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Neonatal Weight Matters: An Examination of Weight Changes in Full-Term Breastfeeding Newborns During the First 2 Weeks of Life

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Abstract

Background: Weight changes in the early weeks of life are important indicators of newborn wellness. Yet, little is known about weight loss patterns for breastfeeding newborns.

Research aim: This study aimed to compare weight changes and exclusive breastfeeding rates in newborns who lost ≤ 7% and > 7% of their body weight after birth.

Methods: A prospective, observational cohort study was completed. Newborns who lost ≤ 7% made up Group 1 and newborns who lost > 7% of birth weight made up Group 2. Mothers used a digital scale to weigh their newborns daily until 14 days of life. Newborn intake and outputs were also recorded.

Results: Mean (with standard deviation in parentheses) weight loss for all newborns (N = 151) was 7.68% (2.35%). Newborns in Group 1 (n = 67) lost 5.7% (0.99%) and newborns in Group 2 lost 9.3% (1.87%). More than half of healthy, full-term newborns (56%) lost > 7%. On Day 14, the exclusive breastfeeding rate for newborns in Group 2 was significantly less than for those in Group 1 (60% vs. 82%; p = .033). Newborns gained a mean of 1.1% body weight daily; those in Group 1 gained 1.2% daily, and those in Group 2 gained 1.0% daily.

Conclusion: Weight loss > 7% may be a normal phenomenon among breastfeeding newborns. Newborns who lost > 7% had a lower exclusive breastfeeding rate at 2 weeks of age. After the weight nadir was reached, most newborns gained weight at a similar pace, despite differences in early weight loss.

Keywords

breastfeeding, feeding patterns, infant nutrition, lactation

Background

Breastfeeding initiation rates in the United States are currently 81%. By Day 2 of life, 17% of breastfed newborns have been introduced to formula. By 3 and 6 months of age, exclusive breastfeeding (EB) rates are down to 44% and 22%, respectively (Centers for Disease Control and Prevention, 2016). Although many factors are responsible for this marked drop in EB, one of the main culprits is the introduction of formula given during the early critical period, before the milk supply is well established (Waldrop, 2013). A common reason that formula is introduced at this time is concern about newborn weight loss (Thulier, 2016). Widespread belief in the United States is that weight loss for healthy breastfed newborns should be no more than 7% (American Academy of Pediatrics, 2012). When a newborn loses more than 7%, it sets off alarms for the providers that there is a problem with breastfeeding and formula is frequently suggested. Formula use at this critical time often leads to premature interruption of breastfeeding (Brown, 2015).

There are many factors that can affect the amount of weight that a newborn loses after birth. Small (< 2,500 g) or preterm newborns (born before 37 weeks gestation) lose more weight than larger, full-term newborns (Goyal, Attanasio, & Kozhimannil, 2014; Moyses, Johnson, Leaf, & Cornelius, 2013). Conversely, newborns who are large for gestational age (> 4,000 g) also lose more weight (Thulier, 2016). Variables associated with neonatal weight loss include advanced maternal age and education, female

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gender, cesarean birth, jaundice, and intravenous (IV) fluid given during labor (Davanzo, Cannioto, Ronfani, Monasta, & Demarini, 2013; Fonseca, Severo, Barros, & Santos, 2014). Tawia and McGuire (2014) described how insufficient milk supply caused by failed lactogenesis II (the onset of copious milk secretion) is frequently a cause of neonatal weight loss. This often develops because of breastfeeding difficulties or mother–newborn separation (Arbour & Kessler, 2013). Other less common causes of failed lactogenesis II include retained placenta, breast surgery, hypothyroidism, mammary hypoplasia, polycystic ovarian syndrome, and Sheehan's syndrome (Arbour & Kessler, 2013). Finally, metabolic or neurologic disorders in newborns may contribute to weight loss (Tawia & McGuire, 2014).

Monitoring weight changes in the early weeks after birth is a vital part of the newborn assessment. Yet, there is little consensus among clinicians regarding how much weight loss is expected. At times, 7% is used as an indicator for too much weight loss (Watson, Hodnett, Armson, Davies, & Watt-Watson, 2012), and at other times, 10% is used (Bertini, Breschi, & Dani, 2015). There is also little consensus regarding how long it takes for newborns to regain their lost birth weight. The American Academy of Pediatrics notes that breastfed newborns usually regain birth weight by 7 days of life (Holt, Wooldridge, Story, & Sofka, 2011). More recent studies indicate that many full-term newborns may take 2 to 3 weeks or longer to regain lost birth weight (Paul et al., 2016).

In a systematic review of expected patterns of weight loss in term breastfed neonates, important methodologic flaws were found in the studies used to establish 7% as a guide to practice (Thulier, 2016). In many studies, newborns were weighed for only 2 days, despite the fact that most lose weight for at least 3 days (Flaherman et al., 2015). Many formula-fed newborns have been included in sample groups, whereas breastfed newborns who lost the most weight were often dropped from sample groups. It was concluded that expected physiologic weight loss for healthy newborns could be higher than has been documented (Thulier, 2016).

In a recent study of 286 term newborns born by cesarean, newborn weights were measured for 3 to 4 days of life (Thulier, 2017). By Day 3, mean weight loss (MWL) for all newborns was 8%. Mean weight loss for newborns who lost > 7% was more than 9% and MWL for those who lost ≤ 7% of birth weight was 6%. More than half (54%) of the newborns lost > 7% of their birth weight. In addition, newborns who lost ≤ 7% had little change in EB, from 87% to 80% by Day 4. In contrast, EB rates in newborns who lost > 7% dropped markedly, from 90% to 53%. Results from this study showed that when newborn weight loss reaches 7%, formula supplementation increased markedly.

The gap that is therefore addressed in this study is the lack of definitive evidence about the expected weight loss patterns for breastfeeding newborns. The primary hypothesis was that the mean percentage of lost birth weight for breastfed newborns is greater than 7%. The first aim of this study was to compare weight changes among newborns who lost ≤ 7% and those who lost > 7% birth weight. The second aim was to examine EB rates among newborns in both groups.

Key Messages

- The gap that was addressed in this study is the lack of definitive evidence about the expected weight loss patterns for breastfeeding newborns.
- More than half of the healthy, full-term breastfeeding newborns in this study lost greater than 7% body weight after birth.
- Exclusive breastfeeding rates at 2 weeks of age were much lower for newborns who lost greater than 7% body weight.
- After the weight nadir was reached, most newborns gained weight at a similar pace, despite differences in early weight loss.

Methods

Design

A prospective, observational cohort study was conducted to examine weight loss patterns. The enrolled cohort (151 mother–infant dyads) was followed for 14 days and then divided into two groups for analysis and comparison. Newborns moved from Group 1 to Group 2 when their weight loss reached > 7%. This occurred on Day 2 of life for 2 newborns, on Day 3 for 40 newborns, on Day 4 for 33 newborns, and on Day 5 for 2 newborns. Approval to conduct the study was obtained from the University of Rhode Island Institutional Review Board. Patient confidentiality and protection of personal health information were maintained throughout the duration of the study and beyond.

Setting

Enrollment in the study occurred on the postpartum unit of a community hospital in the northeast region of the United States. This hospital serves a suburban community with a population that is mostly White (88%), followed by Hispanic (4%) and African American (3%). The hospital has approximately 600 births annually. It has received Baby-Friendly Hospital designation, indicating that its policies promote and support breastfeeding (Centers for Disease Control and Prevention, 2016). The breastfeeding initiation rate at this facility in 2016 was 85%. Mothers who had a vaginal birth were usually discharged on Day 2 of life with their newborns and mothers who had a cesarean birth were usually discharged with their newborns on Day 3.

Sample

A sample of women whose newborns were born between July 2015 and September 2016 were enrolled in the study. Eligibility criteria included English-speaking women, > 21 years of age, at ≥ 37 and < 42 weeks gestation, with a healthy, singleton newborn who weighed ≥ 2,500 g and < 4,200 g. Only mother–infant dyads in which the newborn was exclusively or predominantly breastfed at the time of enrollment were included. Exclusive breastfeeding was defined as newborns who received only their own mother's milk via breast or bottle. Predominant breastfeeding was defined as 75% or more of the newborn's diet comprising their own mother's milk given via breast or bottle; the remainder of the diet was formula (Thulier, 2010). Mothers were excluded from the study for significant illness, medically controlled gestational diabetes, or postpartum hemorrhage. Mothers were also excluded for a recent history of domestic violence, drug abuse, or unstable housing. Newborns were excluded for any illness requiring transfer to a neonatal intensive care unit.

There were 436 women who were screened for eligibility on the days that study personnel were available. A total of 134 mother–newborn dyads did not meet eligibility criteria. Of these, 35 did not meet the feeding criteria for inclusion in the study. Among the remaining 302 women who did meet eligibility for the study, half (50%) agreed to participate. For mothers who declined participation, many (34%) stated that they were too busy to participate in the study. Approximately 10% reported that they were too tired or stressed with new baby care to join a study. The remaining mothers did not provide a reason for declining participation. A total of 151 mother–infant dyads were enrolled and 135 dyads completed data collection for at least 14 days.

All newborns in the study (151) were divided into two groups. Group 1 consisted of newborns who had ≤ 7% total body weight loss. Group 2 consisted of newborns who had > 7% total body weight loss. Seven newborns from Group 1 and two newborns from Group 2 were introduced to formula 1 to 2 days prior to reaching their nadir of weight. The remaining 142 newborns were all exclusively breastfed prior to reaching their nadir. Sixteen mothers dropped out of the study several days after birth. Eight mothers participated for 14 days but did not continue collecting weights until all birth weight was regained. Two of these newborns were less than 1% away from birth weight at 14 days when participation ended. One infant was less than 1% from birth weight at 21 days. Four infants were still 7% to 9% under birth weight at 14 days. Finally, 1 infant was 2% under birth weight at 25 days when data collection ended. Pediatric providers were following all of these newborns.

Measurement

Maternal demographic data were collected from hospital records and included maternal parity, basal metabolic rate, method of delivery, amount of IV fluid administered prior to birth, medical indication for cesarean if needed, and breastfeeding experience. Infant data that were collected from hospital records included gestational age, APGAR scores, the occurrence of phototherapy treatment, daily weights, voids, stools, and type and number of feedings.

Data Collection

After the consent process was completed, enrolled mothers were provided a loaner digital baby scale and paper journal. They were instructed to weigh their newborns daily until 14 days of life and record the weights, feedings, voids, and stools in the paper journal provided. If the newborn had not resumed birth weight by 14 days, mothers were invited to continue collecting data for another 1 to 2 weeks until the newborn had regained birth weight. When data collection was complete, study personnel retrieved the baby scales and paper journals from participants' homes. Scales were checked for accuracy with known weights prior to distribution; one scale required recalibration during the study period.

Data Analysis

Data analysis was performed using SPSS version 23.0. All p values were calculated with a two-sided significance level of .05. Descriptive statistics such as frequency table for each categorical variable and minimum, maximum, range, median, mean, and standard deviation for each continuous variable were used to summarize the data and detect outliers, data entry mistakes, and missing values. To address Aim 1, a one-way analysis of variance (ANOVA) test was conducted to compare differences between weight changes among newborns who lost < 7% and those who lost > 7% birth weight. For Aim 2, chi-square tests were conducted to examine EB rates among newborns between groups. Additional one-way ANOVAs were conducted to detect group differences on feeding and elimination variables.

Results

Demographic Variables

The majority of women in the study were White (95%), had private insurance (87%), were married or partnered (89%), and had a college degree (73%). Fifty-three percent of the newborns were female (n = 80). Demographic variables were similar between the groups (see Table 1).

Clinical Variables of Mothers and Newborns

As expected, newborns born via cesarean lost more weight and were more often in Group 2. No differences in the indicators for cesarean birth (repeat, failure to progress, fetal distress, breech, elective) were noted between groups. Almost half of the mothers had breastfeeding experience with a prior

Table 1. Demographic Variables of Mother–Infant Dyads.

Variable	Total (*N* = 151) No. (%)	Group 1 (< 7% weight loss) (*n* = 67) No. (%)	Group 2 (≥ 7% weight loss) (*n* = 84) No. (%)	*p*
Ethnicity				
White	144 (95.4)	65 (97.0)	79 (94.0)	.614
Black	2 (1.3)	1 (1.5)	1 (1.2)	
Hispanic	3 (2.0)	1 (1.5)	2 (2.4)	
Other	2 (1.3)	0 (0.0)	2 (2.4)	
Insurance				
Private	131 (86.8)	57 (85.1)	74 (88.1)	.586
Marital status				
Married or partnered	135 (89.4)	62 (92.5)	73 (86.9)	.541
Newborn gender				
Female	80 (53.0)	37 (55.2)	43 (51.2)	.446
Education				
High school	13 (8.6)	5 (7.5)	8 (9.5)	.399
Some college	28 (18.5)	10 (14.9)	18 (21.4)	
College degree	68 (45.0)	29 (43.3)	39 (46.4)	
Graduate degree	42 (27.8)	23 (34.3)	19 (22.6)	

Note. Due to missing data on variables, not all columns sum to the total.

child. When women did not have prior breastfeeding experience, their newborns were more often in Group 2 and lost more weight. The occurrence of phototherapy treatment was similar between groups (see Table 2). The median gestational age for delivery was 39.5 weeks (n = 151). There were no significant differences in maternal age, parity, basal metabolic rate, and amount of IV fluid administered during labor.

Newborn Weight Changes

Birth weights were not significantly different between the groups. A Spearman's rho correlation coefficient was calculated for the relationship between newborn birth weight and total weight loss. No correlation was found (rho = –.005, p > .05; see Table 3). It was hypothesized that the mean percentage of lost birth weight for breastfed newborns is greater than 7%. Indeed, more than half (56%) of the full-term breastfeeding newborns in this study lost greater than 7% of their birth weight. Mean weight loss for all newborns (N = 151) was nearly 8%; MWL for newborns in Group 1 was 6% and was over 9% for newborns in Group 2 (see Table 3). Newborns in Group 1 reached their mean nadir of weight on Day 3, whereas newborns in Group 2 reached their mean nadir on Day 4.

Once newborns started gaining weight, more similar patterns of weight gain emerged between the groups. Averaging differences between all time points from Days 5 to 14 showed a mean daily gain of 39 g (n = 127). Group 1 (n = 60) and Group 2 (n = 67) showed mean daily gains of 41 g and 37 g, respectively. This resulted in a gain of 1.1% daily for all newborns (n = 127): 1.2% daily for Group 1, and 1.0% daily for Group 2.

The average time for newborns to resume birth weight was 10 days (n = 127; M = 10.3 days, SD = 4.2 days). Newborns in Group 1 (n = 60) resumed birth weight more quickly compared with newborns in Group 2 (n = 67), who averaged 12 days to regain all lost birth weight (M = 8.4, SD = 2.4 vs. M = 12, SD = 4.7 days; p = .000). By 2 weeks, 91% of newborns had surpassed birth weight: 100% of Group 1 and 84% of Group 2 (p < .000).

Newborn Intake and Output

The average number of daily feedings was not significantly different between groups (see Table 3). In this study, the day of birth was considered Day 1 of life. The EB rate on Day 1 was equal between groups. On the day of weight nadir (usually Days 3-4), the EB rate between groups was still comparable. Yet, on Day 14, the EB rate for newborns in Group 2 was notably less than Group 1 (60% vs. 82%; p = .033) (see Figure 1). On Days 1 and 2 of life, before newborns converted to case status, there was no significant difference in numbers of daily voids and stools. During the 14 days, the average number of daily voids was also not significantly different between the groups. Newborns in Group 2, however, did average fewer stools daily over the course of the 14 days, $F(1, 149) = 6.06$, p < .05 (see Table 3).

Discussion

Very few studies in the United States have collected newborn daily weights beyond 2 to 3 days of life. In this study, daily

Table 2. Clinical Variables of Mother–Infant Dyads.

Variable	Total (*N* = 151) No. (%)	Group 1 (< 7% weight loss) (*n* = 67) No. (%)	Group 2 (≥ 7% weight loss) (*n* = 84) No. (%)	*p*
Delivery method				
Spontaneous vaginal	101 (66.9)	50 (74.6)	51 (60.7)	.049
Cesarean section	50 (33.1)	17 (25.4)	33 (39.3)	
Cesarean indication				
Repeat cesarean	21 (42.0)	9 (52.9)	12 (36.4)	.422
Failure to progress	19 (38.0)	4 (23.5)	15 (45.5)	
Fetal distress	1 (2.0)	0 (0.0)	1 (3.0)	
Breech	6 (12.0)	2 (11.8)	4 (12.1)	
Elective	3 (6.0)	2 (11.8)	1 (3.0)	
Previous breastfeeding experience				
Yes	71 (47.0)	39 (58.2)	32 (38.1)	.014
Phototherapy treatment				
Yes	6 (4.0)	4 (6.0)	2 (2.4)	.262
Feeding at 14 days				
Exclusive human milk	94 (70.1)	50 (82.0)	44 (60.3)	.033
Predominant human milk	27 (20.1)	9 (14.8)	18 (24.7)	
Mixed feeding	12 (9.0)	2 (3.3)	10 (13.7)	

Note. Due to missing data on variables, not all columns sum to the total. Exclusive human milk = 100% mother's own milk; Predominant human milk = > 75% mother's own milk; Mixed feeding = 25% to 75% mother's own milk.

Table 3. Newborn Weights and Average Stools and Voids.

Variable	Total (*n* = 151) *M* (*SD*)	Group 1 (< 7% weight loss) (*n* = 67) *M* (*SD*)	Group 2 (≥ 7% weight loss) (*n* = 84) *M* (*SD*)	*F*	*p*
Birth weight (g)	3429.3 (385.7)	3419.3 (380.2)	3437.3 (392.1)	$F(1, 149) = 0.080$	.777
Nadir of weight loss (%)	−7.680 (2.4)	−5.690 (0.99)	−9.260 (1.9)	$F(1, 149) = 99.91$	.000
Feeds/day	9.96 (2.1)	9.96 (1.9)	9.95 (2.2)	$F(1, 149) = 0.002$	.964
Voids/day	5.56 (1.8)	5.83 (1.9)	5.34 (1.7)	$F(1, 149) = 2.81$	.096
Stools/day	4.35 (1.7)	4.72 (1.6)	4.06 (1.6)	$F(1, 149) = 6.06$	.015

weights were collected for 14 days or more. There were several compelling findings. First, more than half of the healthy, full-term newborns (56%) lost > 7% of their birth weight. This is consistent with findings from a previous retrospective study of 286 newborns that showed that 58% of newborns lost > 7% (Thulier, 2017). This is also consistent with findings from a larger study that showed 25,474 newborns born via cesarean had a MWL of 8.6% at 72 hours after birth (Flaherman et al., 2015). Findings from all three studies suggest that MWL for newborns may be 8% or more. This calls into question the accuracy of 7% as a guide to practice.

A second major finding from this study is the alarming pattern of increased formula use by 14 days when weight loss was greater than 7%. This is similar to previous findings that showed that newborns who lost > 7% had a lower EB rate on Day 3 of life compared with newborns who lost ≤ 7% (Thulier, 2017). In the 2012 executive summary, "Breastfeeding and the Use of Human Milk," the American Academy of Pediatrics reaffirmed its belief that human milk is the normative standard for infant feeding and nutrition. In this same policy statement, authors described how pediatricians should be knowledgeable about how to manage and support the breastfeeding dyad. In this study, it was unknown what kind of feeding directions were provided to parents when newborns lost > 7% of their birth weight. Some mothers may have been encouraged to continue breastfeeding and others may have been advised to provide formula supplementation. What is known, however, is that women commonly

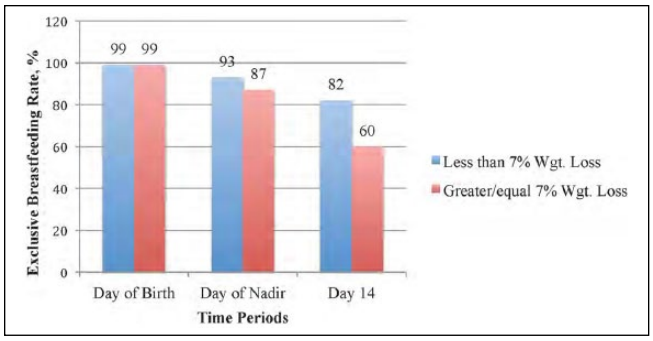

Figure 1. Exclusive breastfeeding rates. Wgt. = weight.

approach breastfeeding tentatively and that confidence in the ability to breastfeed successfully is a powerful factor that can influence feeding outcomes (Roll & Cheater, 2016). When a provider expresses concern about a newborn's weight loss, this has the potential to shake a woman's confidence in her ability to breastfeed. Women who lack confidence in breastfeeding are then more likely to discontinue breastfeeding and/or supplement breastfeeding with formula. The introduction of formula is a well-established variable that negatively affects breastfeeding duration (Brown, 2015; Parry, Ip, Chau, Wu, & Tarrant, 2013). It is therefore critical that guidelines provided to clinicians regarding expected neonatal weight loss are accurate.

The third major finding in this study was related to the patterns of neonatal weight gain. Despite the amount of initial weight loss, after the nadir was reached, most of the newborns in this study gained weight at a similar pace. These findings are consistent with findings from a recent study by Paul et al. (2016) in which researchers sought to determine the distribution of weight loss and subsequent regain during the first month of life (n = 161,471). In that study, increases in weight occurred at a rate of 1.2% (vaginally born) and 1.1% (cesarean born) per day.

Other clinical findings in this study were of interest. Primiparity has been described as the greatest risk factor for delayed onset of lactogenesis, a variable associated with increased weight loss (Nommsen-Rivers, Dolan, & Huang, 2012). Findings in this study indicated that newborns of mothers without prior breastfeeding experience lost more weight. Yet, parity did not make a difference between the groups. This suggests that it is a first-time breastfeeding experience (not parity) that may be associated with more weight loss in newborns.

Some clinical findings in this study were not consistent with previous research. Studies have shown that birth weight affects weight changes (Thulier, 2016). In this study, the mean birth weight was not statistically different between groups. The eligibility criteria, however, excluded the heaviest and lightest of newborns. This may be why there was little variation in birth weight between groups. Newborn jaundice has also been found to be associated with more newborn weight loss (Fonseca et al., 2014). Only six newborns in this study received treatment with phototherapy, too few for meaningful statistical analysis.

Limitations

The primary limitation in the study was the homogeneous sample. A more varied sample population would make the findings more generalizable. During the postpartum hospitalization, newborns were weighed during routine nursing care with a scale calibrated according to hospital guidelines. Nurses recorded newborn feedings and outputs in the medical records. Newborn intake and output may have been underestimated if parents completed a feeding or diaper change and did not communicate this information to the nurses. It is also possible that mothers may have made errors when recording the data in the study journals. Finally, unknown infant pathophysiology may have affected infant weight loss or gain.

Conclusion

The purpose of this study was to compare differences in weight changes and exclusive breastfeeding rates in newborns who lost ≤ 7% and > 7% of their body weight after birth. We found that more than half of the newborns in the study lost > 7%, which challenges the accuracy of 7% expected weight loss as a guide to practice. In this study, weight loss appeared to be the driving force behind formula use; when newborns lost more than 7%, the use of formula increased markedly. Larger studies from a more heterogeneous sample that focus on newborn weight changes are needed. It is well established that professional guidance and care in the early weeks of life can enhance breastfeeding duration. Negative and long-lasting implications on health and wellness can result when breastfeeding is ended prematurely. Findings from this study show the importance of establishing an accurate range of expected neonatal weight loss.

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