, and risk for infection related to prolonged hospitalization and invasive devices.

The primary focus of this case report was acute pain related to invasive procedures, supported by the following findings: facial grimacing, high-pitched crying, increased extremity movement, NIPS score of 7 during invasive procedures, presence of repeated invasive procedures including blood sampling and intravenous catheter insertion.

e. Therapeutic Intervention

Neonatal pain management was implemented using non-nutritive sucking as the primary targeted intervention for procedural pain, applied in addition to the routine developmental care already established in this neonatal intensive care unit. Pain assessment was performed using the Neonatal Infant Pain Scale before, during, and after each invasive procedure, with concurrent continuous monitoring of physiological parameters including facial grimacing, irregular breathing pattern, arm and leg flexion or extension, and restlessness.

Nesting positioning and environmental modification, including maintenance of a warm and stable thermal environment within the incubator, were already established components of routine developmental care in this neonatal intensive care unit prior to the initiation of non-nutritive sucking. Non-nutritive sucking was therefore introduced specifically as an additional targeted intervention for procedural pain

management during venous blood sampling and peripheral intravenous catheter insertion, distinct from and supplementary to these pre-existing routine comfort measures.

The non-nutritive sucking intervention was administered by trained neonatal nurses using a sterile soft silicone pacifier of appropriate size for gestational age. The intervention was initiated two minutes prior to each invasive procedure to allow the neonate to establish a rhythmic sucking pattern, maintained continuously throughout the procedure, and continued for a minimum of two minutes after procedure completion or until the infant returned to a calm and restful behavioral state. Pain reassessment using the Neonatal Infant Pain Scale was conducted upon completion of the two-minute post-procedural non-nutritive sucking period to evaluate the effectiveness of the intervention.

The intervention was applied consistently across all five invasive procedure events throughout the 25-day observation period by the primary nursing team responsible for the neonate's care, under supervision of the attending neonatal nurse in charge. In instances where a pacifier could not maintain adequate positioning due to the neonate's oral anatomy or weak sucking reflex, a gloved finger was used as an alternative device to sustain sucking stimulation.

f. Follow-up and Outcomes

Following implementation of Non-Nutritive Sucking (NNS), the neonate demonstrated progressive and consistent improvement in pain responses across the observation period. NNS was not initiated during the intubation period (2-16 January 2026). Pain assessment using the NIPS was commenced after extubation, when all six behavioral and physiological components could be fully and accurately evaluated. As documented in Table 2, the NIPS score at baseline (19 January 2026, before NNS) was 7, indicating severe pain. Following NNS initiation, pain scores declined gradually from 3–4 and finally to 1, reflecting a sustained reduction in procedural pain

from severe to minimal levels over the course of the intervention.

Table 2

Observational Record of Invasive Procedures with NNS Intervention

Day of care	NIPS Score	Pain Level	Patient Response
January 19 th , 2026	7 (without NNS)	Severe pain	Facial grimacing; strong high-pitched continuous crying; irregular breathing pattern; arm and leg flexion/extension; restlessness
January 24 th , 2026	4-3 (with NNS)	Moderate-mild pain	Facial grimacing; intermittent moaning/whimpering; restlessness
January 26 th , 2026	2 (with NNS)	Mild pain	Facial grimacing; restlessness
February 1 st , 2026	1(with NNS)	Minimal pain	
February 6 th , 2026	1 (with NNS)		Mild facial grimacing only; infant appears relatively calm
February 12 th , 2026	1 (with NNS)		

Behavioral indicators of pain improved markedly, with reduced crying, decreased facial grimacing, and improved comfort. The nursing diagnosis of acute pain related to invasive procedures was considered resolved, and pain management intervention was discontinued.

The infant also demonstrated a consistent and progressive improvement in respiratory status, advancing from mechanical ventilation (PC-SIMV) on admission, through CPAP-B support, to low-flow nasal oxygen, and ultimately achieving independent breathing without supplemental oxygen by the time of transfer. Concurrently, weight increased steadily from 1,100 g at birth to 1,630 g at discharge, reflecting a total weight gain of 530 g over the course of care. Infection risk was managed effectively through consistent aseptic practice and hand hygiene enforcement.

No adverse events associated with the NNS intervention were identified throughout the observation period. Intervention adherence was consistently maintained across all nursing shifts, and no pharmacological analgesic escalation was required at any point during the care episode.

Discussion

Pain management in preterm neonates remains a major challenge in neonatal intensive care

settings because neonates are frequently exposed to repeated invasive procedures during prolonged hospitalization (Fulkoski et al., 2023; Sriraman et al., 2024). Untreated neonatal pain may result in short-term physiological instability and long-term neurodevelopmental consequences, including altered stress regulation and impaired neurobehavioral development (Shiff et al., 2021). Therefore, early recognition and effective management of procedural pain are essential components of neonatal nursing care (Weng et al., 2024). In this case, the preterm neonate demonstrated significant pain responses during invasive procedures, reflected by a NIPS score of 7 accompanied by facial grimacing, high-pitched crying, irregular breathing, and increased extremity movement. These findings are consistent with behavioral indicators of neonatal pain reported in previous neonatal pain studies (Llerena et al., 2022; Vu-Ngoc et al., 2020). The use of validated neonatal pain scales is important to ensure objective assessment and timely intervention (Bruschettini et al., 2022). Non-nutritive sucking was selected as the primary non-pharmacological intervention based on its established mechanistic basis and clinical evidence. The analgesic mechanism of non-nutritive sucking involves activation of the endogenous analgesic pathway via stimulation of oral receptors, resulting in reduced perception of pain through activation of neurochemical pathways associated with pain modulation and

decreased reactivity to nociceptive stimuli (Popowicz et al., 2026).

Non-nutritive sucking has been established as a method for stabilizing neonates during painful procedures, with evidence demonstrating its soothing effect during both single and repeated invasive events in the neonatal intensive care unit (Weng et al., 2024). Ratnaningsih et al. (2024), in an experimental study involving 64 neonates in an Indonesian neonatal intensive care unit, confirmed the analgesic effectiveness of non-nutritive sucking during invasive procedures and recommended its documentation as a standard non-pharmacological pain management strategy to ensure continuity of care and ongoing outcome evaluation (Ratnaningsih et al., 2024).

Following implementation of non-nutritive sucking in the present case, the Neonatal Infant Pain Scale score decreased markedly from 7 to 1, with the neonate transitioning from a distressed to a restful behavioral state while physiological parameters remained stable. These findings are consistent with Irmawati and Irawati (2025), who reported that preterm neonates receiving pacifier-based non-nutritive sucking during intravenous cannulation achieved a mean Neonatal Infant Pain Scale score of 1.65 compared with 4.24 in the control group, with a statistically significant difference ($p = 0.000$) (Irmawati & Irawati, 2025). Vu-Ngoc et al. (2020) similarly demonstrated that non-nutritive sucking is a safe and effective pain-relief method during heel prick procedures in term neonates, with pain scores consistently lower in the intervention group across all measurement time points (Vu-Ngoc et al., 2020). The consistent alignment between the present clinical outcome and these international studies strengthens the validity of non-nutritive sucking as a clinically meaningful nursing intervention for procedural pain in critically ill preterm neonates. Compared with pharmacological approaches, NNS has minimal risk of adverse effects and may be performed repeatedly during routine NICU procedures. This intervention is particularly beneficial for preterm infants who frequently undergo painful procedures during prolonged hospitalization. In addition to pain reduction, NNS may also support oral-motor maturation and coordination of sucking, swallowing, and breathing functions (L. Li et al., 2022; Shaki et al., 2022).

Environmental modification and nesting positioning were already established as

components of routine developmental care in this neonatal intensive care unit and were maintained throughout the observation period. Similarly, nesting positioning has been demonstrated to improve physiological parameters and reduce pain and behavioral state scores in preterm neonates undergoing invasive procedures (Ismail et al., 2024). As these measures were pre-existing routine practices rather than newly introduced interventions, the observed reduction in Neonatal Infant Pain Scale scores across all five procedural events is more readily attributable to the introduction of non-nutritive sucking as the sole additional targeted pain management intervention.

Despite the positive outcome, several limitations should be acknowledged. This report describes only a single case and therefore cannot be generalized to all neonatal populations. In addition, the intervention was evaluated over a short observation period without long-term follow-up regarding neurodevelopmental outcomes.

This case suggests a potential benefit of non-nutritive sucking as an effective and feasible nursing intervention for procedural pain management in preterm neonates. Integration of standardized neonatal pain assessment alongside evidence-based non-pharmacological pain management strategies, with non-nutritive sucking as a primary targeted intervention, into neonatal intensive care unit protocols may improve the consistency and quality of neonatal nursing care, though larger and well-designed studies are needed to confirm these findings across diverse clinical settings.

Patient perspective

As a neonate, the patient was unable to verbally communicate perspectives regarding the intervention. The parents, however, expressed reassurance and satisfaction following education on neonatal pain management and the comfort-focused nursing care provided throughout hospitalization.

Informed Consent

Written informed consent for publication was obtained from the patient's legal guardian. Patient identity and all confidential information have been protected throughout this report.

Conclusion

This case report suggests a potential benefit of non-nutritive sucking in reducing procedural pain in a preterm neonate treated in the neonatal intensive care unit, as evidenced by a reduction in the Neonatal Infant Pain Scale score from 7 to 1 and improved behavioral comfort without adverse effects. As a simple, low-cost, and non-pharmacological intervention, Non-Nutritive Sucking may be considered as part of neonatal pain management strategies in clinical practice. However, the findings of this single-case report should be interpreted with caution, and further studies with larger samples are needed to confirm its effectiveness and establish its role in routine neonatal pain management.

Consent for publication

Written informed consent was obtained from the patient's legal guardian for publication of this case report and any accompanying images. A copy of the written consent is available for review by the Editor in Chief of this journal.

References

- Bruschettini, M., Olsson, E., Persad, E., Garratt, A., & Soll, R. (2022). Clinical rating scales for assessing pain in newborn infants. In *The Cochrane Database of Systematic Reviews* (Vol. 2022, Issue 3). <https://doi.org/10.1002/14651858.MR000064>
- Bueno, M., Rao, M., Aujla, P., Victor, C., & Stevens, B. (2024). A scoping review of the epidemiology and treatment of painful procedures in hospitalized neonates: What has changed in the past three decades? *European Journal of Pain* (London, England), 28(9), 1468–1485. <https://doi.org/10.1002/ejp.2294>
- Fulkoski, N., Kecskes, Z., & Chaudhari, T. (2023). Minor painful procedures in extremely preterm infants admitted to a tertiary neonatal intensive care unit: Opportunities to improve pain mitigation. *Journal of Paediatrics and Child Health*, 59(3), 542–547. <https://doi.org/10.1111/jpc.16352>
- Giordano, V., Deindl, P., Gal, E., Unterasinger, L., Fuiko, R., Steinbauer, P., Weninger, M., Berger, A., & Olischar, M. (2023). Pain and neurodevelopmental outcomes of infants born very preterm. *Developmental Medicine & Child Neurology*, 65(8), 1043–1052. <https://doi.org/https://doi.org/10.1111/dmcn.15505>
- Irmawati1, & Irawati, H. R. (2025). The Effect Of Pacifier Use (Non-Nutritive Sucking) On Pain Intensity In Premature Babies Undergoing IV Infusion In The NICU And Perina Room Alia Hospital Jakarta. *Jurnal Eduhealth*, 16(01), 11–21. <https://doi.org/10.54209/eduhealth.v16i01>
- Ismail, A., Salaghor, S. M., Alshomrani, S. A., & Almodallal, H. (2024). The Impact of Using Nesting Care on Heart Rate, Oxygen Saturation, and Pain Among Premature Neonates in Neonatal Intensive Care Units in Saudi Arabia: A Quasi-Experimental Study. *Cureus*, 16(6), e61775. <https://doi.org/10.7759/cureus.61775>
- Li, L., Liu, L., Chen, F., & Huang, L. (2022). Clinical effects of oral motor intervention combined with non-nutritive sucking on oral feeding in preterm infants with dysphagia. *Jornal de Pediatria*, 98(6), 635–640. <https://doi.org/https://doi.org/10.1016/j.jpmed.2022.02.005>
- Li, Q., Tan, X., Li, X., Tang, W., Mei, L., Cheng, G., & Zou, Y. (2022). Efficacy and safety of combined oral sucrose and nonnutritive sucking in pain management for infants: A systematic review and meta-analysis. *PLoS One*, 17(5), e0268033.

Declarations

Ethics approval and consent to participate

The authors confirm that all appropriate patient consent forms have been obtained. The patient's legal guardians consented to the publication of deidentified clinical information included in this report. All efforts were made to maintain patient anonymity. Ethical principles based on the Declaration of Helsinki were upheld throughout the preparation of this manuscript.

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- Llerena, A., Tran, K., Choudhary, D., Hausmann, J., Goldgof, D., Sun, Y., & Prescott, S. M. (2022). Neonatal pain assessment: Do we have the right tools? *Frontiers in Pediatrics*, 10, 1022751. <https://doi.org/10.3389/fped.2022.1022751>
- Lv, S., Wang, Q., Wei, Y., Chen, L., Zhang, Q., Zhang, J., Fang, Y., Rong, H., Zhou, J., & Gao, H. (2025). Impact of procedural pain during NICU hospitalization on sleep, physical growth, brain maturation and neurobehavioral development in preterm infants: A prospective longitudinal study. *Sleep Medicine*, 136, 106816. <https://doi.org/https://doi.org/10.1016/j.slee.2025.106816>
- Marchal, A., Melchior, M., Dufour, A., Poisbeau, P., Zores, C., & Kuhn, P. (2021). Pain Behavioural Response to Acoustic and Light Environmental Changes in Very Preterm Infants. *Children (Basel, Switzerland)*, 8(12). <https://doi.org/10.3390/children8121081>
- Popowicz, H., Brandt, A., Szablewska, A., Kwiatkowska, W., Kami, B., & Kaczorowska-bray, K. (2026). *Non-Nutritive Sucking (NNS) – Multifaceted Benefits and Limitations: Systematic Review*. 2026. <https://doi.org/10.1155/hsc/9982687>
- Ratnaningsih, T., Peni, T., Firdausiyah, N., & Nugroho, H. S. W. (2024). The analgesic effect of non-nutritive sucking on neonates during invasive procedures. *Anaesthesia, Pain & Intensive Care*, 28(4 SE-ORIGINAL RESEARCH). <https://doi.org/10.35975/apic.v28i4.2511>
- Sarkaria, E., & Gruszfeld, D. (2022). Assessing Neonatal Pain with NIPS and COMFORT-B: Evaluation of NICU's Staff Competences. *Pain Research & Management*, 2022, 8545372. <https://doi.org/10.1155/2022/8545372>
- Shaki, F., Aziznejadroshan, P., Rad, Z. A., Chehrazai, M., & Arzani, A. (2022). Comparison of the effect of two methods of sucking on pacifier and mother's finger on oral feeding behavior in preterm infants: a randomized clinical trial. *BMC Pediatrics*, 22(1), 292. <https://doi.org/10.1186/s12887-022-03352-9>
- Shiff, I., Bucsea, O., & Pillai Riddell, R. (2021). Psychosocial and Neurobiological Vulnerabilities of the Hospitalized Preterm Infant and Relevant Non-pharmacological Pain Mitigation Strategies. *Frontiers in Pediatrics*, 9, 568755. <https://doi.org/10.3389/fped.2021.568755>
- Sriraman, S., Chitamanni, P., Yadav, R. K., & Ranu, S. (2024). Improving Procedural Pain Management for Newborns in a Level 3 Neonatal Intensive Care Unit: A Quality Improvement Initiative. *Cureus*, 16(11), e74410. <https://doi.org/10.7759/cureus.74410>
- Ten Barge, J. A., Baudat, M., Meesters, N. J., Kindt, A., Joosten, E. A., Reiss, I. K. M., Simons, S. H. P., & van den Bosch, G. E. (2024). Biomarkers for assessing pain and pain relief in the neonatal intensive care unit. *Frontiers in Pain Research (Lausanne, Switzerland)*, 5, 1343551. <https://doi.org/10.3389/fpain.2024.1343551>
- Vu-Ngoc, H., Uyen, N. C. M., Thinh, O. P., Don, L. D., Danh, N. V. T., Truc, N. T. T., Vi, V. T., Vuong, N. L., Huy, N. T., & Duong, P. D. T. (2020). Analgesic effect of non-nutritive sucking in term neonates: A randomized controlled trial. *Pediatrics and Neonatology*, 61(1), 106–113. <https://doi.org/10.1016/j.pedneo.2019.07.003>
- Weng, Y., Zhang, J., & Chen, Z. (2024). Effect of non-pharmacological interventions on pain in preterm infants in the neonatal intensive care unit: a network meta-analysis of randomized controlled trials. *BMC Pediatrics*, 24(1), 9. <https://doi.org/10.1186/s12887-023-04488-y>
- Zhao, S., Jiang, H., Miao, Y., Liu, W., Li, Y., Zhang, Y., Wang, A., & Cui, X. (2024). Effects of implementing non-nutritive sucking on oral feeding progression and outcomes in preterm infants: A systematic review and meta-analysis. *PLOS ONE*, 19(4), e0302267. <https://doi.org/10.1371/journal.pone.0302267>
- Zhao, T., Griffith, T., Zhang, Y., Li, H., Hussain, N., Lester, B., & Cong, X. (2022). Early-life factors associated with neurobehavioral outcomes in preterm infants during NICU hospitalization. *Pediatric Research*, 92(6), 1695–1704. <https://doi.org/10.1038/s41390-022-02021-y>