Received: 28 November 2016 | Revised: 2 May 2017 | Accepted: 9 May 2017
DOI: 10.1111/mcn.12472

WILEY Maternal & Child Nutrition

ORIGINAL ARTICLE

Weight gain in the first week of life predicts overweight at 2 years: A prospective cohort study

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Funding information
United States Agriculture-CREES, National Research Initiative, Grant/Award Number: 2008-35215-18838

Abstract

In formula-fed infants, rapid weight gain during the first week of life is associated with later obesity. To examine the association between weight gain during the first week and overweight at age 2 among infants with various feeding practices and the relationship between exclusive breastfeeding in early infancy and overweight, we enrolled a prospective cohort of healthy mother–infant dyads and followed them for 2 years. We enrolled 450 mother/infant pairs and obtained information on 306 infants at year 2. Weight change during the first week of life and detailed feeding information were collected during the first month of life. Anthropometric measures were collected at 2 years. Overweight was defined as body mass index (BMI) ≥85th percentile for age. At 2 years, 81% had normal weights and 19% were overweight. Maternal prepregnancy BMI; infant birth weight; maternal education; and Women, Infants, and Children status were associated with the risk of overweight at age 2. Children who gained more than 100 g during the first week were 2.3 times as likely after adjustment (p = .02) to be overweight at age 2 compared to infants who lost weight. There was no association between feeding type and BMI, but feeding type was significantly associated with change in weight at week 1 and anthropometric measurements at age 2. Infant weight gain in the first week of life is related to overweight at age 2, and exclusively breastfed infants are least likely to gain ≥100 g.

KEYWORDS

breastfeeding, infant feeding, infant growth, obesity, overweight

1 | INTRODUCTION

Overweight and obesity are established risk factors for adverse health outcomes in both adults and children (Park, Falconer, Viner, & Kinra, 2012; Reilly & Kelly, 2011). The most established risk of obesity during infancy and the toddler years is its positive association with continued obesity later in life (Baird et al., 2005), which is linked to a constellation of health risks in adulthood (Baird et al., 2005; Kristiansen et al., 2015; Singh, Mulder, Twisk, Van Mechelen, & Chinapaw, 2008; Taveras et al., 2011; Wheeler, 2013). Paradoxically, increased weight gain during infancy, while associated with increased adult body mass index (BMI), may not be associated with risk of obesity-related diseases such as diabetes in adulthood, and increased birth weight may decrease this risk (Adair et al., 2013). A more recent study suggests that increased weight gain during infancy and later in childhood increases the risk of hypertension at 10 years of age, regardless of birth weight (Perng et al., 2016). There is incomplete information about weight change during the first week of life and outcomes at 2 years of age.

Surveillance data reveal an alarming rate of overweight and obese children including more 2-year-olds that have ≥85 percentile BMI for age from 1978–1980 to 2011–2012 (Reilly et al., 2005). Despite overall stabilization of the obesity epidemic among children, there has been a steady rise in the more severe forms of obesity in recent years (Ogden, Carroll, Kit, & Flegal, 2014; Skinner & Skelton, 2014).

A 2005 meta-analysis of 28 studies found an overall association between breastfeeding and lowered risk of obesity (OR: 0.87; 95% CI [0.85, 0.89]; Owen, Martin, Whincup, Smith, & Cook, 2005). Reilly, in a 2005 systematic review, identified eight critical early risk factors, including velocity of growth in the first year of life, as contributors to obesity; however, the role of breastfeeding, which was assessed retrospectively, was unclear (Reilly et al., 2005). Durmuş found that the protective effect of breastfeeding and later solid food introduction on lower body fat at age 6 years was explained by sociodemographic and lifestyle factors (Durmuş et al., 2014). In contrast, a 20-year

prospective longitudinal cohort study found breastfeeding to be protective for overweight as measured by subscapular skinfold thickness after adjusting for energy and fat intake at 2 years (Péneau, Hercberg, & Rolland-Cachera, 2014). There is insufficient evidence about the importance of exclusive breastfeeding compared to other feeding patterns, such as mostly or token breastfeeding, and the protection from overweight or excess body fat beyond infancy. Thus, the relationship between different breastfeeding patterns, body composition, and development of overweight warrants further investigation.

The exact timing of rapid weight gain during infancy leading to childhood and adult obesity is not clear (Druet et al., 2012; Ekelund et al., 2006). Stettler examined the long-term impact of weight change during the first week of life on obesity later in life, but only bottle or formula-fed newborns were included (Stettler et al., 2005). More recent studies have attempted to define normative trajectories among breastfed newborns during the first few days of life but have lacked follow-up beyond hospital discharge (Flaherman et al., 2015; Macdonald, Ross, Grant, & Young, 2003). Exclusive breastfeeding is associated with greater weight loss than either combination feeding or exclusive formula feeding during the first week of life (Grossman, Chaudhuri, Feldman-Winter, & Merewood, 2012). New studies that examine the risk of rapid weight gain during the first week of life on overweight at age 2 years, when BMI becomes a useful measure, are necessary.

The objectives of this study were to determine a possible association between (a) weight gain during week 1 of life and weight status at age 2 in a group of breastfed, mixed-fed, and formula-fed infants and (b) exclusive breastfeeding at 1 week and 1 month of life and weight status, including body composition, at age 2. Our hypothesis was that rapid weight gain over the first week of life is an independent risk factor for overweight status at age 2 with a secondary hypothesis that exclusive breastfeeding during the first month is associated with a decreased risk of becoming overweight at age 2.

Key messages

- Overfeeding during the first week of life has potential adverse health consequences including the risk of becoming overweight by the second year of life.
- Exclusively breastfed infants, those not receiving supplementation, are least likely to gain excess weight during the first week of life.
- Clinicians should recognize that a large proportion of breastfed babies lose weight during the first week of life and that weight loss during this time is normal and not a reason to discontinue exclusive breastfeeding. This recommendation is consistent with Step 6 of the Ten Steps to Successful Breastfeeding.

2 | PARTICIPANTS AND METHODS

Eligible women were healthy, English- or Spanish-speaking new mothers with healthy, singleton, appropriate-size-for-gestational age infants born at the Boston Medical Center, an urban Baby-Friendly teaching hospital in Massachusetts. Maternal exclusion criteria included any maternal illness, such as any diabetes, are described in Figure 1. All healthy infants born during the enrollment period were eligible and approached. Infants admitted to the neonatal intensive care unit or who are being evaluated for hormonal, syndromic, or other genetic anomalies were excluded. Participants were enrolled after signing approved written informed consents and Health Insurance Portability and Accountability Act forms. The study was approved by the Institutional Review Boards of Boston University Medical Center and Cooper University Hospital.

Bilingual research assistants (RAs) collected demographics at enrollment, including race/ethnicity; place of birth; insurance status; education; smoking; type of delivery; participation in the Women, Infants, and Children program; and gender of child. All feedings were recorded during the first week of life. RAs reviewed the infants' medical records to collect feeding data while infants were in the hospital. At hospital discharge, the study team provided a home feeding log and instructed the mother on how to enter every feeding. On the seventh day of life, RAs visited mother–infant pairs at home, reviewed the feeding log, and collected feeding and anthropometric data for day 7. Anthropometric measurements included triceps skinfold (TSF), weight, and length. RAs were trained in methods of measurement using previously described research (World Health Organization, 1995a). Details regarding weight measurements are reported in our previous paper (Grossman et al., 2012). Lengths were measured using Stationmeter New Born and Paediatric Length Boards by O'Leary (Ellard Instrumentation Ltd.). TSF measurements were conducted in triplicate under standard conditions using Lange Skinfold Calipers (Beta Technology, Santa Cruz, California, USA) at the triceps, halfway between the acromion process and the olecranon process, and mean values for each subject reported. Interrater reliability testing was performed for all RAs for internal validity. At 2, 3, and 4 weeks postpartum, RAs called mothers and asked detailed feeding questions. A detailed description of extent and reliability of infant feeding data collection in this study has been published (Burnham et al., 2014). RAs conducted final home visits within 2 weeks of a child's second birthday and collected the child's anthropometric measurements and demographic and feeding information.

2.1 | Definitions

We defined change in weight at week 1 as the difference between an infant's birth weight and his or her weight on day 7 of life. We categorized change in weight at week 1 as a net weight loss, weight gain of <100 g, or weight gain of ≥100 g. At year 2 of life, we defined "normal weight" as a BMI less than the 85th percentile for age and "overweight" as a BMI equal to or greater than the 85th percentile for age (Grummer-Strawn, Reinold, Krebs, Control, & Prevention, 2010; World Health Organization, 1995a).

For the purposes of this analysis, we looked at feeding status in the first week of life on days 1 through 7, through the first month of life, and at month 1. Feeding status on days 1 through 7 was determined by

looking at every feed recorded in an infant's medical record prior to discharge and then through a daily log kept by the mother at home and reviewed in person by an RA on day 7 postpartum. For the remainder of month 1 of life, feeding was recorded in a weekly interview with the mother. These data, along with week 1 data, were used to determine feeding status through month 1. Feeding status at month 1 only takes into account the type of feeding recorded during the week 4 phone interview. We categorized feeding status during each of these time points as exclusive breast milk (only breast milk or medications received), mostly breast milk (some formula but ≥50% of feedings were breast milk), mostly formula (<50% of feeds received were breast milk but some breast milk consumed), and exclusive formula (infant only received formula).

2.2 | Statistical analysis

We performed bivariate logistic regressions to determine the association between demographic characteristics and overweight status at year 2. We included variables with a *p* value of <.1 in multivariate regression models. Bivariate and multivariate logistic regressions tested the association between predictors of interest and overweight status at year 2. We also looked at BMI at year 2 of life as a continuous variable, performing bivariate and multivariate linear regressions to test its association with predictors of interest. Lastly, we tested the association between our predictors of interest and *z*-score for TSF at year 2 using the World Health Organization Growth Reference Standard, calculating *z*-scores using the WHO Anthro Software version 3.2.2 (World Health Organization, 1995b). We used multivariate linear regression to test the association with change in weight at week 1. Data were analyzed using SAS 9.3 for Windows (SAS Institute, Cary, North Carolina, USA).

3 | RESULTS

Between May 2008 and November 2010, we assessed 3,101 mother/infant pairs for eligibility, of whom 991 were eligible and 910 were available. Of these, we enrolled 450 mother/infant pairs. At year 2, we were able to obtain follow-up on 306 infants. Figure 1 describes the enrollment and follow-up process. There were no differences

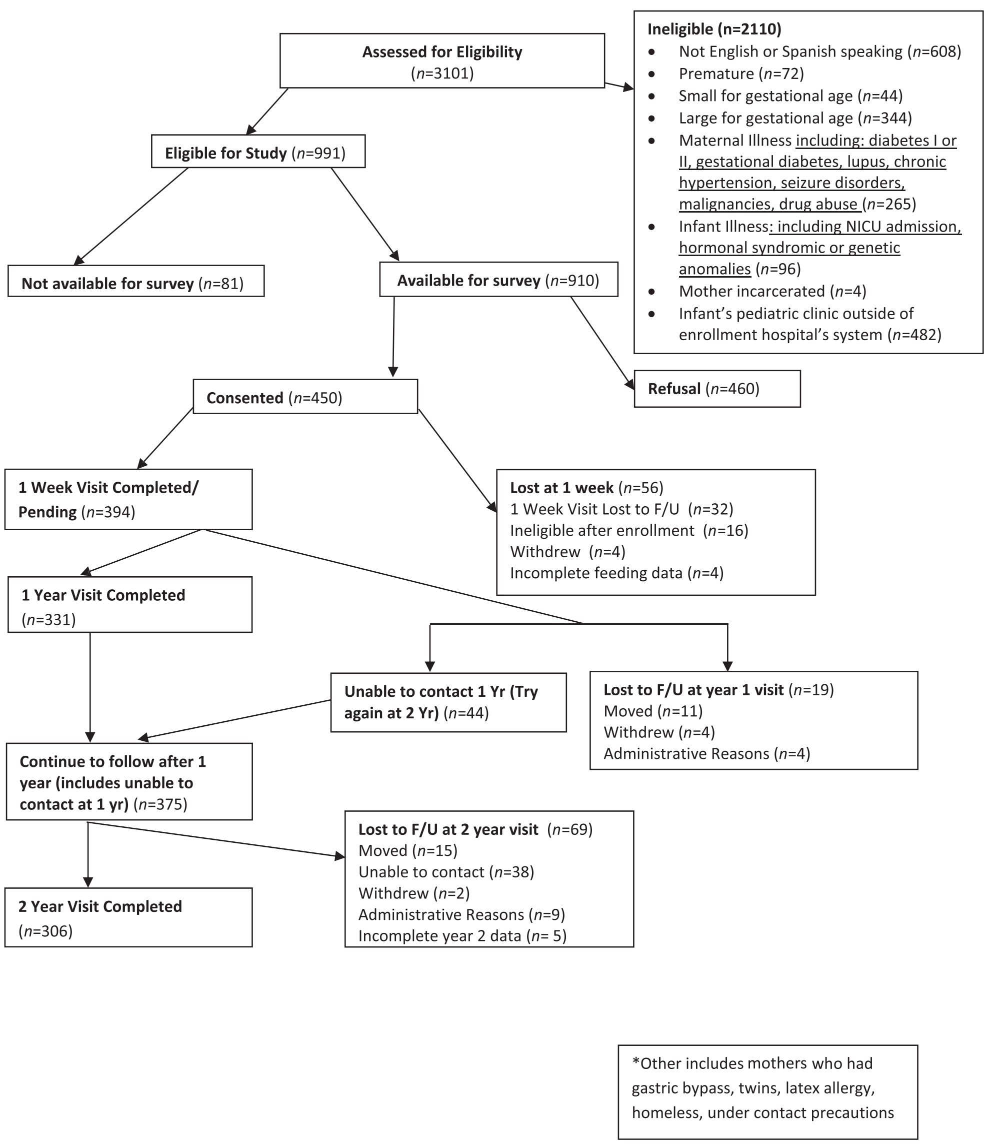

FIGURE 1 Enrollment and follow-up flowchart

TABLE 1 Maternal and infant characteristics

Predictor of interest Continuous variables	All infants *n* = 306 Mean (*SD*)	Overweight *n* = 59 Mean (*SD*)	Normal weight *n* = 247 Mean (*SD*)	*p* value
Maternal pre-pregnancy BMI[a]	25.9 (5.6)	27.9 (6.2)	25.4 (5.4)	.002
Infant birth weight (g)	3,282.2 (330.1)	3,366.4 (323.5)	3,262.1 (329.2)	.03
Gestational age (weeks)	39.7 (1.1)	39.7 (1.1)	39.6 (1.1)	.69
Sleep per day at 2 years (hr)	11.8 (1.5)	11.7 (1.3)	11.8 (1.5)	.66
Screen time per day at 2 years (hr)	1.8 (1.8)	1.9 (2.0)	1.8 (1.8)	.97
Categorical variables	*N* (%)	*N* (%)	*N* (%)	*p* value
Maternal race or ethnicity				.06
Hispanic	215 (70.3)	50 (84.8)	165 (66.8)	
Black	61 (19.9)	7 (11.9)	54 (21.9)	
White	15 (4.9)	0 (0.0)	15 (6.1)	
Asian	6 (2.0)	1 (1.7)	5 (2.0)	
Other	9 (2.9)	1 (1.7)	8 (3.2)	
Maternal place of birth				.48
US born	62 (20.3)	10 (17.0)	52 (21.1)	
Non-US born	244 (79.7)	49 (83.1)	195 (79.0)	
Maternal insurance at enrollment				.34
Public	269 (87.9)	54 (91.5)	215 (87.0)	
Private	37 (12.1)	5 (8.5)	32 (13.0)	
Maternal education				.008
Some middle school	148 (48.4)	39 (66.1)	109 (44.1)	
Some high school	89 (29.1)	13 (22.0)	76 (30.8)	
High school graduate	69 (22.6)	7 (11.9)	62 (25.1)	
Smoking status during pregnancy				.46
Yes	9 (2.9)	2 (3.4)	7 (2.8)	
No	25 (8.2)	7 (11.9)	18 (7.3)	
Never smoked	272 (88.9)	50 (84.8)	222 (89.9)	
Type of delivery				.76
Vaginal	243 (79.4)	46 (78.0)	197 (79.8)	
Cesarean	63 (20.6)	13 (22.0)	50 (20.2)	
Child in this study is the mother's firstborn				.09
Yes	111 (36.3)	27 (45.8)	84 (34.0)	
No	195 (63.7)	32 (54.2)	163 (67.0)	
WIC status at 2 years visit				.05
Yes	259 (84.6)	55 (93.2)	204 (82.6)	
No	47 (15.4)	4 (6.8)	43 (17.4)	
Infant sex				.24
Female	140 (45.8)	31 (52.5)	109 (44.1)	
Male	166 (54.3)	28 (47.5)	138 (55.9)	

Note. BMI = body mass index; SD = standard deviation; WIC = Special Supplemental Nutrition Program for Women, Infants, and Children.
[a]Maternal pre-pregnancy BMI has an *n* = 305.

between variables described in Table 1 for the 306 infants analyzed versus those lost to follow-up (*n* = 144) as described previously. (Burnham et al., 2014) Of these 306 infants, 247 were in the normal weight range at age 2, and 59 (19%) were overweight. Weight and weight-for-length at age 2 years were normally distributed. In accordance with the Boston Medical Center population, study subjects were primarily from racial or ethnic minority groups and families of low socioeconomic status. The average pre-pregnancy maternal BMI was 25.9 (Table 1). Higher maternal pre-pregnancy BMI; higher infant birth weight; lower maternal education; and participation in Women, Infants, and Children were all associated with the increased risk of having an overweight child at age 2. These variables were included in multivariate regression models, along with maternal race or ethnicity and the infants' firstborn status ($p < .1$).

Results in Table 2 describe the association between overweight status at 2 years of age and predictors of interest: change in weight at week 1 analyzed categorically (weight loss, weight gain <100 g, and weight gain ≥100 g), feeding status during the first week of life, and feeding status during the first month of life. Change in weight in week 1 of life was associated with overweight status at age 2. Children who were overweight at

TABLE 2 The relationship between predictors of interest and overweight status at 2 years of age

Predictor of interest Categorical variables	All infants n = 306 % (N)	Overweight n = 59 % (N)	Normal weight N = 247 % (N)	Bivariate regression OR [95% CI]	 p value	Multivariate regression AOR [95% CI]	 Adj p value
Change in weight at week 1							
Weight loss	37.9 (116)	25.4 (15)	40.9 (101)		Ref		
Weight gain <100 g	29.7 (91)	28.8 (17)	30.0 (74)	1.5 [0.7, 3.3]	.93	1.2 [0.5, 2.7]	.52
Weight gain ≥100 g	32.4 (99)	45.8 (27)	29.1 (72)	2.5 [1.3, 5.1]	.02	2.3 [1.1, 4.8]	.02
Feeding status days 1–7							
Exclusive breast milk	23.2 (71)	22.0 (13)	23.5 (58)		Ref		
Mostly breast milk	62.8 (192)	61.0 (36)	63.2 (156)	1.0 [0.5, 2.1]	.94	0.8 [0.4, 1.7]	.58
Mostly formula	10.1 (31)	15.3 (9)	8.9 (22)	1.8 [0.7, 4.9]	.23	1.3 [0.4, 4.1]	.61
Exclusive formula	3.9 (12)	1.7 (1)	4.5 (11)	0.4 [0.0, 3.4]	.41	0.7 [0.1, 7.0]	.79

Note. Multivariate analysis adjusted for maternal pre-pregnancy body mass index; infant birth weight; maternal race or ethnicity; maternal education; first-born status; and Women, Infants, and Children status at 2-year visit. CI = confidence interval; OR = odds ratio; ref = reference group.

age 2 gained an average of 78.3 g in week 1 of life, whereas children who were normal weight at age 2 gained an average of 30.1 g in week 1 (p = .02). Similarly, children who gained more than 100 g between birth and week 1 of life were 2.5 times as likely to be overweight at age 2 compared to infants who lost weight in the bivariate analysis (p = .02). These results remained significant in the multivariate regression model with an odds of overweight of 2.3 (p = .02). When we looked at change in z-score for weight at week 1, we found an OR (95% CI) for overweight of 3.1 (1.0–9.4) and p value of .04. After adjusting for confounders, we found an OR (95% CI) of 4.5 (1.3–16.2) and adjusted p value of .02.

We did not find a significant association between overweight status at year 2 and feeding status during the first week and first month of life. Of note, however, type of feeding was significantly associated with change in weight at week 1 of life, with formula-fed infants gaining more weight. At 1 week of life, 53.5% of infants who received only breast milk remained below birth weight, with an average weight status of −7.7 g below birth weight. By contrast, only 3 of the 12 infants receiving exclusive formula were below birth weight at week 1, and their average weight gain was 82 g (Table 3).

In addition to examining BMI at age 2, we also examined the z-score for TSF and its relationship with our predictors of interest (Table 4). We did not find an association between these measurements and weight gain in week 1 of life or feeding status days 1–7, yet the association between both weight gain ≥100 g and feeding status (exclusive formula vs. exclusive breast milk) approached significance for TSF. The average z-score for TSF measured at year 2 was 0.77 units greater for infants receiving exclusive formula compared to exclusive breast milk during the first week of life, controlling for potential confounders, AOR 2.16 (adj p value .06). The z-scores for these anthropometric measurements were associated with feeding status at month 1 of life when adjusting for confounding factors. There was a significant increase in the odds of greater body fat composition at age 2 for infants receiving exclusive formula versus exclusive breast milk: TSF (AOR 3.19, p < .001).

4 | DISCUSSION

We found that weight gain in week 1 of life was significantly associated with weight status at age 2, and the heaviest infants at age 2 gained the most weight in week 1. We also found that feeding type (exclusive breastfeeding vs. mixed feeding and formula feeding) was strongly predictive of weight gain in week 1, with infants who received more formula gaining the most weight. In infants who were exclusively formula fed in early life, compared to infants who were exclusively breastfed, we found greater anthropometric measures of body fat, including TSF. Our data did not show an association between greater weight gain in the first week of life and adiposity at 2 years, although the relationship approached significance.

TABLE 3 The relationship between change in weight and feeding status during week 1 of life

Continuous variables	Exclusive breast milk (n = 71) Mean (SD)	Mostly breast milk (n = 192) Mean (SD)	Mostly formula (n = 31) Mean (SD)	Exclusive formula (n = 12) Mean (SD)	p value
Change in weight at week 1 (g)	−7.7 (184.9)	53.5 (137.5)	43.2 (102.4)	82 (128.2)	.02
Categorical variables	% (N)	% (N)	% (N)	% (N)	p value
Change in weight at week 1 (g)					
Weight loss	53.5 (38)	34.4 (66)	29.0 (9)	25.0 (3)	.02
Weight gain <100 g	22.5 (16)	28.7 (55)	48.4 (15)	41.7 (5)	
Weight gain ≥100 g	23.9 (17)	37.0 (71)	22.6 (7)	33.3 (4)	

TABLE 4 Association between infant weight and early feeding type and triceps skinfold at 2 years, bivariate and multivariate linear regressions

	Z-score for triceps skinfold							
Predictor of interest	β	*SE*	95% CI	*p* value	Adj β	*SE*	95% CI	Adj *p* value
Change in weight at day 7	<0.001	0.001	[−0.001, 0.001]	.45	0.001	0.001	[−0.0004, 0.002]	.23
Weight gain <100 g versus weight loss	0.13	0.19	[−0.25, 0.51]	.51	0.12	0.18	[−0.24, 0.48]	.52
Weight gain ≥100 g versus weight loss	0.29	0.19	[−0.08, 0.66]	.13	0.33	0.18	[−0.02, 0.68]	.06
Feeding status days 1–7								
Mostly breast milk versus exclusive breast milk	0.19	0.19	[−0.18, 0.57]	.31	0.18	0.19	[−0.18, 0.55]	.32
Mostly formula versus exclusive breast milk	0.48	0.30	[−0.11, 1.06]	.11	0.40	0.29	[−0.16, 0.96]	.17
Exclusive formula versus exclusive breast milk	0.46	0.44	[−0.40, 1.32]	.29	0.77	0.41	[−0.04, 1.58]	.06
Feeding status through month 1								
Mostly breast milk versus exclusive breast milk	−0.13	0.27	[−0.65, 0.40]	.64	−0.13	0.26	[−0.64, 0.01]	.61
Mostly formula versus exclusive breast milk	0.48	0.32	[−0.13, 1.10]	.12	0.59	0.30	[0.01, 1.18]	.05
Feeding status at month 1								
Mostly breast milk versus exclusive breast milk	0.25	0.20	[−0.14, 0.64]	.21	0.30	0.19	[−0.07, 0.67]	.11
Mostly formula versus exclusive breast milk	0.13	0.27	[−0.39, 0.65]	.63	0.11	0.25	[−0.38, 0.59]	.66
Exclusive formula versus exclusive breast milk	1.04	0.24	[0.58, 1.51]	<.0001	1.16	0.23	[0.71, 1.61]	<.0001

Note. Multivariate analysis adjusted for maternal pre-pregnancy body mass index; infant birth weight; maternal race or ethnicity; maternal education; first-born status; and Women, Infants, and Children status at 2-year visit. CI = confidence interval; OR = odds ratio; ref = reference group; SE = standard error.

Given that greater weight gain in week 1 predicted heavier children at age 2 and that greater consumption of formula in week 1 predicted greater weight gain in week 1, the obvious question arises as to why type of feeding (human milk vs. formula) was not associated with weight status at age 2. Several possible explanations exist. It is possible that our sample was not large enough to detect an association, especially considering the low number of exclusively breastfed infants and the low number of overweight/obese children at age 2. It is also possible that other factors mitigated the relationship between early feeding and weight status at age 2, such as formula supplementation in year 1 of life, use of inappropriate foods and fluids early in life, or overfeeding or inappropriate types of foods before age 2 (Jardim-Botelho et al., 2014; Saavedra, Deming, Dattilo, & Reidy, 2013). Finally, weight status using BMI may be a different indicator of overweight at age 2 than anthropometric measures. This may be one explanation as to why we found weight gain during the first week was correlated with overweight using BMI values, whereas feeding method (exclusive formula feeding vs. exclusive breastfeeding) was strongly and independently predictive of higher body fat accumulation using *z*-scores for TSF.

The clinical implications of our findings that weight gain ≥100 g in week 1 of life is associated with overweight at 2 years of age deserve more research. Formula feeding was associated with greater weight gain in this period; thus, hospitals, where most mothers and infants spend the early days of life, should be supportive of practices that encourage exclusive breastfeeding, such as those outlined by the Ten Steps to Successful Breastfeeding (World Health Organization and UNICEF, 1998). Similarly, pediatricians who see infants in the early days should support women to recognize normal patterns of weight loss in week 1 of life and not encourage supplementation with formula, as others have suggested (Flaherman et al., 2013). Our findings confirm that a large proportion of breastfed babies lose weight during the first week of life and that weight loss during this time is normal and not a reason to discontinue exclusive breastfeeding.

4.1 | Limitations

The present study has some limitations. Because subjects were enrolled in a Baby-Friendly designated facility, there were relatively few exclusively formula-feeding infants, which made outcomes in that group difficult to quantify or compare. Feeding categories were captured at the time of the interview and may not represent the feeding during the preceding interval. The study was also limited by the large number of subjects initially enrolled but lost to follow-up. Furthermore, the study was observational in design, limited by sampling bias, and the association of overweight at 2 years of age with rapid weight gain during the first week of life may not be causal and may be due to residual confounding. We also did not test for interactions between the predictor of interest and other predictors of interest beyond infant feeding, or interactions in other models fitted.

Finally, the percent of overweight in the population studied was only 19% at 2 years, whereas the national prevalence of overweight among 2-year to 5-year-old children in 2011–2012 was recorded as 23% (Ogden et al., 2014). Among Hispanic and Black children, the prevalence of obesity among 2-year to 5-year-olds was 30% and 22%, respectively (Ogden et al., 2014). The sociodemographic factors in the study population must therefore be considered with regard to generalizability of our findings. Similar prospective studies should be considered in different populations.

5 | CONCLUSION

Infant weight gain in week 1 of life is related to infant weight at age 2, and infants who gain most weight in week 1 are most likely to be overweight at age 2. Exclusively breastfed infants are least likely to gain ≥100 g in week 1 of life. New studies are needed to elucidate the relationship between feeding method, volume and calories consumed, and weight change during the first week of life. Future research may include more specific measures of infant body composition and reexamine the

outcome of adiposity and tests for interactions. The association between higher weight gain during the first week and higher BMI at 2 years could be, in part, due to lean body mass. Furthermore, the relationship between weight gain ≥100 g in week 1 and overweight at age 2 years needs to be replicated in additional environments and in populations with higher rates of longer exclusive breastfeeding. Finally, the physiological mechanisms underpinning these relationships should be explored to reveal ways to optimize normal metabolism and prevent overweight and its associated consequences.

CONFLICTS OF INTEREST

The authors declare that they have no conflicts of interest.

CONTRIBUTIONS

LF-W partnered with AM in study design, analyses, and manuscript preparation; provided clinical guidance; and approved the final manuscript as submitted. LB collected data, assisted with study management, coordinated the analyses, reviewed and revised the manuscript, and approved the final manuscript as submitted. XG assisted with the design of the data collection instruments; coordinated and supervised enrollment, follow-up, and data collection; and approved the final manuscript as submitted. SM coordinated and supervised data collection and approved the final manuscript as submitted. NC carried out data analyses and approved the final manuscript as submitted. AM partnered with LF-W in study design, analyses, and manuscript preparation; obtained funding for the study; managed the study as project director; and approved the final manuscript as submitted.

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How to cite this article: Feldman-Winter L, Burnham L, Grossman X, Matlak S, Chen N, Merewood A. Weight gain in the first week of life predicts overweight at 2 years: A prospective cohort study. *Matern Child Nutr*. 2018;14:e12472. https://doi.org/10.1111/mcn.12472