

Cord Blood Albumin Level as a Predictor of Neonatal Jaundice in Healthy Term Neonates at a Tertiary Care Hospital

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Abstract

Background: Neonatal hyperbilirubinemia is one of the most common reasons for rehospitalization after early discharge, and severe unconjugated hyperbilirubinemia can lead to bilirubin-induced neurological injury. Because serum albumin binds unconjugated bilirubin and limits its diffusion into tissues, cord blood albumin measured at birth has been proposed as an early, non-invasive predictor of significant jaundice.

Methods: In this prospective observational study, 220 healthy term appropriate-for-gestational-age neonates delivered at a tertiary care hospital were enrolled. Cord blood serum albumin (CSA) was measured by the bromocresol green method at birth, and total and direct serum bilirubin were estimated from venous samples at 72–96 hours of life. Neonates were followed for the development of significant hyperbilirubinemia requiring phototherapy or exchange transfusion. Chi-square tests, correlation analysis, logistic regression, and receiver operating characteristic (ROC) curve analysis were performed using SPSS version 25.0; $p < 0.05$ was considered statistically significant.

Results: The mean CSA was 3.04 ± 0.35 g/dL, and the mean total serum bilirubin at 72–96 hours was 13.04 ± 3.54 mg/dL. Phototherapy was required by 15% of neonates, and exchange transfusion by 1.36%. The phototherapy rate fell from 20.0% in the lowest albumin group (< 2.8 g/dL) to 7.6% in the highest group (> 3.3 g/dL) (chi-square 69.76, $p < 0.0001$). Cord blood albumin was the only independent predictor of phototherapy requirement (OR 0.021, 95% CI 0.007–0.066, $p < 0.0001$), with a model AUC-ROC of 0.789. At the < 2.8 g/dL cut-off, specificity and positive predictive value were both 100%.

Conclusion: Cord blood albumin is a simple, economical, and clinically useful early screening marker for identifying term neonates at risk of significant hyperbilirubinemia, and the < 2.8 g/dL threshold is well suited for selecting high-risk infants for close monitoring.

Keywords: Cord blood albumin; neonatal jaundice; hyperbilirubinemia; phototherapy; prediction; screening; term neonates.

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Introduction

Yellow discoloration of the skin, sclera, and mucous membranes in the first days of life is a frequent clinical finding, resulting from an increase in circulating bilirubin. A substantial proportion of term newborns develop jaundice within the first week of life, usually as a physiological adaptation to the transition from fetal to extrauterine life; in most cases it resolves without treatment, but a small group of neonates develop bilirubin levels high enough to require phototherapy or exchange transfusion, and if untreated, severe

hyperbilirubinemia can cause permanent neurological damage [1-4]. Bilirubin is generated during the physiological degradation of hemoglobin from senescent red blood cells. In fetal life the placenta clears bilirubin into the maternal circulation; after birth the neonatal liver must assume bilirubin conjugation and excretion, but hepatic immaturity — particularly low activity of uridine diphosphate glucuronosyltransferase — together with accelerated erythrocyte turnover and increased enterohepatic recycling leads to the

accumulation of unconjugated bilirubin characteristic of the early neonatal period [3,15,18-22]. When unconjugated bilirubin exceeds the binding capacity of plasma albumin, free bilirubin can cross the immature blood-brain barrier and deposit in brain tissue, producing a spectrum of toxicity ranging from subtle bilirubin-induced neurological dysfunction to acute and chronic bilirubin encephalopathy (kernicterus) with hearing loss, motor impairment, and developmental delay [4,23,24]. Several maternal and neonatal conditions — prematurity, low birth weight, hemolytic disease, sepsis, birth trauma, and genetic disorders — increase the risk of significant hyperbilirubinemia, yet many affected neonates are healthy term infants without obvious risk factors [26-28]. Early discharge, often within 24–48 hours of birth, means that bilirubin frequently peaks after the infant has left hospital, so reliable early predictors are needed to identify newborns likely to develop significant jaundice before it becomes clinically apparent [5,17].

Serum albumin, the most abundant plasma protein, binds unconjugated bilirubin and keeps it confined within the vascular compartment; when albumin is low, free bilirubin rises and the risk of neurotoxicity increases [6,7,9]. Cord blood albumin measurement offers a convenient, non-invasive, inexpensive means of assessing this binding capacity immediately after birth, and accumulating evidence indicates that lower cord blood albumin concentrations are associated with a higher likelihood of subsequent significant hyperbilirubinemia, although reported cut-offs and predictive accuracy vary across populations [8-11,29-43]. The present study was undertaken to evaluate the predictive value of cord blood albumin for neonatal jaundice in healthy term neonates at a tertiary care hospital in North India and to define a clinically useful cut-off for early risk stratification.

Materials and Methods

Study Design and Setting: This prospective observational study was conducted over two years in the Department of Pediatrics at Darbhanga Medical College and Hospital, Laheriasarai, Darbhanga, Bihar, India, after obtaining clearance from the Institutional Ethics Committee.

Study Population: Two hundred and twenty term, appropriate-for-gestational-age neonates of either sex, delivered by normal vaginal delivery or caesarean section, with birth weight ≥ 2.5 kg and an APGAR score ≥ 7 at one minute, were enrolled after written informed consent from parents or guardians. Neonates were followed from birth until the appearance of jaundice or completion of the monitoring period.

Exclusion Criteria: Preterm neonates (gestational age < 37 weeks), intrauterine growth-restricted neonates, Rh incompatibility, neonatal sepsis, instrumental delivery (forceps or vacuum extraction), birth asphyxia, respiratory distress, neonates with jaundice appearing within the first 24 hours of life, and those born through meconium-stained amniotic fluid were excluded.

Sample Size: The sample size was calculated using the formula $n = Z^2pq/d^2$, with $Z = 1.96$ (95% confidence), expected prevalence of neonatal jaundice among term neonates $p = 0.6$, $q = 0.4$, and allowable error $d = 0.7$, yielding 220 neonates.

Data Collection and Laboratory Methods: Immediately after delivery, the umbilical cord was clamped and 2–3 mL of blood was aspirated aseptically from the placental end into a plain vacutainer. Serum was separated within two hours by centrifugation at 3000 rpm for ten minutes, and cord blood albumin was quantified by the bromocresol green dye-binding spectrophotometric method.

Each neonate underwent daily clinical assessment with Kramer staging, and a venous sample was obtained at 72–96 hours of life for total and direct serum bilirubin estimation by the diazotization colorimetric method; indirect bilirubin was calculated as the difference. All assays were performed in duplicate with daily standard calibration curves and internal quality control. Phototherapy was initiated according to the 2022 American Academy of Pediatrics hour-specific guidance, and exchange transfusion was performed when total serum bilirubin exceeded critical thresholds or signs of neurotoxicity appeared [12-14].

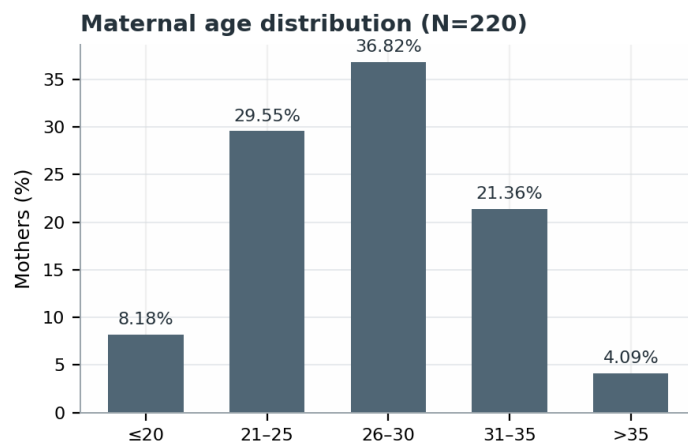
Statistical Analysis: Data were analyzed using SPSS version 25.0. Numerical variables were expressed as means with standard deviations and categorical variables as counts with percentages. Associations between categorical variables were assessed with the chi-square test, and relationships between continuous variables with correlation analysis. Multivariable logistic regression identified independent predictors of phototherapy requirement, and receiver operating characteristic (ROC) curve analysis determined the optimal cut-off and quantified diagnostic accuracy [66-68]. A two-sided p-value below 0.05 was considered statistically significant.

Results

Maternal Characteristics: The mean maternal age was 28.39 ± 4.80 years, with the majority of mothers (66.37%) aged 21–30 years. The mean maternal weight was 54.12 ± 10.28 kg, and the most common blood group was B+ (43.18%) (Table 1–3, Figure 1–3).

Table 1: Distribution of maternal age (N=220)

Age group (years)	Frequency (n)	Percentage (%)
≤20	18	8.18
21–25	65	29.55
26–30	81	36.82
31–35	47	21.36
>35	9	4.09
Mean ± SD		28.39 ± 4.80

**Figure 1: Maternal age distribution****Table 2: Distribution of maternal weight (N=220)**

Weight range (kg)	Frequency (n)	Percentage (%)
39.0–44.9	12	5.45
45.0–49.9	58	26.36
50.0–54.9	72	32.73
55.0–59.9	18	8.18
60.0–64.9	12	5.45
65.0–69.9	10	4.55
70.0–74.9	14	6.36
75.0–79.9	10	4.55
80.0–84.9	6	2.73
85.0–89.9	4	1.82
90.0–94.9	4	1.82
Mean ± SD (kg)		54.12 ± 10.28

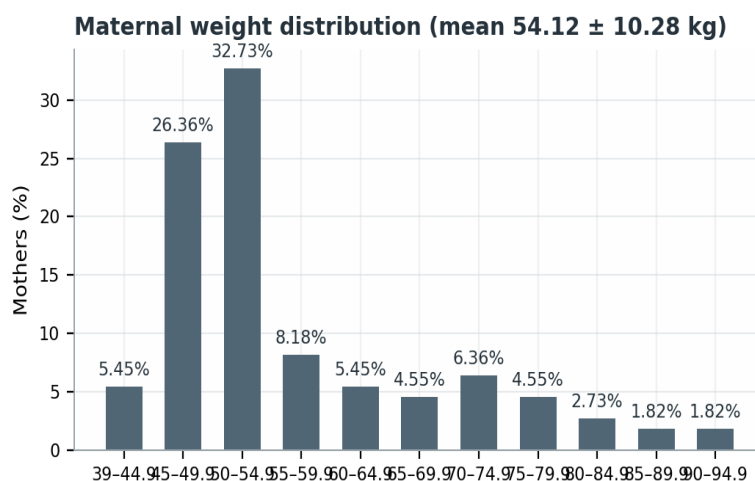
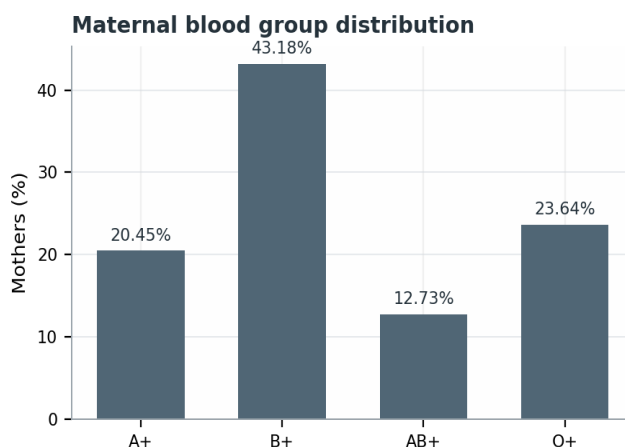
**Figure 2: Maternal weight distribution**

Table 3: Distribution of maternal blood group (N=220)

Blood group	Frequency (n)	Percentage (%)
A+	45	20.45
B+	95	43.18
AB+	28	12.73
O+	52	23.64

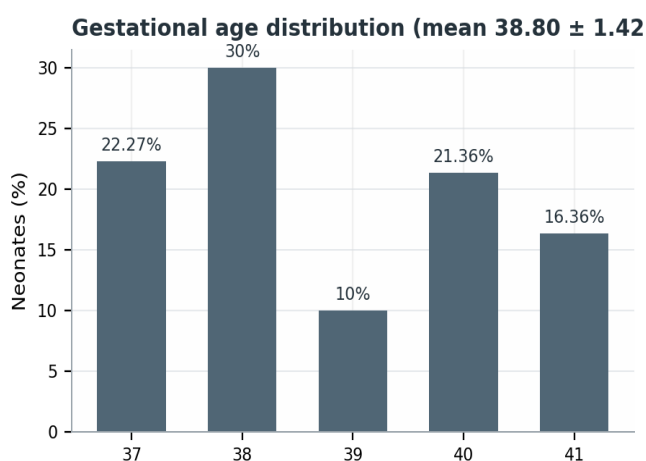
**Figure 3: Maternal blood group distribution**

Neonatal Characteristics: The mean gestational age was 38.80 ± 1.42 weeks, with 52.27% of neonates born at 37–38 weeks. Vaginal delivery accounted for 62% of births. There was a slight male predominance (53.18%, male-to-female ratio

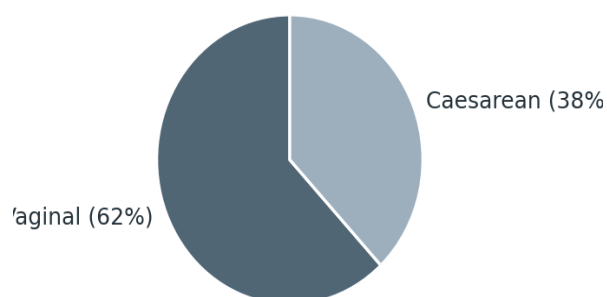
1.14:1). The mean birth weight was 3.15 ± 0.40 kg and the mean APGAR score at one minute was 7.91 ± 0.80 . The most common neonatal blood group was B+ (37.27%) (Table 4–8, Figure 4–8).

Table 4: Distribution of gestational age (N=220)

Gestational age (weeks)	Frequency (n)	Percentage (%)
37	49	22.27
38	66	30
39	22	10
40	47	21.36
41	36	16.36
Mean $\pm$ SD		38.80 ± 1.42

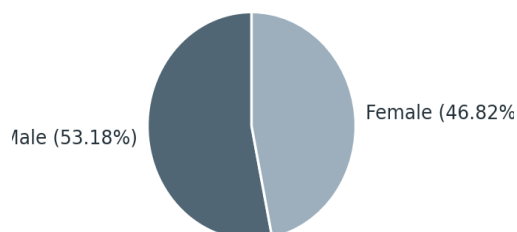
**Figure 4: Gestational age distribution****Table 5: Distribution of mode of delivery (N=220)**

Mode of delivery	Frequency (n)	Percentage (%)
Normal vaginal	136	62
Caesarean	84	38

Mode of delivery (N=220)**Figure 5: Mode of delivery****Table 6: Sex distribution of neonates (N=220)**

Sex	Frequency (n)	Percentage (%)
Male	117	53.18
Female	103	46.82

Male-to-female ratio 1.14:1.

Sex distribution of neonates (N=)**Figure 6: Sex distribution of neonates****Table 7: Distribution of birth weight (N=220)**

Birth weight (kg)	Frequency (n)	Percentage (%)
2.5–2.75	80	36.36
2.75–3.00	65	29.55
3.01–3.25	32	14.55
3.26–3.50	20	9.09
>3.50	23	10.45
Mean $\pm$ SD birth weight (kg)		3.15 $\pm$ 0.40
Mean $\pm$ SD APGAR at 1 min		7.91 $\pm$ 0.80

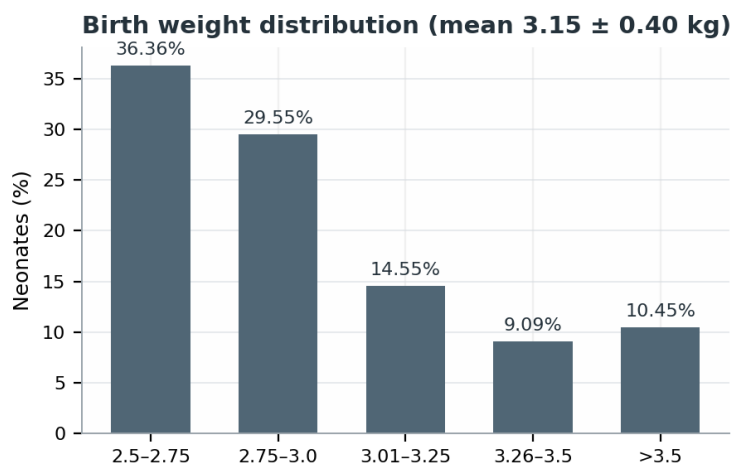


Figure 7: Birth weight distribution

Table 8: Distribution of neonatal blood group (N=220)

Baby blood group	Frequency (n)	Percentage (%)
A+	65	29.55
B+	82	37.27
AB+	32	14.55
O+	41	18.64
Total	220	100

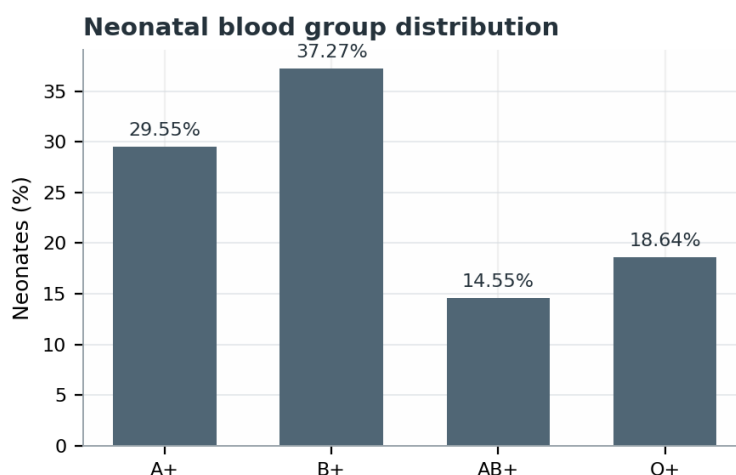


Figure 8: Neonatal blood group distribution

Cord Blood Albumin Distribution: Cord blood albumin levels were stratified into three levels: Level 1 (<2.8 g/dL), Level 2 (2.8–3.3 g/dL), and Level 3 (>3.3 g/dL). The overall mean cord blood albumin was 3.04 ± 0.35 g/dL (Table 9, Figure 9).

Table 9: Distribution of cord blood serum albumin levels (N=220)

Cord blood serum albumin	Frequency (n)	Percentage (%)
Level 1 (<2.8 g/dL)	99	45
Level 2 (2.8–3.3 g/dL)	66	30
Level 3 (>3.3 g/dL)	55	25
Mean $\pm$ SD		3.04 ± 0.35

As reported in the source thesis; the level-wise denominators in subsequent source tables differ (see notes to Tables 10–13).

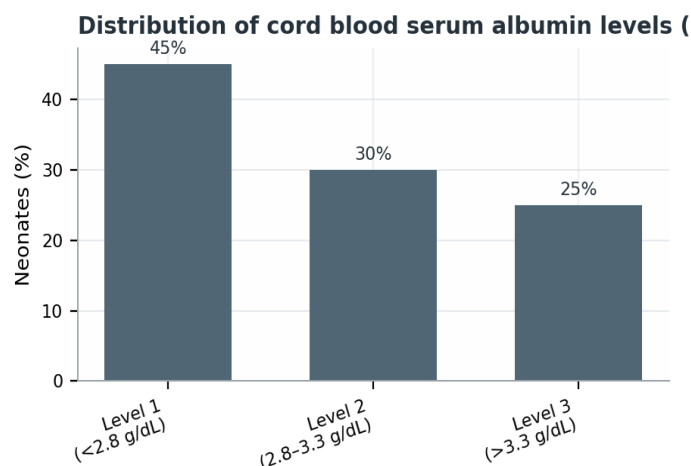


Figure 9: Distribution of cord blood serum albumin levels

Serum Bilirubin Levels Across Albumin Levels

Mean total serum bilirubin at 72–96 hours showed a declining trend with rising cord blood albumin — 13.55±3.21 mg/dL in Level 1, 12.92±2.21 mg/dL in Level 2, and 12.65±1.19 mg/dL in Level 3 ($p<0.05$)

— suggesting an inverse relationship (Table 10, Figure 10). Mean direct bilirubin differed significantly across the three levels (1.30, 1.32, and 1.24 mg/dL respectively; ANOVA $p=0.004$) (Table 11, Figure 11).

Table 10: Total serum bilirubin levels across cord blood albumin levels

CSA level	N	Mean $\pm$ SD (mg/dL)	Media (n)	Min	Max
Level 1 (<2.8 g/dL)	66	13.55 $\pm$ 3.21	13.29	8.49	27.21
Level 2 (2.8–3.3 g/dL)	97	12.92 $\pm$ 2.21	12.36	8.1	27.24
Level 3 (>3.3 g/dL)	57	12.65 $\pm$ 1.19	12.12	8.07	25.28
P-value		<0.05			

Level-wise N as reported in the source thesis table.

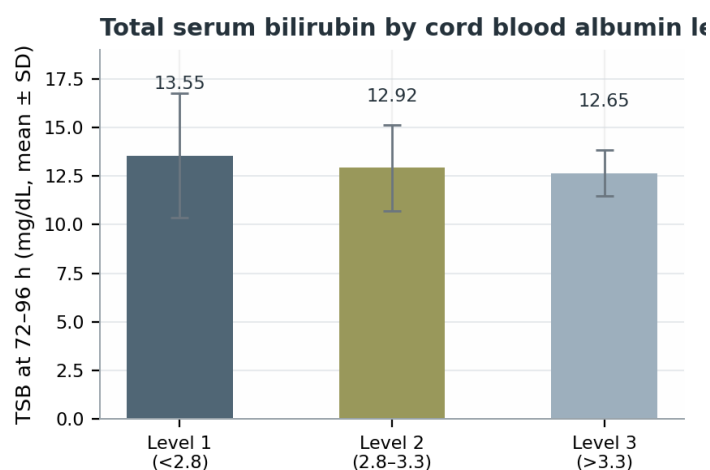


Figure 10: Total serum bilirubin by cord blood albumin level (mean $\pm$ SD)

Table 11: Direct serum bilirubin levels across cord blood albumin levels

CSA level	N	Mean $\pm$ SD (mg/dL)	Median	Min–Max
Level 1 (<2.8 g/dL)	66	1.30 $\pm$ 0.15	1.3	1.1–1.5
Level 2 (2.8–3.3 g/dL)	97	1.32 $\pm$ 0.15	1.3	1.1–1.5
Level 3 (>3.3 g/dL)	57	1.24 $\pm$ 0.14	1.2	1.1–1.5
P-value (ANOVA)		0.004		

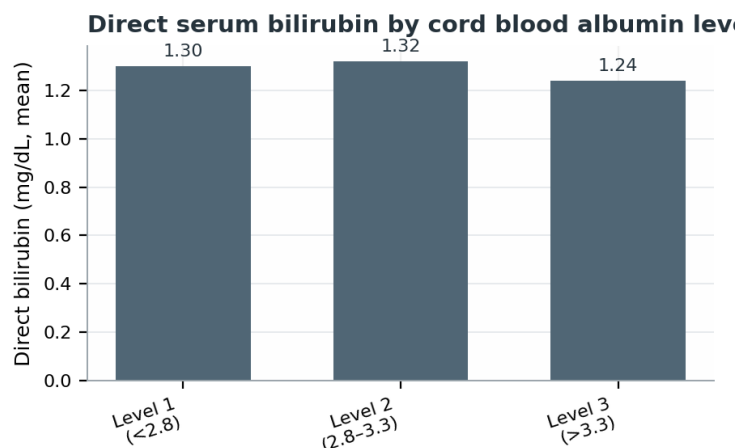


Figure 11: Mean direct serum bilirubin across cord blood albumin levels

Phototherapy and Exchange Transfusion Requirement: Overall, 15% of neonates (33/220) required phototherapy. The requirement fell steadily across albumin levels — 20.0% in Level 1, 12.3% in Level 2, and 7.6% in Level 3 — and the association was highly significant (chi-square

69.76, df=2, $p<0.0001$) (Table 12, Figure 12). Exchange transfusion was required by only 3 neonates overall (1.36%) — 2 in Level 1 (3.03%) and 1 in Level 2 (1.03%) — and the difference was not statistically significant (chi-square 2.277, $p=0.161$) (Table 13, Figure 13).

Table 12: Association between cord blood albumin level and phototherapy requirement

CSA level	Phototherapy No (n)	Phototherapy Yes (n)	Total (n)	Phototherapy rate
Level 1 (<2.8 g/dL)	80	20	100	20.00%
Level 2 (2.8–3.3 g/dL)	71	10	81	12.30%
Level 3 (>3.3 g/dL)	36	3	39	7.60%
Total	187 (85%)	33 (15%)	220 (100%)	15.00%
X^2 (df), p-value	69.7596 (2), <0.0001			

Values as reported in the source thesis.

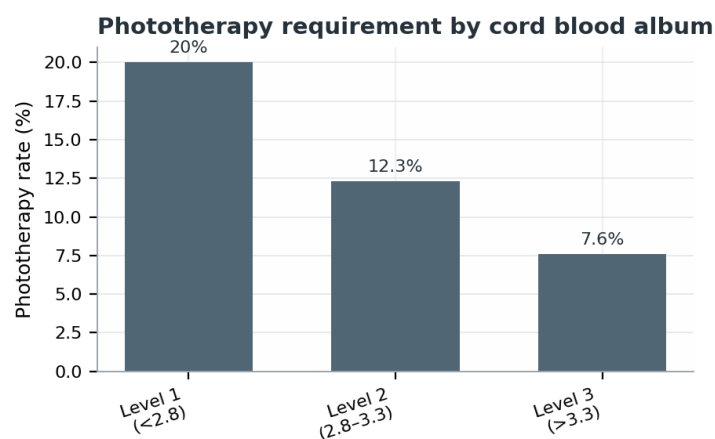


Figure 12: Phototherapy requirement by cord blood albumin level

Table 13: Association between cord blood albumin level and exchange transfusion requirement

CSA level	Exchange No (n)	Exchange Yes (n)	Total (n)	Exchange rate
Level 1 (<2.8 g/dL)	64	2	66	3.03%
Level 2 (2.8–3.3 g/dL)	96	1	97	1.03%
Level 3 (>3.3 g/dL)	57	0	57	0.00%
Total	217	3	220	1.36%
X^2 , p-value	2.2773, 0.1606			

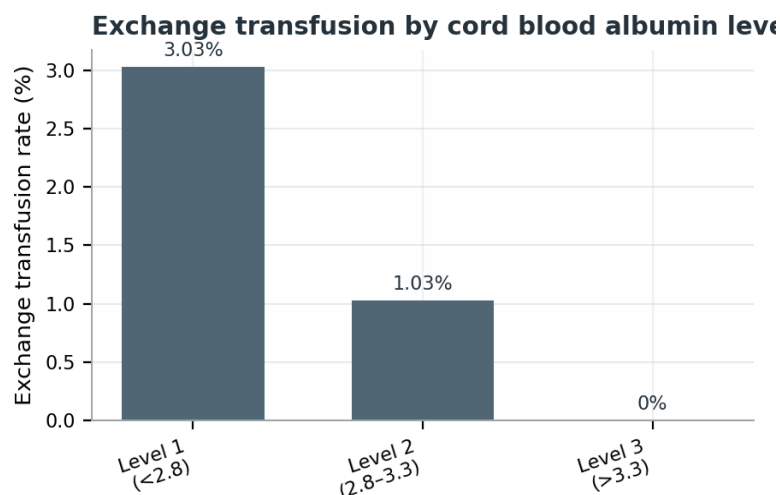


Figure 13: Exchange transfusion rate by cord blood albumin level

Correlation Analyses: Pearson correlation between cord blood albumin and total serum bilirubin was weakly negative and non-significant ($r=-0.0822$, $p=0.2246$); Spearman correlation was similar ($\rho=-0.0840$, $p=0.2147$). Cord blood albumin also showed no significant association with birth weight ($r=0.026$, $p=0.701$), gestational

age ($r=-0.042$, $p=0.540$), APGAR score ($r=0.091$, $p=0.178$), maternal weight ($r=-0.041$, $p=0.543$), or maternal age ($r=-0.090$, $p=0.184$); a weak negative correlation with direct bilirubin ($r=-0.164$, $p=0.014$) was the only significant association (Table 14–15, Figure 14).

Table 14: Correlation between cord blood albumin and total serum bilirubin

Correlation type	Variables	Coefficient	p-value	Direction	Interpretation
Pearson	CSA vs TSB	-0.0822	0.2246	Negative	Not significant
Spearman	CSA vs TSB	-0.084	0.2147	Negative	Not significant

Table 15: Correlation between cord blood albumin and other variables

Variable pair	Pearson r	p-value	Significant ($p<0.05$)
CSA vs birth weight (kg)	0.026	0.7011	No
CSA vs gestational age (weeks)	-0.0416	0.5398	No
CSA vs APGAR at 1 min	0.0911	0.1783	No
CSA vs maternal weight (kg)	-0.0412	0.5434	No
CSA vs maternal age (years)	-0.0899	0.184	No
CSA vs direct serum bilirubin	-0.1643	0.014	Yes

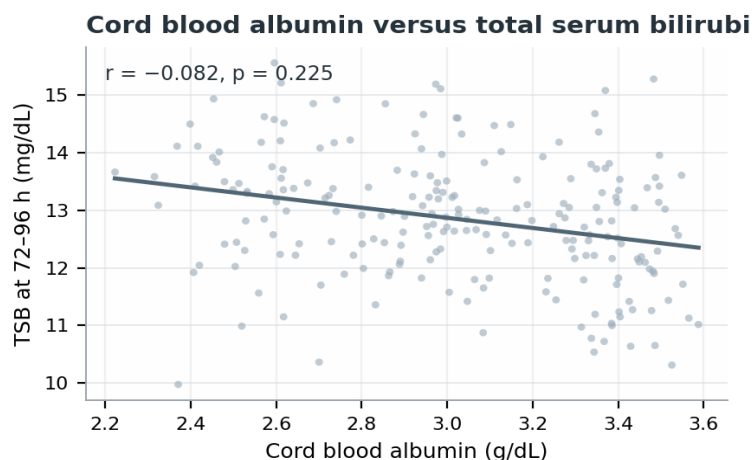


Figure 14: Cord blood albumin versus total serum bilirubin at 72–96 hours

Logistic Regression Analysis: In multivariable logistic regression, cord blood albumin was the

only significant independent determinant of phototherapy requirement ($\beta=-3.861$, $OR=0.021$,

95% CI 0.007–0.066, $p < 0.0001$): each 1 g/dL rise in cord blood albumin was associated with a 97.9% reduction in the odds of phototherapy. Birth weight ($p = 0.254$), gestational age ($p = 0.813$), APGAR

score ($p = 0.555$), and maternal age ($p = 0.392$) were not significant. The model achieved satisfactory discrimination with an AUC-ROC of 0.789 (Table 16, Figure 15).

Table 16: Logistic regression analysis for predicting phototherapy requirement

Variable	Coefficient (β)	Odds ratio	95% CI		p-value
			Lower	Upper	
Cord blood serum albumin (g/dL)	-3.8613	0.021	0.0067	0.0664	<0.0001
Birth weight (kg)	0.4553	1.5766	0.7211	3.4472	0.254
Gestational age (weeks)	0.0267	1.0271	0.823	1.2816	0.8132
APGAR at 1 min	0.1181	1.1254	0.7603	1.6657	0.5549
Maternal age (years)	0.0298	1.0303	0.9622	1.1031	0.392

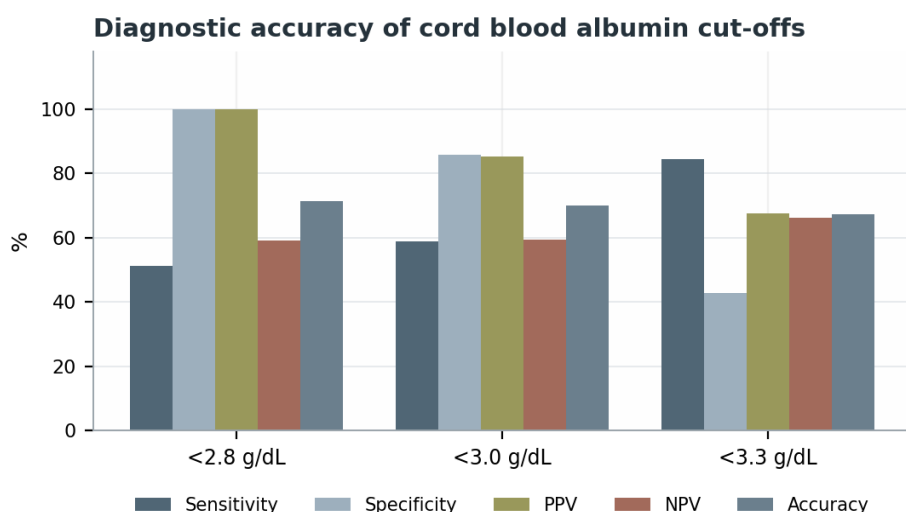


Figure 16: Diagnostic accuracy measures across cord blood albumin cut-offs Model discrimination AUC-ROC = 0.789.

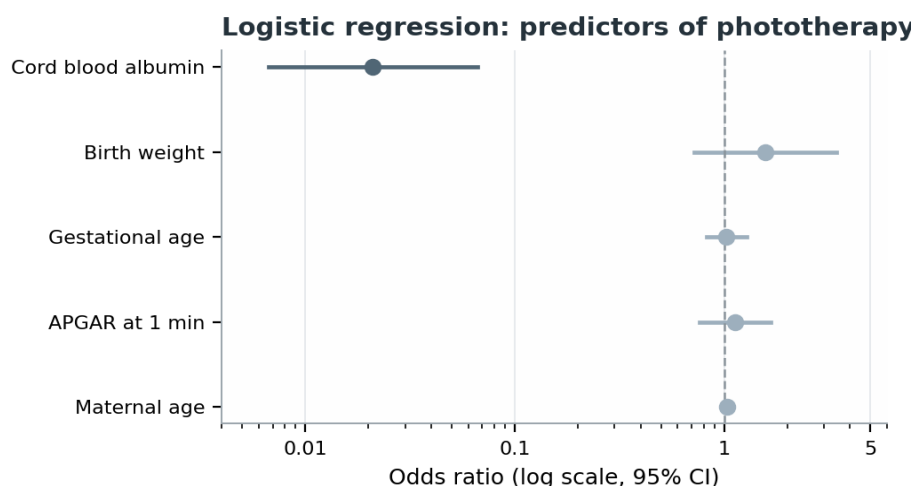


Figure 15: Odds ratios for predictors of phototherapy requirement (log scale)

Diagnostic Accuracy of Cord Blood Albumin Cut-offs: At the <2.8 g/dL cut-off, cord blood albumin showed 51.16% sensitivity, 100% specificity, 100% positive predictive value, 59.09% negative predictive value, and 71.36% accuracy. The <3.0 g/dL cut-off gave 58.91% sensitivity, 85.71% specificity, and 70.00% accuracy, while the

<3.3 g/dL cut-off gave 84.50% sensitivity, 42.86% specificity, and 67.27% accuracy. The <2.8 g/dL cut-off, with perfect specificity and positive predictive value, is best suited to identifying high-risk neonates for close monitoring (Table 17, Figure 16).

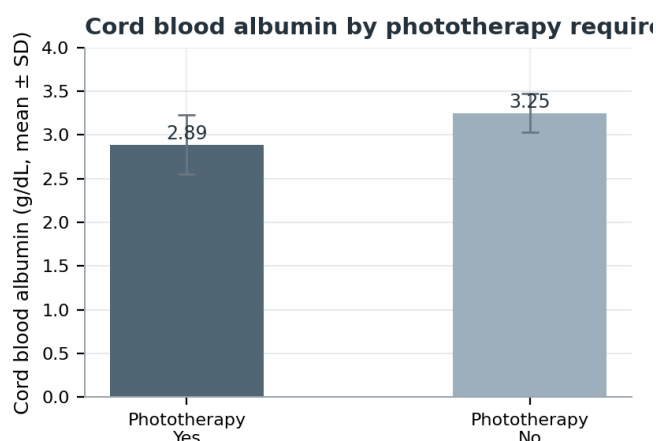
Table 17: Diagnostic accuracy of cord blood albumin cut-offs for predicting phototherapy

Cut-off	T P	T N	F P	F N	Sensitivity	Specificity	PPV	NPV	Accuracy
<2.8 g/dL	6	9	0	6	51.16%	100.00%	100.00%	59.09%	71.36%
	6	1		3					
<3.0 g/dL	7	7	1	5	58.91%	85.71%	85.39%	59.54%	70.00%
	6	8	3	3					
<3.3 g/dL	1	3	5	2	84.50%	42.86%	67.70%	66.10%	67.27%
	9	9	2	0					

Comparison by Phototherapy Requirement: Comparing neonates who required phototherapy with those who did not, only cord blood albumin differed significantly (2.89 ± 0.34 vs 3.25 ± 0.22 g/dL; $t = -8.591$, $p < 0.0001$). Maternal age, maternal weight, gestational age, birth weight, and APGAR score showed no significant differences (Table 18, Figure 17).

Table 18: Comparison of maternal and neonatal factors by phototherapy requirement

Variable	Phototherapy (Mean $\pm$ SD) Yes	Phototherapy (Mean $\pm$ SD) No	t-value	p-value
Maternal age (years)	28.67 ± 4.84	27.98 ± 4.75	1.06 0	0.2903
Maternal weight (kg)	54.05 ± 9.69	53.40 ± 9.69	0.48 8	0.6261
Gestational age (weeks)	38.84 ± 1.42	38.73 ± 1.44	0.61 3	0.5403
Birth weight (kg)	3.16 ± 0.42	3.13 ± 0.37	0.67 7	0.4994
APGAR at 1 min	7.91 ± 0.79	7.92 ± 0.82	-0.14 6	0.884
Cord blood serum albumin (g/dL)	2.89 ± 0.34	3.25 ± 0.22	-8.59 1	<0.0001

**Figure 17: Cord blood albumin levels by phototherapy requirement (mean $\pm$ SD)**

Discussion

This prospective study assessed whether cord blood albumin measured at birth can identify healthy term neonates who subsequently develop significant hyperbilirubinemia requiring intervention. The findings confirm a strong, graded association between lower cord blood albumin and higher phototherapy requirement, and identify cord blood albumin as the only independent predictor among the variables studied.

Maternal and Neonatal Profile: The mean maternal age of 28.39 ± 4.80 years, with two-thirds of mothers aged 21–30 years, is consistent with contemporary institutional obstetric profiles; multicenter data similarly place most delivering mothers between 25 and 35 years, an age range associated with favorable neonatal outcomes, although advanced maternal age has been linked to

a higher likelihood of neonatal hyperbilirubinemia in some cohorts [44-46,55,56,61]. The slight male predominance (53.18%) mirrors the expected sex ratio at birth, and male sex is a recognized intrinsic risk factor for neonatal jaundice — male infants show higher peak bilirubin concentrations and a roughly 1.5- to 2-fold higher risk of significant hyperbilirubinemia, attributed to higher erythrocyte mass and differences in hepatic enzyme activity [3,47,48]. The mean cord blood albumin of 3.04 ± 0.35 g/dL in this cohort falls within the gestational age-dependent reference range of approximately 2.8–3.4 g/dL established for term neonates, and cord blood has been validated as a reliable substitute for neonatal blood in albumin estimation [49,50]. The mean total serum bilirubin of 13.04 ± 3.54 mg/dL at 72–96 hours is consistent with the reported physiological range during the first week of life [51], and the predominance of

birth weights between 2.5 and 3.5 kg and gestational ages of 37–41 weeks resembles the distributions reported in comparable prospective cohorts from Ethiopia and elsewhere [16,52,57,59,60].

Albumin Levels and Bilirubin: Stratifying neonates by cord blood albumin reproduced the distribution pattern described in earlier studies, in which most infants cluster in the mid-range and values below 2.8 g/dL fall into the lowest tertile [40,53,54]. Mean total serum bilirubin declined across rising albumin levels, echoing the inverse relationship reported by Bhat and by Patil and colleagues, although the linear correlation in the present study was weak and non-significant — a pattern others have also observed, suggesting that cord blood albumin alone explains only part of the variance in subsequent bilirubin and is best interpreted alongside other clinical parameters [10,25,33,62]. The bilirubin-to-albumin ratio may offer greater predictive accuracy than albumin alone, as it captures both bilirubin load and binding capacity [32,38,53,63].

Phototherapy and Exchange Transfusion: The phototherapy rate fell steeply from 20.0% in the lowest albumin group to 7.6% in the highest, a highly significant gradient that accords with previous reports of greater phototherapy requirement among neonates with lower cord blood albumin [1,2,8,11,37-43,58]. The overall exchange transfusion rate of 1.36% is low and consistent with the effectiveness of modern phototherapy protocols, which have progressively reduced the need for exchange transfusion to roughly 2–5% even among infants with significant hyperbilirubinemia [63-65]. The non-significant association of exchange transfusion with albumin level reflects the very low event rate and the effectiveness of timely phototherapy.

Predictive Model and Diagnostic Accuracy: In multivariable analysis, cord blood albumin was the sole independent predictor of phototherapy requirement (OR 0.021), with a model AUC-ROC of 0.789 — discrimination in the acceptable-to-good range by conventional ROC interpretation [66,67]. This agrees with predictive modeling studies in which cord blood albumin emerged as the strongest cord blood determinant of phototherapy need [53]. At the <2.8 g/dL cut-off, the marker achieved perfect specificity and positive predictive value: every neonate flagged as high risk genuinely required phototherapy, so no infant above this threshold would be falsely classified as high-risk and no flagged infant would be monitored unnecessarily [33,35,68,69]. The moderate sensitivity at this threshold means some at-risk infants would still be missed, supporting the use of cord blood albumin as a screening adjunct rather

than a stand-alone test — a position consistent with reviews of neonatal hyperbilirubinemia screening that emphasize combining biochemical markers with hour-specific bilirubin assessment [12,68,69].

Strengths and Limitations: Strengths include the prospective design, an adequate sample of 220 term appropriate-for-gestational-age neonates, strict exclusion criteria that minimized confounding by prematurity, sepsis, and birth asphyxia, albumin measurement at birth enabling true early risk assessment, serum bilirubin estimation at 72–96 hours coinciding with the physiological peak, and the use of multiple complementary statistical methods including logistic regression and ROC analysis. Limitations include the single-center design, which may limit generalizability; a sample size still insufficient to detect rare outcomes such as exchange transfusion with adequate power; restriction to term neonates, so findings cannot be extrapolated to preterm or low-birth-weight infants; evaluation of cord blood albumin as a single marker without the bilirubin-to-albumin ratio or other composite indices; the short follow-up limited to the early neonatal period, precluding assessment of late-onset hyperbilirubinemia; and the absence of data on breastfeeding practices and genetic factors.

Conclusion

In healthy term neonates, cord blood albumin measured at birth is a simple, inexpensive, non-invasive marker that identifies infants at increased risk of significant neonatal hyperbilirubinemia. Neonates with lower albumin levels were significantly more likely to require phototherapy, and in multivariable analysis cord blood albumin was the only independent predictor of treatment need, with each 1 g/dL rise reducing the odds of phototherapy by about 98%. At the <2.8 g/dL threshold the test achieved perfect specificity and positive predictive value, making it well suited to selecting high-risk neonates for close monitoring and early intervention. Incorporating cord blood albumin estimation into routine newborn evaluation can support early discharge planning, targeted follow-up, and timely treatment, thereby reducing the risk of bilirubin-related neurological complications.

Declarations:

Ethics approval and consent to participate: The study protocol was approved by the Institutional Ethics Committee of Darbhanga Medical College and Hospital; written informed consent was obtained from parents or guardians.

Availability of data and materials: Available from the corresponding author on reasonable request. Competing interests: The author declares no competing interests. Funding: None.

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