



A Study on Maternal and Neonatal Factors Leading to Weight Loss in a Healthy Term Newborn During the First 72 Hours of Life

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(Received: 08 February 2024

Revised: 11 March 2024

Accepted: 08 April 2024)

KEYWORDS

ABSTRACT:

Background: The first 72 hours of a newborn's life witness physiological weight loss, influenced by complex factors such as fluid dynamics and energy utilization. Existing research, predominantly in Western contexts, has explored these aspects, but a significant gap exists in understanding the patterns and determinants in Asian neonates, particularly in countries like India. **Methods:** A prospective observational cohort study was conducted from January to December 2021 Newborn Weight Loss Tool for assessment. Maternal and neonatal factors were collected, and statistical analyses were performed using SPSS V21. Ethical approval and informed consent were obtained. **Results:** Among 100 term neonates, a mean weight loss of $7.12\% \pm 1.52\%$ within 72 hours was observed. Cesarean section delivery, inadequate breastfeeding, and low birth weight were associated with higher weight loss percentages. Primigravida mothers and those receiving 501-1000ml IV fluids showed increased weight loss, though statistical significance varied. Comparisons with international studies demonstrated context-specific variations. **Conclusion:** This study provides crucial insights into neonatal weight loss patterns in Asian neonates, particularly in India. The observed associations between delivery mode, breastfeeding adequacy, and birth weight offer valuable information for clinical practice. By addressing the knowledge gap in this context, the study contributes to the nuanced understanding of neonatal care, paving the way for tailored guidelines and improved well-being during the critical first days of life.

Introduction

Newborns are expected to have weight loss in the first few days of life and there are various putative mechanisms proposed for the same. (1) Newborns have expanded extracellular fluid (ECF) compartment at birth due to various maternal, fetal and placental factors. Newborn weight loss is primarily due to the contraction of this expanded ECF compartment. In the immediate

post-natal period, changes such as oxygenation, increase in capillary membrane integrity leads to movement of fluid from interstitial space in to the vessels. This aids in maintaining intravascular volume during first 24-48 hrs, when oral fluid intake may be limited. Neonatal weight loss can also a consequence of the use of adipose tissue as a source of energy by the new-borns. (2) A study by vd Wagan et al. tried to explore the cause of post-natal weight loss among small for age new-borns



using a sucrose and deuterium oxide dilution technique. The study concluded the weight loss among small for age infants was due to catabolism rather than dehydration. The following weight gain in later period of life was as a result of growth and not attributed to rehydration.(3)

The extent of this weight loss has been a subject of study since many years. Current clinical practice guidelines vary, with Breastfeeding and the Use of Human Milk, the American Academy of Pediatrics' section on breastfeeding stating that when total weight loss exceeds 7%, it indicates possible breast-feeding issues.(4) However, the American Academy of Pediatrics Clinical Practice Guidelines for Hyperbilirubinemia identify a loss of $\geq 10\%$ as a sign of breastfeeding inadequacy.(5) Excessive weight loss in new born babies can induce maternal anxiety, initiation of formula supplementation, and parenteral fluid administration. A substantial amount of weight loss during the newborn period develops the risk of neonatal morbidities such as hyperbilirubinemia and dehydration.(6)

Many independent factors have been studied to affect newborn weight loss which includes parity of the mother, I.V fluids administered during labor, breast-feeding adequacy, cesarean delivery, maternal age & education and phototherapy treated jaundice.(7–9)

The pattern of weight loss and its extent have been variously reported in different studies. In one landmark study done by MacDonald et al. where they followed infants for 14 days, the infants were weighed daily while in hospital but intermittently after discharge. Based on the results of this study, it appeared that weight loss of up to 12% of birth weight is experienced by about 95% of neonates and on an average newborns started gaining weight by day 4 and regained their birth weight by day 9.(10) In various studies including a systematic review done by Noel Weiss et al., it was found that median percentage weight loss ranged from 3.2% to 8.3%, with the majority of reported medians around 6%.(2)

Newborn weight loss can be calculated using Newborn Weight Loss Tool (NEWT). The sensitivity and specificity of this tool was tested by Smith et al. and it was found that the tool was able to correctly identify 6/28 cases of excessive weight loss and 158/192 healthy

participants. This translated to 21% sensitivity and 82% specificity of the tool.(11)

Newborn weight measurements are used as a key indicator of breastfeeding adequacy. Supplementary feeding is mostly recommended for infants who are not sufficiently breast-fed.(12) Clinicians debate the limits of acceptable neonatal weight loss in the first 3 days. In order to understand the neonatal fluid balance in the perinatal period, we need to recapitulate the physiology of same and the reasons for the changes in the newborn weight in the first few days and the factors associated with it.

The patterns and determinants of neo-natal weight loss in 72 hours after birth have been studied elaborately in western countries. However, this area needs further exploration in Asian countries especially India. Hence, our study aims to assess the pattern of newborn weight loss in initial 72 hours after birth and the maternal and neonatal factors affecting such weight loss. Among the term newborns: The objectives are : To assess the pattern of newborn weight loss in initial 72 hours after birth and to assess the maternal and neonatal factors affecting weight loss

Methodology

Study design and setting

This hospital based prospective observational cohort study was conducted from January 2021 to December 2021 among term neonates of 36 weeks gestational age and on exclusive breastfeeding born at a private tertiary care hospital in Salem. Salem, situated between specific geographical coordinates, served as the district backdrop. This hospital-based prospective observational cohort study spanned from January 2021 to December 2021 and focused on term neonates (36 weeks gestational age) exclusively breastfed at a private tertiary care hospital in Salem, Tamil Nadu. The hospital, Vinayaka Mission's Kirupananda Variyar Medical College & Hospital, is equipped with 560 beds and state-of-the-art facilities, particularly in the Pediatric department..

The study aimed to investigate newborn weight loss within the first 72 hours post-birth, a critical period for neonatal development. All term neonates delivered at the hospital during the study period were considered for inclusion, emphasizing those on exclusive breastfeeding



Exclusion criteria were meticulously defined, excluding neonates requiring intravenous fluids, early discharge, top feeds, resuscitation beyond routine care, and those with specific medical conditions necessitating NICU admission or born with significant congenital anomalies. A sample size of 196 was calculated based on an expected prevalence of newborn weight loss in the initial 72 hours, with a confidence level of 95%, utilizing a consecutive sampling technique.

Maternal history and details were collected from case sheets, and after obtaining informed consent, healthy term newborns meeting the inclusion criteria were enrolled. Birth weight was recorded immediately after drying, and subsequent weight measurements were taken every 12 hours for 72 hours using a digital weighing scale. Urine and stool output were measured in weighing nappies. Adequacy of breastfeeding was assessed by questioning mothers on various aspects, including satisfaction, breast emptying, baby's sucking, post-feeding sleep, and daily urine output.

The study variables included independent factors such as parity, mode of delivery, intravenous fluid status, birth weight, and adequacy of breastfeeding. The dependent variable focused on the percentage of weight loss in the first 72 hours. Statistical analysis was performed using SPSS V21 IBM for Windows, presenting continuous variables as mean (SD) and categorical variables as frequency and percentage. T-tests and ANOVA were employed to analyze associations, with a significance level set at $P < 0.05$.

The study obtained ethical approval from the Institutional Ethics Committee, and informed consent was secured from participants. Data analysis occurred in aggregate, and access was restricted to the research team. The methodology employed aimed to adhere to the rigorous standards expected in high-quality neonatal research.

Sample size and sampling technique

Assuming an expected prevalence of newborn weight loss in initial 72 hours after birth as and confidence level of 95%, a sample size of 196 was calculated using the following equation:

$$\text{Sample size } (n) = Z^2 PQ/E^2$$

Where Z is 1.96 ~ 2

Here $P = 11.4$ (prevalence of inadequate breast feeding)

$$Q = 1 - p$$

L = allowable error at 95% confidence interval

Sample size (n) = 100

Consecutive sampling technique was used to select the study participants.

Results

Among the 100 neonates included in the study, 57 (57%) were males, 43 % (were females). 61% of the infants were born to multigravida mothers and 39% were born to primigravida women. In the study, 71% of the new-borns were born by spontaneous vaginal delivery (SVD), 26% of the new-borns were born by lower segment caesarean section (LSCS) and 3% by vacuum assisted delivery (VAC). Status of IV fluids given to mothers in the study are as follows : 55 % of the mothers received less than 500 ml of fluids, 29 % of mothers received 500-1000 ml and 16 % received more than 1000 ml of fluids. Among the 100 neonates included in the study, 80% of the participants had birthweight between 2500-3500 gms. The mean (SD) of the study participants was 2.96 (2.79-3.24) kg. Among the 100 neonates included in the study, 81% of the participants had birthweight between 2500-3500 gms at 12 hrs after birth.

Among the 100 neonates included in the study, 79% of the participants had birthweight between 2500-3500 gms at 24hrs after birth. Among the 100 neonates included in the study, 79% of the participants had birthweight between 2500-3500 gms at 48hrs after birth. Among the 100 neonates included in the study, 78% of the participants had birthweight between 2500-3500 gms at 60hrs after birth.

The mean (SD) weight loss% among primigravida mothers [7.41 (1.48)] was higher as compared to multigravida mothers [6.93 (1.52)]. However, this difference was not statistically significant (p value=0.125). Association of total weight loss and weight loss % with mode of delivery : The mean (SD) total weight loss and weight loss% was higher among lower segment caesarean section which was 231.15 (42.74) gms and 7.82% (1.65) respectively. The difference in weight loss percent was statistically significant.



The mean (SD) total weight loss was higher among mothers who were given 501-1000ml of IV fluids [214.14 (34.59)]. The mean (SD) weight loss% was

higher among mothers who were given less than 500ml of IV fluids [7.19 (1.73)]. However, the differences were not statistically significant.

Table 1: Association of total weight loss and weight loss % with adequacy of breast feeding

Adequate breast feeding	Total participants	Total weight loss in gms Mean (SD)	Weight loss%
Yes	75	209.52 (47.79)	6.87 (1.53)
No	25	221.48 (40.35)	7.79 (1.26)
P value	-	0.217	0.004

Table 2: Association of total weight loss and weight loss % with initial birth weight of babies

Initial birth weight (kg)	Total participants	Total weight loss in gms Mean (SD)	Weight loss%
<2.5	10	203 (53.14)	8.35 (2.09)
2.5-3.5	80	208.56 (43.81)	6.99 (1.44)
>3.5	10	247.5 (34.54)	6.65 (0.84)
P value	-	0.006	0.023

Intravenous fluids given	Total participants	Total weight loss in gms Mean (SD)	Weight loss%
<500 ml	55	213.18 (53.78)	7.19 (1.73)
501-1000ml	29	214.14 (34.59)	7.14 (1.25)
>1000ml	16	208.75 (36.12)	6.83 (1.16)



P value	-	0.642	0.059
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Table 4: Association of total weight loss and weight loss % with initial birth weight of babies

Initial birth weight (kg)	Total participants	Total weight loss in gms Mean (SD)	Weight loss%
<2.5	10	203 (53.14)	8.35 (2.09)
2.5-3.5	80	208.56 (43.81)	6.99 (1.44)
>3.5	10	247.5 (34.54)	6.65 (0.84)
P value	-	0.006	0.023

The mean (SD) total weight loss was higher among the infants that were not adequately breastfed 221.48 (40.35) gms. The mean (SD) weight loss% was higher among the infants that were not adequately breastfed 7.79% (1.26). However, the difference in weight loss percent was statistically significant. (Table 4)

Table 5: Association of total weight loss and weight loss % with initial birth weight of babies

Initial birth weight (kg)	Total participants	Total weight loss in gms Mean (SD)	Weight loss%
<2.5	10	203 (53.14)	8.35 (2.09)
2.5-3.5	80	208.56 (43.81)	6.99 (1.44)
>3.5	10	247.5 (34.54)	6.65 (0.84)
P value	-	0.006	0.023

The mean (SD) total weight loss was higher among the infants weighing more than 3.5kg [247.5 (34.54)]. The mean (SD) weight loss% was higher among the infants who weighed below 2.5kg [8.35 (2.09)]. The differences in weight loss percent was statistically significant. (Table 5)

Discussion

Our study was conducted among 100 term neonates of 36 weeks gestational age and on exclusive breastfeeding

born at a private tertiary care hospital in Salem from January 2021 to December 2021. The study aimed to assess the pattern of newborn weight loss in initial 72 hours after birth and to determine the maternal and neonatal factors affecting weight loss. The neonatal factors assessed in the study included birth weight and adequacy of breast feeding. The maternal factors that were assessed included parity, mode of delivery and



status of intravenous fluids given to mothers 2 hours prior delivery.

Our study documented a mean (SD) weight loss percent of $7.12\% \pm 1.52\%$. The mean (SD) total weight loss was found to be 212.75 (46.01) gms. Our study findings also revealed that LSCS section, inadequate breast-feeding and low birthweight were significantly associated with higher neonatal weight loss percent in the initial 72 hrs of life.

Mean total weight loss and weight loss percent among babies born to primigravida mothers (219.23 gms) and [7.41% (1.48)] was found to be higher as compared to babies born to multigravida mothers (208.6 gms) and [6.93% (1.52)]. Neonates with mothers who had 501-1000ml IV fluids administered 2 hours prior delivery had the highest mean (SD) total weight loss of 214.14 (34.59) gms. However, the results obtained for parity and amount of IV fluids administered were not statistically significant.

Our study results were supported by the findings of a similar study by Davanzo et al. which reported a mean (SD) weight loss of 228 ± 83 g among 1003 term infants admitted in a tertiary care hospital in Italy. The study also reported a mean percent weight loss of $6.7\% \pm 2.2\%$ among the study participants.(13) Another prospective study by Flaherman et al. conducted among 161471 new-born babies at a tertiary care hospital in California also substantiated our study results. The study recorded a mean percent weight loss of 6.4% at 72 hours of age among the neonates included in the study.(14). A similar study by Grossman et al. reported a mean weight loss of 4.9% among 121 new-born babies at a tertiary care hospital in United States during the initial first week of life.(15) This variance of findings from Martens and Romphf and Grossman et al. from our study results may be attributed to the change in study setting and the difference in time period for which the weight loss of the infants was calculated.(16)

Our study found that 6% of the study participants had a weight loss of $>10\%$. Another study by Miyoshi et al. among 399 term neonates in Japan, estimated that 41% of the babies has excessive neonatal weight loss.(15) The difference between the study results might be attributed to the difference in study setting and also the fact that they excluded only exclusively formula-fed infants from the study and included both formula and

breast-fed infants in the study. Our study included only exclusively breast-fed infants.

Another study by Grossman et al. in United States reported that 19.8% (24 of 121) of the new-borns lost $>7\%$ of their birth weight as opposed to 54% of the neonates in our study. However, none of the neonates lost $>10\%$ of their weight in the study by Grossman et al. This difference in study findings might be due to difference in study setting.(19)

In many studies done to ascertain factors affecting neonatal weight loss including Noel Weiss et al(2), Kools et al (37), Hill P. et al(38), and Dewey et al(39) it was found that babies born to primigravida mothers lose more weight as compared to babies born to multigravida mothers. In one such study done by M.K Cagler et al it was found that significant number of neonates who had $> 10\%$ weight loss were born to primigravida (p value < 0.005). (1) In our study the percentage of weight loss among babies born to primigravida was 7.41(1.48) %, was higher than among infants of multigravida mothers in which it was 6.93(1.52) %. The total weight loss among the neonates born to primigravida was also higher 219.23 (41.32) gms as compared to new-borns of multigravida mothers 208.6 (48.65) gms in our study. However, the results were not statistically significant.

Our study results of higher weight loss among new-borns born by LSCS section was substantiated by other studies conducted by Davanzo et al.(13) (caesarean section was independently associated with a neonatal weight loss of $\geq 8\%$), Miyoshi et al.(15) (adjusted multivariable regression analysis found that excessive weight loss in new born were significantly associated with antepartum Caesarean section), Regnault et al.(16) (significantly higher weight loss at day 3 among infants of planned caesarean section mothers) and Flaherman et al.(17) (median percent weight loss for neonates was higher among neonates delivered by caesarean section as compared to vaginally delivered neonates).

Two studies done by Lamp and Macke(18) and Watson et al.(19) showed that there is no positive correlation between fluids administered to mother and neonatal weight loss. Although the weight loss percent among neonates born to mothers who were administered with <500 ml intravenous fluids 2 hrs before delivery was found to be highest in our study, the difference was not statistically significant. Hence our study also did not show



any correlation between fluids administered to mother and neonatal weight loss.

Our study findings on the association between inadequate breast feeding and excessive weight loss among neonates was evidenced by another study conducted among 72 neonates in Turkey by Caglar et al. The study concluded that there was a significant association between inadequate breast feeding leads to excessive weight which in turn leads to complications like fever, hypernatremia and hyperbilirubinemia.(1)

Our study results stated that the weight loss percent was higher among neonates with <2.5kg weight at birth. Another prospective study by Enzunga et al. determined the factors associated with neonatal weight loss among 330 new-born babies in Zaire.(20) The study also substantiated the findings from our study by reporting that babies with lower birthweight (<2000gms) had higher percent of weight loss. However, a study by Martens and Romphf conducted a study among 812 neonates at 6 hospitals in Canada found that weight loss was associated with higher weight.(21)

STRENGTHS AND LIMITATION Our study has several strengths. Firstly, we used standard and validated tools for assessing the neonatal weight loss at 12hrs, 48hrs, 60 hrs and 72 hrs of life. Secondly, we used consecutive sampling technique for enrolling the patients. Thirdly, the data collected was strictly monitored and statistical packages like SPSS was used to minimize methodological errors. Nonetheless, our study was not without limitations. This being a hospital-based study was prone to sampling bias. However, we employed strict inclusion and exclusion criteria to keep such bias at minimum.

CONCLUSION

The study results study documented a mean (SD) weight loss percent of 7.12% \pm 1.52%. The mean (SD) total weight loss was found to be 212.75 (46.01) gms. Our study findings also revealed that LSCS section, inadequate breast-feeding and low birthweight were significantly associated with higher neonatal weight loss percent in the initial 72 hrs of life.

It is important to monitor neonatal weight loss, as it can be used as a parameter to ascertain breast feeding adequacy. Excessive weight loss can also lead to various complications. It is recommended to focus more

on primi mothers who report inadequate breast feeding and might usually need initial assistance for adequate and successful breast feeding.

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