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Exclusive Breastfeeding among Canadian Inuit: Results from the Nunavut Inuit Child Health Survey

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Abstract

Background: Very little population-based research has been conducted around the exclusive breastfeeding practices of Inuit Canadians.

Objectives: This research aims to assess the distribution of exclusive breastfeeding among Inuit Canadians and to identify factors associated with exclusive breastfeeding as recommended.

Methods: We use data from 188 infant-mother dyads who completed the Nunavut Inuit Child Health Survey, a cross-sectional, population-based survey of Inuit children aged 3 to 5 years. A series of multinomial logistic regression models were run to identify factors associated with 4 exclusive breastfeeding durations (≤ 1 month, > 1 - < 5.5 months, 5.5-6.5 months, and > 6.5 months).

Results: Of infants, 23% were exclusively breastfed as recommended (ie, between 5.5 and 6.5 months; 95% CI, 16.2-29.3). Many infants (61%) were exclusively breastfed for less than 5.5 months and 16% (95% CI, 10.9-22.0) were exclusively breastfed for more than 6.5 months. Families receiving income support were less likely to discontinue exclusive breastfeeding before 5.5 months ($pOR_{1- < 5.5 \text{ months}} = 0.34$; 95% CI, 0.13, 0.85) relative to those not receiving income support, in adjusted models. No other measured factors were significantly related to exclusive breastfeeding duration.

Conclusions: The majority of Inuit Canadian infants receive suboptimal exclusive breastfeeding. National, provincial, and community-specific interventions to protect, promote, and support exclusive breastfeeding should emphasize not only the benefits of exclusively breastfeeding to 6 months but also the importance of timely introduction of complementary foods into the infant's diet.

Keywords

Aboriginal, breastfeeding, epidemiology, exclusive breastfeeding, Inuit

Well Established

The determinants of exclusive breastfeeding are known to vary across populations. Currently, there is no population-based research on the distribution of and factors associated with exclusive breastfeeding in Inuit Canadians.

Newly Expressed

We found that 23% of Inuit infants who began breastfeeding were being exclusively breastfed as recommended. Families currently receiving income support were less likely to discontinue exclusive breastfeeding before 6 months.

Background

Few Canadian mothers exclusively breastfeed their infants to 6 months as recommended by several health authorities including, since 2004, Health Canada.^{1,2} Population-based surveys

estimate that, nationally, between 14%³ and 26%⁴ of Canadian infants are exclusively breastfed to 6 months, and document key disparities among population subgroups. Canadian women who are married, more educated⁵ and who live in the western-most provinces and some territories^{3,5} are more likely to meet the 6-month recommendation than others.

Presently, there are no population-based estimates of exclusive breastfeeding practices among Inuit Canadians, 1 of 3 indigenous populations in Canada.⁶ Available data show

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that Inuit mothers are less likely to begin breastfeeding (66%⁷ compared to 90%³), and are equally as likely practice *any* breastfeeding at 6 months compared to other Canadians (54%⁷ compared to 54%³). Yet the Canadian territory of Nunavut, where approximately 84% of inhabitants are Inuit,⁸ reports one of the highest rates of exclusive breastfeeding to 6 months in all of Canada (19.7% in Nunavut vs 14.4% in Canada).³ However, currently no data are available for comparing exclusive breastfeeding practices among Canadian Inuit and other Canadians, and no study has attempted to identify characteristics associated with variation in exclusive breastfeeding duration among Inuit Canadians.

Living predominantly in the arctic and subarctic regions of Canada,⁹ Inuit populations experience a unique set of contexts that may present both barriers and supports to exclusive breastfeeding to 6 months. For example, a high prevalence of food insecurity^{10,11} may or may not play a role in extending the duration of exclusive breastfeeding,¹² while difficulties accessing timely health care due to the remoteness of several communities may reduce the duration of exclusive breastfeeding because of inadequate means of tangible support from health care professionals,¹³ although the opposite has been observed in Australian Aboriginal groups.¹⁴ Exhibiting a more traditional way of life could, in theory, be more supportive of exclusive breastfeeding duration in this population. Alternatively, factors predictive of exclusive breastfeeding among Canadian Inuit may be similar to other Canadians.

The aim of the present research is to describe the distribution of exclusive breastfeeding and to identify factors associated with exclusive breastfeeding as recommended among Canadian Inuit.

Methods

This study uses data from the Nunavut Inuit Child Health Survey, a population-based, cross-sectional survey conducted in Nunavut in the summer and fall of 2007 and 2008 (August to November). The survey captured key aspects of health among preschool aged Inuit children (aged 3 to 5 years), including information on maternal breastfeeding practices. Ethical approval for the Nunavut Inuit Child Health Survey was granted by the Institutional Review Board of the McGill University Faculty of Medicine, and approval for the secondary data analyses presented here was granted by the University of Toronto's Health Sciences Research Ethics Board.

Nunavut is located in the northeastern most region of Canada and covers a geographic area of almost 2 million square kilometers.¹⁵ It has 3 administrative areas: Baffin, in the far north and east; Kivalliq, in the southwest; and Kitikmeot, in the northwest. The territory has a population of approximately 33 000 persons and is home to 50% of all of Canadian Inuit.⁹ There are 25 communities in Nunavut.¹⁵

Sixteen of these 25 communities participated in the Nunavut Inuit Child Health Survey. The remaining

9 communities had a relatively small number of children relative to the costs of study participation and were excluded for financial and logistical reasons described elsewhere.¹⁰ Inuit children, aged 3 to 5 years, speaking either English or Inuktitut, living in 1 of these 16 communities, were eligible to participate. For the present study, we included only those children who received some breastfeeding from birth. We excluded children who were adopted because previous research¹⁶⁻¹⁹ suggests that adopted children are less likely to receive any breastfeeding. We also excluded any survey that was completed by someone other than a biological parent, such as a grandparent or sibling.

Participants in the Nunavut Inuit Child Health Survey were selected in 1 of 2 ways. In the first way, children of parents who were randomly selected for the IPY Inuit Health Survey, a survey of Inuit adults occurring concurrently, and who met the eligibility criteria were invited to participate. Methods for the IPY Inuit Health Survey are fully described elsewhere.²⁰ In the second way, children themselves were randomly selected from patient rosters at the local community health centre using random number tables and random number generators.

About 2 weeks prior to survey administration, members of the data collection team traveled to communities to begin recruitment. Caregivers of selected children were invited to participate. Often times, invitations were extended by a member of the research team via a personal home visit, but other methods were also employed to contact selected individuals (eg, telephone calls, hand-delivered notification letters). At least 3 contact attempts were made, sometimes more when time permitted.

Those caregivers who formally consented to participate were invited to a local community centre (eg, health facility) within 2 weeks to complete an interviewer-led survey. All surveys were administered by 1 of 5 members of the research team: 2 Inuk interviewers who spoke both English and Inuktitut fluently, 2 English-speaking research assistants from McGill University's Centre for Indigenous Peoples' Nutrition and Environment, and 1 English-speaking nurse who had extensive work experience in Inuit communities. Many of the questions, including those on exclusive breastfeeding practices, were based directly on questions used in the Nunavik Inuit Health Survey (2004),²¹ a population-based survey of Inuit Canadians living in Nunavik—the northern region of Quebec, Canada. Modifications to specific questions were made after consultation with the Nunavut Inuit Child Health Survey steering committee, composed of many stakeholders including Inuk community representatives, regional health representatives, and governmental partners. Surveys were administered in either English or Inuktitut, as appropriate.

The duration of exclusive breastfeeding was measured in response to the question "how many months was your child 'exclusively' breastfed or exclusively fed breast milk." The definition of exclusive breastfeeding was not provided to

participants unless specifically requested. When requested, the definition used was feeding an infant only breast milk.²² Additional information, such as the age of the infant when formula and complementary foods were introduced into their diet, was not captured.

We identified several possible determinants of breastfeeding duration (any and/or exclusive for at least 3 months), most of which were measured directly in the Nunavut Inuit Child Health Survey, including infant birth weight,^{23,24} maternal practices during pregnancy (ie, smoking,²⁵ alcohol consumption²⁶), household overcrowding,²⁷ being lower income^{28,29} or receiving social assistance,^{29,30} place of residence,^{5,28} access to health care and other instrumental support,¹³ and level of engagement with traditional culture.^{31,32} We were also interested to learn whether scarcity of food resources was associated with exclusive breastfeeding duration, so we included measures of household and childhood food security. Last, we were interested in exploring an association between household smoking restrictions and exclusive breastfeeding, since such an association may have important public health implications relating to Inuit Canadian infant respiratory infection. In Nunavut, there is an average of 2 smokers per household with children aged 3 to 5 years, although many of these households (82.5%; 95% CI, 78.3%-86.7%) do not allow indoor smoking.¹⁹ Moreover, Inuit infants appear to be at greater risk for lower respiratory tract infection requiring hospitalization compared to other Canadians.³³

A single indicator variable, primary language spoken at home (Inuit dialects versus other), was used as a proxy measure for level of engagement with traditional culture. Access to health care was measured using 4 community-level indicator variables: living in a community with a birthing centre, living in a community with the Canadian Prenatal Nutrition Program (CPNP), the frequency of prenatal visits per live births per year, and the frequency of preventive care visits per population per year. We obtained community participation in the CPNP from reports released on behalf of the Government of Nunavut for the years of 2004 and 2005.³⁴ We obtained community health care utilization data for the years of 2008 and 2009 from a recent inventory of health care resources in Nunavut (personal communication, Gregory Marchildon). All other variables were extracted directly from the Nunavut Inuit Child Health Survey.

Most of these indicator variables were collected as closed-ended questions and treated as categorical measures in analyses. Household overcrowding was captured by dividing the number of persons in a household by the number of bedrooms in that household. When there was more than 1 person per room, the household was considered overcrowded, a definition consistent with other Canadian research.^{35,36} Household and childhood food security were measured using a modified version of the USDA Food Security Module,³⁷⁻³⁹ revised for Canadian Aboriginal communities.⁴⁰ Both household and childhood food security were categorized as 3-level

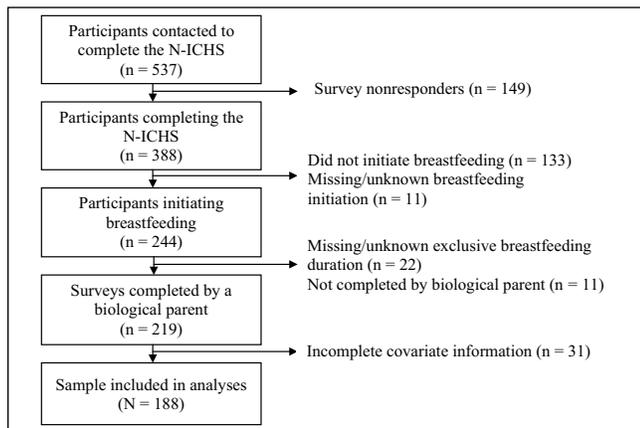
variables (food secure, moderately food insecure, severely food insecure), based on response patterns to the 18-item scale, fully described elsewhere.¹⁰ Last, the proportions of prenatal and preventive care visits in the community each year were dichotomized at the median.

We conducted statistical analyses weighted to the probability of participant selection using SAS version 9.3. Individuals with item nonresponse for any predictor variable were removed from the data set. We used complex survey procedures (eg, SURVEYFREQ, SURVEYLOGISITC) to account for the sampling design, unless otherwise noted. We accounted for the subpopulation (ie, only those who initiated breastfeeding) through use of the DOMAIN statement.^{41,42} Such an approach is necessary for population-based survey research because the simple removal of individuals outside of the domain of interest, the common approach used in non-survey sample research, will correctly estimate the weighted parameter(s) of interest, but may result in inappropriate variance estimation.^{42,43} The final parameters reported in these analyses, after applying the domain statement, reflect the proportion of infants who began breastfeeding who were exclusively breastfeeding for each outcome category.

To better understand the distribution of exclusive breastfeeding within the study sample (ie, those who initiated breastfeeding) we calculated several descriptive statistics. To facilitate comparisons with other Canadian surveys⁵ we also calculated the proportion of exclusive breastfeeding as recommended amongst all children completing the Nunavut Inuit Child Health Survey as well as all children being raised by a biological mother (ie, not excluding those who did not initiate breastfeeding). To facilitate comparisons with other Aboriginal populations,^{7,14,44-46} we described the proportion of infants (in this sample, as well as the full sample of participants in the Nunavut Inuit Health Survey) who were not only receiving exclusive breastfeeding, but any breastfeeding at various time intervals. We also performed a stratified analysis to compare if the duration of exclusive breastfeeding varied by year of birth, since many children in the Nunavut Inuit Child Health Survey would have been born prior to Health Canada's recommendation to exclusively breastfeed infants to 6 months (ie, in 2004).

We used multinomial logistic regression to model the odds of 4 different categories of exclusive breastfeeding duration. We created 2 outcome categories to distinguish 2 different patterns of suboptimal short duration of exclusive breastfeeding (1 month or less and more than 1 month to less than 5.5 months). Our rationale was based on literature suggesting that factors associated with earlier cessation of exclusive breastfeeding (eg, before 1 month) may be different than those associated with a later cessation of exclusive breastfeeding but an earlier cessation than recommended.²⁸ We created another outcome category to define a suboptimal long duration of exclusive breastfeeding (more than 6.5 months). We elected to model this category after data suggested that many Inuit continued to exclusively breastfeed

Figure 1. Flow Diagram of Participants from the Nunavut Inuit Child Health Survey (N-ICHS; 2007-2008) Included in the Present Analysis.



their infants beyond the recommended 6 months. We defined a fourth outcome category to indicate exclusive breastfeeding as recommended (5.5 to 6.5 months). This range was selected to account for variation in infant development that would lead to either earlier or later introduction of complementary foods into the infant's diet.⁴⁷ Sensitivity analysis, modifying the boundaries of the outcome category "exclusive breastfeeding as recommended" were also conducted.

We first tested a series of bivariate regression models. Factors exhibiting at least a weak association with exclusive breastfeeding ($P < .25$) were candidates for the multivariate model. All candidate variables were then tested in a multivariate model. We used a forward stepwise model building strategy, adding the most significant variables sequentially as calculated by likelihood ratio tests, until all variables remaining in the model met our entry and exit criteria ($P_{\text{entry}} = .25$, $P_{\text{exit}} = .30$), consistent with recommendations for building exploratory predictive models.⁴⁸ We also performed a binary logistic regression for comparative purposes.

Results

Figure 1 illustrates the number of participants in the Nunavut Inuit Child Health Survey eligible at each phase of the study and included in these analyses. Of the 388 participants who completed the survey, 219 met the eligibility criteria. There were 188 participants who had complete item response for factors of interest, representing 752 infant-mother dyads after applying population weights.

Table 1 presents the unweighted and weighted characteristics of study respondents. Most of the individual characteristics exhibited similar unweighted and weighted frequencies in our sample.

One half of all Inuit infants were breastfed at 6 months 50.8% (95% CI, 45.4-56.2), as were three quarters of infants who began breastfeeding (77.0%; 95% CI, 70.5-83.6). Table 2 shows the breastfeeding practices of this study

population (ie, those who initiated breastfeeding) as well as various other samples and subsamples of the Nunavut Inuit Child Health Survey. The unweighted and weighted data were quite similar and only weighted results are presented herein. The median duration of exclusive breastfeeding was 4.3 months (95% CI, 3.81-4.69; range: 0 to 11) in the study sample. Exclusive breastfeeding as recommended (5.5 to 6.5 months) was practiced by 22.7% of the study's respondents (95% CI, 16.2-29.3). Among the entire sample of children who participated in the Nunavut Inuit Health Survey (not just those who initiated breastfeeding), 14.2% (95% CI, 10.2-18.1) were exclusively breastfed as recommended. Among children being raised by a biological mother 18.3% (95% CI, 13.0-23.6) were exclusively breastfed as recommended. The proportion of infants being exclusively breastfed as recommended did not vary significantly if the child was born before or after 2004 (29.4% vs 15.5%, $P = .23$).

Table 3 displays the weighted prevalence of select characteristics of interest, by exclusive breastfeeding duration and Table 4 shows their bivariate associations with exclusive breastfeeding duration. The majority of respondents (60.8%) practiced exclusive breastfeeding for a short duration (≤ 1 month: 22.6%; 95% CI, 16.0-29.2; $> 1 - < 5.5$ months: 38.2%; 95% CI, 30.8-45.7), yet a substantial percentage (16.4%; 95% CI, 10.9-22.0) reportedly continued exclusive breastfeeding beyond the recommended 6 months. The prevalence odds ratios in Table 4 demonstrate associations relative to exclusive breastfeeding as recommended. Those receiving income support had a significantly lower odds of exclusive breastfeeding for a shorter duration than recommended, relative to those not receiving income support ($\text{pOR}_{\leq 1 \text{ month}} = 0.36$; 95% CI, 0.14-0.94; $\text{pOR}_{> 1 - < 5.5 \text{ months}} = 0.34$; 95% CI, 0.14-0.81). We identified 4 additional characteristics as candidates for our multivariable model (ie, $P < .25$): speaking Inuit dialects in the household, imposing household smoking restrictions, place of residence and access to the CPNP (see Table 4).

Table 5 presents our multivariate adjusted risk estimates. The indicators, languages spoken at home and living in a community with the CPNP, increased the predictive ability of our model but were not independently significant. Point estimates suggest that receiving income support was associated with a significantly lower odds of stopping exclusive breastfeeding between 1 and 5.5 months relative to not receiving income support ($\text{pOR}_{> 1 - < 5.5 \text{ months}} = 0.34$; 95% CI, 0.13-0.85). Binary logistic regression models, performed for comparative purposes, also suggest that receiving income support was associated with exclusive breastfeeding as recommended (5.5-6.5 months vs other: $\text{pOR} = 0.45$; 95% CI, 0.21, 0.98).

Discussion

This study updates population-based estimates of the duration of exclusive breastfeeding among Canadian Inuit who live in

Table 1. Selected Unweighted (n = 188) and Weighted (n = 752) Household, Maternal, Infant, and Community Characteristics of Respondents, Nunavut Inuit Child Health Survey, 2007-2008.

Characteristics	Unweighted (n = 188)		Weighted (n = 752)	
	n	%	n ^a	%
Household characteristics				
Speaks primarily Inuit dialects at home	96	51.1	390	51.9
Receives income support	83	44.2	330	43.8
Lives in an overcrowded conditions	97	51.6	387	51.4
Household smoking restrictions	172	91.5	690	91.8
Household food security				
Secure	61	32.4	252	33.5
Moderate insecurity	73	38.8	280	37.2
Severe insecurity	54	28.7	220	29.3
Child food security				
Secure	84	44.7	340	45.2
Moderate insecurity	63	33.5	232	30.8
Severe insecurity	41	21.8	180	23.9
Maternal pregnancy behaviors				
Maternal alcohol consumption during pregnancy	47	25.0	194	25.8
Maternal smoking during pregnancy	155	82.4	606	80.6
Infant characteristics				
Infant birth weight < 2500 g	12	6.4	43	5.8
Community characteristics				
Community has < 1600 population	101	53.4	287	38.2
Community region				
Baffin	86	45.8	365	48.5
Kitikmeot region	65	34.6	268	35.7
Kivalliq region	37	19.7	118	15.7
Community has Canadian Prenatal Nutrition Program	98	52.1	326	43.4
Frequency of preventive care (≥ 3.5 visits per 100 persons)	97	51.6	304	40.4
Frequency of prenatal care (≥ 1 visit per live birth)	99	52.7	308	41.0

^aWeighted values were rounded to the nearest whole number.

Nunavut, and identifies factors associated with exclusive breastfeeding duration. We estimate the prevalence of exclusive breastfeeding for the entire sample of participants in the Nunavut Inuit Child Health Survey was 14.2%, and 18.3% in reports provided by biological mothers. This is similar to rates reported in other Canadians (14% and 26%).^{3,4} Importantly, the proportion of Inuit infants exclusively breastfed as recommended did not increase significantly among children born after Health Canada adopted the current national exclusive breastfeeding recommendation in 2004.

Despite significant cultural, environmental, and biological variation among Canadian indigenous populations, the pattern of breastfeeding practices of Inuit Canadians are remarkably similar to those estimated for several groups of Metis and First Nations peoples⁷ and also Greenland Inuit.⁴⁴ In particular, a substantial portion of indigenous infants from these communities continue to receive any breastfeeding (not necessarily exclusively) at 6 months. That said, there are some differences in breastfeeding across indigenous populations: Inuit Canadians are more likely than both Alaskan

Inuit⁴⁵ and Australian Aboriginals^{14,46} to practice any breastfeeding at 3 and 6 months.

The majority of the analyses presented here exclude data on infants whose mothers did not initiate breastfeeding. Results indicate that more than three quarters (77%) of Inuit infants who began breastfeeding continued to breastfeed to at least 5.5 months, and just over one third (39%) were exclusively breastfed to at least 5.5 months. Almost one quarter of Inuit women who initiated breastfeeding did not practice exclusive breastfeeding beyond 1 month, a trend characteristic of other Canadian and western populations.⁴⁹⁻⁵¹ Among infants exclusively breastfed to at least 5.5 months in our sample (39%), a substantial portion (16%) continued beyond the recommended 6 months. Overall, 23% of breastfed Inuit Canadian infants were reportedly exclusive breastfed as recommended.

Many Inuit mothers reportedly continued exclusive breastfeeding beyond the recommended 6 months postpartum. This high proportion of mothers (16%) presents a public health challenge separate from the more commonly observed

Table 2. Weighted Proportion of Inuit Canadians Reportedly Breastfeeding at Various Points in Time, by Select Characteristics of Interest ($n_{\text{weighted}} = 1383$).

	Time			
	1 Month, % (95% CI) ^a	3 Months, % (95% CI)	6 Months, % (95% CI) ^b	As Recommended, % (95% CI) ^c
Exclusive breastfeeding				
Those initiating breastfeeding (n = 752)	80.9 (74.5-87.2)	70.9 (63.8-78.1)	39.1 (31.4-46.8)	22.7 (16.2-29.3)
All Inuit children (n = 1383) ^d	45.7 (40.2-51.2)	41.3 (35.9-46.7)	24.7 (20.0-29.4)	14.2 (10.2-18.1)
All Inuit children raised by biological mother (n = 1004) ^e	54.9 (48.3-61.6)	50.3 (43.6-57.0)	31.2 (25.0-37.5)	18.3 (13.0-23.6)
Born before 2004 (n = 401)	78.2 (69.0-87.4)	69.5 (59.0-80.0)	47.6 (36.4-58.8)	29.4 (19.8-39.0)
Born in 2004 or later (n = 351)	76.6 (67.0-86.3)	72.6 (62.7-82.5)	33.9 (23.0-44.8)	15.5 (7.6-23.5)
Any breastfeeding				
Those initiating breastfeeding (n = 752)	93.1 (89.0-97.3)	88.0 (82.6-93.3)	77.0 (70.5-83.6)	—
All Inuit children (n = 1383) ^d	59.0 (53.6-64.4)	57.2 (51.8-62.6)	50.8 (45.4-56.2)	—
All Inuit children raised by biological mother (n = 1004) ^e	69.0 (62.8-75.3)	67.4 (61.1-73.7)	60.2 (53.7-66.7)	—

^aConfidence limits calculated using the Wald method.

^bDefined as at least 5.5 months to be consistent with other analyses.

^cDefined as between 5.5 months and 6.5 months.

^dBreastfeeding rates (exclusive or any, as indicated) of all children who completed the Nunavut Inuit Child Health Survey.

^eBreastfeeding rates (exclusive or any, as indicated) of all children who completed the Nunavut Inuit Child Health Survey and were being raised by a biological mother.

challenge of shorter than recommended duration of exclusive breastfeeding.⁵² Results of many retrospective cohort studies indicate that most infants require complementary feeding in addition to breast milk between ages 6 and 23 months, although direct comparisons of exclusively breastfed infants older than 6 months are rare. Current expert opinion is that delaying the introduction of complementary foods beyond approximately 6 months, when most healthy infants are developmentally ready, constrains energy and micronutrient intakes below requirements and is associated with stunting,⁵³ wasting,⁵⁴ and delayed psychomotor and cognitive development in early childhood.^{55,56} Despite this concern, in light of the present results, recent anthropometric measurements of preschool-aged Inuit children in the Nunavut Inuit Child Health Survey do not suggest any stunting or wasting between ages 3 and 5 years.⁵⁷ Further assessment of the potential health implications of extended exclusive breastfeeding among some Inuit Canadian infants should include investigation of the extent to which misclassification of exclusive breastfeeding duration may have occurred due to systematically upward bias in recall errors, intentional overstatement of the duration of exclusive breastfeeding due to a belief that a longer duration of exclusive breastfeeding is more socially desirable, misinterpretation of the meaning of exclusive breastfeeding, or some combination of these causes. The data were not available to make this assessment in our analyses.

In the weighted sample of 752 participants, receiving income support was the only factor significantly associated ($P < .05$) with exclusively breastfeeding as recommended.

We identified 2 additional characteristics that were only weakly associated ($P < .25$) with the practice: speaking Inuit dialects at home—a surrogate for traditionalism—and community access to the CPNP. This suggests there may be other unmeasured influences on variation in duration of exclusive breastfeeding yet to be identified among Inuit Canadian communities. Identifying factors associated with exclusive breastfeeding can help inform public health campaigns by establishing population subgroups that are particularly at risk for early cessation of exclusive breastfeeding for targeted messaging.

A finding that infants in households' receiving income support (an inverse surrogate for household income) were less likely to be breastfed exclusively for a short duration is generally inconsistent with research in other western populations, in which lower income tends to be associated with shorter exclusive breastfeeding duration.^{28,30} Other exceptions include Australian Aboriginal populations, among whom income does not appear to be associated with breastfeeding duration.¹⁴ While some research suggests income itself is related to exclusive breastfeeding duration only when other, highly correlated factors (eg, education) are not adequately adjusted for,⁵⁸ it seems unlikely that this would explain our finding. The direction of the effect is opposite to what one would expect and we were not able to adjust for other socioeconomic variables.

One alternative explanation may be that mothers in households not receiving income support returned to work shortly after giving birth, a powerful risk factor for early cessation of exclusive breastfeeding.^{49,59,60} Information on individual

Table 3. Weighted Distribution of Exclusive Breastfeeding Practices, by Select Household, Maternal, Infant, and Community Characteristics of Respondents, Nunavut Inuit Child Health Survey, 2007-2008 ($n_{\text{weighted}} = 752$).

Characteristic	Exclusive Breastfeeding Duration								P Value ^c
	As Recommended		Suboptimal Duration				Longer Than Recommended		
			Shorter Than Recommended						
	5.5-6.5 Months (n = 171, 22.7%)		≤ 1 Month (n = 170, 22.6%)	> 1- < 5.5 Months (n = 288, 38.2%)		> 6.5 Months (n = 124, 16.4%)			
n ^a	% ^b	n	%	n	%	n	%		
Household characteristics									
Languages spoken at home									
Inuit dialects (n = 390)	102	26.1	78	19.9	124	31.8	87	22.2	.06
Other dialects (n = 361)	69	19.1	92	25.4	164	45.3	37	10.2	
Income support									
No (n = 422)	70	16.7	112	26.4	193	45.8	46	11.0	< .01
Yes (n = 330)	100	30.4	58	17.6	94	28.6	77	23.4	
Household crowding									
≤ 1 person/room (n = 365)	92	25.3	86	23.5	121	33.2	65	17.9	.65
> 1 person/room (n = 387)	79	20.3	84	21.7	166	43.0	58	15.0	
Household smoking restrictions									
Yes (n = 690)	162	23.5	152	22.1	274	39.7	101	14.7	.14
No (n = 62)	9	14.2	17	28.1	14	22.0	22	35.6	
Household food security									
Secure (n = 252)	60	23.7	55	21.6	99	39.4	38	15.2	.99
Moderate insecurity (n = 280)	62	22.1	67	23.9	104	37.3	47	16.7	
Severe insecurity (n = 220)	49	22.4	48	22.0	84	38.1	39	17.5	
Childhood food security									
Secure (n = 340)	78	23.0	82	24.0	129	38.0	51	15.0	.99
Moderate insecurity (n = 232)	56	24.2	44	18.8	89	38.4	43	18.6	
Severe insecurity (n = 180)	36	20.2	45	24.8	70	38.6	29	16.2	
Maternal pregnancy behaviors									
Alcohol consumption									
No (n = 558)	123	22.0	132	23.7	205	36.8	98	17.6	.80
Yes (n = 194)	48	24.9	38	19.4	83	42.6	26	13.2	
Smoking									
No (n = 146)	37	25.2	41	28.1	44	29.9	24	16.7	.72
Yes (n = 606)	134	22.1	129	21.3	244	40.2	99	16.4	
Infant characteristics									
Infant birth weight									
< 2500 grams (n = 43)	7	15.7	19	44.9	12	27.5	5	11.9	.35
≥ 2500 grams (n = 708)	164	23.2	150	21.2	276	38.9	118	16.7	
Community characteristics									
Community size									
< 1600 people (n = 287)	65	22.5	45	15.6	124	43.4	53	18.4	.37
≥ 1600 people (n = 465)	106	22.9	125	26.9	163	35.1	71	15.2	
Region									
Baffin (n = 365)	85	23.4	60	16.4	166	45.5	53	14.6	.18
Kitikmeot (n = 268)	52	19.6	87	32.3	73	27.4	56	20.7	
Kivalliq (n = 118)	33	27.8	23	19.5	48	40.4	14	12.2	

(continued)

Table 3. (continued)

Characteristic	Exclusive Breastfeeding Duration								P Value ^c
	As Recommended	Suboptimal Duration							
		Shorter Than Recommended				Longer Than Recommended			
		5.5-6.5 Months (n = 171, 22.7%)		≤ 1 Month (n = 170, 22.6%)		> 1- < 5.5 Months (n = 288, 38.2%)		> 6.5 Months (n = 124, 16.4%)	
n ^a	% ^b	n	%	n	%	n	%		
Prenatal nutrition program									
No (n = 426)	91	21.3	119	27.8	143	33.4	74	17.4	.23
Yes (n = 326)	80	24.6	51	15.7	145	44.5	49	15.1	
Frequency of preventive care									
<3.5 visits per 100 persons (n = 448)	106	23.6	115	25.7	153	34.2	73	16.4	.51
≥3.5 visits per 100 persons (n = 304)	65	21.4	55	18.0	134	44.1	50	16.4	
Frequency of prenatal care									
<1 visit per live birth (n = 444)	117	26.3	91	20.5	175	39.4	61	13.8	.39
≥1 visit per live birth (n = 308)	54	17.6	78	25.6	113	36.6	62	20.2	

^aWeighted values rounded to the nearest whole number; may not equal column totals due to rounding.

^bRow percentage may not total to 100 due to rounding.

^cP values generated from Wald tests.

Table 4. Weighted Bivariate Prevalence Odds Ratios and 95% Confidence Interval of Selected Household, Maternal, Infant, and Community Characteristics from Multinomial Logistic Regression Models, by Exclusive Breastfeeding Duration, Nunavut Inuit Child Health Survey, 2007-2008 (n_{weighted} = 752).

Characteristic	Exclusive Breastfeeding Duration				P Value ^a
	As Recommended	Suboptimal Duration			
		Shorter Than Recommended		Longer Than Recommended	
		5.5-6.5 Months (n = 171, 22.7%)		≤ 1 Month (n = 170, 22.6%)	
pOR	pOR (95% CI) ^a	pOR (95% CI)	pOR (95% CI)		
Household characteristics					
Speaking Inuit dialects	1.00	0.57 (0.22-1.49)	0.51 (0.22-1.19)	1.60 (0.58-4.40)	.058
Receiving income support	1.00	0.36 (0.14-0.94)	0.34 (0.14-0.81)	1.17 (0.40-3.10)	.016
Crowding > 1 person/room	1.00	1.14 (0.44-2.97)	1.61 (0.69-3.72)	1.04 (0.38-2.90)	.624
No smoking restrictions	1.00	2.10 (0.41-10.69)	0.92 (0.17-4.96)	4.00 (0.82-19.55)	.194
Household food security (vs secure)					
Moderate insecurity	1.00	1.18 (0.38-3.65)	1.02 (0.37-2.77)	1.18 (0.36-3.85)	.998
Severe insecurity	1.00	1.08 (0.32-3.65)	1.02 (0.36-2.87)	1.22 (0.34-4.41)	
Childhood food security (vs secure)					
Moderate insecurity	1.00	0.74 (0.24-2.28)	0.96 (0.38-2.43)	1.17 (0.38-3.66)	.989
Severe insecurity	1.00	1.17 (0.35-3.97)	1.16 (0.39-3.40)	1.22 (0.32-4.75)	

(continued)

Table 4. (continued)

Characteristic	Exclusive Breastfeeding Duration				P Value ^a
	As Recommended	Suboptimal Duration			
		Shorter Than Recommended		Longer Than Recommended	
		5.5-6.5 Months (n = 171, 22.7%)	≤ 1 Month (n = 170, 22.6%)	> 1- < 5.5 Months (n = 288, 38.2%)	
pOR	pOR (95% CI) ^a	pOR (95% CI)	pOR (95% CI)		
Maternal pregnancy behaviors					
Alcohol consumption during pregnancy	1.00	0.72 (0.23-2.24)	1.02 (0.40-2.64)	0.66 (0.21-2.10)	.815
Smoking during pregnancy	1.00	0.87 (0.29-2.62)	1.54 (0.52-4.50)	1.12 (0.33-3.76)	.780
Infant characteristics					
Infant birth weight					
<2500 g (vs ≥ 2500 g)	1.00	3.12 (0.42-22.85)	1.04 (0.13-8.50)	1.05 (0.11-9.64)	.438
Community characteristics					
Community size ≥1600 people	1.00	1.69 (0.68-4.21)	0.80 (0.36-1.76)	0.81 (0.31-2.10)	.334
Region (vs Baffin)					
Kitikmeot	1.00	2.35 (0.80-6.92)	0.72 (0.27-1.89)	1.70 (0.55-5.27)	.248
Kivalliq	1.00	1.00 (0.24-4.14)	0.74 (0.25-2.25)	0.70 (0.19-2.56)	
Has prenatal nutrition program	1.00	0.49 (0.19-1.26)	1.15 (0.50-2.62)	0.75 (0.28-2.03)	.164
Frequency of preventive care					
≥3.5 visits per 100 persons	1.00	0.77 (0.30-1.98)	1.42 (0.62-3.21)	1.10 (0.42-2.89)	.541
Frequency of prenatal care					
≥1 visit per live birth	1.00	1.86 (0.74-4.63)	1.38 (0.62-3.06)	2.18 (0.82-5.80)	.354

Abbreviations: pOR, prevalence odds ratios; CI, confidence interval

^aConfidence intervals and P values calculated using the Wald method.

Table 5. Multivariate Adjusted Weighted Prevalence Odds Ratios and 95% Confidence Intervals, by Exclusive Breastfeeding Duration, Nunavut Inuit Child Health Survey, 2007-2008 (n_{weighted} = 752).

Characteristic	Exclusive Breastfeeding Duration				P Value ^a
	As Recommended	Suboptimal Duration			
		Shorter Than Recommended		Longer Than Recommended	
		5.5-6.5 Months (n = 171, 22.7%)	≤ 1 Month (n = 170, 22.6%)	> 1- < 5.5 Months (n = 288, 38.2%)	
pOR	pOR (95% CI) ^a	pOR (95% CI)	pOR (95% CI)		
Speaking Inuit dialects	1.00	0.74 (0.27-2.04)	0.50 (0.21-1.21)	1.77 (0.54-5.78)	.212
Receiving income support	1.00	0.39 (0.14-1.05)	0.34 (0.13-0.85)	1.06 (0.38-2.95)	.043
Has prenatal nutrition program	1.00	0.61 (0.22-1.68)	1.70 (0.68-4.24)	0.62 (0.20-1.96)	.059

Abbreviations: pOR, prevalence odds ratios; CI, confidence interval

^aConfidence limits and P values calculated using the Wald method.

employment histories was not available to explore this hypothesis. It is also possible that Inuit women who do not receive income support, may be more likely to choose formula feeding because they can afford it or have jobs with limited maternity leave.⁶¹⁻⁶³ Another alternative explanation is that mothers receiving income support may practice exclusive breastfeeding for a longer duration because of the cost savings.⁶⁴⁻⁶⁶ Although grocery prices tend to be much higher in the communities studied than in other regions in Canada,⁶⁷ household food security was not associated with exclusive breastfeeding duration in our sample, which would be expected if those receiving income support were motivated to continue exclusive breastfeeding for its cost-savings. Last, this finding may have arisen by chance alone. Regardless, these data suggest that more research is needed, with better measures of socioeconomic position, to understand its relationship with exclusive breastfeeding practices among Inuit in northern Canada.

Limitations

This cross-sectional survey collected information on participants' exclusive breastfeeding practices up to 5 years after giving birth. The determinants of exclusive breastfeeding used in this study most often reflect the status of the child at the time of survey administration, and not at time the child was being exclusively breastfed. We assume that many of these characteristics are stable over the 3- to 5-year period, but we are unable to verify this inference. The cross-sectional design of the comparisons precluded direct testing of any underlying causal links between the variables tested because we cannot demonstrate a clear temporal sequence between our exposures and exclusive breastfeeding duration. Moreover, many of these factors were measured by self-report, and may be subject to a higher degree of misclassification.

The Nunavut Inuit Child Health Survey asked specifically about the duration of exclusive breastfeeding, presupposing that those asked understand this definition, which may not always be true. A more common measurement approach is to ascertain the age of the infant when (1) formula or milk substitutes and (2) complementary foods were introduced into the diet. Yet, this approach also has its limitations. In a review of validity and reliability studies from a variety of populations, Li et al⁶⁸ found that approximately 58% of mothers were able to accurately recall the transition from exclusively breastfeeding to at least some formula feeding within 1 month^{69,70} and between 65%⁷¹ and 88%⁷⁰ were able to accurately recall the timing of complementary food introduction into the diet within 1 month.⁶⁸ Accuracy in recalling the timing of transition to solid foods was higher when the time period between the behavior and recall was shorter (ie, less than 1 year⁷⁰ compared to 14 to 15 years⁷¹). On average, mothers were more likely to recall an earlier date of introduction of formula (ie, exclusive breastfeeding occurred for

longer durations than reported) and a later date of introduction to semisolid foods (ie, transition to complementary foods occurred sooner than recalled).⁶⁸ Recognizing the limitations of maternal recall, the World Health Organization recommends that exclusive breastfeeding be measured by recent (24 hour) dietary recall of a cross-section of children between the ages of 0 to 6 months.²² Prospective research beginning immediately following an infant's birth could provide a more accurate representation of the exclusive breastfeeding practices of Inuit Canadians.

It is possible that our income support finding is also related to measurement error and misclassification, that is, the dichotomous income support variable did not accurately measure income or was not sensitive enough to identify an inverse association between exclusive breastfeeding duration and income. However, it seems unlikely that the latter is exclusively true since other studies tend to demonstrate more of a dose-response effect of income on exclusive breastfeeding duration.⁵ We conducted a sensitivity analysis (not shown) extending the limits of breastfeeding duration as recommended in various ways and still were not able to find strongly significant predictors of exclusive breastfeeding duration beyond receiving income support.

We used a multinomial logistic regression to model our data, enabling the identification of characteristics not only associated with a shorter duration, but also with a longer duration of exclusive breastfeeding. It is possible that we were not able to find any evidence of factors associated with exclusive breastfeeding other than receiving income support because these methods require a larger sample than standard logistic regressions.⁴⁸ We also performed a binary logistic regression for comparative purposes and the results were similar.

Not all participants in the Nunavut Inuit Child Health Survey were included in these analyses (only 35%, 188/537) because of survey nonresponse, missing covariate information, or varying inclusion criteria. Although this may increase the possibility of selection bias and reduce the generalizability of these results, there were no statistically significant differences between those included and excluded in these analyses on the characteristics evaluated in this study (eg, household crowding, receiving income support, household food insecurity; analyses not shown). The distribution of most factors also appeared similar to those reported in other population-based surveys of Canadian Inuit. Some exceptions were that there was a higher prevalence of household food security and a lower prevalence of speaking primarily Inuit dialects in those included in these analyses compared to those in the Aboriginal Peoples' Survey (2006)⁷² or the Aboriginal Children's Survey (2006).^{73,74}

Finally, we did not have data on some factors that have been found to be associated with exclusive breastfeeding duration in other studies, such as maternal age,^{75,76} maternal education,⁷⁶ and maternal work history.⁴⁹ Moreover, we did not have a direct measure of maternal income and used

receiving income support as a surrogate measure. Failing to control for these important factors may have biased some of our effect estimates.

Conclusions

We offer what may well be the first population-based estimates of exclusive breastfeeding rates among Inuit Canadians. Given the population-based sampling of the Nunavut Inuit Health Survey and the few exclusion criteria imposed in the present study, the study findings may allow general conclusions about exclusive breastfeeding patterns among Inuit Canadians. The findings indicate that fewer than one half of Inuit Canadian infants are exclusively breastfed to at least 6 months (39%) and only about 1 in every 5 Inuit Canadian infants are exclusively breastfed as recommended (23%) because a significant proportion of respondents report an extended duration of exclusive breastfeeding beyond 6 months. Based on these findings, we recommend that public health campaigns promoting breastfeeding among Inuit Canadians in Nunavut not only include messages about the many known benefits of exclusive breastfeeding to 6 months, but also include messages about the value and importance of introducing other nutrient rich foods to the diet of breastfed infants at approximately 6 months. Promoting increased exclusive breastfeeding in Canada's North has the potential to improve health outcomes for women and children and save thousands of dollars in health care costs^{77,78} because of the many health benefits to infants and mothers.⁷⁹

However, no specific population subgroups could be identified as less likely to meet the current national recommendation on exclusive breastfeeding within this particular Canadian Inuit sample using the data available. Although receiving income support may be related to optimal exclusive breastfeeding duration, we suggest more work be conducted to clarify the mechanisms of this association. Public health efforts to protect, promote, and support exclusive breastfeeding should be targeted to all Inuit Canadians living in Nunavut, as is also needed elsewhere in Canada.

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