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ORIGINAL ARTICLE

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Exclusive breastfeeding in hospital predicts longer breastfeeding duration in Canada: Implications for health equity

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Abstract

Background: Breastfeeding has many established health benefits for women and children. We examined the association between maternal education, newborn feeding in hospital, and long-term breastfeeding duration.

Methods: We studied 3195 Canadian mother-infant dyads in the CHILD pregnancy cohort. Newborn feeding was documented from hospital records. Caregivers reported sociodemographic factors and infant feeding at 3, 6, 12, 18, and 24 months.

Results: Overall, 97% of newborns initiated breastfeeding and 74% were exclusively breastfed in hospital. Exclusively breastfed newborns were ultimately breastfed longer compared with those who received formula supplementation during their hospital stay (median 11.0 vs 7.0 months, $P < .001$). After controlling for maternal age, ethnicity, birth mode, and gestational age, exclusively breastfed newborns had a 21% reduced risk of breastfeeding cessation (HR = 0.79, 0.71-0.87). This effect was strongest among women without a postsecondary education (HR = 0.65, 0.53-0.79).

Discussion: Exclusive breastfeeding in hospital is associated with longer breastfeeding duration, particularly among women of lower socioeconomic status. Initiatives that support exclusive breastfeeding of newborns in hospital could improve long-term breastfeeding rates and help reduce health inequities arising in early life.

KEYWORDS

breastfeeding exclusivity and duration, hospital practices, maternal-child health equity, newborn feeding, perinatal care

1 | INTRODUCTION

Breastfeeding is an important determinant of infant growth and development. Recent meta-analyses have determined that longer breastfeeding duration is associated with protection from infectious diseases and enhanced neurodevelopment compared with nonbreastfed children or those who were breastfed for a shorter duration.[1,2] Further meta-analyses have suggested that breastfeeding may protect children from obesity and diabetes.[3,4] Mothers also experience health benefits from prolonged breastfeeding, including protection from breast cancer, improved birth spacing, and a reduced risk of diabetes and ovarian cancer.[5] Accordingly, promotion of breastfeeding is considered a key public health initiative to support maternal, newborn, and child health.

The World Health Organization (WHO) recommends exclusive breastfeeding for 6 months and continued breastfeeding until 2 years.[6] Promoting breastfeeding has been identified as a major global health priority,[7] with many national agencies endorsing the WHO guidelines.[8] Despite these efforts, most North American mother-infant dyads do not achieve the recommended duration of breastfeeding. The Centers for Disease Control and Prevention reported that nearly 80% of American newborns initiated breastfeeding in 2013; however, only 27% were still breastfed at 12 months and <20% were exclusively breastfed for 6 months.[9] A national Canadian survey in 2011 similarly found that only 26% of infants were exclusively breastfed for 6 months.[10] A review of electronic medical records in the Canadian province of Ontario spanning the years 2002-2013 supports this observation, as the rate of exclusive breastfeeding at 6 months was 25%.[11] Systematic reviews and population-based studies have found that key social determinants of health, including maternal education, age, socioeconomic status or income, and ethnicity all influence breastfeeding initiation and duration.[12-17] This is compounded by the observation that younger women and those with lower income or less education are more likely to be offered formula in hospitals.[16] Therefore, strategies to support long-term and exclusive breastfeeding are needed, particularly among vulnerable populations.

Health services interventions that promote exclusive breastfeeding and discourage formula supplementation during the newborn hospital stay can positively influence long-term breastfeeding outcomes.[18,19] The Baby-Friendly Hospital Initiative and its "Ten Steps to Successful Breastfeeding," which include providing only breastmilk to newborn infants unless supplementation is medically indicated, have been found to positively influence short-, medium-, and long-term breastfeeding outcomes.[20-22] Conversely, one small clinical trial found that limited early formula supplementation of at-risk newborns increased rates of exclusive breastfeeding at 3 months.[23] In the general population, formula supplementation during the postpartum hospital stay delays breastfeeding initiation,[24] interferes with the normal frequency of breastfeeding[25,26] and reduces maternal confidence in her ability to breastfeed,[27] which may lead to continuation of supplemental feedings after the hospital stay. A previous Canadian report found that antenatal support and education during the hospital stay had a greater influence on breastfeeding outcomes than many of the traditional social determinants of health.[16] However, in some populations, such interventions may not benefit all women equally and therefore may not effectively reduce, and may even exacerbate, inequalities.[28]

This study sought to describe associations between early breastfeeding exclusivity and long-term breastfeeding duration in a national cohort of Canadian children followed from birth until 2 years of age. Furthermore, we explored the possibility that the impact of avoiding formula during the postpartum period would be influenced by social determinants of health, represented in this study by maternal education level. We hypothesized that exclusive breastfeeding in hospital would be associated with longer breastfeeding duration, particularly among mother-infant dyads with lower maternal education.

2 | METHODS

2.1 | Study design and population

We accessed data from the general cohort of the Canadian Healthy Infant Longitudinal Development (CHILD) study, a national population-based birth cohort recruited from four centers across Canada.[29] Women from the general population were enrolled during a singleton pregnancy between 2009 and 2012, and remained eligible if they gave birth to a healthy infant ≥34 weeks gestational age (N = 3299, of which 3195 initiated breastfeeding). The current analysis excluded mother-infant dyads who never breastfed (n = 104) or did not breastfeed in hospital (n = 26), and those missing data for hospital feeding (n = 476) or total breastfeeding duration (n = 91), leaving 2602 dyads for analysis. Multivariable models further excluded mother-infant dyads with missing data for maternal education, maternal weight, or other essential covariates (n = 317), leaving a total of 2285 dyads in final analyses (Figure S1). These 2285 dyads were comparable to the full cohort of 3195 ever breastfed dyads in terms of maternal demographics, infant gestational age, and total breastfeeding duration (Table S1). Written informed consent was obtained from all participating women at enrolment. The study was approved by the Human Research Ethics Boards of the Universities of Alberta, British Columbia, Manitoba and Toronto and McMaster University.

2.2 | Main exposure and outcome measures: newborn and infant feeding

The main exposure considered in this analysis was newborn feeding in hospital. Birth characteristics and newborn feeding in hospital were recorded by nursing staff using a standardized questionnaire. These data were validated against hospital records by retrospective chart review for a subset of participants (n = 847), demonstrating strong agreement for breastfeeding (98.3% agreement), and formula supplementation (87.6% agreement). Breastfeeding in hospital was defined as exclusive (breastfeeding without formula supplementation), partial (breastfeeding with formula supplementation), or none (no breastfeeding).

The main outcome measures were exclusive breastfeeding at 6 months and total breastfeeding duration. Exclusive breastfeeding after the hospital stay was defined as receiving only breastmilk after hospital discharge, and does not consider in-hospital feeding; the end of exclusive breastfeeding was defined as the introduction of any formula, juice, nonhuman milk, infant cereal, or solid food after the hospital stay. Total breastfeeding duration was determined from the first reported date of breastfeeding cessation, collected from standardized infant feeding questionnaires administered at 3, 6, 12, 18, and 24 months of age (Table S2). For breastfed infants with no reported cessation date due to skipped questionnaires (n = 367), the minimum confirmed breastfeeding duration was used.

2.3 | Potential confounders and effect modifiers

Infant sex, gestational age at birth, and method of delivery were recorded by nursing staff using a standardized questionnaire. Maternal characteristics including age, education, ethnicity, and study site were self-reported during pregnancy. Maternal education (completion of college or university degree) was used as an indicator of socioeconomic status to address health equity.[29] Maternal ethnicity was self-selected from 13 options, which were condensed for this analysis into four categories: Caucasian, Asian, First Nations, and Other. Ethnicity was considered in this study because women who belong to minority ethnic groups are often less likely to breastfeed.[13] Maternal body mass index (BMI) was calculated from measured height and self-reported prepregnancy weight, or estimated from measured weight at 1 year after birth if women could not recall their prepregnancy weight. Validation against prepregnancy weight from medical records in a subset of women demonstrated strong correlation for both estimates ($r = .95$, $P < .0001$, for self-reported prepregnancy weight in 301 women; $r = .92$, $P < .0001$ for weight measured at 1 year postpartum in 355 women). The timing of introduction of solid foods was determined from infant feeding questionnaires administered at 3, 6, and 12 months of age.

2.4 | Statistical analysis

Since breastfeeding duration was not normally distributed, medians were compared across covariate groups using the nonparametric Kruskal-Wallis test. Chi-square tests were used to compare the proportion of mother-infant dyads that exclusively breastfed in hospital. Cox regression models were used to determine the association of exclusive breastfeeding in hospital and breastfeeding cessation over time, with adjustment for potential confounders selected a priori (maternal age, ethnicity, and birth method) or identified through bivariate screening. Results are reported as crude or adjusted hazard ratios with 95% confidence intervals (HR or aHR, 95% CI). Interaction terms were used to test for effect modification by maternal education. In addition, logistic regression models were used to evaluate the dichotomous outcomes of exclusive breastfeeding at 6 months and sustained breastfeeding at 12 and 24 months, with associations reported as adjusted odds ratios (aOR). Statistical analysis was completed, using SAS version 9.4 (SAS Institute, Cary, NC, USA).

3 | RESULTS

Nearly all newborns in the CHILD cohort initiated breastfeeding (n = 3195, 97.5%). Of these, 74.1% were exclusively breastfed during their hospital stay, while 25.9% received supplementation with formula (Table S1). The median breastfeeding duration was 10.0 months (interquartile range 5.0-14.0), with 75.1% of infants breastfed for at least 6 months and 43.9% breastfed for 12 months or more. Exclusive breastfeeding was reported for 61.1% of infants at 3 months, and fell to 18.5% by 6 months. Women included in this analysis had a mean age of 32.4 ± 4.7 years; 73.0% were Caucasian, 36.3% were overweight, and 77.1% had completed postsecondary education.

Exclusive breastfeeding in hospital was more common among women with versus without a postsecondary degree (76.8% vs 69.7%, $P < .001$), and among normal weight versus overweight women (79.2% vs 68.4%, $P < .001$; Table 1). Exclusive breastfeeding in hospital was also more common after vaginal versus cesarean delivery (79.6% vs 60.6%, $P < .001$) and with greater gestational age (79.7% of full term infants vs 41.7% of late preterm infants, $P < .001$). Exclusive breastfeeding rates were higher in Vancouver and Toronto hospitals (both >85%) compared with Winnipeg and Edmonton (both <70%, $P < .001$).

Many of these same factors were also associated with total breastfeeding duration. Median breastfeeding duration was longer for women with versus without a postsecondary

TABLE 1 Exclusive breastfeeding in hospital and total breastfeeding duration according to maternal and infant characteristics in the CHILD birth cohort, Canada, 2009-2014

Characteristic	N [Total = 2285]	Exclusive breastfeeding in hospital[1]	Duration of any breastfeeding (months)[2]
		n (%)	Median [IQR]
Newborn feeding in hospital			
Breastfeeding and formula	568	0 (0.0)	7.0 [3.0-13.0]***
Exclusive breastfeeding	1717	1717 (100.0)	11.0 [6.5-15.0]
Infant sex			
Female	1079	810 (75.1)	11.0 [6.0-15.0]
Male	1206	907 (75.2)	10.0 [6.0-14.0]
Gestational age			
Late preterm (34-36 weeks)	96	40 (41.7)***	10.5 [6.1-14.5]**
Early term (37-38 weeks)	505	355 (70.3)	9.0 [5.0-13.0]
Full term (39-40 weeks)	1302	1038 (79.7)	11.0 [6.0-14.0]
Late and postterm (41-42 weeks)	382	284 (74.3)	11.5 [6.0-15.0]
Birth mode			
Vaginal	1744	1389 (79.6)***	11.0 [6.0-14.0]*
Cesarean	541	328 (60.6)	10.0 [5.0-14.0]
Maternal prepregnancy weight			
Normal weight (BMI <25)	1424	1128 (79.2)***	11.0 [6.5-15.0]***
Overweight (BMI ≥25)	861	589 (68.4)	9.0 [4.0-13.0]
Maternal age			
18-24 years	161	104 (64.6)*	4.3 [1.5-11.0]***
25-29 years	551	411 (74.6)	10.0 [6.0-13.0]
30-34 years	958	714 (74.5)	11.0 [6.0-15.0]
35-39 years	518	410 (79.2)	12.0 [6.3-17.0]
40+ years	97	78 (80.4)	12.0 [8.0-18.0]
Maternal education			
No postsecondary degree	542	378 (69.7)***	8.0 [3.0-12.0]***
Completed postsecondary degree	1743	1339 (76.8)	11.0 [6.3-15.0]
Maternal ethnicity			
Asian	343	239 (69.7)***	12.0 [6.0-15.0]
Caucasian	1719	1331 (77.4)	11.0 [6.0-14.0]
First Nations	90	56 (62.2)	9.0 [3.5-14.0]
Other	133	91 (68.4)	11.0 [6.0-15.0]
Introduction of solid foods			
≥4 months	1884	1433 (76.1)*	11.0 [6.0-15.0]***
<4 months	401	284 (70.8)	7.0 [3.0-11.0]
Study site			
Edmonton	578	395 (68.3)***	9.0 [5.0-13.0]***
Toronto	470	401 (85.3)	10.0 [6.0-14.0]
Vancouver	421	373 (88.6)	12.0 [9.0-18.0]
Manitoba	816	548 (67.2)	10.0 [5.4-14.0]

CHILD, Canadian Healthy Infant Longitudinal Development; BMI, body mass index; IQR, interquartile range.

Percentages reflect proportion of nonmissing data. N = 2285 breastfed infants with complete data for hospital feeding, breastfeeding duration, and covariates. Comparisons by [1]chi-squared or [2]Kruskal-Wallis test.*$P < .05$,**$P < .01$,***$P < .001$.

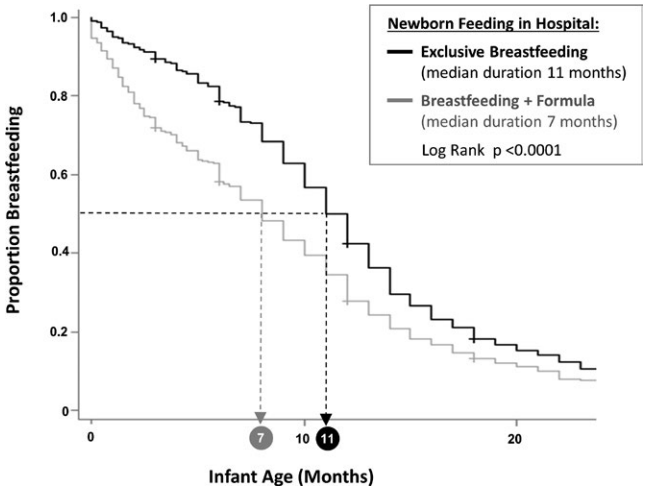

FIGURE 1 Total breastfeeding duration in the Canadian Healthy Infant Longitudinal Development (CHILD) cohort according to newborn feeding in hospital, Canada, 2009-2014. N = 2602 breastfed infants with complete data for hospital feeding and breastfeeding duration, from the CHILD pregnancy cohort

degree (11 vs 8 months, $P < .001$), and for normal weight versus overweight women (11 vs 9 months, $P < .001$). Shorter breastfeeding duration was observed among younger women (4 vs 12 months for women <24 vs >35 years, $P < .001$) and those who introduced solid foods to their infants before 4 months (7 vs 11 months, $P < .001$).

Median breastfeeding duration was 4 months longer among infants who were exclusively breastfed in hospital compared with those who received formula supplementation (11 vs 7 months, $P < .0001$; Figure 1 and Table 1). In a multivariable model controlling for the key confounders identified above, exclusive breastfeeding in hospital was associated with a 21% reduced risk of breastfeeding cessation over time (aHR 0.79; 95% CI 0.71-0.87; Table 2). Solid food introduction before 4 months was strongly associated with earlier breastfeeding cessation (aHR: 1.63, CI 1.45-1.84, $P < .0001$). Other factors independently associated with earlier breastfeeding cessation included maternal overweight and younger maternal age. The risk of breastfeeding cessation was significantly lower for dyads living in Vancouver compared with Edmonton (aHR: 0.71, CI 0.62-0.81, $P < .0001$), Manitoba, or Toronto. Similar patterns of association were observed for dichotomous breastfeeding outcomes (Table 3), with a 63% increased likelihood of exclusive breastfeeding at 6 months (aOR 1.63; 95% CI 1.21-2.20) and sustained breastfeeding at 1 year (aOR 1.63; 95% CI 1.30-2.04) among infants who were exclusively breastfed in hospital.

Lower maternal education was associated with earlier breastfeeding cessation (crude HR 1.30; 95% CI 1.18-1.44). This association, however, was no longer significant after adjustment for newborn feeding and other covariates (aHR 1.07; 95% CI 0.96-1.20). Further analyses revealed that the association between maternal education and breastfeeding duration was modified by hospital feeding practices (Figure 2). The socioeconomic inequity in breastfeeding duration was reduced among infants who were exclusively breastfed in hospital (median duration 12.0 vs 9.0 for high vs low maternal education; equity gap = 25%, or 3.0 months) compared with those who received formula supplementation (median 9.0 vs 4.5; equity gap = 50%, or 4.5 months). In multivariable analyses, exclusive breastfeeding in hospital was associated with a significant 16% reduced risk of breastfeeding cessation among women with a postsecondary degree (aHR 0.84, 95% CI 0.74-0.95); this beneficial effect increased to 35% among women without a postsecondary degree (aHR 0.65; 95% CI 0.53-0.79; P for interaction = .02).

4 | DISCUSSION

Our findings from the prospective CHILD birth cohort demonstrate that breastfeeding exclusivity during the first few days of life is positively associated with long-term breastfeeding duration. Breastfeeding cessation occurred significantly earlier among infants who received formula supplementation in hospital compared with those who received only breastmilk during this critical period. This association remained after adjustment for factors known to influence breastfeeding initiation and duration, and was strongest among women at higher risk for early breastfeeding cessation.

Overall, mother-infant dyads who breastfed exclusively in hospital had a 21% reduced risk of breastfeeding cessation over time. On average, these infants were breastfed for 4 months longer than those who received formula supplementation in hospital, and they were 63% more likely to meet the WHO recommendation of exclusive breastfeeding for 6 months. These results confirm a recent literature review that identified early exclusive breastfeeding in hospital as an effective strategy to increase breastfeeding duration.[18] Previous research has shown that in-hospital formula supplementation can lead to earlier breastfeeding cessation in the first 6 weeks of life.[21] Our study extends these results through the first 2 years of life, showing that the association persists well beyond early infancy.

One recent study found that 89% of United States hospitals delivering maternity care provide nonbreastmilk supplements (primarily formula) to healthy breastfed newborns.[30] Thus, a considerable proportion of healthy newborns are unnecessarily receiving formula supplementation, and our study suggests this practice could have a long-term influence on total breastfeeding duration and related maternal and child health outcomes. Promoting exclusive breastfeeding in hospital could therefore have a substantial influence on maternal and child health at the population level.

TABLE 2 Crude and adjusted associations of hospital feeding and maternal and infant characteristics with total breastfeeding duration (hazard of breastfeeding cessation) in the CHILD cohort, Canada, 2009-2014

Characteristic	Crude HR (95% CI)	Adjusted[a] HR (95% CI)
Newborn feeding in hospital		
Breastfeeding and formula	Reference	Reference
Exclusive breastfeeding	0.73 (0.66-0.81)***	0.79 (0.71-0.87)***
Infant sex		
Female	Reference	Reference
Male	1.04 (0.95-1.13)	1.06 (0.97-1.15)
Gestational age		
Late preterm (34-36 weeks)	0.98 (0.79-1.22)	0.82 (0.65-1.02)
Early term (37-38 weeks)	1.14 (1.02-1.27)*	1.11 (1.00-1.24)
Full term (39-40 weeks)	Reference	Reference
Late and postterm (41-42 weeks)	0.93 (0.82-1.05)	0.86 (0.76-0.97)*
Birth mode		
Vaginal	Reference	Reference
Cesarean	1.10 (1.00-1.22)	1.08 (0.97-1.20)
Maternal prepregnancy weight		
Normal weight (BMI <25)	Reference	Reference
Overweight (BMI ≥25)	1.27 (1.16-1.39)***	1.20 (1.10-1.32)**
Maternal age		
18-24 years	1.89 (1.59-2.25)***	1.73 (1.44-2.09)***
25-29 years	1.29 (1.15-1.44)***	1.28 (1.14-1.43)***
30-34 years	Reference	Reference
35-39 years	0.86 (0.77-0.89)*	0.89 (0.80-1.00)
40+ years	0.71 (0.56-0.89)**	0.74 (0.58-0.93)*
Maternal education		
No postsecondary degree	1.30 (1.18-1.44)***	1.07 (0.96-1.20)
Completed postsecondary degree	Reference	Reference
Maternal ethnicity		
Asian	0.91 (0.81-1.03)	0.91 (0.80-1.04)
Caucasian	Reference	Reference
First Nations	1.12 (0.90-1.39)	0.85 (0.68-1.06)
Other	0.89 (0.73-1.07)	0.77 (0.64-0.94)*
Introduction of solid foods		
≥4 months	Reference	Reference
<4 months	1.82 (1.63-2.04)***	1.63 (1.45-1.84)***
Study site		
Edmonton	Reference	Reference
Toronto	0.86 (0.76-0.98)*	0.96 (0.84-1.10)
Vancouver	0.59 (0.52-0.68)***	0.71 (0.62-0.81)***
Manitoba	0.92 (0.82-1.03)	0.88 (0.79-0.98)*

CHILD, Canadian Healthy Infant Longitudinal Development (2009-2012 pregnancy cohort); HR, hazard ratio; CI, confidence interval.

[a]Mutually adjusted for all variables shown. N = 2285 breastfed infants with complete data for hospital feeding, breastfeeding duration, and covariates. Associations determined by Cox regression; ratios >1 reflect an increased probability of breastfeeding cessation (ie, shorter breastfeeding duration) while ratios <1 reflect a reduced probability of breastfeeding cessation (ie, longer breastfeeding duration).*$P < .05$,**$P < .01$,***$P < .001$.

TABLE 3 Association of newborn feeding in hospital and breastfeeding outcomes at 6, 12, and 24 months in the CHILD cohort, Canada, 2009-2014

	Exclusive breastfeeding at 6 months		Any breastfeeding at 12 months		Any breastfeeding at 24 months	
Newborn feeding in hospital	n/N (%)	Adjusted[a] OR (95% CI)	n/N (%)	Adjusted[a] OR (95% CI)	n/N (%)	Adjusted[a] OR (95% CI)
Breastfeeding and formula	70/556 (12.6%)	Reference	194/550 (35.3%)	Reference	33/528 (6.3%)	Reference
Exclusive breastfeeding	338/1687 (20.0%)	1.63 (1.21-2.20)	833/1653 (50.4%)	1.63 (1.30-2.04)	143/1563 (9.2%)	1.21 (0.78-1.87)

[a]Adjusted for study site; maternal age, education, ethnicity, overweight; method of birth; infant sex and gestational age; and introduction of solid food before 4 months.

A novel finding in our study was the differential influence of exclusive breastfeeding in hospital on breastfeeding duration among women of lower socioeconomic status. As others have reported,[16] we found that lower maternal education was associated with higher rates of formula supplementation and shorter breastfeeding duration. Previous studies in developed countries have consistently found that key social determinants of health, particularly lower maternal education and socioeconomic status are associated with lower rates of breastfeeding initiation and increased rates of in-hospital formula supplementation.[14,16,17,28,31] Notably in our study, the estimated effect of exclusive breastfeeding in hospital was twice as great for women with lower education, compared with women with higher educational attainment. While highly educated women experienced a 16% reduced risk of breastfeeding cessation if they exclusively breastfed in hospital, women with lower education experienced a 35% reduced risk. Furthermore, the association of maternal education and breastfeeding duration was no longer significant in models adjusting for hospital feeding practices. These results suggest that promoting and facilitating exclusive breastfeeding in hospital could have a long-term influence on breastfeeding duration, especially among less-educated women, who are most at risk for early breastfeeding cessation.

Another key finding of our study is that solid food introduction before 4 months was strongly associated with an increased risk of breastfeeding cessation, independent of hospital feeding and maternal education. Currently the WHO recommends that complementary food be introduced to breastfed infants at 6 months,[6] although some organizations have begun to recommend solid food introduction "no later than 4-6 months" based on new evidence that earlier introduction of allergenic foods can help prevent food allergy.[32] Our study found that very early introduction of complementary foods (before 4 months) was associated with a 61% increased risk of breastfeeding cessation. Further research is needed to clearly determine and distinguish the independent and combined effects of breastfeeding duration and timing of solid food introduction on infant and child health.

We also found differences in breastfeeding duration across study sites, with dyads in Vancouver having significantly lower risks of breastfeeding cessation compared with dyads at the other CHILD Study sites. This association was independent of key sociodemographic characteristics that differed across sites (eg, maternal age, education, and ethnicity), suggesting a potential role for unmeasured regional or hospital differences in breastfeeding culture, attitudes, and postnatal support programs. Indeed, the largest birthing hospital in Vancouver achieved WHO/UNICEF Baby-Friendly Hospital Initiative certification in 2008 (before the CHILD study began),[33] while health facilities in Manitoba and Edmonton were in earlier stages of implementation at this time.[34]

Finally, our study confirms previous findings that formula supplementation in hospital is significantly more likely after cesarean versus vaginal delivery.[14,35,36] Cesarean-delivered infants

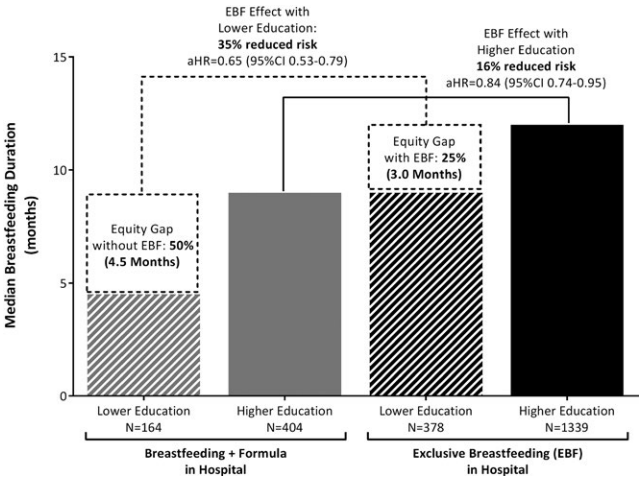

FIGURE 2 Breastfeeding duration in the Canadian Healthy Infant Longitudinal Development (CHILD) cohort according to newborn feeding in hospital, stratified by maternal education, Canada, 2009-2014. N = 2285 breastfed infants with complete data for hospital feeding, breastfeeding duration, and covariates, from the CHILD pregnancy cohort; aHR, adjusted hazard ratio (adjusted for maternal ethnicity, maternal age, maternal overweight, birth by cesarean section, infant sex, infant gestational age, introduction of solid foods before 4 months, and study site); CI, confidence interval; EBF, exclusive breastfeeding. Lower education = no postsecondary degree; higher education = postsecondary degree completed. *P* for interaction = .02

were also found to have a shorter duration of any breastfeeding. However, this association was not significant in adjusted models, indicating that formula supplementation in hospital or other covariates associated with cesarean delivery (such as maternal obesity) may be responsible for this relationship. These findings suggest that early efforts to support breastfeeding among mothers delivering by cesarean section could have a long-term beneficial influence on their breastfeeding duration.

The major strength of our study is the prospective collection of infant feeding data from birth through 2 years of age in a large national cohort, including detailed newborn feeding information from hospital records and repeated maternal questionnaires. Our results substantially expand upon previous studies on the long-term impact of newborn feeding practices, few of which measure breastfeeding rates beyond 6 months. Breastfeeding initiation rates in our study (96%) were somewhat higher than the Canadian average (89%)[10] and other settings (eg, 80% in the United States),[9] which may limit the generalizability of our findings. Another limitation is that reasons for supplementation in hospital were not fully documented, and we were unable to control for some factors known to influence breastfeeding outcomes, including maternal breastfeeding intent, maternal employment, breastfeeding self-efficacy, breastfeeding education, and family support. However, we controlled for many other established predictors of breastfeeding, including maternal age, ethnicity, education, and overweight. Finally, we acknowledge that evaluating health equity in a pan-national cohort is complex; however, maternal education is recognized as a core determinant of health that relates to equity, along with income, place, and ethnocultural status.[37] Future research on this topic should address the complexity of assessing health equity through the analysis of additional social determinants of health.

This study provides evidence that formula supplementation of newborns in hospital is negatively associated with breastfeeding duration, especially among women of lower education, who are at higher risk for early cessation. Our results suggest that programs supporting new mothers to exclusively breastfeed in hospital will facilitate sustained breastfeeding within and beyond the first year of life and the plethora of associated health benefits for these women and their children. Previous research has shown that untargeted breastfeeding interventions can be successful in the general population without benefiting women of lower socioeconomic status,[28] which may exacerbate health inequities among new mothers and their infants. Our findings suggest that promoting exclusive breastfeeding among vulnerable women could substantially reduce social inequities in breastfeeding. In other words, disadvantaged women and their children stand to benefit the most from policies supporting exclusive breastfeeding in hospital. Such policies could therefore have a significant influence on reducing health inequities across the lifespan.

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SUPPORTING INFORMATION

Additional Supporting Information may be found online in the supporting information tab for this article.

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