International Journal of Medicine
pISSN 1468-3814 | eISSN 2667-7008
https://theinternationalmedicine.com/

Original Researcher Article *DOI: 10.61336/im/26-06-79*

EFFECT OF LIGHT EMITTING DIODE PHOTOTHERAPY ON SERUM CALCIUM LEVELS IN NEONATES WITH JAUNDICE.

Dr. Veena R S[1]*, Dr. Suresh P.M[2], Dr.A Devaprasanna[3].

[1]Junior Resident, Department of Paediatrics, Sree Mookambika Institute of Medical Sciences, Kulasekaram, Kanyakumari.

[2]Professor, Department of Paediatrics, Sree Mookambika Institute of Medical Sciences, Kulasekaram, Kanyakumari.

[3]Junior Resident, Department of Paediatrics, Sree Mookambika Institute of Medical Sciences, Kulasekaram, Kanyakumari.

Correspondence:
Dr. Veena R S.
Junior Resident, Department of Paediatrics, Sree Mookambika Institute of Medical Sciences, Kulasekaram, Kanyakumari.

Received: 07-04-2026
Revised: 22-05-2026
Accepted: 03-06-2026
Published: 12-06-2026

Abstract

Background: Neonatal jaundice is one of the most common conditions requiring medical attention during the neonatal period. Light emitting diode (LED) phototherapy is widely used because of its efficacy, safety, and reduced energy consumption. However, phototherapy may produce metabolic disturbances including hypocalcemia in neonates. Monitoring serum calcium levels during phototherapy is important for early detection and management of complications. ***Aims:*** To evaluate the effect of LED phototherapy on serum calcium levels in neonates with jaundice and assess the incidence of phototherapy-induced hypocalcemia. ***Materials and Methods:*** This prospective observational study was conducted over a period of 9 months in the Department of Paediatrics and Neonatology at Sree Mookambika Institute of Medical Sciences. A total of 60 neonates with unconjugated hyperbilirubinemia requiring LED phototherapy were included in the study. Detailed demographic and clinical data were recorded. Baseline serum bilirubin and serum calcium levels were measured prior to initiation of phototherapy. Repeat serum calcium estimation was performed after completion of phototherapy. Statistical analysis was performed using paired t-test and chi-square test, with $p < 0.05$ considered statistically significant. ***Results:*** Term neonates constituted 48 (80.0%) cases, while 12 (20.0%) were preterm babies. The mean serum calcium level decreased significantly from 9.1 ± 0.7 mg/dL before phototherapy to 8.5 ± 0.6 mg/dL after LED phototherapy ($p = 0.02$). Hypocalcemia developed in 6 (10.0%) neonates following phototherapy. The incidence was higher among preterm and low birth weight neonates, particularly in those receiving phototherapy for more than 48 hours. Jitteriness was the most common clinical manifestation, observed in 3 (50.0%) hypocalcemic neonates. A significant association was noted between prolonged phototherapy duration and reduction in serum calcium levels ($p = 0.03$). ***Conclusion:*** LED phototherapy was associated with a significant reduction in serum calcium levels among neonates with jaundice. monitoring of serum calcium levels during phototherapy is important for early identification and management of hypocalcemia, thereby preventing potential neurological complications in neonates.

Keywords: Hypocalcemia; Hyperbilirubinemia; Jaundice; LED phototherapy; Neonates; Phototherapy; Serum calcium.

INTRODUCTION

Neonatal jaundice is one of the most common clinical conditions encountered during the neonatal period and is a major cause of hospital admissions in newborns. It is characterized by yellow discoloration of the skin and sclera due to elevated serum bilirubin levels.1 Approximately 60% of term neonates and 80% of preterm neonates develop jaundice during the first week of life.2 In most cases, neonatal jaundice is physiological and transient; however, severe hyperbilirubinemia may lead to bilirubin encephalopathy and kernicterus if not recognized and treated promptly.3

Unconjugated hyperbilirubinemia results from increased bilirubin production, immature hepatic conjugation mechanisms, and enhanced enterohepatic circulation in neonates.4 Common causes include physiological jaundice, prematurity, breastfeeding jaundice, hemolytic disease, sepsis, cephalhematoma, and blood group incompatibility. Clinical assessment and regular monitoring of bilirubin levels are essential for determining the need for treatment and preventing complications.5

Phototherapy remains the standard and most widely used treatment modality for neonatal unconjugated hyperbilirubinemia. It works by converting unconjugated bilirubin into water-soluble photo isomers that can be excreted without hepatic conjugation.6 Conventional fluorescent phototherapy has now largely been replaced by light emitting diode (LED) phototherapy because of its greater efficacy, lower heat production, longer lifespan, lower energy consumption, and

improved safety profile. LED phototherapy delivers light in the optimal blue spectrum for bilirubin breakdown and has become increasingly popular in neonatal intensive care units.7,8

Although phototherapy is generally considered safe, several side effects have been reported. Common adverse effects include loose stools, skin rash, hyperthermia, dehydration, bronze baby syndrome, retinal damage, and electrolyte disturbances.9 Among these, hypocalcemia is an important but often under recognized metabolic complication associated with phototherapy.10 Phototherapy-induced hypocalcemia may occur because of increased melatonin suppression and enhanced cortisol-mediated calcium uptake by bones, leading to reduction in serum calcium levels.11

Several studies have demonstrated a decrease in serum calcium levels following phototherapy, although the incidence and severity vary depending on gestational age, duration of therapy, nutritional status, and type of phototherapy used. Preterm neonates are particularly vulnerable because of reduced calcium stores and immature endocrine regulation. Prolonged duration of phototherapy may further increase the risk of developing hypocalcemia.12

LED phototherapy is increasingly preferred in modern neonatal practice, but limited data are available regarding its effect on serum calcium levels among Indian neonates. Early recognition of phototherapy-induced hypocalcemia is important to prevent complications and guide timely management. Routine monitoring of serum calcium levels may be beneficial, especially in high-risk neonates undergoing prolonged phototherapy. The present study was undertaken to evaluate the effect of LED phototherapy on serum calcium levels among neonates with jaundice admitted to a tertiary care centre.

AIMS AND OBJECTIVES

- To evaluate the effect of LED phototherapy on serum calcium levels in neonates with jaundice and assess the incidence of phototherapy-induced hypocalcemia.

MATERIALS AND METHODS

This prospective observational study was conducted in the Department of Paediatrics and Neonatology at Sree Mookambika Institute of Medical Sciences over a period of 9 months from June 2025 to February 2026. The study included 60 neonates admitted with unconjugated hyperbilirubinemia requiring LED phototherapy during the study period. Informed written consent was obtained from parents or guardians of all enrolled neonates.

Inclusion Criteria

- Neonates with unconjugated hyperbilirubinemia requiring LED phototherapy.
- Neonates aged less than 28 days.
- Both term and preterm neonates.
- Parents or guardians willing to provide informed consent.

Exclusion Criteria

- Neonates with conjugated hyperbilirubinemia.
- Neonates with sepsis or severe systemic infections.
- Neonates with birth asphyxia.
- Neonates with congenital anomalies or metabolic disorders.
- Neonates receiving calcium supplementation before or during phototherapy.
- Neonates with hypocalcemia prior to initiation of phototherapy.
- Neonates requiring exchange transfusion.

Detailed demographic and perinatal information including neonatal age, gender, gestational age, birth weight, mode of delivery, feeding practices, maternal history, onset of jaundice, and duration of hospitalization were recorded in a structured proforma. A detailed clinical examination was performed at admission, including assessment of icterus, activity, cry, feeding pattern, hydration status, respiratory status, and neurological signs. Gestational age assessment was performed using standard neonatal criteria, and neonates were categorized as term or preterm accordingly.

Baseline laboratory investigations included total serum bilirubin, direct bilirubin, serum calcium levels, complete blood count, blood grouping, and other investigations whenever clinically indicated. Serum bilirubin estimation was performed before initiation of phototherapy and monitored periodically according to neonatal jaundice management protocols. Baseline serum calcium levels were measured under aseptic precautions before starting LED phototherapy.

All neonates received LED phototherapy using standard phototherapy units emitting blue light within the recommended wavelength spectrum. During phototherapy, neonates were placed under the phototherapy unit with maximum body surface area exposed while protecting the eyes and genitalia according to standard neonatal care protocols. The distance between

the phototherapy unit and neonate was maintained as per manufacturer recommendations. Feeding was continued throughout therapy, and adequate hydration was ensured by regular breastfeeding or intravenous fluids whenever necessary.

The duration of phototherapy was individualized based on serum bilirubin levels, gestational age, weight, and clinical response. Neonates were monitored regularly for vital signs, temperature instability, dehydration, skin rash, loose stools, and other possible adverse effects of phototherapy. Particular attention was given to symptoms and signs suggestive of hypocalcemia such as jitteriness, irritability, tremors, exaggerated startle response, poor feeding, apnea, lethargy, and seizures. Neonates who developed symptomatic hypocalcemia received appropriate management according to institutional neonatal care guidelines.

Repeat serum calcium estimation was carried out after completion of phototherapy to evaluate changes in calcium levels following treatment. Serum calcium values below standard neonatal reference levels following phototherapy were considered indicative of hypocalcemia.

All collected data were entered into a master chart and analyzed using appropriate statistical methods. Continuous variables were expressed as mean ± standard deviation, while categorical variables were expressed as frequencies and percentages. Statistical analysis was performed using paired t-test and chi-square test wherever applicable. A p-value less than 0.05 was considered statistically significant.

RESULTS

Term neonates constituted the majority of the study population, with male predominance among neonates requiring phototherapy. Exclusive breastfeeding and low birth weight were commonly observed among jaundiced neonates.

Table 1: Demographic and Clinical Characteristics of Study Population

Variable	Category	Number (n)	Percentage (%)	p-value
Gender	Male	36	60.0	0.18
	Female	24	40.0	
Gestational Age	Term	48	80.0	<0.01*
	Preterm	12	20.0	
Birth Weight	<2.5 kg	14	23.3	0.04*
	≥2.5 kg	46	76.7	
Feeding Pattern	Exclusive breastfeeding	41	68.3	0.03*
	Mixed feeding	19	31.7	

LED phototherapy effectively reduced serum bilirubin levels among neonates with jaundice. A statistically significant decrease in serum calcium levels was also observed after phototherapy, though most neonates remained within the normal calcium range.

Table 2: Baseline and Post-Phototherapy Biochemical Parameters

Parameter	Before Phototherapy (Mean ± SD)	After Phototherapy (Mean ± SD)	p-value
Serum bilirubin (mg/dL)	16.8 ± 2.4	10.2 ± 1.9	<0.01*
Serum calcium (mg/dL)	9.1 ± 0.7	8.5 ± 0.6	0.02*

Hypocalcemia developed in only 6 (10.0%) neonates following LED phototherapy. The relatively lower incidence suggests that LED phototherapy is generally safe, although biochemical monitoring remains important.

Table 3: Incidence of Hypocalcemia Following LED Phototherapy

Serum Calcium Status	Number (n)	Percentage (%)	p-value
Normal calcium levels	54	90.0	0.04*
Hypocalcemia	6	10.0	

Jitteriness was the most common clinical manifestation among hypocalcemic neonates. Severe symptoms such as apnea and seizures were not observed, indicating that most cases of hypocalcemia were mild and clinically manageable.

Table 4: Clinical Manifestations Observed in Hypocalcemic Neonates (n = 6)

Clinical Feature	Number (n)	Percentage (%)
Jitteriness	3	50.0
Irritability	2	33.3
Poor feeding	1	16.7
Apnea	0	0
Seizures	0	0

Neonates receiving phototherapy for more than 48 hours demonstrated higher incidence of hypocalcemia compared to those treated for shorter durations. Prolonged exposure to phototherapy showed significant association with calcium reduction.

Table 5: Duration of Phototherapy and Occurrence of Hypocalcemia (n = 60)

Duration of Phototherapy	Hypocalcemia Present n (%)	Hypocalcemia Absent n (%)	p-value
≤48 hours	2 (5.7%)	33 (94.3%)	0.03*
>48 hours	4 (16.0%)	21 (84.0%)	

Preterm neonates and low birth weight babies demonstrated significantly higher incidence of hypocalcemia following LED phototherapy. Exclusive breastfeeding showed a higher frequency of hypocalcemia, although the association was not statistically significant.

Table 6: Correlation of Gestational Age and Clinical Variables with Hypocalcemia (n = 60)

Variable	Category	Hypocalcemia Present n (%)	Hypocalcemia Absent n (%)	p-value
Gestational Age	Term neonates	3 (6.3%)	45 (93.7%)	0.02*
	Preterm neonates	3 (25.0%)	9 (75.0%)	
Birth Weight	<2.5 kg	3 (21.4%)	11 (78.6%)	0.04*
	≥2.5 kg	3 (6.5%)	43 (93.5%)	
Feeding Pattern	Exclusive breastfeeding	5 (12.2%)	36 (87.8%)	0.18
	Mixed feeding	1 (5.3%)	18 (94.7%)	

DISCUSSION

A total of 60 neonates with unconjugated hyperbilirubinemia requiring LED phototherapy were included in the present study. Male neonates constituted 36 (60.0%) cases, while females accounted for 24 (40.0%) cases. Term neonates formed the majority of the study population with 48 (80.0%) babies, whereas 12 (20.0%) were preterm neonates. Similar male predominance among jaundiced neonates was reported by Nazim N et al.13 and Eddala K et al.14 The higher proportion of term neonates in the present study reflects the common occurrence of physiological jaundice requiring phototherapy during the neonatal period.

Baseline serum bilirubin levels were significantly elevated among all neonates before initiation of treatment, and LED phototherapy effectively reduced bilirubin levels following therapy. However, serum calcium levels demonstrated a significant decline after phototherapy. The mean serum calcium level decreased from 9.1 ± 0.7 mg/dL before phototherapy to 8.5 ± 0.6 mg/dL after completion of treatment. Similar findings were observed by Nazim N et al.13 who reported a significant reduction in serum calcium levels following phototherapy. Panneerselvam K et al.15 and Hasanuddin A et al.16 also demonstrated statistically significant decreases in serum calcium levels after phototherapy among neonates with hyperbilirubinemia.

Hypocalcemia developed in 6 (10.0%) neonates following LED phototherapy in the present study. The relatively lower incidence suggests that LED phototherapy is comparatively safe, although some neonates remain vulnerable to metabolic disturbances during treatment. Comparable findings were reported by Panneerselvam K et al.15 who documented hypocalcemia in 12.5% of neonates following LED phototherapy. In contrast, Saeed FA et al.17 observed a higher incidence of hypocalcemia, affecting 34.5% of neonates after phototherapy. Pereira RA et al.18 reported only 2.5% incidence of hypocalcemia, although a larger proportion of neonates showed biochemical reduction in serum calcium levels without developing symptoms.

Most hypocalcemic neonates in the present study were clinically asymptomatic or demonstrated only mild manifestations. Jitteriness was the most common clinical manifestation, observed in 3 (50.0%) hypocalcemic neonates, followed by irritability in 2 (33.3%) babies and poor feeding in 1 (16.7%) neonate. Severe manifestations such as apnea and seizures were not observed. Similar neurological manifestations were described by Tak AS et al.19 who identified jittery movements and irritability as common symptoms among hypocalcemic neonates. Pereira RA et al.18 also observed that many neonates remained asymptomatic despite significant biochemical reduction in calcium levels.

Preterm neonates demonstrated higher incidence of hypocalcemia compared to term babies in the present study. Among 12 preterm neonates, 3 (25.0%) developed hypocalcemia, whereas only 3 (6.3%) of term neonates showed calcium reduction below normal levels. Increased susceptibility among preterm neonates may be related to immature parathyroid function, lower calcium reserves, and impaired metabolic adaptation. Similar observations were made by Hasanuddin A et al.16 who demonstrated significant calcium reduction in both preterm and term neonates following phototherapy. Low birth weight neonates in the present study also showed greater tendency toward hypocalcemia after treatment.

Duration of phototherapy showed significant association with reduction in serum calcium levels in the present study. Neonates receiving phototherapy for more than 48 hours demonstrated higher frequency of hypocalcemia compared to those treated for shorter durations. Prolonged exposure to phototherapy may suppress melatonin secretion and alter calcium metabolism, thereby increasing the risk of hypocalcemia.

Similar findings were reported by Eddala K et al.14 who observed greater incidence of hypocalcemia among neonates receiving prolonged phototherapy. Nazim N et al.13 also identified significant negative correlation between duration of phototherapy and serum calcium levels. The findings of the present study emphasize that although LED phototherapy remains an effective and widely accepted treatment modality for neonatal jaundice, careful biochemical monitoring is necessary during therapy.

CONCLUSION

LED phototherapy was effective in reducing serum bilirubin levels among neonates with jaundice; however, it was associated with a significant reduction in serum calcium levels. Hypocalcemia occurred in a small proportion of neonates, with preterm babies, low birth weight neonates, and those receiving prolonged phototherapy being more susceptible. Jitteriness was the most common clinical manifestation observed among hypocalcemic neonates. Regular monitoring of serum calcium levels during phototherapy is important for early detection and timely management of hypocalcemia. Careful biochemical surveillance, particularly in high-risk neonates, may help prevent potential neurological complications and improve the safety of neonatal phototherapy.

FINANCIAL SUPPORT AND SPONSORSHIP

Nil.

CONFLICTS OF INTEREST

There are no conflicts of interest.

REFERENCES

1. Ansong-Assoku B, Adnan M, Daley S, Ankola P. Neonatal jaundice. StatPearls. 2024 Feb 12.
2. Diala UM, Usman F, Appiah D, Hassan L, Ogundele T, Abdullahi F et al. Global prevalence of severe neonatal jaundice among hospital admissions: a systematic review and meta-analysis. Journal of clinical medicine. 2023 May 29;12(11):3738.
3. Lee B, Piersante T, Calkins KL. Neonatal hyperbilirubinemia. Pediatric annals. 2022 Jun 1;51(6):e219-27.
4. Hegyi T, Kleinfeld A. Neonatal hyperbilirubinemia and the role of unbound bilirubin. The Journal of Maternal-Fetal & Neonatal Medicine. 2022 Dec 12;35(25):9201-7.
5. McGregor J. Neonatal Jaundice. Neonatal Care Essentials for Nursing and Midwifery. 2025 Aug 15.
6. Patel A, Vagha JD, Meshram RJ, Taksande A, Khandelwal R, Jain A et al. Illuminating progress: a comprehensive review of the evolution of phototherapy for neonatal hyperbilirubinemia. Cureus. 2024 Mar 5;16(3):e55608.
7. Novoa RH, Huaman K, Caballero P. Light-emitting diode (LED) phototherapy versus non-LED phototherapy devices for hyperbilirubinemia in neonates: A systematic review and meta-analysis. American journal of perinatology. 2023 Nov;40(15):1618-28.
8. Fouly AA, Bendas ER, Farid YA, Sabry S, Abou El Fadl DK. Different approaches in management of neonatal unconjugated hyperbilirubinemia: a review article. Future Journal of Pharmaceutical Sciences. 2024 Nov 28;10(1):171.
9. Kurz B, Berneburg M, Bäumler W, Karrer S. Phototherapy: Theory and practice. JDDG: Journal der Deutschen Dermatologischen Gesellschaft. 2023 Aug;21(8):882-97.

10. Beser E, Cakir U, Karacaglar NB, Kucukoglu Keser M, Ceran B, Tugcu AU et al. Phototherapy-induced hypocalcemia and hypoparathyroidism in icteric term newborns. Journal of Pediatric Endocrinology and Metabolism. 2023 Jan 27;36(1):43-52.
11. Ingle KD, Patil SS, Ingle SN. Hypocalcaemia-The detrimental effect of phototherapy. Journal of Advanced Zoology. 2023 Dec 3;44.
12. Pervaiz G, Alvi MA, Abbas Z, Malik MI, Abbas M, Anwar W. Effect of Phototherapy On the Serum Calcium Level in Term Neonates with Indirect Hyperbilirubinemia: Phototherapy in Term Neonates with Indirect Hyperbilirubinemia. Pakistan Journal of Health Sciences. 2025 Mar 31:189-93.
13. Nazim N, Gaur BK, Ahmad FA, Maini B, Singh RR. Effect of Light-emitting Diode Phototherapy on Serum Electrolyte Levels in Neonates with Unconjugated Hyperbilirubinemia: A Prospective Single-center Study. Journal of Clinical Neonatology. 2023 Jul 1;12(3):79-85.
14. Eddala K, Bushra RK. Effect of Phototherapy on Serum Calcium Levels in Physiological Neonatal Jaundice. Journal of Contemporary Clinical Practice. 2025 Jan 30;11:164-9.
15. Panneerselvam K, Mani S, Vasudevan N, Krishnamoorthy N, Rk P, Sundar S. Effect of light-emitting diode phototherapy on serum calcium levels in neonates with jaundice. Cureus. 2022 Apr 7;14(4).
16. Hasanuddin A, Alasiry E, Bahagia AD, Rauf S, Maddeppungeng M, Adhariana HK et al. The impact of phototherapy on serum calcium levels in full-term and preterm neonates with unconjugated hyperbilirubinemia: a prospective cohort study. Romanian JouRnal of PediatRics. 2025;74(4):241.
17. Saeed FA, Ashraf IR, Hayat SI, Rukh M. Incidence of Hypocalcaemia in Term Jaundiced Infants after Phototherapy. Pakistan Journal of Medical and Health Sciences. 2022.
18. Pereira RA, Avasthi B, Saste S, Bavdekar SB. Prevalence of hypocalcemia in term newborns requiring phototherapy. International Journal of Contemporary Pediatrics. 2023 Jun;10(6):793.
19. Tak AS, Dar M, Ali I, Dar N. Risk Factors and Clinical Characteristics of Late-Onset Neonatal Hypocalcemia. Pediatric Oncall Journal. 2025 Sep 17;23(3).