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EARLY NEONATAL BODY WEIGHT LOSS AS A PREDICTOR OF SIGNIFICANT HYPERBILIRUBINEMIA AT 72 HOURS OF LIFE: A PROSPECTIVE OBSERVATIONAL STUDY

Paediatrics

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ABSTRACT

Background: Early neonatal weight loss and hyperbilirubinemia share a common pathophysiological basis in inadequate feeding and increased enterohepatic circulation. This study assessed the correlation between percentage body weight loss during the first 72 hours of life and significant hyperbilirubinemia in term neonates.**Methods:** A single-centre, hospital-based, prospective observational study was conducted at Amaltas Institute of Medical Sciences, Dewas, over 18 months (IEC No. IEC/AIMS/2024/015, dated 15 February 2024). A total of 150 eligible term neonates (gestational age 37–42 weeks, birth weight >2500 g, APGAR score ≥7) were enrolled after excluding 28 neonates who developed jaundice before 72 hours or required NICU admission. Weight was measured at birth, 24, 48, and 72 hours. Total serum bilirubin was measured at 72 hours. Significant hyperbilirubinemia was defined as TSB >15 mg/dL. **Results:** Mean percentage weight loss progressed from 3.88±0.898% at 24 hours to 7.43±1.69% at 72 hours. Significant hyperbilirubinemia was present in 22 (14.67%) neonates. Excessive weight loss (>7%) was seen in 83 (55.33%). Percentage weight loss was significantly higher in the hyperbilirubinemia group at all time points ($p < 0.001$ for all). A moderate positive correlation existed between percentage weight loss and serum bilirubin ($r = 0.61$, $p < 0.001$). Total weight loss at 72 hours strongly predicted hyperbilirubinemia on logistic regression (OR = 9.96, 95% CI 3.84–26.84; $p = 0.003$). Inadequate breastfeeding frequency (<8 times/day) was also a significant predictor (OR = 1.89, $p = 0.045$).**Conclusion:** Early neonatal weight loss is significantly associated with, and predictive of, significant hyperbilirubinemia at 72 hours. Serial weight monitoring and breastfeeding support should be prioritised in routine neonatal care, particularly in settings where laboratory investigations are not readily available for all newborns.

KEYWORDS

Neonatal Weight Loss; Hyperbilirubinemia; Neonatal Jaundice; Breastfeeding; Total Serum Bilirubin; Term Neonate

INTRODUCTION

Neonatal hyperbilirubinemia is one of the most common conditions requiring clinical evaluation in the first week of life, affecting approximately 60% of term and up to 80% of preterm neonates.[1] In most cases, jaundice is physiological and self-limiting. However, rapid or severe elevation of unconjugated bilirubin can cross the blood–brain barrier and cause acute bilirubin encephalopathy, with the risk of permanent neurological sequelae including kernicterus in the most severe cases.[2,3] Early identification of neonates at risk for significant hyperbilirubinemia is therefore essential to guide closer monitoring and timely intervention. A significant proportion of term neonates lose weight in the first three to four days of life, primarily due to loss of extracellular fluid and limited caloric intake before maternal lactation is established.[4] A weight loss of up to 7% of birth weight is generally considered within the physiological range for term neonates. Excessive weight loss — typically defined as greater than 7% by day three — is most commonly associated with inadequate breastfeeding and dehydration.[5] The physiological link between early weight loss and hyperbilirubinemia is well-recognised. Inadequate caloric intake reduces intestinal motility and delays meconium passage, allowing unconjugated bilirubin in the gut lumen to be reabsorbed via enterohepatic circulation rather than excreted.[6] At the same time, dehydration impairs hepatic bilirubin conjugation and clearance. Both mechanisms operate simultaneously, making neonatal weight loss a logical and potentially measurable early predictor of clinically significant jaundice. Several studies from East Asian and Indian populations have demonstrated statistically significant associations between the degree of early weight loss and subsequent serum bilirubin levels.[7,8] Most of these studies, however, have been retrospective or conducted outside central India, where nutritional profiles, breastfeeding practices, and healthcare access differ substantially from other populations. There remains a need for prospective, well-defined studies from this region to establish locally applicable data that can be translated into clinical guidance.

This study was conducted to prospectively assess the relationship between percentage body weight loss at 24, 48, and 72 hours of life and the occurrence of significant hyperbilirubinemia at 72 hours in term neonates admitted to a tertiary care centre in Madhya Pradesh.

Aim

To analyse the body weight loss of term neonates at 24, 48, and 72 hours after birth and to establish its relationship with significant hyperbilirubinemia at 72 hours of life.

Material and Methods

This was a single-centre, hospital-based, single-group, prospective observational study. The study was conducted in the Department of Paediatrics at Amaltas Institute of Medical Sciences, Dewas, central Madhya Pradesh — a tertiary care teaching hospital. The study was conducted over 18 months, organised into a three-month planning phase, a twelve-month recruitment and data collection phase, and a three-month analysis and write-up phase. Ethical clearance was obtained from the Institutional Ethics Committee of Amaltas Institute of Medical Sciences under protocol number IEC/AIMS/2024/015, dated 15 February 2024. The study was conducted in accordance with the Declaration of Helsinki. Written informed consent was obtained from parents or guardians of all enrolled neonates, in Hindi or English as preferred, after explanation of the study objectives and voluntary nature of participation. The primary outcome was the correlation between percentage body weight loss during the first 72 hours of life and significant hyperbilirubinemia at 72 hours. The secondary outcomes were the weight trend over 72 hours, the incidence of excessive weight loss, and the association of breastfeeding practices with weight loss and hyperbilirubinemia. Significant hyperbilirubinemia was defined as total serum bilirubin >15 mg/dL at 72 hours of life, aligned with the Bhutani hour-specific nomogram. Excessive weight loss was defined as a reduction of more than 7% of birth weight at 72 hours.

Inclusion Criteria:

1. Term neonates born at 37 to 42 weeks gestation.
2. Birth weight greater than 2500 grams.
3. Admitted to the neonatal unit for monitoring.

Exclusion Criteria:

1. Mothers not willing to participate in the study.
2. ABO or Rh incompatibility.
3. Neonates of diabetic mothers.
4. Neonates requiring NICU/HDU admission(for phototherapy etc).
5. Congenital anomalies.
6. Conjugated hyperbilirubinemia.
7. Instrumental deliveries (forceps or vacuum).
8. Neonates with early-onset jaundice appearing before 24 hours of life.
9. G6PD deficiency.
10. Isoimmune haemolytic anaemia.
11. Birth asphyxia or metabolic acidosis.
12. Temperature instability or sepsis.

Sample Size and Sampling Methodology The required sample size was estimated using the formula $N = Z^2 \times P(1-P) / d^2$, where $Z = 1.960$, $P = 0.11$ (expected prevalence of hyperbilirubinemia), and $d = 0.05$, yielding a minimum sample of 150 neonates. A non-randomised convenience sampling method was used; eligible neonates delivered at the institution were recruited consecutively until the required sample was reached.

Data Collection Procedure A total of 178 neonates were enrolled. Of these, 28 were excluded from final analysis: 18 developed jaundice before 72 hours of life and 10 required NICU admission. The final analysis was performed on 150 neonates. Neonatal weight was measured at birth, 24, 48, and 72 hours using a calibrated digital weighing machine. All measurements were taken before feeds, with the infant unclothed. The machine was calibrated daily using standard weights. Percentage body weight loss was calculated as: [(Birth weight − Measured weight) / Birth weight] × 100. Feeding details including time of first breastfeed, frequency per 24 hours, and exclusive breastfeeding status were recorded from nursing charts and confirmed with mothers. Venous blood samples for total serum bilirubin were collected at 72 hours and analysed in the institutional biochemistry laboratory using standard automated analysers.

Statistical Analysis

Data were analysed using Stata version 17.0. Continuous variables are expressed as mean ± SD; categorical variables as frequencies and percentages. Group comparisons were performed using independent t-test or Mann–Whitney U test for continuous variables and chi-square or Fisher's exact test for categorical variables. Pearson's correlation coefficient was used to assess the relationship between percentage weight loss and serum bilirubin. Logistic regression was used to identify independent predictors of significant hyperbilirubinemia. A p-value of <0.05 was considered statistically significant.

RESULTS

A total of 178 neonates were enrolled; 28 were excluded (18 developed jaundice before 72 hours, 10 required NICU admission). The final analysis was performed on 150 term neonates. All participants had complete weight and bilirubin data. The detailed findings are presented below.

Table 1: Characteristics of Participants

Category	Frequency (n)	Percentage (%)
Gestational Age (weeks)		
37	6	4.00
38	36	24.00
39	40	26.67
40	30	20.00
41	32	21.33
42	6	4.00
Gender		
Male	84	56.00
Female	66	44.00
Mode of Delivery		
Normal vaginal delivery	98	65.33
Caesarean section	52	34.67
Micturition in First 24 Hours		
≥6 voids	138	92.00
<6 voids	12	8.00
Meconium Passage within 24 Hours		
Yes	124	82.67
No	26	17.33
Breastfeeding		
Initiated within 1 hour	128	85.33
Not initiated within 1 hour	22	14.67
Frequency ≥8 times/day	90	60.00
Frequency <8 times/day	60	40.00
Exclusively breastfed (0–72h)	140	93.33
Not exclusively breastfed	10	6.67

Table 1 presents the baseline characteristics of the 150 neonates. Gestational age of 39 weeks was the most common (26.67%), followed by 41 weeks (21.33%) and 38 weeks (24.00%). Male neonates predominated (56.00%). Normal vaginal delivery accounted for 65.33% of births. Micturition was adequate (≥6 voids/day) in 92.00% and meconium was passed within 24 hours in 82.67%. Breastfeeding was initiated within one hour in 85.33% of neonates. Feeding frequency ≥8 times/day was achieved in 60.00%, and 93.33% were exclusively breastfed in the first 72 hours.

Table 2: Trend in Body Weight and Percentage Weight Loss Over 72 Hours

Parameter	Mean	SD
Birth weight (g)	2876	191
Weight at 24 hours (g)	2764	190
Weight at 48 hours (g)	2701	188
Weight at 72 hours (g)	2663	191
Total reduction 0–72 hours (g)	213	47.9
% body weight loss at 24 hours: 3.88 ± 0.898 | At 48 hours: 6.08 ± 1.35 | At 72 hours: 7.43 ± 1.69		
Excessive weight loss (>7% at 72h): 83 neonates (55.33%)		

Table 2 shows a consistent decline in mean weight from birth (2876±191 g) through 24 hours (2764±190 g), 48 hours (2701±188 g), to 72 hours (2663±191 g), with a mean total reduction of 213±47.9 g. Mean percentage weight loss increased progressively from 3.88% at 24 hours to 7.43% at 72 hours. Excessive weight loss (>7%) was present in 83 neonates (55.33%), indicating that more than half of the cohort exceeded the physiological threshold.

Table 3: Association of Significant Hyperbilirubinemia with Absolute Weight Parameters

Parameter	No SHB n=128 Mean	No SHB SD	SHB n=22 Mean	SHB SD | P-value
Birth weight (g)	2884	191	2830	191 | 0.841
Weight at 24h (g)	2778	188	2683	189 | 0.403
Weight at 48h (g)	2721	183	2586	183 | 0.166
Weight at 72h (g)	2686	183	2527	182 | 0.099
Total reduction 0–72h (g)	198	30.9	303	24.8 | < 0.001
SHB = Significant hyperbilirubinemia (TSB >15 mg/dL at 72h). Only total weight reduction was significantly different between groups.				

Table 3 shows that birth weight, weight at 24h, 48h, and 72h were comparable between neonates with and without significant hyperbilirubinemia ($p > 0.05$ for all). However, the total reduction in weight from 0 to 72 hours was significantly higher in neonates with hyperbilirubinemia (303±24.8 g vs 198±30.9 g; $p < 0.001$), confirming that the absolute magnitude of weight loss, rather than baseline weight, is the key discriminator.

Table 4: Association of Significant Hyperbilirubinemia with Percentage Weight Loss

Time point	No SHB (n=128) Mean	No SHB SD	SHB (n=22) Mean	SHB SD	P-value
% weight loss at 24h	3.65	0.686	5.22	0.825	< 0.001
% weight loss at 48h	5.64	0.805	8.64	0.979	< 0.001
% weight loss at 72h	6.86	1.01	9.2	0.862	< 0.001
Percentage weight loss was significantly higher in the SHB group at all three time points.					

Table 4 shows that percentage weight loss was significantly higher in the significant hyperbilirubinemia group at all three time points ($p < 0.001$ for all). At 24 hours, the difference was 1.57 percentage points (5.22% vs 3.65%). By 72 hours, the gap widened to 2.34 percentage points (9.2% vs 6.86%). These findings demonstrate that the predictive signal emerges as early as 24 hours and strengthens progressively.

Table 5: Mean Bilirubin by Weight Loss Category and Correlation

Parameter	Value	P-value
Mean bilirubin – Normal weight loss (<7%)	11.06 ± 1.93 mg/dL	0.002
Mean bilirubin – Excessive weight loss (>7%)	13.29 ± 4.29 mg/dL	
Difference in mean bilirubin	−2.2349 mg/dL	
Pearson correlation (% weight loss vs TSB at 72h)	r = 0.61	< 0.001

Table 5 shows that neonates with excessive weight loss (>7%) had significantly higher mean bilirubin (13.29±4.29 mg/dL) compared to those with normal weight loss (11.06±1.93 mg/dL; p = 0.002). A moderate positive Pearson correlation was found between percentage weight loss and serum bilirubin at 72 hours (r = 0.61, p < 0.001), indicating that as weight loss increases, bilirubin rises proportionally.

Table 6: Logistic Regression: Predictors of Significant Hyperbilirubinemia

Variable	Category	OR	P	95% CI Lowe	95% CI Upper	Signifi cant?
Total weight loss at 72h	1 g increment	9.96	0.003	3.84	26.84	Yes ✓
BF frequency	<8 vs ≥8 times	1.89	0.045	1.29	12.35	Yes ✓
Voids in 24h	<6 vs ≥6	1.89	0.859	1.42	2.80	No
Meconium passage	Yes vs No	2.57	0.229	1.55	11.92	No
Early BF initiation	Yes vs No	2.18	0.327	0.46	10.33	No
Exclusive BF	Yes vs No	1.11	0.929	0.10	12.24	No
BF = breastfeeding. Only total weight loss at 72h and breastfeeding frequency were statistically significant predictors.						

Table 6 presents the logistic regression results. Total weight loss at 72 hours was the strongest independent predictor (OR = 9.96, 95% CI 3.84–26.84; p = 0.003), indicating that neonates with greater weight loss had nearly ten-fold higher odds of developing significant hyperbilirubinemia. Inadequate breastfeeding frequency (<8 times/day) was also a significant predictor (OR = 1.89, p = 0.045). Other variables including voids, meconium passage, early initiation, and exclusive breastfeeding did not achieve statistical significance.

DISCUSSION

This prospective study enrolled 150 term neonates at a tertiary care centre in central Madhya Pradesh and assessed the relationship between early postnatal weight loss and significant hyperbilirubinemia at 72 hours. The findings consistently demonstrated that greater percentage weight loss at 24, 48, and 72 hours is significantly associated with higher serum bilirubin and increased risk of significant hyperbilirubinemia. Total weight loss was the strongest independent predictor on logistic regression.

The mean percentage weight loss in the present study rose from 3.88% at 24 hours to 7.43% at 72 hours. Excessive weight loss (>7%) was seen in 55.33% of neonates. Yang WC et al. (2013) reported similar values (4.14%, 7.37%, 8.4% at days 1, 2, and 3 respectively),[7] and Chang RJ et al. (2012) also described progressive weight loss with comparable proportions developing excessive loss.[8] Pulmamidi R et al. (2021) found that 63.6% of neonates had weight loss >7% at 72 hours,[9] slightly higher than the 55.33% in the present study. Boskabadi H et al. (2014) reported a similar proportion of approximately 46% with excessive weight loss.[10] Sankhwar D et al. (2025) documented weight loss reaching 7.8–9.2% at 72 hours in their cohort.[11] The progressive weight loss pattern and the proportion exceeding 7% in the present study are broadly consistent with Indian and international literature, suggesting this is a consistent physiological pattern amenable to clinical tracking. Significant hyperbilirubinemia (TSB >15 mg/dL at 72h) was present in 14.67% of neonates in the present study, with a mean bilirubin of 12.4±3.7 mg/dL. This is lower than the rates reported by Chang RJ et al. (2012) (25.1%),[8] Yang WC et al. (2013) (33.5%),[7] and Sankhwar D et al. (2025) (~60%), the latter using a lower diagnostic threshold of ≥12 mg/dL.[11] Wadhwa L et al. (2025) also reported a higher rate of ~55% using the lower cut-off.[12] The lower incidence in the present study is consistent with the strict AAP-aligned threshold of >15 mg/dL and the relatively high rates of early breastfeeding initiation (85.33%) in this cohort, which may have partially mitigated bilirubin accumulation. Percentage weight loss was significantly higher in neonates who developed significant hyperbilirubinemia at all three time points (p < 0.001), with differences appearing as early as 24 hours. The mean difference between groups was 1.57% at 24h, 3.00% at 48h, and 2.34% at 72h. These findings align with Yang WC et al. (2013), who found differences of 0.52%, 1.08%, and 2.0% at corresponding time points,[7] and Pulmamidi R et al. (2021), who reported a strong association between >7% weight loss and hyperbilirubinemia.[9] Wadhwa L et al. (2025) demonstrated a significant positive correlation between percentage weight loss at 48 hours and serum bilirubin (r = 0.525, p < 0.001),[12] and Sankhwar D et al. (2025) showed that neonates with hyperbilirubinemia had significantly higher weight loss reaching ~9.2% at 72 hours.[11] In the present study, a moderate positive Pearson correlation (r = 0.61, p < 0.001) was observed between percentage weight loss and serum bilirubin, indicating that higher weight loss is accompanied by proportionally higher bilirubin. This is physiologically consistent: insufficient feeding reduces gut motility and meconium passage, increasing enterohepatic reabsorption of bilirubin; simultaneously, caloric deprivation and dehydration impair hepatic conjugation and excretion.[6] Both pathways converge to elevate serum bilirubin in proportion to the degree of weight loss.

Total weight loss at 72 hours was the strongest independent predictor of significant hyperbilirubinemia in logistic regression (OR = 9.96, 95% CI 3.84–26.84; p = 0.003). This nearly ten-fold odds ratio underscores the clinical importance of weight tracking in the first three days of life. Inadequate breastfeeding frequency (<8 times/day) was also a significant predictor (OR = 1.89, p = 0.045), while early initiation, exclusive breastfeeding, voiding frequency, and meconium passage did not independently reach significance. These findings suggest that it is not merely the initiation of breastfeeding but its adequacy — in terms of frequency and consequently caloric intake — that determines the degree of weight loss and associated bilirubin elevation. Chang RJ et al. (2012)[8] and Boskabadi H et al. (2014)[10] similarly identified feeding adequacy as a key driver of both weight loss and hyperbilirubinemia outcomes. The practical implication is that breastfeeding support should focus not only on initiation but on sustained, frequent feeding sessions of adequate duration in the first 72 hours. These findings have direct practical relevance for routine neonatal care. Weight measurement is non-invasive, inexpensive, and universally feasible, including in settings where routine serum bilirubin screening for all neonates is not practical. The predictive signal emerges as early as 24 hours, allowing early identification of at-risk neonates and proactive breastfeeding support before bilirubin reaches clinically significant levels. A cut-off of >7% at 72 hours reliably identifies neonates who warrant closer bilirubin monitoring. Introducing a simple weight-monitoring protocol into standard neonatal care checklists, alongside targeted lactation support, could reduce the proportion of neonates reaching the threshold for phototherapy or readmission.

CONCLUSION

Early neonatal body weight loss is significantly associated with significant hyperbilirubinemia at 72 hours of life. Percentage weight loss was higher in the hyperbilirubinemia group at all time points (p < 0.001), and a moderate positive correlation was found between weight loss and serum bilirubin (r = 0.61, p < 0.001). Total weight loss at 72 hours was the strongest independent predictor on logistic regression (OR = 9.96, p = 0.003). Inadequate breastfeeding frequency was also a significant predictor (OR = 1.89, p = 0.045). Serial weight monitoring and breastfeeding frequency support should be integrated into routine neonatal care protocols, particularly in resource-limited settings, as a simple, accessible strategy for early identification of neonates at risk for significant hyperbilirubinemia.

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