Relationship Between Intention to Supplement With Infant Formula and Breastfeeding Duration

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ABSTRACT

OBJECTIVES: According to Health Canada and the Canadian Paediatric Society, infants should be exclusively breastfed for the first six months with continued breastfeeding for two years and beyond. This study examined the relationship between a mother's intention to supplement with infant formula and the risk of discontinuing breastfeeding during the 12 months postpartum.

METHODS: Surveys were administered to a cohort of mothers at 6 weeks, 6 months and 12 months postpartum as part of York Region's Infant Feeding Survey. Those who initiated breastfeeding were included in the analysis (n=345). The relationship between a mother's prenatal intention to supplement with infant formula and breastfeeding duration was examined using Cox proportional hazards regression controlling for mother's age, prenatal education, immigration status, parity, household income, mother's ethnicity and education.

RESULTS: Nearly one third of mothers intended to supplement with infant formula. Of those mothers, 69% actually supplemented their baby with infant formula within 12 months postpartum. Intention to supplement was found to be associated with shorter breastfeeding duration (HR=2.64, 95% CI 1.83-3.81). First-time mothers experienced shorter breastfeeding duration compared to experienced mothers (HR=2.13, 95% CI 1.39-3.27). Mothers who identified as European experienced shorter breastfeeding duration compared to East, Southeast or South Asian mothers (HR=1.79, 95% CI 1.05-3.06).

CONCLUSIONS: Continued breastfeeding is not only beneficial for the infant, but it also has important benefits for the mother. The analysis indicates that a mother's prenatal intent to supplement may be associated with shorter breastfeeding duration. Further research is required to confirm these findings and to address the underlying assumptions and limitations.

KEY WORDS: Breastfeeding; cessation; intention; supplementation; risk factors; Proportional Hazards Models

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Breastmilk is the normative source of nutrition for a baby's growth and development.¹ The World Health Organization (WHO), Health Canada and the Canadian Paediatric Society recommend exclusive breastfeeding for the first six months of a child's life with continued breastfeeding for two years and beyond in conjunction with appropriate solids.¹⁻³ According to the American Academy of Paediatrics, breastfeeding should be considered a public health issue and not simply a lifestyle choice.⁴

In Canada, several studies have explored factors that may be associated with the duration of exclusive breastfeeding for up to six months,⁵⁻¹¹ but to our knowledge, no Canadian studies have observed factors that may be associated with duration of breastfeeding beyond six months, which may also have important health implications. A systematic review by Ip et al. (2007) observed that continued breastfeeding may be associated with lower rates of gastrointestinal infections, asthma, childhood obesity and type 2 diabetes among children.¹² Continued breastfeeding also may provide important maternal benefits such as reduced risk of breast cancer, ovarian cancer and type 2 diabetes.¹²

There are currently no studies that have looked at a mother's prenatal intention to supplement with infant formula and its potential effects on breastfeeding duration. The early introduction of infant formula may compromise breastfeeding duration.^{13,14} In part, this may be attributed to the fact that breastfeeding is a supply and demand system where introduction of formula could lead to decreased infant demand of breastmilk, therefore decreasing sup-

ply.¹⁵ Based on the Theory of Reasoned Action,¹⁶ intention along with attitude and subjective norms help predict behaviour. A study by Donath and Amir (2003) observed that among 10,548 women from the United Kingdom, maternal prenatal intention to breastfeed predicted breastfeeding duration for six months and was a stronger predictor than all collected demographic factors combined.¹⁷ Further, Martens and Young (1997) found that among 56 Canadian Ojibwa mothers, prenatal intent was one of the best predictors of breastfeeding choice.¹⁸ It is important to note that mothers who intend to breastfeed may also intend to supplement with infant formula. We hypothesized that intention to supplement would also be associated with shorter duration of overall breastfeeding. By identifying whether an association exists, it may be possible to intervene prenatally.

The primary purpose of this study was to determine whether there was a relationship between a mother's intention to supplement with infant formula and the risk of discontinuing breast-

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feeding before 12 months postpartum in an Ontario Public Health Unit setting. The secondary purpose was to investigate whether other maternal characteristics were associated with breastfeeding duration up to 12 months.

METHODS

Data from the York Region *Infant Feeding Survey* (IFS) were used in the analysis. The IFS was a prospective cohort study that determined the rates of breastfeeding initiation, duration, exclusivity and other feeding practices adopted in a child's first year of life. All mothers residing in York Region who delivered between January and April 2010 and had consented to be contacted by the Public Health Unit prior to hospital discharge (representing 89% of births) were sent an information letter about the study and were added to a weekly list. Mothers were recruited when their baby was one to three weeks old through our contacting every second mother on the list to obtain study consent. Eligible mothers were those who had a telephone number, were living with their baby and spoke English. Mothers of singleton ($n=336$) and multiple births ($n=9$) were included in the study, but mothers of multiple births were asked to comment on their first-born child. Mothers were surveyed at 6 weeks, 6 months and 12 months postpartum. Intention to supplement was self-reported and was obtained six to eight weeks postpartum. York Region's *Internal Research Review Committee* approved the IFS, confirming that the consent process outlined was informative and non-coercive, that the possible risks and harms from the study to participants were minimal, and that anonymity and confidentiality were maintained.

Only mothers who initiated breastfeeding, based on self-report at six to eight weeks postpartum, were included in the analysis. This included 345 (96%) of the 360 mothers who were not interval censored or had missing data who participated in the IFS (Figure 1). Breastfeeding was defined as feeding breastmilk by breast or by bottle. Mothers could be breastfeeding in combination with infant formula (i.e., not exclusively breastfeeding). Mothers were considered to have initiated breastfeeding if they had ever put their baby to the breast or given breastmilk within the first week of giving birth to their child.

Seven maternal factors that may be associated with breastfeeding duration were specified a priori based on a literature review. These included mother's age at time of baby's birth,^{5-7,11} prenatal education,⁷ immigration status,⁷⁻⁹ parity,^{5,9,19} household income,⁷⁻⁹ ethnicity²⁰ and education.^{5-8,11} While progress towards Baby-Friendly Initiative (BFI) designation of the delivery hospital²¹ may also be associated with breastfeeding duration, none of the delivery hospitals in York Region were BFI-designated. The main exposure of interest was intention prior to birth to supplement with infant formula. The outcome took into account breastfeeding status (yes/no) and duration of breastfeeding (self-reported and converted into months), which data were obtained with each successive survey. Descriptive analyses were completed for all variables.

Missing values were imputed using linear and logistic regression respectively for maternal age (2.4%) and household income (9.7%). This was done to maintain an adequate number of events to support our model. Level of education and parity were used to impute maternal age, while education²² and immigration status²³ were used to impute household income. According to Statistics Canada, the increase in delayed childbearing is largely related to societal

Figure 1. Study flow diagram

changes which see women staying in school longer, entering the labour force later and delaying having their first child.²⁴ Summary statistics for maternal age and household income were also completed after imputation to assess the impact on the distribution.

A Kaplan-Meier curve based on crude rates was graphed to illustrate the proportion of mothers breastfeeding at each time point from birth up to 12 months of age. Separate curves were estimated for mothers who intended to supplement and those who did not. A chi-square test was conducted to determine whether the exposure groups were significantly different in terms of their breastfeeding rate. Cox proportional hazard regression was used to assess the relationship between covariates and the "hazard", which is the risk of ceasing breastfeeding up to 12 months postpartum. This type of analysis also handles censored data which refers to when a mother was either lost to follow-up before being able to determine when she had stopped breastfeeding or if a mother was still breastfeeding at the end of the study. To determine the accuracy of the imputed proxy data, the regression analysis was rerun excluding the proxy data to observe any change in relationship between the exposure and outcome variable. A Likelihood Ratio Test observed whether intention to supplement was associated with the outcome after adjusting for all covariates.

The Cox proportional hazards model assumes that the hazard ratio does not vary over time. Scaled Schoenfeld residuals were plot-

Table 1. Baseline Characteristics of Mothers in York Region by Intention to Supplement With Infant Formula (N=345)

	Intended to Supplement n=96		Did Not Intend to Supplement n=249	
	Freq	% (95% CI)	Freq	% (95% CI)
Mother's age (mean $\pm$ SD)	33.0 (4.65)		32.7 (4.48)	
Prenatal class attendance	26	27 (18-36)	66	27 (21-32)
Immigration status	53	55 (45-65)	151	61 (55-67)
First-time mother	38	40 (30-49)	113	45 (40-51)
Household income				
Low (<\$40,000)	15	16 (8-23)	34	14 (9-18)
Moderate (\$40,000-\$79,999)	14	15 (8-22)	70	28 (23-34)
High ($\geq$ \$80,000)	67	70 (61-79)	145	58 (52-64)
Self-identified ethnicity				
Canadian	19	20 (12-28)	78	31 (26-37)
European	20	21 (13-29)	52	21 (16-26)
East, Southeast, South Asian	34	35 (26-45)	68	27 (22-33)
Other	23	24 (16-33)	51	21 (16-26)
Education				
High school or less	2	2 (0-5)	21	8 (5-12)
Trade, some college, college	28	29 (20-38)	73	29 (24-35)
University degree or higher	66	69 (60-78)	155	62 (56-68)

95% CI - confidence interval; SD - standard deviation.

ted to test this assumption. All tests were completed at the .05 significance level, using R version 2.13.1 software.

RESULTS

Baseline characteristics of the study population by prenatal intention to supplement with infant formula are presented in Table 1. The mean age of mothers who intended to supplement and those who did not were comparable, 33 years (SD 4.65) and 32.7 years (SD 4.48), respectively. Overall, mothers were well educated, affluent and ethnically diverse. In general, mothers who were contacted at six weeks and had initiated breastfeeding were not dissimilar to the York Region population from the 2006 Census. We were not able to compare the study population to mothers in the Region due to lack of information. Approximately 51% of York Region's population were affluent (household income $\geq$ \$80,000) compared to 55% in our sample and 57% were born in Canada compared to 59%, respectively. Nearly one third of mothers intended to supplement with infant formula. Sixty-nine percent of mothers who intended to supplement did go on to supplement their baby in the 12 months postpartum. Mothers who intended to supplement had higher household incomes than mothers who did not intend to supplement, 70% (95% CI 60.8-79.2) versus 58.2% (95% CI 52.1-64.3), respectively. A larger proportion of mothers who did not intend to supplement were first-time mothers (45.4%, 95% CI 39.8-51.2) compared to those who did intend to supplement (39.6%, 95% CI 29.8-49.4). Among mothers who intended to supplement, 35.4% (95% CI 25.8-45.0) were of East, Southeast, South Asian ethnicity compared to 27.3% (95% CI 21.8-32.8) of mothers who did not intend to supplement.

Imputation did not greatly affect the distribution of maternal age (mean and standard deviation: 32.8 $\pm$ 4.57 compared to 32.8 $\pm$ 4.52) and household income (low 13.5% compared to 14.2%; moderate 25.6% compared to 24.3%; high 60.9% compared to 61.4%).

Figure 2 includes the Kaplan-Meier survivor function plotted by exposure group (mother's intention to supplement). Mothers who intended to supplement experienced a higher risk of premature weaning (shorter breastfeeding duration) between two to four months as evidenced by the drop in the curve. At four months, 84.6% (95% CI 79.9-89.5) of mothers who did not intend to supplement were still breastfeeding compared to 62.9% (95% CI 52.6-75.3) of mothers who did intend to supplement. At approximately

eight months, both groups experienced comparable risk until the end of the study period. By 12 months, only 18.2% (95% CI 10.5-31.6) of mothers who intended to supplement were still breastfeeding compared to 44.1% (95% CI 37.3-52.0) of mothers who did not intend to supplement. A chi-square test was conducted and mothers who intended to supplement were significantly different than those who did not with a chi-square statistic of 23 ($p < 0.0001$). The difference among the two groups may be attributed to the Cox proportional hazard estimate.

The power of the Cox proportional hazard model is more dependent on the number of events (i.e., mothers who ceased breastfeeding by 12 months) than the number of study participants.²⁵ Simulation work by Peduzzi et al.²⁵ recommended a minimum requirement of 10 "events" per covariate to support the model, which was satisfied in this study. At six weeks, 21.7% of mothers were censored (lost to follow-up when contacted at six months) and by six months 8.4% were censored.

Results of the Cox proportional hazard regression analyses are presented in Table 2. Intention to supplement and parity were positive predictors of breastfeeding duration. Mothers who intended to supplement were 2.6 times (HR=2.64, 95% CI 1.83-3.81) more likely to wean prior to 12 months postpartum compared to mothers who did not intend to supplement, adjusting for all of the following covariates: parity, education, household income, age, prenatal education, immigration status and ethnicity. First-time mothers were 2.1 times (95% CI 1.39-3.27) more likely to cease breastfeeding in their child's first year compared to experienced mothers, adjusting for all covariates. Ethnicity as a whole was not found to be a predictor of breastfeeding duration, but differences were seen between subgroups of mothers self-identifying as European and those identifying as East, Southeast or South Asian (referent group). European mothers experienced 79% greater risk of ceasing breastfeeding than mothers who identified as East, Southeast or South Asian (95% CI 1.05-3.06).

In order to assess the potential impact of imputing the missing observations, the same Cox proportional hazard model was analyzed without the imputed observations ($n=304$). Similarly to our imputed model, intention to supplement (HR 2.85, 95% CI 1.93-4.19) and parity (HR 2.45, 95% CI 1.55-3.88) were found to be significant predictors. Although we were able to find an increased risk of shorter breastfeeding duration among European mothers com-

Figure 2. Kaplan-Meier Curve by mother's intention to supplement

pared to East, Southeast or South Asian mothers, it was not significant (HR 1.41, 95% CI 0.81-2.46).

A Likelihood Ratio Test determined that intention to supplement was negatively associated with the duration of breastfeeding after adjusting for all covariates in the model (chi-square = 2.52, $p < 0.0001$). The scaled Schoenfeld residuals for all covariates were plotted and displayed slopes that were close to zero; satisfying the proportional hazards assumption.

DISCUSSION

Promoting breastfeeding initiation has been very successful in York Region, with an initiation rate of 96.4%, but our results identify that there is also a case to be made to focus on helping mothers sustain longer breastfeeding duration. In order to help mothers meet infant feeding targets as set out by the *Nutrition for Healthy Term Infants* report, it is important to identify mothers who are at risk of shorter breastfeeding duration.¹

We found that mothers who intended to supplement their child with infant formula were 2.6 times more likely to experience shorter breastfeeding duration compared to mothers who did not intend to supplement their child (HR=2.64; 95% CI 1.83-

3.81). These results were consistent with our hypothesis. It is important to understand what determines intention in order to be able to address these underlying factors. The Theory of Reasoned Action states that intention is determined by three constructs: attitude toward the specific behaviour, subjective norms and perceived behavioural control.¹⁶ Further research is required to understand these maternal attitudes in relation to intention to supplement.

First-time mothers were 2.1 times more likely to experience shorter breastfeeding duration compared to experienced mothers (HR=2.13; 95% CI 1.39-3.27). One explanation could be that first-time mothers do not anticipate the challenges with breastfeeding compared to experienced mothers. Some studies have reported a longer duration of breastfeeding with increased parity,^{8,19,20} while others have failed to find any significant association.²⁶ There is also evidence that a mother's previous breastfeeding experience is a stronger predictor of breastfeeding duration compared to parity, assuming that it was a positive experience.^{19,27,28} In particular, 25% of mothers in the IFS stated that they stopped breastfeeding by six months because they were concerned about not having enough breastmilk; of these, 83% were first-time mothers.

Table 2. Cox Proportional Hazards Model of Shorter Breastfeeding Duration

Characteristics	Hazard Ratio	95% CI
Intention to supplement	2.64	(1.83-3.81)
Mother's age	1.22	(0.93-1.60)
Prenatal class attendance	0.73	(0.47-1.14)
Immigration status	1.02	(0.65-1.60)
First-time mother	2.13	(1.39-3.27)
Household income		
Low (<\$40,000)	1.08	(0.61-1.93)
Moderate (\$40,000-\$79,999)	1.27	(0.83-1.94)
High (≥\$80,000)	1.00	Referent
Self-identified ethnicity		
Canadian	1.66	(0.96-2.87)
European	1.79	(1.05-3.06)
East, Southeast, South Asian	1.00	Referent
Other	1.55	(0.96-2.50)
Education		
High school or less	1.78	(0.86-3.69)
Trade, some college, college	1.37	(0.95-1.98)
University degree or higher	1.00	Referent

CI - confidence interval.

Bolded text represents statistically significant results.

Mothers who identified themselves as European experienced 79% greater risk of shorter breastfeeding duration compared to mothers who identified as East, Southeast or South Asian (95% CI 1.05-3.06). This is consistent with WHO findings that 43% of South-East Asians were exclusively breastfeeding for at least the first six months postpartum between 2000 and 2008 compared to only 18% of Europeans.²⁹ These results should be interpreted with caution as we were not able to observe these same findings when we removed the imputed observations.

Although maternal age, education, household income, immigration status and prenatal class attendance have been found to be associated with breastfeeding duration in previous studies, this study did not observe a significant association. The lack of variability among mothers in York Region may have been why this study failed to observe an association with household income and maternal education. Further, while the general prenatal classes offered by York Region include breastfeeding education, the primary focus of these classes is not breastfeeding, therefore, attendance may not affect breastfeeding duration.

Strengths

One of the main strengths of this study was using the Kaplan-Meier and Cox proportional hazard regression for the analysis. These two methods allowed mothers who did not complete all three questionnaires to still contribute to the model and resulted in a more powerful analysis compared to logistic regression.

Limitations

There are a number of limitations that should be considered in this study. The IFS was designed to determine the rates of breastfeeding and feeding practices, not for the specific purposes of addressing the outlined research question; therefore, we were not able to control for a number of potential confounders in our analyses. These included marital status, baby birth weight, method of delivery, time until mother returns to work and psychosocial constructs for maternal attitude and subjective norms (i.e., maternal confidence in breastfeeding, maternal optimism regarding breastfeeding, maternal self-efficacy in breastfeeding, breastfeeding role models and support to breastfeed).¹⁶ These modifiable psychosocial factors have been found to be more predictive of breastfeeding duration than socio-demographic factors.^{18,30}

Maternal intention to supplement was determined six to eight weeks postpartum, after mothers in the study had already initiated breastfeeding. If there was a bias in recall among our outcome groups, then the results will be biased away from the null, resulting in a significant association. Future studies should attempt to capture intention to supplement prenatally.

Although imputation of household income and maternal age explained 16.9% and 17.2% of the variance in our models, respectively, the variables were still used in the model to maintain the number of events to support our model. Our small sample size may have prevented us from observing significant associations among covariates which have otherwise been proven to be predictors of early weaning, as previously mentioned. There was a high refusal rate for the survey (see Figure 1), which was not unexpected for new mothers; however, the study population was comparable to the general York Region population when compared to socio-demographic indicators from the 2006 Census.

Future implications

As York Region moves towards becoming BFI-designated, one of the responsibilities will be to encourage and support women to continue breastfeeding their children up to two years and beyond. Recognizing and understanding the maternal factors that may contribute to shorter breastfeeding duration will help public health and other health care providers identify mothers at risk of early weaning. Assessing feeding intentions and self-efficacy prenatally might help to identify mothers who are at higher risk for premature weaning as well as provide opportunities for education and facilitate access to prenatal and postnatal supports, including International Board Certified Lactation Consultants and breastfeeding clinics. The content and format of the existing prenatal classes, which are currently primarily attended by first-time mothers, could be revised to impact supplementation intentions by providing more families with the knowledge, skills and attitude to breastfeed exclusively. It is hoped this would result in an increased rate of exclusive breastfeeding to six months, as well as an increased percentage of mothers continuing to breastfeed to two years or longer.

CONCLUSION

This study found evidence to support an association between prenatal intention to supplement with infant formula and the risk of discontinued breastfeeding for the period up to 12 months postpartum among mothers in York Region. Future studies addressing the limitations outlined should be conducted in order to confirm these preliminary results.

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RÉSUMÉ

OBJECTIFS : Selon Santé Canada et la Société canadienne de pédiatrie, les nourrissons devraient être exclusivement allaités pendant les six premiers mois, et l'allaitement maternel devrait se poursuivre pendant deux ans et plus. Nous examinons la relation entre l'intention d'une mère de compléter le lait maternel avec de la préparation pour nourrissons et le risque qu'elle cesse d'allaiter au cours des 12 mois qui suivent l'accouchement.

MÉTHODE : Des sondages ont été administrés à une cohorte de mères à 6 semaines, 6 mois et 12 mois du post-partum dans le cadre du sondage « Infant Feeding Survey » de la Région de York. Les mères ayant commencé à allaiter leur enfant étaient incluses dans l'analyse (n=345). À l'aide du modèle de régression à effet proportionnel de Cox, nous avons étudié la relation entre l'intention prénatale d'une mère de compléter le lait maternel avec de la préparation pour nourrissons et la durée de l'allaitement, après avoir apporté des ajustements pour tenir compte des effets de l'âge de la mère, de l'enseignement prénatal, du statut d'immigration, de la parité, du revenu du ménage, ainsi que de l'ethnicité et du niveau d'instruction de la mère.

RÉSULTATS : Près du tiers des mères avaient l'intention de compléter leur lait avec de la préparation pour nourrissons. De ces mères, 69 % offraient en effet de la préparation pour nourrissons à leur bébé en plus du lait maternel dans les 12 mois post-partum. L'intention de compléter le lait maternel était associée à une durée d'allaitement abrégée (indice de risque (IR)=2,64, intervalle de confiance (IC) de 95 % : 1,83-3,81). La durée de l'allaitement était plus courte chez les mères primipares que chez les mères multipares (IR=2,13, IC de 95 % : 1,39-3,27). Cette durée était aussi plus courte chez les mères s'identifiant comme d'ascendance européenne que chez les mères venant de l'Asie de l'Est, du Sud-Est ou du Sud (IR=1,79, IC de 95 % : 1,05-3,06).

CONCLUSIONS : L'allaitement continu est bénéfique pour le nourrisson, mais comporte aussi d'importants avantages pour la mère. Notre analyse montre que l'intention prénatale de compléter le lait maternel peut être associée à une durée d'allaitement abrégée. Il faudrait pousser la recherche pour confirmer ces constatations et aborder les hypothèses et les contraintes sous-jacentes.

MOTS CLÉS : allaitement maternel; arrêt; intention; compléments alimentaires; facteurs de risque; modèles à risques proportionnels