

Original Research Article

Weight loss of term babies in 48 hours of life as a tool to predict non-pathological neonatal hyperbilirubinemia

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ABSTRACT

Background: The aim of this study is to analyse the percentage of weight loss in 48 hours in term neonates as a predictor of non-pathological neonatal hyperbilirubinemia.

Methods: The study was carried out in Department of Paediatrics in GITAM Institute of Medical Sciences and Research. A total of 120 babies were studied. Babies with pathological jaundice were excluded from the study.

Results: While 45% of participants in the current study had normal bilirubin levels, 55% had hyperbilirubinemia (TSB>12). Percentage weight loss at 48 hours was positively correlated with total serum bilirubin with correlation coefficient (r) of 0.525 which was statistically significant (p value <0.001). On performing ROC analysis between percentage weight loss at 48 hours and hyperbilirubinemia, it was found that, at an optimum cut off >6.3% weight loss at 48 hours, patient will have hyperbilirubinemia.

Conclusions: According to the above study, there is a clear link between hyperbilirubinemia and weight loss in newborns. Increased levels of bilirubin are strongly correlated with notable weight loss within the first 48 hours of life. Jaundice has been demonstrated to occur if the weight loss is more than 6.3% in the first 48 hours of life.

Keywords: Neonate, Weight, Hyperbilirubinemia, Bilirubin

INTRODUCTION

During the first two to three days of life, the majority of new-borns lose weight. The body weight loss ranges from 5 to 8% of the birth weight. Nevertheless, reports on what defines a new-born body weight drop vary. Low milk consumption may be linked to weight loss. Initial weight loss is caused by the passage of meconium, the elimination of vernix, the removal of mucus and blood from the skin, and a decrease in the volume of extracellular fluid. Excessive loss of weight in the initial few days of life can indicate dehydration in new-borns, which leads to reduced blood volume, decreased urination and decreased liver function which in turn concentrates bilirubin levels in the blood, increasing the risk of hyperbilirubinemia. Delayed onset of breastfeeding or inadequate milk intake in the first 48 hours of life can contribute to greater weight loss and

subsequent dehydration, potentially exacerbating the risk of hyperbilirubinemia.¹

The most frequent condition observed in babies during their 1st week of life is hyperbilirubinemia. Jaundice affects more than two thirds of babies. Indirect bilirubin accumulation is the reason behind the physical observation of a new-born's mucous membranes becoming yellowish. Majority of the babies' experience unconjugated hyperbilirubinemia as a normal physiological occurrence. 60% of term babies and greater than 80% of preterm babies have high bilirubin levels in their first seven days of life.^{1,2}

Six percent of term new-borns serum bilirubin levels are greater than twelve percent. In three percent of term babies, levels of serum bilirubin exceed 15 mg%. Severe unconjugated hyperbilirubinemia, however, has the potential to be neurotoxic if left untreated.

In the current era of discharge from postnatal wards of hospitals, it is primarily the reason why new-borns are readmitted again within their first few days of life. Concerns about neonatal hyperbilirubinemia are shared by the parents.³

High values of indirect serum bilirubin may lead to encephalopathy and kernicterus thus causing severe, lifelong issues with neurological development. Conjugated hyperbilirubinemia is a sign of serious liver disease or upcoming systemic infections. Therefore, it's crucial to treat neonatal hyperbilirubinemia appropriately. Treatment options for hyperbilirubinemia include phototherapy, exchange transfusions, and pharmaceuticals.^{4,5}

One important aspect of managing and preventing hyperbilirubinemia is phototherapy. Phototherapy converts bilirubin into water-soluble isomers that can be removed from the body without undergoing the conjugation in the liver. The main benefit of phototherapy that has been demonstrated is the reduction of the requirement for exchange transfusion.

Identifying babies at risk of developing hyperbilirubinemia within the first 48 hours of life allows for early intervention strategies such as increased feeding frequency, phototherapy, or monitoring, thus, prevent the progression of hyperbilirubinemia to dangerous levels.³⁻⁶

A cut-off percentage of weight loss at 48 hours of life beyond which babies are expected to land in hyperbilirubinemia is helpful for early intervention. The timeframe of the study is limited to the first 48 hours after birth. This early period is crucial for monitoring new-borns as it encompasses the initial transition to extrauterine life and establishment of feeding.

If weight loss within the first 48 hours of life proves to be a reliable predictor of hyperbilirubinemia, it can be integrated into neonatal care protocols for early identification and management of at-risk infants which is helpful to reduce the risk of complications and improve neonatal outcomes. This will be helpful for accurate follow up of the baby and explaining the need for re-visits to parents.

Aims and objectives

Aims and objectives of the study were to analyse the percentage of weight loss in 48 hours in term neonates as a predictor of non-pathological neonatal hyperbilirubinemia, and to evaluate the relationship between the weight loss and its factors in term neonates with non-pathological hyperbilirubinemia after 72 hours of life.

METHODS

A cross-sectional type study was conducted among the babies delivered in GIMSR Hospital from October 2022 to January 2024.

Study design

It was a cross-sectional study.

Study place

The study was conducted at GIMSR Hospital, Visakhapatnam.

Inclusion criteria

Newborns with a gestational age of 37 weeks, and a birth weight of more than 2500 grams were included.

Exclusion criteria

Preterm babies, birth weight of less than 2500 grams, conditions leading to pathological hyperbilirubinemia like: ABO incompatibility or Rh incompatibility, perinatal asphyxia, early onset neonatal sepsis, hemolytic disorders, and cephalohematoma were excluded.

Sample size

As previous studies were not available on weight loss of term babies in 48 hours of life as a tool to predict non-pathological neonatal hyperbilirubinemia, "correlation coefficient (r) of 72-hour bilirubin with percentage of weight loss on the second day (i.e., $r=0.305$)" from the study by Yang et al was used to estimate sample size.

The standard normal deviate for $Z\alpha=1.9600$.

The standard normal deviate for $Z\beta=0.8416$.

$$C = 0.5 \times \ln[(1 + r)/(1 - r)] = 0.3150$$

$$\text{Total sample size} = N = [(Z\alpha + Z\beta)/CI2 + 3] = 82$$

Here, α (two-tailed)=0.05=threshold probability for rejecting the null hypothesis, type I error rate; $\beta=0.20$ =probability of failing to reject the null hypothesis under the alternative hypothesis, type II error rate; and $r=0.305$ =the expected correlation coefficient.

However, during study period, 120 babies fulfilled the inclusion criteria and were included in the study.¹⁶

Methodology

Between October 2022 and January 2024, a cross-sectional study was carried out on 120 term babies born via lower segment caesarean section or normal vaginal delivery with a greater than 37 weeks' gestational age and a weight at birth which is more than 2500 grams.

Immediately after delivery, the birth weight was recorded in kilograms using an electronic scale that can detect changes of up to 0.001 grams. The newborn was weighed

as soon as possible using a transfer paper that was placed on the scale; the scale was cleaned in between uses. The newborn was never left alone.

Before taking a measurement, the machine was always balanced to the zero position, and it was routinely tested using standard weights.

Likewise, the baby's weight was recorded every morning before the first feed (7 AM) at 24 and 48 hours of life.

The percentage of weight loss from birth at 24 and 48 hours of life was calculated.

An aseptic peripheral venepuncture blood sample (2 ml) in a red vacuum-sealed container was taken at 72 hours of life to quantify the total serum bilirubin using COBAS C 311 Machine.

A baby was said to have hyperbilirubinemia if the blood bilirubin level was greater than 12 milligram/deciliter. Newborns whose jaundice fit the criterion for exclusion were eliminated.

To determine a cut-off, the percentage of weight loss in newborns with hyperbilirubinemia (≥ 12 mg/dl) from birth to 48 hours of life was calculated using appropriate statistical tests.

RESULTS

The study was conducted in 120 newborn babies delivered in a tertiary care hospital. The following observations were made from this study.

In the current study, 53.3% of the children in the current study were male, and 46.7% were female.

40% of participants had normal vaginal delivery and 60% had Lower segment caesarean section.

The majority of the study participants (71.7%) were breastfed, 10.8% had top-up feeds, and the remaining 17.5% received both forms of feeding (Table 1).

While 45% of participants in the current study had normal bilirubin levels, 55% had hyperbilirubinemia (TSB >12).

The current study's mean birth weight was 3.003 ± 0.31 kg, and mean weight was 2.86 ± 0.3 kg on day one and 2.805 ± 0.3 kg on day two.

The average % weight reduction was 4.42 ± 1.87 after 24 hours and 6.55 ± 2.09 at 48 hours.

The average serum bilirubin level was 11.57 ± 2.25 mg/dl (Table 3).

Table 1: Sex distribution, mode of delivery, and mode of feeding of subjects.

Variables	Frequency	Percentage
Female	56	46.7
Male	64	53.3
LSCS	72	60.00
NVD	48	40.00
Breast feeds	86	71.7
Top up feeds	13	10.8
Breastfeed and top up feeds	21	17.5

Table 2: Frequency of hyperbilirubinemia.

Variables	Frequency	Percentage
Hyperbilirubinemia	66	55.0
No hyperbilirubinemia	54	45.0
Total	120	100.0

Mean birth weight was 3.02 ± 0.3 in hyperbilirubinemia group and 2.97 ± 0.33 in normal group. The unpaired t test revealed that this difference was not statistically significant (p value >0.05).

Mean weight on day 1 was 2.87 ± 0.29 in hyperbilirubinemia group and 2.86 ± 0.32 in normal group. The unpaired t test revealed that this difference was not statistically significant (p value >0.05).

Mean birth weight was 2.79 ± 0.29 in hyperbilirubinemia group and 2.82 ± 0.31 in normal group. It was determined that this difference was not statistically significant (p value >0.05) using the unpaired t test (Table 4).

In the hyperbilirubinemia group, the mean percentage weight loss at 24 hours was 5.16 ± 1.8 , while in the normal group it was 3.52 ± 1.54 . The unpaired t test revealed that this difference was statistically significant (p value <0.05).

48-hour weight loss mean percentages were 5.05 ± 1.47 for the normal group and 7.75 ± 1.71 for the hyperbilirubinemia group. The unpaired t test revealed that this difference was statistically significant (p value <0.05) (Table 5).

Table 3: Mean, median, and standard deviation of birth weight, percentage of weight loss on day 1 and 2, total serum bilirubin and weights on day 1 and 2.

Variables	Birth weight	Day 1 weight	% of weight loss at 24 hours	Day 2 weight	% of weight loss at 48 hours	TSB
Mean	3.00337	2.86907	4.423	2.80582	6.553	11.574
Median	2.98750	2.81100	4.350	2.76500	6.200	12.000

Continued.

Variables	Birth weight	Day 1 weight	% of weight loss at 24 hours	Day 2 weight	% of weight loss at 48 hours	TSB
Standard deviation	0.319996	0.308279	1.8730	0.303023	2.0976	2.2507
Minimum	2.500	2.333	0.1	2.273	1.0	4.0
Maximum	3.990	3.871	11.9	3.751	12.6	17.5
Percentiles						
25	2.72625	2.59075	3.100	2.55900	5.100	10.100
50	2.98750	2.81100	4.350	2.76500	6.200	12.000
75	3.20500	3.07425	5.500	3.01800	8.100	12.675

Table 4: Mean and standard deviations of birth weight and weights on day 1 and 2 of life with respect to hyperbilirubinemia.

Variable	Hyperbilirubinemia		No hyperbilirubinemia		P value
	Mean	SD	Mean	SD	
Birth weight	3.02917	0.307848	2.97183	0.334427	0.331
Day 1 weight	2.87117	0.294916	2.86650	0.326653	0.935
Day 2 weight	2.79073	0.291563	2.82462	0.318523	0.546

Table 5: Mean and standard deviations of percentage of weight loss at 24 and 48 hours of life with respect to hyperbilirubinemia.

Variables	Hyperbilirubinemia		No hyperbilirubinemia		P value
	Mean	SD	Mean	SD	
% of weight loss at 24 hours	5.161	1.8002	3.520	1.5474	0.001
% of weight loss at 48 hours	7.758	1.7167	5.053	1.4713	0.001

Percentage weight loss at 24 hours was positively correlated with total serum bilirubin with correlation coefficient (r) of 0.362 which was statistically significant (p value <0.001).

Percentage weight loss at 48 hours was positively correlated with total serum bilirubin with correlation coefficient (r) of 0.525 which was statistically significant (p value <0.001) (Table 6).

Table 6: Correlation between the percentage of weight loss and total serum bilirubin levels.

TSB	% of weight loss at 24 hours	% of weight loss at 48 hours
Pearson's correlation	0.362	0.525
P value	0.001	0.001

Table 7: Percentage of weight loss at 24 hours with hyperbilirubinemia.

Variables	Values
Area under the ROC curve (AUC)	0.759
95% confidence interval	0.673 to 0.832
Significance level for p (area=0.5)	<0.0001
Cut off	>4.4
Sensitivity	68.18
Specificity	74.07
PPV	76.3

NPV 65.6

On performing ROC analysis between percentage weight loss at 24 hours and hyperbilirubinemia, it was found that, baby will have hyperbilirubinemia at an optimal cut off weight loss of >4.4% after 24 hours, with a sensitivity level of 68.18%, specificity level of 74.07%, positive predictive value of 76.3%, and negative predictive value of 65.6%. In terms of anticipating hyperbilirubinemia, the area under the curve was 0.759 (95% CI: 0.673-0.832), which was determined to be statistically significant (p value <0.05).

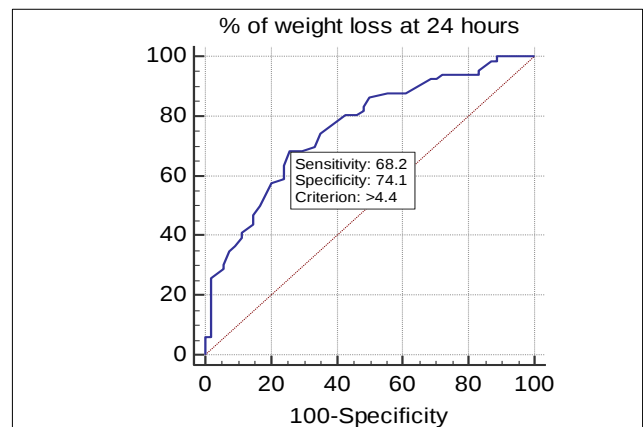


Figure 1: ROC 1 - percentage of weight loss at 24 hours with hyperbilirubinemia.

On performing ROC analysis between percentage weight loss at 48 hours and hyperbilirubinemia, it was found that, at an optimum cut off >6.3% weight loss at 48 hours, patient will have hyperbilirubinemia at sensitivity level of 78.79%, a specificity level of 88.68% with a positive predictive value being 89.7% and a negative predictive value of 77%. Predicting hyperbilirubinemia was shown to be statistically significant (p value <0.05) based on the area under the curve value of 0.885 (95% CI: 0.813-0.936).

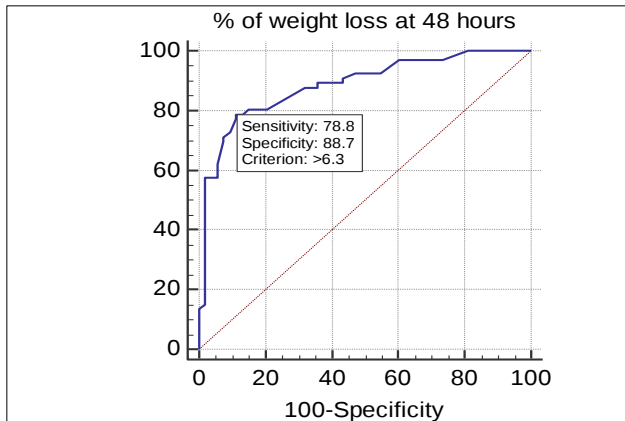


Figure 2: ROC 2 - percentage of weight loss at 48 hours with hyperbilirubinemia.

DISCUSSION

The current study showed statistically significant differences in weight loss between the hyperbilirubinemia and normal groups, with higher weight loss associated with higher bilirubin levels. Pulmamidi et al reported a higher percentage of weight loss (>7%) in a majority of cases.⁷ Chang et al provided detailed predictive values for weight loss percentages on the 2nd and 3rd days.⁸ Maisels et al also reported higher weight loss associated with increased bilirubin levels.⁹

The weight loss thresholds used to predict significant hyperbilirubinemia varied among the studies. Bhutani et al and Flaherman et al utilized prospective designs, providing a more controlled environment to monitor infants from birth and systematically measure weight loss and bilirubin levels.^{10,11} These studies identified a critical point between 5% and 10% weight loss. A study conducted by Pulmamidi et al found that 63.6% of term neonates with greater weight loss (>7%) were associated with hyperbilirubinemia.⁷ The study also noted that inadequate breastfeeding was seen in 81.8% of cases, indicating a link between feeding problems and weight loss.

Maisels et al found that weight loss greater than 7% is associated with bilirubin levels of 15 mg/dl, whereas Sarici et al identified a 10% weight loss threshold associated with 16 mg/dl bilirubin levels.^{9,12} Indriyani et al employed a cross-sectional design for measuring weight and bilirubin levels at multiple points within the first week of life to establish correlations and identify predictive factors,

showing that hyperbilirubinemia is the only significantly associated factor with weight loss in newborns on the third day.¹³

The timing of weight loss and bilirubin measurements is crucial. Studies generally agreed that weight loss measured at 48 to 72 hours' post-birth is most predictive of subsequent hyperbilirubinemia. Maisels et al and Yang et al conducted retrospective reviews, which allowed for the analysis of large datasets to identify trends and correlations between weight loss and bilirubin levels.⁹

Yang et al demonstrated that weight loss greater than 8.15% on the third day is a strong predictor of significant hyperbilirubinemia.

In a different study, Pulmamidi et al examined weight loss in healthy term newborns 24, 48, and 72 hours postpartum to predict hyperbilirubinemia.⁷ According to the study, severe hyperbilirubinemia (total bilirubin >15 mg/dl) at 72 hours was linked to larger body weight loss percentages throughout the first three days following delivery. 4.48% on the first day, 7.60% on the second day, and 8.15% on the third day were the ideal cut-off body weight loss percentages for detecting hyperbilirubinemia.

Numerous studies show a clear correlation between elevated bilirubin levels and newborn weight loss. Significant weight loss in the first few days of life is generally associated with higher levels of bilirubin in a variety of study designs and groups.

Limitations

The sample size may not be sufficient to extrapolate the findings to the complete population of full-term newborns. The study populations were frequently constrained by geographic limitations and may not have taken into consideration the ethnic and racial disparities in the frequency of hyperbilirubinemia and feeding behaviours. Differences in breastfeeding teaching and assistance can impact outcomes linked to weight loss and hyperbilirubinemia.

CONCLUSION

According to the above study, there is a clear link between hyperbilirubinemia and weight loss in new-borns. Increased levels of bilirubin are strongly correlated with notable weight loss within the first 48 hours of life. Jaundice has been demonstrated to occur if the weight loss is more than 6.3% in the first 48 hours of life. Feeding behaviour has a significant influence on the connection. It is important to adequately feed the baby in order to prevent excessive weight loss which in turn prevents dehydration and jaundice. To lower potential dangers, clinical professionals should closely monitor weight loss and bilirubin levels. It is essential to have strong nutritional and nursing support.

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Conflict of interest: None declared

Ethical approval: The study was approved by the Institutional Ethics Committee

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