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Article *in* Research in Nursing & Health · October 2008

DOI: 10.1002/nur.20275 · Source: PubMed

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Predictors of the Duration of Exclusive Breastfeeding Among First-Time Mothers

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Accepted 12 January 2008

Abstract: Few women currently meet revised WHO recommendations to breastfeed exclusively for 6 months postpartum. In this prospective study we aimed to determine the influence of socio-demographic, psychosocial, and perinatal factors on the length of exclusive breastfeeding among 189 Canadian primiparous mothers. A majority of the participants did not meet their exclusive breastfeeding goals, and only 5% breastfed exclusively for a full 6 months. Breastfeeding self-efficacy, in-hospital formula supplementation, prenatal class attendance, and type of delivery independently predicted exclusive breastfeeding duration. Findings underscore the complex interplay of factors influencing breastfeeding, highlight the early postpartum weeks as a critical period for the establishment of exclusive breastfeeding, and suggest the need for a continuum of pre- and postnatal strategies for prolonging the exclusive breastfeeding period.
Res Nurs Health 31:428–441, 2008

Keywords: exclusive breastfeeding; breastfeeding duration; self-efficacy; formula supplementation; Cox regression

Breastfeeding is associated with significant infant and maternal health benefits (Ip et al., 2007) and is promoted worldwide as the optimal method of infant feeding (World Health Organization [WHO], 2003). In light of the dose–response relationship between breastfeeding and health outcomes, exclusive breastfeeding (i.e., no fluids or foods other than breast milk) for the first 6 months of life and the continuation of breastfeeding well beyond the first year of life, are recommended (American Academy of Pediatrics, 2005; WHO, 2002). Revised *Healthy People 2010* objectives include increasing the proportion of women who breastfeed exclusively to 60% at 3 months and 25% at 6 months (U. S. Department of Health and Human Services, 2007). Yet, despite a resurgence in breastfeeding initiation in North America, a minority of women practice exclusive

This article is based on data collected for a doctoral dissertation supported in part by fellowships from the Canadian Institutes of Health Research, the Order of Nurses of Quebec, and McGill University Faculty of Graduate Studies. We gratefully acknowledge the contribution of Jim Ramsay and Danielle Groleau to Dr. Semenic's dissertation committee, and thank all the new parents who volunteered their time to participate in this study.
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Published online 6 March 2008 in Wiley InterScience (www.interscience.wiley.com). DOI: 10.1002/nur.20275

breastfeeding beyond the early postpartum months. National health surveys indicate that only 17% of Canadian (Millar & Maclean, 2005) and 11% of American (Centers for Disease Control and Prevention, 2007) women breastfeed exclusively to 6 months; actual rates may be lower owing to biases (e.g., recall, social desirability) associated with retrospective telephone health surveys.

Breastfeeding is a multidimensional health behavior shaped by a complex interplay of biological, psychological and social factors. Women in both Canada (Millar & Maclean, 2005) and the US (Li, Ogden, Ballew, Gillespie, & Grummer-Strawn, 2002) are more likely to breastfeed and to do so exclusively if they are older, married, better-educated, more affluent, non-smoking, foreign-born, and returning later to paid employment. Yet, socio-demographic determinants offer limited guidance for how to prolong the exclusive breastfeeding period among women already motivated to breastfeed. Few studies to date have been conducted to explore more modifiable predictors of longer-term exclusive breastfeeding, in part, because the WHO's (2002) revised breastfeeding recommendations have only recently been integrated into policy (e.g., American Academy of Pediatrics, 2005; Health Canada, 2004). In a prospective study of over 500 breastfeeding mothers in Argentina, Cernados, Noceda, Barrera, Martinez, and Garsd (2003) found, after controlling for socio-demographic factors, that exclusive breastfeeding duration during the first 6 months was significantly associated with maternal attitudes toward breastfeeding, husband support of breastfeeding, mother-infant bonding, and breastfeeding difficulties. In a population-based follow-up of maternal, infant, and hospital factors associated with breastfeeding duration in Italy ($n = 1601$), Riva et al. (1999) found the rate of exclusive breastfeeding to be 8.1% at 6 months and identified in-hospital formula supplementation and pacifier use as significant predictors of shorter exclusive breastfeeding duration. In a smaller ($n = 74$) survey of psychosocial factors influencing infant feeding during the first year of life in New Zealand, Heath, Tuttle, Simons, Cleghorn, and Parnell (2002) found that only 3% of mothers continued exclusive breastfeeding to 6 months, and those who believed they did not have enough milk had a significantly shorter duration of exclusive breastfeeding. Ekstrom, Widstrom, and Nissen (2003a,b) found, in their retrospective study of 488 Swedish mothers, that the length of exclusive breastfeeding was positively related to maternal perceptions of overall breastfeeding support, length of time partners remained present after labor, earlier initiation of breastfeeding, and later postpartum hospital discharge; and negatively related to in-hospital formula supplementation for non-medical reasons. Other risk factors for earlier cessation of exclusive breastfeeding identified in multivariate analyses of breastfeeding exclusivity up to 4 months postpartum include inadequate prenatal breastfeeding information, cesarean delivery, and return to work or school (McLeod, Pullon, & Cookson, 2002), as well as lower breastfeeding self-efficacy (Blyth et al., 2002).

Unfortunately, comparisons across the scant literature on longer-term exclusive breastfeeding are limited by inconsistent definitions of breastfeeding exclusivity, investigation of different factors, use of unvalidated study measures, and different sociocultural contexts. Little is also known about the relative impact of different types of factors (e.g., demographic, personal, socio-environmental) on the length of exclusive breastfeeding, or how these may interact to influence infant feeding behaviors over the recommended period of exclusive breastfeeding. To promote and support extended exclusive breastfeeding, a better understanding is required of the key factors that predict sustained exclusive breastfeeding in different populations. The purpose of this prospective correlational study was to examine the relative impact of socio-demographic, psychosocial, and perinatal factors on exclusive breastfeeding duration in a sample of Canadian women. An interactional model (Christensen & Johnson, 2002; Loiselle & Delvigne-Jean, 1998) was used to explore the predictive as well as interactive influence of personal and contextual factors on the continuation of exclusive breastfeeding; no a priori hypotheses were made.

METHOD

Participants and Procedure

Between February and July 2003, a convenience sample of breastfeeding women was recruited from the maternity wards of three large teaching hospitals with similar obstetrical services in Montreal, Quebec, Canada. Ethics committee approval was granted from ethics boards of a university and in each hospital site. Eligible women were all first-time mothers (to control for previous breastfeeding experience) who planned to breastfeed exclusively for at least 6 weeks (as is commonly advised to ensure adequate milk production). Additional inclusion criteria were:

minimum of 18 years of age; birth of a single, healthy, full-term baby; able to speak and read English; and, living with a spouse/partner who could read English. Exclusion criteria included any maternal or infant illness or abnormality that potentially could interfere with the initiation of breastfeeding. Of 248 eligible mothers approached for recruitment, 43 (17%) refused to participate, and 16 (6%) consented but were discharged home prior to study participation (Fig. 1). A total of 189 mothers completed a brief verbal interview about their infant feeding plans and current breastfeeding status, and a self-report questionnaire assessing socio-demographic characteristics, perinatal factors and psychosocial variables. All data were collected between 24 and 72 hours post-birth (Time 1). Participants' partners ($n = 179$) completed a measure of paternal infant feeding beliefs at the same time. Follow-up psychosocial measures mailed to the mothers at 6 weeks (Time 2) and 4 months (Time 3) post-birth were returned by 154 (81%) and 132 (70%) of the 189 participants, respectively. Participants also were interviewed by telephone at 6 weeks ($n = 179$) about their breastfeeding status and any use of either formula or solids foods and, again, at 4 months ($n = 149$) and 6 months ($n = 130$) if they were still breastfeeding at the previous contact. Up to five attempts were made to reach participants for each telephone interview. Infant

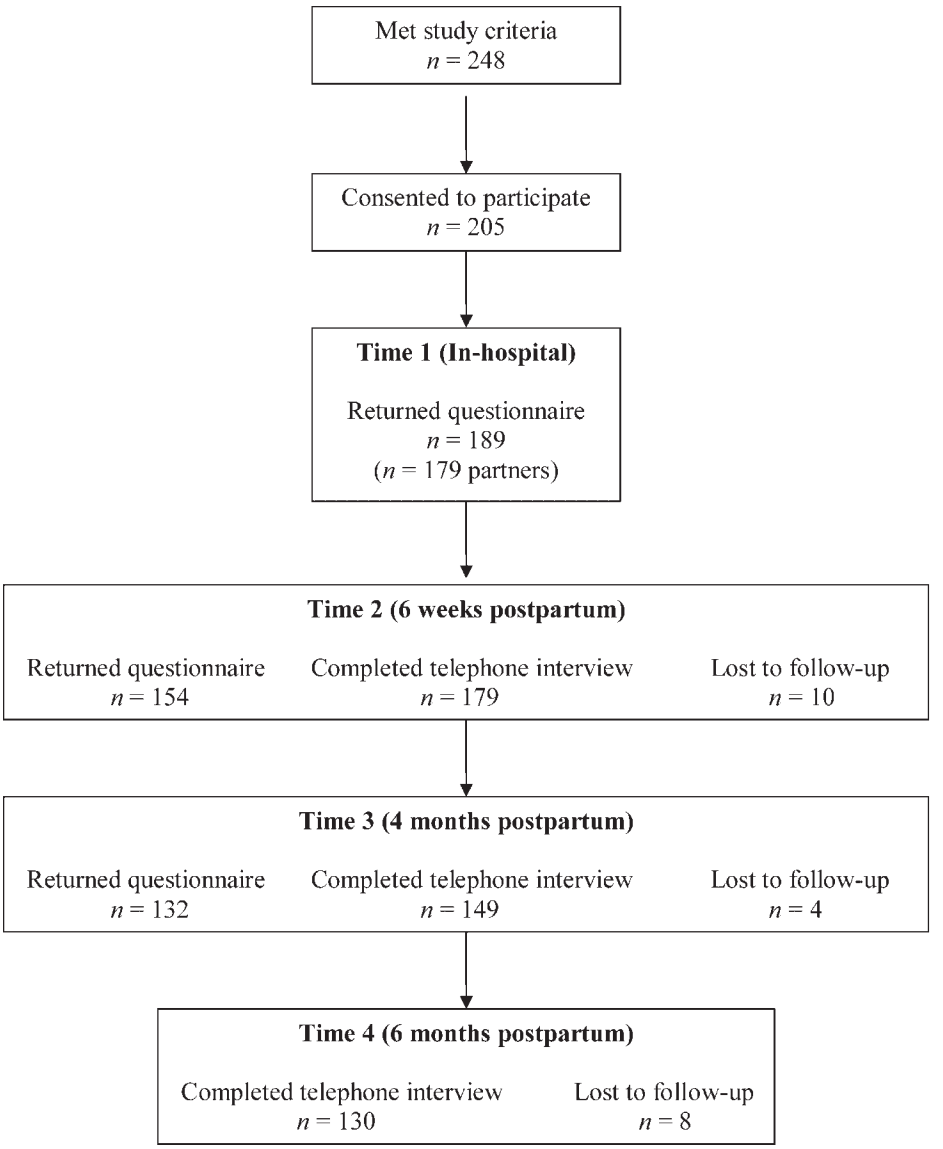

FIGURE 1. Participant recruitment and retention.

feeding data until time of complete cessation of breastfeeding or 6 months postpartum (whichever came first) were obtained from 167/189 (88%) of the mothers; 22/189 participants (12%) were lost to follow-up over the 6-month study period.

Measures

A number of socio-demographic, perinatal and psychosocial factors previously associated with exclusive breastfeeding duration were investigated. Socio-demographic data included maternal age, education, employment status, return to work plans, country of birth, number of years in Canada (if born elsewhere), smoking status, household income, and partner's education level. Perinatal variables related to the mothers' childbirth experience included prenatal class attendance (*yes/no*), type of delivery (*vaginal* or *cesarean* birth), infant birth weight (kg) and gestational age (weeks), intended duration of exclusive and any breastfeeding, number and type of breastfeeding problems during the first 6 weeks postpartum, and in-hospital use of formula supplements (*yes/no* and reasons). Potentially modifiable psychosocial variables included three personal (maternal infant feeding beliefs, breastfeeding self-efficacy, perceived infant satisfaction with breastfeeding) and three contextual factors (paternal infant feeding beliefs, general postpartum support, breastfeeding informational support).

Infant feeding beliefs. Maternal and paternal attitudes toward infant feeding methods were measured using the Breastfeeding Beliefs, and Bottle (Formula) Feeding Beliefs scales (Martens & Young, 1997). The Breastfeeding Beliefs tool has 10 statements exploring beliefs about the consequences of breastfeeding (e.g., "breastfeeding is convenient") rated from 1 (*strongly disagree*) to 5 (*strongly agree*), with higher scores reflecting more positive beliefs about breastfeeding. The Bottle (Formula) Feeding Beliefs tool contains identical items with the word *breastfeeding* replaced by *bottle feeding*, so that higher summed scores reflect more positive beliefs related to formula feeding. Slightly revised versions of these two measures demonstrated Cronbach alphas of .68–.88 (Breastfeeding Beliefs) and .85–.88 (Bottle feeding Beliefs) in studies of the effect of breastfeeding education on breastfeeding beliefs and attitudes (Martens, 2000a, 2001). To adapt the tool for use by fathers in our study, we modified three items by exchanging the word "you" for "your partner" (e.g., "Breastfeeding helps *your partner* regain her figure"). We only assessed infant feeding beliefs at baseline (in hospital); Cronbach alphas were .80 (Breastfeeding Beliefs) and .75 (Bottle Feeding Beliefs) for the maternal scores ($n = 188$), and .72 (Breastfeeding Beliefs) and .75 (Bottle Feeding Beliefs) for the paternal scores ($n = 178$). As breastfeeding and bottle (formula) feeding beliefs were significantly negatively correlated among both mothers and fathers in our study, the bottle (formula) feeding beliefs scores were reverse-scored and summed with the breastfeeding beliefs scores to create a composite measure of *Infant Feeding Beliefs* ranging from 20 to 100, with lower scores reflecting a more pro-formula feeding attitude and higher scores indicating more pro-breastfeeding attitudes.

Breastfeeding self-efficacy. Breastfeeding self-efficacy (BSE) refers to a mother's perceived confidence in her ability to successfully breastfeed, and was measured using the Breastfeeding Self-Efficacy Scale—short form (BSES-SF; Dennis, 2003). The BSES-SF contains 14 items preceded by the stem "I can always. . ." (e.g., "I can always successfully cope with breastfeeding like I have with other challenging tasks"), rated from 1 (*not at all confident*) to 5 (*always confident*) and summed for a range of 14 to 70, with higher scores indicating higher perceived breastfeeding self-efficacy. Psychometric assessment of the BSES-SF demonstrated a Cronbach's alpha of .94, and found that BSES-SF scores at 1-week postpartum predicted exclusive breastfeeding at both 4 and 8 weeks (Dennis, 2003). Chronbach alphas in our sample were .89 in hospital, .93 at 6 weeks, and .92 at 4 months postpartum.

Perceived infant satisfaction with breastfeeding. Mothers' evaluations of their infants' satisfaction with breastfeeding were measured using the Infant Satisfaction/Growth sub-scale of the Maternal Breastfeeding Evaluation Scale (MBFES; Leff, Jefferis, & Gagne, 1994). This sub-scale contains 4 positively keyed (e.g., "My baby loves to nurse") and 4 negatively keyed (e.g., "While breastfeeding, I worry about my baby gaining enough weight") statements rated from 1 (*strongly disagree*) to 5 (*strongly agree*). Scores are summed for a range of 8–40 following reverse-scoring of negative items, with higher scores reflecting higher perceived infant satisfaction and growth related to breastfeeding. Cronbach alphas for the Infant Satisfaction/Growth sub-scale have ranged from .83 to .88 (Leff et al.; Riordan, Woodley, & Heaton, 1994). We measured perceived infant satisfaction with breastfeeding at 6 weeks ($\alpha = .68$) and 4 months ($\alpha = .77$), once breastfeeding was established.

Postpartum support. Mothers' perceptions of postpartum social support were measured using the Postpartum Support Questionnaire (PSQ; Logsdon, Usui, Birkimer, & McBride, 1996), which consists of 34 items assessing material (9 items), emotional (10 items), informational (10 items), and comparison (5 items) support. The PSQ measures how important the mother perceives each particular item of support to be (from 0 = *not important* to 7 = *very important*), as well as how much help she expects (when measured in-hospital) or feels she received for each item (from 0 = *no help* to 7 = *lots of help*), with a range of 0–238 for each scale. Data from four studies demonstrated Cronbach alphas of .90–.94 for total instrument, and factor analysis supported the four categories of support with emotional support accounting for the most variance (Logsdon et al.). To create a score for postpartum support weighted by the mother's perceptions of the importance of that support, we multiplied the "importance" and "expected/received" scores for each PSQ item and summed their products across all items. We assessed postpartum support in-hospital as a measure of anticipated support ($\alpha = .94$), and at 6 weeks ($\alpha = .93$) at 4 months ($\alpha = .95$) as a measure of received support.

Breastfeeding informational support. Breastfeeding informational support was measured using an adapted version of the Breastfeeding Informational Support Inventory (BISI; Loiselle, Semenic, Côté, Lapointe, & Gendron, 2001). This revised BISI includes 23 items referring to specific types of breastfeeding information (e.g., "why breastfeeding is good for my baby's health"). For each item, mothers indicate whether they had *ever* received that type of information (*yes*, *no*, *not sure*), as well as rate their perceived importance of that information from 1 (*not very important*) to 5 (*extremely important*). The importance ratings for all items of information received were summed for a total measure of breastfeeding informational support with a range of 0–115. We only measured BISI at 6 weeks ($\alpha = .90$) and 4 months ($\alpha = .92$), to avoid cueing the new mothers about unmet informational needs during the breastfeeding initiation phase.

The study's main outcome measure of number of weeks of exclusive breastfeeding was calculated from maternal reports of their infants' precise ages at introduction of either formula or solid foods. As we did not systematically assess the use of other liquids, such as water or juice, *exclusive breastfeeding* in this study is consistent with the Labbok and Krasovec (1990) definition of "almost exclusive breastfeeding" and refers to the feeding of breast milk (including pumped/expressed breast milk) without supplementary use of either infant formula or solid foods. *Weaning* referred to the cessation of any breastfeeding; maternal reports of the number of weeks of *any breastfeeding* were obtained from those who weaned during the study period.

Data Analysis

All analyses were conducted using the Statistical Package for Social Sciences software (SPSS 12.0 for Windows). Correlation matrices were computed to explore relationships between all study variable pairs. Changes in personal and contextual variable scores over time were examined using paired *t* tests and repeated measures analyses. Because a substantial subset of mothers failed to initiate exclusive breastfeeding as planned, residuals for the outcome measure of exclusive breastfeeding duration were non-normally distributed. The influence of the predictor variables on duration of exclusive breastfeeding were therefore assessed by survival analysis using Cox proportional-hazards regression modeling. Cox regression modeling is increasingly used to study breastfeeding duration as it allows joint estimation of the effects of variables measured at baseline on the "hazard" (or risk) of breastfeeding cessation over time. We used the time-dependent Cox regression model (Aydemir, Aydemir, & Dirschedl, 1999) to incorporate follow-up scores for three covariates with repeated measures beyond baseline (number of breastfeeding problems, breastfeeding self-efficacy, postpartum support), allowing for a more precise estimate of the influence of these variables over time. Kaplan–Meier survival curves were estimated for number of weeks of exclusive breastfeeding as well as any breastfeeding to 6 months postpartum. Bivariate Cox regression analyses were conducted to determine the individual association of all variables measured at baseline (i.e., in hospital) with continued exclusive breastfeeding, and all those significant to $p = .25$ were retained for further multivariate testing (as per Hosmer & Lemeshow, 1999). Sequential regression analysis was used to explore the relative contribution of different types of variables to exclusive breastfeeding duration. Socio-demographic (i.e., temporally prior) factors were entered in the first block. Personal variables were entered before contextual resources, as they were considered to be temporally prior and/or more stable than the contextual factors.

Perinatal variables were entered last. The preliminary multivariate model was then reduced one variable at a time in order of diminishing statistical significance and refit at each step to identify independent predictors of exclusive breastfeeding duration. Potential interactions among the resulting main effect variables were investigated by adding their cross-product terms to the equation for the final model-building step, and variable residuals and DfBetas were examined to assess adequacy of the final model fit (Hosmer & Lemeshow).

RESULTS

Participant Characteristics

Participants ($n = 189$) were predominately well-educated (64% had university degrees, as did 56% of the partners), affluent (46% had annual household incomes from CDN $50 to $99,000, 28% had incomes $\geq$ CDN $100,000), non-smoking, and older for mean age at delivery of first child (30.1 years, range = 19–42 years). Although all the participating mothers spoke English, the sample reflected Montreal's culturally diverse population of English Canadians, French Canadians, and immigrants; 36 (19%) were foreign-born (from 23 different countries) and had been in Canada for a mean of 13 years. Most of the participants were employed during pregnancy (57% full-time), and 76% had attended prenatal classes. Given Canada's extended maternity leave benefits, only 10 of the 189 participants (5%) planned to return to work before 6 months postpartum, and almost half (48%) did not intend to resume working for at least 1 year. Seventy percent of the mothers had a vaginal birth, and 30% delivered via cesarean section, consistent with local obstetrical practice. Mean infant birth weight was 3.469 kg (range = 2.740–5.025 kg), with a mean gestational age of 39.8 weeks (range = 37.0–42.0 weeks). No significant differences in background characteristics were found among participants recruited from different hospitals or between immigrant and Canadian-born women, therefore, data were pooled for all further analyses.

Participants reported an average of 1 (range = 0–4) breastfeeding problem during postpartum hospitalization ($n = 189$) and 2 (range = 0–5) problems at 6 weeks ($n = 177$). Commonly reported breastfeeding difficulties included "not enough milk," baby having difficulty latching, sore nipples, and maternal fatigue related to frequent feedings. Almost half the participants ($n = 90$, 48%) reported their infant was supplemented with formula at least once during postpartum hospitalization despite intentions to breastfeed exclusively, most often because their newborn was "too hungry" or unable to suckle. Given high rates of formula use in the early postpartum period, Martens (2000b) suggested quantifying the duration of full breastfeeding as the time from birth to the time of first regular supplementation. As many participants resumed exclusive breastfeeding following hospital discharge, we redefined all those who successfully transitioned to exclusive breastfeeding by 1 week post-delivery as exclusive breast-feeders and assessed in-hospital formula supplementation as an individual predictor of exclusive breastfeeding duration.

Breastfeeding Intentions and Patterns

All participants ($n = 189$) planned to breastfeed exclusively for at least 6 weeks. Of these, 35% planned to breastfeed exclusively for a full 6 months as recommended, 35% for at least 4 months, and 30% intended to introduce either formula or solid foods before 4 months of infant age. Of the 167 participants followed until time of weaning or 6 months (whichever came first), 108 (65%) were still breastfeeding at least some amount at 6 months. Those who had weaned ($n = 59$) stopped breastfeeding at a median of 8.3 weeks. The rate of exclusive breastfeeding was 75%, 67%, 59%, 37%, 17%, and 5% at 1, 2, 3, 4, 5, and 6 months, respectively (Fig. 2). A within-subjects comparison ($n = 163$) of participants' intended versus actual duration of exclusive breastfeeding revealed the majority (61%) breastfed exclusively for a shorter length of time than originally planned. Data on the precise duration of exclusive breastfeeding were available for 175 participants. Mean infant age at cessation of exclusive breastfeeding was 13.3 weeks ($SD = 8.1$), or 3.1 months. By 6 weeks, 34% of the participants (60/175) were no longer breastfeeding exclusively or had weaned; more than half of these new mothers (35/175) never managed to establish exclusive breastfeeding following delivery. Participants who succeeded to breastfeed exclusively for at least 6 weeks as planned (115/175), on the other hand, continued exclusive breastfeeding for a mean of 18.1 weeks (4.2 months). At 6 months postpartum, one-third of the mothers (56/167) were still breastfeeding without using any supplementary formula. Among

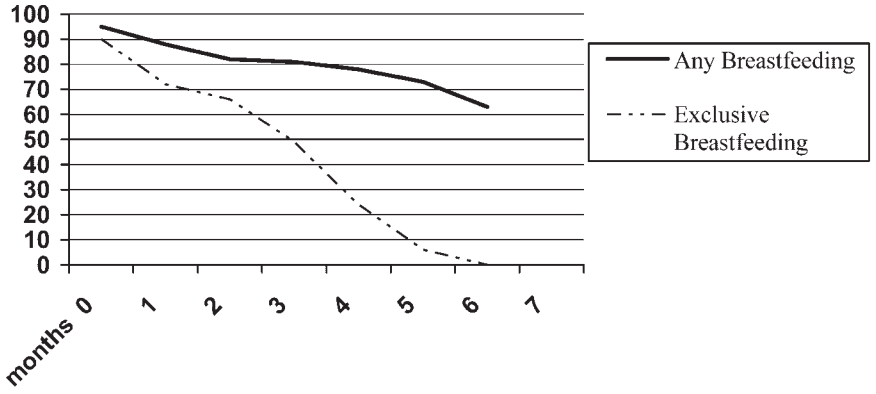

FIGURE 2. Cumulative survival of breastfeeding in months (n = 167).

those who began using formula by 6 months ($n = 111$), mean infant age at introduction of formula was 10.7 weeks (*range* = 1–26 weeks). Mean infant age at first introduction of solid foods (available for 136 participants) was 19 weeks (*range* = 5–28 weeks); only 10/136 mothers (7%) reported waiting a full 6 months before introducing solid foods.

Personal and Contextual Variables

Descriptive information on the psychosocial variables is presented in Table 1. Mother and partner infant feeding beliefs were significantly correlated ($r = .44$, $p < .01$) and reflected strongly positive attitudes towards breastfeeding. Maternal breastfeeding self-efficacy (BSE) increased significantly between postpartum hospitalization and 4 months (F [2,234] = 43.28, $p < .001$), as a likely combination of breastfeeding confidence gained through experience and attrition of non-successful breastfeeders who weaned. Similarly, perceived infant satisfaction with breastfeeding increased overall between 6 weeks and 4 months (t [117] = −2.88, $p \leq .01$). Closer analysis revealed that during the first 6 weeks postpartum, BSE decreased among mothers who were either supplementing with formula ($n = 31$, $M_{\text{difference score}} = -4.6$) or had weaned ($n = 13$, $M_{\text{difference score}} = -11.2$) by 6 weeks, but increased among those who successfully continued exclusive breastfeeding ($n = 107$, $M_{\text{difference score}} = 7.5$) ($F$[2,148] = 31.2, $p < .001$). Mothers who weaned completely by 4 months postpartum also reported lower BSE ($M = 36.7$ vs. 54.7, $p < .001$) and lower infant satisfaction with breastfeeding ($M = 25$ vs. 32.7, $p < .001$) at 6 weeks, than those who were still breastfeeding at 4 months. The composite measure of postpartum support decreased between Times 1 and 3 (F[2,218] = 12.3, $p < .001$), suggesting parti-

Table 1. Means Scores for Psychosocial Variables at Time 1 (In-Hospital), Time 2 (6 Weeks) and Time 3 (4 Months)

	Time 1		Time 2		Time 3	
	n	*M* (*SD*)	*n*	*M* (*SD*)	*n*	*M* (*SD*)
Personal variables						
Maternal infant feeding beliefs[a]	188	79.2 (8.2)		—		—
BF self-efficacy	189	48.0 (9.4)	156	51.9 (11.7)	130	56.9 (10)
Infant satisfaction with BF		—	154	31.5 (5.0)	132	33.3 (5.3)
Contextual factors						
Paternal infant feeding beliefs[a]	178	76.5 (7.9)		—		—
Postpartum support[a,b]	183	777 (271)	154	698 (276)	123	698 (297)
BF informational support		—	153	67 (19.7)	130	73.7 (22)

Note: BF, breastfeeding.
[a]Scores are for the composite measures.
[b]Time 1, expected postpartum support; Times 2 and 3, received postpartum support.

cipants expected more postpartum help from their social network than they actually received at 6 weeks and 4 months. Breastfeeding informational support, however, increased between 6 weeks and 4 months ($t[113] = -3.18, p \leq .01$), indicating mothers continued to seek and/or receive specific breastfeeding advice over the course of breastfeeding.

Predictors of Exclusive Breastfeeding Duration

Complete data for multivariate Cox regression analyses were available for 178 participants. We had adequate power to model up to 15 variables simultaneously, based on a recommended minimum of 10 "events" (i.e., participants who ceased exclusive breastfeeding by 6 months) per predictor variable (Harrell, 2001). Two main variables that we did not measure at baseline (perceived infant satisfaction with breastfeeding, and breastfeeding informational support) had to be excluded from the Cox analyses. Table 2 displays the unadjusted association of each variable investigated with the risk of cessation of exclusive breastfeeding by 6 months postpartum. Use of in-hospital formula supplements, not attending prenatal classes, and cesarean delivery were each significant ($p < .05$) risk factors for a shorter duration of exclusive breastfeeding, whereas higher maternal BSE and more positive maternal as well as paternal attitudes towards breastfeeding (relative to formula feeding) were significantly associated with a longer duration of exclusive breastfeeding.

Table 3 displays regression coefficients for the preliminary multivariate model of predictors of exclusive breastfeeding duration, composed of all variables individually associated up to $p = .25$ with exclusive breastfeeding duration. The influence of different levels of variables was determined via the model log-likelihood change following each entered block. Socio-demographic factors (maternal age and education) did not contribute significantly to the model. The addition of personal variables (BSE and maternal infant feeding beliefs) significantly improved the model. The contextual factor of paternal infant feeding beliefs was not significant. The remaining set of perinatal variables, however, contributed significantly to the model after adjusting for the socio-demographic, personal, and contextual variables. Step-by-step removal of non-significant variables from the preliminary multivariate model yielded four independent predictors of the duration of exclusive breastfeeding: prenatal class attendance, in-hospital formula supplementation, type of delivery, and breastfeeding self-efficacy (Table 4).

Relationships Among Study Variables

No significant interactions were found among the final model's main effect variables. Yet, several significant ($p \leq .05$) correlations were observed

Table 2. Unadjusted Association of Variables With Exclusive Breastfeeding to 6 Months ($n = 178$)

Factor	β	Wald[a]	p
In-hospital supplementation (Yes/No[c])	.48	8.75	.003
Prenatal class attendance (Yes[c]/No)	.52	6.93	.008
Type of delivery (vaginal[c]/cesarean)	.45	6.34	.01
BF self-efficacy	−.02	4.92	.03
Paternal feeding beliefs	−.02	4.02	.04
Maternal feeding beliefs	−.02	3.67	.05
Exclusive BF plan ($<$6 months/Full 6 months[c])	.32	3.50	.06
Maternal education ($\leq$College/$\geq$University[c])	−.25	2.22	.14
Maternal age	.07	1.91	.17
Number of BF problems	.08	1.33	.25
Return to work plans ($\leq$6/$>$6 months[c])		2.01	.35[b]
Infant birth weight		.46	.50[b]
Postpartum support		.43	.51[b]

Note: BF, breastfeeding.
[a]From bivariate Cox regression analyses.
[b]Level of significance $>.25$, variable not included in subsequent multivariate analyses.
[c]Reference group.

Table 3. Coefficient Estimates of Cox Regression Model for Exclusive Breastfeeding to 6 Months

Factor	β	*SE*	Wald[a]	*p*
Block 1 (*socio-demographic factors*)				
Maternal education	.21	.18	1.35	.25
Maternal age	.03	.02	1.54	.22
	Change in −2 log likelihood: $\chi^2(2, N=178)=4.65$, $p=.10$			
Block 2 (*personal factors*)				
BF self-efficacy	−.01	.01	1.30	.25
Maternal infant feeding beliefs	−.01	.01	.15	.70
	Change in −2 log likelihood: $\chi^2(2, N=178)=5.76$, $p=.05$			
Block 3 (*contextual factors*)				
Paternal infant feeding beliefs	−.01	.01	.58	.45
	Change in −2 log likelihood: $\chi^2(1, N=178)=.90$, $p=.34$			
Block 4 (*perinatal factors*)				
Prenatal class attendance	.51	.21	6.10	.01
Type of delivery	.32	.19	2.91	.09
Exclusive BF plan	.24	.18	1.75	.19
In-hospital supplementation	.25	.18	2.09	.15
Number of BF problems	.04	.08	.24	.62
	Change in −2 log likelihood: $\chi^2(5, N=178)=15.89$, $p=.007$			

Note: Initial (baseline) −2 log likelihood = 1338.51. Entire model $\chi^2(10, N=178)=28.97$, $p<.001$.
HR, hazard ratio for cessation of exclusive breastfeeding; CI, confidence interval; BF, breastfeeding.
[a]From multivariate Cox regression analysis.

among the final model predictors and other study variables. BSE correlated most strongly with perceived infant satisfaction with breastfeeding ($r=.57$ at 6 weeks, and .67 at 4 months), although this may have been due, in part, to overlap between scale content. Similarly, BSE was negatively associated with the number of perceived breastfeeding problems during postpartum hospitalization ($r=-.41$) as well as at 6 weeks ($r=-.52$). Mothers with higher initial BSE held more positive attitudes towards breastfeeding relative to formula feeding ($r=.36$) and had partners with more positive breastfeeding attitudes ($r=.28$). BSE was also positively associated with breastfeeding informational support, but only at 4 months ($r=.35$). In-hospital formula supplementation was related to more perceived breastfeeding problems in hospital ($r=.31$), lower BSE both in-hospital ($r=-.25$) and at 6 weeks ($r=-.25$), and lower partner infant feeding beliefs scores (i.e., less positive beliefs towards breastfeeding and/or more positive beliefs towards formula feeding; $r=-.22$). Mothers who attended prenatal classes reported more general postpartum support ($r=.19$) as well as breastfeeding informational support ($r=.22$) at 4 months, but not at

Table 4. Independent Predictors of Exclusive Breastfeeding to 6 Months ($n=178$)

Variable	β	*SE* (β)	p^*	HR	95% CI
Prenatal class attendance	.52	.20	.008	1.7	1.14–2.49
BF self-efficacy	−.02	.01	.04	.98[a]	.96–.99
Type of delivery	.37	.19	.04	1.5	1.01–2.08
In-hospital supplementation	.34	.17	.05	1.4	1.01–1.96

Note: Initial (baseline) −2 log likelihood = 1348.87, Model χ^2 improvement = 22.13, df = 4, $p<.001$.
HR, hazard ratio for cessation of exclusive breastfeeding; CI, confidence interval; BF, breastfeeding.
$^*p$ values are based on the Wald test for significance of Cox regression coefficients.
[a]HR for a one-unit increase in the independent variable; $HR=e^{5\,(-.020)}=.905$, for every 5-point increase in breastfeeding self-efficacy.

6 weeks. Mothers who had a cesarean delivery were more likely to supplement with formula in-hospital ($r = .25$), and also perceived their infants to be less satisfied with breastfeeding at 6 weeks ($r = -.18$).

DISCUSSION

This prospective study sought to identify key predictors of exclusive breastfeeding duration among first-time mothers in Canada. Study participants were predominately socially advantaged, motivated to breastfeed exclusively, supported by partners with positive breastfeeding attitudes, and on lengthy maternity leave, all well-established determinants of breastfeeding duration. Nonetheless, the majority did not achieve their exclusive breastfeeding goals, and only 5% (9/167) breastfed exclusively for a full 6 months as recommended. One third of participants ceased exclusive breastfeeding by 6 weeks, consistent with other studies demonstrating a precipitous drop in breastfeeding rates during the early postpartum period (Haiek, Gauthier, Brosseau, & Rocheleau, 2007; Sheehan et al., 1999). Early introduction of solid foods accounted for cessation of exclusive breastfeeding before 6 months among those who continued breastfeeding without supplemental formula, providing further evidence that a majority of infants receive solid foods before the recommended age of 6 months (Freeman, van't Hof, & Haschke, 2000; Haiek et al.).

Guided by the interactional model, analysis of the predictive power of study variables revealed that personal and perinatal factors were more strongly associated with the duration of exclusive breastfeeding than socio-demographic or contextual factors. No significant interactions between personal and contextual factors were found. The limited influence of demographic and social support factors on breastfeeding outcomes in our study may be partially explained by sample homogeneity, as we only included mothers who were planning to breastfeed exclusively. However, studies based on the theory of planned behavior have consistently indicated that breastfeeding intentions account for a relatively small proportion of variance in actual breastfeeding duration (Duckett et al., 1998; Goksen, 2002; Wambach, 1997), as internal and external events such as unanticipated breastfeeding problems can alter the intention-behavior relationship. Kelleher (2006) described how new mothers are often surprised and overwhelmed by the physical challenges of early breastfeeding. Our contextual variables of partner breastfeeding beliefs and general postpartum help include more indirect forms of breastfeeding support that may have had little impact on the acquisition of skills needed to successfully initiate and sustain exclusive breastfeeding, particularly among novice breastfeeders. Sullivan, Leathers, and Kelley (2004) also found general postpartum support to be unrelated to breastfeeding duration among first-time mothers, suggesting that *breastfeeding* support (i.e., support tailored to the physical, emotional, and learning needs of breastfeeding women) is a distinctive form of social support for new mothers.

We found four independent factors associated with the duration of exclusive breastfeeding among our sample of first-time mothers who planned to breastfeed exclusively: breastfeeding self-efficacy, in-hospital formula supplementation, prenatal class attendance, and type of delivery. Breastfeeding confidence/self-efficacy is well-recognized as an important determinant of breastfeeding outcomes (Blyth et al., 2002; Dennis, 1999; O'Campo, Faden, Gielen, & Wang, 1992). Self-efficacy influences the effort required to master new behaviors, therefore, mothers with stronger BSE would be expected to engage more fully in breastfeeding and persevere when confronted with new challenges (Dennis & Faux, 1999). The main sources of efficacy information are emotional/physiological arousal, performance accomplishments, vicarious learning, and social/verbal persuasion (Bandura, 1977). As self-efficacy theory would predict, we found mothers with higher BSE reported fewer breastfeeding problems, felt their infant to be more satisfied with breastfeeding, and perceived more breastfeeding informational support. We also found BSE continued to increase over the first 4 months among mothers who successfully initiated exclusive breastfeeding, but eroded from baseline among those who experienced breastfeeding difficulties. Multiparous women with prior breastfeeding experience consistently report higher initial BSE than primiparous women (Blyth et al.; Dennis and Faux), underscoring the importance of successful experiences in the development of breastfeeding confidence.

The significant association between BSE and perceived infant satisfaction with breastfeeding reflects previous studies that have linked breastfeeding confidence with maternal perceptions of milk supply (Hill & Aldag, 1991; Segura-Millan, Dewey, & Perez-Escamilla, 1994). Although we did not directly assess the influence of perceived infant satisfaction with breastfeeding on exclusive breastfeeding duration, others have identified

maternal concerns about insufficient milk and perceived infant hunger as main reasons for earlier-than-intended introduction of both formula (Blyth et al., 2002; Sacco, Caulfied, Gittelsohn, & Martinez, 2006) and solid foods (Kwavnick, Reid, Joffres, & Guernsey, 1999; Wright, Parkinson, & Drewett, 2004). A content and thriving baby may be a key condition underlying persistence with exclusive breastfeeding when other feeding options are available.

Routine in-hospital formula supplementation has long been considered detrimental to the establishment of breastfeeding by interfering with maternal milk production and infant suckling behaviors (WHO, 1998), and has been previously identified as a significant risk factor for earlier cessation of exclusive breastfeeding (Riva et al., 1999). Yet, Sheehan et al. (1999) cautioned that in-hospital use of formula may be a marker of early breastfeeding difficulties rather than a precursor to breastfeeding failure. We found in-hospital formula supplementation to be associated with perceived breastfeeding problems as well as lower BSE at both baseline and 6 weeks, providing further evidence that breastfeeding confidence may be a key mediator of exclusive breastfeeding outcomes. For example, mothers with lower initial BSE may have been more likely to perceive common breastfeeding challenges as problematic and to resort to formula supplementation as a feeding option. Alternatively, mothers who encountered unexpected problems in-hospital and who needed (or were persuaded by others) to use formula may have lost confidence in their ability to breastfeed exclusively.

Our finding that prenatal class attendance independently predicted exclusive breastfeeding duration is consistent with evidence that structured prenatal breastfeeding education increases continuation of breastfeeding to at least 2 months postpartum (Guise et al., 2003). Although we did not document the specific content of the participants' classes, local prenatal courses routinely include breastfeeding education and skills training in addition to vicarious learning activities such as inviting "graduates" to share their parenting experiences. We found prenatal class attendance to be unrelated to maternal socio-demographic or personal factors, but mildly correlated with breastfeeding informational support and general postpartum support at 4 months. Prenatal class attendance may, therefore, be a proxy for broader social support, either because more socially adept women or those with higher pre-existing social resources were more likely to engage in prenatal education, or prenatal courses helped link the first-time mothers to breastfeeding information and support networks.

Although we identified cesarean delivery as a significant risk factor for earlier cessation of exclusive breastfeeding, other studies that included multiparous women indicate no relationship between type of delivery and length of exclusive breastfeeding (Cernadas, Noceda, Barrera, Martinez, & Garsd, 2003; Riva et al., 1999). The potential consequences of cesarean delivery (e.g., post-birth mother-infant separation; post-surgical pain; longer postpartum recovery) may present greater obstacles to the initiation of exclusive breastfeeding among first-time mothers, in particular.

Study Limitations

Sample homogeneity may have contributed to ceiling effects and lower variability among study measures. Although it was logical to confine our study to those who intended to breastfeed exclusively, generalizability of our findings is limited to first-time, partnered mothers living in socio-cultural contexts similar to Canada. As breastfeeding is highly valued, our use of self-report questionnaires and telephone interviews (rather than direct observation) may have increased the potential for social desirability bias, and mothers may have under-reported the use of formula or solid foods. Participation in the study may have also led to learning effects or additional breastfeeding support among our sample of first-time mothers. Yet, the rate of exclusive breastfeeding to 6 months remained extremely low despite this potential for over-estimation of exclusive breastfeeding duration, and may have been lower had we considered all participants who supplemented in-hospital to be no longer exclusively breastfeeding. The often-transitory practice of formula supplementation and the reversible nature of breastfeeding patterns raise the issue of how best to define the event when the infant is no longer exclusively breastfed (Bodnarchuk, Eaton, & Martens, 2006). For example, new Canadian breastfeeding definitions include the category of "total breastmilk" for infants exclusively breastfeeding at the time of data collection, but not necessarily from birth (Breastfeeding Committee for Canada, 2006). Another study limitation is that our predictive measures did not include pacifier use, which has been associated in some studies with decreased rates of breastfeeding duration and exclusivity (Howard et al., 2003; Riva et al., 1999).

Recommendations for Research and Practice

Validation of our findings among multiparous mothers or those facing different social conditions is needed to identify additional robust predictors of exclusive breastfeeding duration. For example, poorer maternity leave protection in the US (Humenick & Gwayi-Chore, 2001) may be a particularly important barrier to continued exclusive breastfeeding among American samples. As we only assessed predictor variables at three predetermined points in time, future researchers also need to clarify the actual timing of events that may threaten breastfeeding exclusivity. BSE, in particular, merits further exploration as a key predictor of exclusive breastfeeding outcomes. A BSE-based trial of breastfeeding peer counseling significantly increased breastfeeding exclusivity to 3 months postpartum in Canada (Dennis, Hodnett, Gallop, & Chalmers, 2002); more research is needed to test and compare the optimal timing and relative impact of BSE-focused interventions on exclusive breastfeeding duration in different cultural settings. Two of our main study variables (breastfeeding informational support and perceived infant satisfaction with breastfeeding) had to be excluded from analyses and merit re-examination in future studies. More thorough explication of the relationship between type of delivery and breastfeeding exclusivity is also warranted, given the steadily increasing rate of caesarean birth worldwide (Klein, 2004). To understand exclusive breastfeeding practices better, future research would also benefit from more in-depth study of additional factors (e.g., infant temperament, beliefs/opinions of others) that may influence breastfeeding mothers' perceptions of whether they are adequately meeting their infant's nutritional needs, and how these factors may shift over the course of breastfeeding.

Our findings suggest that a continuum of pre- and postnatal strategies is needed to promote and support a longer duration of exclusive breastfeeding among first-time mothers. Prenatal classes may provide BSE-enhancing activities, anticipatory breastfeeding guidance, and linkages to breastfeeding support networks. In-hospital interventions may include enhanced labor and delivery support to promote vaginal birth, supervising and reinforcing early breastfeeding attempts to help build BSE and identify early breastfeeding challenges, discouraging unnecessary formula supplementation, and referring at-risk mothers to specialized post-discharge breastfeeding resources. Targeting the early weeks post-delivery as a critical intervention point for breastfeeding follow-up and support may be key to increasing longer-term exclusive breastfeeding rates. Routine well-baby/vaccination visits at 2, 4, and 6 months may also serve as strategic opportunities for positively reinforcing continued exclusive breastfeeding for the recommended duration of 6 months.

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