




# The sleeper effect of perceived insufficient milk supply in US mothers

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## Abstract

**Objective:** To test whether perception of insufficient milk (PIM) supply in the breast-feeding relationship of one child predicts how long mothers breast-feed subsequent children, and whether this association differs for first-time mothers *v.* mothers with previous children.

**Design:** Secondary analysis of Infant Feeding Practices Study II (ordinary least squares regression) and Year 6 follow-up.

**Setting:** Mailed, self-report survey of US mother–infant dyads, 2005–2012.

**Participants:** Women pregnant with a singleton were recruited from a consumer opinion panel. Exclusion criteria included: mother age <18; infant born <5 lbs, born before 35 weeks or with extended NICU stay, and mother or infant diagnosed with condition that impacts feeding. A subsample with PIM data (*n* 1460) was analysed.

**Results:** We found that women who weaned because of PIM with the index child stopped breast-feeding 5.7 weeks earlier than those who weaned due to other reasons (4.9 weeks earlier for multiparas,  $P < 0.001$ ; 7.1 weeks earlier for primiparas,  $P < 0.001$ ). Using Year 6 follow-up data (*n* 350), we found subsequent child 1 weaned 9.2 weeks earlier if the mother experiences PIM as a multipara ( $P = 0.020$ ) and 10.6 weeks earlier if the mother experiences PIM as a primipara ( $P = 0.019$ ). For subsequent child 2 (*n* 78), the magnitude of association was even larger, although insignificant due to low power.

**Conclusions:** These findings indicate that PIM may carry forward in the reproductive life course, especially for first-time mothers. Perceptions of breast milk insufficiency and contributors to actual inadequate milk supply with the first child should be targeted, rather than intervening later in the reproductive life course.

**Keywords**  
Perceived insufficient milk  
Milk supply  
Breast-feeding  
Life Course Theory  
Parity  
Longitudinal

The health and economic advantages of sustained breast-feeding within low-, middle- and high-income countries are well established<sup>(1)</sup>. As such, the WHO and the American Academy of Pediatrics recommend that infants be exclusively breastfed for the first 6 months of life, followed by breast-feeding with complementary foods until at least the first or second birthday<sup>(2,3)</sup>. Yet, few US mothers meet these established benchmarks or their own goals for breast-feeding duration or exclusivity<sup>(4,5)</sup>. Perception of insufficient milk (PIM) is among the most commonly cited reason for premature weaning from breast-feeding for mothers in the USA over the first year of life. Between 43 and 55 % of women cite PIM within the top three reasons for why they weaned<sup>(6,7)</sup>. Other studies have found that in certain communities – notably among Hispanic women and women from low-income

households – PIM is even more widespread, reaching 80 % in some samples<sup>(8,9)</sup>. First-time mothers appear to be at heightened risk for both PIM and early breast-feeding cessation<sup>(10,11)</sup>.

The prevalence of true physiological insufficiency of milk supply, either as a result of hormonal or genetic predisposition, or the result of mismanagement of early breast-feeding, remains unclear<sup>(12)</sup>. However, the consensus of the field remains that many more women *perceive* inadequacy than actually have an inadequacy stemming from physiological issues. Anthropologists hypothesise that this discrepancy is in large part due to inaccurate information about how often an exclusively breastfed infant should nurse, and the culturally laden definition of what makes a ‘good baby’<sup>(13)</sup>. Qualitative research has also indicated that

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women may misinterpret normal diurnal fluctuations in milk volume and physiological adaptations in infant breast-feeding patterns and breast fullness over time as ominous indications of insufficient milk supply<sup>(14)</sup>.

PIM is associated with other negative outcomes as well, beyond the early termination of breast-feeding. Women with PIM are more likely to be anxious, and they tend to feel less efficacious about their general parenting abilities<sup>(15,16)</sup>. Evidence also suggests that PIM might be associated with breast-feeding decisions with subsequent children. A common reason for the early termination of breast-feeding for mothers who have had other children is previous 'trouble' with breast-feeding<sup>(10,17)</sup>. The experience of breast-feeding, including how long the relationship lasts, how favourably women feel about it and whether they intend to breast-feed again is highly context dependent. We contend, as have others, that part of that context is a mother's previous experiences with breast-feeding<sup>(18)</sup>. This 'carrying forward' is known as a *sleepers effect* or lagged effect<sup>(19)</sup>. Studying sleeper effects is a relatively common way to study other life course developmental phenomena. The question of whether there is a sleeper effect of PIM has not been adequately studied in the literature; generally, each breast-feeding relationship is considered in isolation<sup>(20)</sup>. However, by studying breast-feeding as a developmental phenomenon, situated in the maternal life course, we may better understand how mothers decide to feed their infants over time<sup>(21)</sup>. As recent theory work has described, situating breast-feeding decision-making in the maternal life course has many benefits, including the discovery of underexamined, and thus underutilised, levers of breast-feeding promotion and support<sup>(21)</sup>. Examining breast-feeding behaviours and decisions across the reproductive life course – over time and over the births of multiple children – is one way to extend our knowledge that is in line with a life course approach.

Emerging research on the plasticity of the maternal brain also suggests that the transition to parenthood is a time in which environments and experiences may be especially powerful determinants of later parenting behaviours. Studies have shown profound functional and structural changes taking place in the brains of pregnant and lactating women that are associated with sensitivity and responsiveness to infant cues<sup>(22)</sup>. Furthermore, animal models have demonstrated that these neurological changes differ by parity, with primiparous mothers (i.e., first-time mothers) and multiparous mothers (i.e., not first-time mothers) showing differing patterns of change over time<sup>(23)</sup>. It is therefore plausible that PIM may differentially impact the subsequent breast-feeding experiences of first-time *v.* experienced mothers. The current study thus seeks to address two research questions:

1. Does the PIM production in the breast-feeding relationship of one child predict how long a mother breast-feeds subsequent children?

2. Is the strength or direction of this association different for primiparas compared with multiparas?

## Methods

The current study is a secondary analysis of the Infant Feeding Practices Study II (IFPS-II), conducted by the Center for Disease Control and Prevention in collaboration with the US Food and Drug Administration (FDA) and the National Institutes of Health (NIH) from 2005 to 2007, and its 6-year follow-up conducted in 2012<sup>(24,25)</sup>. Participants were recruited through a 500 000-person national consumer opinion panel in the USA. Year 1 data were collected via the following: a mailed survey in the third trimester (Prenatal wave); a phone call around the time of birth during which participants were screened for ongoing eligibility (Neonatal wave) and additional surveys mailed approximately monthly until the 12th month postpartum (Month 2 through Month 12). Basic demographic information was also collected from the initial consumer opinion panel (Demographics wave). Year 1 surveys focused on infant feeding topics and maternal dietary patterns. Participants were also instructed to complete a separate section (Module B) on the wave at which they reported completely weaning from breast-feeding; this module focused on reasons for weaning and post-weaning perceptions of the newly concluded breast-feeding relationship.

The same participants were contacted again by mail for the Year 6 follow-up survey, which consisted of a single survey instrument. The Year 6 survey focused on child and maternal health and diet, as well as continued child-bearing and infant feeding for subsequent children born to that mother. Compared with Year 1, Year 6 survey had a response rate of about 50%<sup>(25)</sup>.

## Participants

A total of ~4900 participants were initially sampled from the national consumer opinion panel. Participants were considered eligible if they were at least 18 years old and pregnant at the time of the survey. Exclusion criteria included: infant born prior to 35-weeks' gestation; infant born with a medical condition that would impact feeding; twin or higher-order multiple birth; infant weighed less than 5 lbs at birth or infant stayed in the intensive care unit for more than 3 d postpartum<sup>(24)</sup>. In sum, 3033 participants completed the Demographic, Prenatal and Neonatal survey waves during Year 1, with 1460 of those participants having completed Module B (i.e., 1460 participants have PIM data). The Year 6 follow-up has a total sample size of 1542 mothers, 708 of whom had at least one subsequent child. Module B data referencing the Year 1 index child were available for 350 of those 708 participants.

Table 1 shows the demographic characteristics of the IFPS-II subsample used in each of the analyses described

**Table 1** Maternal demographics and reasons for weaning for those who completed Module B post-weaning\*

	Full sample (n 1460, %)	Subsample	
		Subsequent child 1 (n 350, %)	Subsequent child 2 (n 78, %)
<b>Education</b>			
HS diploma or less	20.1	17.0	15.8
Some college	40.7	34.9	39.5
College graduate	39.3	48.1	44.7
<b>Race/ethnicity</b>			
Black/African American	4.4	2.9	1.3
Hispanic/Latina	7.1	4.9	7.7
White	80.9	86.3	88.5
Asian/Pacific Islander	2.5	2.9	0.0
<b>Age (years)</b>			
<25	24.3	21.4	21.8
25–30	40.1	26.3	17.9
>31	35.5	52.3	60.3
<b>Parity</b>			
Primipara	33.7	48.5	38.7
Multipara	66.3	51.5	61.3
<b>Marital status</b>			
Married	78.3	83.9	85.3
Unmarried	21.8	16.1	14.7
<b>Postnatal WIC enrollment</b>			
Enrolled	39.9	30.0	34.6
Not enrolled	60.1	70.0	65.4
<b>Reasons for weaning†</b>			
Perceived insufficient milk (PIM)	66.6	65.7	64.1
Baby not satisfied	49.9	44.8	49.4
Low weight gain	15.6	14.7	15.6
Trouble getting milk to flow	22.6	25.1	28.6
Didn't have enough milk	46.5	46.8	39.0
Doctor said low weight gain	12.4	11.6	9.1
Pain or discomfort	35.1	32.0	30.8
Other reasons	18.8	22.0	28.2

HS, high school or high school equivalence; WIC, Special Supplemental Nutrition Program for Women, Infants and Children.

\*Demographic data were collected during Year 1 survey.

†Mothers may have selected more than one reason for weaning.

below. Although the IFPS-II is a national sample of mothers, it is not nationally representative. Compared with the USA as a whole, the IFPS-II sample has higher average education and income; the sample is also significantly more likely to be white and to be breast-feeding their infant<sup>(24)</sup>.

## Measures

### Outcome: breast-feeding duration

The outcomes of interest for this study are the durations for each of a mother's breast-feeding relationships during the study period: with the index child and the next two children born to that mother (if applicable). Breast-feeding duration (in weeks) for the index child was a variable created by the Center for Disease Control and Prevention using all waves of Year 1 data<sup>(24)</sup>. During the Year 6 follow-up survey,

mothers were asked to indicate if they had given birth to subsequent children since the original study. For each subsequent birth, mothers were asked if they breastfed that child, and if so, for how many weeks.

### Predictor: perception of insufficient milk

As originally defined by Hill & Humenick<sup>(26)</sup>, PIM (also called perceived insufficient milk supply) is 'based on a perception of too little breast milk being produced for appropriate infant weight gain and infant satisfaction' (page 145). However, there are many ways to operationalise this perception; definition and measurement of PIM remains an important question. Mothers may have PIM in a transitory or mild manifestation, or PIM may be intense and persistent. In the current study, we operationalise PIM to be the PIM supply to such an extent that it is reported as an important reason for weaning from breast-feeding.

At the time of weaning (Module B), mothers were asked to respond to a list of thirty-two statements, rating how important each was in the decision to wean the child on a Likert scale from 1 – 'Not at all important' to 4 – 'Very Important'. Five statements were most closely conceptually related to PIM: 'Breast milk alone did not satisfy baby'; 'Baby was not gaining enough weight'; 'A health professional said baby was not gaining enough weight'; 'Mom had trouble getting the milk flow to start' and 'Mom did not have enough milk'. A mother was classified as having weaned due to PIM if she indicated 3 – 'Somewhat Important' or 4 – 'Very Important' for any of those five statements. Of the 1460 mothers who completed Module B, 972 (66.6%) were classified as having weaned at least in part due to PIM (see Table 1). Individual items in this composite measure were correlated between  $r=0.2$  and  $r=0.7$ , indicating significant conceptual overlap between the items.

Operationalising PIM in this way precludes transient or potentially inconsequential perceptions of insufficiency. It also limits our sample to those mothers who have weaned before the end of Year 1 data collection; therefore, we are comparing mothers who have weaned by their child's first birthday for reasons having to do with PIM to mothers who have weaned due to other reasons, such as pain or inconvenience. Mothers who did not wean by this time are not included in these analyses, because they did not complete Module B.

### Predictor: parity

Parity during the index pregnancy was measured during the Prenatal wave. Mothers were asked how many previous children they had given birth to; mothers who responded that they had zero previous children were coded as primipara, and mothers with at least one other child were coded as multipara; 479 out of 1460 mothers in the study sample (33.7%) were first-time mothers.

### Covariates

In each model, we controlled for a number of confounding covariates that might alternatively explain the relationships

**Table 2** Results of regressing breast-feeding duration on the perception of insufficient milk production during index child infancy\*

	Coefficient	SE	P-value	95 % CI	
Index child ( <i>n</i> 1460)					
Multipara	-4.87	1.16	<0.001	-7.15	-2.60
Primipara	-7.08	1.56	<0.001	-10.14	-4.02
Subsequent child 1 ( <i>n</i> 350)					
Multipara	-9.21	3.88	0.019	-16.88	-1.55
Primipara	-10.59	4.49	0.020	-19.46	-1.72
Subsequent child 2 ( <i>n</i> 78)					
Multipara	-9.56	8.90	0.290	-27.59	8.47
Primipara	-23.41	8.57	0.013	-41.23	-5.59

\*All analyses control for gestational age, WIC enrollment, race/ethnicity indicators, southern residence, c-section birth and birth attendant occupation.

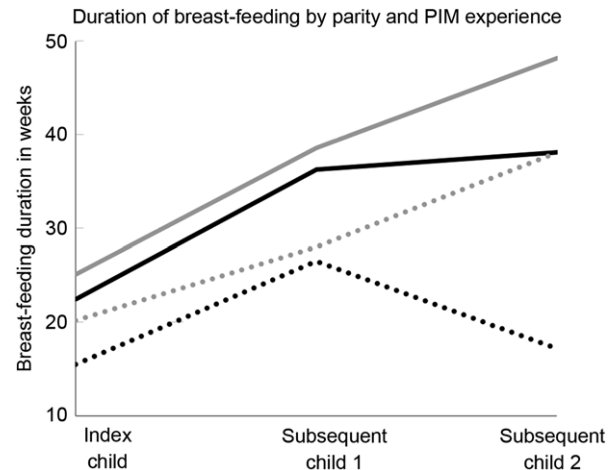
between parity, PIM and/or breast-feeding duration. These included demographic characteristics found to be associated with both breast-feeding rates and access to evidence-based breast-feeding support: maternal race/ethnicity (indicators for Black/African American race or Hispanic/Latina ethnicity; white as the reference category), postnatal Special Supplemental Nutrition Program for Women, Infants and Children enrollment (dichotomous) and giving birth in the Southern US (dichotomous). We also controlled for near-birth factors that might disrupt lactogenesis or early breast-feeding management outside of the effects of PIM, including: caesarean section birth (dichotomous), gestational age (continuous, in weeks) and whether the mother had midwifery care for the birth or for prenatal care (dichotomous). Sporadic missing data were under 5% for each covariate and were resolved using case-wise deletion.

### Statistical analysis

Our sample was split into two groups for all analyses: those who were primiparous during the original Year 1 study, and those who were multiparous. We first conducted ordinary least squares regression for each parity group to determine if weaning *the index child due to PIM* predicted breast-feeding duration for that index child (*n* 1460). We then conducted ordinary least squares regressions for each parity group to determine if weaning *the index child due to PIM* predicted breast-feeding duration for subsequent child 1 (*n* 350) and subsequent child 2 (*n* 78).

### Results

For the 1460 mothers completing Module B (assessment of breast-feeding experience for the index child), 100% of mothers initiated breast-feeding and breast-feeding duration for the index child averaged 20.2 weeks (*SD* = 17.1). For subsequent child 1 (*n* 350), 90.1% of mothers initiated breast-feeding and breast-feeding duration averaged 31.0 weeks (*SD* = 25.6). For subsequent child 2 (*n* 78), 89.7% initiated breast-feeding, with an average breast-feeding duration of 35.0 weeks (*SD* = 28.0).



**Fig. 1** Breast-feeding duration, in weeks, over 6 years by parity during index year and perception of insufficient milk (PIM) experience during index year. •••, PIM, primipara; —, no PIM, primipara; •••, PIM, multipara; —, no PIM, multipara

PIM predicted shorter durations of breast-feeding for the index child during study Year 1, compared with mothers who weaned because of other reasons. Controlling for covariates, the difference in duration is about 7 weeks ( $P < 0.001$ ) for primiparas and about 5 weeks ( $P < 0.001$ ) for multiparas (Table 2).

We found that mothers who weaned the index child due to PIM also breastfed their next child (subsequent child 1) for shorter durations on average compared with mothers who weaned for other reasons. The differences in duration between mothers with and without experiences of PIM also grew larger over time (Fig. 1). For primiparas, the experience of PIM compared with other reasons for weaning was associated with about 11 fewer weeks of breast-feeding for subsequent child 1 ( $P = 0.020$ ) and about 23 fewer weeks of breast-feeding for subsequent child 2 ( $P = 0.013$ ). For multiparas, PIM-related weaning *v.* other reasons for weaning was associated with about 9 fewer weeks of breast-feeding for subsequent child 1 ( $P = 0.019$ ), and although the association between PIM and breast-feeding duration for subsequent child 2 was similar in magnitude (~10 fewer weeks), it did not reach statistical significance ( $P = 0.29$ ).



## Discussion

In this analysis, we found that women who stopped breast-feeding due to PIM did so significantly earlier compared with women who weaned for other reasons. We also found evidence of a 'sleeper effect' for PIM-associated weaning, in that its negative association with breast-feeding duration seemed to amplify with each successive child relative to other reasons for breast-feeding cessation (even though overall breast-feeding duration was longer with increasing parity). The sleeper effect was especially pronounced when PIM was experienced as a primipara, suggesting that first-time motherhood is a potentially sensitive period in determining the trajectory of the initial and all future breast-feeding experiences.

A potential explanation for this 'sleeper effect' is provided by a recent qualitative study involving prospective interviews with twenty ethnically diverse, low-income mothers. This study reported a relationship between PIM and early postpartum maternal distress related to the inability to control infant behaviour (i.e., crying) through breast-feeding<sup>(27)</sup>. Over a period of months, however, mothers became more ambivalent towards PIM and accepted formula supplementation and weaning as a matter of course. This suggests that mothers who have previously endured emotional distress related to PIM and its sequelae may become desensitised to these experiences over time and more readily choose to forgo breast-feeding if difficulties resurface with the next child. Another explanation is that guilt, stigma and self-doubt related to the perceived inability to produce a full milk supply and the decision to use formula may be so intense for some mothers so as to develop a type of avoidance reaction, that is, the decision to stop breast-feeding is made more quickly and decisively with subsequent children to circumvent the emotional toll of indecision<sup>(18,28)</sup>. This would suggest that weaning because of PIM may be a uniquely difficult emotional event for mothers in ways that weaning for other reasons (pain or return to employment, for example) is not, thus producing a lagged effect in which the gap between breast-feeding durations for mother with PIM and those without widen over time.

Previous research has shown that primiparous mothers may be at higher risk for PIM and truncated exclusive breast-feeding than their multiparous counterparts<sup>(20,29)</sup>. This may be due to first-time mothers' tendency to have delayed lactogenesis (i.e., delayed start of 'mature' milk production) compared with mothers who have given birth before and/or first-time mothers' increased likelihood of experiencing mismanagement of early feeding<sup>(11)</sup>. In addition to this increased risk, we found that primiparous mothers are also at higher risk of truncated future breast-feeding as a result of PIM. This provides further evidence that first-time motherhood is a particularly sensitive period of time during which environmental and experiential inputs can have an outsized impact on later health and well-being.

Regardless of the aetiology of an observed PIM sleeper effect, our results do emphasise the importance of correcting inaccurate perceptions of insufficient milk volume and contributors to actual inadequate supply with the index child and with primiparas specifically, rather than intervening later in the reproductive life course. Several recent studies have aimed to prevent PIM (including those focusing on first-time mothers only) through interventions designed to increase breast-feeding self-efficacy and address misperceptions related to milk supply and infant breast-feeding behaviour<sup>(30,31)</sup>. Interventions focused on increasing breast-feeding self-efficacy may be especially effective, as illustrated in a recent study of first-time breast-feeding mothers, which found that PIM was associated with breast-feeding self-efficacy at 2 weeks postpartum, but not actual physiological insufficiency<sup>(12)</sup>. Research and practice may also benefit from more focus on the social and contextual factors that may contribute to perceptions of insufficiency. Previous research has shown that larger cultural narratives around what makes a 'good baby' and what makes a 'good mother' may be particularly damaging to one's self-perception as sufficient<sup>(32)</sup>, even if those attitudes are not personally endorsed<sup>(13,33)</sup>. Given the importance of breast-feeding support and promotion as a public health target<sup>(1,34)</sup>, continued advancements in intervention development at the intrapersonal, social and societal levels of the maternal ecology are crucial.

Across tested models, various control covariates were shown to be significantly related to breast-feeding duration, over and above the influence of parity and PIM. In predicting index child duration, younger gestational age, Special Supplemental Nutrition Program for Women, Infants and Children enrollment, and being a resident of a southern state were predictive of shorter durations; in predicting subsequent child durations, these covariates were also significantly predictive, as was identifying as Black or African American. These findings could help define a priority population for future research and action. Specifically, they suggest that interventions and policy priorities should centre the needs of mothers who are impacted by racism and white supremacy, mothers with late-preterm or early-term infants, families in the South and mothers enrolled in Special Supplemental Nutrition Program for Women, Infants and Children.

### **Limitations and future directions**

This study has several limitations. One limitation is that our measurement of the PIM production does not take into account women who do or do not have a verifiable, physiological insufficiency of breast milk. It is likely that a proportion of the sample that reported weaning due to the perception of insufficiency do in fact have a true insufficiency. We are unable to estimate what proportion that may be, however, with the data available.

Perceptions and reality are overlapping in this regard; different, but not entirely separate. Future research may wish to combine the types of survey measures used in this study with measures of actual insufficiency as measured by a physician in order to tease apart the relative contributions of each to future breast-feeding decision-making.

Additionally, while the IFPS-II is among the most comprehensive national data sets addressing maternal breast-feeding behaviour, the Year 1 data are now 12 years old and the Year 6 follow-up is over 6 years old. Given recent progress in breast-feeding support practices and initiatives (e.g., Baby-Friendly Hospital Initiative<sup>(35)</sup>), as well as current trends in breast-feeding practices (e.g., increases in women exclusively pumping/expressing milk rather than feeding at breast<sup>(36)</sup>), it is unclear whether this data set reflects current PIM prevalence and patterns. Another limitation is that we were unable to ascertain reason(s) for weaning subsequent children in the analysis. Therefore, whether the observed PIM 'sleeper effect' pertains mainly to women weaning subsequent children due to PIM recurrence or due to other breast-feeding concerns is unknown. Similarly, we are unable to discern whether multiparas experiencing PIM with their index pregnancy also experienced PIM as primiparas before the IFPS-II study began. If this were the case for large numbers of multiparas, it is possible that the observed parity differences in PIM-associated weaning are biased upward.

Finally, the data collection for the IFPS-II was time censored at 12 months for the Year 1 sample and at 6 years for the follow-up sample. This means that many mothers who did not wean by the end of Year 1 did not complete Module B, thus are not included in our analytic sample. Similarly, we are only able to determine breast-feeding durations for subsequent children if mothers gave birth, began breast-feeding and weaned those children by the time they completed the Year 6 survey. This greatly reduced our sample size, limiting power to detect what might be meaningful breast-feeding differences between groups, especially with regard to the second subsequent child born after the index child. More generally, the structure of the data limits the ability to examine all breast-feeding relationships for a given mother. Thus, even though we approach the examination of PIM from a life course perspective<sup>(21)</sup>, we are unable to speak to the *whole* of the reproductive life course – merely a 6-year portion of it for each mother. Future studies, perhaps with follow-up spanning the entire reproductive life course, are needed to corroborate, clarify and extend these findings.

### Conclusion

Using a national longitudinal sample of US mothers and their infants, this study found that the PIM predicted shorter breast-feeding durations for the child with whom that concern was reported, as well as for the next two

subsequent children born to that mother. The negative association between PIM and ongoing breast-feeding behaviours also appears to be stronger for primiparas than it is for multiparas. These findings provide evidence that PIM may influence breast-feeding behaviours later in the reproductive life course of American mothers, which suggests both a 'sleeper effect' of PIM and a sensitive period during which PIM may be especially harmful (e.g., the first breast-feeding experience). Future research is needed to probe these findings further. Efforts to prevent unnecessarily truncated breast-feeding should address the perception – or reality – of insufficient breast milk production as early as possible during the transition to motherhood.

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