Associations of maternal obesity and psychosocial factors with breastfeeding intention, initiation, and duration[1–4]

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ABSTRACT

Background: Psychosocial factors influence breastfeeding outcomes, but little is known about these characteristics and how they influence breastfeeding behavior of obese women, who are a group that experiences poor breastfeeding outcomes.

Objectives: Our objectives were to determine whether *1*) maternal prepregnancy body mass index (BMI) is associated with social knowledge of, social influence toward, maternal confidence in, and behavioral beliefs about breastfeeding; *2*) BMI and these psychosocial factors predict outcomes of intention to breastfeed, ever breastfed, and the duration of breastfeeding; and *3*) BMI and psychosocial factors are associated with these breastfeeding outcomes independent of each other.

Design: Participants (n = 2824) in the Infant Feeding Practices Study II provided data on psychosocial characteristics and breastfeeding outcomes. In this prospective cohort study, data were analyzed by using logistic and proportional hazards regression models.

Results: Prepregnancy BMI was associated with confidence in ($P < 0.0001$), social influence toward ($P = 0.02$), and social knowledge of ($P < 0.0001$) breastfeeding but not with behavioral beliefs about breastfeeding ($P = 0.45$). Obese women did not differ from under- and normal-weight women in the intention to breastfeed ($P = 0.07$) but had lower odds of ever breastfeeding ($P = 0.04$) and were at greater risk of an earlier cessation of exclusive ($P = 0.0009$) and any ($P = 0.03$) breastfeeding. Only the association with exclusive breastfeeding remained significant after controlling for psychosocial factors ($P = 0.01$). All psychosocial factors were positively associated with each breastfeeding outcome.

Conclusions: Despite their intentions to breastfeed, women with high prepregnancy BMI had psychosocial characteristics associated with poor breastfeeding outcomes. However, these characteristics did not fully explain the association between maternal obesity and breastfeeding outcomes. *Am J Clin Nutr* 2014;99:524–34.

INTRODUCTION

Although breastfeeding is the recommended method of infant feeding (1), and national rates of breastfeeding have increased in recent years (2, 3), many women still never breastfeed, and those who do breastfeed continue to breastfeed for shorter periods than recommended (2). This is especially the case in overweight and obese women (4–7). Reasons for poor breastfeeding outcomes in heavier women are not fully understood but include both biological and psychosocial causes (8).

Various psychosocial constructs influence a woman's intention to breastfeed as well as the subsequent initiation and duration of breastfeeding. Research has shown that maternal confidence in breastfeeding is associated with breastfeeding initiation (9) and a longer duration (10–12). Similarly, maternal attitudes and beliefs about the benefits of breastfeeding relate to greater odds of an intention to breastfeed (9) and initiation of breastfeeding (13) as well as a longer breastfeeding duration (14). Finally, exposure to breastfeeding role models (15) as well as greater social support for breastfeeding from individuals in the mother's social network influence the mother's decisions to begin and continue breastfeeding (9, 11, 16).

However, few studies have focused on roles that these psychosocial characteristics play in the negative association between maternal obesity and breastfeeding outcomes, and no study to our knowledge has done so by using a national cohort. In a study of 151 women in rural New York, we (17) reported no difference by BMI category in beliefs about breastfeeding, maternal confidence related to breastfeeding, knowledge of breastfeeding, social support for breastfeeding, or familiarity with breastfeeding role models. In a study of 1375 women in Denmark, Kronborg et al (18) showed an association between BMI and self-efficacy. Kronborg et al (18) also reported that high BMI, low maternal self-efficacy, and low maternal confidence in the ability to produce enough breast milk were all independently associated with the early cessation of exclusive breastfeeding (EBF)[5].

Past explorations of the influence of psychosocial factors on breastfeeding behavior have been grounded in the theory of reasoned action (19, 20) and the social learning theory (21, 22). Similarly, we used these theories to guide our selection of psychosocial factors to understand breastfeeding behavior in overweight and obese women. Objectives of this study were to determine whether *1*) maternal prepregnancy BMI is associated with the psychosocial characteristics of social knowledge of

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[5] Abbreviations used: ABF, any breastfeeding; EBF, exclusive breastfeeding; IFPS II, Infant Feeding Practices Study II; PIR, poverty income ratio.

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breastfeeding, social influence to breastfeed, maternal confidence, and behavioral beliefs about breastfeeding; *2*) maternal BMI and these psychosocial characteristics predict breastfeeding outcomes of prenatal intention to breastfeed, ever breastfed, and the duration of EBF and any breastfeeding (ABF); and *3*) maternal BMI and psychosocial factors are associated with breastfeeding intention, initiation, and duration independent of each other.

SUBJECTS AND METHODS

Study sample

The Infant Feeding Practices Study II (IFPS II) is a longitudinal cohort study of women from late pregnancy through their infants' first year of life that was drawn from a nationally distributed consumer panel in the United States from May 2005 to June 2007 (23). Study data were collected via mail-in questionnaires, one questionnaire prenatally and 10 questionnaires postpartum. Detailed information on the study's methods are shown elsewhere (23). The 3033 women who completed both the birth screener and neonatal questionnaire were available for this study. Of these women, 154 women were ineligible because they lacked data on prepregnancy weight or height, which were necessary to calculate BMI ($n = 39$), or they did not declare their infant-feeding intention in the prenatal questionnaire ($n = 115$). Of eligible women, 55 women were excluded because they had identifiable, extreme values for BMI [in kg/m^2; <16 ($n = 9$) or >60 ($n = 3$)], a gestation duration >42 wk ($n = 42$), or the infant's birth weight was >6000 g ($n = 1$). As a result, we included 2824 participants in our analyses. This research was considered exempt by the Institutional Review Board at Cornell University.

Variables

The IFPS II data set has many relevant variables for numerous constructs. To account for this, some quantitative variables were recoded into groups (described below) on the basis of our previous knowledge and convention in the field.

Prepregnancy BMI was coded as under- or normal-weight (BMI <25.0) (there were too few underweight women to categorize them separately), overweight (BMI from 25.0 to 29.9), or obese (BMI ≥ 30.0) on the basis of self-reported height and weight measures.

Psychosocial factors

We created the following 4 psychosocial variables that we believed could be related to BMI and breastfeeding outcomes on the basis of past findings and the theory of planned behavior (24) and social cognitive theory (25): social knowledge of breastfeeding, social influence toward breastfeeding, attitude and behavioral beliefs toward breastfeeding, and maternal confidence in breastfeeding (**Table 1**; *see* Supplemental Table 1 under "Supplemental data" in the online issue for additional information).

Maternal and infant characteristics

Household income was reported as a percentage of the poverty income ratio (PIR) and categorized as $<185\%$ of PIR, between 185% and 350% of PIR, and $>350\%$ of PIR. Maternal race-ethnicity was categorized as non-Hispanic white, non-Hispanic black, non-Hispanic other, and Hispanic (any race). Planned return time to work was categorized on the basis of the time in weeks postpartum when a mother planned to return to work as follows: not planning return to work, ≤ 6, 7–12, or >12 wk. Actual return time to work was categorized as the time in weeks postpartum when a woman returned to work as follows: did not return to work, returned at ≤ 6, 7–12, or >12 wk. Education was categorized as high school education or less, some college education, or a college graduate. Marital status and smoking status were ascertained during the woman's third trimester of pregnancy, and both variables were categorized as yes or no. The delivery method was categorized as vaginal or cesarean. Past breastfeeding experience was categorized as yes if a woman had

TABLE 1
Descriptions of psychosocial factors used in analyses[1]

Psychosocial factor	Description
Social knowledge of breastfeeding	None; 1 or 2; 3–5; or >5 of mother's friends or relatives had breastfed. None included no friends or relatives had breastfed, no friends or relatives had children, or mother did not know.
Social influence toward breastfeeding	Low, medium, and high tertiles of a range of scores on the basis of infant-feeding opinions (and their importance to the mother) of the infant's father, the mother's mother, her mother-in-law, her obstetrician, and the infant's pediatrician.
Attitudes and behavioral beliefs about breastfeeding	Low, medium, and high tertiles of a range of scores on the basis of the quality of the mother's opinion of the best infant-feeding method in the first few weeks postpartum and the quality of her beliefs about breastfeeding.
Maternal confidence in breastfeeding	Low, medium, and high on the basis of a 5-point scale on which a mother ranked how confident she was that she would breastfeed as long as her prenatal breastfeeding goal.

[1] *See* Supplemental Table 1 under "Supplemental data" in the online issue for more-detailed descriptions of these variables.

breastfed a previous infant ≥1 mo or no if she had never breastfed or had breastfed a previous infant <1 mo. The gestation duration (wk) and infant birth weight (g) were both included as continuous variables.

Infant-feeding outcomes

Infant-feeding intention was categorized as the intention to breastfeed if the mother intended to breastfeed her infant to any extent after birth or intention to formula feed if she did not intend to breastfeed to any extent. Of mothers who intended to breastfeed, the intended duration of breastfeeding was categorized as ≤6, 6–12, or >12 mo. Ever breastfed was categorized as whether mothers said their infants ever breastfed or tried to breastfeed or who ever received breast milk (yes or no). The duration of ABF referred to the period during which milk was removed from a woman's breast by her (manually or with a pump) or her infant. The duration of EBF referred to the period during which the infant received only breast milk and no other liquids or solids.

Statistical analyses

We compared psychosocial, sociodemographic, and infant-feeding variables in prepregnancy BMI groups by using chi-square tests for categorical variables and ANOVA for continuous variables. Chi-square tests were also used to test differences in BMI groups and psychosocial, sociodemographic, and infant-feeding variables in outcomes of intention to breastfeed and ever breastfed. Finally, the Kaplan-Meier life-table method was used to determine whether the outcome variables of EBF and ABF duration differed by maternal prepregnant BMI categories as well as other psychosocial, sociodemographic, and infant-feeding variables. Participants who were still breastfeeding when they completed their last questionnaire (2.5% EBF; 36% ABF) were right censored for analyses that involved the duration of breastfeeding.

Psychosocial variables that were associated with BMI in the bivariate analysis were analyzed as the outcome in multivariate ordinal logistic regression with BMI as the predictor, with adjustment for sociodemographic confounders. Proportional odds models assume that logit surfaces are parallel. This assumption was confirmed with a nonsignificant score test for the proportional odds assumption.

For dichotomous outcomes of intention to breastfeed and ever breastfed, binary logistic regression was used to test associations of BMI with these outcomes, with adjustment for psychosocial variables. For time-to-event analyses of the duration of EBF and ABF, Cox proportional hazards regression was used to test associations of BMI with these outcomes, with adjustment for the psychosocial variables. The proportional hazards assumption was checked by visually inspecting Kaplan-Meier log survival plots for each covariate for the proportionality of curves. None of the covariates appeared to violate this assumption. Potential covariates were evaluated for multicollinearity, and there were no concerns.

Models were built in stages by first regressing BMI as a single predictor on all outcomes. Next, psychosocial factors were added to the model to test their impact on BMI and independent effect on each outcome. Additional covariates that differed significantly at $P < 0.10$ in bivariate analyses were added to the models. Predictors of interest (BMI and psychosocial factors) were retained. Models were reduced by removing sociodemographic and infant-feeding variables one by one if they were no longer significant in the adjusted model and did not contribute to a better-fitting model. Covariates that were used in analyses were planned time of return to work (or actual time of return to work in duration outcomes), prenatal intention to breastfeed (compared with formula feed), intended breastfeeding duration, marital status, past breastfeeding experience, smoking status, educational level, household income level, race-ethnicity, mode of delivery, gestation duration, and infant birth weight. Finally, potential interactions in retained psychosocial variables and maternal BMI were investigated by adding their cross-product terms to the equation. None of the interactions were significant ($P < 0.10$), and thus, interactions were removed for the final model-building step. For some variables, the sample size was too small to complete a stable interaction analysis. Statistical analyses were completed only with individuals who provided complete data on all variables required for an analysis. Analyses were conducted with SAS software (version 9.3; SAS Institute). Differences were considered to be statistically significant at $P < 0.05$.

RESULTS

Descriptive statistics by BMI category

Maternal prepregnancy BMI category was associated with social knowledge of, social influence toward, and maternal confidence in breastfeeding (**Table 2**), and these associations held when adjusted for sociodemographic variables (**Table 3**). However, women in the BMI groups did not differ in their attitudes or behavioral beliefs about breastfeeding. In addition, BMI category was not associated with smoking or marital status, gestation duration, subjects' planned or actual time of return to work, their prior breastfeeding experience, or their intended duration of breastfeeding. As expected, BMI category was significantly associated with education, income status, race-ethnicity, mode of delivery, and infant birth weight (Table 2).

Descriptive statistics by infant-feeding intention

The association between intended infant-feeding method and BMI category was not statistically significant ($P = 0.07$) (**Table 4**), and there was no difference in intended duration of breastfeeding (in women who intended to breastfeed) by BMI category (Table 2). There was a significant and expected association between infant-feeding intention and each psychosocial variable measured, whereby women with >5 friends or relatives who breastfed, had high social influence to breastfeed, and had good attitudes and behavioral beliefs about breastfeeding intended to breastfeed in greater proportions than did women with fewer friends or relatives, low social influence, and poor behavioral beliefs. Finally, women who intended to feed their infants only formula differed from women who intended to breastfeed their infants to any extent after birth in education, income, race-ethnicity, smoking status, planned return time to work postpartum, and past breastfeeding experience (Table 4).

Descriptive statistics by having ever breastfed

There was an association between women who ever breastfed (or fed their infant human milk after giving birth) and BMI

TABLE 2
Maternal and infant characteristics of IFPS II participants by prepregnancy BMI category[1]

	BMI category			
	Underweight/normal weight (<25.0 kg/m^2; n = 1406)	Overweight (25.0–29.9 kg/m^2; n = 741)	Obese (≥30.0 kg/m^2; n = 677)	P^2
Social knowledge [% (n)]				<0.0001
0 people/do not know	11.4 (160)	13.7 (100)	18.7 (125)	
1–2 people	20.9 (292)	21.7 (159)	23.6 (158)	
3–5 people	26.3 (368)	29.7 (218)	27.6 (185)	
>5 people	41.4 (578)	34.9 (256)	30.1 (202)	
Social influence [% (n)]				0.02
Low	26.6 (374)	27.6 (205)	31.6 (214)	
Medium	33.6 (473)	35.0 (259)	35.9 (243)	
High	39.8 (559)	37.4 (277)	32.5 (220)	
Attitudes and behavioral beliefs [% (n)]				0.40
Poor	9.1 (128)	10.8 (80)	11.8 (80)	
Fair	20.8 (293)	20.6 (153)	20.2 (137)	
Good	70.1 (985)	68.6 (508)	68.0 (460)	
Maternal confidence [% (n)][3]				<0.0001
Not confident	5.4 (63)	8.8 (55)	10.3 (54)	
Neutral	21.0 (244)	26.4 (166)	27.2 (142)	
Confident	73.6 (854)	64.8 (407)	62.5 (326)	
Education [% (n)]				0.0002
High school graduate or less	19.9 (257)	18.4 (125)	24.0 (152)	
Some college	37.3 (480)	43.9 (299)	42.7 (270)	
College graduate	42.8 (551)	37.7 (256)	33.3 (211)	
Income [% (n)]				0.005
<185% of PIR	38.1 (536)	41.7 (309)	45.9 (311)	
185–350% of PIR	36.8 (51)	35.9 (266)	35.0 (237)	
>350% of PIR	25.1 (353)	22.4 (166)	19.1 (129)	
Race-ethnicity [% (n)]				0.0002
Non-Hispanic white	82.9 (1135)	86.5 (622)	87.0 (576)	
Non-Hispanic black	4.3 (59)	5.2 (37)	4.7 (31)	
Non-Hispanic other	6.7 (92)	2.2 (16)	3.3 (22)	
Hispanic (any race)	6.1 (83)	6.1 (44)	5.0 (33)	
Smoking [% (n)]				0.82
Yes	9.5 (133)	9.1 (67)	10.1 (68)	
No	90.5 (1269)	90.9 (670)	90.0 (607)	
Married [% (n)]				0.77
Yes	79.6 (1029)	79.4 (544)	80.9 (516)	
No	20.4 (263)	20.6 (141)	19.1 (122)	
Planned return to work postpartum [% (n)]				0.66
Not planning to return to work	38.4 (536)	40.4 (298)	39.2 (263)	
≤6 wk	19.2 (268)	19.0 (140)	20.3 (136)	
7–12 wk	28.0 (390)	27.9 (206)	29.0 (194)	
>12 wk	14.4 (201)	12.7 (94)	11.5 (77)	
Actual time of return to work [% (n)]				0.70
Did not return to work	43.3 (524)	43.9 (285)	44.6 (261)	
≤6 wk	11.2 (136)	13.5 (88)	10.6 (62)	
7–12 wk	25.3 (306)	24.3 (158)	25.3 (148)	
>12 wk	20.2 (245)	18.3 (119)	19.5 (114)	
Past breastfeeding experience [% (n)]				0.23
Yes	53.2 (727)	55.6 (392)	51.0 (337)	
No	46.8 (640)	44.4 (313)	49.0 (324)	
Intended breastfeeding duration [% (n)][3]				0.61
≤6 mo	33.2 (389)	35.3 (224)	32.1 (169)	
6–12 mo	52.8 (619)	49.4 (314)	52.4 (276)	
>12 mo	14.0 (164)	15.3 (97)	15.5 (82)	
Mode of delivery [% (n)]				<0.0001
Vaginal	79.5 (1116)	69.9 (518)	59.0 (399)	
Cesarean	20.5 (288)	30.1 (223)	41.0 (277)	

(Continued)

TABLE 2 (*Continued*)

	BMI category			
	Underweight/normal weight (<25.0 kg/m^2; n = 1406)	Overweight (25.0–29.9 kg/m^2; n = 741)	Obese (≥30.0 kg/m^2; n = 677)	P^2
Gestation duration (wk)	39.3 ± 1.2 (1406)[4]	39.3 ± 1.3 (741)	39.2 ± 1.2 (677)	0.17
Infant birth weight (g)	3398 ± 448 (1445)	3499 ± 471 (757)	3532 ± 477 (686)	<0.0001

[1] IFPS II, Infant Feeding Practices Study II; PIR, poverty income ratio.
[2] Significance was determined by using the chi-square test for categorical variables and ANOVA for continuous variables.
[3] In women who intended to breastfeed.
[4] Mean ± SD; n in parentheses (all such values).

category as well as all psychosocial variables (Table 4). Similar to the pattern of differences of those with intentions to breastfeed, women with >5 friends or relatives who breastfed and had high social influence to breastfeed and good attitudes and behavioral beliefs about breastfeeding, ever breastfed in greater proportions than did women with fewer friends or relatives, low social influence, and poor behavioral beliefs. (Table 4). In addition, there was an association between ever breastfed and maternal education, income, race-ethnicity, smoking and marital status, planned return to work postpartum, past breastfeeding experience, and mode of delivery.

Descriptive statistics for durations of EBF and ABF

There was also an association of BMI category with EBF ($P <$ 0.0001) and ABF (P = 0.01). Obese women had a median duration of EBF ~6 wk shorter than that of both under-/normal-weight and also overweight women and a median duration of ABF ~9 wk shorter than that of under-/normal-weight women. Also expected, there was a positive relation between all psychosocial variables and both durations of EBF and ABF (Table 4). The greater women's social knowledge, the higher their social influence, the better their attitude/behavioral beliefs about breastfeeding, and the greater their confidence in their ability to breastfeed until their planned duration, the longer were their median durations of both EBF and ABF (all $P < 0.0001$). Finally, women who had more education, did not smoke, were married, returned to work at a later time postpartum, had previous breastfeeding experience, or intended to breastfeed for a longer duration had significantly longer median durations of EBF and ABF than those of their counterparts without these characteristics (all $P < 0.0001$).

Predictors of intention to breastfeed

BMI category was not independently associated with intention to breastfeed in either unadjusted or adjusted models (**Table 5**). In the final model, which was adjusted for significant covariates, all psychosocial factors were significantly associated with the intention to breastfeed. Relative to women with >5 friends or relatives who had breastfed, women with 0, 1–2, or 3–5 friends all had lower odds of intending to breastfeed. Similarly, relative to women with high social influence, women with low and medium social influence also had lower odds of intending to breastfeed. Finally, women with poor or fair behavioral beliefs also had lower odds of intending to breastfeed than did women with high behavioral beliefs.

Predictors of having ever breastfed

Obese women had lower odds of ever breastfeeding than did under-/normal-weight women (unadjusted, P = 0.04), but this difference was not significant after adjustment for psychosocial variables (Table 5). Women with lower social knowledge, lower social influence, and poorer behavioral beliefs about breastfeeding also had lower odds of ever breastfeeding in unadjusted models. In the final model adjusted for covariates, social knowledge was no longer independently associated with ever breastfed. However, women with fair or poor behavioral beliefs were >50% less likely to ever breastfeed than were women with good behavioral beliefs (adjusted, P = 0.002).

Predictors of cessation of EBF

Obese women were at greater risk of ceasing EBF earlier than under-/normal-weight women in the unadjusted model (HR: 1.32; 95% CI: 1.14, 1.52), the model adjusted for psychosocial

TABLE 3
Adjusted ORs (95% CIs) for the association between BMI and psychosocial factors[1]

Psychosocial factor	Underweight/normal weight	Overweight	Obese	P
Social knowledge (n = 2559)	Reference	1.22 (1.03, 1.45)	1.58 (1.32, 1.88)	<0.0001
Social influence (n = 2579)	Reference	1.07 (0.90, 1.27)	1.28 (1.08, 1.53)	0.02
Attitudes and behavioral beliefs (n = 2579)	Reference	1.11 (0.90, 1.35)	1.13 (0.92, 1.39)	0.45
Maternal confidence (n = 2127)	Reference	1.55 (1.25, 1.94)	1.71 (1.36, 2.16)	<0.0001

[1] Adjusted for maternal education, income, and race-ethnicity. Values were determined by using proportional odds models with ordinal logistic regression. Probabilities modeled were cumulated over lower-ordered values.

TABLE 4
Maternal and infant characteristics by intention to breastfeed, ever breastfed, and durations of EBF and ABF[1]

	Intention to breastfeed (n = 2444)[2]	Ever breastfed (n = 2423)[2,3]	EBF (n = 1258)[4]	ABF (n = 2423)[4]
			wk	*wk*
BMI category				
P	0.07	0.04	0.0001	0.01
Underweight/normal weight	87.2 (1226)	86.4 (1215)	14.7 [12.3–15.4] (676)	34.4 [30.1–38.7] (1215)
Overweight	87.7 (650)	87.3 (647)	14.1 [9.4–15.7] (310)	30.1 [25.8–34.4] (647)
Obese	83.9 (568)	82.9 (561)	8.1 [5.4–11.6] (272)	25.8 [21.5–30.1] (561)
Social knowledge				
P	<0.0001	<0.0001	<0.0001	<0.0001
>5 people	96.0 (994)	95.0 (984)	16.5 [15.3–18.1] (586)	47.3 [43.0–49.4] (984)
3–5 people	87.3 (673)	87.2 (672)	10.1 [6.9–13.4] (325)	25.8 [24.7–30.1] (672)
1–2 people	77.3 (138)	76.9 (468)	7.4 [5.3–9.4] (210)	17.5 [13.7–24.7] (468)
0 people/do not know	73.5 (283)	71.7 (276)	5.6 [3.9–9.5] (126)	16.0 [12.0–20.4] (276)
Social influence				
P	<0.0001	<0.0001	<0.0001	<0.0001
High	99.3 (1049)	98.0 (1035)	15.4 [14.5–17.0] (587)	38.7 [34.4–43.0] (1035)
Medium	94.0 (916)	92.6 (903)	10.1 [7.4–14.2] (466)	30.1 [25.8–34.4] (903)
Low	60.4 (479)	61.2 (485)	8.1 [6.1–9.9] (205)	17.2 [15.1–23.7] (485)
Attitudes and behavioral beliefs				
P	<0.0001	<0.0001	<0.0001	<0.0001
Good	97.0 (1895)	95.8 (1871)	15.1 [14.0–15.6] (1056)	38.7 [35.0–43.0] (1871)
Fair	76.2 (444)	74.3 (433)	4.3 [3.6–6.4] (166)	13.0 [10.2–14.6] (433)
Poor	36.5 (105)	41.3 (119)	3.3 [2.1–6.6] (36)	8.0 [4.6–10.0] (119)
Maternal confidence[5]				
P		<0.0001	<0.0001	<0.0001
Confident	—	98.6 (1565)	15.4 [14.5–16.4] (902)	43.0 [38.7–44.4] (1565)
Neutral	—	95.8 (529)	5.1 [3.8–6.8] (230)	16.0 [13.0–21.5] (529)
Not confident	—	88.4 (152)	4.1 [2.9–8.0] (54)	9.0 [7.0–12.0] (152)
Education				
P	<0.0001	<0.0001	<0.0001	<0.0001
High school graduate or less	77.2 (412)	76.4 (408)	6.8 [4.6–9.6] (191)	16.0 [12.9–21.5] (408)
Some college	88.4 (927)	87.3 (916)	9.8 [7.1–11.6] (490)	25.8 [25.8–30.1] (916)
College graduate	91.4 (930)	91.2 (928)	17.5 [15.5–18.3] (513)	43.0 [41.5–47.3] (928)
Income				
P	0.0003	0.0002	0.23	0.0001
<185% of PIR	83.9 (970)	82.8 (957)	12.1 [9.7–14.8] (497)	25.8 [23.0–33.9] (957)
185–350% of PIR	87.0 (887)	86.8 (885)	11.5 [9.4–14.9] (463)	34.4 [30.1–38.7] (885)
>350% of PIR	90.6 (587)	89.7 (581)	14.5 [11.4–15.6] (298)	30.1 [25.8–34.4] (581)
Race-ethnicity				
P	0.002	0.0007	0.08	0.002
Non-Hispanic white	85.8 (2002)	84.8 (1980)	14.0 [11.4–14.9] (1103)	34.4 [30.1–34.4] (1980)
Non-Hispanic black	84.3 (107)	85.0 (108)	5.1 [2.7–10.9] (28)	17.0 [12.0–25.8] (108)
Non-Hispanic other	95.4 (124)	94.6 (123)	17.0 [6.6–19.3] (44)	30.1 [19.9–42.1] (123)
Hispanic (any race)	92.5 (148)	93.1 (149)	10.3 [6.1–15.1] (57)	21.5 [14.0–30.1] (149)
Smoking				
P	<0.0001	<0.0001	<0.0001	<0.0001
Yes	69.4 (186)	68.3 (183)	14.4 [12.5–15.1] (1172)	34.4 [30.1–34.5] (2235)
No	88.5 (2253)	87.8 (2235)	3.6 [2.6–4.9] (85)	8.0 [6.0–12.5] (183)
Married				
P	0.05	0.001	<0.0001	<0.0001
Yes	87.8 (1834)	87.6 (1830)	4.6 [3.5–5.9] (195)	12.9 [10.0–15.0] (432)
No	84.6 (445)	82.1 (432)	15.2 [14.5–15.8] (1004)	38.7 [34.4–43.0] (1864)
Return to work postpartum[6]				
P	0.0003	0.003	<0.0001	<0.0001
No return to work	88.4 (970)	87.9 (964)	16.9 [15.4–17.8] (510)	43.0 [38.7–47.3] (933)
≤6 wk	81.6 (444)	81.3 (442)	5.9 [4.3–9.1] (146)	21.5 [21.5–30.1] (247)
7–12 wk	85.7 (677)	85.6 (676)	9.9 [7.6–13.3] (271)	25.8 [25.8–34.4] (524)
>12 wk	90.1 (335)	87.1 (324)	11.4 [8.0–14.5] (193)	25.8 [21.5–30.1] (421)
Past breastfeeding experience				
P	<0.0001	<0.0001	<0.0001	<0.0001
Yes	98.2 (1429)	97.7 (1423)	7.4 [5.4–9.9] (386)	15.0 [13.0–17.2] (923)
No	73.3 (936)	72.3 (923)	15.3 [14.5–16.4] (840)	43.0 [38.7–47.1] (1423)

(Continued)

TABLE 4 (*Continued*)

	Intention to breastfeed (n = 2444)[2]	Ever breastfed (n = 2423)[2,3]	EBF (n = 1258)[4]	ABF (n = 2423)[4]
Prenatal feeding intention				
P	—	<0.0001	—	—
Breastfeeding	—	97.0 (2371)	—	—
Formula	—	13.7 (52)	—	—
Intended ABF duration[5]				
P	—	—	<0.0001	<0.0001
≤6 mo	—	—	4.1 [3.5–5.4] (295)	11.0 [9.0–12.0] (623)
6–12 mo	—	—	14.4 [11.4–15.3] (672)	38.7 [38.7–43.0] (1194)
>12 mo	—	—	19.5 [18.8–21.0] (228)	— [—] (342)[7]
Mode of delivery				
P	—	0.008	0.65	0.38
Vaginal	—	86.9 (1766)	12.7 [10.5–14.6] (993)	32.4 [30.1–34.4] (1766)
Cesarean	—	83.0 (654)	14.1 [9.7–15.2] (264)	30.1 [25.8–34.4] (654)
Gestation duration (wk)				
P	—	0.74	0.01[8]	0.002[8]
	—	39.3 ± 1.2[9]	—	—
Infant birth weight (g)				
P	—	0.19	0.001[8]	<0.001[8]
	—	3461 ± 456[9]	—	—

[1] ABF, any breastfeeding; EBF, exclusive breastfeeding; PIR, poverty income ratio.

[2] Unless otherwise specified, all values are percentages; *n* in parentheses. Significance was determined by using the chi-square test for categorical variables and *t* test for continuous variables.

[3] Ever breastfed was defined as women who ever breastfed or tried to breastfeed or who indicated their infant ever received breast milk.

[4] All values are medians; IQRs in brackets; *n* in parentheses. Medians [IQRs] were determined by using the Kaplan-Meier life-table method. *P* values were determined by using Wilcoxon's signed-rank test.

[5] In women who intended to breastfeed.

[6] For outcomes of intention to breastfeed and ever breastfed, this variable referred to maternal plans to return to work postpartum. For duration outcomes, it referred to the actual time when the mother returned to work postpartum.

[7] Median value could not be estimated because >50% of respondents in this category were still breastfeeding at the time they filled out the last questionnaire. The mean (±SE) was estimated at 50.5 ± 0.9 wk.

[8] Significance was determined by using the chi-square test from a Cox proportional hazard model with a single continuous predictor (because it was not feasible to calculate a Kaplan-Meier curve for continuous predictors).

[9] Mean ± SD (all such values).

factors (HR: 1.25; 95% CI: 1.07, 1.46), and the final adjusted model (HR: 1.29; 95% CI: 1.09, 1.53) (Table 5). Women with less social knowledge of and lower social influence toward breastfeeding were at higher risk of ceasing EBF earlier than were women with greater social knowledge of and higher social influence toward breastfeeding. Women with poor or fair behavioral beliefs were more than twice as likely to cease EBF earlier than were women with good behavioral beliefs (unadjusted, $P < 0.0001$). Similarly, women who were not confident had a higher hazard of ceasing EBF earlier than did women who were confident ($P < 0.0001$). These associations were attenuated but remained significant in adjusted models.

Predictors of cessation of ABF

Both overweight (HR: 1.14; 95% CI: 1.01, 1.28) and obese (HR: 1.16; 95% CI: 1.02, 1.31) women were at significantly higher risk of ceasing ABF earlier than under-/normal-weight women, but this association did not hold in the model adjusted for psychosocial factors (Table 5). In contrast, women who knew ≤5 friends or relatives who had breastfed were at greater risk of ceasing breastfeeding earlier than were women with >5 friends or relatives in both unadjusted and adjusted models ($P < 0.0003$). Women with low or medium social influence had greater risk of ceasing ABF earlier than did women with high social influence in the unadjusted model only. Similarly, women with fair or poor behavioral beliefs were more than twice as likely to cease ABF earlier than were women with good beliefs (unadjusted, $P < 0.0001$); however, this difference was attenuated in the final adjusted model ($P = 0.07$). In addition, women who were not confident that they would reach their breastfeeding-duration intentions were ~3 times as likely to cease breastfeeding earlier than women who were confident (unadjusted, $P < 0.00001$).

DISCUSSION

We showed that overweight and obese women exhibited psychosocial characteristics that were independently associated with poor breastfeeding outcomes. Overweight and obese women were less confident that they would reach their breastfeeding goals than were under-/normal-weight women. Overweight and obese women reported fewer close friends or relatives who had breastfed, and they experienced lower social influence from others to breastfeed. The novel finding of these associations in a national cohort is in line with those of Kronborg et al (18) who showed lower maternal self-efficacy in obese women in their sample in Denmark. However, our results differed from those in

TABLE 5
Unadjusted and adjusted models for the association of maternal prepregnancy BMI and PSFs with intention to breastfeed, ever breastfed, and duration of EBF and ABF in all participants[1]

	Outcome			
Predictor	Intention to breastfeed (n = 2824)[2,3]	Ever breastfed (n = 2824)[2,4]	Duration of EBF (n = 1258)[5,6]	Duration of ABF (n = 2423)[5,7]
BMI category				
Unadjusted model[8]				
P	0.07	0.04	0.0009	0.03
Underweight/normal weight	Reference	Reference	Reference	Reference
Overweight	1.05 (0.80, 1.37)	1.08 (0.83, 1.41)	1.12 (0.97, 1.29)	1.14 (1.01, 1.28)
Obese	0.77 (0.59, 1.00)	0.76 (0.60, 0.98)	1.32 (1.14, 1.52)	1.16 (1.02, 1.31)
n	2824	2824	1258	2423
Model adjusted for all PSFs[9]				
P	0.26	0.17	0.02	0.79
Underweight/normal weight	Reference	Reference	Reference	Reference
Overweight	1.32 (0.92, 1.90)	1.32 (0.95, 1.84)	1.06 (0.92, 1.23)	1.00 (0.88, 1.13)
Obese	0.98 (0.69, 1.41)	0.95 (0.69, 1.32)	1.25 (1.07, 1.46)	1.04 (0.91, 1.19)
n	2801	2801	1176	2225
Final adjusted model[10]				
P	0.74	0.64	0.01	0.31
Underweight/normal weight	Reference	Reference	Reference	Reference
Overweight	1.03 (0.66, 1.59)	1.07 (0.63, 1.84)	1.09 (0.93, 1.27)	1.00 (0.87, 1.15)
Obese	0.87 (0.57, 1.33)	0.82 (0.49, 1.38)	1.29 (1.09, 1.53)	1.11 (0.96, 1.29)
n	2487	2466	1000	1785
Social knowledge				
Unadjusted model[8]				
P	<0.0001	<0.0001	<0.0001	<0.0001
>5 people	Reference	Reference	Reference	Reference
3–5 people	0.29 (0.20, 0.42)	0.36 (0.25, 0.51)	1.48 (1.28, 1.70)	1.64 (1.45, 1.86)
1–2 people	0.14 (0.10, 0.21)	0.18 (0.13, 0.25)	1.64 (1.39, 1.93)	1.88 (1.64, 2.15)
0 people/do not know	0.12 (0.08, 0.17)	0.13 (0.09, 0.19)	1.86 (1.52, 2.27)	2.16 (1.84, 2.54)
n	2801	2801	1247	2400
Model adjusted for BMI and all PSFs[9]				
P	<0.0001	<0.0001	<0.0001	<0.0001
>5 people	Reference	Reference	Reference	Reference
3–5 people	0.42 (0.27, 0.67)	0.55 (0.37, 0.82)	1.45 (1.25, 1.69)	1.49 (1.30, 1.69)
1–2 people	0.24 (0.15, 0.38)	0.31 (0.21, 0.46)	1.64 (1.38, 1.94)	1.63 (1.41, 1.88)
0 people/do not know	0.28 (0.17, 0.45)	0.30 (0.19, 0.45)	1.61 (1.30, 1.99)	1.63 (1.37, 1.94)
n	2801	2801	1176	2225
Final adjusted model[10]				
P	0.02	0.55	0.001	0.0003
>5 people	Reference	Reference	Reference	Reference
3–5 people	0.54 (0.32, 0.92)	0.97 (0.53, 1.78)	1.31 (1.11, 1.54)	1.35 (1.17, 1.56)
1–2 people	0.44 (0.26, 0.74)	0.73 (0.39, 1.35)	1.36 (1.13, 1.64)	1.22 (1.04, 1.44)
0 people/do not know	0.50 (0.28, 0.88)	0.68 (0.34, 1.36)	1.20 (0.95, 1.53)	1.37 (1.12, 1.67)
n	2487	2466	1000	1785
Social influence				
Unadjusted model[8]				
P	<0.0001	<0.0001	<0.0001	<0.0001
High	Reference	Reference	Reference	Reference
Medium	0.10 (0.05, 0.23)	0.25 (0.16, 0.42)	1.27 (1.12, 1.44)	1.19 (1.06, 1.34)
Low	0.01 (0.01, 0.02)	0.03 (0.02, 0.05)	1.52 (1.29, 1.79)	1.56 (1.37, 1.78)
n	2824	2824	1258	2423
Model adjusted for BMI and all PSFs[9]				
P	<0.0001	<0.0001	0.12	0.53
High	Reference	Reference	Reference	Reference
Medium	0.18 (0.08, 0.40)	0.42 (0.25, 0.70)	1.12 (0.98, 1.28)	0.96 (0.85, 1.08)
Low	0.03 (0.01, 0.06)	0.09 (0.05, 0.14)	1.16 (0.98, 1.40)	1.03 (0.89, 1.20)
n	2801	2801	1176	2225

(Continued)

TABLE 5 (*Continued*)

Predictor	Outcome			
	Intention to breastfeed (n = 2824)[2,3]	Ever breastfed (n = 2824)[2,4]	Duration of EBF (n = 1258)[5,6]	Duration of ABF (n = 2423)[5,7]
Final adjusted model[10]				
P	<0.0001	0.02	0.04	0.99
High	Reference	Reference	Reference	Reference
Medium	0.16 (0.06, 0.44)	0.73 (0.37, 1.43)	1.20 (1.04, 1.38)	0.99 (0.87, 1.13)
Low	0.03 (0.01, 0.06)	0.42 (0.21, 0.83)	1.15 (0.95, 1.39)	0.99 (0.84, 1.16)
n	2487	2466	1000	1785
Attitude/behavioral beliefs				
Unadjusted model[8]				
P	<0.0001	<0.0001	<0.0001	<0.0001
Good	Reference	Reference	Reference	Reference
Fair	0.10 (0.07, 0.14)	0.13 (0.10, 0.17)	2.04 (1.72, 2.41)	2.10 (1.86, 2.37)
Poor	0.02 (0.01, 0.03)	0.03 (0.02, 0.04)	2.18 (1.56, 3.05)	2.50 (2.03, 3.07)
n	2824	2824	1258	2423
Model adjusted for BMI and all PSFs[9]				
P	<0.0001	<0.0001	<0.0001	<0.0001
Good	Reference	Reference	Reference	Reference
Fair	0.18 (0.13, 0.26)	0.22 (0.16, 0.30)	1.77 (1.47, 2.13)	1.76 (1.54, 2.01)
Poor	0.04 (0.03, 0.06)	0.07 (0.05, 0.10)	2.01 (1.41, 2.86)	1.75 (1.37, 2.25)
n	2801	2801	1176	2225
Final adjusted model[10]				
P	<0.0001	0.002	0.002	0.07
Good	Reference	Reference	Reference	Reference
Fair	0.22 (0.15, 0.34)	0.41 (0.25, 0.67)	1.28 (1.04, 1.58)	1.17 (1.01, 1.37)
Poor	0.05 (0.03, 0.08)	0.50 (0.26, 0.97)	1.81 (1.22, 2.69)	1.22 (0.91, 1.63)
n	2487	2466	1000	1785
Maternal confidence[11]				
Unadjusted model[8]				
P	—	—	<0.0001	<0.0001
Confident	—	—	Reference	Reference
Neutral	—	—	1.74 (1.50, 2.02)	2.08 (1.84, 2.34)
Not confident	—	—	2.02 (1.53, 2.68)	2.98 (2.48, 3.59)
n	—	—	1186	2246
Model adjusted for BMI and all PSFs[9]				
P	—	—	<0.0001	<0.0001
Confident	—	—	Reference	Reference
Neutral	—	—	1.56 (1.33, 1.82)	1.81 (1.60, 2.04)
Not confident	—	—	1.66 (1.24, 2.21)	2.50 (2.07, 3.02)
n	—	—	1176	2225
Final adjusted model[10]				
P	—	—	0.02	<0.0001
Confident	—	—	Reference	Reference
Neutral	—	—	1.27 (1.07, 1.51)	1.32 (1.15, 1.52)
Not confident	—	—	1.16 (0.84, 1.61)	1.68 (1.34, 2.09)
n	—	—	1000	1785

[1] Values are ORs; 95% CIs in parentheses for intention to breastfeed and ever breastfed; values are HRs; 95% CIs in parentheses for duration of EBF and duration of ABF. ABF, any breastfeeding; EBF, exclusive breastfeeding; PSF, psychosocial factor.

[2] Logistic regression models that predicted the odds of intention to breastfeed and ever breastfed.

[3] All final models were adjusted for education, income, race-ethnicity, smoking status, and past breastfeeding experience.

[4] All final models were adjusted for race-ethnicity, planned return to work, past breastfeeding experience, prenatal infant-feeding intention, and marital status.

[5] Cox proportional hazard models that predicted the hazard of earlier cessation of EBF and ABF.

[6] All final models were adjusted for marital status, education, intended duration of breastfeeding, and actual return time to work.

[7] All final models were adjusted for intended duration of breastfeeding, actual return time to work, education, past breastfeeding experience, gestation duration, and marital and smoking status.

[8] Unadjusted model of the single predictor with each outcome.

[9] Model was adjusted to include BMI and psychosocial variables for each outcome.

[10] Best-fitting model for each outcome was determined by using the Akaike information criterion score. Models included BMI and psychosocial variables as well as particular covariates as described in footnotes 3, 4, 6, and 7.

[11] Maternal confidence was not used as a predictor for outcomes of intention to breastfeed or ever breastfed because only women with a prenatal intention to breastfeed responded to the question about their breastfeeding confidence.

our previous report (17) in which no association between BMI and psychosocial factors was shown. This difference may have been because of the small size and geographical locale of our past sample and because different questions were asked.

That women with high BMI display these psychosocial characteristics has important implications because these traits are often associated with worse breastfeeding outcomes. Fortunately, in intervention studies, other researchers have shown that breastfeeding initiation and duration increased in women who received support to increase their confidence (26) or increased support from family members (27) and other mothers who have breastfed (28). Surprisingly, the only support interventions in obese women did not result in an increase in breastfeeding duration (29, 30). Future research should continue to explore the effect of increasing breastfeeding support and confidence in overweight and obese mothers.

One psychosocial factor that did not differ by BMI status was that of behavioral beliefs related to breastfeeding. Approximately 70% of women in each BMI group had "good" behavioral beliefs. Women's beliefs influence their decision to breastfeed, and perhaps this played a role in our finding that overweight and obese women intended to breastfeed in similar proportions to under-/normal-weight women and that overweight and obese women intended to breastfeed for similar lengths of time. To our knowledge, the role that psychosocial factors play in an association between maternal BMI and breastfeeding intentions has not previously been studied.

The positive effect of maternal intention to breastfeed and intended duration length on the actual duration has been widely noted in the literature (15, 31–33). However, the association of maternal obesity with infant-feeding intentions is inconclusive. In 117 women living in a rural area with strong support for breastfeeding, we (17) previously observed that obese women intended to breastfeed for 3 mo less than did under-/normal-weight women. Similarly, in a sample of 200 women from Belgium, Guelinckx et al (34) showed that the incidence of intention to breastfeed was lower in obese than under-/normal-weight and overweight women. However, this information was collected retrospectively, which may not accurately represent a mother's intentions during the prenatal period. In contrast, Hauff and Demerath (35) reported that, in 239 American women who intended to breastfeed, there was no difference in the length of the intended duration by BMI. Our results from the current study supplement these findings and, for the first time to our knowledge, showed that BMI was not associated with breastfeeding intention in a large, national cohort. This finding suggests that overweight and obese women are as motivated to breastfeed as are under-/normal-weight women and that the message that breastfeeding is the best way to feed one's infant is reaching all women regardless of their BMI.

Although overweight and obese women were committed to breastfeeding their infants before giving birth, they experienced lower odds of ever breastfeeding their infants after delivery than did under-/normal-weight women, which is a finding that has been well supported in the literature (5, 7, 36). We also showed that less social knowledge, lower social influence, and poor behavioral beliefs about breastfeeding lowered the odds of ever breastfeeding. When the statistical models were adjusted for psychosocial factors, BMI was no longer significant. Because of the high correlation between intention to breastfeed and ever breastfed, it follows that psychosocial characteristics would likely have similar importance in both outcomes.

We showed a significant negative association between high maternal BMI and duration of EBF, even when adjusted for psychosocial factors and other significant covariates. Although this finding replicated the association between BMI and EBF duration shown by other authors (37, 38), it also suggested that obesity may be acting on the ability of women to breastfeed in ways unrelated to the intention, support, and knowledge of breastfeeding. For example, obese women may be ceasing EBF earlier because they need, or perceive they need, to supplement their milk supply. We and other authors (17, 39–41) have observed that obese women experience a delay in lactogenesis II. In addition, obese women have been reported to have more breastfeeding difficulties in the early postpartum period (38), a reduced prolactin response to suckling (42), and less confidence that they are producing a sufficient milk supply for the needs of their infants (38). Finally, we (43) showed in a previous analysis of this data set that obese women were more likely than under-/normal-weight women to express breast milk at 2 mo and respond that they did so to keep up their milk supply. These findings point to the possibility that obese women experience early postpartum breastfeeding difficulty because of milk-supply problems. When combined with our current result that obese women cease EBF earlier than under-/normal-weight and overweight women, despite the lack of differences in intention and independent of psychosocial characteristics, these findings suggest that obese women may begin supplementing because of a biological consequence of obesity.

Finally, our unadjusted results support our earlier finding (5, 37) that BMI was also significantly associated with ABF duration. However, in the current study, this association was eliminated when the model was adjusted for psychosocial characteristics. The intended duration of breastfeeding was strongly positively associated with the actual duration of ABF. The lack of an association in adjusted models could have resulted from the fact that women did not differ in the intended duration by BMI or because of the strong association between psychosocial variables and ABF duration. Although all 4 psychosocial variables were significantly associated with both EBF and ABF in unadjusted models, social knowledge and maternal confidence remained significant predictors in the duration of ABF. This result suggests that, once breastfeeding is well established, a mother's knowledge of other women close to her who have breastfed themselves and her own confidence to meet her breastfeeding goals are important to the continuation of breastfeeding.

Our results were both strengthened and limited by the design and outcome of the IFPS II. This longitudinal series of surveys is extensive, widely distributed, and provides a large sample size. These characteristics allowed us to test hypotheses in a temporal sequence, and they supported our analyses with appropriate statistical power. Although subjects were nationally distributed, they were unfortunately not nationally representative, especially in regard to racial-ethnic diversity. In addition, although maternal responses were provided for a vast array of subjects, the quantitative nature of the surveys limited our interpretation of the findings. Finally, it is possible that nondifferential misclassification of psychosocial factors may have biased our results toward the null.

In conclusion, women in this study showed positive beliefs about breastfeeding and strong intentions to breastfeed, which enabled us to identify specific times during the breastfeeding process when additional research or interventions may be most effective. Although obese women intended to breastfeed, they had many psychosocial characteristics that resulted in lower proportions of women who initiated breastfeeding and shorter durations of breastfeeding in women who ever began to breastfeed. Qualitative data exploring how these characteristics uniquely influence breastfeeding behavior in obese women, especially while the milk supply is being established, would be especially informative.

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