



# Low milk supply and the pediatrician

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## Purpose of review

Human milk is the optimal food for human infants, and provides many diverse and well described benefits for both mother and infant. Low milk supply, whether perceived or actual, is one of the most common reasons why mothers stop breastfeeding. Breastfeeding mothers often seek out the guidance and support of their pediatrician in evaluating and resolving milk production concerns.

## Recent findings

Recent evidence supports the importance of breastfeeding for maternal and child health in both developing and developed countries. Lack of knowledge regarding optimal breastfeeding management accounts for the large majority of low milk supply concerns, but there is emerging evidence that impaired glucose tolerance may contribute to intrinsic low milk supply.

## Summary

Breastfeeding mother–infant dyads should be followed closely until lactation is well established and the infant is gaining well. Further research is needed to understand the physiologic contributors to low milk supply and to guide evidence-based interventions to optimize maternal success in reaching breastfeeding goals, particularly for women of poorer metabolic health.

## Keywords

breast milk, breastfeeding, breastfeeding management, low milk production, low milk supply

## INTRODUCTION

Human milk is the optimal food for human infants, and provides many diverse and well described benefits for both mother and infant. National organizations, including the American Academy of Pediatrics (AAP) and the American College of Obstetrics and Gynecology recommend exclusive breastfeeding for 6 months followed by the introduction of complementary foods in combination with breastfeeding for at least 1 year [1,2<sup>¶</sup>]. For the infant, formula feeding increases the risk of infectious respiratory and gastrointestinal diseases, diabetes, obesity, leukemia, and sudden infant death syndrome [3]. In mothers, early weaning or never breastfeeding is associated with increased risk of breast and ovarian cancer and increased risk of diabetes and hypertension [4]. Recent analyses suggest that these risks apply to women and infants in low, medium, and high-income countries and that if breastfeeding rates were significantly scaled-up worldwide over 800 000 child deaths and 20 000 cases of breast cancer could be prevented per year [5<sup>¶¶</sup>].

Increasing awareness of the public health importance of breastfeeding has led to multiple initiatives to improve exclusive breastfeeding duration in the United States. Among these initiatives are the Surgeon General's Call to Action on Breastfeeding

[6], protection of the mothers' right to express milk during the workday under the Patient Protection and Affordable Care Act [7], and the Joint Commission's requirement that maternity hospitals track their exclusive breastfeeding rates as part of the perinatal care core measure set [8]. Concurrent with these initiatives was an upward trend in breastfeeding initiation rates in the United States. Based on the most recent data available from the Centers for Disease Control Breastfeeding Report Card, 81% of new mothers in the United States initiate breastfeeding [9]. With more mothers than ever before initiating breastfeeding, it is becoming more common for the pediatrician to be called upon to address mothers' breastfeeding problems and concerns. The AAP highlights the role of the pediatrician as the central supporter of breastfeeding

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## KEY POINTS

- The American Academy of Pediatrics recommends that the pediatrician play a leadership role in supporting mothers to meet their breastfeeding goals.
- In the mother with low milk supply, careful management is necessary to ensure good infant growth and to build mother's milk supply. Referral to a provider with expertise in the management of breastfeeding should be considered when typical interventions are not successful.
- There is evidence that abnormalities in glucose metabolism may play a role in low milk supply for some women.

beginning in the hospital or at the newborn visit at 3–5 days of life. This support includes practices that avoid non medically indicated formula supplementation. With the frequency of visits for the newborn in the first few months of life, the pediatrician is uniquely positioned to oversee and coordinate breastfeeding care during a time when many mothers and infants can fall through the cracks [10<sup>¶</sup>]. The most common breastfeeding concern of new mothers is insufficient milk production [11]. In one prospective cohort study of first-time mothers who initiated breastfeeding, 40% voiced concerns about their milk supply in the first 72 h postpartum alone, and 22% of those who still had milk supply concerns at day 14 postpartum stopped breastfeeding within the first 2 months [11]. Retrospectively, the Infant Feeding Practices Survey (II) revealed that one of the top reasons mothers gave for stopping breastfeeding before 2 months postpartum was the concern that, 'breast milk alone was not enough to satisfy my infant' [12].

The physiologic norm is that infants are exclusively breastfed from birth without the need for formula supplementation. In modern life, many factors can interfere with this process and concern about milk supply can develop. In this review, we will address the evaluation and management of inadequate milk production in the pediatric office. Our overview begins with the most common presentations, which center on maternal misunderstanding of normal lactation leading to perceived or real inadequacy of infant breast milk intake. We then devote the remainder of our review to summarizing what is currently known about maternal physiologic contributors to insufficient milk production.

## OVERVIEW OF THE MOST COMMON PRESENTATIONS OF LOW MILK SUPPLY

The most common milk supply concerns include: delay of lactogenesis with or without excess

newborn weight loss, maternal concern about milk supply in the context of a normally gaining infant, milk supply concern in the context of overly restrictive breastfeeding patterns, or suboptimal infant breastfeeding behavior. No matter the source of mother's milk supply concern, prompt evaluation is key to successful resolution because the mammary gland is more responsive to interventions to increase milk production the earlier they are initiated (Table 2).

## Delayed lactogenesis and excess newborn weight loss

The AAP recommends that breastfed newborns be evaluated by their pediatrician at 3–5 days of age, which is typically 24–72 h after discharge from the maternity hospital [1]. At this age, it is likely that the pediatrician will see the infant at the nadir of newborn weight loss, or at the beginning of weight

**Table 1.** Adaptation of WHO weight velocity (g/day) standards for rate of weight gain over the first 60 days of life, based on empirical centiles for exclusively breastfed infants born at 37 weeks gestation or later who were enrolled in the WHO Growth Reference Study, all birth weights combined [32]

Age (n)	Centile	Girls (g/day)	Boys (g/day)
0–7 days	Median	14	21
	25th	0	0
	10th	–14	–21
	5th	–29	–36
	(n)	(384)	(383)
7–14 days	Median	29	36
	25th	14	19
	10th	0	0
	5th	–7	–7
	(n)	(382)	(381)
14–28 days	Median	39	47
	25th	32	38
	10th	25	32
	5th	21	25
	(n)	(441)	(417)
28–42 days	Median	35	40
	25th	27	32
	10th	21	25
	5th	18	21
	(n)	(441)	(417)
42–60 days	Median	29	34
	25th	22	28
	10th	18	22
	5th	15	18
	(n)	(440)	(416)

**Table 2.** Strategies for increasing milk supply**Strategies for applying the 'supply and demand' principle of milk production**

The rate of breast milk production is based on the 'supply and demand' principle: the more milk that the infant 'demands' through more frequent and thorough breastfeeding, the stronger the signal to the mammary gland to increase the 'supply' of breast milk.

The primary method for stimulating an increase in milk production is to increase the frequency and thoroughness of breast emptying. Just a few days of intensive focus on this principal often results in a noticeable increase in milk supply for most mothers.

Strategies for frequent and thorough breast emptying include:

Offer the breast anytime the infant displays an early sign of interest in breastfeeding, such as lip smacking, sucking on hands or fist, searching, rooting, and so on. Carrying the baby in a sling or front pack will facilitate awareness of early feeding cues.

Wake the infant who falls asleep before thoroughly breastfeeding on both sides. Use hand expression to stimulate milk flow as a strategy for arousing the infant to reinitiate suckling and ensuring thorough breast drainage.

Set an alarm to ensure that the infant breastfeeds at least every 3–4 h at night and every 2–3 h during the day (at least 8–12 times in 24 h).

If the infant leaves milk behind at a feeding or does not feed well at the breast, follow the breastfeeding with breast expression, preferably using 'hands on pumping' to ensure thorough breast drainage after every feeding.

regain. Breastfeeding newborns should be closely monitored until the infant has surpassed birth weight and is gaining 'a minimum' of 20 g/day (Table 1).

A major contributor to excess newborn weight loss is delayed lactogenesis [13], which is a delay of the onset of copious milk production of greater than 72 h from the time of birth [14]. Delayed lactogenesis is highly prevalent among women in the United States [14–17], possibly attributable to high rates of maternal obesity [14,15,17–22], and cesarean delivery [15,19,20,23–25]. Although 'delayed' lactogenesis is common in many US settings, mothers can be assured that 'failed' lactogenesis (i.e., never experiencing onset of copious milk production) appears to be far less common, with one cohort study citing less than 3% prevalence of no lactogenesis symptoms by the first week postpartum [17].

In the situation of the infant with excess weight loss because of delayed lactogenesis that has now resolved (i.e., lactogenesis was delayed but there is now evidence of copious milk production) all that may be needed is confirmation that adequate milk transfer is now occurring during breastfeeding. Once this has been confirmed, review strategies to ensure frequent and thorough breastfeeding and recheck infant weight the following day to confirm that the infant is now gaining weight. These are the mother–infant dyads for whom the 'runway' was just a little longer than optimal before 'taking off' with breastfeeding.

If the pediatrician is seeing the dyad within the first 3–4 days postpartum and there are not yet signs of lactogenesis but the infant is feeding well at the breast and weight loss is within normal limits [26"], encouragement to continue frequent breastfeeding with daily follow-up with weight checks until lactogenesis occurs is appropriate. These visits can occur

with any appropriate health care provider (e.g., registered nurse, lactation consultant) unless the pediatrician's expertise is deemed essential. However, if lactogenesis signs are not apparent and the infant is exhibiting excessive weight loss, short-term supplementation is necessary to ensure sufficient infant nutrition until milk supply is fully established and infant weight gain is within normal limits. It is important to encourage continued frequent and thorough breast emptying, ideally with infant feeding well at the breast, but this could also be augmented with pumping. Close follow-up should be provided so that the mother is supported in transitioning back to exclusive feeding at the breast once lactogenesis occurs.

In mothers with risk factors for delayed lactogenesis, 'prophylactic' pumping is sometimes recommended. However, this practice should be discouraged because results from two randomized controlled trials did not find any advantage (and possible harm) of routine breast pumping in the first 24–48 h to prevent delayed lactogenesis in women who are obese [27] or who had a cesarean delivery [28], without any individuation based on how well the infant is feeding at the breast. The study results suggest that routine breast pumping may reduce the frequency of feeding. Evidence does support the importance of liberally offering the breast starting within the first hour of childbirth to hasten lactogenesis and build milk supply [29]. Thus, breast pumping is warranted in the early postpartum only if the infant is feeding poorly.

### Maternal concern within the context of normal infant weight gain

Concern about adequacy of milk supply is common and a reason for early weaning [11,12]. In many

cases, mothers can be reassured that their milk supply is sufficient by confirming that the infant is feeding well at the breast and gaining weight at a normal velocity. Growth velocity can be evaluated using the WHO growth velocity tables. In contrast to the WHO growth charts used in standard clinical practice to evaluate attained growth [30], the WHO growth velocity tables provide reference values for 'rate' of weight gain, in grams per day (g/day), over specific newborn time intervals (Table 1) [31,32]. Unlike attained growth, growth 'velocity' does not 'track' at a certain percentile. Most healthy infants are expected to gain at the median rate during most intervals. Based on the WHO growth velocity tables, 75% of exclusively breastfed newborns are back at birth weight by day 7. By 2 weeks of age, girls are gaining about 1 ounce per day and boys a little more than about 1 ounce per day.

Once an infant 'settles in' to their growth trajectory, attained growth should be assessed according to the WHO growth standards that were released in 2006 [33], as recommended by the American Academy of Pediatrics [1]. These charts represent standards for normal growth of children from birth to 2 years of age and are based on breastfed infants. Once established, the infant's attained growth should track along the same curve.

Even if the exclusively breastfed infant is breastfeeding well and gaining appropriately, it is nonetheless prudent to be empathetic to mother's milk supply concerns. One study noted that even among mothers exclusively breastfeeding at day 7 with infants gaining appropriately, those who reported milk supply concerns were more likely to exhibit biochemical evidence of less progress toward mature milk production [34], suggesting that the mother is sensing a subclinical symptom in her milk production. In the same cohort, mothers who exhibited a pattern of high breastfeeding frequency as a result of uninterrupted cue-based feeding showed significantly more biochemical progress toward mature milk production at day 7 postpartum [35]. In this situation, parents can be reassured that their infant's growth is within normal limits but should be encouraged to continue to exclusively breastfeed on demand according to early feeding cues to build and sustain abundant milk production (Table 2).

### Restricted feedings

If the exclusively breastfed infant is not gaining appropriately, a detailed feeding history should be obtained. In many cases, artificial restrictions on feeding can be identified. Lack of awareness regarding early feeding cues, expecting the infant to sleep through the night too soon, placing infant on a

structured feeding schedule, or inappropriately restricting feedings to only one breast per feeding because of concern for 'foremilk/hindmilk imbalance,' can all impact infant milk intake and ultimately maternal milk supply through infrequent breast drainage. Once these patterns are identified, the mother can be counseled on the early signs of infant hunger (early feeding cues) and provided with strategies for increasing milk production (Table 2) [36]. A follow-up weight check should be completed within a few days or a few weeks, depending upon the severity of the weight gain deficit.

### Suboptimal infant breastfeeding behavior/latch problems

If an infant is feeding frequently on demand but still has poor weight gain, poor transfer may be the cause. This is typically evidenced by difficulty with latch and maternal pain, but may also present as weak, shallow, and/or sleepy breastfeeding behavior. The mother may still feel breast fullness after feedings. Infant should be assessed for abnormalities in oral anatomy such as ankyloglossia [37] or disorganized suck, and the latch should be observed. Mothers should also be asked whether they are using a nipple shield with feedings as this may be an indication of difficulty with latch. Evaluation by an International Board Certified Lactation Consultant (IBCLC) is often helpful, and should include assessment of pre and postfeeding weight. The mother will need to use a hospital-grade breast pump to express her milk after each breastfeeding to improve her milk supply while the dyad is undergoing assessment and working on improving milk transfer. Supplementation is sometimes needed if mother's supply has drifted down because of poor breast drainage; however, mother's own pumped milk is preferred and should be used first to supplement the infant after each breastfeeding. In this situation, 'nutritive' vs. 'nonnutritive' feeding patterns may need to be reviewed with mother, and she should be encouraged to keep infant at breast only while actively feeding.

The technique used during pumping can also make a difference. 'Hands on pumping' which integrates hand expression with electric pumping, has been shown to increase pumped volumes significantly in mothers pumping for preterm infants, and can be taught to any mother who is pumping to increase her milk supply [38].

### Maternal milk quality

A relatively common response from care providers when the exclusively breastfed infant is having



trouble with growth is to wonder if it is because mother's milk is lacking in calories or fat. In the absence of severe maternal malnutrition or restriction of diet, there is no evidence that caloric deficiency of mother's milk is a cause for poor growth in the otherwise healthy full-term infant [39]. In practice, insufficient growth is typically because of inadequate volume of breast milk intake, either because of restriction in access to the breast, mechanical problems with milk transfer, or because of intrinsic low milk supply in the mother.

## **MATERNAL PHYSIOLOGIC IMPEDIMENTS TO SUFFICIENT MILK PRODUCTION**

When the above measures to increase milk supply are initiated but result in limited improvement in milk output, intrinsic problems with milk production should be considered. Historically, the prevailing thought was that it was very unusual for a mother to be physiologically unable to produce enough milk for her infant [40]. Because of this long-held belief, mothers who struggle with milk supply often feel that they are not doing something right, and that it must somehow be their fault. Our clinical experience suggests that difficulties with milk supply because of an underlying maternal health condition may be increasingly common in many US settings, possibly because of increasing prevalence of maternal obesity [41] and worsening metabolic health [42<sup>¶</sup>].

### **Evaluation of maternal health history, medication, and prior surgery**

A thorough assessment of maternal health history and medication use is important to uncover any impact these may have on mother's milk production. Complications during delivery such as significant hemorrhage resulting in pituitary hypoperfusion or retained placenta are rare causes of low milk supply [43]. Untreated hypothyroidism may be another cause of low milk supply [44].

Insufficient glandular tissue of the breast may also contribute to low milk supply and can be identified on exam by experienced providers [45]. Insufficient glandular tissue is usually associated with poor or no breast growth during pregnancy. Severe insufficient glandular tissue can be associated with lack of breast development during puberty [46].

Polycystic ovary syndrome (PCOS) has also been posited to increase the risk of insufficient milk production [46,47]. However, median breastfeeding duration was 9 months in a large cohort of Norwegian women with PCOS [48], suggesting that not all women with PCOS are similarly impacted. Notably,

lack of breast growth during pregnancy was a strong risk factor for short breastfeeding duration in this cohort. Mothers presenting with low milk supply should be asked about breast growth during pregnancy.

A history of breast surgery is also important to obtain. Breast reduction surgery has been associated with decreased total length of breastfeeding and decreased exclusivity of breastfeeding [49]. Breast augmentation surgery itself has not been shown to cause low milk supply; however, it is important to ask about reasons for augmentation. Women with insufficient glandular tissue and abnormal pubertal development will sometimes pursue breast augmentation. In this situation, low milk supply is most likely because of the preexisting condition, not the operation itself.

Common medications that can impact milk supply include decongestants such as pseudophedrine [50] and estrogen, such as contained in combined oral contraceptives [51<sup>¶</sup>]. Pregnancy should also be considered in the mother who has an abrupt change in milk supply.

Postpartum depression has been reported to be a significant risk factor for 'disrupted lactation', defined as at least two of the following conditions: low milk production, breast or nipple pain, and latch problems. It is not known whether the causal factors underlying this association are behavioral or physiologic in origin, but evaluation for depressive symptoms should be considered in mothers presenting with low milk supply [52].

### **Glucose intolerance and milk production**

Rates of maternal overweight and obesity are at an all-time high in the United States [53]. Obese mothers are more likely to experience delayed lactogenesis and shorter overall breastfeeding duration [14,17,22]. A physiological hallmark of obesity is insulin resistance. Although initially not thought to play a role in lactation, there is now emerging research that implicates deficits in insulin secretion and sensitivity as underlying lactation difficulties in obese women [16,42<sup>¶</sup>,54–56]. Analysis of the human lactocyte transcriptome shows strong upregulation of insulin-stimulated genes during the onset of lactation [54], paralleling contemporary murine research [57]. Clinically, correlates of glucose intolerance have been shown to be significant risk factors for delayed lactogenesis [17]. Furthermore, a case-control study revealed that women diagnosed with low milk supply were more likely to have had diabetes in pregnancy as compared with women diagnosed with latch problems [58<sup>¶</sup>]. Preliminary baseline data from our current study of

women with low milk supply shows that those with indicators of insulin resistance have a significantly lower rate of milk production as compared with those without signs of insulin resistance [55]

Much more research is needed to elucidate the role of insulin secretion and insulin sensitivity on milk production so that vulnerable women can be identified and appropriately supported.

### Management of intrinsic low milk supply

The first priority when the mother does not produce enough milk is to assure that the infant is getting enough calories. Introduction of supplementation may be needed, but should be done carefully to minimize impact on milk supply. The mother should be instructed to breastfeed first, then offer supplementation (either pumped milk or formula). Using a hospital-grade pump and 'hands on' pumping [36] to drain the breasts more fully after nursing may help increase supply when the infant is not draining the breast well because of slow milk flow and/or decreased interest in the breast. It is important to establish a plan for close follow-up, as this 'triple feeding' routine (breastfeed, bottle feed, and then pump) is typically very difficult for mother to maintain over a long period of time. If this method is going to improve milk supply, an increase should be seen within 1 week. If the infant is draining the breast well at each feeding, it may not be helpful to add in breast pumping, as it could deter the mother from more frequent breastfeeding. A referral to an International Board Certified Lactation Consultant can be very helpful in these situations as the pediatrician is likely to be too time constrained to fully evaluate whether or not breast pumping is necessary to ensure thorough breast emptying.

Many herbal preparations and foods have been reputed to be helpful for milk supply, but there is very little evidence to these claims [36,59]. Foods ranging from oatmeal to 'lactation cookies,' to beer are recommended as effective in increasing milk supply, with no evidence to support their use. Mothers will often expend much time, energy, and money to try to increase milk supply with these interventions. The herbal agent Fenugreek is perhaps the most widely used to increase milk supply, but there is little evidence to support its effectiveness [60]. It is also important to consider inconsistent quality and contamination of dietary supplements because of the lack of regulation [61], and potential side-effects of fenugreek such as allergic reaction [62], hypoglycemia and interaction with anticoagulants.

Two prescription medications with the side-effect of increasing prolactin secretion, metoclopramide and domperidone, have been prescribed off label for the

purpose of increasing milk supply. Domperidone is not approved by the Food and Drug Administration in the United States. Side-effects of metoclopramide are well described and include jitteriness, fatigue, extrapyramidal symptoms, and depression. In our experience these side-effects are especially difficult for the postpartum woman who is already struggling with breastfeeding. Owing to lack of strong evidence of benefit to milk production, the Academy of Breastfeeding Medicine does not endorse either medication for use as a galactagogue [36]. Galactagogues should not be considered until breast drainage has been maximized and underlying causes of low milk supply have been ruled out.

Mothers with low milk supply may view their condition as being incompatible with continuing to breastfeed. It is important to counsel women with persistent low milk supply despite intervention on alternatives to weaning. Many mothers are able to combine breastfeeding with formula supplementation for long periods of time, especially when the infant feeds well at the breast and enjoys breastfeeding. Some infants will lose interest in latching if milk supply remains low. In this situation, another option is for mother to pump and bottle feed what she can, and continue to supplement with formula. The pediatrician should work with the mother to develop a strategy for combining breastfeeding and supplementation that ensures good infant growth while being sustainable for the family in the long term.

### CONCLUSION

Further research is needed to improve our understanding of the physiologic basis of intrinsic low milk production and to guide interventions to optimize the provision of human milk without compromising infant growth or overwhelming the new mother [63,64]. Timely, empathetic, and effective support to the mother struggling with her milk production will not only impact how much human milk her infant will ultimately take in, but will also influence the mother's self-concept of mothering and competency in nourishing her infant.

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## Conflicts of interest

There are no conflicts of interest.

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- of special interest
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