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# Maternal Perceptions of Insufficient Milk Supply in Breastfeeding

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## Abstract

**Purpose—**Improving the duration of exclusive breastfeeding is a national and international priority. Insufficient milk supply is one of the most commonly cited reasons for early cessation or decreased exclusivity in women who have initiated breastfeeding. This paper is an integrative review of current research pertaining to perceived insufficient milk (PIM).

**Design and Methods—**CINAHL, MEDLINE, and PubMed were searched combining "human milk" and "milk supply" and "perceived milk supply." Articles were limited to original research studies related to healthy, full-term breastfeeding dyads conducted over the past 10 years. Critical review indicated robust findings, limitations, and gaps in this body of literature.

**Findings—**A lot of women discontinue breastfeeding during the first few weeks of the post-partum period because of PIM and approximately 35% of all women that wean early report PIM as the primary reason. Many women utilize infant satisfaction cues as their main indication of milk supply and many researchers, clinicians, and women do not evaluate actual milk supply. The relationships between PIM and socioeconomic or demographic variables as well as early breastfeeding behaviors have not been adequately addressed in the literature.

**Conclusions—**Recommendations include improvement of maternal education about behaviors to ensure adequate supply, assessment of milk supply, and infant cues as well as further research into the root causes of PIM.

**Clinical Relevance—**Practitioners involved with maternal child health can improve their care of women and infants by understanding the subjective nature and questionable accuracy of PIM and changing assessment of milk supply.

### Keywords

human milk; breastfeeding; prenatal education

The benefits of breastfeeding, including the reduction in infant mortality and morbidity, are well documented in healthcare literature (Chen & Rogan, 2004). Infants who receive breastmilk during their first year of life have decreased risk of infectious diseases including diarrhea and respiratory, ear, and urinary tract infections (American Academy of Pediatrics, 2005). Long-term benefits of breastfeeding include decreased incidence of obesity and

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chronic illnesses such as diabetes, allergies, and asthma (Baldwin & Friedman, 2006). The American Academy of Pediatrics (AAP) and the World Health Organization (WHO) now recommend exclusive breastfeeding for the first 6 months of life with continued breastfeeding until at least 1 year to obtain these benefits (AAP, 2005; WHO, 2000). However, less than 15% of infants in the United States (US) have received this recommended course of human milk at 6 months of age (Centers for Disease Control and Prevention, 2006). Similar rates exist in many countries and societies across the world. Therefore, goals have been set by organizations such as Healthy People 2010 and WHO to improve rates of both initiation and duration of breastfeeding (U.S. Department of Health and Human Services, 2000; WHO, 2000).

In the US, national data shows that although an increasing number of mothers are initiating breastfeeding, many are unable to meet the recommendations for exclusivity and duration. The highest rate of drop-off occurs during the first weeks after birth (Centers for Disease Control and Prevention, 2006). Persisting rates of low exclusivity and duration have prompted researchers and clinicians to investigate factors that affect women's success once breastfeeding has been initiated. Perceived insufficient milk supply is a frequently cited reason for cessation of breastfeeding in many populations across the world (WHO, 2000).

Although a method known as 24-hour testing and weighing has been validated for measuring milk supply, many clinicians and women do not utilize this technique to assess actual milk supply. Instead, maternal perceptions of milk supply are commonly used in practice and in research. Specifically, the terms perceived insufficient milk (PIM) and insufficient milk supply (IMS) are assessed. These terms are used interchangeably in the literature, but for the sake of clarity the term PIM will be used in this paper. PIM is defined as a state in which a mother has or perceives that she has an inadequate supply of breast milk to meet her infant's needs (Hill & Humenick, 1989). It is important to note that actual milk supply is frequently not measured, and that reports of PIM is based on maternal perceptions. The accuracy of maternal perceptions, or PIM, in relation to actual milk supply has not been determined.

The purpose of this paper is to review the published research of the last 10 years (1996–2007) that has indicated perceived milk supply as a factor in the success of breastfeeding. Findings of this analysis address the effect of perceived milk supply on breastfeeding outcomes, the relationship between perceived milk supply to other variables, and the status of current tools used to predict who is at risk for problems with perceived milk supply.

## Methods

An integrative literature search was conducted to identify all current literature pertaining to the issue of perceived milk supply from the key disciplines of nursing, medicine, and public health. CINAHL, MEDLINE, and PubMed were searched in August 2007 for articles that combined the search terms breastfeeding and milk supply and for articles with the term “perceived milk supply.” Searches were limited to English-language, human, research from 1996–2007. Additionally, classic articles about PIM were obtained. Only articles indicating

original research were considered. All articles that met these criteria were assessed for relevance.

Because the aim of this investigation was to analyze the issue of perceived milk supply, articles that included examination of populations with known problematic milk production were excluded. Accordingly, research pertaining to premature delivery, women with endocrine disorders, women who smoked cigarettes, and women taking certain specific medications, were excluded because the establishment of breastfeeding and milk supply might be compromised in such populations (Hartmann, Cregan, Ramsay, Simmer, & Kent, 2003; Letson, Rosenberg, & Wu, 2002; Stage, Norgard, Damm, & Mathiesen, 2006). Also, because of recommendations for feeding changes at 6 months, articles that were focused on problems with breastfeeding after this time period were excluded. Several international studies were excluded based on this criterion. Therefore, only articles that were focused on issues of milk supply in uncomplicated, full-term dyads during the first 6 months of breastfeeding were included.

The relevant literature was analyzed using a table of evidence. A condensed version of this (Table) shows the methods and samples of these studies. A comparison among articles, in conjunction with the assessment of individual studies, allowed for a critical review of the current knowledge on perceived milk supply. This allowed identification of robust findings as well as uncertainties or gaps in the current literature. Accordingly, recommendations for changes in current practice and future research are given.

## Findings

The previously described literature search yielded 20 relevant research articles published over the last 10 years. While approximately half of the studies (9 out of 20) were conducted in the US, a substantial number (5) came from Australia and New Zealand. Two studies came from Canada and one study each from Mexico, Hong Kong, Thailand, and Turkey. This suggests that PIM is a concept that is relevant across cultures and is a global problem.

The majority of the studies (15) were conducted with a prospective, longitudinal design. Most investigators enrolled women shortly before or after delivery and collected data throughout the first few months of the postpartum period. Authors of two of these articles included qualitative interviews (Lewallen et al., 2006; Sacco et al., 2006). Investigators of three of the longitudinal studies used the method of factor analysis (Hill & Humenick, 1996; Kirkland & Fein, 2003; Punthmartharith & Singh, 2005). Two studies were completed as secondary analyses from previously conducted prospective studies (Ahluwalia, Morrow, & Hsia, 2005; Humenick, Hill, Thompson, & Hart, 1998). Three studies had a cross-sectional design (McCarter-Spaulding & Kearny, 2001; Sheehan, Krueger, Watt, Sword, & Bridle, 2001; Wojnar, 2004). The sample size of each study was appropriate given its design, with a range from $N = 60$ to $N = 30{,}000$. A total of over 36,700 participants' responses were included in this analysis.

All of the research was designed to address at least one of three major questions. The primary aim of 12 of the 20 studies was to examine the reasons that women had low rates of duration and exclusivity of breastfeeding. Many of the researchers did not explicitly intend

to study perceived milk supply, though it became the focus of the findings. Five of the studies were primarily interested in associations between perceived milk supply and other maternal perceptions (Blyth et al., 2002; Cooke et al., 2003; McCarter-Spaulding & Kearney, 2001; Sacco et al., 2006; Wojnar 2004). Investigators of four studies examined tools to predict insufficient milk supply (Hill & Humenick 1996; Humenick et al., 1998; McCarter-Spaulding & Kearney, 2001; Punthmatharith & Singh, 2005).

## Effect of Perceived Insufficient Milk

The frequent and influential nature of PIM was pervasive across this body of literature. A large percentage of women reported insufficient milk supply as the most common problem with breastfeeding and the primary reason for early cessation. While exact prevalence of PIM is unknown (reported between 30% and 80% of women) many investigators report the rates of PIM as the percentage of the women who wean early because of PIM. These rates ranged from 23% to 56% of women who had weaned by the completion of their respective studies (Schluter, Carter, & Percival, 2006; Sheehan et al., 2001). Across this literature, most found that approximately 35% of women reported that PIM was the primary reason for early weaning (Ahluwalia et al., 2005; Heath, Tuttle, Simons, Cleghorn, & Parnell, 2002; Lewallen et al., 2006).

One study indicated the percentage of women who weaned early because of PIM was 44% of the study population (Chan et al., 2000). All studies that included relative frequencies of reasons for early cessation indicated that PIM was either the top or within the top several reasons (along with nipple pain) when not further differentiated. The finding that early cessation is often because of PIM supply was robust because it was derived from several different methods. While some researchers asked women to choose from a list of options, others asked open-ended questions.

Overall duration or the timing of cessation because of PIM is also of particular interest. Consistent with national data, the highest drop-off was during the first 1 to 4 weeks after initiation (Ahluwalia et al., 2005; Avery, Duckett, Dodgson, Savik, & Henly, 1998; Binns & Scott, 2002; Chan et al., 2000; Lewallen et al., 2006). One study showed that up to 63% of the women who had weaned early because of PIM had done so during the first week (Sheehan et al., 2001).

Several researchers also reported that PIM continues to be the most common problem and the most frequent cause of cessation for several months (Ahluwalia et al., 2005; Binns & Scott, 2002; Blyth et al., 2002; Cooke et al., 2003; Kirkland & Fein, 2003). In the only study that reported measurement of actual milk supply, a finding was that some women who had a proven adequate supply at 6 weeks postpartum (through the use of 24-hour test-weights) still reported PIM 2 weeks later at 8 weeks postpartum when their milk supply was no longer objectively measured (Hill & Aldag, 2007). This body of literature therefore suggests that while women are at highest risk for cessation because of PIM during the early postpartum period, PIM is a continued risk throughout all of lactation.

Exclusivity is another important factor addressed by this literature. Many studies showed that PIM was correlated with decreased exclusivity. Before cessation, many women began

mixed-feeding in response to PIM (Blyth et al., 2002; Lewallen et al., 2006; Sacco et al., 2006). Not many of the women who continued to breastfeed for the duration of their studies were doing so exclusively and PIM was the most common reason for supplementation (Alikassifogglu et al., 2001; Blyth et al., 2002; Cooke et al., 2003; Heath et al., 2002; Schluter et al., 2006). One study indicated PIM at 8 weeks postpartum was predictive of decreased exclusivity at 12 weeks, that these variables were significantly correlated ($p < 0.001$), and that 76.9% of women reporting PIM were supplementing at 12 weeks (Hill & Aldag, 2007). A qualitative study by Sacco et al. (2006) showed that supplementation was the most common response when women were asked how they coped with PIM (82%–85% of women). The effect of PIM on exclusivity is important to measure, because the benefits of breastfeeding are associated with exclusive or nearly exclusive breastfeeding.

## Relationship With Other Variables

**Infant satisfaction—**Infant satiety (satisfaction) is a variable frequently related to perceived milk supply in this body of literature. Neither infant satiety nor infant satisfaction was clearly defined or measured in this literature. Instead, these terms were applied to the subjective assessment made by women about whether their infant appeared satisfied. Many investigators found that women who reported PIM also reported that their infants did not seem satisfied.

Occasionally these perceptions (PIM and infant dissatisfaction) were independently documented with no discussion of how they were related (Ahluwalia et al., 2005; Alikassifogglu et al., 2001; Schluter et al., 2006; Wojnar 2004). Frequently, decreased infant satisfaction in the form of crying or fussiness was discussed directly as the primary indication of PIM (Binns & Scott 2002; Hill et al., 1997; Kirkland & Fein 2003; Lewallen et al., 2006; McCarter-Spaulding & Kearney 2001; Sacco et al., 2006;). Cooke et al. (2003) found a significant difference in perceived infant satisfaction scores between those who reported PIM and those who believed their supply was adequate ($p < 0.05$). Investigators for two studies tested tools for PIM and reported on the relationship between these two concepts, finding that infant satiety had the most consistent loading on factor analysis of the questions tested. Hill and Humenick (1996) reported a correlation of 0.43 between the perception of infant satiety and mother's perception of PIM. Punthmatharith and Singh (2005) found questions related to this variable to have the strongest loading on their factor analysis (0.49 to 0.82). None of the studies indicated whether women were appropriately interpreting infant satiety cues or the role that infant temperament might play in this equation.

**Other maternal perceptions—**Correlation with other maternal perception scales, such as maternal satisfaction and self-efficacy, was also indicated in this literature. Other maternal perceptions have also been shown to affect breastfeeding outcomes, and several studies showed the relationship between PIM and specific tools that measure these other perceptions. Maternal satisfaction is generally described as a woman's perception of personal satisfaction and success with breastfeeding (Cooke et al., 2003). When maternal satisfaction was measured with the Maternal Breastfeeding Evaluation Scale, significant differences in scores ($p < 0.001$) were found between women who reported PIM and those

who did not (Cooke et al., 2003). PIM was also associated with lower self-efficacy or maternal confidence scores (Blyth et al., 2002; Hill & Humenick, 1996; McCarter-Spaulding & Kearney 2001; Wojnar 2004). While these two terms were generally used synonymously to assess the level of confidence that women have in their own ability, the definitions and methods of measuring self-efficacy or maternal confidence were not consistent in the literature. Within discussions about maternal perceptions and PIM, only one set of investigators reported causation: McCarter-Spaulding & Kearney reported a significant correlation between self-efficacy scores and PIM ($r = 0.49$, $p < 0.01$), and suggested that lower self-confidence might cause a woman to doubt her ability to produce adequate milk. Other researchers reported correlations without directional causation.

**Previous experience—**Parity and previous breastfeeding experience is often reported as a significant factor in predicting successful breastfeeding. Specifically, women who are breastfeeding for the first time are usually thought to be at higher risk for problems or early cessation when compared to women who have previously breastfed. However, many studies showed that even women with previous breastfeeding experience reported problems with PIM. This was often indicated by inclusion of women with previous experience in the group that reported problems with PIM without conducting analysis on differences along parity (Ahluwalia et al., 2005; Alikassifogglu et al., 2001; Blyth et al., 2002; Chan et al., 2000; Cooke et al., 2003; Heath et al., 2002; Hill & Aldag, 2007; Hill & Humenick, 1996; Hill et al., 1997; Humenick et al., 1998; Kirkland & Fein, 2003; Punthmatharith & Singh, 2005; Schluter et al., 2006; Sheehan et al., 2001; Wojnar, 2004). The percentage of women with previous breastfeeding experience varied greatly among studies. In studies that reported parity but did not include it as a consideration for enrollment, the percentage of primiparous women ranged from 33% to 80% (Heath et al., 2002; McCarter-Spaulding & Kearney, 2001).

Three teams of investigators stated that previous experience can be a confounding factor when studying maternal perceptions and therefore limited their studies to primiparous women (Avery et al., 1998; Lewallen et al., 2006; Sacco et al., 2006). Few investigators conducted analysis along this variable. One study indicated that while initial differences were significant at $p = 0.0006$ (89% of first-time breastfeeders compared to 79% of women with experience reported breastfeeding problems before they were discharged), this difference did not continue afterward (Binns & Scott, 2002). Researchers in only two studies explicitly analyzed whether parity made a difference in PIM. Hill et al. (1997) found that while there was not a statistically significant difference in the report of PIM between first- and second-time breastfeeders, women with previous experience tended to report less PIM than did women who were breastfeeding for the first time.

McCarter-Spaulding and Kearney (2001) found no difference in the occurrence of PIM between multiparous and primiparous women. While these findings indicate that PIM is not an issue that women experience only during their first experience, discrepancies between methods and findings leave the issue of parity largely unresolved.

## Breastfeeding Behaviors

Early breastfeeding behaviors, including those influenced by birth-hospital policy and procedure, are often discussed when breastfeeding outcomes are assessed. Although many articles indicate the importance of these factors in relation to overall duration, many investigators did not analyze the relationship between these variables and PIM. The few studies that did include these analyses found that use of formula in the hospital was often accompanied by PIM and early cessation (Chan et al., 2000; McCarter-Spaulding & Kearney 2001; Sheehan et al., 2001). Chan et al. (2000) reported that 77% of the infants in study population were fed supplemental formula during their hospital stay because of insufficient milk supply. Additionally, Binns and Scott (2002) reported that 16.7% of the women who stopped breastfeeding before leaving the hospital reported that PIM was the reason and that 23% of the study population was anxious about PIM at the time of discharge.

These findings are particularly relevant because most women have not entered lactogenesis II (the stage of copious milk production) before being discharged. Milk production at this point is not indicative of milk supply and supplementation might affect milk production. Alikassifogglu et al. (2001) reported that insufficient milk production was the most common reason that formula was given in the hospital, and that inhospital supplementation was associated with decreased exclusivity at 4 months ($p = 0.002$) and decreased total duration ($p = 0.01$). The one study that showed maternal behaviors extensively, including supplementation and number of times breasts were stimulated, showed that many behaviors during the first 6 weeks of breastfeeding were highly correlated to actual milk production (Hill & Aldag, 2007).

## Screening Tools

The need for identification of women at risk for developing PIM has prompted the development of several screening tools. Two teams of investigators examined the psychometric properties of the H & H Lactation Scale, which was developed to measure direct and indirect indicators of PIM (Hill & Humenick, 1996; Punthmatharith & Singh, 2005). When organized into three subscales this tool was found to have sound reliability (alpha coefficient 0.91 – 0.92), concurrent validity ($r = 0.62$), and predictive validity ($r = 0.43$ with future level of breastfeeding) for mothers of full-term infants in the US (Hill & Humenick, 1996). A factor analysis completed in Thailand, however, showed that not all of the content or its organization was valid for Thai women (Punthmatharith & Singh, 2005). The authors reported that a shortened version of the tool was appropriate in this population and they recommended that this tool might need to be modified for use outside of the US. Both studies found that the items related to infant satiety had the most consistent loading on factor analysis and that this subscale was strongly correlated to breastfeeding level.

The Perceived Insufficient Milk Tool was developed to measure more direct indications of a woman's perception of her milk supply (McCarter-Spaulding & Kearney, 2001). While formal psychometric testing has not been completed on this tool, the authors report good content validity and appropriate internal consistency (alpha coefficient 0.70).

An elevated level of sodium in early breast milk samples was previously found to be associated with low milk supply (Morton, 1994). Therefore, testing sodium levels of early breast milk is viewed as a potential tool for identifying women at risk for inadequate milk supply. A study which indicated the relationship between early sodium levels, perceived milk supply, and breastfeeding outcomes showed that elevated levels of sodium were in fact only predictive of early cessation in women who perceived they had inadequate supply (Humenick et al., 1998). Specifically, within the group of women who were seen as high-risk on the H & H lactation scale, 75% of women with elevated sodium levels had stopped breastfeeding by 4 weeks post-partum compared to 22% of women with normal sodium levels.

No significant difference was seen within the women with low-risk H & H lactation scores. Additionally, when these perception scores were added to a regression model, sodium levels were no longer significantly predictive ($p = 0.32$) of breastfeeding level at 4 weeks. When duration was analyzed, women deemed high-risk as indicated by the H & H Lactation Scale had a significantly shorter duration ($p = 0.02$) than did women deemed low-risk, but sodium level was not significantly associated with duration. This situation indicates that maternal perceptions of supply are highly influential on outcomes and that biological markers might not allow assessment of true risk of breastfeeding problems.

## Discussion

### Key Findings

The issue of perceived insufficient milk supply is a frequently occurring problem and is reported globally. PIM is often reported as the most common problem that women experience with breastfeeding. The occurrence of PIM frequently leads to early weaning or decreased exclusivity. The high rate of cessation during the first 1 to 4 weeks of breastfeeding and the relationship to early or in-hospital behavior suggests that the very early postpartum period is critical in the development of PIM. The importance for creating tools that identify women who are at high risk for problems with milk supply early in lactation has been recognized. The H & H Lactation Scale and the Perceived Insufficient Milk Tool have been found useful to identify women at risk during the early postpartum period, but the utility of breastmilk sodium levels is unresolved. Finally, most women use infant satiety cues as the primary indication of milk supply and verification of actual milk supply is extremely rare.

An integrative and critical review of this literature showed that these key findings are robust. The large number of prospective, longitudinal studies was appropriate and desirable to answer the intended research questions. The inclusion of a variety of techniques, such as factor analysis and open-ended interviews, allowed for validation and verification of these findings. Sample sizes were adequate and appropriate, with several of the studies having relatively large, random samples. Though the individual populations in most of the studies would not be considered generalizable on their own, this body of literature indicates a largely diverse population in total. Therefore, the key findings described here can be considered valid, robust, and relatively generalizable.

### Limitations

While in total this body of literature is comprised of a largely diverse population, we cannot conclude that perceptions of milk supply affect all women equally. Although many of the samples included diversity on at least one demographic variable they often had otherwise highly homogenous samples. The most salient limitation in regards to sample populations involves the lack of statistical analysis along demographic variables. While these variables are reported in aggregate form for the study populations, differences along these variables are not fully analyzed.

Many studies indicated whether differences in variables such as parity, age, employment, education, and prenatal intentions were associated with overall duration, but not with reasons for cessation. Specifically, many studies did not indicate whether prevalence of PIM was different across these variables. It is likely that these analyses were not performed because they were not part of the original research questions. Many of the studies were aimed at determining the reasons that women did not meet breastfeeding recommendations rather than at studying PIM directly. Now that it has been repeatedly reported that PIM is the most common breastfeeding problem, research should determine who is at risk for developing PIM.

The lack of ability to assess causation is a major limitation of this body of literature. While the reported correlations are helpful, directional causation cannot be determined in any of these studies. This is true for the relationship with other maternal perceptions as well as with behaviors such as supplementation with formula. Because some investigators report that women have thoughts and anxiety about PIM in the prenatal period, it is particularly difficult to determine if PIM causes supplementation and other behaviors or if supplementation and other behaviors decrease supply and cause PIM. Perhaps this is a bidirectional relationship. Researchers who study early behaviors and early perceptions (including prenatal perceptions) might be helpful for establishing where the origin of these issues most frequently lies.

The most striking limitation of this literature is that many researchers use the term insufficient milk supply interchangeably with perceived insufficient milk supply. Only one study indicated actual supply insufficiency as its own variable, and PIM was not measured at the same time points that this measurement was made (Hill & Aldag, 2007). Clearly many researchers do not make a distinction between confirmed inadequate milk supply and PIM. This is a critical issue because actual milk insufficiency and perceived milk insufficiency are being recorded and analyzed indiscriminately as PIM. While both are influential to breastfeeding outcomes, they might ultimately have different causes that require different interventions.

## Gaps and Future Directions

The fact that many women perceive that they have insufficient milk supply is now well documented in the literature. Although we know that maternal perceptions of supply can be highly influential, we do not know if they are accurate. Several authors point out that this is a fundamental gap in our knowledge (Blyth et al., 2002; Cooke et al., 2003; McCarter-

Spaulding & Kearney, 2001). The relationship between perceived and actual milk supply should be determined. In other words, research that indicates correlation between the subjective label of PIM actual inadequate supply should be conducted. This knowledge could greatly assist future efforts for improving the rate of successful breastfeeding. If PIM does not correlate with an actual inadequate supply, then maternal education about perceptions of supply should be addressed. However, if PIM is correlated with low milk supply, then maternal behaviors that influence supply should be the main focus of intervention and study.

The influence of attitudes and behaviors in the very early postpartum period should be further examined. Because some women report PIM early in the postpartum period, before milk supply has even been established, prenatal perceptions, intentions, breastfeeding education, and motivation are all likely factors in how women perceive their milk supply and react to this perception.

Behaviors such as early supplementation can lead to a decrease in breast-milk supply. Unclear, however, is how the cycle of perceived milk supply, behaviors, and actual milk supply usually occurs. Detailed recording of behaviors, perceptions, and actual supply in the first 2 weeks after delivery could give better insight into how these issues emerge and are propagated. Again, this knowledge could assist in guiding future efforts for increasing successful breastfeeding.

The absence of research on interventions to alleviate this problem constitutes a significant gap in this body of literature. While much is still unknown about the issues of milk supply and PIM, some important pieces of knowledge are well-established and can be used to change practice. Interventions based on our current knowledge should be created and tested. This body of literature indicates that most women use infant satisfaction as their major indication of milk supply. Many women perceive crying, fussiness, and wakefulness as signs that their infant is not receiving enough milk. While these signs might be part of an infant's feeding cues, they can also be normal infant behavior, and might vary as infant temperaments vary.

Obstetric and pediatric providers should therefore explicitly discuss information about normal newborn behaviors, appropriate feeding cues, differences in infant temperament, and proper ways to assess infant intake, such as wet diapers and weight gain, with new mothers. Additionally, providers should inform women that they should not make decisions about milk supply on their own, but should seek assistance and assessment through their pediatric, obstetric, or family providers if the mothers perceive that they are not producing enough milk. Providers then need to be able to complete a comprehensive assessment of infant nutrition and milk supply through the use of test-weights and weight tracking and be able to counsel women on recommendations for increasing supply if actual insufficiency is detected. The effectiveness of these interventions should be recorded and shared with obstetric and pediatric communities. Healthcare professionals should move past the observation that many women report PIM and instead find ways to effectively improve this situation.

## Conclusions

Mounting evidence indicates that PIM is one of the most common and influential reasons for the continuing low rates of breastfeeding duration and exclusivity throughout much of the world. It is important for clinicians and researchers to build on the knowledge that this is a common phenomenon. Future research should be conducted to determine who is at high risk and to further validate screening tools. Also important is determining whether PIM is a physiological or psychological issue. This can be determined by research into the correlation between actual and perceived milk supply as well as the relationship among early behavior, perceptions, and supply. The new knowledge that this research can generate should help guide changes to breastfeeding practices in the future. Perceived milk supply is considered modifiable. Therefore, well-informed interventions to reduce the incidence of PIM might be a key element for improving rates of successful breastfeeding.

### Clinical Resources

- American Academy of Pediatrics (current policy statement) http://aappolicy.aappublications.org/cgi/content/full/pediatrics;115/2/496
- The Children's Hospital of Philadelphia (performing test weights) http://www.chop.edu/newborn_infant/pdf/13-b-51.pdf
- International Lactation Consultants Association (testing breastfeeding knowledge) http://www.ilca.org/ismoriginal.html

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## Table

Design and Sample of Research concerning Perceived Insufficient Milk Supply

| Article | Design & methods | Sample |
|---|---|---|
| Ahluwalia et al. (2005) | •Secondary analysis of national U.S. dataset, pregnancy to 4 months PP | *N* = 30,000 |
| | •Data pooled, statistically weighted to represent population from 10 states | Random sample |
| | •BF levels according to standard definitions and reasons for stopping were assessed at 1 week, 1 month, and 4 months PP | Demographics representative of US |
| Alikassifogglu et al. (2001) | •Prospective data from birth to 4 months PP | *N* = 91 |
| | •All low-risk dyads from 1 birth hospital and well-child practice in Turkey were eligible; 91% participation rate | 49% primiparous |
| | | 33% <8 years education |
| | •Validated questionnaires used to assess correlations between PIM, supplementation, and BF level | 51% housewives |
| Avery et al.(1998) | •Prospective data from birth to 1 year PP | *N* = 602 |
| | •All low-risk primiparous dyads from 1 U.S. Midwest hospital were eligible; 90% consented | 100% primiparous |
| | | 85% married |
| | •BF difficulties were measured through a validated tool and assessed with factor analysis. Theory of Planned Behavior guided methods and analysis | 6% low-income |
| Binns & Scott (2002) | •Prospective data from birth to 24 weeks PP | *N* = 556 |
| | •All women delivering in 2 urban hospitals in Western Australia were eligible, no differences between consented versus declined | 31% primiparous |
| | | 76% Australian |
| | •Comprehensive lists allowed measurement of problems and reasons for cessation at all time points | 70% married |
| | | 46% employed |
| Blyth et al. (2002) | •Prospective data from prenatal period to 4 months PP | *N* = 300 |
| | •Healthy women at 1 prenatal clinic in urban Australia intending to BF were eligible; 90.6% participation rate | 86% Caucasian |
| | | 88% married |
| | •BF level and BF self-efficacy were measured using standard definitions and validated tools | 63% high school |
| Chan et al. (2000) | •Prospective data from 1 week to 6 months PP | *N* = 64 |
| | •Low-risk women intending to exclusively BF or exclusively formula feed in 1 Hong Kong hospital were enrolled | 100% Chinese origin |
| | | Mean parity 1.5 |
| | •Investigators created tools (not previously validated) to document inpatient management, reasons for decreasing BF and support | 96% high school |
| Cooke et al. (2003) | •Prospective data from prenatal period to 3 months PP | *N* = 365 |
| | •All women planning to deliver at 3 public hospitals in urban Australia were eligible; 81% participation rate | 52% primiparous |
| | | 49% some college |
| | •Questionnaires based on standard definitions and BF satisfaction measured with validated tool. Open-ended questions used to augment | 73% married |
| | | 9% receiving aid |
| Heath et al. (2002) | •Prospective data from birth to 12 months PP | *N* = 74 |

| Article | Design & methods | Sample |
|---|---|---|
| | •Convenience sample: Low-risk, white dyads in one urban area of New Zealand were contacted; 20% participated | 33% primiparous |
| | | 100% white |
| | •Data were categorized according to standard definitions, data collection tools were not validated | 47% some college |
| | | 93% married |
| Hill & Aldag (2007) | •Prospective data from birth to 12 weeks PP | *N* = 97 |
| | •Low-risk women intending to exclusively BF for 12 weeks were recruited from 1 hospital, US; 26% dropped out | 50% experience |
| | | 92% white |
| | •Extensive data were collected daily with validated methods and regression run to predict BF level at 12 weeks PP | 92% living with father |
| Hill & Humenick (1996) | •Prospective data collected 1 week to 20 weeks PP | *N* = 120 |
| | •Convenience sample: low-risk full-term dyads in one Midwest, U.S. area were recruited; 50% participation, no differences in those that declined | 60% primiparous |
| | | 85% white |
| | •To develop and test the H&H tool; it was completed weekly, assessed with factor analysis, and regressed on 8-week BF level | 83% married |
| Hill et al. (1997) | •Prospective mixed-method data collected 1 week to 20 weeks PP | *N* = 120 |
| | •Convenience sample: low-risk full-term dyads in one Midwest, U.S. area were recruited; 50% participation, no differences in those that declined | 67% no experience |
| | •Open-ended questions used to ask women about reasons for cessation and compared with BF level and previous BF experience | 85% Caucasian |
| | | 83% married |
| Humenick et al. (1998) | •Secondary analysis on dataset of 340 women over 1st 20 weeks PP | *N* = 109 |
| | •Original sample came from 10 hospitals, US. Stratified sample chosen to balance experience and low versus high risk for PIM | 50% experience |
| | | 89% Caucasian |
| | •Validated methods used to measure PIM and sodium levels; both were regressed on BF level at week 4 | 85% married |
| Kirkland & Fein (2003) | •Prospective data collected from prenatal to 1 year PP | *N* = 758 |
| | •Sample came from a U.S. consumer mail panel; 50,000 households were surveyed, all women BF at 1 week were contacted; 72% participation | Random sample |
| | | 40% primiparous |
| | •Factor analysis performed to assess reasons for cessation through the construct of thriving | 27% high school or less |
| | | 90% married |
| Lewallen et al. (2006) | •Prospective, qualitative data collected from birth to 8 weeks PP | *N* = 339 |
| | •All low-risk women intending to BF for the first time and for at least 8 weeks at several hospitals, Southeast US were approached | 100% no experience |
| | | 26% racial minority |
| | •Open-ended questions were asked to determine hospital support, home support, and reasons for cessation | 16% < “some college” |
| McCarter-Spaulding & Kearney (2001) | •Cross-sectional data collected between 1 and 11 weeks PP | *N* = 60 |
| | •Convenience sample: Healthy BF dyads recruited from 5 pediatric practices, Northeast US | 80% primiparous |
| | •Investigators first validated tools for specific use in this study, and compared parenting self-efficacy to perceptions of milk supply | 98% married |

| Article | Design & methods | Sample |
|---|---|---|
| Punthmatharith & Singh (2005) | •Prospective data with repeated measures from 2 days to 1 month PP | *N* = 196 |
| | •All low-risk dyads delivery at 1 urban hospital, Thailand were recruited and randomized into a trial. All completed data collection | 62% experience |
| | •Exploratory and confirmatory factor analysis was completed on the H & H scale for 2 time points, and modifications to the scale were tested | 100% Thai |
| Sacco et al. (2006) | •Prospective data collected for pregnant women or dyads less than 6 months PP | *N* = 317 |
| | | 100% primiparous |
| | •All primiparous pregnant or early PP women were eligible from 1 health clinic and 1 hospital, Mexico; 92% participation rate | 100% Mexican |
| | | 44% high school |
| | •Qualitative methods including semi-structured interviews, free lists, and ranking of items explored signs of and coping strategies for PIM | 5% single |
| | <<qa: Meaning of text in last bullet point not clear, please fix> | |
| Schluter et al. (2006) | •Prospective data collection from 6 weeks to 24 months PP | *N* = 1376 |
| | •All Pacific Islands' infants born at 1 one hospital were eligible; 93% consent rate for first visit with 77% completing data collection | 100% Pacific origins |
| | | 20% single mothers |
| | •Data from interviews were quantified to assess feeding practices, problems and reasons for cessation and survival analysis was conducted | 27% some college |
| | | 94% not employed |
| Sheehan et al. (2001) | •Cross-sectional data collected at 4 weeks PP | *N* = 1250 |
| | •All low-risk dyads at 5 hospitals were eligible, Ontario, Canada; 41% were enrolled; 70% enrolled completed data collection | 43% primiparous |
| | | 66% Canadian |
| | •Reasons and potential risk factors for early cessation were collected using investigator constructed lists and questionnaire | 79% married |
| | | 18% low-income |
| Wojnar (2004) | •Cross-sectional data collected at 6 weeks PP | *N* = 107 |
| | •All low-risk dyads that were planning to BF for at least 6 weeks at 1 hospital in Canada were invited to participate | 62% primiparous |
| | •Perceptions of infant behavior, the experience of BF, and self as mother were measured with validated tools; BF level with standard definitions | 88% had some college |

Note.