

Household food security and breast-feeding duration among Canadian Inuit

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Abstract

Objective: There have been few studies investigating the association between food security and breast-feeding duration and none have been conducted among Canadian Inuit, a population disproportionately burdened with food insecurity. We evaluated the association between household food security and breast-feeding duration in Canadian Inuit children.

Design: Data were obtained from the Nunavut Inuit Child Health Survey, a population-based cross-sectional survey.

Setting: The Canadian Territory of Nunavut in 2007 and 2008.

Subjects: Caregivers of Inuit children aged 3–5 years. Participating children were randomly sampled from community medical centre lists.

Results: Out of 215 children, 147 lived in food-insecure households (68.4%). Using restricted mean survival time models, we estimated that children in food-secure households were breast-fed for 16.8 (95% CI 12.5, 21.2) months and children in food-insecure households were breast-fed for 21.4 (95% CI 17.9, 24.8) months. In models adjusting for social class, traditional knowledge and child health, household food security was not associated with breast-feeding duration (hazard ratio = 0.82, 95% CI 0.58, 1.14).

Conclusions: Our research does not support the hypothesis that children living in food-insecure households were breast-fed for a longer duration than children living in food-secure households. However, we found that more than 50% of mothers in food-insecure households continued breast-feeding well beyond 1 year. Many mothers in food-secure households also continued to breast-feed beyond 1 year. Given the high prevalence of food insecurity in Inuit communities, we need to ensure infants and their caregivers are being adequately nourished to support growth and breast-feeding, respectively.

Keywords

Inuit

Food insecurity

Breast-feeding

Restricted mean survival time

Food insecurity, namely failing to have 'access to sufficient, safe, nutritious food(s) to maintain a healthy and active life'⁽¹⁾, is pervasive in Canadian Inuit communities: a 2007 survey estimated that 63% of Inuit households experienced food insecurity in the previous year, eight times greater than what has been estimated for the general Canadian population over the same period^(2,3). Despite this, not all of those who live in food-insecure households are food insecure themselves, and this is particularly true of young children. A survey of pre-school aged Canadian Inuit children and their caregivers found that while 70% of households with young children could be classified as food insecure, 56% of children living in these households could be classified as food insecure⁽⁴⁾. The observed discordance between household and childhood food insecurity is not surprising. Previous research has found

adult caregivers struggling to afford nutritious foods attempt to shelter their children from food insecurity, making personal concessions like skipping meals or restricting energy intake^(5–8). One potential strategy that could also be utilized to keep children food secure is continued breast-feeding.

In the face of food insecurity, breast milk may be a nutritionally robust alternative, remaining a high fat, energy and protein source throughout maternal lactation⁽⁹⁾. Breast milk may also be a cost-effective alternative: it has been estimated that toddlers aged 6 to 12 months can receive approximately half of their energy needs from breast milk and toddlers aged 12 to 23 months can receive approximately 35–40% of their daily energy intake from breast milk^(10,11). Globally, public health organizations recommend infants receive exclusive breast-feeding to

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6 months and continued breast-feeding in complement with solid, semi-solid or soft foods up to 2 years of age and beyond^(12–14). The Canadian Maternity Experiences Survey (2006) reported that just over half (53%) of Canadian infants were still being breast-fed at 6 months of age⁽¹⁵⁾, and we recently estimated more than 60% of Inuit children who were raised by a biological mother were still being breast-fed at 6 months of age⁽¹⁶⁾. Among Canadian Inuit, factors associated with continued breast-feeding at and beyond 6 months have not been identified, and food insecurity may be one such factor.

There have been few studies examining the association between food insecurity and breast-feeding practices and most of this work has been conducted in developing countries^(17–20). Moreover, the findings have been inconsistent: differences in study populations, definitions of food security and control for confounding could be driving these inconsistencies. Previous research has examined how food insecurity impacted breast-feeding initiation⁽²¹⁾ and exclusive breast-feeding at 6 months⁽¹⁶⁾ among Canadian Inuit infants, but failed to find sufficient evidence to support associations. However, existing research suggests food insecurity may have the greatest impact on breast-feeding duration beyond the infant's first 6 months of life and there has been no work in this regard in Inuit communities^(19,20).

Understanding if food security affects overall breast-feeding duration would be of public health importance for this disproportionately burdened population. Our study sought to examine the association between household food security and the duration of breast-feeding in a population of Canadian Inuit children. We hypothesized that food-insecure homes would breast-feed their children for longer durations, in an attempt to shelter them from food insecurity.

Methods

Study design and sample

The Nunavut Inuit Child Health Survey was a population-based, cross-sectional survey of Inuit children conducted in the Canadian Territory of Nunavut between July and November, 2007 and 2008. The survey was designed to capture the health profiles, demographic profiles and home environments of pre-school aged Inuit children (aged 3 to 5 years old) living in Nunavut and used a community-based participatory research model. The survey received ethical approval from the McGill University Research Ethics Board and we received supplementary ethical approval for the current analyses from the University of Toronto's Research Ethics Board.

Nunavut is Canada's north-eastern most territory; it has the largest land mass of any Canadian territory or province and has the lowest population density⁽²²⁾. It is also home to almost half (46%) of Canada's Inuit population⁽²²⁾.

In 2011, approximately 32 000 Canadians lived in one of Nunavut's twenty-five communities and 85% of these self-identified as Inuit⁽²²⁾.

Sixteen Nunavut communities were selected to participate in the Nunavut Inuit Child Health Survey; including the remaining nine communities was not feasible due to the small number of inhabitants relative to the cost of northern travel. Children living in one of the sixteen selected communities were randomly sampled from lists provided by the community health centres and, as the sole source of health care in these communities, these lists were expected to be free of coverage errors. More information about the sampling strategy and the generation of sampling weights is provided elsewhere^(4,21).

Once a child was randomly selected from the community centre lists (i.e. the sampling frame), a member of the research team contacted the primary caregiver and asked them to view an informational DVD. This DVD was used to help caregivers provide informed consent. The primary caregiver was defined as the person most responsible for the child's care. After watching the DVD, those caregivers consenting to participate were invited to a community site, usually a health centre, where an English- or Inuk-speaking member of the research team orally administered a series of questionnaires. Interviews typically occurred within two weeks of initial contact with the child's primary caregiver.

Because our prior research has demonstrated food insecurity was not associated with beginning breast-feeding⁽²¹⁾, we restricted the present study to children who received some breast-feeding as infants. We excluded children who did not initiate breast-feeding because we were specifically interested in knowing, among those mothers who already began breast-feeding, whether food security played an instrumental role in their decision to continue breast-feeding.

Measures of interest

The main outcome of interest was time to cessation of breast-feeding. All respondents were asked to complete the open-ended question, 'How many months was your child breast-fed or fed breast milk, including mixed feedings (i.e. formula, food, cows' milk)?' In the analyses, we grouped the reported breast-feeding duration into two-month intervals. We elected to use two-month intervals to avoid inflated effect sizes resulting from artificial accuracy of recalled breast-feeding duration. Studies suggest that at least 80% of mothers are able to recall duration of breast-feeding fairly accurately within two months and this may drop to 60% for one-month increments^(23,24).

The primary exposure was household food insecurity. This was measured using a modified version of the US Department of Agriculture's eighteen-item Food Security Module⁽²⁵⁾, a tool that has been validated in a variety of populations around the world^(26–28). The Food Security

Module is designed to measure the household-level economic and social condition of limited or uncertain access to adequate food. It asks questions pertaining to individuals' and their households' experience with food insecurity in the previous year and includes questions such as 'The foods that we bought just didn't last'. Modifications to the language used in the scale were made to increase acceptability and applicability in an Inuit population. These modifications are described elsewhere and included replacing the response options 'always true', 'sometimes true' or 'never true' to 'often', 'sometimes' or 'never'⁽²⁹⁾. Like the original scale, ten questions on the modified inventory pertained to adult food security and eight pertained to child food security. The adult and child scales were scored separately in accordance with Health Canada's recommendations⁽³⁰⁾: adults and children scoring between 0 and 1 were classified as food secure; adults scoring between 2 and 5 and children scoring between 2 and 4 were classified as moderately food insecure; adults scoring 6 or more and children scoring 5 or more were classified as severely food insecure⁽³⁰⁾. These separate child and adult scores were then used to generate an overall household food security classification. For the purposes of the present analyses, we collapsed together households that would have been classified as being 'moderate' and 'severe' food insecure if we had used Health Canada's recommendations⁽³⁰⁾. Specifically, if adults and children were both food secure, the household was classified as food secure; if adults or children or both were food insecure, the household was classified as food insecure⁽³⁰⁾.

In effort to obtain the most accurate estimate of the association between food security and breast-feeding duration, we included other covariates in our analyses. We divided these into three categories: (i) indicators of socio-economic position; (ii) indicators of infant and child health; and (iii) indicators of Inuit traditional knowledge.

Lower socio-economic position has been associated with shorter duration of breast-feeding^(31,32) and greater food insecurity^(3,33,34). Three self-reported indicators were used to measure socio-economic position: if a household was receiving income support, if the home was privately owned and if the home had mould or was in need of major repair. Other indicators of socio-economic position, like occupation, education and household income, were not collected in the Nunavut Inuit Child Health Survey. Indicators of socio-economic position were dichotomized as yes/no in our analyses.

Three indicators of infant and child health were used: the caregiver's perception of the child's health, infant birth weight and child's BMI (centile). Caregiver's perception of health was measured on a five-point Likert scale with response options ranging from 'excellent' to 'poor'. Children whose caregivers indicated they had excellent or very good health were classified as having 'excellent or very good' self-rated health; others were classified as

having 'suboptimal' self-rated health in analyses. In terms of infant birth weight, infants were classified as either being born low birth weight (<2500 g) or not. Poor infant health has been associated with earlier cessation of breast-feeding and also with food insecurity⁽³⁵⁾.

Finally, two indicators of Inuit traditional knowledge were used: speaking Inuit dialects at home and hunting for country food. Historically, it has been reported that Inuit women practised breast-feeding for up to 3 years⁽³⁶⁾; it is possible that a longer duration of breast-feeding could exist in the present day among women who are more engaged with Inuit culture. Similarly, having a hunter in the household to provide country food has been shown to mitigate food insecurity in Canada's north⁽²⁾.

Statistical analyses

Analyses were conducted using the statistical software packages SAS version 9.4 and Stata version 13. Both software packages offer procedures to account for the random sampling strategy of the Nunavut Inuit Child Health Survey, to make population-level inferences using sampling weights⁽³⁷⁾ and to appropriately estimate variances for sub-populations^(37,38). We used a complete case analysis strategy, wherein only those with complete data on all indicators of interest were included. All statistical inferences were two-sided and confidence limits that did not cross 1 were considered statistically significant.

We performed descriptive analyses, exploring how demographic characteristics, socio-economic position, infant health and measures of traditional knowledge varied by household food security. Kaplan–Meier curves, both ignoring and taking into account sample weighting, were used to estimate the probability of continued breast-feeding across household food security categories. The association between food security and breast-feeding duration was evaluated using two survival models: Cox and flexible parametric proportional hazards models. We used the latter to estimate restricted mean time to breast-feeding cessation (i.e. restricted mean survival time) across household food-secure and food-insecure respondents.

Flexible parametric proportional hazards were estimated using the *stpm2* Stata program⁽³⁹⁾. These models first compute the survival function (i.e. $S(t)$) after fitting a Cox proportional hazards model, which is used to estimate a log cumulative hazard function. The log cumulative hazard function is smoothed on the log scale and is comprised of restricted cubic splines that allow for flexible parameterization over time⁽⁴⁰⁾. These models were used to estimate the relative instantaneous hazard of discontinuing breast-feeding by household food security. All infants who were still being breast-fed at the time of the survey or beyond 60 months of age were right censored. Because these analyses were based on a cross-section of data reported at 60 months, no observations were censored due to loss to follow-up.

We fit four sets of nested models in succession. In our first model, we examined the crude association between

food insecurity and breast-feeding; the second model adjusted for socio-economic position; the third model adjusted for infant health characteristics; the fourth and final model adjusted for Inuit traditional knowledge. Departures from proportionality over time were assessed for all covariates using statistical tests and visual inspection⁽⁴¹⁾. For Cox models, covariates exhibiting potentially disproportionate effects over time were modelled as stratification variables rather than independent effects⁽⁴¹⁾. For flexible parametric models, these variables were allowed to have partitioned parameter effects over time (i.e. time-varying coefficients) for optimal adjustment of potential confounding. Standard errors for the restricted means were computed using bootstrapping methods.

Results

There were 537 caregivers who were successfully contacted and asked to participate in the Nunavut Inuit Child Health Survey, and 388 completed the questionnaires (response rate of 72.2%). Of these, 263 began breast-feeding and were eligible for the current analyses. We excluded those missing information on breast-feeding duration (*n* 20), household food security (*n* 7) and other covariates (*n* 21); in that order. There were 215 participants who remained and were included in the analyses.

Overall, we found that sixty-eight (31.6%) households were food secure and 147 (68.4%) were food insecure. Table 1 shows the characteristics of study respondents by household food security classification. Those of lower socio-economic position were significantly more likely to report household food insecurity. For example, 26% of food-secure households and 53% of food-insecure households reported receiving income support in the previous month ($P < 0.001$). There were no differences in children's health indicators by food insecurity, or in traditional knowledge by food insecurity.

The estimated restricted mean time to breast-feeding cessation for food-secure and food-insecure households was 16.8 (95% CI 12.5, 21.2) months and 21.4 (95% CI 17.9, 24.8) months, respectively, ignoring sample weights; and 16.0 (95% CI 11.6, 20.3) months and 19.8 (95% CI 16.3, 23.2), respectively, with sample weights. Figure 1 shows the unweighted Kaplan-Meier curves estimating the probability of continued breast-feeding over time by household food security. These graphs indicate that 50% of children in food-insecure households were breast-fed for 12 months or more and 50% of children in food-secure households were breast-fed for 8 months or more, although these differences were not statistically significant (log-rank test, $P = 0.09$). Weighted curves were similar (not shown).

Table 2 presents the instantaneous hazard of discontinuing breast-feeding according to household food security status. Estimates from both Cox and flexible

Table 1 Demographic characteristics of the study sample, by food security status; Nunavut Inuit Child Health Survey, 2007–2008 (*n* 215)

Characteristic	Food secure (<i>n</i> 68)		Food insecure (<i>n</i> 147)	
	<i>n</i> or mean	% or SD	<i>n</i> or mean	% or SD
Caregiver demographics				
Sex†				
Male	7	11	13	9
Female	59	89	133	91
Relationship to child†				
Biological parent	61	93	129	88
Other	5	7	17	12
Child demographics				
Age (years), mean and SD	4.0	0.8	3.8	0.8
Sex				
Male	29	43	71	48
Female	39	57	76	52
Socio-economic position				
Receives income support***				
Yes	18	26	78	53
No	50	74	69	47
Lives in public housing***				
Yes	31	46	121	82
No	37	54	26	18
House needs repairs***				
Yes	20	29	71	48
No	48	71	76	52
Childhood health status				
BMI (centile), mean and SD	89.6	14	88.0	16
Birth weight				
Low birth weight	2	3	12	8
Healthy birth weight	66	97	135	92
Self-rated health				
Suboptimal	5	7	10	7
Very good, excellent	63	93	137	93
Traditional knowledge				
Having a hunter in house				
Yes	49	72	105	71
No	19	28	42	29

*** $P < 0.001$.

†Characteristics reported for 212 respondents; three were missing, two food secure and one moderately food secure.

parametric proportional hazards models were not materially different, suggesting an approximate 20% reduced hazard of breast-feeding cessation among food-insecure households. However, this effect was not statistically significant because all of our 95% confidence limits crossed the null value of 1. Furthermore, there was no indication of confounding by socio-economic position, child health or traditional knowledge factors.

Discussion

We used a population-based representative sample to explore the association between food insecurity and breast-feeding duration in Canadian Inuit. Although our point estimates suggest that infants and children who lived in food-insecure households were breast-fed for a longer duration than children who lived in food-secure

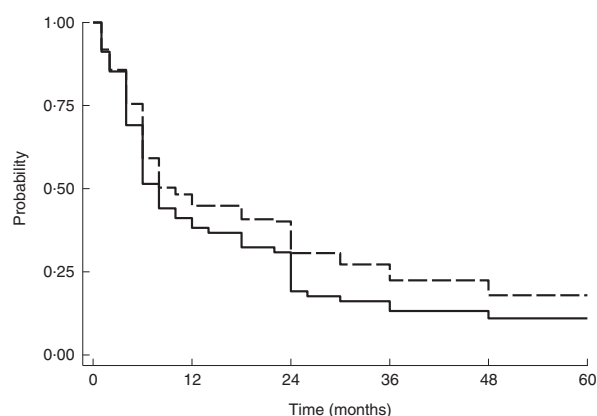


Fig. 1 Sample unweighted Kaplan–Meier functions illustrating the crude probability of continued breast-feeding by household food security status (—, food secure; - - - -, food insecure); Nunavut Inuit Child Health Survey, 2007–2008 (*n* 215)

households, we did not find sufficient evidence to suggest these differences were statistically significant. This supports similar null findings reported in Bangladesh⁽¹⁸⁾; but is inconsistent with research in low-income American women and Brazilian women that reports food insecurity is associated with longer duration of breast-feeding^(19,20).

The high prevalence of food insecurity in Canadian Inuit communities is concerning although not surprising; policy makers, community members and scholars have all spoken of this pervasive and troubling concern^(42,43). Although the prevalence of food insecurity has been reported previously by the Inuit Health Survey^(2,4,33), our research is the first to consider if food insecurity may impact breast-feeding decisions in Canada's north. From a public health standpoint, receiving adequate nutrition in the first 2 years of life is essential to prevent growth faltering and persistent stunting throughout the life course^(44,45). Recent research in Nunavik, an Inuit-inhabited region in Canada, estimated that food-insecure Inuit children were, on average, 2 cm shorter than their food-secure counterparts at ages 8 to 15 years⁽⁴⁶⁾; this may speak to inadequate nutrition early in the life course. We did not have information on the diets of study participants during their first 2 years of life, but such information is pertinent. Although breast milk can provide sufficient nutrition in the first 6 months of life (especially in concert with a daily vitamin D supplement (10 µg/400 IU)), additional, complementary foods are required thereafter^(10,13); breast-feeding alone cannot protect a child from childhood food insecurity.

It is also important to note that women who practise breast-feeding require additional energy to support lactation. To maintain current weight, a breast-feeding women requires an extra 2092 kJ (500 kcal) per day between 6 and 8 months postpartum and an extra 1464 kJ (350 kcal) per day at 9 months postpartum and beyond⁽⁴⁷⁾. We estimate that many Inuit women living in food-insecure

households were breast-feeding for extended durations: 50% of food-insecure mothers breast-fed their infants for 12 months or more. It is unclear if these women received the nutrition they needed to support lactation; and as such they may have been compromising their own health. Anthropometric measures for the biological mother (e.g. height, weight) were available only for biological mothers who participated in the Nunavut Health Survey, a concurrently running health survey of Inuit adults. This applied to less than 25% of the children in our study, i.e. fewer than 25% had maternal height and weight on record.

That said, recent research suggests that Inuit women of childbearing age have adequate, if not excess, energy intake but that many of the foods consumed are of poor quality⁽⁴⁸⁾. As a result, many Inuit women of childbearing age have substantial nutrient deficiencies⁽⁴⁸⁾. Breast milk's nutritional composition is directly affected by the maternal diet; even if women in our study had sufficient energy to breast-feed, the micronutrients they were passing to their child may be at suboptimal levels⁽⁴⁹⁾.

Limitations

Our research should be interpreted with the following limitations in mind. First, we used cross-sectional survey data to obtain information on food insecurity in the year prior to data collection. Children were aged 3–5 years at the time of the survey and many had stopped breast-feeding. These analyses assume that food insecurity was static since the child's birth, which may or may not be true. To truly understand the relationship between food insecurity and breast-feeding, prospective data should be collected starting before the infant is born. Such prospective data can also help inform if household food availability and scarcity has affected growth trajectories in Inuit children in Canada. A second and related limitation, children and their caregivers had to be alive and willing to participate in the cross-sectional survey. Because food insecurity is associated with increased morbidity and mortality⁽³⁵⁾, our sample may include healthy food-insecure survivors. Such healthiness may be related to breast-feeding, which has been shown to mitigate infant morbidity and mortality⁽⁵⁰⁾. As a result, our sample drawn at 3–5 years of age may have over-selected food-insecure children who were breast-fed for longer durations than we would have obtained had we drawn our sample shortly after birth. There are also concerns with measurement error. Responses were from the child's primary caregiver at the time of the survey: this may have been the biological mother but it could also have been the biological father, an adoptive parent or a grandparent. Recall of breast-feeding duration for these other caregiver groups is not certain. It should also be noted that the survey measured household food insecurity and we cannot be certain that the child was food insecure. Finally, our failure to find sufficient evidence to support an association between food insecurity and

Table 2 Hazard ratios (HR) and 95 % confidence intervals indicating risk of breast-feeding cessation for food-insecure relative to food-secure households; Nunavut Inuit Child Health Survey, 2007–2008 (n 215)

	Cox proportional hazards model				Flexible parametric proportional hazards model				
	Unweighted		Weighted†		Unweighted		Weighted†		
	HR	95% CI	HR	95% CI	HR	95% CI	HR	95% CI	
Model 1									
Model 2									
Model 3									
Model 4									
	Crude	0.77	0.56, 1.05	0.79	0.59, 1.06	0.76	0.56, 1.04	0.78	0.57, 1.08
	Socio-economic position‡	0.78	0.56, 1.10	0.81	0.58, 1.13	0.79	0.56, 1.11	0.81	0.57, 1.14
	Socio-economic position‡ + child health§	0.77	0.54, 1.10	0.82	0.60, 1.11	0.79	0.56, 1.11	0.80	0.56, 1.14
	Socio-economic position‡ + child health§ + traditional knowledge	0.78	0.54, 1.11	0.84	0.63, 1.11	0.82	0.58, 1.14	0.81	0.57, 1.15

†Models were weighted for the probability of participant selection in each community.

‡Socio-economic position indicators: house in need of repairs, living in public housing, receiving income support.

§Child health indicators: birth weight, caregiver-rated health, child BMI centile.

||Traditional knowledge indicators: hunter in household, spoken Inuit language.

breast-feeding duration may have been due to inadequate study power; the Nunavut Inuit Child Health Survey was powered to determine the prevalence of iron-deficiency anaemia ($\pm 5\%$) and not to study the association between food insecurity and breast-feeding duration. Indeed, our confidence interval suggests that food-insecure homes could have as low as a 50% reduced hazard of breast-feeding cessation or as high as a 15% increased hazard of breast-feeding cessation compared with food-secure homes.

Conclusion

Household food insecurity was pervasive among Inuit households, although it did not appear to be associated with breast-feeding duration: we did not find an association between food insecurity and breast-feeding duration in our population-based sample of Canadian Inuit. Programmes and services that can address the nutrition of vulnerable women and children in food-insecure northern Canadian communities are needed.

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