First-Day Newborn Weight Loss Predicts In-Hospital Weight Nadir for Breastfeeding Infants

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Abstract

Background: Exclusive breastfeeding reduces infant infectious disease. Losing $\geq 10\%$ birth weight may lead to formula use. The predictive value of first-day weight loss for subsequent weight loss has not been studied. The objective of the present study was to evaluate the relationship between weight loss at <24 hours and subsequent in-hospital weight loss $\geq 10\%$.

Methods: For 1,049 infants, we extracted gestational age, gender, delivery method, feeding type, and weights from medical records. Weight nadir was defined as the lowest weight recorded during birth hospitalization. We used multivariate logistic regression to assess the effect of first-day weight loss on subsequent in-hospital weight loss.

Results: Mean in-hospital weight nadir was $6.0 \pm 2.6\%$, and mean age at in-hospital weight nadir was 38.7 ± 18.5 hours. While in the hospital 6.4% of infants lost $\geq 10\%$ of birth weight. Infants losing $\geq 4.5\%$ birth weight at <24 hours had greater risk of eventual in-hospital weight loss $\geq 10\%$ (adjusted odds ratio 3.57 [1.75, 7.28]). In this cohort, 798 (76.1%) infants did not have documented weight gain while in the hospital.

Conclusions: Early weight loss predicts higher risk of $\geq 10\%$ in-hospital weight loss. Infants with high first-day weight loss could be targeted for further research into improved interventions to promote breastfeeding.

Introduction

BREASTFEEDING PROTECTS against gastroenteritis, lower respiratory infection, and other infectious diseases in infancy.¹⁻⁶ Longer duration of exclusive breastfeeding is associated with greater benefit.^{1,5} Low breastfeeding confidence in the first week of life predicts early breastfeeding discontinuation,^{7,8} and poor infant weight gain has been associated with reduced breastfeeding confidence.^{9,10} Macdonald et al.¹¹ found that the breastfed infant loses an average of 6.6% of birth weight prior to beginning weight gain at an average of 2.7 days, and more than 10% of exclusively breastfed infants lose $\geq 10\%$ of birth weight. Similar results have been reported in other studies.¹²⁻¹⁴ Weight loss of $\geq 10\%$ may be especially detrimental to maternal breastfeeding confidence because such weight loss is associated with increased risk of hypernatremic dehydration¹⁵ and may result in clinician recommendation of either formula supplementation or additional clinical testing. Early prediction of infants at risk for eventual weight loss $\geq 10\%$ could allow the development of interventions targeted to maintain breastfeeding confidence and reduce weight loss in this group.

First-day weight loss is routinely measured for newborns, but no studies have examined whether greater weight loss in the first day predicts subsequent weight loss. Dewey et al.¹⁶ found that first-day suboptimal infant breastfeeding behavior

is strongly associated with excess weight loss on the third day. However, breastfed infants with greater weight loss have increased levels of vasopressin and decreased interfeeding interval, which might compensate for greater early weight loss.¹⁷ Serum leptin levels in breastfed infants fall during the period of maximal weight loss, providing a possible compensatory mechanism for earlier weight loss.¹⁸ We conducted a retrospective cohort study to describe the relationship between first-day weight loss and subsequent in-hospital weight loss.

Subjects and Methods

We used a retrospective cohort design to study 1,049 infants born between June 2007 and February 2008 at the University of California, San Francisco who received Level 1 care only. We extracted data on gestational age, birth weight, gender, delivery method, feeding type (breast, formula, or both), and all recorded infant weights. Infant weight was measured by usual clinical procedures, at our institution typically occurring between 9 p.m. and midnight. Infants born shortly before that time period were often not weighed until the following day according to clinical judgment. Weight change was defined as the difference between birth weight and weight recorded subsequently, calculated as a percentage of birth weight. Maximum weight loss was defined as the largest

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TABLE 1. INFANT CHARACTERISTICS FOR ENTIRE COHORT AND INFANTS WITH ANY BREASTFEEDING

Infant characteristic	Mean $\pm$ SD (n, %) ^a		
	Entire cohort	Among 997 breastfed infants	Among 67 infants with eventual documented 10% weight loss
Birth weight (g)	3,373 $\pm$ 469 (1,049, 100%)	3,376 $\pm$ 468 (997, 100%)	3,340 $\pm$ 487 (67, 100%)
Gestational age (weeks)	39.5 $\pm$ 1.2 (395, 37.7%)	39.6 $\pm$ 1.2 (380, 38.1%)	39.5 $\pm$ 1.6 (35, 52.2%)
Weight change <24 hours	3.1 $\pm$ 1.8% (718, 68.4)	3.2 $\pm$ 1.8% (677, 67.9%)	4.4 $\pm$ 2.6% (40, 59.7)
Age (hours) at documented weight <24 hours	15.6 $\pm$ 6.5 (718, 68.4)	15.4 $\pm$ 6.5 (677, 67.9)	14.2 $\pm$ 6.7 (40, 59.7)
Weight change <30 hours	3.7 $\pm$ 1.9% (923, 88.0)	3.8 $\pm$ 1.9% (873, 87.6)	5.1 $\pm$ 2.6% (52, 77.6)
Age (hours) at documented weight <30 hours	19.7 $\pm$ 6.7 (923, 88.0)	19.7 $\pm$ 6.8 (873, 87.6)	18.8 $\pm$ 7.5 (52, 77.6)
Weight change <36 hours	4.6 $\pm$ 2.1% (1,016, 96.9)	4.7 $\pm$ 2.0% (966, 96.9)	6.9 $\pm$ 2.7 (62, 92.5)
Age (hours) at documented weight <36 hours	25.2 $\pm$ 7.4 (1,016, 96.9)	25.4 $\pm$ 7.4 (966, 96.9)	27.7 $\pm$ 6.8 (62, 92.5)
Weight change 24–48 hours	6.0 $\pm$ 2.3% (836, 79.7)	6.1 $\pm$ 2.1% (806, 80.8)	8.7 $\pm$ 3.3% (62, 92.5)
Age (hours) at documented weight 24–48 hours	36.1 $\pm$ 6.1 (836, 79.7)	36.1 $\pm$ 6.0 (806, 80.8)	38.5 $\pm$ 6.2 (62, 92.5)
Maximum documented in-hospital weight loss	6.0 $\pm$ 2.6% (1,049, 100%)	6.2 $\pm$ 2.6% (997, 100%)	11.3 $\pm$ 2.3% (67, 100%)
Infants losing 10% birth weight	67 (6.4%)	67 (6.7%)	NA

NA, not applicable.

^aWhere *n* represents the number with non-missing data.

negative weight change during the birth hospitalization. Weight nadir was defined as the lowest weight recorded during birth hospitalization. We had no data on weights subsequent to discharge from birth hospitalization.

We used χ^2 analysis to assess whether weight loss at <24 hours was associated with eventual in-hospital $\geq 10\%$ weight loss. We used multivariate logistic regression to assess whether weight loss at <24 hours was associated with in-hospital weight loss $\geq 10\%$ after adjusting for clinical predictors and to assess whether 24-hour weight loss predicted whether or not there was a subsequent recorded weight, after adjusting for other clinical predictors. Because time of birth may have affected whether an infant is reweighed at <24 hours, we conducted sensitivity analysis examining the above outcomes for weights measured at <30 hours and <36 hours. All statistical analyses were performed using Stata version 9.2 (Stata Corp., College Station, TX).

Results

Among the cohort, 853 infants (85.6%) were documented as breastfeeding exclusively, 144 (14.4%) were documented as

mixed feeding, and 53 (5%) were documented as formula feeding only. We had no data on maternal intention to breastfeed. Mean age at in-hospital weight nadir was 38.7 ± 18.5 hours. For 798 (76.1%) infants, in-hospital weight nadir was the last recorded weight. Table 1 gives other cohort characteristics.

Among 150 infants who had lost 4.5% of birth weight by 24 hours, 16 (10.7%) eventually were documented as losing $\geq 10\%$ birth weight, whereas only 24 (4.3%) of the 568 infants who did not lose 4.5% birth weight by 24 hours eventually were documented as losing $\geq 10\%$ birth weight ($p = 0.002$). If we consider weight loss $\geq 4.5\%$ as a test for later in-hospital weight loss $\geq 10\%$, test sensitivity was 40%, and test specificity was 80%. All infants with in-hospital weight loss $\geq 10\%$ were breastfeeding. Among breastfed infants, each additional percentage weight loss by 24 hours was associated with an odds ratio (OR) of 1.47 (1.23, 1.74) for eventual in-hospital weight loss $\geq 10\%$. Among breastfed infants, the relationship between weight loss at <24 hours and subsequent in-hospital weight loss $\geq 10\%$ persisted after adjusting for method of delivery, with each additional percentage weight loss by 24 hours associated with an OR of 1.57 (1.31, 1.89). Breastfeeding

TABLE 2. ORs FOR THE EFFECT OF 4%, 4.5%, AND 5% EARLY NEWBORN WEIGHT LOSS IN BREASTFED INFANTS ON THE OUTCOME OF EVENTUAL WEIGHT LOSS $\geq 10\%$, BY INFANT AGE AT PREDICTOR MEASUREMENT AFTER ADJUSTING FOR METHOD OF DELIVERY, IN COMPARISON TO INFANTS WITHOUT SUCH WEIGHT LOSS

Weight loss	Measured at		
	<24 hours	<30 hours	<36 hours
$\geq 4\%$	2.09 (1.06, 4.10)	1.94 (1.08, 3.49)	2.60 (1.29, 5.24)
$\geq 4.5\%$	3.57 (1.75, 7.28)	2.85 (1.57, 5.14)	3.04 (1.58, 5.85)
$\geq 5\%$	5.00 (2.42, 10.3)	3.01 (1.67, 5.43)	3.30 (1.79, 6.07)

infants who lost $\geq 4.5\%$ birth weight at <24 hours had an OR of 3.57 (1.75, 7.28) for eventual in-hospital weight loss $\geq 10\%$ after adjusting for delivery method. In sensitivity analysis, we examined the ORs for weight loss at <30 hours and <36 hours because 32% of babies were not weighed at <24 hours. ORs for the effect of $\geq 4\%$, $\geq 4.5\%$, and $\geq 5\%$ at <30 hours and <36 hours were similar to results at <24 hours (Table 2).

Greater percentage weight loss at <24 hours was associated with lower odds of having a recorded weight at 24–48 hours in both bivariate analysis and after adjusting for delivery method and hours of age at the time of first weight recorded subsequent to birth weight (OR 0.88 [0.80, 0.98]). Weight loss at <24 hours was not associated with whether a weight was recorded at 48–72 hours, 72–96 hours, or 96–120 hours, in either bivariate or multivariate analysis.

Discussion

Newborn weight loss in the first 24 hours is a strong predictor of eventual weight loss during birth hospitalization. Infants with weight loss $\geq 4.5\%$ by 24 hours have an OR of 3.57 (1.75, 7.28) for total weight loss $\geq 10\%$ prior to hospital discharge in multivariate analysis. Even weight loss of 4% by 24 hours is associated with a twofold increase in odds of eventual in-hospital weight loss $\geq 10\%$. Because weight loss of $\geq 10\%$ is often considered an indication for formula supplementation, early weight loss may identify infants at higher risk of breastfeeding discontinuation.

Our study has several important limitations. First, we examined inpatient weights only and therefore did not capture actual weight nadir for many infants. If greater early weight loss lengthened hospital stay, and if longer length of stay captured weight nadir for more infants, our results could be biased toward a relationship between early weight loss and subsequent in-hospital weight nadir. If this were the case, we would expect that infants with higher early weight loss would be more likely to have weights documented subsequently during birth hospitalization. However, our study showed that infants with higher weight loss at <24 hours were less likely to have a weight recorded at 24–48 hours, and we found no relationship between weight loss at <24 hours and whether or not infants had a measured weight at 48–72 hours, 72–96 hours, or 96–120 hours. Further research using both inpatient and outpatient weights is needed to address this question more fully. Second, we did not have data on amount or timing of formula feeding. If most infants documented as both breast- and formula-fed had initiated exclusive breastfeeding but formula was added because of weight concerns even though weight loss remained $<10\%$, we may have underestimated the odds of eventual weight loss $\geq 10\%$ for exclusively breastfeeding infants with high early weight loss. Third, we did not have information on indicators of suboptimal breastfeeding, intrapartum fluids, or primiparity and thus cannot assess the impact of these variables on potential risk.

Conclusions

Infants with more weight loss at <24 hours appear to be at risk of greater subsequent in-hospital weight loss. Further research should explore the relationship between weight changes early in hospitalization and infant inpatient and out-

patient outcomes, adjusting for clinical predictors available early in hospitalization. If infants at especially high risk for $\geq 10\%$ weight loss could be identified early in hospitalization, it might be possible to design targeted interventions to support breastfeeding in this group.

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Disclosure Statement

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