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Breastfeeding Pattern and Duration and Post-Partum Maternal Weight Retention

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Abstract

Background/Aim: The aims were to investigate the association of breastfeeding (BF) duration with maternal postpartum weight retention (PPWR) at 12 months after delivery.

Methods: In this prospective cohort study, mothers were interviewed at birth, and at 3, and 12 months after delivery to gather information on socio-demographic and reproductive maternal characteristics, BF initiation, BF pattern at 3 months and BF duration, as well as to measure maternal anthropometric indicators.

Results: A negative association between BF intensity at 3-months and maternal PPWR was found at 3-months and 12-months after delivery. In adjusted multivariable linear regression, for each month of EBF increase between birth and 3-months postpartum, there was a mean decrease of 0.21 kg in maternal long-term PPWR; and for each month of any BF increase between birth and 12 months postpartum, there was a mean decrease of 0.11 kg in maternal long-term PPWR. Maternal younger ages weakened the negative long-term effect of BF on PPWR and the greater levels of maternal pre-gestational body mass index annulled the effect of any BF on PPWR.

Conclusion: This study supports the evidence that BF improves the reduction of PPWR and suggests that encouraging prolonged EBF and any BF may contribute to decrease PPWR.

Keywords: Postpartum; Maternal weight; Breastfeeding

Introduction

In high and middle income countries, the morbidity and mortality associated with obesity are increasing and the overweight prevalence is progressive, with overweight and obesity linked to more deaths worldwide than underweight [1]. Women of reproductive age have potential risk of major weight gain compared with men of all ages and with older women. Pre-pregnancy maternal weight, maternal gestational weight gain (GWG), race/ethnicity and parity are the most important determinants of weight change from preconception to postpartum [2]. High pre-pregnancy body mass index (BMI) and excessive GWG are associated to metabolic dysfunction, cardiovascular disease risk [3,4], hypertensive disorders, cancer, depression [5], long-term obesity, and higher postpartum weight retention (PPWR). Pregnancy is considered as a contributor to increment of adiposity in women [6] and the GWG can lead to both short-term and long-term postpartum weight imbalance [7]. Excessive PPWR has been cited as a contributor to development of overweight and obesity [8].

Although many factors influence women's weight throughout adulthood, findings from studies examining the association between breastfeeding (BF) (as the exposure) and PPWR (as the outcome) have been mixed [9-11]. BF has been shown to have many health benefits for mother; and the intensity and duration of BF is considered potentially protective against maternal obesity [12]. However, its role in postpartum weight management is unclear. Therefore, the aims of the present study were to investigate the relationship between BF pattern and 3 months and duration of any BF over PPWR at 3 and 12 months after delivery among mothers from the 2004 Pelotas Birth Cohort (Brazil).

Methods

A perinatal study was started in Pelotas, Southern Brazil in 2004. This birth cohort included 4,231 newborns from residents in the urban area of the city. Five hospitals of the city (99% of deliveries) received the visit of standardized interviewers who applied a questionnaire to the mothers.

Demographic, socio-economic, reproductive, behavioral, prenatal care, gestational and pre-gestational morbidities, and newborn characteristics information were collected [13]. A written informed consent was obtained from the mothers before every follow-up. Children in the cohort were followed up at different times; maternal and children information at perinatal study, 3-months (95.7%) and 12-months (94.3%) of single births was used in this study.

Maternal variables

PPWR at immediately postpartum, 3-month and 12-month after delivery were calculated as the difference between the measured maternal weight at each follow-up and pre-pregnancy weight. Maternal weight at the beginning of pregnancy was extracted from prenatal card or when absent by self-report.

To estimate immediately postpartum weight, the birth weight of the infant and an estimate of the weight of the placenta (placental weight 1/6 of baby´s birth weight) were subtracted of maternal weight at end of pregnancy [14].

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Maternal covariates selected of perinatal questionnaire were: family monthly income at birth (continuous variable); maternal schooling (continuous); skin color as self-reported (white, black, mulatto/brown, mixed or others); smoking (yes/no) and alcohol consumption (yes/no) during the pregnancy; parity (primiparous/multiparous); maternal age (continuous); history of diseases (arterial hypertension and diabetes mellitus), and type of delivery (caesarean, vaginal) [13]. Pre-pregnancy BMI was calculated as kg/m^2. Maternal height was measured and registered in the first follow-up at three months postpartum [13]. Maternal GWG in kg was calculated as the difference between pre-pregnancy weight and the last register of weight in the prenatal card at delivery. Maternal employment status (yes/no) was obtained 3-month after delivery.

Children variables

The frequency of exclusive breastfeeding (EBF) and any BF were evaluated by means of a personal interview with the mother at the 3-month and 12-month follow-ups [15]. BF pattern was investigated at 3-month after delivery. Children were considered on EBF if they were given nothing but breastmilk, direct from the breast or pumped, and no other liquid of food with the exception of drops or syrups; as on BF if they were given any breast-milk, irrespective of whether or not they were receiving other foods; in predominant BF if they were given breast milk, herbal tea, fruit juice, and/or water; and in partial BF if they received breast milk, herbal tea, fruit juice, and/or water, other milk, and/or semisolids [16].

Child sex and gestational age were collected at birth. Gestational age was estimated using an algorithm proposed by the National Center for Health Statistics (NCHS) based on the last menstrual period [17]. If the birthweight, length and head circumference were inconsistent with the normal curves for the gestational age calculated, or if the date of the last menstrual period was unknown [18], then gestational age was determined using the Dubowitz method which was performed on almost all newborns [19].

Statistical analysis

Descriptive statistics were calculated for all basic variables that compared mothers included in the analyses with those lost to follow-up or with missing information on BF and/or maternal weight. The chi-square test assessed differences in characteristics between these groups. PPWR at 3-month and 12-month after delivery were the depend variables. The main independent variables were exclusive and any BF duration, calculated in months, and BF patterns at 3-month after delivery. For comparison of maternal PPWR mean at 3-months and 12-months according to BF patterns at 3-months, the one-way ANOVA for homogeneous variances and the ANOVA for linear trend were used. To assess whether BF could affect PPWR at 3 and 12 months after delivery, crude and adjusted β coefficients to PPWR were estimated using multiple linear regression models.

A test of interaction between independent variables was performed through the MFPIgen command (a STATA command that permits to develop an interaction analysis for specific dependent variable) [20]. Statistically significant interaction between PPWR at 12-month after delivery and maternal age, as well as between PPWR at 12-month after delivery and PG-BMI were found; so, subsequent analyses were run according to these variables. Multiple linear regression models were used to adjustment of the interaction terms. The regression models included a continuous-by continuous interaction of the predictor variable with the interaction term (maternal age and PG-BMI).

The multiple linear regression models were adjusted for mother´s schooling, socio-economic level, mother´s skin color, parity, smoking during pregnancy, alcohol consumption, history of diseases (arterial hypertension and diabetes mellitus), type of delivery (cesarean and vaginal), pre-pregnancy maternal weight, GWG, PPWR at immediately postpartum, child sex, birth weight, and gestational age at birth. To the analysis of the effect of any BF duration over PPWR at 12 months after delivery, the variable PPWR at 3 months was added to the model. Statistical analyses were carried out using Stata version 12.0 (Stata Corp, College Station, Texas).

Results

Information on maternal PPWR and BF at 3-months and 12-months after delivery was available for 3517 and 3661 children, respectively. Table 1 compares maternal and child characteristics of the children included in the analyses, excluding those with incomplete data, with the original cohort. The follow-up rates were lower in less educated mothers, among those from families with low monthly income, with underweight or normal pre-pregnancy BMI, multiparous, and with black skin color.

Co-variables	**Original cohort (n=4147) N (%)**	**Localed (n=3517) N (%)**
Family monthly income (quintiles)	**p<0.001**	
1 (poorest)	846 (20.4)	647 (18.4)
2	841 (20.3)	688 (19.6)
3	802 (19.3)	713 (20.3)
4	846 (20.4)	795 (21.2)
5 (wealthiest)	812 (19.6)	758 (21.6)
Schooling, years	**p<0.001**	
Up to 4	639 (15.6)	467 (13.4)
5-8	1691 (41.2)	1420 (40.8)
9-11	1362 (33.2)	1228 (35.2)
≥ 12	414 (10.1)	370 (10.6)
Maternal PG-BMI	**p=0.003**	
Underweight	188 (4.9)	165 (4.7)
Normal	2340 (61.0)	2123 (60.4)
Overweight	890 (23.2)	836 (23.8)
Obese	418 (10.9)	390 (11.1)
Maternal age, y	**p=0.28**	
<20	792 (19.1)	659 (18.7)
20-35	2919 (70.4)	2493 (70.9)
>35	434 (10.5)	364 (10.4)
Parity	**p<0.001**	

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Primiparous	1644 (39.7)	1449 (41.2)
Multiparous	2502 (60.3)	2067 (58.8)
Maternal skin color	**p<0.001**	
White	2528 (61.7)	2197 (63.1)
Black	675 (16.5)	547 (15.7)
Brown/others	896 (21.9)	737 (21.2)
P value: Chi-squared test. Single birth participants. Maternal PG-BMI: maternal pre-gestational body mass index		

Table 1: Characteristics of participants in the original cohort and the percentage analyzed.2004 Pelotas Birth Cohort; Pelotas, Brazil.

Almost one fourth (23.8%) and 11.1% of the mothers were, respectively, overweight and obese at the beginning of the pregnancy (Table 2). Mean values of PPWR at immediately postpartum, 3-months and 12-months after delivery were 8.7 kg (SD 6.0), 1.9 kg (SD 5.6), and 2.0 kg (SD 6.2), respectively. Approximately 75% of the mothers experienced substantial weight retention (body weight at least 5 kg above pre-conception weight) after delivery, 27.9% at 3-months postpartum and 26.0% at 12-months postpartum. Prevalence of overweight and obesity were, respectively, 26.2% and 19.7% at 3 months and 22.6% and 25.9% at 12 months postpartum.

Table 2 shows the association between BF patterns at 3-months after delivery and maternal PPWR at 3 and 12 months. For mothers in exclusive and predominant BF at 3 months there was a decrease of 0.67 kg (95% CI: -1.01 to -0.33) and 0.78 kg (95% CI: -1.16 to -0.41), respectively, in postpartum weight, compared with those that had already weaned their infants. At 12-months after delivery the decrease in PPWR was 0.75 kg (95% CI: -1.15 to -0.34) and 0.70 kg (95% CI: -1.13 to -0.26), respectively, in mothers with exclusive and predominant BF.

Breastfeeding patterns at 3 months of age	**PPWR at 3 months in kg, mean (SD)**	**PPWR at 3 months after delivery**		**PPWR at 12 months in kg, mean (SD)**	**PPWR at 12 months after delivery**	
		Crude	**Adjusteda**	**Crude**	**Adjustedb**	
		β (95% CI)	**β (95% CI)**	**β (95% CI)**	**β (95% CI)**	
	p=0.073[c]	**p=0.03[c]**	**p<0.0001[c]**	**p<0.0001[d]**	**p <0.0002[d]**	**p <0.0002[d]**
None	2.14 (8.20; -3.91)	Ref	Ref	2.79 (9.66; -4.06)	Ref	Ref
Partial	2.04 (7.82; -3.74)	-0.11 (-0.61; 0.39)	-0.11 (-0.44; 0.23)	2.37 (8.76; -4.04)	-0.43 (-0.99; 0.13)	-0.14 (-0.54; 0.26)
Predominant	1.64 (6.92; -3.65)	-0.51 (-1.07; 0.45)	-0.78 (-1.16; -0.41)	1.57 (7.05;-3.90)	-1.22 (-1.84; -0.61)	-0.70 (-1.13; -0.26)
Exclusive	1.86 (7.12; -3.41)	-0.29 (-0.78; -0.21)	-0.67 (-1.01; -0.33)	1.36 (6.98; -4.27)	-1.44 (-1.99; -0.89)	-0.75 (-1.15; -0.34)
PPWR: Post-Partum Weight Retention p value of linear regression, β coefficients; BMI: Body mass index; GWG: gestational weight gain; SD: Standard deviation 95% CI: 95% confidence interval. [a] Model 1: Adjusted for pre-gestational weight, weight retention after delivery, family income, schooling at birth, skin color, maternal age, parity, maternal smoking and alcohol consumption during the pregnancy, history of arterial hypertension, history of diabetes mellitus, pre-pregnancy BMI, GWG, gestational age, maternal employment status, birth weight, child's sex, and type of delivery. [b] Adjusted for variables to model 1 more weight retention at 3 months after delivery. [c] Test for heterogeneity, [d] Test for linear trend						

Table 2: Association between breastfeeding patterns at 3 months and maternal postpartum weigh retention (PPWR) at 3 an 12 months after delivery. 2004 Cohort Pelotas, Brazil.

Table 3 shows the results of the multivariable regression analyses for maternal PPWR at 12 months after delivery taking EBF duration between birth and 3 months after the delivery and any BF duration as continuous variables. There was an inverse association between EBF and any BF duration with maternal PPWR in crude and adjusted analyses. After adjustment for confounders, for each month of EBF increase, there was a mean decrease of 0.21 kg in maternal PPWR at 12 months after delivery. For each month of any BF increase, there was a mean decrease of 0.11 kg in maternal PPWR. Maternal younger ages weakened the long-term (12 months postpartum) effect of any BF duration on PPWR (Figure 1) and the greater levels of maternal PG-BMI annulled the long-term effect of any BF duration on PPWR (Figure 2).

Breastfeeding duration (months)	**PPWR (kg) at 12 months after delivery**					
	Linear regression					
	Crude			**Adjusted**		
	N	**β (95% CI)**	**P value**	**N**	**β (95% CI)**	**P value**
Exclusive BF duration between 0-3 months (in months)	3517	-0.25 (-0.36; -0.15)[e]	<0.001	3406	-0.21 (-0.30; -0.12)[a]	<0.001
Any BF duration (months)	3517	-0.17 (-0.21; -0.13)[e]	<0.001	3345	-0.11 (-0.14; -0.08)[b]	<0.001

I: maternal age (years)	-	-	-	3345	-0.36 (-0.48; -0.23)[c]	<0.001
<20	659	-0.22 (-0.32; -0.11)	<0.001	629	-0.22 (-0.30; -0.15)[e]	<0.001
20-35	2493	-0.16 (-0.21; -0.11)	<0.001	2379	-0.09 (-0.13; -0.05)[e]	<0.001
>35	365	-0.12 (-0.24; -0.0003)	0.05	337	-0.02 (-0.12; 0.07)[e]	0.61
I: maternal PG-BMI (kg/m2)	-	-	-	3345	-0.37 (-0.53; -0.21)[d]	<0.001
Underweight	165	-0.10 (-0.26; 0.05)	0.18	134	-0.09 (-0.22; 0.04)[f]	0.19
Normal weight	2123	-0.15 (-0.19; -0.09)	<0.001	1492	-0.12 (-0.16; -0.08)[f]	<0.001
Overweight	836	-0.25 (-0.35; -0.15)	<0.001	801	-0.15 (-0.22; -0.08)[f]	<0.001
Obese	390	-0.14 (-0.32; 0.04)	0.14	375	0.08 (-0.06; 0.23)[f]	0.28

PPWR: Post-Partum Weight Retention; BF: Breastfeeding; kg: kilogram; β coefficient; 95% CI: 95% confidence interval; I interaction;PG-BMI pre-gestational body mass index; [a] Model 1: Adjusted for pre-gestational weight, weight retention after delivery, family income, schooling at birth, skin color, maternal age, parity, maternal smoking and alcohol consumption during the pregnancy, history of arterial hypertension, history of diabetes mellitus,PG-BMI, gestational weight gain, gestational age, maternal employment status ,birth weight, child's sex, and type of delivery. [b] Model 2 Adjusted for variables to model 1 more weight retention at 3 months after delivery; [c] Model 3 Adjusted for variables to model 2 more interaction termmaternal age *BF, [d] Model 4 Adjusted for variables to model 2 more interaction term maternal PG-BMI*BF, [e] Adjusted for variables to model 2 without maternal age, [f] Adjusted for variables to model 2 without PG-BMI.

Table 3: Association between exclusive and any breastfeeding (BF) durations and maternal postpartum weigh retention (PPWR) at 12 months after delivery. 2004 Cohort Pelotas, Brazil.

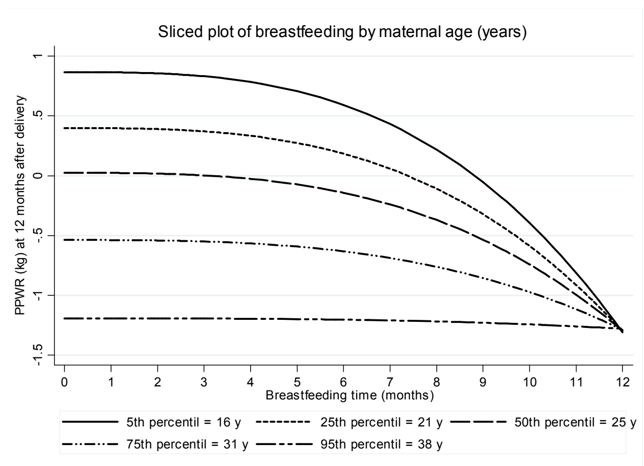

Figure 1: Adjusted linear predictor of PPWR (kg) at 12 months after delivery and any breastfeeding duration according to maternal age interaction term. 2004 Cohort, 2005-06 Follow-up (Pelotas, Southern Brazil).

Discussion

This study found two clear associations: First, EBF and any BF are inversely associated with long-term PPWR; second, mothers who give exclusive and predominant BF at 3 months after delivery present less maternal PPWR at 3 and 12 months after delivery compared with mothers who practice partial BF and weaned. Additionally, the observed interaction between maternal age and BF duration highlights the negative effect of adolescence pregnancy on long-term PPWR reduction in young mother's subgroup; and the interaction between PG-BMI and BF duration emphasizes a negative effect of higher BMI on long-term PPWR reduction decrease in obese mother´s subgroup. The energy cost of breastfeeding is generally considered to represent a substantial drain in maternal nutritional metabolism [21]. Some human observational studies suggested that BF affects insulin and glucose homeostasis and showed differences in metabolic parameters between BF and non-BF women at 3 and 6 months postpartum, independently of BMI [21]. Pregnancy and the post-partum period are a time of increased vulnerability for retention of excess body fat in women [12]. After the first month postpartum the average monthly rate of weight loss is 0.5 to 1 kg [22]. Findings of the current study highlight the importance of predominant and exclusive BF in the loss of PPWR. Studies in which postpartum weight change was estimated (rather than measured directly), found no association with BF [23,24] but studies, in which postpartum weight change was measured showed greater loss of weight in women who breastfed longer, particularly at 3 to 6 months postpartum [25-27].

Maternal age associated with PPWR was not explored widely but it is known that adolescent mothers are at higher risk for becoming overweight or obese and for PPWR [28]. Others have shown that growing-adolescent pregnant women continue to accrue fat, have larger gestational weight gains and retain more of their GWG into the early postpartum period than non-growing adolescent pregnant women [29]. The mature pregnant women who accrue maternal fat during the first and second trimesters of pregnancy mobilize it during the third. Young still-growing women do not mobilize fat reserves late in pregnancy to enhance fetal growth; instead they continue to gain fat throughout gestation, apparently reserving it for their own continued development [29]. BF duration was more effective for PPWR reduction in underweight and normal weight mothers than in those at the heaviest category of PG-BMI. This study suggested a marginally constant effect of any BF duration on PPWR in overweight mothers but not in obese women, despite the continuity of BF until 12 months postpartum. Obesity produces physiological changes in body composition, reduction in insulin sensitivity, decreased intention to BF, decreased initiation of BF, and decreased duration of BF [30]. Less

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duration of BF in overweight mothers may further amplify the risk of no recovery to their pre-pregnancy weight and increase the prevalence rate of obese mothers through excessive PPWR.

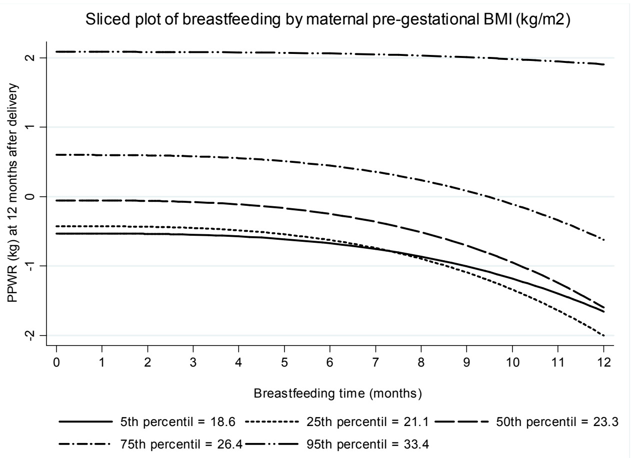

Figure 2: Adjusted linear predictor of PPWR (kg) at 12 months after delivery and any breastfeeding duration according to maternal pre-gestational body mass index interaction term.2004 Cohort, 2005-06 Follow-up (Pelotas, Southern Brazil).

The higher percentage of children followed-up at ages 3 (95.7%) and 12 months (94.3%), the nature of data collection and the population-based recruitment are the strengths of this birth cohort [13]. Most of the mothers (98%) from the Pelotas 2004 cohort attended antenatal care, most of them (72.3%) starting at the first trimester of pregnancy [31]. In this manner, only a low proportion of the mothers self-reported their weight at the beginning of pregnancy. However, one limitation in the study was the accuracy of the self-reported pre-pregnancy weight; a degree of measurement error can be expected, self-reported measures in adult weight generally is overestimated in underweight groups and underestimated in overweight and obese groups [32]. Even though, the high correlation between weight measurement and self-reported weight would allow for adequate BMI category classification [33].

Conclusion

In summary, after allowing for confounders, this study found that BF intensity at 3 months postpartum was associated with reduced long-term PPWR at the first year after delivery. Two critical mothers groups were identified: younger mothers and obese mothers at the beginning of the pregnancy. Those groups got less or no benefit from BF to the prevention of long-term high PPWR.

In setting like ours where more than one third of the women were overweight or obese at the beginning of the pregnancy and that experienced an increase in that prevalence to 45.9% at 12 months after the delivery, BF promotion may be a potential intervention aimed at preventing the accumulation of postpartum body fat. Focusing in adolescent and overweight/obese pregnant women may have far reaching impact and be critically important in reducing the excessive PPWR.

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References

1. World Health Organization. Global Strategy on Diet, Physical Activity and Health. 2013.
2. Gunderson EP, Abrams B (1999) Epidemiology of gestational weight gain and body weight changes after pregnancy. Epidemiol Rev 21: 261-275.
3. Bogaerts A, Devlieger R, Van den Bergh BR, Witters I (2014) Obesity and pregnancy, an epidemiological and intervention study from a psychosocial perspective. Facts Views Vis Obgyn 6: 81-95.
4. Nelson SM, Matthews P, Poston L (2010) Maternal metabolism and obesity: modifiable determinants of pregnancy outcome. Hum Reprod Update 16: 255-275.
5. Kulie T, Slattengren A, Redmer J, Counts H, Eglash A, et al. (2011) Obesity and women's health: an evidence-based review. J Am Board Fam Med 24: 75-85.
6. Berggren EK, Groh-Wargo S, Presley L, Hauguel-de Mouzon S, Catalano PM (2016) Maternal fat, but not lean, mass is increased among overweight/obese women with excess gestational weight gain. Am J Obstet Gynecol 214: 745.
7. Zourlas PA (1975) Response to exogenous gonadotropins in the unresponsive ovary syndrome. Int J Gynaecol Obstet 13: 23-28.
8. Mannan M, Doi SA, Mamun AA (2013) Association between weight gain during pregnancy and postpartum weight retention and obesity: a bias-adjusted meta-analysis. Nutr Rev 71: 343-352.
9. Gore SA, Brown DM, West DS (2003) The role of postpartum weight retention in obesity among women: a review of the evidence. Ann Behav Med 26: 149-159.
10. Sebire NJ, Jolly M, Harris JP, Wadsworth J, Joffe M, et al. (2001) Maternal obesity and pregnancy outcome: a study of 287,213 pregnancies in London. Int J Obes Relat Metab Disord 25: 1175-1182.
11. Li R, Ogden C, Ballew C, Gillespie C, Grummer-Strawn L (2002) Prevalence of exclusive breastfeeding among US infants: the Third National Health and Nutrition Examination Survey (Phase II, 1991-1994). Am J Public Health 92: 1107-1110.
12. Baker JL, Gamborg M, Heitmann BL, Lissner L, Sørensen TI, et al. (2008) Breastfeeding reduces postpartum weight retention. Am J Clin Nutr 88: 1543-1551.
13. Neville CE, McKinley MC, Holmes VA, Spence D, Woodside JV (2014) The relationship between breastfeeding and postpartum weight change--a systematic review and critical evaluation. Int J Obes (Lond) 38: 577-590.
14. Santos IS, Barros AJ, Matijasevich A, Domingues MR, Barros FC, et al. (2011) Cohort profile: the 2004 Pelotas (Brazil) birth cohort study. Int J Epidemiol 40: 1461-1468.
15. Thomson AM, Billewicz WZ, Hytten FE (1969) The weight of the placenta in relation to birthweight. J Obstet Gynaecol Br Commonw 76: 865-872.

16. Santos IS, Mota DM, Matijasevich A, Barros AJ, Barros FC (2009) Bed-sharing at 3 months and breast-feeding at 1 year in southern Brazil. J Pediatr 155: 505-509.
17. Martin JA, Hamilton BE, Sutton PD, Ventura SJ, Menacker F, et al. (2003) Births: final data for. National vital statistics reports: from the Centers for Disease Control and Prevention, National Center for Health Statistics, National Vital.
18. Martin JA, Hamilton BE, Sutton PD, Ventura SJ, Menacker F, et al. (2005) Births: final data for 2003. Natl Vital Stat Rep 54: 1-116.
19. Fenton TR (2003) A new growth chart for preterm babies: Babson and Benda's chart updated with recent data and a new format. BMC Pediatr 3: 13.
20. Dubowitz LM, Dubowitz V, Goldberg C (1970) Clinical assessment of gestational age in the newborn infant. J Pediatr 77: 1-10.
21. Royston P, Sauerbrei W (2008) Interactions. Multivariable Model-Building: A pragmatic approach to regression analysis based on fractional polynomials for modeling continuous variables. 151-182.
22. Butte NF, Hopkinson JM, Mehta N, Moon JK, Smith EO (1999) Adjustments in energy expenditure and substrate utilization during late pregnancy and lactation. Am J Clin Nutr 69: 299-307.
23. Smith DE, Lewis CE, Caveny JL, Perkins LL, Burke GL, et al. (1994) Longitudinal changes in adiposity associated with pregnancy. The CARDIA Study. Coronary Artery Risk Development in Young Adults Study. JAMA 271: 1747-1751.
24. Haiek LN, Kramer MS, Ciampi A, Tirado R (2001) Postpartum weight loss and infant feeding. J Am Board Fam Pract 14: 85-94.
25. Potter S, Hannum S, McFarlin B, Essex-Sorlie D, Campbell E, et al. (1991) Does infant feeding method influence maternal postpartum weight loss? J Am Diet Assoc 91: 441-446.
26. Dewey KG (2004) Impact of breastfeeding on maternal nutritional status. Adv Exp Med Biol 554: 91-100.
27. Ohlin A, Rössner S (1996) Factors related to body weight changes during and after pregnancy: the Stockholm Pregnancy and Weight Development Study. Obes Res 4: 271-276.
28. Ueno Y, Nagata S, Tsutsumi T, Hasegawa A, Yoshida F, et al. (1996) Survey of microcystins in environmental water by a highly sensitive immunoassay based on monoclonal antibody. Nat Toxins 4: 271-276.
29. Dewey KG, Heinig MJ, Nommsen LA (1993) Maternal weight-loss patterns during prolonged lactation. Am J Clin Nutr 58: 162-166.
30. Hediger ML, Scholl TO, Schall JI (1997) Implications of the Camden Study of adolescent pregnancy: interactions among maternal growth, nutritional status, and body composition. Ann N Y Acad Sci 817: 281-291.
31. Scholl TO, Hediger ML, Schall JI, Khoo CS, Fischer RL (1994) Maternal growth during pregnancy and the competition for nutrients. Am J Clin Nutr 60: 183-188.
32. Amir LH, Donath S (2007) A systematic review of maternal obesity and breastfeeding intention, initiation and duration. BMC Pregnancy Childbirth 7: 9.
33. Victora CG, Matijasevich A, Santos IS, Barros AJ, Horta BL, et al. (2008) Breastfeeding and feeding patterns in three birth cohorts in Southern Brazil: trends and differentials. Cad Saude Publica 3: 409-416.
34. Yu SM, Nagey DA (1992) Validity of self-reported pregravid weight. Ann Epidemiol 2: 715-721.
35. Holland E, Moore Simas TA, Doyle Curiale DK, Liao X, Waring ME (2013) Self-reported pre-pregnancy weight versus weight measured at first prenatal visit: effects on categorization of pre-pregnancy body mass index. Matern Child Health J 17: 1872-1878.
36. Cahall DL, Youmans GP (1975) Conditions for production, and some characteristics, of mycobacterial growth inhibitory factor produced by spleen cells from mice immunized with viable cells of the attenuated H37Ra strain of Mycobacterium tuberculosis. Infect Immun 12: 833-840.