

Research Article

Maternal Beliefs Surrounding Infant Feeding, but Not Maternal BMI or Hospital Experience, Predict Breastfeeding Exclusivity and Behavior

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Abstract

Background: Overweight/Obese (OW/Ob) women are at risk for breastfeeding failure. How maternal BMI affects lactation support received in-hospital, or maternal attitudes and beliefs surrounding infant feeding remains poorly understood. We investigated 1) the impact of in-hospital lactation support and maternal attitudes and behaviors regarding infant feeding on breastfeeding exclusivity, and 2) whether these potentially modifiable attitudes and behaviors differed between normal weights (NW) versus OW/Ob women.

Methods: NW (n=18) and OW/Ob (n=20) women and their infants were followed from birth to 4-months postpartum. In-hospital experiences, problems and help received regarding breastfeeding were documented. Six maternal attitudes and behaviors surrounding infant feeding were assessed at 2-weeks and 4-months. These factors were compared between NW and OW/Ob women, and in relation to breastfeeding exclusivity.

Results: In-hospital experiences, assistance received regarding breastfeeding difficulties, and infant breastfeeding exposure did not differ between NW and OW/Ob women. At 4-months OW/Ob women were more likely to feed their infant on a schedule ($p<0.03$); this was the only difference in attitudes/behaviors between BMI-groups. Feeding the infant on a schedule was predictive of lower total breastfeeding exposure ($p<0.05$). Maternal concern about infant under-eating/becoming underweight was associated with several negative feeding behaviors, including reduced breastfeeding exposure ($p<0.02$), pressuring feeding style ($p<0.01$), and feeding to calm fussiness ($p<0.01$).

Conclusion: This hospital setting provided equitable breastfeeding support to OW/Ob and NW women. Maternal concern over infant under-eating/under-gaining and encouragement to feed on-demand are prime interventional targets to improve breastfeeding outcomes; the latter may be especially relevant to OW/Ob mothers.

Keywords: Breastfeeding Attitudes; Breastfeeding Support; Maternal Behavior; Infant Feeding Patterns; Breastfeeding Exclusivity

Abbreviations

NW: Normal Weight; OW/Ob: Overweight/Obese; WHO: World Health Organization; BFHI: Baby-Friendly Hospital Initiative

Introduction

The multi-faceted benefits of breastfeeding, specifically exclusive breastfeeding, are well established and exclusive breastfeeding is universally recommended for the first 4-6 months of life [1-3]. Yet, rates of exclusive breastfeeding rarely meet recommendations in the United States where the average duration of any and exclusive breastfeeding fall well below stated Healthy People 2020 goals [4,5].

Postpartum practices in the hospital setting, including the delivery of lactation support, are important means to aid women in establishing a positive breastfeeding experience. The World Health Organization's (WHO) Baby-Friendly Hospital Initiative (BFHI) Ten Steps to Successful Breastfeeding have been proven to increase rates

of breastfeeding initiation, duration, and exclusivity [6-8]. Evidence supporting the impact of most of the Ten Steps is substantial, even when implemented individually [6]. Particularly, attempted breastfeeding within the first hour (step 4), giving no in-hospital supplementation (step 6), and mother/infant rooming-in (step 7) have individually been associated with higher rates of breastfeeding [9,10].

Given the evidence that breastfeeding may protect against later obesity and that children of obese mothers are at higher risk of becoming obese themselves, [11-13] it is particularly important that overweight and obese women are encouraged and supported in breastfeeding efforts. Supportive practices are essential for these women as they are at risk for poor lactation outcomes, including lower initiation rates, shorter intended duration, and earlier cessation of breastfeeding [14-16]. The reasons for this are complex and likely include a combination of physiological, psychological, and biological factors. However, even in the face of such barriers, most overweight

women can successfully exclusively breastfeed when provided adequate lactation guidance and support [14,17].

The role of parental feeding styles during early childhood has often been examined as an additional risk factor for later obesity [18,19]. However, feeding style in the infant period is less-studied. Maternal beliefs and behaviors surrounding infant feeding in the first months of life are particularly relevant given that rapid and excess weight gain during the first 6 months of infancy is a powerful predictor of obesity later in life [20]. Maternal choice to feed formula has been associated with a higher level of maternal control of childhood feeding [21]. Additionally, higher pressuring and indulgent parental infant feeding styles were associated with higher infant intake, decreased odds of breastfeeding, and more feeding of age-inappropriate liquids and solids [22]. While one study reported that maternal BMI was inversely associated with responsiveness to infants' fullness cues [23], the impact of maternal obesity on infant feeding style remains poorly understood.

This study aimed to further investigate the interplay and relationships between maternal obesity and maternal beliefs and behaviors surrounding infant feeding with breastfeeding outcomes. Specifically, we sought to determine 1) the impact of the following factors on breastfeeding exclusivity: in-hospital lactation support following delivery, hospital adherence to four of the ten BFHI steps, and maternal feeding beliefs and practices regarding infant feeding; and 2) whether any of these modifiable factors or breastfeeding exclusivity differed between lean versus overweight/obese women.

Materials and Methods

Study participants

These analyses were undertaken within the context of a longitudinal cohort study following normal weight (NW) and overweight/obese (OW/Ob) breastfeeding mothers and their infants in Denver, CO. All aspects of the study were approved by the Colorado Multiple Institutional Review Board (COMIRB), and all participants provided informed consent. Women were recruited and consented during pregnancy between 2012 - 2014. All women were between 20-36 years, carrying a singleton fetus, planning to exclusively breastfeed for at least four months and otherwise healthy. Women who developed gestational diabetes or pregnancy-induced hypertension, or who delivered their infant <37 weeks were also excluded. All women delivered their infants at the University of Colorado Hospital (UCH; Denver, CO). This hospital does not hold Baby-Friendly Accreditation.

Study personnel visited mothers in the hospital after delivery. Infant weight and sex, gestational age, gestational weight gain, and delivery type were obtained from medical record. Maternal pre-pregnant BMI was based on maternal self-report of pre-pregnant weight, and measured height.

Infant feeding practices and maternal beliefs and behaviors

Two weeks after delivery, women were administered a modified version of the Infant Feeding Practices II questionnaire which queried about current feeding practices, breastfeeding problems, and intrapartum hospital experiences with breastfeeding and lactation

Table 1: The Four (of Ten) Baby-Friendly Hospital Initiative Steps to Successful Breastfeeding Measured.

Step #	Guideline
4	Help mothers initiate breastfeeding within one hour of birth ¹
6	Give infants no food or drink other than breast-milk, unless medically indicated
7	Practice rooming in - allow mothers and infants to remain together 24 hours a day
10	Foster the establishment of breastfeeding support groups and refer mothers to them upon discharge from the hospital or birth center

support [24]. Questions about hospital care and experiences following delivery included maternal self-report of: the number of breastfeeding problems experienced, the time to receipt of breastfeeding assistance, the amount and quality of help received, whether lactation support was sought by the patients, and adherence to four of the ten BFHI steps while inpatient. The four steps studied were: step 4, step 6, step 7, and step 10 (Table 1).

The global steps advocate helping mothers initiate breastfeeding within a half-hour of birth; however, the standard used in the United States is initiating within one hour of birth [25].

At two-weeks and four-months, mothers were administered modified age-appropriate versions of the "Infant Feeding Styles" and the "Maternal Feeding Practices and Beliefs" Questionnaires [26,27]. Altogether 24 likert-scale items were administered and used to calculate six validated attitude and behavioral constructs as directed [26,27]. These six constructs included the following two maternal feeding attitude constructs and four infant feeding behavior constructs.

Maternal feeding attitudes

1. Concern about infant under-eating or becoming underweight [27].
2. Concern about infant overeating or becoming overweight [27].

Maternal feeding behaviors

1. Feeding infant on a schedule [27].
2. Using food to calm infant's fussiness [27].
3. Feeding Style: Pressuring/Controlling [26].
4. Feeding style: Responsive [26].

At two-months and four-months postpartum, mothers were administered age-appropriate versions of the Infant Feeding Practices questionnaire to assess breastfeeding exclusivity over the previous 7 days [24].

Breastfeeding exclusivity was calculated at two-weeks, two-months, and four-months postpartum as the percentage of feedings in the past week that were breast milk. At 4-months, total breastfeeding exposure was calculated as the weighted mean of breastfeeding exclusivity at 2-weeks, 2-months, and 4-months. Breastfeeding exposures are expressed as a percentage such that 100% indicates exclusive breastfeeding for full 4-months.

At 4-months, study personnel measured (naked) infant weight in

Table 2: Maternal and Infant Characteristics.

Study group	NW ¹	OW/Ob ¹	p value ²
Pre-pregnant BMI (kg/m ²)	20.9±0.48	31.1±1.0	<0.0001
Gestational Age at Delivery (wks)	39.8±0.17	39.9±0.25	0.79
Gestational Weight Gain (lbs)	34.8±1.9	30.5±3.2	0.27
Maternal age (yrs)	30.7±0.55	30.3±0.98	0.70
Infant Birth Weight (g)	3246±74	3651±122	0.01 ³
Parity	1.1±0.38	2.3±0.30	0.02
Infant Sex (%male)	39%	65%	0.19
Vaginal Delivery (%)	78%	70%	0.72
Infant weight at 4-months (g)	6182±676	6764±924	0.16 ²
# Breastfeeding problems experienced after delivery	1.6±0.44	2.3±0.36	0.23
BFHI Step 4 reported % adherence	78%	80%	0.72
BFHI Step 6 reported % adherence	100%	90%	0.11
BFHI Step 7 reported % adherence	83%	75%	0.40
BFHI Step 10 reported % adherence	94%	79%	0.34
Breastfeeding Exclusivity at 2-wks ⁴	96%	98%	0.94
Total Breastfeeding Exposure over 4-mos ⁴	92%	71%	0.09
Infant weight at 4-months (g)	6182±676	6764±924	0.16 ²

1. Data presented as mean ± SEM
 2. p-value for comparison between NW vs OW/Ob group
 3. Controlling for infant sex
 4. 100% indicates exclusive breastfeeding
- NW: Normal Weight; OW/Ob: Overweight/Obese; BFHI: Baby Friendly Hospital Initiative
 BFHI Step 4: Help mothers initiate breastfeeding within one hour of birth.
 BFHI Step 6: Give infants no food or drink other than breast-milk, unless medically indicated.
 BFHI Step 7: Practice rooming in - allow mothers and infants to remain together 24 hours a day.
 BFHI Step 10: Refer mothers to breastfeeding support groups upon discharge from the hospital.

triplicate using a Sartorius Signum 2 research scale.

Statistics

All study data were collected and managed using REDCap electronic data capture tools hosted at The University of Colorado. REDCap (Research Electronic Data Capture) is a secure, web-based application designed to support data capture for research studies [28]. Maternal belief and behavioral construct scores were linear variables and thus linear regression analysis was used to investigate relationships between breastfeeding exclusivity and feeding practice construct scores. Multiple linear regression was used to test these relationships controlling for maternal BMI group. Chi-square and independent sample t-tests were used to test whether lactation support/hospital practices and behavioral constructs differed between maternal BMI groups, respectively. Statistical analysis was performed using Graph Pad Prism software V6.03 (La Jolla, CA). All values are presented as mean ± SEM, unless otherwise stated. P-values < 0.05 were considered significant.

Results

Cohort Characteristics The final sample size consisted of 18 NW women and 20 OW/Ob women. Characteristics of the cohort are presented by BMI group in Table 2. All mothers delivered healthy,

term infants. The only differences between groups were a higher parity and birth weight in the OW/Ob group.

In-hospital breastfeeding experience

The majority of women (73.7%) reported receiving help with breastfeeding sometime in the first two weeks after delivery and rated this help with a mean score of 4.04 on a scale from 1 to 5, with 5 representing “Very helpful.” The largest percentage of these women (42.9%) received breastfeeding assistance within one hour of delivery and the median time-interval in which help was received was between one and six hours postpartum. 57.1% of women reported receiving guidance regarding breastfeeding problems experienced while still in the hospital and rated this help with a mean score of 3.87. Of the four BFHI steps evaluated (step 4, 6, 7, and 10), mothers reported generally high adherence, >75% for each (Table 2). Rates of supplementation of liquid other than breast milk in the cohort as a whole were relatively low at 5%.

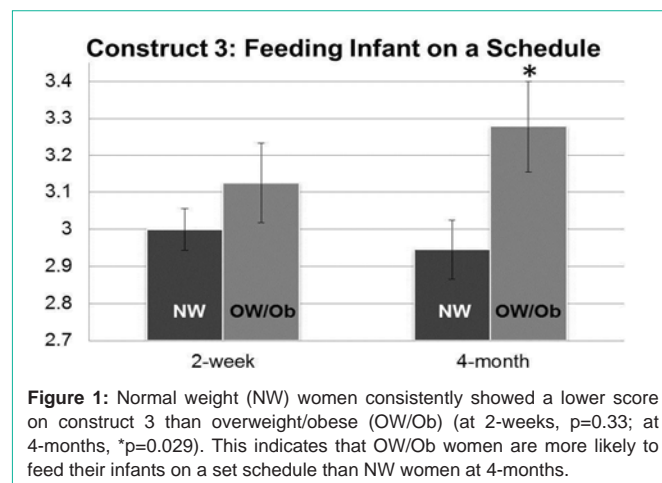
The percentages of women receiving breastfeeding aid while under hospital care did not differ between NW and OW/Ob women. Additionally, women’s responses concerning hospital care, type of breastfeeding aid, or satisfaction with aid received following delivery did not differ between NW and OW/Ob women. This included the number of breastfeeding problems experienced by women and adherence to the four BFHI steps (Table 2).

Infant feeding attitudes and behaviors by maternal BMI

None of the maternal beliefs or feeding behavioral constructs differed between NW vs OW/Ob women at 2-weeks. At 4-months, NW women demonstrated a significantly lower score for construct 3 (Feeding infant on a schedule) than OW/Ob women (p=0.029; Figure 1), indicating that NW women were less likely to practice this behavior.

Inter-relationships between infant feeding attitudes and behaviors

In the cohort as a whole at 2-weeks, construct 1 (Concern about infant under-eating) was positively associated with construct 5 (Pressuring/controlling feeding style) (p=0.002; n=32; R²=0.27), while construct 2 (Concern about infant over-eating) was negatively correlated with construct 6 (Responsive feeding style) (p=0.032; n=38; R²=0.12).



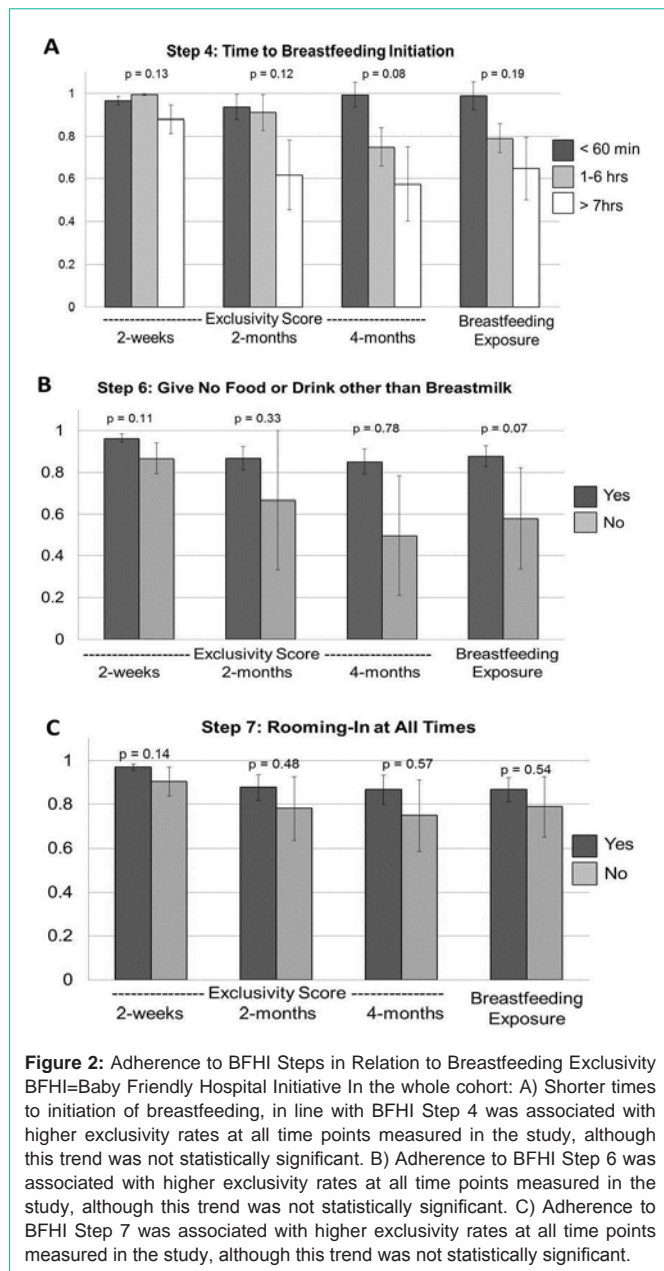


Figure 2: Adherence to BFHI Steps in Relation to Breastfeeding Exclusivity BFHI=Baby Friendly Hospital Initiative In the whole cohort: A) Shorter times to initiation of breastfeeding, in line with BFHI Step 4 was associated with higher exclusivity rates at all time points measured in the study, although this trend was not statistically significant. B) Adherence to BFHI Step 6 was associated with higher exclusivity rates at all time points measured in the study, although this trend was not statistically significant. C) Adherence to BFHI Step 7 was associated with higher exclusivity rates at all time points measured in the study, although this trend was not statistically significant.

At 4-months, in the cohort as a whole, construct 1 remained positively associated with construct 5 ($p=0.004$; $n=34$; $R^2=0.24$) and was also positively associated with construct 4 (Using food to calm infant fussiness) ($p=0.007$; $n=36$; $R^2=0.19$). Construct 2 remained negatively associated with construct 6 ($p=0.024$; $n=36$; $R^2=0.14$). No other inter-relationships were detected among the six attitude/behavioral constructs.

In-Hospital predictors of exclusivity

Neither breastfeeding exclusivity at any time point nor total breastfeeding exposure differed significantly between study groups. However there was a trend for lower breastfeeding exclusivity in OW/Ob women at 4-months (92.1% versus 71.3%; $p=0.09$).

A larger number of breastfeeding problems experienced by 2-weeks postpartum was correlated with lower breastfeeding

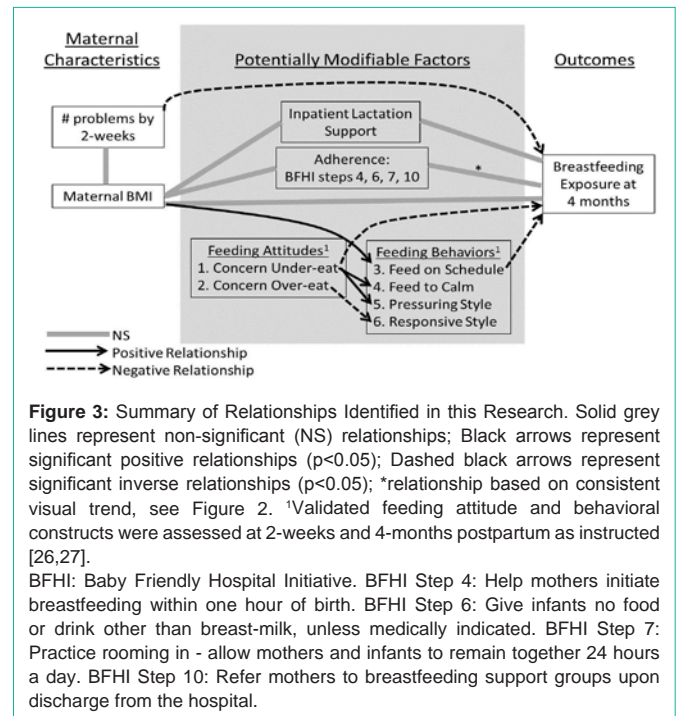


Figure 3: Summary of Relationships Identified in this Research. Solid grey lines represent non-significant (NS) relationships; Black arrows represent significant positive relationships ($p<0.05$); Dashed black arrows represent significant inverse relationships ($p<0.05$); *relationship based on consistent visual trend, see Figure 2. ¹Validated feeding attitude and behavioral constructs were assessed at 2-weeks and 4-months postpartum as instructed [26,27]. BFHI: Baby Friendly Hospital Initiative. BFHI Step 4: Help mothers initiate breastfeeding within one hour of birth. BFHI Step 6: Give infants no food or drink other than breast-milk, unless medically indicated. BFHI Step 7: Practice rooming in - allow mothers and infants to remain together 24 hours a day. BFHI Step 10: Refer mothers to breastfeeding support groups upon discharge from the hospital.

exclusivity at all time points ($p<0.01$) and overall breastfeeding exposure over the first 4 months ($p<0.001$). Other than this, none of the other in-hospital care variables (whether and when any help was received; whether help was received for a specific problem experienced; and quality of the help) were significantly correlated with breastfeeding exclusivity. Of the four BFHI steps studied, none were significantly correlated with exclusivity. However, there was a visual trend toward higher exclusivity rates when adherence was reported individually for: initiating BF within the first hour after birth (step 4), providing no liquid other than breast milk (step 6), and rooming-in (step 7) (Figure 2a, 2b, and 2c).

Relationships between behavioral constructs and breastfeeding exclusivity

At 2-weeks, behavioral construct 1 (Concern about infant under-eating) was significantly inversely related to exclusivity scores at 2-weeks, 2-months, 4-months, and total breastfeeding exposure ($p<0.001$, $p=0.019$, 0.017 , 0.018 , respectively). This suggests that increasing maternal concern about infants under-eating and/or becoming underweight was associated with increased supplementation with infant formula at all time points. The degree of concern over infant under-eating/under-gaining reported by mothers at 2-weeks explained 15% of the variation in total infant breastfeeding exposure over the first 4 months. This relationship also remained significant when controlling for maternal BMI group. Maternal report of Construct 3 (Feeding infant on a schedule) at 2-weeks was negatively related to exclusivity at 2-months, 4-months, and total breastfeeding exposure ($p=0.009$, 0.013 , and 0.003 , respectively).

Maternal report of Construct 3 at 4-months was also negatively correlated with breastfeeding exclusivity score at 4-months and total breastfeeding exposure ($p=0.024$ and 0.024 respectively). The degree to which mothers reported feeding on a schedule at 2-weeks and 4-months explained 18% and 14% of the variation in total infant

breastfeeding exposure, respectively.

Discussion

These data reveal a comprehensive assessment of 1) the impact of maternal overweight on potentially modifiable factors including in-hospital lactation support and maternal feeding attitudes and behaviors and 2) how all of these factors affect ultimate breastfeeding exposure at 4-months. We identified two specific potentially modifiable factors that would serve as ideal targets to improve infant breastfeeding exclusivity: maternal concern over infant under-eating/under-gaining (especially early postpartum), and feeding the infant on a schedule. Both of these constructs were predictive of reduced breastfeeding exclusivity. A summary of the inter-relationships identified in this research is depicted in Figure 3.

In this academic teaching-hospital setting, there were no differences in hospital care provided, lactation support received, or experiences related to breastfeeding efforts between NW and OW/Ob women. While these data are subjective as they are based on maternal self-report, this observations remains a noteworthy positive outcome given that overweight women are at higher risk of lactation failure and any anti-fat bias exhibited by hospital staff would only exacerbate this risk. Studies have indicated that healthcare professionals, including nurses, physicians, and other care providers can carry anti-fat biases and have negative attitudes directed at obese patients [29-31]. These negative attitudes have improved and affect the delivery of care much less in recent years [31]. Our data suggest that this academic teaching hospital is providing equitable and helpful postpartum care in support of breastfeeding to all women regardless of body mass.

This study failed to identify any specific hospital practices, including adherence to BFHI steps that were significantly related to breastfeeding exclusivity. However, larger studies have clearly shown the effectiveness of the BFHI steps, specifically: initiating breastfeeding within the one hour after birth (step 4), providing no other food or drink other than mother's milk after delivery (step 6), and rooming-in at all times (step 7) [9]. Even in our smaller sample size, adherence to these steps resulted in a consistent protective visual trend on breastfeeding exposure (figure 2). In this hospital specific setting, adherence to steps 6, and 10 were excellent (>86%). However, adherence to step 4 and 7 (initiating breastfeeding in the first hour and encouraging infant rooming-in at all times) were slightly less at <80%. In this healthy cohort of uncomplicated pregnancies and deliveries, improving adherence to these two steps represents an ideal target for improvement with the goal of increasing exclusivity rates. Given that the number of problems with breastfeeding experienced by two-weeks was negatively associated with exclusivity at all time points, another goal to improve breastfeeding success is to efficiently support women experiencing difficulties immediately so that subsequent additional problems are less likely to develop.

In this cohort OW/Ob women did not experience more breastfeeding problems than NW women and there were no differences in breastfeeding exposure between the groups (Figure 3). However, the OW/Ob cohort did have a significantly higher parity than the NW group. While the relationship between parity and breastfeeding success is controversial [14,32,33], it has been reported that parity is a predictor for breastfeeding success [14], and

so it is plausible that differences in breastfeeding problems and/or exclusivity could have been masked by an underlying difference in parity. Additionally, women in this study received additional follow-up and access to lactation support (due to study protocol) that could have helped eradicate differences between NW and OW/Ob women that would be observed on a population level.

The only feeding behavior/practice construct that differed between the cohorts was construct 3 (Feeding infant on a schedule), with higher scores reported by OW/Ob mothers at 4 months. Maternal BMI has been previously associated with decreased responsiveness to infants' fullness cues in other studies [23], which could drive this relationship. Given that construct 3 at both 2-weeks and 4-months was in turn associated with decreased exclusivity at almost all time points, these data suggest highlighting on-demand feeding (as opposed to on a set schedule) as a potential point of intervention, especially among OW/Ob women, to improve breastfeeding outcomes in this at-risk group (Figure 3).

This study identified Construct 1 (Concern about infant under-eating or being underweight) as a predictor of several negative feeding outcomes. Construct 1 was significantly correlated with construct 5 (Pressuring/controlling style) at both 2-weeks and 4-months and with construct 4 (Using food to calm infant's fussiness) at the 4-month time-point. These results are similar to other data in a similar age-group that report maternal belief that infants' appetite is lower than other babies' is associated with a less desirable pressuring feeding style [34]. Furthermore, construct 1 as reported on the 2-week questionnaire, was inversely correlated with exclusivity rates at all prospective time points. This relationships held in the cohort as a whole, and when controlling for maternal BMI group. These data suggest that mothers who are overly concerned about their infants' under-eating/under-gaining may be more likely to develop undesirable feeding practices such as: pressuring feeding behavior, supplementation with infant formula, and feeding as a first response to fussiness, amongst other forms of over-controlling and/or indulgent feeding.

Others have suggested that the relationship between feeding style and infant size is likely bidirectional (ie: mother's of smaller infants may respond with a more pressuring feeding style) [22]. This may be the case in our cohort as there was a trend for an inverse relationship between infant weight and Construct 1 at 4-months ($p=0.07$). However, maternal concern about infant under-eating/under gaining early postpartum only (at 2-weeks) was the predictor of negative feeding outcomes, and maternal report of Construct 1 at this time was unrelated to infant weight, or weight at birth. It is also particularly noteworthy that all infants in this cohort were of normal birth weight and exhibited appropriate growth patterns over the course of the study, likely indicating that much of maternal concern over infant becoming underweight was unwarranted. Together, these data contribute to the larger body of literature indicating that maternal anxiety about milk supply and infant intake are both powerful predictors of and primary sources of poor breastfeeding outcomes [32,35-37].

Our data are unable to identify the source of this maternal anxiety at the 2-week time-point. It is likely that some of the maternal concern arises from internal insecurity over ability to produce milk/breastfeed. Additional anxiety may result from health care providers who focus primarily on infant weight gain and are ill-equipped to

address breastfeeding issues and concerns. Our data clearly identify this attitude as a primary potential area for both provider and maternal educational intervention as a means to improve feeding behaviors and breastfeeding exclusivity among similar healthy populations.

A limitation of this study is the setting of only one hospital, which limits generalizability. However this academic teaching hospital, while not carrying Baby-Friendly Certification, demonstrated equity in post-delivery lactation support provided to women irrelevant of BMI. This serves as an example to be emulated in other similar institutions. We also did not measure maternal prenatal strength of intention to breastfeed, which may impact breastfeeding success. An additional limitation is the relatively small sample size of this cohort. A larger sample size may have revealed additional significant interactions and relationships in the variables explored. However with this sample size, our data were able to identify significant modifiable factors that would make ideal targets for intervention. Figure 3 summarizes the data from this study and clearly identifies the primary modifiable factors that impact negative feeding outcomes including reduced breastfeeding exclusivity. These include: the number of breastfeeding problems experienced in the first 2 postpartum weeks, maternal concern about infant under-eating/under-gaining, and feeding the infant on a schedule. Maternal concern about infant under-eating is associated with several negative feeding outcomes. Future interventions should target this propensity among mothers; efforts to improve maternal education regarding normal infant weight gain and normal milk production patterns may improve feeding outcomes. Education emphasizing feeding-on-demand in response to hunger and fullness cues may help prevent the inappropriate practice of feeding to calm fussiness and feeding infants on a schedule [1,6]. This particular component should be especially targeted for OW/Ob mothers who, according to this research, may be more likely to feed their infants on a schedule.

Conclusions

This work suggests that, in a research hospital setting, NW and OW/Ob women receive similarly excellent lactation care post-partum, although better adherence to initiating breastfeeding in the first hour and rooming-in are suggested areas for improvement as a strategy to increase breastfeeding exclusivity. The following maternal attitudes/behaviors were identified as risk factors for poor feeding outcomes in this group: concern about their infant under-eating/becoming underweight and feeding their infant on a schedule. These attitudes/behaviors represent key targets for future interventions among similar healthy populations to improve breastfeeding outcomes.

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