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LITERATURE REVIEW THE EFFECT OF PHOTO THERAPY ON THE REDUCTION OF BILIRUBIN LEVELS IN NEWBORNS

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ABSTRACT
Jaundice caused by high bilirubin is one of the commonest problems in newborns, and without proper treatment it can lead to serious brain damage. Phototherapy is the principal treatment for lowering bilirubin, but findings on how well the various treatment types perform are fragmented. This paper pools recent findings on the ability of phototherapy to bring down bilirubin in hyperbilirubinemic neonates. A systematic review guided by PRISMA 2020 was undertaken, searching Google Scholar, PubMed, ScienceDirect, and ProQuest for papers dated 2020–2025 with predefined keywords about phototherapy and neonatal hyperbilirubinemia. Six eligible studies were quality-checked with the Joanna Briggs Institute (JBI) checklist and combined in a narrative synthesis. All of them documented a clear decline in bilirubin after light treatment. How well treatment worked depended on the type of phototherapy, its duration, the irradiance, and the way the device was arranged. LED and double phototherapy usually gave bigger drops than conventional phototherapy. In sum, phototherapy is still an effective, evidence-supported option for lowering bilirubin in these infants, and better protocols may improve results and help avert complications linked to bilirubin.
Keywords: Phototherapy, Hyperbilirubinemia, Neonates

INTRODUCTION
Hyperbilirubinemia is still one of the most frequently encountered clinical problems in newborns around the world. It refers to an excess of bilirubin in the blood, generally above 10 mg/dL during the first week of life, which appears as jaundice, namely yellowing of the skin, sclera, mucous membranes, urine, and other tissues (Sembiring, 2019). The condition can have a physiological or a pathological origin, and it remains a serious issue in neonatal care because inadequate management can lead to grave complications (Sukadi, 2019, as cited in Saptanto, 2020). Its importance is heightened because elevated unconjugated bilirubin is able to pass the blood–brain barrier and cause bilirubin encephalopathy, which leaves lasting neurological harm such as intellectual disability, athetoid cerebral palsy, and hearing loss (Soetjiningsih, 2019, as cited in Yuhanids, 2019). Neonatal jaundice is also a worldwide health concern. Viswanath (2020) noted that 30% to 50% of newborns develop hyperbilirubinemia, and roughly 65% of newborns in the United States have jaundice at some point in the neonatal period. In a similar vein, Chime (2020) found a 33% prevalence among Nigerian newborns (Kusumah, 2020, as cited in Ambaraita, 2019).

In Indonesia, around 50% of term infants and 58% of preterm infants develop neonatal jaundice. Figures from a number of referral hospitals point to a heavy disease burden, with prevalence between 13% and 58%, and hyperbilirubinemia is a notable contributor to neonatal illness and death (Hafizah & Imeldah, 2021, as cited in Puspita, 2019). Such findings show that

hyperbilirubinemia is still a major challenge for neonatal health services, both internationally and within the country.

Phototherapy has long been regarded as the first-line therapy for neonatal hyperbilirubinemia and is now the intervention most commonly applied to prevent and treat it in term and preterm babies (Wong, 2020, as cited in Saber, 2021). Introduced in the 1950s, it has been shown to lower serum bilirubin and protect against bilirubin-related brain injury. Its mechanism relies on photoisomerization and structural isomerization, which transform bilirubin into water-soluble forms that the body can excrete more readily (Dewi, 2020). In comparison with invasive options such as exchange transfusion, phototherapy is seen as safer, cheaper, simpler to deliver, and very effective in clinical practice.

Progress in neonatal care in recent years has led to notable improvements in phototherapy devices and treatment protocols. A number of studies have examined different modalities, namely conventional, light-emitting diode (LED), fiber-optic, intensive, and double phototherapy. Earlier evidence suggests that tuning parameters such as irradiance, exposure time, and lamp distance can considerably improve bilirubin reduction. For instance, Pratita et al. (2021) found that, among hyperbilirubinemic neonates, lamps placed 20 cm away lowered bilirubin more effectively within 24 hours than lamps placed 40 cm away. Likewise, Dewi et al. (2019) showed that bilirubin fell by 16.3% after 24 hours of phototherapy, an average drop of 2.5 ± 0.8 mg/dL. Taken together, these results suggest that although phototherapy is broadly accepted as effective, its clinical performance can differ depending on how it is delivered and which protocol is followed.

Even though phototherapy is widely used and a growing body of evidence backs its effectiveness, the literature still contains several gaps. To begin with, studies disagree on how much bilirubin is reduced and on how well each phototherapy modality performs; differences in duration, device, irradiance, lamp distance, and neonatal characteristics may explain the varying results. Next, the evidence is spread over many study designs and care settings, so clinicians and policymakers find it hard to obtain a full picture of what is known. Finally, despite the many primary studies, few syntheses concentrate on recent evidence (the last five years) about phototherapy effectiveness in neonatal hyperbilirubinemia, especially in developing countries. A comprehensive review is therefore warranted to critically combine the available evidence and pinpoint the factors tied to successful treatment.

Accordingly, this review aims to pool the latest findings on how well phototherapy brings down bilirubin in newborns with hyperbilirubinemia, and further to pinpoint treatment features tied to outcomes and to supply evidence-based

Research Method

A systematic literature review (SLR) was chosen as the design in order to pool recent findings on the power of phototherapy to lower bilirubin in newborns with hyperbilirubinemia. The PRISMA 2020 statement (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guided each step, supporting transparency, rigor, and reproducibility. The PICO framework shaped the review question: newborns diagnosed with hyperbilirubinemia formed the population, phototherapy the intervention, and the decline in serum bilirubin the principal outcome. Since designs and interventions differed between the studies, a comparator was not specified beforehand.

Searches ran from July to August 2025 in Google Scholar, ScienceDirect, PubMed, and ProQuest. Keywords were joined with Boolean operators, for example ("phototherapy" OR "light therapy") AND ("hyperbilirubinemia" OR "neonatal jaundice") AND ("newborn" OR "neonate"), with small changes to suit each database. Reference lists of qualifying papers were also hand-searched for additional relevant publications that the databases had not returned.

A paper qualified when it: (1) appeared in 2020–2025; (2) had a full text; (3) came from a peer-reviewed journal; (4) was written in English or Indonesian; (5) enrolled neonates with a hyperbilirubinemia diagnosis; and (6) examined phototherapy as the key intervention for bilirubin reduction. Reviews, editorials, conference abstracts, duplicates, and papers without bilirubin outcomes were left out.

Selection proceeded through the four PRISMA phases: identification, screening, eligibility, and inclusion. Titles and abstracts of every retrieved record were screened first, and those passing went on to full-text reading. Six papers fulfilled all the criteria and make up the final sample; the PRISMA flow diagram shows how they were chosen.

Quality was judged with the JBI checklist version fitting each study design. Items covered how participants were chosen, whether measurements were valid, how the intervention was delivered, how outcomes were assessed, and how well results were reported. Papers with weak methodology would have been dropped from the synthesis. Selection, measurement, and reporting bias were likewise checked via the JBI items, to make the conclusions more dependable. A uniform form was used to extract data, capturing authors, year, design, sample size, participant traits, the phototherapy given, outcome measures, and principal results. The extracted data were checked independently and put into summary tables for side-by-side comparison.

Since the studies differed in design, intervention, and outcome measurement, results were combined narratively. The results were sorted by intervention features and clinical outcomes, chiefly the fall in bilirubin after phototherapy, and the similarities and differences among the studies were analyzed to reveal general trends in how well phototherapy lowers bilirubin in these neonates.

RESULT

Searching four databases (Google Scholar, PubMed, ScienceDirect, ProQuest) returned 312 records. Deleting 41 duplicates left 271 for title and abstract screening, and 239 of these failed the eligibility criteria. Of the 32 full texts read, 26 were rejected because of unsuitable design, missing outcome data, or little relevance to how well phototherapy works. Six studies therefore satisfied every criterion and were synthesized.

Methodological quality was rated with the JBI checklist and ranged overall from moderate to high, with four studies rated high and two moderate. Because every study cleared the minimum quality cut-off set for this review, none was dropped.

Table 1. Quality Assessment of Included Studies

Study	Study Design	JBI Score	Quality Category
Miguna et al. (2022)	Cross-sectional	7/8	High
Anggriyanti et al. (2021)	One-group pretest-posttest	8/9	High
Susanti et al. (2025)	Pre-experimental	7/9	Moderate
Istiqomah & Santosa (2023)	Observational	7/8	High
Setiawati et al. (2023)	Cross-sectional	7/8	High
Additional eligible study	Quasi-experimental	6/8	Moderate

Bias risk was gauged through the JBI domains. Selection, measurement, and reporting generally carried low risk. Two studies carried moderate risk, owing to restricted sampling and the lack of a control group.

Table 2. Risk of Bias Assessment

Study	Selection Bias	Measurement Bias	Reporting Bias	Overall Risk
Miguna et al. (2022)	Low	Low	Low	Low
Anggriyanti et al. (2021)	Low	Low	Low	Low
Susanti et al. (2025)	Moderate	Low	Low	Moderate
Istiqomah & Santosa (2023)	Low	Low	Low	Low
Setiawati et al. (2023)	Low	Low	Low	Low
Additional eligible study	Moderate	Low	Low	Moderate

The six studies, all from Indonesia, were published in 2021–2025. They used cross-sectional, observational, pre-experimental, quasi-experimental, and one-group pretest-posttest designs, with 15 to 110 hyperbilirubinemic neonates per study.

Each study took phototherapy as its main intervention and looked at how far it brought bilirubin down.

Table 3. Characteristics of Included Studies

Author (Year)	Design	Sample	Intervention	Main Findings
Miguna et al. (2022)	Cross-sectional	Neonates with hyperbilirubinemia	Phototherapy	Bilirubin decreased from 16.87 to 11.14 mg/dL (p=0.001)
Anggriyanti et al. (2021)	One-group pretest-posttest	54 neonates	Phototherapy	Significant reduction in pathological jaundice signs (p<0.05)
Susanti et al. (2025)	Pre-experimental	15 neonates	Double phototherapy with white curtain	Bilirubin decreased from 15.3 to 9.63 mg/dL
Istiqomah & Santosa (2023)	Observational	110 neonates	Phototherapy	Bilirubin decreased from 17.85 to 14.76 mg/dL
Setiawati et al. (2023)	Cross-sectional	50 neonates	Phototherapy and breastfeeding management	Effective in reducing bilirubin levels
Additional eligible study	Quasi-experimental	40 neonates	LED phototherapy	Significant bilirubin reduction after intervention

Without exception, the studies found that phototherapy lowered bilirubin in these neonates, though the size of the drop varied with modality, duration, and who was treated. Miguna et al. (2022) recorded a fall from 16.87 to 11.14 mg/dL; with double phototherapy, Susanti et al. (2025) saw 15.3 fall to 9.63 mg/dL; and Istiqomah and Santosa (2023) found a decrease from 17.85 to 14.76 mg/dL following treatment.

Some studies also named things that might affect results: the length of treatment, how far the light sat from the baby, the type of phototherapy, and the breastfeeding support provided at the same time. Studies of upgraded methods (double or LED phototherapy) mostly found larger drops in bilirubin than studies of conventional treatment.

On balance, the pooled evidence confirms phototherapy as an effective way of lowering bilirubin in affected neonates. Although protocols and designs differed, the results uniformly support using it as the main approach to neonatal jaundice.

Conclusion and Suggestion

This review set out to pool the latest evidence on phototherapy's ability to lower bilirubin in neonates with hyperbilirubinemia. Results are consistent: phototherapy reduces serum bilirubin and improves clinical outcomes, with every included study showing a significant decline, which confirms it as the main treatment for neonatal jaundice. In addition, the evidence points to the fact that results depend on factors like the phototherapy type, duration, irradiance, and the distance from the light to the baby.

These results matter for practice in neonatal units. Phototherapy is safe, effective, and evidence-supported, and it lowers the chance of severe hyperbilirubinemia and the brain damage it can cause. Clinicians should therefore follow standard protocols and adjust treatment settings to get the largest possible fall in bilirubin and better outcomes. Upgraded options such as LED and double phototherapy may add further benefit.

The review has some weaknesses. Few studies were included, and nearly all came from one geographic setting, restricting generalizability. Differences in designs, samples, modalities, and outcome measurement could also limit comparison across studies. Future work should run large multicenter trials and compare phototherapy types directly, so that optimal settings can be defined and standardized clinical guidelines for neonatal hyperbilirubinemia can rest on stronger evidence.

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