



## Social housing construction and improvements in housing outcomes for Inuit in Northern Canada

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### ABSTRACT

One-third of Inuit households in the Canadian Arctic are in core housing need—three times the national average. In 2014–2015, over 400 social housing units were constructed in Nunavik and Nunavut, two of the four Inuit land claims regions in Canada. This article examines whether rehousing, following this large-scale construction commitment, is associated with significant improvements in housing outcomes. People on the waiting list for social housing were recruited in 12 communities in Nunavik and Nunavut. Of the 186 adults who were rehoused, 102 completed the study. Questionnaires were administered 1–6 months before and 15–18 months after rehousing. After rehousing, household crowding, major repairs needed, and thermal discomfort were significantly reduced. The sense of home, including factors such as perceived control, privacy, and identity, improved significantly post-move. Social housing construction significantly improves living conditions in Nunavik and Nunavut. Integration of housing and social policies are needed to maximize benefits of new housing construction and to avoid or mitigate unintended effects.

### ARTICLE HISTORY

Received 8 January 2019  
Accepted 2 March 2020

### KEYWORDS

Housing; interventions; indigenous populations; Inuit; Canada

## Introduction

Indigenous populations in Canada experience disparities in access to adequate and appropriate housing, a well-recognized chronic source of social and health inequities. The coercive transition into settlement living and subsequent territorial disenfranchisement has helped produce the overcrowded and poor quality housing that are today commonplace in many Indigenous communities. In Canada, the largest housing

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 Supplemental data for this article can be accessed [here](#).

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inequities are borne by the Inuit, the Indigenous inhabitants of the Arctic, where the prevalence of overcrowding and of housing needing major repairs needed are 10 and 5 times higher than the national average respectively.

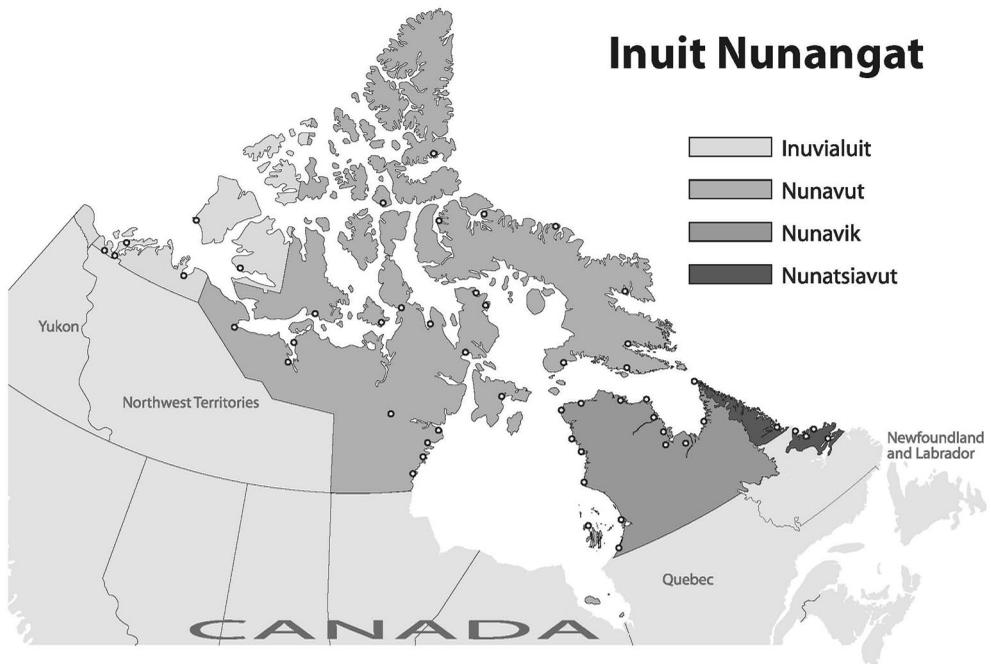
Large-scale housing interventions such as housing mobility (Acevedo-Garcia *et al.*, 2004) and major renovations including improved energy efficiency (Thomson *et al.*, 2013) have been shown to significantly improve housing, social and health outcomes in general populations. Evidence of the impacts of housing interventions in Indigenous communities in improving housing conditions and other outcomes are more limited (Alaazi *et al.*, 2015; Bailie *et al.*, 2010, 2011; Howden-Chapman *et al.*, 2007). This type of information is required to support decision-making and investments to improve the housing conditions of Indigenous Peoples.

In 2014–2015, large-scale social housing construction in selected communities in Nunavik and Nunavut, two of the four Inuit regions in the Canadian Arctic (Figure 1), presented an opportunity to examine the impacts of rehousing to a different dwelling on housing and health outcomes. In this article, we report on improvements in a range of housing outcomes associated with rehousing. Changes in health status after rehousing are reported in another article (Riva *et al.*, 2019). The article begins with an overview of the historical and current accounts of housing in Inuit regions of Canada.

### **Historical background**

Inuit are the Indigenous Peoples of the circumpolar north occupying lands in the Chukchi Peninsula in Eastern Siberia, Alaska, Canada, and Greenland. In Canada, the define majority of Inuit live in one of four regions known collectively as Inuit Nunangat: Nunavut, Nunavik (northern Quebec), Nunatsiavut (Labrador), and the Inuvialuit Settlement Region (Figure 1). In each of the four regions, the relationship between Inuit and the State is structured through modern land-claim agreements, modern treaties that define rights and responsibilities over many domains of life including community organization and housing. In their current form, Inuit communities are recent interjections on the Arctic landscape. These emerged out of colonial arrangements that saw the transformation of traditional subsistence and mixed trading economies of highly mobile Inuit family groups into more sedentary wage- and transfer-dependent lifestyles in fixed dwellings in contemporary towns. In most of Inuit Nunangat, this shift has occurred in living memory beginning with the end of the Second World War and accelerating in the 1960s and 1970s.

In most regions, Inuit were self-sufficient in housing until well into the 20th century. Traditional dwellings and seasonal subsistence activity varied across the north depending on animal resources and building materials available. The iconic igloo and cone-shaped tents so prominent in popular culture depictions of Inuit were common throughout the Eastern Arctic and were complemented by other forms of housing including sod-walled semi-subterranean dwellings (*qaqmait*), wood and skin structures, and long-house styled multi-family dwellings using whale bone for roofing support. In western regions where wood was more readily available, a variety of mixed material dwellings were created. Cyclical patterns of seasonal land use over large



**Figure 1.** Map of Inuit Nunangat. Source: Inuit Tapiriit Kanatami. Available at [https://www.itk.ca/wpcontent/uploads/2016/07/InuitNunaat\\_Basic\\_0.pdf](https://www.itk.ca/wpcontent/uploads/2016/07/InuitNunaat_Basic_0.pdf)

territories favored materials that were light and close at hand for dwelling construction. While patterns of land use and dwelling began to change with the arrival of Europeans pursuing furs and whale oil in the 18th century, it was not until the Second World War that most communities in their current guise began to emerge in the North. Military installations at Fort Chimo (Kuujjuaq, Nunavik) and Frobisher Bay (Iqaluit, Nunavut) provided the nucleus for what have become large administrative centers. Trading posts and Catholic and Anglican missions also attracted semi-permanent populations and several have subsequently become villages and hamlets (Tester, 2006). There was no consistent housing policy or programming in the Eastern Arctic until the late 1950s when modernization and economic transformation came into vogue in the Federal government. Important administrative differences have arisen between Nunavik, which is part of the province of Quebec, and the federally administered Nunavut which was created from the Northwest Territories in 1999. Nunavik is administered by the Inuit-run Kativik Regional Government which was created through the James Bay and Northern Quebec Agreement signed in 1975.

From the 1960s to the 1980s, a number of houses were built in Nunavik following federal government initiatives. These “tee-shirt” and “matchbox” house types were made of poor quality materials that deteriorated rapidly in the harsh climate and were uncomfortable to live in. Nunavut saw similar housing strategies and designs implemented. Almost as soon as they were constructed, they were seen as overcrowded and inadequate by administrators and Inuit alike. In the early 1980s, the Government of Canada conducted a review of its housing assistance policy. Several agreements were subsequently signed between federal and provincial/territorial

governments in order to alleviate growing housing needs. Quebec took charge of social housing in Nunavik through the Société d'habitation du Québec and works with regional and municipal organizations created through the James Bay and Northern Quebec Agreement to supply housing. In 1993, the federal government announced that it was unilaterally ceasing to fund any new long-term commitments in the area of social housing, including interventions in Nunavut and Nunavik (Société d'habitation du Québec, 2014; Tester, 2009). For the next decade, little social housing was built in Inuit regions despite important needs and a rapid increase of the population. The Kelowna Accord, signed in 2005, committed the federal government to meeting 35% of Nunavut's housing needs within 5 years (Tester, 2006). Change in government from a Liberal to a Conservative majority saw the abrogation of the accord and the abandonment of the housing commitments, exacerbating the housing crisis and its social effects in the North. Since 2010, different provincial and federal governmental strategies have committed to social housing construction in Inuit Nunangat (Government of Canada, 2016, 2017; Société d'habitation du Québec, 2014). Whereas these initiatives have been welcomed by Inuit representative organizations, they are still far from addressing the entirety of housing needs across Inuit Nunangat (Inuit Tapiriit Kanatami, 2016).

The current housing market in Inuit Nunangat is largely subsidized, with over 80% of the population in Nunavut and Nunavik living in social (subsidized) housing (Statistics Canada, 2017a). The young and rapidly growing population maintains the demands for the construction of new housing. Whereas the Canadian population grew by 11% between 2006 and 2016, the Inuit population grew by 20% (Statistics Canada, 2017b, 2017c). In 2016, 33% of the Inuit population was under 15 years old compared to 16% for Canada (Statistics Canada, 2017b, 2017c). The annual residential construction, limited by the short construction season and the high cost of materials, does not keep up with the demand for housing. To meet housing needs, it is estimated that 900 housing units are needed in Nunavik (Société d'habitation du Québec, 2014). In Nunavut, about 3800 residents were waiting for public housing in 2009–2010 (Nunavut Housing Corporation, 2011). Housing shortages coupled with the high prevalence of unacceptable housing conditions have multiple and complex intersections with various social and health outcomes.

### ***Current housing conditions in Nunavik and Nunavut***

In Canada, a dwelling is deemed acceptable if it is in adequate structural condition, suitable in size for the number of occupants, and affordable (Canada Mortgage and Housing Corporation, 2014). Housing is adequate if it does not require any major repairs, such as defective plumbing or electrical wiring, and structural repairs needed to walls, floors, or ceilings. At the 2016 Canadian Census, 24% and 34% of the population in Nunavik and Nunavut, respectively, reported living in houses requiring major repairs, compared to 7% of non-Indigenous Canadians (Statistics Canada, 2017d).

The 2016 Census measured housing suitability according to the National Occupancy Standards, that is, whether the dwelling has enough bedrooms for the size and composition of the household. In Nunavik and Nunavut, respectively, 52% and

56% of the population lives in a dwelling with at least a one-bedroom shortfall, compared to 5% for general Canadian population (Statistics Canada, 2017d).

Housing affordability is difficult to ascertain in the Arctic, given the predominance of social housing tenancy. In Nunavut, tenants pay monthly rent on a geared-to-income basis; in Nunavik rent is based on the size of the house and tenants' income. There are few privately owned houses. Because living in social housing is largely independent of income levels in these regions, this form of housing tenure is not a marker of socioeconomic status as it is elsewhere in the country.

Overall, 36% of Inuit households were in core housing need in 2011 (compared to about 12% of Canadian households), meaning that their house was not adequate, suitable, or affordable; this proportion was 53% in Nunavik and 48% in Nunavut (Canada Mortgage and Housing Corporation, 2015). At the 2016 census, 37% of households in Nunavut were reported to be in core housing need (Statistics Canada, 2017e). These statistics speak to the high level of housing needs across Inuit Nunangat, which may compromise 'sense of home'.

The distinction made between the functional necessity of being housed and the affective sense of having a *home* (Padgett, 2007; Rykwert, 1991) is especially relevant to consider in Indigenous contexts given the close relationship between sedentarization and housing provision in colonial history. From a broad Indigenous perspective, 'home' means belonging to culture, land, family, and community; it is a practice centered around visiting family and constantly reaffirming connections to a complex kinship network (Alaazi *et al.*, 2015; Christensen, 2016). Some authors have talked about the 'psychosocial dimension' of housing (Kearns *et al.*, 2011) referring to the 'meaningful' (Dunn, 2000) or 'soft' (Shaw, 2004) aspects associated with the house, or to the *ontological security* the home conveys, which is to say the sense of being at home or of feeling well in one's dwelling (Padgett, 2007).

The imposed form and mode of provision of housing in the Arctic may have had a profound effect on sense of home, which may be further compounded by overcrowding. In a previous article, we examined the cross-sectional relationship between overcrowding and psychosocial components of sense of home in Inuit from Nunavik and Nunavut (Perreault *et al.*, 2019). Results showed that living in an overcrowded dwelling, defined as a dwelling with more than one person per room, was associated with a lower sense of home. It was also, especially associated with poorer perceptions of psychosocial factors related to: identity, getting along with people in the house, control over the dwelling environment, and the use of space in relation to activities with strong cultural meanings like having a kitchen large enough to prepare hunted, fished, and gathered foods and to cook food for the family.

### **Study objectives**

With the large-scale construction of social housing units in Nunavik and Nunavut we asked the following question: Is rehousing associated with significant improvements in housing conditions? Although the answer to this question can appear self-evident, the high prevalence of housing needs and important backlog in construction may limit positive housing outcomes. This study examines the impact of rehousing, made

possible by large-scale construction of social housing units, on household crowding, housing adequacy, household wealth, and sense of home. Rehousing is defined here as relocating to a different dwelling, either a newly built dwelling or a dwelling already existing in the community but that recently became available for new tenants to occupy. We hypothesize that rehousing will be associated with improved housing adequacy, improved sense of home, and with modest improvements in household crowding given the current housing needs in these regions. Additionally, we hypothesize that rehousing will be associated with reduced household wealth, as new households will be starting on their own in a new house.

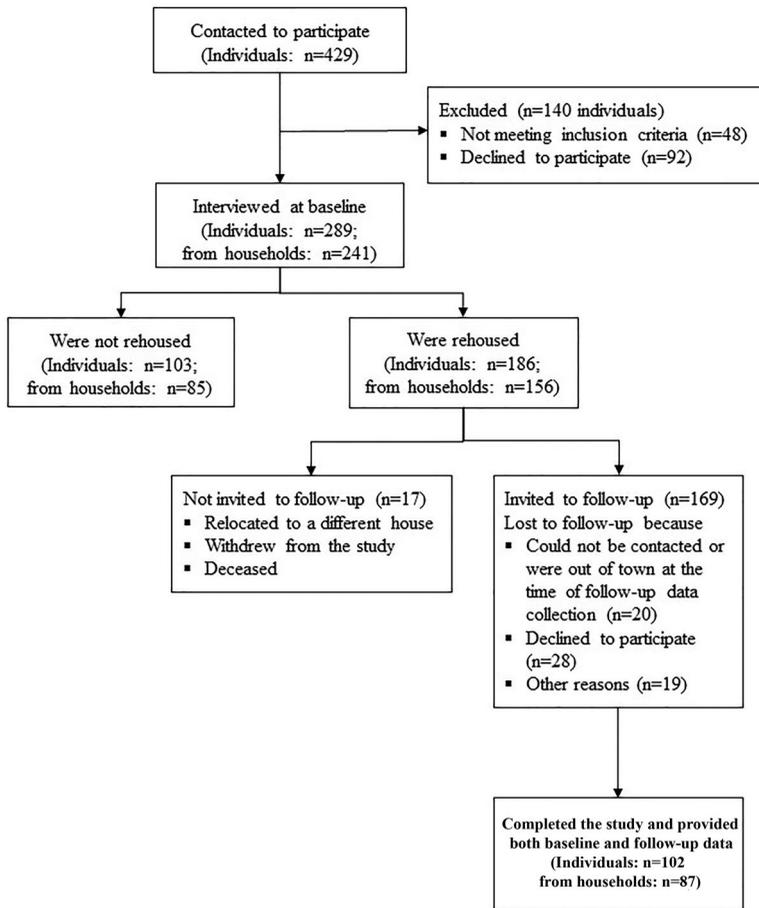
## Methods

Data for this study are from the project *Housing, health and well-being in the Arctic*, conducted in Nunavik and Nunavut. This project is a collaboration between academic researchers and territorial, regional, and provincial organizations responsible for housing, public health, and for preserving Inuit values and rights. Ethical approval was obtained from the Comité d'éthique de la recherche du CHU de Québec – Université Laval and from McGill University's Internal Review Board. The methodological description of the project has been reported elsewhere (Perreault *et al.*, 2019; Riva *et al.*, 2019) and is summarized here.

Nunavik covers an area larger than the state of California. Its 13,000 inhabitants live in one of 14 coastal communities ranging from 209 to 2,754 inhabitants. Nunavut spans an area similar in size to Mexico; it is one of the world's most sparsely populated areas with a population of 35,944 living in 25 communities ranging from 129 to 7,740 inhabitants. In Nunavik and Nunavut, there are no roads connecting the communities between themselves, or with southern population centers.

In 2014–2015, 216 social housing units were constructed in eight communities in Nunavik; Nunavut saw the construction of 210 housing units in 12 communities. To accommodate single-person and small and large family households, construction included a mix of one-, two-, and four-bedroom houses and apartments in multiplexes. In Nunavik and Nunavut, the design of social housing units varies mostly according to the number of bedrooms, and to whether the house is a detached family unit or part of duplex or multiplex. Inside the house, the design is similar to that of the typical southern Canadian house organized around the nuclear family and valuing individual and couple's privacy in sleeping areas. Floor plans are ill-designed to accommodate traditional cooking practices and social activities for Inuit households where there is a need for highly integrated spaces; there may also be limited storage space to accommodate cultural practices (Dawson, 2008).

In both regions, housing units are allocated first to communities where the housing shortage is most acute. The housing construction season extends from May to December. All material for housing construction is sent by ship from southern Canada the year prior to the construction. New houses come equipped with a refrigerator and cooking range. Local housing committees then allocate units according to the waiting list of applicants most in need of housing. When units are ready to be occupied, tenants are generally informed a few days to a few weeks in advance that they will be rehoused.



**Figure 2.** Flowchart of the recruitment of participants to the project.

### ***Study design, recruitment of participants, and sample size***

Baseline data were collected in Fall 2014 in six communities in Nunavik and in Spring 2015 in six communities in Nunavut. Follow-up data was collected 15–18 months after rehousing. Local housing officers contacted and recruited individuals ranked at the top of the waiting list for social housing. In each community, names on the waiting list were oversampled by 25% to accommodate the likelihood that not everyone met at baseline would be rehoused. All adults aged  $\geq 18$  years living with the person whose name was on the waiting list, and who would be moving with them, were invited to participate. From the 429 individuals (in 357 households, here referring to people whose name is on the waiting list plus adults who would move with them), 289 adults (from 241 households) participated in baseline interviews.

The flow diagram of participants recruited to the project, and who completed the project, is presented in [Figure 2](#). Of the baseline participants, 186 (64.4%) were rehoused. At follow-up, 169 participants were invited, and 102 (from 87 households) completed the study (were met both at baseline and follow-up).

Of the 102 participants, 83 moved to a newly constructed social housing unit (81.4%), and 16 (15.7%) moved to a unit that was already present in the community and that became available (some of the units were renovated; percentages do not add up to 100% because of missing information for 3 participants). There was no difference between selected housing outcomes for participants who moved into newly built units vs. already existing units (see [supporting material, Table S1](#)). We return to this point in the discussion.

## **Data collection**

Face-to-face survey questionnaires were administered at baseline and follow-up, in English or in Inuktitut by an interpreter. Data collection took place in a neutral environment (e.g. rented rooms at the municipality building), using two questionnaires. The *Household Questionnaire* was administered to the main household respondent, the participant whose name was on the waiting list. It collected information on household crowding, housing adequacy, and household wealth. All participants answered the *Individual Questionnaire*, which collected information on psychosocial factors associated with sense of home, demographic and socioeconomic characteristics, and health status. Most questions were adapted from surveys and studies previously conducted among Inuit and Indigenous populations in Canada (Nunavut Bureau of Statistics, 2009; SLiCA, 2002; Statistics Canada, 2006). Questionnaires were pilot-tested in Nunavik, and with Inuit in Quebec City but who had lived for an extensive period of time in Inuit Nunangat. At recruitment, potential participants were informed that their decision to participate or not in the study would not affect their rank on the waiting list, their housing situation, or whether or not they would be rehoused.

## **Measures**

### **Household crowding**

Participants reported the number of occupants, rooms, and bedrooms in their house, from which a ratio of person per room was computed. A household was considered overcrowded if it had more than one person per room (Statistics Canada, 2008).

### **Housing adequacy**

Participants reported whether their house needed major repairs (such as holes in the walls or in the ceiling, water coming in through the roof, etc.), minor repairs, regular maintenance, or no repairs. Thermal comfort of the house refers to a range of environmental factors including air temperature, air circulation, relative humidity, and ventilation (Ormandy & Ezratty, 2012). Thermal comfort was assessed using items related to the frequency, over the past year, of experiencing problems related to humidity inside the house (5 items; e.g. the house is humid, there is condensation on the walls) and to protection from outside climate (3 items; e.g. drafts coming from windows, cold floors in winter). Frequency of problems was measured on a 5-point scale, ranging from never (attributed a score of 1) to always (attributed a score of 5) experiencing the problem. A score of thermal comfort was calculated by summing

answers to the eight items. The score ranges from 8 to 40, with higher values indicating higher thermal discomfort.

### **Household wealth**

Participants reported on whether or not a selection of 20 household items and appliances were present in the house, including stand-alone freezer (to store country food), computer/tablet, internet access, phone, vehicle (car/truck, snowmobile, all-terrain vehicle), etc. A continuous index of ownership of household items was computed using principal components analysis (Lear *et al.*, 2014). Household wealth ranged between 0 and 100, with higher values denoting higher household wealth.

### **Sense of home**

A detailed description of individual items related to sense of home and of the computation of the overall sense of home score is reported elsewhere (Perreault *et al.*, 2019). We measured 21 items enclosed in one of eight constructs related to: identity, control, privacy, satisfaction, relationships, safety and residential stability, space, and location. Items were derived from previous studies (Dunn, 2002; Kearns *et al.*, 2011), and their cultural relevance was explored in qualitative interviews prior to their integration in the questionnaire). Participants reported agreement with each item on a 5-point Likert scale, ranging from strongly disagree to strongly agree. Responses were grouped to contrast participants holding positive vs. negative or neutral perceptions. From the initial 21 items, a continuous 8-item sense of home score was computed. The score varies from 8 to 40, with higher values indicating a stronger sense of home.

### **Statistical analyses**

Descriptive statistics are reported for selected housing conditions and socioeconomic characteristics of the 289 participants at baseline. At the suggestion of project partners, and where possible, results are presented in a positive way to set objectives for improvements. For example, we report the proportion of participants being satisfied with their house, rather than being dissatisfied. Crude changes in housing-related outcomes between baseline and follow-up for the 102 participants who completed the study are explored using paired *t*-test and  $\chi^2$  tests.

To assess the impacts of rehousing on housing outcomes, we applied multilevel regression models for longitudinal data. Multilevel models used here to account for the nested structure of the data collected in this project: observations within individuals, within households, and within communities. They are not used to assess variability in parameters or variation partition between levels. In the models, the main independent variable is time, denoting baseline vs. follow-up differences. Models are adjusted for participants' age, sex, and region. Further adjustment by household financial situation or by the type of housing unit moved into (newly constructed vs. already existing) did not change the results. These variables were therefore not included in the final models. To test the sensitivity of the results to the type of regression modeling used, we analyzed the data using multilevel models without the household or community clusters (see [Table S2 in supporting material](#)). As the fixed

effect coefficients were similar across models, we present those from the 4-level multi-level models described above. All analyses were conducted using Stata v14.2 (StataCorp, 2017).

## Results

More women than men participated in the study, and the average age of participants at baseline was 31 years old (Riva et al., 2019). At baseline, 16% of participants reported having a post-secondary education (completed or not), and almost 60% reported an annual personal income below \$20,000 (Riva et al., 2019). The socio-economic circumstances of participants involved in the project reflect some of the hardships experienced by many in the Arctic (Duhaimé & Édouard, 2015).

With regards to housing conditions at baseline, 78% lived in social housing and 33% had been on the waiting list for social housing for four years or more (results not tabulated). Seventy percent of participants lived in a house composed of three adults or more with dependent children (Perreault *et al.*, 2019). On average, participants had moved houses more than once in the past five years, but most (70%) had spent their whole life in the community (results not tabulated).

Household overcrowding, housing adequacy, and household wealth at baseline, follow-up, and changes between baseline and follow-up for those who were rehoused are presented in Table 1 (data for the main household respondent are presented). At baseline, there was an average of 6.5 people per household, with an average of 2.5 children per household. Houses had, on average, 3.3 bedrooms. More than half (58%) of households were overcrowded (defined by a ratio of more than one person per room). The urgency of housing needs is further evidenced by the extent of hidden homelessness in the regions. Although everyone met at baseline was 'housed', about one third of participants reported having offered shelter in the previous year to someone who had no place to live. This speaks to concern about widespread hidden homelessness across the Canadian Arctic (Christensen, 2016), where extreme climate conditions limit the visible homelessness.

Changes in household crowding, housing adequacy, and household wealth are reported for the 87 main household respondents who completed both baseline and follow-up data collection (right-hand side of Table 1). Between baseline and follow-up, the proportion of respondents living in overcrowded dwellings significantly decreased from 66% to 20% ( $p < 0.001$ ); this represents a reduction in overcrowding of almost 70% among those who were rehoused. The average number of people living in the house was reduced by nearly half, from 6.5 to 3.3. Whereas the proportion of participants reporting having offered shelter to non-household members was not statistically different at follow-up, the average number of days that people offered shelter was significantly reduced (results not tabulated).

With respect to housing adequacy at baseline, 34% of the main household respondents reported their house to be in good condition (not needing repairs), and 37% reported that major repairs were needed. Some problems with water leakage, humidity, or condensation on walls were reported. About half reported problems with condensation on windows, and many reported problems with dry air, cold

**Table 1.** Indicators of housing acceptability for the 241 main household respondents at baseline, and for the 87 households seen at both baseline and follow-up.

	241 Households at baseline	87 Households at both baseline and follow-up		Change <sup>a</sup> ( <i>p</i> -value)
		Baseline	Follow-up	
<b>Household crowding</b>				
Nb people in the house, mean (SE)	6.5 (0.2)	6.9 (0.4)	3.3 (0.2)	<0.001
Nb children aged ≤17 years, mean (SE)	2.5 (0.1)	2.6 (0.2)	1.6 (0.2)	<0.001
Nb bedrooms, mean (SE)	3.3 (0.1)	3.4 (0.1)	1.9 (0.1)	<0.001
Person per room, mean (SE)	1.2 (0.0)	1.3 (0.1)	0.8 (0.0)	<0.001
Overcrowded dwelling <sup>b</sup> , <i>n</i> (%)	140 (58.1)	57 (65.5)	17 (19.5)	<0.001
<b>Housing adequacy</b>				
Repairs needed in the house, <i>n</i> (%)				0.036
None	83 (34.4)	32 (36.4)	39 (44.8)	
Regular maintenance	21 (8.7)	6 (6.9)	9 (10.3)	
Minor repairs	48 (19.9)	18 (20.7)	27 (31.0)	
Major repairs	88 (36.5)	30 (34.5)	12 (13.8)	
<b>Thermal comfort</b>				
In the past 12 months, how often did you have these problems (% reporting never vs. sometimes or always):				
Water leaking from the ceiling	213 (88.4)	78 (89.7)	86 (98.9)	0.022
Humidity/condensation on windows	134 (55.6)	50 (57.5)	72 (82.8)	<0.001
Humidity/condensation on walls	210 (87.1)	79 (90.8)	86 (98.9)	0.070
The house is humid/damp	169 (70.1)	66 (75.9)	80 (92.0)	0.002
The house is dry	80 (33.2)	29 (33.3)	34 (39.1)	0.392
In winter: drafts coming from doors or windows	80 (33.2)	32 (36.8)	49 (56.3)	0.010
In winter: drafts coming from places other than doors or windows	171 (71.0)	67 (77.0)	79 (90.8)	0.027
In winter: cold floors	73 (30.3)	24 (27.6)	44 (50.6)	0.001
Thermal comfort score, mean (SE)	17.4 (0.4)	16.4 (0.5)	13.2 (0.4)	<0.001
<b>Household wealth</b>				
Household financial situation, <i>n</i> (%)				0.012
Run out of money before pay day	98 (40.7)	36 (41.4)	26 (29.9)	
Just enough money to get us through to the next pay day	78 (32.4)	22 (25.3)	42 (48.3)	
Can save money	61 (25.3)	28 (32.2)	19 (21.8)	
Household wealth score, mean (se)	66.6 (1.3)	72.5 (2.2)	49.3 (2.7)	<0.001

<sup>a</sup>Marginal homogeneity test.<sup>b</sup>Overcrowded defined as dwellings with >1 person per room.

floors, and drafts coming from windows and/or doors during winter. About one-third reported problems with poor air circulation and molds.

Between baseline and follow-up, the proportion reporting their house needing major repairs decreased from 35% to 14% ( $p < 0.001$ ), a reduction of 60%. Although there were significant improvements in thermal comfort in the house (as indicated by the lower score at follow-up), problems with cold floors and with drafts coming from doors or windows remained after rehousing.

We observed significantly lower household wealth at follow-up among participants who were rehoused. Likewise, whereas fewer participants reported running out of money before payday at follow-up, more reported having just enough money to get through the next payday and fewer reported being able to save money.

Sense of home, and items related to sense of home, at baseline, follow-up, and changes between baseline and follow-up for those who were rehoused are presented in Table 2 (data for 102 participants presented). At baseline, about 50% perceived

**Table 2.** Proportion of participants who agreed or strongly agreed (vs. those who neither agreed or disagreed, disagreed, or strongly disagreed)<sup>a</sup> with statements associated with sense of home, for the 289 participants at baseline and the 102 participants seen at both baseline and follow-up.

Constructs and items	289 Participants at baseline	102 Participants at both baseline and follow-up		
	<i>n</i> (%)	Baseline <i>n</i> (%)	Follow-up <i>n</i> (%)	Change <sup>b</sup> ( <i>p</i> -value)
<b>Space</b>				
Too many rooms <sup>y</sup>	212 (73.4)	75 (73.5)	89 (87.3)	0.020
Rooms are too small <sup>y</sup>	93 (32.2)	33 (32.4)	42 (41.2)	0.180
Kitchen big enough to cook food	166 (57.4)	57 (55.9)	75 (73.5)	0.017
Enough storage space <sup>c</sup>	141 (48.8)	50 (49.0)	56 (54.9)	0.446
<b>Identity</b>				
House is a good reflection of who I am <sup>c</sup>	152 (52.6)	52 (51.0)	83 (81.4)	<0.001
Home provides a good place to live life	152 (52.6)	54 (52.9)	87 (85.3)	<0.001
Can do all activities I want in house	153 (52.9)	64 (62.7)	84 (82.4)	0.002
<b>Control</b>				
Can do what I want, when I want	147 (50.9)	56 (54.9)	91 (89.2)	< 0.001
Can make changes as I want	114 (39.4)	43 (42.2)	89 (87.3)	< 0.001
Feel in control, can decide what happens <sup>c</sup>	99 (34.3)	35 (34.3)	81 (79.4)	< 0.001
<b>Privacy and retreat</b>				
Feel I have privacy <sup>c</sup>	145 (50.2)	50 (49.0)	82 (80.4)	< 0.001
Can get away from it all	151 (52.2)	53 (52.0)	81 (79.4)	< 0.001
Can't stand to be at home <sup>y</sup>	64 (22.1)	29 (28.4)	49 (48.0)	0.003
<b>Satisfaction</b>				
I like living in this house	131 (45.3)	47 (46.1)	87 (85.3)	<0.001
I am satisfied with my house <sup>c</sup>	150 (51.9)	59 (57.8)	88 (86.3)	<0.001
<b>Relationships</b>				
I get along with people in my house <sup>c</sup>	195 (67.5)	71 (69.6)	94 (92.2)	<0.001
<b>Location</b>				
House well located to meet everyday needs <sup>c</sup>	206 (71.3)	77 (75.5)	67 (65.7)	0.096
I have friends and family living nearby	227 (78.5)	83 (81.4)	90 (88.2)	0.178
I have a view on nature	196 (67.8)	78 (76.5)	80 (78.4)	0.739
<b>Safety</b>				
I feel safe in my house <sup>c</sup>	217 (75.1)	79 (77.5)	90 (88.2)	0.071
Sense of home 8 items score, mean (SE)	26.6 (0.3)	27.0 (0.6)	31.2 (0.4)	<0.001

<sup>a</sup>Except for items marked with <sup>y</sup>where proportions of participants who strongly disagreed or disagreed are presented (vs. those who neither agreed or disagreed, agreed, or strongly agreed).

<sup>b</sup>Marginal homogeneity test.

<sup>c</sup>Items used to compute the sense of home 8-item score.

their house to be a reflection of who they are. With regards to control, between 40% and 50% of participants agreed that they could make changes in their houses and that they could do whatever they wanted; 35% felt in control of their house. This could be explained because participants at baseline were those on the waiting list for social housing, living in houses that were more likely to be overcrowded and not their 'own'. About half perceived their house to be offering privacy and space for retreat, and were satisfied with their house. Overall, most felt safe and got along with people in their house.

The overall sense of home significantly improved 15 to 18 months after rehousing. We noted an improved appreciation for most items related to concepts of space, identity, control, privacy, satisfaction, and relationships. For example, after rehousing, participants reported greater control of their home environment, getting along better with people in their house, more privacy and retreat, and that their new dwelling reflected their identity. Kitchen being large enough to cook for family and overall satisfaction with the house was reported more often at follow-up.

**Table 3.** Multilevel models of change in housing outcomes for the 102 participants seen at both baseline and follow-up.

	Unadjusted Coeff (SE) <sup>a</sup>	Adjusted <sup>b</sup> Coeff (SE)
Number of people in the house	−3.7 (0.3)*	−3.7 (0.3)*
Thermal comfort score	−3.3 (0.5)*	−3.2 (0.5)*
Household wealth score	−23.3 (2.1)*	−22.8 (2.1)*
Sense of home score	4.1 (0.6)*	3.9 (0.6)*

<sup>a</sup>Coefficients for the time variable are presented.

<sup>b</sup>Adjusted for age, sex and region.

\* $p < 0.001$ .

Changes between baseline and follow-up for participants who were rehoused are robust ( $p < 0.001$ ) to adjustment for age, sex, and region (Table 3). In fully-adjusted multilevel models, household size at follow-up was lower by 3.7 individuals. The score of thermal (dis)comfort was significantly lower after rehousing, indicating improvements. Whereas the sense of home score was almost 4 points higher at follow-up, the score for household wealth was significantly lower.

To assess the extent of selection bias, we examined differences in baseline housing conditions between participants who did not move vs. those who were rehoused, and between participants who were rehoused and did not complete vs. completed the study (Table 4). In comparison to participants who did not move, those who were rehoused lived in houses that were significantly more crowded at baseline. This was anticipated given that one of the criteria used to rank households on the waiting list for social housing is the extent of overcrowding, and the number of dependent children. Household wealth at baseline was higher for participants who moved compared to those who were not rehoused. However, participants did not significantly differ in terms of repairs needed, thermal comfort, or sense of home. Among participants who were rehoused, the only difference in housing characteristics at baseline pertains to thermal comfort, with participants who completed the study perceiving lower thermal comfort at baseline compared to those who were rehoused but did not complete the study. There was no statistical difference in age, gender, or annual income between participants who did not move and those who were rehoused and completed the study (Riva et al, 2019).

## Discussion and conclusion

In this article we describe housing conditions experienced by Inuit adults on the waiting list for social housing in Nunavik and Nunavut, and examine changes in housing conditions for a subset of 102 people who were rehoused and who completed both baseline and follow-up assessments.

Baseline data from this project indicate a high prevalence of overcrowding among participants, which was significantly reduced for those who were rehoused. These findings differ from those of Bailie *et al.* who tested the association between housing construction, improvement in housing infrastructure, and reduction in common childhood illnesses in 10 Indigenous communities in Australia (Bailie *et al.*, 2012). In their study, there was an average of 11 people per dwelling at baseline and the number of houses built in each community increased the local housing stock only by

**Table 4.** Comparison of baseline housing characteristics between a) participants/households who did not move vs. those who were rehoused and completed the study; and b) between participants/households who were rehoused but who did not complete the study vs. those who completed the study.

	a) Comparing baseline values between households/participants who :		b) Comparing baseline values between households/participants who were rehoused and:	
	Did not move ( $n_i = 103$ ; $n_h = 85$ ) <sup>a</sup>	Were rehoused and completed the study ( $n = 102$ ; $n_h = 87$ ) <sup>a</sup>	Did not complete the study ( $n = 82$ ; $n_h = 66$ ) <sup>a</sup>	Completed the study ( $n = 102$ ; $n_h = 87$ ) <sup>a</sup>
			<i>p</i> -value	<i>p</i> -value
Number of people in the house [mean (se)]	6.0 (0.4)	7.0 (0.4)	0.043	7.0 (0.4)
Overcrowding [n (%)]	42 (49.4)	59 (67.0)	0.014	59 (67.0)
Major repairs needed [n (%)]	30 (35.3)	32 (36.4)	0.839	32 (36.4)
Thermal comfort score [mean (se)]	17.7 (0.7)	16.5 (0.5)	0.238	16.5 (0.5)
Household wealth score [mean (se)]	62.6 (2.5)	72.5 (2.2)	0.003	72.5 (2.2)
Sense of home score [mean (se)]	26.9 (0.5)	27.0 (0.6)	0.833	27.0 (0.6)

<sup>a</sup> $n_i$ : Number of participants;  $n_h$ : number of households.

about 10%. The authors observed only a marginal reduction in household crowding, and most families were still living in crowded conditions at follow-up (Bailie *et al.*, 2011, 2012). By contrast, for the 102 people who completed the current study, average household size was considerably lower at baseline, at 6.9 people per house, and was significantly reduced to 3.3 people per house at follow-up. The number of housing units constructed in the Inuit communities involved in this study might have been sufficient to alleviate, but not completely eliminate, overcrowding over a 15–18 month period.

We observed statistically significant improvements in housing adequacy and thermal comfort among people who were rehoused. These results concur, to some extent, with those of a cluster-randomized trial of insulating existing houses in low-income communities in New Zealand, where improved insulation was significantly associated with warmer and drier houses (Howden-Chapman *et al.*, 2007).

Among those who were rehoused, there was a significant reduction in household wealth, as measured by the number of household items and appliances. Although not unexpected, this result was not intended by the construction of social housing. The diminution in household wealth likely reflects the situation of people starting in a new dwelling with fewer household items available and the high costs of household goods and appliances. Cost of living is high in Nunavik and Nunavut, and acquiring household items (e.g., cooking gear), furniture (e.g., sofas; mattresses), and appliances (e.g., washer and drier) not provided with the house will likely burden household finances, at least for the initial years when people get established into a new housing environment. Housing strategies in these regions should consider unintended social impacts, such as the effect on household wealth, when allocating new housing units.

One particularly interesting aspect of our results is the significant increase in sense of home. For example, the increased proportion of participants reporting ‘*The kitchen is big enough to prepare and cook food for my family*’, ‘*My house is a good reflection of who I am*’, and ‘*I get along with people in my house*’ reflect substantial improvements in important cultural aspects relating to food practices, identity, and family relationships. As for improvements in items related to control, such as ‘*I feel in control in my house, I can decide what happens in my house*’, they may result from the decrease in crowding, likely accompanied by fewer boundary struggles and less of the unpredictability that often comes with overcrowding (Dunn, 2000; Suglia *et al.*, 2011). These observations are paralleled by an increased number of participants reporting ‘*I feel I have privacy in my house (my own space, space to be alone, space to be on my own)*’. Improvements in feelings of control and privacy challenge the argument of ‘crowding preference’ among Inuit (Lauster & Tester, 2010) and other cultural groups (Evans *et al.*, 2000). In fact, cross-sectional data from this project, along with other studies in Inuit populations, indicate that overcrowding is associated with lower sense of home (Perreault *et al.*, 2019), elevated chronic stress (Riva *et al.*, 2014) and poorer psychological well-being (Riva *et al.*, 2014).

As argued by Dawson (2008), design considerations acknowledging Inuit culture and values should be reflected in the physical configuration of housing in the Arctic. Such considerations could facilitate Inuit ways of living, and in that sense, represent potential contributors to sense of home. A guide for good practices in housing

construction in Nunavik describes procedures for construction projects, specifying design criteria that relate to siting, exterior finish, and architecture, among others (Société d'habitation du Québec, 2018). Examples of such criteria include outfitting considerations such as built-in cold porches large enough for occupants to safely store heavy equipment (boots, parkas, fishing and hunting gear, etc.), or kitchen counters wide enough for butchering game. This guide, however, has no regulatory authority. The guide was published after the present research project was conducted, and it is not clear if the criteria were reflected in the construction of units in which participants were rehoused. Information regarding adaptations potentially made by participants themselves to their new dwelling is also not available.

Findings of this study should be interpreted in light of some limitations. The selection of participants was not random. Participants ranked at the top of the waiting list for social housing in each community were purposefully recruited to this study. Therefore, results cannot be generalized to those on the waiting list for social housing in these regions, or to other populations.

The housing intervention assessed in this project, that is, rehousing following the construction of social housing, can be defined as a 'natural experiment'—an intervention for which the research team does not control the allocation to particular communities or individuals, but where predetermined variation in allocation occurs (Petticrew *et al.*, 2005). Because of unforeseen climatic events, housing construction was delayed by several months in some communities. This explains the difference in time between baseline interviews and the move to a new house. Also, given the remoteness and costs of travel to some of the communities, the time period between receiving the intervention and the follow-up data collection varied. Delays experienced in the context of this project are similar, and even smaller, than those reported in another housing intervention in remote Indigenous communities in Australia where access to communities were cut for several months because of difficult environmental conditions (Bailie *et al.*, 2012).

Housing allocation was outside the control of the research team. Several participants relocated to a different house after the initial rehousing and therefore were not eligible at follow-up. At follow-up, every attempt was made to contact participants, yet many were absent from the community and could not be reached. The high cost of data collection prevented the research team from returning to the communities to interview these participants at a later time. Overall, there was little difference in baseline housing conditions between participants who did not move, those who moved, and those who completed the study, suggesting limited selection bias. Nonetheless, we are dealing with a small number of participants who contributed information to both baseline and follow-up. Therefore, the study might not have been sufficiently powered to detect some differences, for example differences in housing outcomes by household financial situation, or between those moving to newly constructed housing units vs. those moving to already existing units in the community.

The feasibility of having a control group was limited by budgetary and ethical considerations (Riva *et al.*, 2019). A comparable control group would have been composed of people for whom the 'treatment as usual' means waiting several years before rehousing, if rehousing at all. This was not justifiable for the context of a research project.

By the design of the study, the recruitment of people on the waiting list for social housing, most participants experienced high housing needs at baseline. An overestimation of housing problems at baseline, but not at follow-up, would overestimate the effect of the intervention. Finally, we cannot exclude the possibility of other events that might have co-occurred with the intervention and that may have affected housing outcomes. Whereas the occurrence of unknown major housing-related events during the intervention is unlikely, it is possible that smaller changes impacted housing outcomes. For example, we could hypothesize that changes made by residents themselves to their units might have influenced sense of home. Potential adaptations to the house made by occupants to accommodate cultural practices were not assessed in the project. Future research investigating these questions would bring valuable knowledge to disciplines engaged with northern and indigenous housing.

Despite these limitations, results from this project contribute to the limited scientific literature assessing the impacts of housing interventions in Indigenous communities. Findings indicate that social housing construction in Nunavik and Nunavut significantly improves living conditions. This evidence supports the argument for continued investments in social housing construction in these regions, in addition to investments for retrofitting houses to improve their structural integrity and energy efficiency and for exploring other modes of tenure such as rent-to-own and homeownership. Nevertheless, cost considerations and chronic underinvestment remain important barriers to the construction of more sustainable and culturally adapted housing in Inuit Nunangat (Inuit Tapiriit Kanatami, 2019). While there have been innovative housing programs implemented with published recommendations, most have yet to be replicated and scaled up (Goldhar *et al.*, 2013). Evaluation studies of these programs, and of other housing interventions, are needed to support actions and to identify impacts beyond improvements in housing outcomes.

## Acknowledgments

This study was conducted in collaboration with the following organizations who reviewed the article prior to submission: Kativik Municipal Housing Bureau, Kativik Regional Government, Nunavik Regional Board of Health and Social Services, Société d'habitation du Québec, Nunavut Housing Corporation, Government of Nunavut Department of Health, Nunavut Tunngavik Incorporated. The project was approved and supported by mayors of the communities involved, the Nunavik Nutrition and Health Committee, and the Nunavut Research Institute. Results reported in this article have been approved for publication by the above mentioned partners, and by the Nunavik Nutrition and Health Committee. We acknowledge the collaboration of Inuit research assistants, local housing committees and managers, and mayors without whom this study would not have been possible. We thank participants who generously gave their time to participate in the project. We acknowledge the contribution of other co-researchers on this project, and the contribution of research assistants who collected data.

## Disclosure statement

No potential conflict of interest was reported by the author(s).

## Funding

The project Housing, health and well-being in the Arctic received financial support from the Canadian Institutes of Health Research (# GIR-134230) and from ArcticNet - a Network of Centres of Excellence of Canada. M. Riva holds a Canada Research Chair in Housing, Community, and Health (CIHR 950-231678). L. Potvin holds a Canada Research Chair in Community Approaches and Health Inequalities (CIHR 950-232541). K. Perreault is supported by a Doctoral Research Award from the Canadian Institutes of Health Research.

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