

Neonatal Weight Loss at a US Baby-Friendly Hospital

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ABSTRACT

Few if any studies have examined weight loss among term newborns by weighing infants daily for the first week of life. Perhaps because so few data exist, there is no standard in the United States for normal newborn weight loss. Our objective was to investigate normal newborn weight loss among infants born in a US Baby-Friendly hospital, by weighing infants daily for the first week of life. Using a prospective cohort design, infants born at an urban Boston, MA, hospital were enrolled within 72 hours of delivery and weighed daily for the first week of life. In hospital, infant weight was obtained from the medical record; post discharge, a research assistant visited the home daily and weighed the baby. All feeds in week 1 of life were recorded. Birth-related factors potentially affecting weight loss were abstracted from the medical record. Complete data were collected on 121 infants. Mean weight loss was 4.9% (range=0.0% to 9.9%); 19.8% (24 of 121) of infants lost >7% of their birth weight; no infant lost >10%. Maximum percent weight loss was significantly associated with feeding type: exclusively and mainly breastfed infants lost 5.5%, mainly formula-fed infants lost 2.7% and exclusively formula-fed infants lost 1.2% ($P<0.001$). Type of delivery and fluids received during labor were not associated with weight loss. Clinical practices at a Baby-Friendly hospital, which support and optimize breastfeeding, appear to be associated with only moderate weight loss in exclusively and mainly breastfed infants.

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THERE IS NO ONE STANDARD FOR NORMAL NEONATAL weight loss among term infants in the medical literature, and guidelines differ by, and sometimes within, medical organizations. In their policy statement, *Breastfeeding and the Use of Human Milk*, the American Academy of Pediatrics' section on breastfeeding states that "weight loss in the infant of greater than 7% from birth weight indicates possible breastfeeding problems" (1). However, the American Academy of Pediatrics *Clinical Practice Guidelines for Hyperbilirubinemia* state that "adequacy of intake should be evaluated and the infant monitored if weight loss is more than 10%" (2). The American Academy of Breastfeeding Medicine protocol, *Hospital Guidelines for the Use of Supplementary Feedings in the Healthy Term Breastfed Neonate*, acknowledges that although weight loss of 8% to 10% can be normal, "it is an indication for careful assessment and possible breastfeeding assistance" (3). These guidelines do not address timing of weight loss, nor do they take into account other factors that can affect infant weight loss, such as type of delivery or maternal fluids in labor.

Differences between guidelines might reflect a paucity of evidence-based data regarding neonatal weight loss. We were unable to locate any studies reporting mean weight-loss nadir for infants weighed daily for the first week of life. Because weight-loss nadir (ie, maximum point of weight lost) can occur on any day in the first week postpartum, studies that do not weigh infants daily can only estimate weight loss and might have failed overall to capture this measurement. Macdonald and colleagues weighed infants at birth, before discharge, and then on subsequent home visits by a midwife, which generally occurred on days 5, 7, and 10 of life (4). Chantry and colleagues measured weight on days 3 and 7 (5), and Martens and Romphf assumed maximum weight loss to be the difference between birth weight and weight at discharge (6). Accurate knowledge of normal weight loss is important to support exclusive breastfeeding and optimal breastfeeding policies and practices, as well as to identify infants that are having feeding difficulties and create safe discharge plans.

The goals of our study were to determine weight-loss nadir among infants born at a Baby-Friendly hospital and to identify predictors of weight loss in the first week of life using a prospective design. Infant-feeding policies and procedures at a Baby-Friendly hospital comply with *The Ten Steps to Successful Breastfeeding* (7), considered by the World Health Organization as the optimal standard of breastfeeding management in hospitals. It is routine practice at a Baby-Friendly hospital to put the newborn skin-to-skin at birth, practice rooming-in, help a mother initiate breastfeeding within an hour of birth, and give a breastfeeding newborn food or drink other than breast milk only when medically indicated. Thus, neonatal weight loss among exclusively breastfed infants in our cohort likely reflects normal neonatal weight loss, and is unlikely to reflect patterns caused by poorly managed early infant feeding.

METHODS

Between June 2008 and June 2009, mother/infant dyads who consented to participate in a 2-year-long prospective cohort study to investigate the influence of early nutrition on obesity were given the option of participating in a nested cohort study in which infant weights would be measured daily for the first week of life. Following the enrollment criteria for the larger cohort study, infants were enrolled within 72 hours of birth and were healthy, term, singleton, appropriate for gestational age, and born at Boston Medical Center, an urban Baby-Friendly hospital in Boston, MA.

Daily weights were obtained from the medical record while the infant was hospitalized. In-hospital weights were obtained by standard hospital procedure using a Scale-Tronix Model 4800 digital scale (Scale-Tronix, Carol Stream, IL), which is accurate to 5 g. Post discharge, research assistants visited the home daily and weighed the infant using a digital Medela BabyWeigh scale (Medela, McHenry, IL), which is accurate to 2 g. Following standard procedures, the clothing and diaper were removed before weighing and the scale was zeroed with a blanket to maintain the infant's body temperature. Hospital weights were measured during

the night; post-discharge weights were completed during the day. All feeds in week 1 of life were obtained from the bedside feeding chart postpartum and from a food diary completed by the mother post discharge, in which she recorded all feeds given at home. At each home visit, the research assistant answered any questions that the mother had about completing the food record; no nutrition counseling was provided. In addition, a verbal questionnaire was administered at the time of enrollment to obtain demographic data; birth-related factors that can affect weight loss were abstracted from the medical record. This study was approved by the Boston University Medical Center Institutional Review Board.

Infant feeding at the time of weight-loss nadir was categorized into one of four feeding categories based on the number of feeds; exclusive breast milk (100% breast milk feeds), mainly breast milk ($\geq 50\%$ breast milk feeds), mainly formula ($>50\%$ formula feeds), and exclusive formula (100% formula feeds).

Independent *t* tests, analyses of variance, and Pearson or Spearman correlation coefficients were run to determine bivariate predictors of maximum percent infant weight loss. Variables that were significant at $P < 0.20$ in bivariate analysis were entered as predictor variables into an initial regression model, and variables that were not significant at $P < 0.05$ were removed using backwards stepwise regression. All statistical analyses were conducted using Statistical Analysis Software (version 9.1, 2002-3, SAS Institute Inc, Cary, NC).

RESULTS AND DISCUSSION

One hundred and thirty-two mother/infant dyads were enrolled between June 2008 and June 2009. Of these, 11 were excluded from analysis for the following reasons: lost to follow-up before infant weight-loss nadir was reached ($n=6$), mother or infant hospitalized and unable to complete feeding records or obtain infant weights ($n=3$), and missing data ($n=2$). Final analyses were conducted on 121 mother/infant dyads with complete information. Descriptive information is presented in the Table.

Mean weight loss was $4.9\% \pm 2.4\%$ (range=0.0% to 9.9%); 19.8% (24 of 121) of infants lost $>7\%$ of their birth weight, 7.4% (9 of 121) of infants lost $>8\%$, and no infant lost $>10\%$. Mean weight loss differed significantly based on feeding type; exclusively breastfed infants lost 5.5% and mainly breastfed infants lost 5.5% of birth weight; mainly formula-fed infants lost 2.7% and exclusively formula-fed infants lost 1.2% of birth weight ($P < 0.001$) (Table). In bivariate analysis, maternal birthplace (US-born vs non-US-born), gestational age, volume of fluids received in labor, and infant feeding category were significantly associated with percent weight-loss nadir.

Mean time to nadir was 2.5 days after birth and ranged from 0 to 7 days after birth (Figure); 58.7% (71 of 121) of infants reached their weight nadir within 2 days after birth. Only one infant reached weight-loss nadir on day 7 of life. This infant was followed for an additional day to ensure that nadir was captured. At time of weight-loss nadir, 26.4% of infants had been exclusively breastfed, 54.6% had been mainly breastfed, 13.2% had been mainly formula-fed, and 5.8% had been exclusively formula-fed. There was no difference in mean time to nadir by feeding group ($P=0.56$). Given the small number of exclusive formula feeders ($n=7$), mainly and exclusive formula feeders were combined for linear regression analyses.

The following variables ($P < 0.20$ in bivariate analysis) were entered into the initial regression as possible predictors of percent weight-loss nadir: infant-feeding category, maternal birthplace, volume of fluids received in labor, medical insurance, gestational age, and birth weight. After backwards selection, only infant-feeding category, gestational age, and medical insurance remained in the final model. Compared with formula-fed infants, exclusively breastfed infants lost, on average, 3.2% more weight (standard error [SE]=0.5; $P < 0.001$), and mainly breastfed infants lost 3.4% more weight (SE=0.5; $P < 0.001$). For each 1-week increase in gestational age, there was a 0.4% decrease in weight loss (SE=0.2; $P=0.009$). Compared with infants of mothers with private insurance, those with public insurance lost 1.6% less weight

(SE=0.6; $P=0.005$). Overall, feeding category, gestational age, and insurance were the most robust predictors of percent weight-loss nadir, contributing to 37.8% of the variability in the model.

In contrast to other reports (4-6,8-11), no infant lost $\geq 10\%$ of birth weight. This is most similar to that found in a study by Konetzny and colleagues, in which 2.4% (67 of 2,788) of exclusively breastfed infants lost at least 10% of birth weight at a Baby-Friendly hospital in Switzerland (8). In contrast, in Manganaro and colleagues' Italian study of 686 exclusively breastfed infants, 7.7% of infants lost at least 10% of their birth weight (9); in Dewey and colleagues' study, 12% of breastfed infants (those who consumed <2 oz non-breast milk in the first 72 hours of life) lost at least 10% of birth weight (10); and in Chantry and colleagues' recent study, 19% of 134 exclusively breastfed infants and 14% of the entire study sample lost at least 10% of their birth weight (5).

At Boston Medical Center, the newborn service reviews each infant weight loss $>7\%$ (normal vaginal delivery) and 8% (cesarean birth), at which point a referral is made to the lactation service, and an International Board Certified Lactation Consultant provides a consultation for the dyad. Although it is theoretically possible that the minimal weight loss found in our study could reflect aggressive remedial formula supplementation in infants who are losing weight, this is not routine practice, considering the hospital's Baby-Friendly status and referral guidelines. The authors propose that the limited weight loss in this cohort was likely a result of optimal infant-feeding support and policies in a Baby-Friendly hospital. Of interest, exclusively breastfed infants lost the same amount of weight as mainly breastfed infants.

Some studies have found cesarean section delivery (9) and maternal fluid balance (5) to be associated with increased neonatal weight loss, others have not (11). Given that lactogenesis stage II can be delayed after a cesarean section (12,13), it was surprising to find that infants delivered by cesarean section did not lose more weight than infants born vaginally. This finding might result because we were weighing all infants every day; in other studies, cesarean-born infants might be weighed more often and for more days because they are more closely followed and remain in the hospital for longer than vaginally delivered infants. In addition, no association was found between maternal fluid intake during labor and maximum weight loss in our final regression model. This supports findings by Lamp and Macke (11), but differs from Chantry and colleagues (5). Weights in this study might be more accurate than those obtained by Chantry and colleagues because of daily weighing, or this outcome might be a result of a limitation in our study; ie, fluid intake in labor was our variable of interest instead of fluid balance, as fluid output in the medical record was not reliably recorded.

This study has clinical relevance by demonstrating that with supportive breastfeeding policies and practices in place, exclusively and mainly breastfed newborns lose relatively little weight. Using the American Academy of Pediatrics section on breastfeeding's weight-loss cut-off of 7% (1), 19.8% of the infants in this sample would have been identified as potentially having a breastfeeding problem. This raises a complex issue. Although it is indeed possible that 5.5% is normal for weight loss among exclusively breastfed infants in the supportive environment, these findings should not be clinically interpreted to define infants who lose $>5\%$ of birth weight as high-risk candidates for remedial care requiring formula supplementation. The vast majority of US hospitals do not have Baby-Friendly status, and there is no indication that infants who lose $>5\%$ in a non-Baby-Friendly setting are in imminent danger of dehydration. Although more data are needed to confirm these findings, under optimal settings, neonatal weight loss among exclusively or mainly breastfed infants appears moderate.

At the opposite extreme, mainly and exclusively formula-fed infants lost almost no weight. More research is needed to determine whether a lack of weight loss among these infants, when compared with optimally managed exclusive or mainly breastfed

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