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The Effectiveness of Bathing and Massage Methods on Stress Levels and Physiological Parameters in Premature Infants in the NICU: A Systematic Review

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ABSTRACT
Premature infants are at high risk of physiological and neurological disturbances due to organ immaturity. Although bathing is often considered a calming routine, it may act as a significant sensory stressor for premature infants in the neonatal intensive care unit (NICU). This study aimed to evaluate the effectiveness of various bathing methods and complementary interventions in reducing stress levels and maintaining physiological stability in premature infants. A systematic review was conducted following the PRISMA 2020 guidelines. Literature searches were performed across five electronic databases PubMed, Scopus, ScienceDirect, ProQuest, and Sage Journals as well as additional website sources, covering publications from 2016 to 2025. The search used combinations of keywords including premature infant, preterm infant, bathing, stress, physiological stability, and NICU. A total of 634 records were identified, with 50 duplicates removed. After title and abstract screening, 70 full-text articles were assessed for eligibility. Seven randomized controlled trials involving 523 premature infants met the inclusion criteria and were included in the final review. Data were analyzed using narrative synthesis. Swaddled bathing was consistently more effective than conventional bathing methods in maintaining physiological stability and reducing acute stress responses. Complementary interventions, such as aromatherapy massage and mother-led multisensory stimulation, were beneficial as post-bathing strategies to enhance recovery and relaxation. Swaddled bathing is an effective and recommended bathing method for premature infants in the NICU to reduce stress and support physiological stability.

Keywords: neonatal stress; NICU; physiological parameters; premature infants; swaddled bathing

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INTRODUCTION

Premature infants are those born before reaching 37 weeks of gestational age. This condition represents a significant global health issue. Globally, an estimated 15 million babies are born prematurely each year, and this number continues to increase, making prematurity the leading cause of death among children under five years of age, with more than 900,000 deaths reported in 2019 (WHO, 2023). In Indonesia, the prevalence of preterm birth remains high (approximately 10–11%, or hundreds of thousands of cases annually) and constitutes a major contributor to neonatal mortality. It is estimated that around 35% of neonatal deaths are caused by prematurity and its complications, while the national infant mortality rate reached 16.85 per 1,000 live births in 2020 (Ministry of Health of the Republic of Indonesia, 2022).

Premature infants are highly vulnerable to various medical complications due to the immaturity of multiple organ systems, including the respiratory, neurological, cardiovascular, and immune systems (March of Dimes, 2021). In the neonatal intensive care unit (NICU), premature infants are frequently exposed to invasive medical procedures that may induce toxic stress, potentially affecting brain development and long-term outcomes (Smith et al., 2011). Immaturity of the nervous system limits the infant's ability to regulate stress responses, which often manifests as physiological and behavioral instability (Als, 2009). One routine procedure that is often underestimated but may have a significant impact is bathing.

Bathing is a standard procedure in infant care aimed at maintaining hygiene and comfort and reducing the risk of infection (WHO, 2024). However, in premature infants, bathing may trigger excessive stress, thermoregulatory disturbances (hypothermia), and alterations in cardiovascular and respiratory function (Cistone et al., 2024). These stress responses occur due to the extreme sensitivity of premature infants to changes in temperature, touch, and physical manipulation.

In clinical practice, various bathing methods are applied in the NICU. The traditional method of tub bathing without swaddling is still widely used. However, several studies indicate that this method tends to provoke greater stress responses and thermal instability due to extensive skin exposure (Tasdemir & Efe, 2019). As an alternative, swaddled bathing has been introduced to provide a sense of security and reduce excessive stimulation, minimize startle responses, and protect infants from temperature fluctuations and extreme movements that may cause discomfort (Paran et al., 2016). In this method, the infant is wrapped in a cloth during bathing, allowing the infant to remain in a controlled position while being protected from sudden temperature changes and excessive movement.

In addition to traditional and swaddled bathing, another commonly used method is wipe bathing, which involves cleansing the infant's body with a damp cloth without immersion in water. Wipe bathing is considered a gentler and less stimulating option, particularly for very preterm or clinically unstable infants; however, it may increase the risk of heat loss through evaporation (tapia-rombo et al., 2003). Furthermore, infant massage before or after bathing is also used as a non-pharmacological intervention to enhance infant comfort. Numerous studies have evaluated the effectiveness of these bathing methods in maintaining physiological stability and reducing stress in premature infants during bathing procedures. Nevertheless, reported outcomes remain varied, and there is no clear consensus regarding the most effective method. Therefore, a systematic review of the existing scientific literature is warranted. This systematic review aims to evaluate and compare the effectiveness of various bathing methods (tub bathing, swaddled bathing, and wipe bathing) on stress levels and physiological responses in premature infants in the NICU, based on findings from recent randomized controlled trials (RCTs).

METHOD

Search Strategy

This study was conducted as a systematic review and developed in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) 2020 guidelines. The review focused on instruments used to assess and compare the effectiveness of various bathing methods on stress levels and physiological parameters in premature infants admitted to the NICU. A comprehensive literature search was performed across five major databases: Scopus, ScienceDirect, ProQuest, SAGE Journals, and PubMed, covering publications from 2016 to 2025. The search terms included combinations of: (Premature OR Preterm OR Neonate) AND (Bathing Methods OR Swaddled Bathing OR Tub Bathing OR Sponge Bathing OR Aromatherapy Massage after bathing). In addition, a manual search was conducted to identify relevant articles that met the eligibility criteria. The literature search focused on bathing interventions in premature infants and their primary effects on stress and physiological parameters. The search methodology is illustrated in Figure 1.

Study Selection

Articles included in this review were required to meet the following eligibility criteria: (1) Population: premature infants with gestational age ≤37 weeks; (2) Intervention: various bathing methods, including swaddled bathing, conventional tub bathing, sponge bathing, and bathing combined with aromatherapy massage; (3) Primary outcomes: stress scores (behavioral and/or physiological); and (4) Publication period: studies published between 2016 and 2025. Studies

presented solely as case reports, literature reviews, or those that did not provide quantitative data relevant to the research objectives were excluded. The screening process was conducted by first removing duplicate articles, followed by title and abstract screening of all retrieved records using the Rayyan application. Articles that met the inclusion criteria were then reviewed in full text to confirm eligibility.

Data Extraction and Risk of Bias Assessment

Eligible studies underwent independent assessment through title and abstract screening, followed by full-text review. Extracted data included author names, year of publication, country of study, study design, sample size, characteristics of the intervention, and primary outcomes (physiological parameters and behavioral stress indicators) (Table 1). Methodological quality was assessed using the Cochrane Risk of Bias 2.0 tool (Higgins, 2008). Six domains of bias were evaluated: random sequence generation, allocation concealment, blinding of participants and personnel, blinding of outcome assessment, management of incomplete outcome data, and selective reporting. Each domain was categorized as low risk, some concerns, or high risk of bias. Overall, all included studies demonstrated acceptable methodological quality, although several did not fully report blinding procedures.

Study Selection

Of the 623 potentially relevant articles identified, 50 were removed due to duplication, and 503 were excluded for not meeting the predefined eligibility criteria. The remaining 68 articles underwent full-text review, of which 2 studies met the inclusion criteria. Manual searching identified an additional 11 studies; however, 6 were excluded after full-text assessment as they met the exclusion criteria. The entire identification and selection process, including the number of articles at each stage, is presented in Figure 1.

Study Characteristics

Seven randomized controlled trials (RCTs) included in this review were conducted in China, Iran, and Turkey, involving a total sample of 526 premature infants. All studies were carried out in NICU settings, with variations in intervention protocols and outcome measurements; however, all generally assessed physiological variables and infant behavioral responses.

Gestational Age and Sex of Participants

Most studies focused on late preterm infants, defined as infants born at a gestational age of 34 weeks or more, indicating a relatively clinically stable study population. Specific mean gestational age and standard deviation (SD) values were not consistently reported across all extracted abstracts. Regarding sex distribution, only one study (Dağ et al., 2022) provided complete data, reporting 89 (46.7%) female and 103 (53.3%) male infants, indicating a balanced distribution.

Bathing Method Interventions

The interventions examined in this review were categorized into four main groups:

1. Swaddled Bathing (SB), accounting for approximately 24.9% (131 participants) of all interventions and consistently demonstrating positive outcomes in stress reduction;
2. Traditional Tub Bathing (TB), which represented the largest intervention group at 36.3% (191 participants);
3. Non-Immersion Bathing (Sponge/Wipe Bathing, SpB), comprising 20.5% (108 participants);
4. Tactile/Sensory Interventions (Massage and Multisensory Stimulation), applied as complementary interventions. Non-aromatherapy massage accounted for 9.1% (48 participants), while Maternal Multisensory Stimulation (MSS) as an adjunct to swaddled bathing represented 4.6% (24 participants).

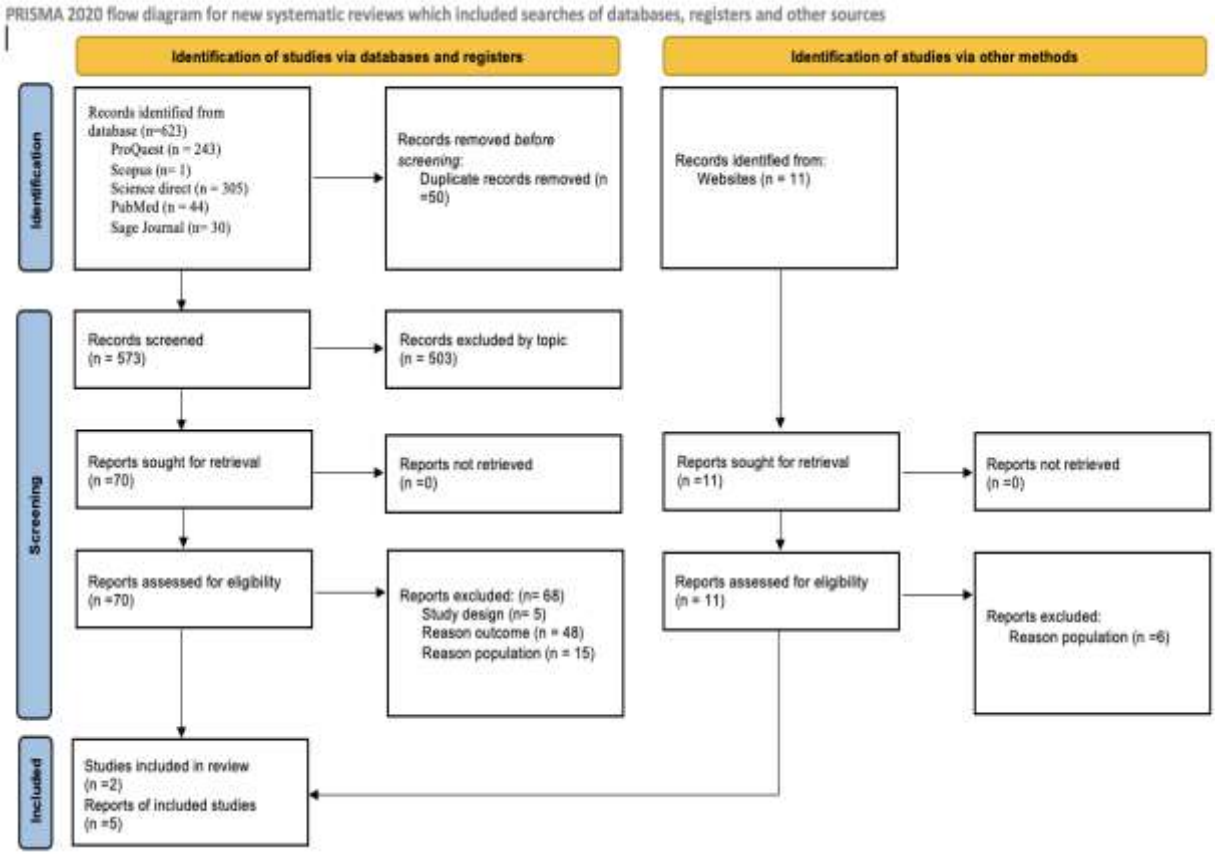

Figure 1. Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) 2020

RESULT

Table 1.
Literature Search Results (n=7)

No.	Author (Year)	Study Title	The main purpose	N (Baby)	Duration of Intervention	Instruments (Stress/Physiological)	Key Results
1	Huang & Zhou (2022), China	*Effects of swaddled and traditional tub bathing on stress and physiological parameters of preterm infants: A randomized clinical trial in China*	Comparing SB and TB on stress and physiology.	N=60 I=30 K=30	10 minutes of observation	HR, RR, SpO2, Stress Score (Crying time)	SB maintained more stable HR, RR, and SpO2 ($p<0.05$). Physiological stress was lower.
2	Dağ et al. (2022), Türkiye	*The effect of massage, wipe bathing and tub bathing on physiological measurements of late premature newborns: A randomized controlled trial*	Analyzing the effects of Massage, WB, and TB on physiological measurements.	N=192 soak=48 control= 48 massage =48	Immediately /30 minutes After Intervention	HR, RR, Body Temperature	WB tends to cause temperature instability compared to TB/Massage.
3	Paran et al. (2016), Iran	*Comparing the Effects of Swaddle and Conventional Bathing Methods on Behavioral Responses in Preterm Neonates*	Comparing SB and CB on behavioral responses to stress.	50	During the Procedure	Neonatal Behavioral Assessment Scale (NBAS)	SB results in less crying and more organized behavioral responses.

No.	Author (Year)	Study Title	The main purpose	N (Baby)	Duration of Intervention	Instruments (Stress/Physiological)	Key Results
4	Mokhtari_naseri et al. (2021), Iran, Iran	*A comparison between the effect of bathing in a tub with and without a swaddle on behavioral responses to stress in premature infants*	Comparing TB with *Swaddle* vs. TB without *Swaddle* on behavioral stress responses.	55	During the Bath	Neonatal Infant Pain Scale (NIPS)	Bathing with *Swaddle* significantly reduced behavioral stress scores.
5	Tasdemir & Efe (2019), Türkiye	*The effect of tub bathing and sponge bathing on neonatal comfort and physiological parameters in late preterm infants: A randomized controlled trial*	Testing the effectiveness of TB and SpB on physiological parameters and comfort.	60	During the Procedure	HR, RR, SpO2, Body Temperature, COMFORTneo	TB was superior in maintaining SpO2 and body temperature. SpB had a higher discomfort score.
6	Soltani et al. (2022), Iran	*The effect of maternal multisensory stimulations on bath stress in premature infants: A randomized controlled clinical trial*	Assessing the effects of maternal multisensory stimulation during bathing on stress.	n=50 control=25 Intervention=25	10 minutes	NIPS, HR, RR	Maternal multisensory stimulation significantly stabilized HR and RR, and reduced NIPS scores.
7	Jia et al. (2025), China	*Swaddle bath vs. Bath tubs for physiological outcomes and skin microbiota in late preterm infants: a randomized trial*	Comparing SB vs. TB on physiological outcomes and skin microbiota.	56	During the Procedure	Thermal Stability, HR, RR	SB reduces thermal instability and stress-related behaviors, which is important for late preterm infants.

DISCUSSION

This systematic review demonstrates that bathing methods exert a significant influence on behavioral stress responses and physiological stability in premature infants cared for in the NICU. Among the interventions evaluated, swaddled bathing (SB) consistently emerged as the most effective approach in reducing stress indicators, stabilizing physiological parameters, and supporting neurobehavioral regulation. These findings reinforce the importance of minimizing stress exposure during routine nursing procedures in neonates with immature regulatory systems.

The findings of this systematic review are supported by several recent primary studies. An experimental study by Huang et al. (2022) demonstrated that swaddled bathing significantly reduced stress scores and crying duration while maintaining thermal stability in premature infants compared with conventional bathing methods. Similar results were reported by Mokhtari-Naseri et al. (2021), who found that swaddled bathing promoted more adaptive behavioral responses and improved physiological stability, including heart rate and oxygen saturation.

Liu et al. (2023) further confirmed that swaddled bathing facilitated a faster transition to quiet sleep and reduced pain and stress scores compared with sponge bathing. In addition, Dağ et al. (2022) emphasized that although several bathing methods are physiologically safe, immersion-based bathing provides greater comfort than non-immersion methods. The study by Taşdemir and Efe (2019), along with subsequent findings from the 2020s, indicates that bathing methods that preserve body temperature and minimize physical manipulation play an important role in maintaining

stability in premature infants. Theoretical support from the World Health Organization (2022) and recent neurodevelopmental research underscores that neonatal care interventions should be tailored to gestational age and sensory tolerance, while also promoting parental involvement to modulate stress and support early brain development.

Behavioral Responses and Stress in Premature Infants

Premature infants in the NICU are frequently exposed to routine yet potentially stressful procedures that may induce toxic stress, which has been associated with altered brain development and adverse long-term neurodevelopmental outcomes (Smith et al., 2011). Due to immaturity of the central and autonomic nervous systems, premature infants have limited capacity to regulate responses to environmental stressors.

Across the reviewed studies, SB and maternal multisensory stimulation (MSS) were associated with significant reductions in stress scores measured by standardized instruments such as NIPS, COMFORTneo, and NBAS. Infants bathed using the SB method demonstrate a faster return to quiet sleep, a critical state for energy conservation and brain recovery. Notably, SB substantially reduced crying duration, for example from an average of 94.43 seconds to 32 seconds, highlighting its calming effect.

Two studies (Huang et al., 2022; Mokhtari-Naseri et al., 2021) consistently showed that SB was superior to conventional tub bathing in reducing stress scores, stabilizing body temperature, and shortening crying duration. By maintaining the infant in a wrapped position throughout bathing and exposing body parts sequentially, SB provides a sense of physical containment that mimics the intrauterine environment. This containment reduces excessive sensory input, which is common in the NICU setting. These findings align with the principles of Developmentally Supportive Care (DSC), which emphasize reducing external stressors and enhancing sensory comfort during neonatal care (Altimier & Phillips, 2016). SB minimizes tactile and thermal overstimulation that could otherwise trigger excessive sympathetic nervous system activation, negatively affecting heart rate, respiration, and thermal regulation (Cong et al., 2017).

Physiological Responses in Premature Infants

From a physiological perspective, premature infants are highly sensitive to fluctuations in temperature, light, noise, and physical manipulation. Bathing can easily provoke stress responses such as increased heart rate (HR), respiratory rate (RR), and decreased oxygen saturation (SpO_2) due to immature autonomic regulation (Liu et al., 2023).

The reviewed evidence indicates that SB and tub bathing (TB) are more effective in maintaining thermal stability compared with sponge or wipe bathing (SpB), which carries a higher risk of heat loss through evaporation. SB, in particular, was shown to preserve stable HR and RR and maintain higher SpO_2 levels than conventional bathing methods. One study also reported that SB was safe and did not disrupt normal skin microbiota colonization in premature infants.

The physiological benefits of SB can be explained by its ability to maintain a flexible posture, reduce exposure to ambient air, and provide consistent thermal containment. These effects are supported by findings from Edraki et al. (2016), who demonstrated that swaddling during routine or invasive procedures reduces negative motor reflexes and helps preserve body temperature. Additionally, self-regulation theory (McCain & Mustard, 2015) emphasizes the importance of supportive environments in facilitating infants' regulatory capacities during the critical neonatal period. Importantly, SB was also associated with a faster transition to quiet sleep following bathing, which is essential for neurodevelopment. Consistent with Liu et al. (2023), swaddled bathing reduced crying duration, stress scores, and pain levels compared with conventional tub or sponge bathing, contributing positively to autonomic nervous system maturation and sleep–wake stability.

Comparative Analysis of Bathing Methods

Evidence consistently supports the superiority of SB over traditional tub bathing without swaddling. SB significantly reduced behavioral stress scores, shortened crying duration, and better controlled thermal instability and physiological fluctuations (HR, RR, SpO_2). Comparisons between immersion (TB) and non-immersion methods (SpB) indicate that TB is generally more effective in maintaining body temperature and improving neonatal comfort (Taşdemir & Efe, 2019). However, Dağ et al. (2022) reported no significant differences among TB, SpB, massage, and control groups in physiological parameters, suggesting that all methods can be safe when implemented under optimal environmental conditions and close monitoring. SpB remains a viable option for extremely premature or medically unstable infants, as it minimizes handling and transfer from the incubator. Although its stress-reducing effect is inferior to SB, SpB contributes to daily hygiene without compromising hemodynamic stability when properly executed.

Role of Massage and Sensory Stimulation

Maternal multisensory stimulation (MSS) added to SB was shown to be a highly effective supportive intervention. While bathing itself—even when swaddled—may still act as a stressor, positive sensory input from the mother (voice and touch) effectively buffers the stress response. This finding underscores the role of parental involvement as a powerful modulator of neonatal stress. Although aromatherapy massage was mentioned in the scope of this review, it was not directly evaluated in the included studies. Nevertheless, WHO guidelines (2022) emphasize that caregiving interventions must be tailored to gestational age, medical stability, and sensory tolerance. For extremely premature infants (<32 weeks) or those with hemodynamic instability, non-immersion methods may be more appropriate.

Mechanistic and Neurobehavioral Implications

The superior effectiveness of SB can be explained by the Thermal Stabilization and Containment Hypothesis. By limiting excessive limb movement and maintaining a flexible posture, swaddling reduces motor disorganization and behavioral stress responses. Warm water immersion combined with swaddling provides a consistent thermal blanket, minimizing evaporative heat loss and supporting cardiovascular and respiratory stability.

The positive effects of MSS support the Neurobehavioral Modulation Hypothesis, whereby maternal sensory input acts as a buffer against acute stress pathways. Together, these mechanisms highlight the importance of environmental and sensory modulation in neonatal care.

From a neuroplasticity perspective, early sensory experiences during critical neonatal periods play a pivotal role in shaping brain structure and function (Pineda et al., 2017). Stabilizing behavioral states and promoting quiet sleep through SB may therefore have long-term benefits for neurocognitive development.

Clinical and Theoretical Relevance

The findings of this review strengthen neurodevelopmental and neuroplasticity theories, highlighting that early sensory experiences directly influence central nervous system regulation. Routine clinical procedures such as bathing should be designed not only for hygiene but also to optimize healthy sensory stimulation and brain development. Swaddled bathing represents a simple, low-cost, yet highly impactful intervention aligned with individualized developmental care (IDC) principles. Moreover, gentle and stabilizing bathing practices enhance parent–infant bonding and may reduce parental stress, which is especially valuable in the NICU environment where physical contact is often limited.

CONCLUSION

This systematic review highlights that bathing methods play a crucial role in maintaining physiological stability and reducing stress levels in preterm infants in the NICU. Among the

approaches reviewed, swaddled bathing consistently emerged as the most effective method for lowering behavioral stress scores, preserving body temperature, reducing crying duration, and maintaining hemodynamic stability, primarily through mechanisms of containment and thermal stabilization. Maternal multisensory stimulation was identified as a strong adjunct intervention that further attenuates stress responses, whereas the specific contribution of aromatherapy massage remains inconclusive and warrants further investigation. Other bathing methods, such as sponge bathing and conventional tub bathing, were found to be physiologically safe but demonstrated limited effectiveness in reducing behavioral stress, although they remain relevant alternatives depending on the infant's clinical condition and available resources. Importantly, the no single bathing method is universally appropriate for all preterm infants; individualized, developmentally supportive care tailored to gestational age, medical stability, and family involvement is essential. Bathing should therefore be recognized not merely as a routine hygiene procedure, but as a valuable opportunity to promote comfort, bonding, and neurodevelopment, underscoring the need for evidence-based protocols, staff training, and family education to optimize neonatal care and support long-term quality of life for preterm infants.

REFERENCES

Altimier, L., & Phillips, R. M. (2016). The neonatal integrative developmental care model: Seven neuroprotective core measures for family-centered developmental care. Newborn and Infant Nursing Reviews, 16 (4), 230–244. https://doi.org/10.1053/j.nainr.2016.09.030

Basdas, RN, et al. (2024). Effects of aromatherapy on pain, stress, and behaviors of newborns. Alternative Therapies in Health and Medicine ; Aliso Viejo Vol. 30, Iss. 12, (Dec 2024): 43-47.

Chorna, O.D., Slaughter, J.C., Wang, L., Stark, A.R., & Maitre, N.L. (2021). A pacifier-activated music player with mother's voice improves oral feeding in preterm infants. Pediatrics, 137 (3), e20153741. https://doi.org/10.1542/peds.2013-2547

Cong, X., Ludington-Hoe, S. M., McCain, G., & Fu, P. (2017). Kangaroo care modifies preterm infant heart rate variability in response to heel stick pain: Pilot study . Neonatal Network : NN; New York Vol. 32, Iss. 5, (Sep/Oct 2013): 353-7. https://doi.org/10.1891/0730-0832.32.5.353

Dağ, Y.S., Yayan, E.H., & Özdemir, R. (2022). The effect of massage, wipe bathing and tub bathing on physiological measurements of late premature newborns: A randomized controlled trial. Journal of Neonatal Nursing, 28(4), 164–169.

Edraki, M., Paran, M., Razavi, R., Montaseri, S., & Montaseri, Z. (2016). Comparing the effects of swaddled and conventional bathing methods on body temperature and crying duration in premature infants: a randomized clinical trial. Journal of Caring Science. https://doi.org/10.5681/jcs.2014.009

Huang, Y., Zhou, L., Abdillah, H., Hu, B., & Jiang, Y. (2022). Effects of swaddled and traditional tub bathing on stress and physiological parameters of preterm infants: A randomized clinical trial in China. Journal of Pediatric Nursing, 64 , e154–e158. https://doi.org/10.1016/j.pedn.2021.11.028

Jia, X., Wu, Y., Huang, Z., Fan, W., Chen, J., Huang, X., & Feng, H. (2025). Swaddle bath vs. Tub baths for physiological outcomes and skin microbiota in late preterm infants: a randomized controlled trial. Frontiers in Pediatrics , 13, 1700944.

Liu, B., Sun, X., Xu, J., Zhou, R., & Gu, Z. (2023). Effectiveness of Different Bathing Methods on Physiological Indexes and Behavioral Status of Preterm Infants: A Systematic Review and Meta-Analysis. BMC Pediatrics, 23 , Article 36. https://doi.org/10.1186/s12887-023-04280-y

McCain, M. N., & Mustard, J. F. (2015). Early years study 3: Making decisions, taking action . Margaret & Wallace McCain Family Foundation.

Ministry of Health of the Republic of Indonesia (Kemenkes RI). (2022). Health Data and Information: Indonesia Health Profile 2021.

Mokhtari-Naseri, S., Zabihi, A., Akbarian-Rad, Z., Jafarian-Amiri, S.R., & Haji Ahmadi, M. (2021). A comparison between the effect of bathing in a tub with and without a swaddle on behavioral responses to stress in premature infants. Iranian Journal of Neonatology, 12 (1), 1–6. https://doi.org/10.1016/j.jnn.2020.09.008

Pineda, R.G., et al. (2017). Parent participation in the neonatal intensive care unit and its association with parent and infant outcomes: A systematic review. Journal of Perinatology, 37 (4), 481-490. https://doi.org/10.1016/j.earlhumdev.2017.12.008

PRISMA. (2020). Preferred Reporting Items for Systematic Reviews and Meta-Analyses: The PRISMA statement . http://www.prisma-statement.org/

Smith, G.C., Gutovich, J., Smyser, C., Pineda, R., Newnham, C., Tjoeng, T.H.,... Inder, T. (2011). Neonatal intensive care unit stress is associated with brain development in preterm infants. Annals of Neurology , 70(4), 541–549.

Soltani, N., Seyedrasooli, A., Jabraeili, M., & Mousavi, S. (2022). The effect of maternal multisensory stimulation on bath stress in premature infants. Infant Behavior and Development 67 (2022) 101720 . https://doi.org/10.1016/j.infbeh.2022.101720

Suna Dağ, Y., Yayan, E. H., & Özdemir, R. (2022). The effect of massage, wipe bathing, and tub bathing on physiological measurements of late premature newborns: A randomized controlled trial. Journal of Neonatal Nursing 28 (2022) 164–169 . https://doi.org/10.1016/j.jnn.2021.08.018

Taneja, A., Kaur, J., & Kaur, H. (2018). Effect of lavender aromatherapy on physiological and behavioral pain response in neonates: A randomized clinical trial. International Journal of Nursing Education, 10 (3), 84–88. https://doi.org/10.5958/0974-9357.2018.00073.1

Taşdemir, H. İ., & Efe, E. (2019). The effects of tub bathing and sponge bathing on physiological parameters of newborns. Journal of Neonatal Nursing, 25(6), 287–292. https://doi.org/10.1016/j.jnn.2019.05.003

The Joanna Briggs Institute. (2020). Checklist for randomized controlled trials. https://jbi.global/critical-appraisal-tools

World Health Organization (WHO). (2023). Preterm birth.

World Health Organization (WHO). (2024). WHO recommendations on newborn health.

World Health Organization. (2022). WHO recommendations for care of the preterm or low-birth-weight infant. WHO Press.

World Health Organization. (2022). WHO recommendations on newborn health: Guidelines approved by the WHO Guidelines Review Committee. https://www.who.int/publications