Review Article

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Impact of Foot Reflexology on Neonates with Hyperbilirubinemia: A Systematic Review

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ABSTRACT

Background: Neonatal hyperbilirubinemia is a prevalent condition commonly treated with phototherapy. While effective, phototherapy can cause adverse effects such as dehydration and maternal separation, necessitating complementary care strategies. **Objectives:** This systematic review aims to evaluate the efficacy of foot reflexology and related tactile interventions on bilirubin levels and physiological parameters in neonates undergoing treatment for hyperbilirubinemia. **Methods:** A systematic search was conducted across five electronic databases (PubMed, Scopus, Web of Science, Google Scholar, and Cochrane Library) for studies published between 2019 and 2025. The review followed the PRISMA guidelines and (Population, Intervention, Comparison, Outcome, Study) framework. Twenty studies, including Randomized Controlled Trials (RCTs) and quasi-experimental designs, met the inclusion criteria. **Results:** The synthesized evidence indicates that foot reflexology is associated with a significant reduction in serum bilirubin levels compared to standard care alone. Additionally, the intervention demonstrated a stabilizing effect on physiological parameters, specifically reducing heart rate (HR) and respiratory rate (RR) while improving oxygen saturation (SpO_2). **Conclusion:** Foot reflexology appears to be a safe and effective complementary therapy that may enhance bilirubin excretion and promote physiological stability in jaundiced neonates.

Keywords: Foot Reflexology; Neonatal Hyperbilirubinemia; Nursing Care; Physiological Parameters; Systematic Review

INTRODUCTION

The neonatal period represents a critical window of physiological adaptation due to immaturity of vital organs (Hussein & Shawq, 2025). Neonatal hyperbilirubinemia is a frequent challenge during this transition, often requiring admission to the Neonatal Intensive Care Unit (NICU) to prevent neurotoxicity and sequelae such as hearing loss or intellectual impairment. While phototherapy remains the gold standard for treatment, it is associated with adverse effects, including skin rashes, dehydration, hyperthermia, and the disruption of parent-infant bonding (Galala *et al*., 2024; Seyedi *et al.*, 2019; Namnabati *et al.*, 2019).

Phototherapy remains the gold standard and most effective non-invasive treatment for hyperbilirubinemia, crucial for preventing bilirubin-induced neurological damage (Shoris *et al*., 2023; Al-Musawi *et al.*, 2020). However, its use is not without drawbacks. Documented adverse effects include skin rashes, dehydration, and stress from parent-infant separation, which can interfere with maternal bonding and disrupt feeding schedules (Mahajan *et al.*, 2022; Mohammed, 2022). Furthermore, concerns regarding potential oxidative stress or DNA damage, particularly in premature infants, highlight the need for adjunctive therapies that can mitigate these limitations (Casavant *et al*., 2019). In this context, complementary therapies have gained prominence in neonatal nursing. Among these, massage therapy is a well-established intervention known to support infant development and improve sleep, digestion, and immunity (Bahig *et al*., 2020; Nawaz *et al*., 2021; Shahbazi *et al.*, 2022).

To mitigate these stressors and enhance clinical outcomes, non-pharmacological complementary therapies have gained prominence. Among these, foot reflexology, a specialized manual therapy applying pressure to specific reflex points on the feet, is theorized to stimulate neurohormonal pathways and improve physiological homeostasis. Proposed mechanisms include the modulation of the autonomic nervous system (increasing vagal

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tone) and the stimulation of gastrointestinal motility, which may accelerate bilirubin elimination (Jazayeri *et al*., 2021; Chen *et al*., 2019; Ghaljaei & Jalalodini, 2021). As non-pharmacological care expands, it is imperative for neonatal nurses to be knowledgeable about such evidence-based techniques to enhance comprehensive care, improve patient outcomes, and reduce costs (Ashor *et al.*, 2016; Vindis *et al.*, 2024). According to this viewpoint, foot reflexology, which is among the top six alternative medicine treatments, can be used to treat illnesses and maintain good health (Chen *et al.*, 2011).

Despite the growing use of reflexology, existing literature has been fragmented. Previous reviews have often combined pediatric populations or lacked specific focus on the mechanism of bilirubin reduction. Furthermore, the specific linkage between reflexology-induced vagal tone and clinical jaundice outcomes requires clearer synthesis. This systematic review aims to consolidate contemporary evidence regarding the impact of foot reflexology on bilirubin levels and physiological stability in neonates, providing evidence-based implications for nursing practice (Mahajan *et al*., 2022; Mohammed, 2022).

METHODOLOGY

Study Design

This review was conducted in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines. The review protocol was directed by the specific research question: What is the impact of foot reflexology on clinical outcomes (bilirubin levels and vital signs) in neonates with hyperbilirubinemia when utilized as an adjuvant to phototherapy?

Search Strategy

A comprehensive search was performed on five electronic databases: PubMed, Scopus, Web of Science, Google Scholar, and the Cochrane Library. The search was limited to articles published from 2019 to 2025 to capture the most recent evidence. Search terms utilized Medical Subject Headings (MeSH) and Boolean operators: ("neonatal hyperbilirubinemia" or "neonatal jaundice") and ("foot reflexology" or "reflexology" or "massage therapy" or "acupressure") and ("bilirubin reduction" or "physiological parameters"). The study selection process is detailed in Figure 1.

Eligibility Criteria (PICOS)

Studies were selected based on the following PICOS framework:

Population: Neonates (0-28 days) with clinically diagnosed hyperbilirubinemia (preterm and full-term).

Intervention: Tactile manual therapy applied to the feet, including foot reflexology, foot massage, foot acupressure, or combined "bundle" care where foot stimulation is a defined component.

Comparison: Standard care (phototherapy only) or sham intervention.

Outcomes: Quantitative measures of Total Serum Bilirubin (TSB), Heart Rate (HR), Respiratory Rate (RR), Oxygen Saturation (SpO2), or pain scores.

Study Design: Randomized Controlled Trials (RCTs) and quasi-experimental studies. Systematic reviews and meta-analyses were included only for reference list hand-searching and qualitative contextualization, not as primary sources for quantitative synthesis.

Exclusion Criteria: To ensure the specificity of the findings to the neonatal population, studies involving non-neonatal populations (e.g., children undergoing chemotherapy or hemodialysis or adults) were excluded, along with neonates with pathological jaundice caused by hemolytic disease or congenital anomalies; review articles, editorials, and duplicate records were also excluded.

Data Extraction and Quality Assessment: Data was extracted regarding author/year, study design, sample size, specific intervention protocols, and key clinical findings. The methodological quality of RCTs was assessed using the Cochrane Risk of Bias tool, while quasi-experimental studies were evaluated using JBI checklists.

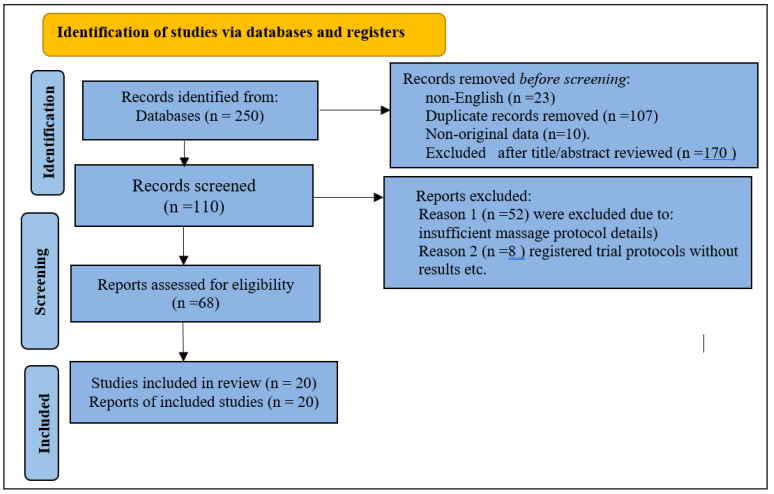

Figure 1: The Detailed Selection of Literature

Study Selection Results: The initial search yielded 250 records. After removing duplicates (n=107) and non-English/non-original records (n=33), 110 records were screened by title/abstract. Fifty-two were excluded for insufficient protocol details or irrelevant populations of the remaining full-text articles assessed, and 20 met all inclusion criteria.

RESULTS

The systematic research identified 18 primary studies investigating foot reflexology and related manual therapies. The findings from primary studies are synthesized below. Findings from secondary syntheses (e.g., Fitri *et al*., 2021; Jing *et al*., 2022) are reserved for contextual discussion in the subsequent section. The results are categorized into three primary domains bilirubin reduction, physiological stabilization, and procedural pain management.

Effect on Bilirubin Levels

The synthesis of evidence suggests a positive correlation between reflexology and bilirubin reduction. Several RCTs reported that the intervention group had significantly lower Total Serum Bilirubin (TSB) levels on days 3 through 5 of treatment compared to controls.

Quantitative findings: Studies reported mean reductions in TSB ranging from 1.5 to 2.8 mg/dL in intervention groups (Ibrahim *et al*., 2022; Korkmaz & Esenay, 2020).

Duration of treatment: The combination of massage and phototherapy was associated with a shorter duration of hospitalization and phototherapy exposure (Fatwa *et al*., 2024; Nour *et al*., 2025).

Effect on Physiological Parameters

Reflexology demonstrated a stabilizing effect on vital signs, consistently shifting neonates toward a state of relaxation.

Heart Rate (HR): Meta-analysis data and individual RCTs indicated a significant decrease in HR, averaging 8 to 12 beats per minute (bpm) lower in intervention groups, attributed to reduced sympathetic activity (Fitri *et al*., 2021; Mahdy *et al.*, 2023).

Respiratory Rate (RR) and Oxygen Saturation (SpO_2): Interventions were associated with a mean reduction in RR of approximately 4 to 6 breaths/minute, moving tachypneic infants toward optimal ranges (Nikzad *et al*., 2021). Concurrently, SpO_2 levels increased by 1.5% to 2.5% in reflexology groups compared to controls (Badr & Ibrahim, 2023; Salehi *et al*., 2019).

To provide a structured overview, the key findings from the included studies are synthesized below and summarized in Table 1

Table 1: Summary of Included Studies

Sl. No.	First Author (Year)	Design	Population	Intervention	Key Outcomes
1.	Salehi *et al*. (2019)	RCT	80 Preterm	Foot Reflexology	↓ HR, ↓ RR, ↑ SpO_2; attributed to enhanced vagal tone.
2.	Moghadam *et al*. (2020)	RCT	60 Term	Foot Reflexology vs Sham	Significant reduction in TSB levels in reflexology group.
3.	Korkmaz & Esenay (2020)	RCT	Neonates (Photo)	Reflexology and Massage	↓ TSB levels, ↑ bowel movements, ↓ phototherapy duration.
4.	Fitri *et al*. (2021)	Meta-Analysis	1,058 Neonates	Reflexology Massage	↓ HR by mean of ~8–12 bpm; reduced sympathetic tone.
5.	Nikzad *et al*. (2021)	RCT	100 Preterm	Reflexology	↓ RR (mean reduction of 2-8 breaths/min) toward optimal range.
6.	Jamali *et al*. (2021)	RCT	51 Newborns	Reflexology and Body Massage	Improved physiological stability and TSB reduction.
7.	Ibrahim *et al*. (2022)	RCT	90 Neonates	Reflexology vs Massage	Reflexology was more effective than general massage for TSB reduction.
8.	Jing *et al*. (2022)	RCT	120 Term	Foot Massage & Acupressure	Significant reduction in pain scores (p=0.000) during heel lancing.
9.	Mahdy *et al*. (2023)	RCT	60 Neonates	Foot Reflexology	Significant decrease in HR ($p < 0.001$); cardio-stabilizing effect.
10.	Badr & Ibrahim (2023)	RCT	60 Neonates	Foot Reflexology	↓ TSB, ↑ SpO_2, stabilized HR and RR by day 5.
11.	Fatwa *et al*. (2024)	Quasi-Exp	60 Term	Bundle Massage	↓ TSB, increased stool frequency, shortened phototherapy.
12.	Elkandoz *et al*. (2024)	RCT	60 Preterm	Massage and White Noise	More stable HR and higher SpO_2 compared to control.
13.	Nour *et al*. (2025)	RCT	Neonates	Foot Massage and Local Heat	Effective in reducing pain from heel blood sampling; ↓ TSB.

DISCUSSION

This systematic review synthesizes recent evidence supporting foot reflexology as a beneficial adjunct to phototherapy for neonatal hyperbilirubinemia. The results consistently highlight improvements in bilirubin clearance, physiological stability, and comfort.

Bilirubin Metabolism and Excretion

The most clinically significant finding is the reduction in total serum bilirubin levels reported across multiple studies (Moghadam *et al*., 2020; Badr & Ibrahim, 2023). The mechanism likely involves the stimulation of the gastrointestinal system. Research by Rashwan *et al*. (2023) and Elkandoz *et al*. (2024) links the reduction in bilirubin to increased gastric motility, feeding tolerance, and stool frequency. By enhancing the enterohepatic circulation, reflexology may facilitate the faster excretion of bilirubin in stool, thereby reducing the required duration of phototherapy. The proposed mechanisms for this effect are multifactorial. Studies by Rashwan *et al.* (2023) and Elkandoz *et al*. (2024) provide a critical insight, directly linking bilirubin reduction to increased frequency of stool passage and feeding amounts. This suggests that these therapies, particularly massage, may enhance the enterohepatic circulation and elimination of bilirubin by stimulating gastrointestinal motility.

Autonomic Regulation and Physiological Stability

Beyond bilirubin management, reflexology aids in stabilizing vital signs during the stress of NICU admission and phototherapy. The observed reductions in heart rate and respiratory rate, alongside improved oxygen saturation, suggest a shift from a sympathetic-dominant "stress state" to a parasympathetic-dominant "calm state." This vagal enhancement is crucial for energy conservation in neonates. Lower metabolic demand (indicated by stable HR and RR) allows energy to be redirected toward growth and recovery rather than stress responses (Hansen *et al*., 2020). Although the evidence is still emerging and has to be rigorously examined, recent studies indicate that foot reflexology may have a good impact on physiological parameters in jaundiced neonates, such as bilirubin levels, Heart Rate (HR), Respiratory Rate (RR), and Oxygen Saturation (SpO_2) (Nikzad, 2021; Patel *et al.*, 2024). This suggests that these therapies, particularly massage, enhance the

enterohepatic circulation and fecal elimination of bilirubin by stimulating gastrointestinal motility (Field & Diego, 2014; Abdelgawad *et al*., 2025). Consequently, this leads to clinically relevant outcomes such as a shorter duration of phototherapy (Jazayeri *et al*., 2021; Moghadam *et al*., 2020; Nour *et al*., 2025). This respiratory stabilization is complemented by consistent improvements in oxygen saturation levels in neonates receiving phototherapy (Mahdy *et al*., 2023; Badr & Ibrahim, 2023). Research in pediatric nursing is considered the cornerstone for providing advanced care and solving complex health problems in neonates. Specialized pediatric nursing knowledge is crucial for refining research topics and enhancing scholarly contributions to the field (Shawq & Ahjil, 2025).

Procedural Pain and Comfort

Reflexology also serves as a non-pharmacological analgesic. Studies by Jing *et al*. (2022) and Nour *et al.* (2025) demonstrated that foot massage and acupressure significantly reduced pain scores and physiological distress during invasive procedures like heel lancing. This aligns with the gate control theory of pain, where tactile stimulation competes with pain signals, providing relief and reducing crying duration (Barzegari *et al.*, 2025). Beyond bilirubin reduction, a significant body of evidence points to the profound calming and stabilizing effects of these interventions on the neonatal autonomic nervous system. The meta-analyses by Fitri *et al.* (2021) and Jing *et al*. (2022), which synthesize data from over a thousand patients, provide high-level evidence for a consistent and significant reduction in heart rate (HR). Similarly, reductions in respiratory rate (RR) and increases in oxygen saturation (SpO_2) were documented in multiple RCTs (Salehi *et al*., 2019; Jamali *et al*., 2021; Mahdy *et al*., 2023; Düken *et al*., 2024). For fragile neonates, this stabilization is not merely a comfort measure; a lower, more stable HR and RR reduce metabolic demand and conserve energy, which can be redirected toward growth and healing (Hansen *et al*., 2020; Patel *et al*., 2024). These findings are not too different from those of Ramezani *et al*. (2017), which declared, "A slight increase was observed in the mean of the oxygen saturation across the intervention days."

Several considerations must be acknowledged when interpreting these findings. The included studies encompass a diverse mix of full-term and preterm neonates, and while the benefits appear to transcend these categories, the optimal protocol may vary based on gestational age and clinical stability. Although the majority of evidence comes from randomized controlled trials (RCTs), a strength of this body of literature, the inclusion of some quasi-experimental designs (Rashwan *et al*., 2023; Fatwa *et al*., 2024; Amelia *et al*., 2025) carries a higher risk of bias.

Limitations

While the results are promising, limitations exist. The heterogeneity of protocols (duration of massage, specific pressure points used) makes direct comparison difficult. Additionally, some included studies utilized quasi-experimental designs, which may introduce selection bias compared to pure RCTs. Future research should focus on large-scale RCTs with standardized reflexology protocols to establish precise dosing and frequency guidelines.

CONCLUSION

Current evidence suggests that tactile manual therapy applied to the feet (encompassing reflexology, massage, and acupressure) is a safe, non-invasive, and effective complementary therapy for neonates with hyperbilirubinemia. Nursing professionals should consider training in these techniques, with the understanding that protocols vary and should be applied based on the best available evidence for a specific technique. Future research should focus on large-scale, standardized trials to determine optimal foot reflexology protocols for neonates, exploring its effects on bilirubin reduction, physiological stability, and phototherapy duration.

Conflict of Interest

The authors declare that they have no competing interests.

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