Household Crowding and Food Insecurity Among Inuit Families With School-Aged Children in the Canadian Arctic

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Inadequate housing conditions (e.g., crowding and structural damage) are prevalent among First Nations and Inuit communities in Canada and elsewhere.[1] In Nunavik, the Inuit homeland in Arctic Quebec, Canada, the government promoted the relocation of many Inuit families to fledgling communities during the 1950s. Relocated families were moved to small, poorly heated and insulated accommodations. Since then, different programs have been designed by the federal, provincial, territorial, and regional governments to address the housing problem in Nunavik and across the Canadian Arctic.[2] At present, more than 90% of the Nunavik population has reported living in social (subsidized) housing.[3] In this region, social housing units are allocated locally through a point-based system set according to specific criteria, so that applicants most in need are given first priority (e.g., families with lower income, with young children, and living in overcrowded dwellings).[2] Rent is set according to household income, while also considering the cost of living.[4] Thus, in Nunavik, housing tenure does not differentiate between households on the basis of financial security or income level, given that nearly all of the population resides in social housing. Such organization rather highlights the high degree of financial need throughout this population and a limited private residential market unattainable by most of the population.

Household overcrowding, generally defined as more than 1 person per room,[5] is particularly problematic in Nunavik. According to Statistics Canada, 49% of the 2006 population lived in overcrowded houses.[5] Often, overcrowding is approached as a consequence of economic difficulties. Living in smaller homes or in shared accommodation has been known as a way to lower living costs to dedicate the available financial resources to other basic necessities.[6] In such situations, overcrowded households may experience higher food

insecurity as a result of a precarious economic situation. In the particular case of Nunavik, however, crowding is a direct consequence of an underlying, and persistent, lack of housing. Household crowding in Nunavik is not only a product of financial difficulties but also an effect of the rapidly growing and young population. Between 2001 and 2006, the population in Nunavik increased by 12% compared with 4% for the province of Quebec. During the past 3 decades, the population has doubled from 5860 in 1986 to 12 090 in 2011.[7] In 2008, it was estimated that more than 900 new housing units were needed, but only 239 units were constructed.[8] The housing backlog is further compounded by high costs of construction and short building seasons.

The housing situation in Nunavik and throughout the Canadian Arctic raises concerns, in terms of both public health and the health of each individual resident, especially that of children.[9–14] Indeed, studies have shown that household crowding is associated with poorer respiratory health, especially

among children.[12,15] In crowded dwellings, the lack of privacy and the difficulty of withdrawing from (unwanted) social interactions may limit the ability of controlling one's home situation and lead to "overarousal."[16] Household crowding also has been identified as eliciting chronic stress responses in adults,[17] anger and depression[18] with possible repercussions on behaviors,[19–22] withdrawal,[23] and reduced social support[24] that, we contend, could influence household food insecurity.

Food insecurity occurs when it is not possible to obtain safe, sufficient, and nutritiously adequate foods for a healthy life in socially and culturally acceptable ways.[25–27] Studies have shown that in a situation of food insecurity, adults generally first reduce their own food consumption. As the situation becomes more severe, children's diets also will be reduced, particularly in low-income households with single mothers.[28,29] In 2012, 14% of the households in Canada experienced food insecurity.[30] In Canadian Arctic communities, food insecurity is high: 62.2% and 31.6% of

Objectives. We examined the relation of household crowding to food insecurity among Inuit families with school-aged children in Arctic Quebec.

Methods. We analyzed data collected between October 2005 and February 2010 from 292 primary caregiver–child dyads from 14 Inuit communities. We collected information about household conditions, food security, and family socioeconomic characteristics by interviews. We used logistic regression models to examine the association between household crowding and food insecurity.

Results. Nearly 62% of Inuit families in the Canadian Arctic resided in more crowded households, placing them at risk for food insecurity. About 27% of the families reported reducing the size of their children's meals because of lack of money. The likelihood of reducing the size of children's meals was greater in crowded households (odds ratio = 3.73; 95% confidence interval = 1.96, 7.12). After we adjusted for different socioeconomic characteristics, results remained statistically significant.

Conclusions. Interventions operating across different levels (community, regional, national) are needed to ensure food security in the region. Targeting families living in crowded conditions as part of social and public health policies aiming to reduce food insecurity in the Arctic could be beneficial. (*Am J Public Health.* 2015;105:e122–e132. doi:10.2105/AJPH.2014.302290)

children live in food-insecure households in Nunavut and Northwest Territories, respectively.[30] In Nunavik, the proportion of Inuit children experiencing food insecurity reached 30% in 2006.[31] Studies emphasize that a reduction of the quality in diet and nutrient intake resulting from food insecurity is linked to various health issues in children, including poor health,[25,32–34] developmental delays,[35] and poor mental health.[36]

Access to food products supplied from southern regions of Quebec comes at a very high cost to Nunavik, with an average price 57% higher than in the provincial capital.[37] Despite efforts to redress this situation, food costs remain very high and often inaccessible to many Nunavik families who must resort to reducing the amount of food supplies or buying products of lower nutritional quality,[38] which compromises health and well-being.[36,37,39]

In a study conducted among low-income families in the United States, Cutts et al.[40] found a higher risk of food insecurity and child food insecurity in households with higher housing insecurity. In their study, crowding and multiple moves were considered as indicators of housing insecurity. This association was independent of maternal and family characteristics such as education and household employment. In a recent study involving Inuit households from Nunavut, in the eastern Canadian Arctic, Huet et al.[41] reported higher food insecurity among Inuit living in overcrowded households and in houses requiring major repairs. This observation, however, was based on bivariate associations between housing conditions and food insecurity and did not account for other factors such as socioeconomic conditions. These studies nonetheless suggest that food insecurity is not only explained in terms of low socioeconomic status and poverty.[40,42]

We examined whether household crowding was associated with food insecurity among Inuit families with school-aged children, independently of socioeconomic disadvantage.

METHODS

We collected cross-sectional data in Nunavik, a region located north of the 55th parallel, where almost all of the 12 090 inhabitants are Inuit and live in 1 of 14 villages located on the coasts of Ungava Bay and Hudson Bay (Figure 1). Potential participants were families that had participated in the Cord Blood Monitoring Program (1993–1998) or the Environmental Contaminants and Child Development Study (1996–2000).[43–45] Between September 2005 and February 2010, 461 mothers or caregivers (hereafter, primary caregivers) were contacted by telephone. They were given information about the Child Development Study protocol and invited to participate with their school-aged children in a follow-up study. All families came from the same geographic area and thus were considered as coming from 1 population, with 3 of the largest communities being overrepresented. Inclusion criteria were families with children between ages 8.5 and 14.5 years; birth weight of 2.5 kilograms or greater; gestation duration of 35 weeks or longer; no major birth defects or neurological or chronic health problems; no medication used at the time of the interview; and cord blood sample collected at birth.[46]

Of the 461 families, 34 were not eligible. The main reasons were that the family moved to a community not participating in the study (n = 28) and infant mortality (n = 6). From the 427 remaining potential participants, 45 could not be contacted, and 88 refused to participate.

After obtaining written informed consent, we conducted interviews with primary caregivers in French, English, or Inuktitut. Questionnaires were used to collect information on food security, housing conditions, and socioeconomic and psychosocial characteristics.

Food Security

We assessed food security with 4 questions selected and adapted from the 18-item Food-Security Scale that has been used in the United States,[47] Canada,[48] and Nunavut,[49] from which 3 dichotomous variables were created: (1) "Not enough food to eat," defined as not having enough food to eat either sometimes or often (vs never); (2) "Cutting down on the adults' meal size because there is not enough money" (yes vs no); and (3) "Cutting down on the size of children's meals because there is not enough money" (yes vs no).

From these questions, we created 2 outcome measures. First, an overall dichotomous indicator of food insecurity categorized families as "food insecure" if they responded affirmatively to at least 1 of the 3 questions. Second, "Cutting down on the size of children's meals because there is not enough money" was considered as a measure of severity of food insecurity.[28,29]

Household Crowding and Overcrowding

In the Nunavik Child Development Study, respondents reported on the number of bedrooms and the number of persons in the

FIGURE 1—Map of Nunavik, Quebec.

household, broken down by the number of children (≤ 18 years old) and number of adults. On the basis of previous research on housing conditions and health in nonindigenous populations,[50,51] a continuous measure of household crowding was defined as the number of people per room. We assumed that adding 2 rooms (kitchen and living room) to the number of bedrooms would be a reasonable proxy for the total number of rooms in the house.

Household overcrowding was defined as households with more than 1 person per room (dichotomous variable), keeping in line with Statistics Canada's definition of overcrowding.[5] Because the threshold across which a dwelling is deemed to be overcrowded and problematic for health differs among studies and health outcomes investigated, we considered household crowding and overcrowding as main exposure variables.[50,51]

Covariates

We examined several maternal and family characteristics of the primary caregiver on food insecurity based on previous studies.[41,52–55] We used different indicators to examine family socioeconomic position[56]: (1) socioeconomic status, measured with the Hollingshead Index score; (2) parental occupational status; (3) social assistance; and (4) education. The Hollingshead Index is a composite continuous measure that combines the level of educational attainment of both parents with the degree of social prestige associated with the type of occupation of each parent.[57] Education was graded on a 7-step scale (1 = less than a seventh-grade education to 7 = graduate training), and the occupational scale values ranged from 1 (menial service workers) to 9 (higher executives, proprietors of large businesses, and major professionals). The educational scale value was multiplied by 3, and the occupational scale value was multiplied by 9. Both values were summed to obtain the Hollingshead Index score, with values ranging from 8 to 66.[57] Higher Hollingshead Index scores denote higher socioeconomic status. Parental occupational status was categorized as no occupation; unskilled and semiskilled labor; skilled craftsmen; clerical and sales; technical and small business; or professionals. Receiving social assistance (i.e., whether the principal

caregiver received income support benefits [welfare]) was categorized as working and not receiving welfare; not working and not receiving welfare; or not working and receiving welfare. Years of education were categorized as primary school completed or not (≤ 6 years of education); some high school education but not completed (7–11 years of education); or high school completed and postsecondary education (≥ 12 years of education). Because education was not associated with either measure of food insecurity in bivariate analyses, it was not retained as a variable in the multivariate logistic models.

Marital status, defined as being single (including those reporting being divorced, separated, or widowed) or in a relationship (either married or living with a partner), and coast of residence (Hudson Bay or Ungava Bay) were also covariates. Because communities were visited only once during the study period and communities on the same coast were visited during the same season, we were unable to distinguish seasonal variation from coastal location. Thus, seasonal variation was not considered in the final analysis.

Statistical Data Analysis

Frequencies and means were used to describe the characteristics of the participating families. First, we used χ^2 and t-test analyses to examine associations between primary caregiver, family characteristics, and household (over)crowding and the 2 dichotomous outcome measures of food security in bivariate analysis. We then used multivariate logistic regression analyses to examine the influence of covariates on these associations in models unadjusted (model 1) and adjusted for the different measures of socioeconomic position (models 2–4). Model 2 further adjusted model 1 for the Hollingshead Index; model 3 further adjusted model 1 for occupational status; and model 4 further adjusted model 1 for social assistance. The final model (model 5) further adjusted model 1 for occupational status, social assistance, marital status, and coast of residence.

We performed a complete case analysis to assess the effect of missing data. No differences were found between families with missing values (n = 27) and those without missing data (n = 265). Thus, we present results of analysis

completed on a subsample of respondents with valid information on all variables (n = 281). No collinearity was observed among covariates in the fully adjusted model (model 5; tolerance value > 0.1; variance inflation factor < 10). We performed ancillary analyses to predict overall measures of food insecurity by different combinations of number of persons per number of rooms, thus for different values of crowding. Analyses were performed with Stata 11.0.[58]

RESULTS

Estimates of food insecurity and household conditions are presented in Table 1. On average, there were 6.6 individuals per house, with a median of 6 individuals. The prevalence of overcrowding was high, with 6 out of 10 households with more than 1 person per room. Nearly 50% of the families were food insecure, and about one quarter of the families had to cut down the size of their children's meals because of lack of money.

Comparisons of overcrowded and not overcrowded households, in relation to maternal and family characteristics of the principal caregiver, are presented in Table 2. Food insecurity was more common in overcrowded households. For example, the proportion of primary caregivers reporting cutting down the size of children's meals was twice as high in houses with more than 1 person per room. Those living in overcrowded houses were more likely to be in a relationship, to have lower socioeconomic status as measured by the Hollingshead Index score, and to live on the Hudson Bay coast. Overcrowding was not related to caregiver age, education, or social assistance status.

Descriptive statistics of maternal and family characteristics of the principal caregiver in relation to food insecurity and severe food insecurity are presented in Table 3. Food-insecure households had lower socioeconomic and occupational status and were more likely to be located on the Hudson Bay coast and to receive social assistance.

Tables 4 and 5 show results from logistic regression analyses examining the association between the overall measure of food insecurity (Table 4) and cutting down on the size of children's meals (Table 5) and (1) household crowding and (2) household overcrowding

TABLE 1—Estimates of Food Insecurity and Household Conditions: Nunavik Child Development Study, Quebec, 2005–2010

		Interquartile Range				
	No. (%)	Min	25%	50%	75%	Max
Food insecurity						
Enough food to eat						
Yes	178 (61.00)					
No	114 (39.04)					
Cut down on the size of adults' meals	116 (39.73)					
Yes	78 (26.71)					
No	214 (73.30)					
Food insecure						
Yes (≥ 1 affirmative response)	145 (49.66)					
No	147 (50.34)					
Household conditions						
Total no. of people		2	5	6	8	19
≤ 6	169 (57.88)					
> 6	123 (42.12)					
No. of adults		1	2	2	3	10
≤ 2	172 (58.90)					
> 2	120 (41.10)					
No. of children		1	3	4	5	12
≤ 4	218 (74.66)					
> 4	74 (25.34)					
No. of rooms		3	5	5	6	9
Missing values for no. of rooms	11 (3.77)					
No. of people per room		0.50	1	1.20	1.50	3
≤ 1	113 (38.70)					
> 1 (overcrowding)	168 (57.53)					
Missing values	11 (3.77)					

before and after adjusting for socioeconomic position and other covariates. Experiencing food insecurity was more likely in more crowded households and was more than twice as likely in overcrowded households. When we adjusted for different indicators of socioeconomic position (models 2–4), the strength of associations between household crowding and food insecurity was reduced but remained statistically significant, yet the effect of overcrowding was no longer significant.

Household crowding and overcrowding also were significantly associated with the measure of severity of food insecurity (i.e., cutting down on the size of children's meals because of lack of money). Compared with households that were not overcrowded, the odds of cutting down on the size of the children's meals were twice as high in

overcrowded households. The strength of these associations was reduced but remained statistically significant after adjusting for indicators of socioeconomic position.

We found inequalities in food insecurity by socioeconomic position and marital status. Higher socioeconomic status, as measured by the Hollingshead Index (model 2), and higher occupational status (model 3) were protective of overall food insecurity and cutting down on the size of children's meals, whereas receiving social assistance and not working (model 4) was associated with greater odds in these outcomes. The final model (model 5) simultaneously adjusted for indicators of socioeconomic position and for marital status and coast of residence. Being in a relationship was also associated with lower odds of overall food insecurity but not of cutting down on the size of children's meals.

Figure 2 shows the predicted probability to experience food insecurity in the fully adjusted models (model 5) with every covariate constant. The probability of experiencing overall food insecurity in a 4-person household living in a 4-room house (1 person per room) is 0.41 (95% confidence interval [CI] = 0.33, 0.49); for a 6-person household living in a 4-room house (1.5 persons per room) and an 8-person household living in a 4-room house (2 persons per room), the probabilities are 0.55 (95% CI = 0.46, 0.64) and 0.68 (95% CI = 0.53, 0.83), respectively. Similarly, the predicted probability of reducing the size of children's meals in a 6-person household living in a 6-room house (1 person per room) and a 12-person household living in a 6-room house (2 persons per room) is 0.19 (95% CI = 0.13, 0.25) and 0.39 (95% CI = 0.24, 0.53), respectively.

DISCUSSION

The aim of this study was to examine the relation between household crowding and food insecurity among Inuit families with school-aged children. Overcrowding was high, with almost 60% of households living in dwellings with more than 1 person per room. The proportion of households reporting food insecurity was also high, ranging from 27% to 50%, depending on the indicator being examined. These results are consistent with other studies reporting high levels of overcrowding and food insecurity in other regions of the Canadian Arctic.[9,18,38,49] As reported elsewhere,[40,43] greater household crowding was associated with a higher likelihood of food insecurity generally, and especially with the risk of reducing the size of children's meals, a more severe measure of food insecurity.

Results of this study further identified geographic inequalities in overcrowding, with higher prevalence among families living in villages on the Hudson Bay coast (vs the Ungava Bay coast). Between 2001 and 2006, the population of the 8 communities of the Hudson Bay coast increased by 13%, whereas the population on the Ungava Bay coast increased by only 7%.[8] In 2011, 56.6% of the population in Nunavik lived on the Hudson Bay coast and 43.4% on the Ungava Bay coast.[7] Because the construction of new social

TABLE 2—Food Insecurity and Socioeconomic Characteristics, by Household Overcrowding (n = 281): Nunavik Child Development Study, Quebec, 2005–2010

Characteristics	Overcrowding		
	No	Yes	Test[a] (95% CI)
Total	113 (40.21)	168 (59.79)	
Food insecurity			
Enough food to eat, no. (%)			
Yes	81 (71.68)	93 (55.36)	
No	32 (28.32)	75 (44.64)	2.04** (1.22, 3.43)
Cut down on the size of adults' meals, no. (%)			
Yes	36 (31.86)	75 (44.64)	
No	77 (68.14)	93 (55.36)	1.72* (1.04, 2.86)
Cut down on the size of children's meals, no. (%)			
Yes	19 (16.81)	55 (32.74)	
No	94 (83.19)	113 (67.26)	2.41** (1.32, 4.39)
Food insecure, no. (%)			
No affirmative responses	68 (60.18)	75 (44.64)	
≥ 1 affirmative response	45 (39.82)	93 (55.36)	1.87* (1.15, 3.06)
Caregiver characteristics			
Age in y, mean ±SD	39.48 ±9.53	38.34 ±8.51	1.13 (−1.01, 3.27)
Marital status, no. (%)			
Not in a relationship	39 (34.51)	34 (20.24)	
In a relationship	74 (65.49)	134 (79.76)	2.08** (1.20, 3.59)
Socioeconomic status via Hollingshead Index,[b] mean ±SD	30.32 ±1.21	27.01 ±0.80	3.31* (0.57, 6.05)
Occupational status, no. (%)			
No occupation	21 (18.58)	35 (20.83)	
Unskilled laborers/semiskilled	21 (18.58)	51 (30.36)	1.46 (0.69, 3.08)
Skilled craftsmen, clerical, sales	26 (23.01)	38 (22.62)	0.88 (0.42, 1.84)
Technical, small business	19 (16.81)	14 (8.33)	0.44 (0.18, 1.09)
Professionals	26 (23.01)	30 (17.86)	0.69 (0.32, 1.48)
Education, y, mean ±SD	8.52 ±2.62	8.36 ±2.37	0.16 (−0.43, 0.75)
Education, no. (%)			
Primary school completed (≤ 6 y)	13 (11.50)	20 (11.90)	
High school not completed (7–11 y)	91 (80.53)	143 (85.12)	1.02 (0.48, 2.16)
High school completed (≥ 12 y)	9 (7.96)	5 (2.98)	0.36 (0.09, 1.39)
Social assistance, no. (%)			
Working, not receiving welfare	86 (79.63)	116 (73.42)	
Not working, not receiving welfare	16 (14.81)	33 (20.89)	1.53 (0.79, 2.97)
Not working, receiving welfare	6 (5.56)	9 (5.70)	1.11 (0.38, 3.25)
Coast of residence, no. (%)			
Hudson Bay	47 (41.59)	127 (76.05)	
Ungava Bay	66 (58.41)	40 (23.95)	0.22*** (0.13, 0.39)

Continued

housing units is not keeping pace with population growth, the housing shortage could explain the high proportion of overcrowding in these villages. Despite efforts to prioritize families with children and lower income in the allocation of housing units and monthly rent set according to household income, living in overcrowded conditions was higher among people with lower socioeconomic status (as measured by the Hollingshead Index) but was not significantly associated with the principal caregiver's education or whether he or she received social assistance.

As reported in other studies linking socioeconomic disadvantage to food insecurity,[28,41,50,52–53,59–61] we observed that food insecurity was more prevalent among families with lower occupational status and among those receiving social assistance benefits, families possibly with lower access to health-promoting food products, resources, and services. Nonetheless, the observed associations between household crowding and food insecurity remained statistically significant when considering different measures of socioeconomic position, although the effect size was reduced. This indicates that socioeconomic position only partially explains the associations between household crowding and food insecurity.

International studies have suggested that poor housing conditions, such as crowding, may lead occupants to socially withdraw as a way of coping with the situation.[62–64] Others have argued that chronic exposure to crowded living conditions may disrupt or erode social support networks.[65,66] In a recent study set in Greenland, lower levels of social support were reported by Inuit individuals living in more crowded households.[24] Social support and network systems are important components of Inuit culture, and eroding social support and social networks may influence the extent of food sharing within and between communities. Living in crowded conditions has been associated with physiological stress levels among Inuit adults in Nunavik and with anger and depression among young Inuit adults in Nunavut.[17,18] These factors might interfere with the sharing of resources within and between households (especially between members of extended or different families), elevate conflict and diminish cooperation, and ultimately lead to increased food insecurity.

Changing consumption patterns are also to be taken into account. Among Inuit youths, the consumption culture is shifting away from traditional cultural values of sharing and reciprocity, a phenomenon best understood against the backdrop of individualism and self-determination.[67] As Chabot[68,69] has argued, an increase in financial resources can lead to less altruistic behavior. As a result, unequal income distribution patterns within the household might arise, possibly creating situations in which some individuals benefit more than others or in which not all individuals contribute

TABLE 2—Continued

	Household characteristics		
Total no. of people, mean ±SD	4.72 ±1.11	7.83 ±2.48	-3.12*** (-3.61, -2.63)
No. of adults, mean ±SD	2.12 ±0.77	3.36 ±1.78	-1.25*** (-1.60, -0.90)
No. of children, mean ±SD	2.60 ±0.94	4.47 ±1.67	-1.87*** (-2.21, -1.53)

Note. CI = confidence interval. Overcrowding is defined as more than 1 person per room.
[a]χ^2 test for categorical variables, *t* test for continuous variables.
[b]Hollingshead Index is based on the level of educational attainment of both parents and the degree of social prestige associated with the type of occupation. Percentages do not include missing values; there were 11 missing values (3.8%) for the variable overcrowding. After cross-tabulation, there were 15 missing values (5.15%) for social assistance and 1 missing value (0.34%) for coast of residence.
*P < .05; **P < .01; ***P < .001.

to the household as they should—or as other individuals would expect them to. This imposes more (unwanted) responsibility on the head of household. As Duhaime et al.[70] have shown, food consumption in Nunavik may be less influenced by the number of wage earners than by the role of each individual in the household.

Sharing networks are an important component of Inuit culture. Households with better economic conditions may support more often those with less opportunities and thus contribute to the redistribution of wealth.[2] Because housing costs do not consider this system of sharing, in some cases, this situation may become socially stressful to those people who provide for others.[71] Thus, in a context where the quality, quantity (enough food), and variety of foods depend on a complex system that includes access to food from the land (e.g., hunting, fishing) and the market, in addition to the power of social networks, the

TABLE 3—Socioeconomic Characteristics of Caregivers, by Measures of Food Insecurity (n = 292): Nunavik Child Development Study, Quebec, 2005–2010

	Food Insecurity			Cutting Down on the Size of Children's Meals		
	No	Yes	Test[a] (95% CI)	No	Yes	Test[a] (95% CI)
Total	147 (50.34)	145 (49.66)		214 (73.29)	78 (26.71)	
Age, y, mean ±SD	38.83 ±9.41	38.85 ±8.23	-0.02 (-2.06, 2.02)	38.78 ±9.23	39.01 ±7.68	-0.23 (-2.54, 2.07)
Marital status, no. (%)						
Not in a relationship	29 (19.73)	48 (33.10)		50 (23.36)	27 (34.62)	
In a relationship	118 (80.27)	97 (66.90)	0.50* (0.29, 0.85)	164 (76.64)	51 (65.38)	0.58 (0.33, 1.02)
Socioeconomic status via Hollingshead Index,[b] mean ±SD	32.48 ±11.82	24.20 ±9.84	8.27*** (5.77, 10.78)	29.72 ±11.91	24.67 ±10.00	5.05*** (2.07, 8.03)
Occupational status, no. (%)						
No occupation	16 (10.88)	43 (29.66)		34 (15.89)	25 (32.05)	
Unskilled laborers/semiskilled	26 (17.69)	48 (33.10)	0.69 (0.32, 1.46)	49 (22.90)	25 (32.05)	0.69 (0.34, 1.41)
Skilled craftsmen, clerical, sales	33 (22.45)	33 (22.76)	0.37* (0.17, 0.81)	51 (23.83)	15 (19.23)	0.40* (0.18, 0.89)
Technical, small business	25 (17.01)	8 (5.52)	0.12*** (0.039, 0.36)	28 (13.08)	5 (6.41)	0.24** (0.08, 0.75)
Professionals	47 (31.97)	13 (8.97)	0.10*** (0.04, 0.28)	52 (24.30)	8 (10.26)	0.21*** (0.08, 0.55)
Education, y, mean ±SD	8.73 ±2.68	8.19 ±2.18	0.54 (-0.02, 1.10)	8.55 ±2.58	8.21 ±2.06	0.35 (-0.29, 0.99)
Education, no. (%)						
Primary school completed (≤ 6 y)	14 (9.52)	19 (13.10)		22 (10.28)	11 (14.10)	
High school not completed (7–11 y)	122 (82.99)	122 (84.14)	0.74 (0.35, 1.54)	155 (72.43)	54 (69.23)	0.74 (0.34, 1.62)
High school completed (≥ 12 y)	11 (7.48)	4 (2.76)	0.27* (0.07, 1.10)	37 (17.29)	13 (16.67)	0.14 (0.01, 1.38)
Social assistance, no. (%)						
Working, not receiving welfare	114 (81.43)	94 (69.12)		163 (79.90)	45 (62.50)	
Not working, not receiving welfare	22 (15.71)	29 (21.32)	1.60 (0.86, 2.98)	33 (16.18)	18 (25.00)	1.98* (1.01, 3.86)
Not working, receiving welfare	4 (2.86)	13 (9.56)	3.94* (1.22, 12.73)	8 (3.92)	9 (12.50)	4.08** (1.46, 11.41)
Coast of residence, no. (%)						
Hudson Bay	80 (54.42)	104 (72.22)		129 (60.28)	55 (71.43)	
Ungava Bay	67 (45.58)	40 (27.78)	0.46** (0.28, 0.76)	85 (39.72)	22 (28.57)	0.61 (0.34, 1.07)

Note. CI = confidence interval.
[a]χ^2 test for categorical variables, *t* test for continuous variables.
[b]Hollingshead Index is based on the level of educational attainment of both parents and the degree of social prestige associated with the type of occupation of each parent. Percentages do not include missing values; after cross-tabulation, there were 16 missing values for social assistance (5.5%) and 1 missing value for coast of residence (0.34%).
*P < .05; **P < .01; ***P < .001.

TABLE 4—Results of Logistic Regression Measuring the Association Between Food Insecurity and Household Crowding and Household Overcrowding in Models Unadjusted and Adjusted for Participants' Socioeconomic Characteristics: Nunavik Child Development Study, Quebec, 2005–2010

	Model 1,[a] OR (95% CI)	Model 2,[b] AOR (95% CI)	Model 3,[c] AOR (95% CI)	Model 4,[d] AOR (95% CI)	Model 5,[e] AOR (95% CI)
Household crowding					
Household crowding (no. of people per room)	4.83*** (2.47, 9.45)	3.42** (1.70, 6.85)	3.42** (1.68, 6.99)	4.15 (2.10, 8.21)***	3.02** (1.37, 6.60)
Socioeconomic status via Hollingshead Index[f]		0.94*** (0.92, 0.97)			
Occupational status					
No occupation (Ref)			1.00		1.00
Unskilled laborers/semiskilled			0.65 (0.30, 1.43)		0.74 (0.31, 1.76)
Skilled craftsmen, clerical, sales			0.44* (0.20, 0.95)		0.48 (0.20, 1.14)
Technical, small business			0.15*** (0.06, 0.42)		0.17** (0.06, 0.50)
Professionals			0.11*** (0.05, 0.27)		0.12*** (0.04, 0.32)
Social assistance					
Working, not receiving welfare (Ref)				1.00	1.00
Not working, not receiving welfare				1.38 (0.71, 2.68)	1.04 (0.51, 2.14)
Not working, receiving welfare				3.33 (1.00, 11.07)	1.04 (0.28, 3.86)
Marital status					
Not in a relationship (Ref)					1.00
In a relationship					0.44* (0.23, 0.86)
Coast of residence					
Hudson Bay (Ref)					1.00
Ungava Bay					0.76 (0.42, 1.38)
Household overcrowding					
Household overcrowding (> 1 person per room)	1.87* (1.16, 3.04)	1.63 (0.97, 2.73)	1.60 (0.94, 2.72)	1.71* (1.04, 2.82)	1.36 (0.75, 2.48)
Socioeconomic status via Hollingshead Index[f]		0.94*** (0.91, 0.96)			
Occupational status					
No occupation (Ref)			1.00		1.00
Unskilled laborers/semiskilled			0.72 (0.34, 1.54)		0.79 (0.34, 1.85)
Skilled craftsmen, clerical, sales			0.40 (0.19, 0.86)*		0.44 (0.19, 1.03)
Technical, small business			0.14*** (0.05, 0.37)		0.15** (0.05, 0.44)
Professionals			0.10*** (0.04, 0.24)		0.11*** (0.04, 0.28)
Social assistance					
Working, not receiving welfare (Ref)				1.00	1.00
Not working, not receiving welfare				1.56 (0.82, 2.94)	1.14 (0.67, 2.30)
Not working, receiving welfare				3.48* (1.03, 11.05)	1.00 (0.27, 3.67)
Marital status					
Not in a relationship (Ref)					1.00
In a relationship					0.48* (0.25, 0.92)
Coast of residence					
Hudson Bay (Ref)					1.00
Ungava Bay					0.64 (0.35, 1.15)

Note. AOR = adjusted odds ratio; CI = confidence interval; OR = odds ratio.
[a]Unadjusted model (sample size = 281; missing data: 11 observations, 3.8%).
[b]Model 1 adjusted for Hollingshead Index (sample size = 281; missing data: 11 observations, 3.8%).
[c]Model 1 adjusted for occupational status (sample size = 281; missing data: 11 observations, 3.8%).
[d]Model 1 adjusted for social assistance (sample size = 266; missing data: 26 observations, 8.1%).
[e]Model 1 adjusted for occupational status, social assistance, coast of residence, and marital status (sample size = 265; missing data: 27 observations, 9.2%).
[f]Hollingshead Index is based on the level of educational attainment of both parents and the degree of social prestige associated with the type of occupation of each parent.
*P < .05; **P < .01; ***P < .001.

TABLE 5—Results of Logistic Regression Measuring the Association Between Cutting Down of the Size of Children's Meals and Household Crowding and Household Overcrowding in Models Unadjusted and Adjusted for Participants' Socioeconomic Characteristics: Nunavik Child Development Study, Quebec, 2005–2010

	Model 1,[a] OR (95% CI)	Model 2,[b] AOR (95% CI)	Model 3,[c] AOR (95% CI)	Model 4,[d] AOR (95% CI)	Model 5,[e] AOR (95% CI)
Household crowding					
Household crowding (no. of people per room)	3.73*** (1.96, 7.12)	3.11** (1.61, 6.20)	2.98** (1.52, 5.85)	3.00** (1.54, 5.87)	2.66* (1.26, 5.59)
Socioeconomic status via Hollingshead Index[f]		0.97* (0.95, 1.00)			
Occupational status					
No occupation (Ref)			1.00		1.00
Unskilled laborers/semiskilled			0.68 (0.32, 1.42)		0.73 (0.32, 1.66)
Skilled craftsmen, clerical, sales			0.45 (0.20, 1.01)		0.52 (0.21, 1.26)
Technical, small business			0.32* (0.11, 0.98)		0.39 (0.12, 1.27)
Professionals			0.25** (0.09, 0.65)		0.27* (0.09, 0.80)
Social assistance					
Working, not receiving welfare (Ref)				1.00	1.00
Not working, not receiving welfare				1.83 (0.91, 3.69)	1.61 (0.78, 3.32)
Not working, receiving welfare				4.25** (1.43, 12.61)	2.25 (0.69, 7.36)
Marital status					
Not in a relationship (Ref)					1.00
In a relationship					0.65 (0.34, 1.27)
Coast of residence					
Hudson Bay (Ref)					1.00
Ungava Bay					1.07 (0.55, 2.07)
Household overcrowding					
Household overcrowding (> 1 person per room)	2.41** (1.34, 4.34)	2.23** (1.23, 4.06)	2.19* (1.19, 4.02)	2.13* (1.16, 3.92)	2.03* (1.03, 3.99)
Socioeconomic status via Hollingshead Index		0.96** (0.94, 0.99)			
Occupational status					
No occupation (Ref)			1.00		1.00
Unskilled laborers/semiskilled			0.71 (0.34, 1.48)		0.77 (0.34, 1.74)
Skilled craftsmen, clerical, sales			0.40* (0.18, 0.90)		0.48 (0.20, 1.17)
Technical, small business			0.29* (0.10, 0.87)		0.37 (0.12, 1.17)
Professionals			0.21** (0.08, 0.55)		0.25* (0.09, 0.72)
Social assistance					
Working, not receiving welfare (Ref)				1.00	1.00
Not working, not receiving welfare				2.04* (1.03, 4.02)	1.70 (0.83, 3.49)
Not working, receiving welfare				4.33** (1.46, 12.84)	2.13 (0.65, 6.93)
Marital status					
Not in a relationship (Ref)					1.00
In a relationship					0.61 (0.31, 1.20)
Coast of residence					
Hudson Bay (Ref)					1.00
Ungava Bay					0.99 (0.52, 1.91)

Note. AOR = adjusted odds ratio; CI = confidence interval; OR = odds ratio.
[a]Unadjusted model (sample size = 281; missing data: 11 observations, 3.8%).
[b]Model 1 adjusted for Hollingshead Index (sample size = 281; missing data: 11 observations, 3.8%).
[c]Model 1 adjusted for occupational status (sample size = 281; missing data: 11 observations, 3.8%).
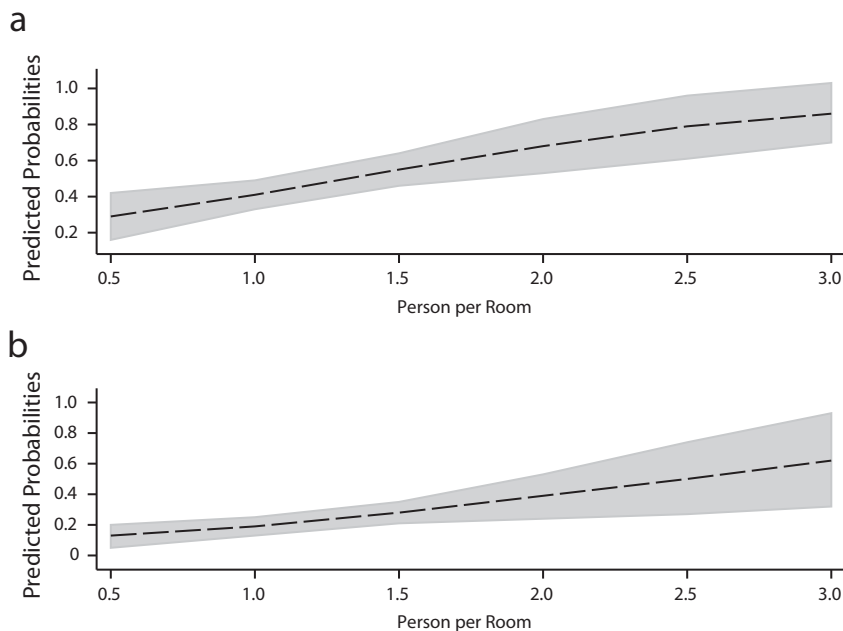[d]Model 1 adjusted for social assistance (sample size = 266; missing data: 26 observations, 8.1%).
[e]Model 1 adjusted for occupational status, social assistance, coast of residence, and marital status (sample size = 265; missing data: 27 observations, 9.2%).
[f]Hollingshead Index is based on the level of educational attainment of both parents and the degree of social prestige associated with the type of occupation of each parent.
*$P < .05$; **$P < .01$; ***$P < .001$.

FIGURE 2—Predicted probabilities in the fully adjusted models to experience (a) food insecurity and (b) cutting down on the size of children's meals: Nunavik Child Development Study, Quebec, 2005–2010.

association between household income and food insecurity is still not well understood.[72]

Limitations

One limitation of this study was the use of a short adaptation of the Food Security Scale (i.e., only 4 of the 18 items) to measure food security. This scale (and its adaptation) can be criticized for focusing on access to store-bought food (strongly linked to income) and not considering access to and consumption of traditional food—shared among family and friends or obtained from the community freezer—which is an important component of the nutritional environment across the Canadian Arctic. Indicators of access to traditional foods and practices such as fishing or hunting need to be included in the measurement of food security in the Arctic.[49] Moreover, the traditional cultural values with regard to sharing and reciprocity must be considered in present-day Inuit communities when measuring food insecurity.[72] Despite these limitations, elsewhere it was shown that food insecurity, as measured here, was associated with nutritional deficiencies

among children and reduced child growth in Nunavik, suggesting content validity.[73]

Information on household income (monetary and nonmonetary), which might provide a better indicator of socioeconomic position, is lacking.[41] Our measures of socioeconomic position may have inaccurately captured financial strain in the household. Adjusting the statistical models for household income might have explained the association between household crowding and food insecurity. Although measures of socioeconomic position used in this study were limited (both conceptually and culturally), they were nevertheless indicative of precarious socioeconomic circumstances that may limit the spending power of households and their ability to access food. Further studies should include information on income in the study protocols and culturally adapt (or validate) existing measures of socioeconomic position for population health research among the Inuit. The cultural relevance of measures such as household crowding and overcrowding as applied in this study has been criticized as an indicator to measure residential crowding in the Arctic[18] and more largely in indigenous

contexts.[74] Although it has been suggested that the subjective experience of crowding might be a more culturally appropriate measure,[50,74] studies have yet to empirically examine the associations between alternative measures of household crowding and health outcomes. Lauster and Tester[18] discuss the problems of the application of the overcrowding measure in the Canadian Arctic. They argued that in this region, feeling of crowding and the housing crisis are particularly problematic because of the rapid cultural transition. The authors discussed how southern Canada cultural norms are embedded in Inuit culture, which leads to an increase in the perception of overcrowding, especially among younger adults. No alternative indicators or thresholds, however, have been proposed for use with indigenous populations. More research is needed to conceptualize, operationalize, and validate measures of household crowding, in coherence with the Inuit culture and with indigenous cultures more broadly, for population health studies. Research then would provide better understanding of adult behavior in crowded households while addressing cultural changes and associated contemporary behavior patterns.

Crowding and food insecurity may increase during the coldest months, between hunting and fishing seasons, when transportation of food by barge or airplane is limited by meteorological conditions. Unfortunately, because season and coast of residence were closely interlinked in the recruitment of participants, it was impossible to disentangle seasonal from coastal effects in this study. Finally, the cross-sectional nature of the data prevents assigning causality to the associations observed. Despite these limitations, this study provides important insights into the social and economic challenges faced by this population that have implications on food security of families with school-aged children.

Conclusions

Our research shows that household crowding (and overcrowding) is an important risk factor for food insecurity among Inuit families with school-aged children. It also provides new knowledge about these risk factors among indigenous populations. In Nunavik, policies are in place to reduce food insecurity (e.g., subsidized selected food products, promotion of healthy eating, hunting and fishing support

program, distribution of traditional food, nutrition education, and retail training in proper food handling and storage). Yet results of this study suggested a need for interventions operating across different levels (community, regional, national) to ensure food security in the region.

Supplementing public health and social policies with interventions targeting the most vulnerable families, such as those living in overcrowded conditions, might contribute to reducing food insecurity in Nunavik. ∎

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