

## Household overcrowding and psychological distress among Nunavik Inuit adolescents: a longitudinal study

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### ABSTRACT

About half of Nunavik Inuit live in overcrowded households compared to very few Canadians from the general population. Living in overcrowded households is associated with greater risks of suffering from mental health problems for Canadian adolescents. The present work aims at studying prospectively the hypothesised relationship between household overcrowding at childhood and psychological distress during adolescence among Nunavik Inuit, as well as the hypothesised relationship between these phenomena when they are both measured at adolescence. Recruited as part of the Nunavik Child Development Study, 220 participants were met at 11 years old in average and then when they were 18 years old in average. Household overcrowding was assessed using the people per room ratio. Psychological distress symptoms were operationalised at adolescence using depressive symptoms and suicidal thoughts. The results did not show that childhood household crowding had a long-term effect on psychological distress. An absence of moderation by sex of the association was also found in the present study. Despite those results, household crowding could be a risk factor only when in interaction with other elements related with poverty or housing or could be experienced as a difficulty for adolescents on other aspects than depressive symptoms and suicidal thoughts.

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### Introduction

Inuit are the Indigenous people of the circumpolar north. In Canada, the majority of Inuit live in one of four regions known collectively as Inuit Nunangat. The Inuit were traditionally a seminomadic cultural group and part of their territory is situated in Nunavik (north of the Québec province in eastern Canada; of which inhabitants are the focus of this paper). During the 20th century, they were relocated in the current communities in order to assert Canadian sovereignty in the Arctic, for trade reasons [1,2] and to live close to dispensaries and to newly mandatory schools for the children [2]. Since this massive delocalisation, the federal government has made successive investments in housing. However, housing units have chronically been insufficient, badly adapted to the weather, quick to fall in disrepair [3,4] and too small to meet the cultural preference for having many generations under the same roof [5]. Between 85% and 90% of the Nunavik population live in social housing, and units are attributed according to a points system that depends on many criteria, and on a lesser manner on the socio-economic status of tenants [6]. However, a census conducted

by the Kativik Municipal Housing Bureau in 2013 shows that there is a backlog of 899 housing units in Nunavik [6]. This situation led to household overcrowding,<sup>1</sup> that is, a people per room (PPR) ratio above 1, being a reality for 49% of Nunavik Inuit compared to 3% of the Canadian general population in 2006 [7]. In the 2016 census, the measure was different but led to a similar proportion of 52% of Nunavik Inuit living in overcrowded households [8]. These data could however underestimate the real household overcrowding rate because they do not consider hidden homelessness, that is, living semipermanently at a friend or a family member's house because one does not have a permanent dwelling [9], and which could characterise a fifth of the houses in the Inuit Nunangat [10]. Inuit authorities consider the household overcrowding situation a critical public health issue [4] and plead for more household units. Thus, the housing context in Nunavik does not allow for selection into overcrowded households because of personal or mental health characteristics.

The household overcrowding situation in Nunavik must be understood within the demographic characteristics of this territory. With 34.3% of the Nunavik

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<sup>1</sup>In this paper, the term 'household crowding' will be used to describe the general phenomenon with the full range of people per room ratios. 'Household overcrowding' will be referring to the specific situation of a people per room ratio above 1.

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population being aged under 14 years compared to 16.1% of the Canadian general population [11], Nunavik Inuit form a very young society. From 2004 to 2008, the fertility rate in Nunavik was 3.22, which is approximately twice the rate reported in the Canadian general population [11]. Also, according to the 2008 Canadian Community Health Survey, more Northern Aboriginal children aged 12- to 17-year-old live in overcrowded households than Southern Aboriginal or non-Aboriginal people [12]. Thus, in the very young and rapidly growing Nunavik population, many children and adolescents experience household overcrowding.

Many young Inuit also experience psychological distress, a state of emotional suffering characterised by symptoms of depression and anxiety. The results from the 2004 Nunavik Inuit Health Survey, which provided a sample representative of the adult population, indicated that 15.1% of the women and 13.3% of the men aged 15–29 years were experiencing psychological distress [13]. In comparison 6.7% of adolescents aged 12–19 years and 11% of adults aged 20–29 years from the Canadian general population were suffering from an anxiety or mood disorder in 2009 [14]. Furthermore, between 2004 and 2008, the risk of committing suicide for Inuit children and adolescents was 30 times greater than for their peers from the Canadian general population [15]. The prevalence of psychological distress in Nunavik adolescents is therefore much higher than in the general population.

The high prevalence of household overcrowding and psychological distress among Nunavik adolescents raises the question of their association. Many studies conducted among various populations corroborate the existence of such an association. Among American university students, moving to an overcrowded household is associated with higher scores of psychological distress 2 months after moving, but only when social support is low. However, 8 months after moving, household overcrowding is associated to psychological distress despite social support and initial distress levels [16]. A longitudinal study using data from the 1985 census and reported cases of suicide during the period studied also supports the hypothesis that household overcrowding is a risk factor for suicide [17]. In a Thai study, modest but significant associations were found between psychological distress and the PPR ratio. However, the associations were more important when subjective household overcrowding, that is the perception that there are too many people living in the house, was used instead of the PPR ratio [18]. Household overcrowding therefore seems to be associated with

psychological distress, but the results vary according to the crowding indicator being used.

Household overcrowding often occurs concomitantly with other deleterious housing conditions, and other studies raise the question whether household overcrowding is a direct causal factor of psychological distress or is merely one of the factors related to other adverse housing conditions or poverty that are as a whole cause of psychological distress. One longitudinal and four cross-sectional studies support the hypothesis that household overcrowding can put tenants at risk of psychological distress [19–22] when considered as one aspect of housing among others. However, a Cochrane systematic review documenting the health of tenants and the impacts of housing improvement interventions reports contrary results: only the studies that presented the highest risk of bias concluded to an association between housing enhancement interventions and mental health improvement [23]. With similar results, a recent study showed an association between a composite measure of housing characteristics (ownership status, housing affordability, and a household crowding measure) and psychological distress. However, poverty predicted psychological distress up to 2 years later, but not housing characteristics, which could suggest that some confounding factors were not considered [24]. In addition, the Housing in the Canadian Arctic: assessing the impacts of rehousing for Inuit Health Study is a before-and-after study aiming at addressing the impacts of moving to a newly built social housing unit on the health and well-being of Inuit in Nunavik and Nunavut. In this study, PPR at baseline predicted perceived stress at follow-up, but not psychological distress [25]. These last results suggest that household overcrowding might not have specific long-term effects on psychological distress, and that other factors related to adverse housing conditions or poverty could play a more important role.

Household overcrowding's specific impact may however be observed when subgroup characteristics are taken into account. Moving into a bigger household with more opportunities for privacy would be beneficial for the mental health of parents of young children, but not for other adults [26]. Nevertheless, household overcrowding seems to be experienced similarly across cultures and ethnic groups [27–30]: Asian Americans, Latin Americans, Anglo Americans and African Americans suffer from psychological distress when they live in an overcrowded household [31]. Also, women living in an overcrowded

household may be more likely than men to suffer from associated mental health problems [27,32], though this is not always observed [18]. Household overcrowding was reported to have a more important impact on Greenlandic Inuit women, especially for those who did not benefit from good social support [33]. Women's traditional role in the Inuit society lead them to spend more time in the household, and they therefore could be more exposed to the deleterious conditions associated with household overcrowding [2]. We however do not know if the association between household overcrowding and psychological distress differs between girls and boys for Inuit adolescent. Thus, some characteristics such as age, sex, role in the family, or socioeconomic status could lead to different ways of experiencing household overcrowding, which could explain the lack of association between household overcrowding and psychological distress in studies that failed to take specific subgroups into account.

In this vein, little is known about the specific long-term effects of experiencing household overcrowding during childhood and adolescence. However, many studies conclude to a negative long-term impact of poverty experienced during childhood or adolescence, and of its associated adversities such as household overcrowding on poor mental health during adulthood [34]. Household overcrowding is one of the factors associated to functional deficiency, which includes depressive and anxiety symptoms, among 10- to 15-year-old children [35]. The more time children spend in poverty from birth to age 9, the more they are at risk of suffering from externalising symptoms and of showing signs of learned helplessness at the beginning of adulthood [34]. Furthermore, social adversities experienced in the adolescent years, including household overcrowding, increase the risk of following a poor developmental trajectory that includes more anxiety or sadness symptoms until adulthood [36]. Among Nunavik Inuit adolescents, one cross-sectional study has been realised, and has identified household overcrowding as having negative impacts on self-esteem and suicidal ideations [37]. Living in an overcrowded household was also associated with food insecurity in households with school-aged children [38]. Household overcrowding experienced at a young age therefore seems to be one of the factors associated to poverty that predict psychological distress later in life.

To summarise, an association between household overcrowding and psychological distress is documented, but with diverging results that might come from different ways of experiencing household

overcrowding depending on characteristics such as age or sex. Also, the specific impact of household overcrowding is hard to pinpoint because of its frequent association with other aspects of poverty or housing. The Nunavik Inuit population is very young, and a greater proportion of Inuit adolescents is experiencing household overcrowding and psychological distress than their peers in the southern Canadian population. Still, the association between household overcrowding and psychological distress in adolescent Inuit has yet to be probed, and whether this putative association differs between young boys and girls. Finally, psychological impacts associated with household overcrowding experienced during childhood need parsing from current overcrowding experienced by adolescents.

## Objectives and hypothesis

The first objective is to investigate the longitudinal association between household overcrowding experienced during childhood and psychological distress during adolescence. We hypothesise that living in an overcrowded household during childhood is a risk factor for psychological distress in Nunavik adolescents, and that the association will remain after the models are adjusted for socioeconomic status (SES) and sex. The secondary objective of this study is to examine the cross-sectional association between household overcrowding and psychological distress, when both are measured during adolescence. We hypothesise that such an association will exist. A third objective is to test for differences linked to participants' sex in these associations. Psychological distress is expected to be more important for women living in overcrowded households than for men living in similar conditions.

## Methods

### Data and participants

The participants are part of the Nunavik Child Development Study and come from the 14 Nunavik communities. Between 2005 and 2010 (Time 1, from now on referred as T1), eligible children (between 8 and 15 years old, born after at least 35 weeks of pregnancy, weighting a minimum of 2.5 kg, and without major birth defects) met the research team with their principal caregiver, usually the mother, who were first contacted by phone, then met by a research assistant who explained them the project. They then signed a consent form and children gave

their verbal assent. Every child who participated at T1 ( $n = 294$ ) was invited to participate at Time 2 (T2), when they were 18 years old on average between 2013 and 2016. At T2, the adolescents participated by themselves (without their parents) and provided written consent ( $n = 212$ ). The participation rate at Time 2 was 73.3%.

### **Protocol**

At T1 and T2, data gathering took place with the research team in half-day encounters in Kuujuaq, Puvirnituk and Inukjuak. Participants living in other communities were flown in to meet the team (travel costs paid by the study). At T1, a structured interview was conducted with the principal caregiver in French, English or in Inuktitut with an interpreter, according to participants' preference. At T2, the adolescents were met alone for an interview in their chosen language. At T1, parents were compensated for their participation; they also received a t-shirt and a children book. At T2, a 50\$-value music player was given to the adolescent. Laval University's and CHU of Québec's Research Ethics Committees approved all procedures at T1 and T2. The research team obtained the approbation of the Nunavik communities, the Nunavik Regional Board of Health and Social Services and of the Kativik Regional Government.

### **Measures**

#### **Household crowding**

Household crowding at T1 and T2 was measured using the PPR ratio: the number of inhabitants divided by the number of rooms (excluding bathrooms, halls and rooms used strictly for business purposes). This ratio was used as a continuous variable and also transformed into a dichotomous variable, with a ratio  $> 1$  corresponding to an overcrowded household. Because there is no consensus about the use of this PPR ratio cut-off in Nunavik [39], other indexes operationalising household overcrowding were used in prediction models: the mean PPR ratio, one standard error above the mean PPR ratio and categorical variables comparing participants who have not experienced household overcrowding at T1 or T2, and participants who have experienced it at T1 and/or T2.

#### **Psychological distress**

The measure of psychological distress was based on depressive symptoms and suicidal thoughts. At T2, a 10-item version of the Center for Epidemiologic Studies Depression Rating Scale (CESD) [40] was used to measure self-rated depressive symptoms during the week before the interview on a Likert scale going from 0 (almost never) to 3 (all of the time). This measure has been validated with a North American aboriginal population [41]. Self-rated suicidal thoughts during the previous year, documented at T2, have been measured using a yes/no question extracted from the Suicidal Ideation Questionnaire 'In the past 12 months, have you thought seriously about committing suicide?' [42]. Epidemiological studies have often used this question in the Inuit population [37], and this indicator is moderately associated with depressive symptoms and low self-esteem [13].

#### **Control variable**

Control variables were chosen from a list based on previous papers, and retained if they had a significant correlation ( $p \leq 0.20$ ) with both independent and dependent variables. Mother's distress level at T1 and participants' age were tested as control variables but were not chosen because they did not reach these criteria. Socioeconomic status (SES) at T1 and T2 was used as a control variable. SES was assessed using a composite variable based on the job of the principal provider, which was sometimes the adolescent, and his/her education level [43]. This indicator is associated with depressive symptoms [44] as well as with suicidal thoughts and attempts in adolescents [45]. Furthermore, low SES is a correlate of household overcrowding in the general population [46], but not necessarily in Nunavik because almost everyone is living in social housing [38]. SES at T1 was used as a control variable for the longitudinal analysis and SES at T2 was used for the cross-sectional analysis. Both were significantly associated with the variables of interest ( $p \leq 0.05$ ). Sex was also used as a control variable in all analysis except the moderation models.

#### **Analysis**

Between 2.8% and 5.2% of data were missing for the variables of interest. The examination of the mean difference between the participants with and without

missing data for each of the study's measure did not reveal any specific pattern; data were considered to be missing at random. To verify the first and second objectives, regression analyses were conducted. Multiple regressions were used for the models including the continuous depressive symptoms variable and logistic regressions were used for the models including the dichotomous suicidal thoughts variable. Also, in both sets of prediction models, other indexes operationalising household overcrowding were used: the mean PPR ratio, one standard error above the mean PPR ratio and categorical variables comparing participants who have not experienced household overcrowding at T1 or T2 and participants who have experienced it at T1 and/or T2. Regression analyses were conducted using SPSS version 21 (IBM Corporation, 2012). To test the third objective, moderation by sex analysis while controlling for SES were realised using the PROCESS macro version 2.16 for SPSS [47].

## Results

Descriptive statistics of household crowding and psychological distress indicators are presented in Table 1. The prevalence of household overcrowding was high at T1, with a little over six out of 10 children living in households characterised by a PPR above 1. This prevalence decreased to four out of 10 at T2. A third of the participants were living in overcrowded households during both childhood and adolescence, and 26.7% were not exposed

to household overcrowding at both data collection times. At T2, nearly one-third of the adolescents reached a clinical level of depressive symptoms. Also, nearly one out of five adolescents had suicidal thoughts during the year preceding the interview.

### Prediction of adolescence psychological distress by childhood household overcrowding

To verify the existence of a longitudinal association between childhood household overcrowding and adolescence psychological distress, multiple regressions were realised for the models including the continuous depressive symptoms variable and logistic regressions were used for the models including the dichotomous suicidal thoughts variable. Associations remained non-significant, independently of the psychological distress or the household overcrowding measure being used (Tables 2 and 3).

### Association between psychological distress and household overcrowding at adolescence

To verify the existence of a cross-sectional association between household overcrowding and psychological distress when both are measured at adolescence, multiple regressions were conducted for the models including the continuous depressive symptoms variable and logistic regressions were used for the models including the dichotomous suicidal thoughts variable. Again, associations remained non-significant, independently

**Table 1.** Demographic characteristics, estimates of household crowding and psychological distress.

	No. (%)	Mean	S.D. <sup>1</sup>	Min.	Max.
<b>Demographic characteristics</b>					
Sex (women)	117 (55.20)				
Age T1 <sup>2</sup>		11.50	0.60	9.90	13.90
Age T2 <sup>3</sup>		18.47	1.11	16.01	21.88
SES <sup>4</sup> T1		28.38	11.38	8.00	66.00
SES T2		28.54	13.03	8.00	61.00
<b>Household crowding T1</b>					
People/room		1.27	0.42	0.50	3.00
People/room > 1	127 (63.20)				
<b>Household crowding T2</b>					
People/room		1.13	0.40	0.25	2.80
People/room > 1	91 (45.30)				
<b>Longitudinal household overcrowding</b>					
Never overcrowded	51 (26.70)				
Overcrowded T1 only	53 (27.70)				
Overcrowded T2 only	19 (9.90)				
Overcrowded T1 and T2	68 (35.60)				
<b>Psychological distress at T2</b>					
Depressive symptoms <sup>5</sup>		7.92	4.16	0	23.00
Clinical level of depressive symptoms	59 (28.3)				
Suicidal thoughts during the previous year	36 (17.60)				

1. Standard deviation.

2. Time 1 of the Nunavik Child Development Study data collection, between 2005 and 2010.

3. Time 2 of the Nunavik Child Development Study data collection, between 2013 and 2016.

4. Socioeconomic status (Hollingshead, 1957).

5. Center for Epidemiologic Studies Depression Rating Scale (Radloff, 1977).

**Table 2.** Multiple regressions: association of household crowding with depressive symptoms taking SES and sex into account.

Predictors	Stand. beta	p	R <sup>2</sup> change
<b>Model 1: Longitudinal, prediction by household overcrowding at T1<sup>1</sup> (people/room &gt; 1; n = 195)</b>			
Household overcrowding	-0.02	0.80	R <sup>2</sup> = 0.01
SES <sup>2</sup> T1	-0.12	0.11	F(3, 191) = 0.98
Sex	0.03	0.72	p = 0.40
<b>Model 2: Longitudinal, prediction by household crowding at T1 (continuous ratio of people/room; n = 195)</b>			
Household crowding	0.05	0.53	R <sup>2</sup> = 0.02
SES T1	-0.10	0.16	F(3, 191) = 1.09
Sex	0.03	0.70	p = 0.35
<b>Model 3: Cross-sectional, prediction by household overcrowding at T2<sup>3</sup> (people/room &gt; 1; n = 199)</b>			
Household overcrowding	-0.10	0.16	R <sup>2</sup> = 0.02
SES T2	-0.12	0.10	F(3, 195) = 1.62
Sex	0.04	0.54	p = 0.19
<b>Model 4: Cross-sectional, prediction by household crowding at T2 (continuous ratio of people/room; n = 199)</b>			
Household crowding	-0.13	0.06	R <sup>2</sup> = 0.03
SES T2	-0.13	0.07	F(3, 195) = 2.13
Sex	0.05	0.49	p = 0.10
<b>Model 5: Comparison of not having experienced household overcrowding at T1 or T2 to other situations (n = 191)</b>			
Overcrowded T1 vs never overcrowded <sup>4</sup>	0.02	0.82	R <sup>2</sup> = 0.03
Overcrowded T2 vs never overcrowded	-0.10	0.24	F(5, 185) = 1.30
Overcrowding T1 and T2 vs never overcrowded	-0.10	0.25	p = 0.26
SES T1	-0.15	0.05	
Sex	0.03	0.69	

1. Time 1 of the Nunavik Child Development Study data collection, between 2005 and 2010.

2. Socioeconomic status (Hollingshead, 1957).

3. Time 2 of the Nunavik Child Development Study data collection, between 2013 and 2016.

4. Never overcrowded stands for not overcrowded at T1 or T2.

**Table 3.** Logistic regressions: association of household crowding with suicidal thoughts taking SES and sex into account.

Predictors	Exp (B)	p	R <sup>2</sup> change
<b>Model 1: Longitudinal, prediction by household overcrowding at T1<sup>1</sup> (people/room &gt; 1; n = 194)</b>			
Household overcrowding	0.74	0.43	Nagelkerke R <sup>2</sup> : 0.04
SES <sup>2</sup> T1	0.97	0.15	
Sex	1.53	0.27	
<b>Model 2: Longitudinal, prediction by household crowding at T1 (continuous ratio of people/room; n = 194)</b>			
Household crowding	0.51	0.17	Nagelkerke R <sup>2</sup> : 0.05
SES T1	0.97	0.10	
Sex	1.51	0.29	
<b>Model 3: Cross-sectional, prediction by household overcrowding at T2<sup>3</sup> (people/room &gt; 1; n = 199)</b>			
Household overcrowding	0.63	0.25	Nagelkerke R <sup>2</sup> : 0.03
SES T2	0.98	0.28	
Sex	1.36	0.43	
<b>Model 4: Cross-sectional, prediction by household crowding at T2 (continuous ratio of people/room; n = 199)</b>			
Household crowding	0.60	0.31	Nagelkerke R <sup>2</sup> : 0.02
SES T2	0.98	0.26	
Sex	1.39	0.39	
<b>Model 5: Comparison of not having experienced household overcrowding at T1 or T2 to other situations (n = 191)</b>			
Overcrowded T1 vs never overcrowded <sup>4</sup>	0.71	0.50	Nagelkerke R <sup>2</sup> : 0.05
Overcrowding T2 vs never overcrowded	0.57	0.43	
Overcrowding T1 and T2 vs never overcrowded	0.44	0.10	
SES T1	0.97	0.94	
Sex	1.30	0.51	

1. Time 1 of the Nunavik Child Development Study data collection, between 2005 and 2010.

2. Socioeconomic status (Hollingshead, 1957).

3. Time 2 of the Nunavik Child Development Study data collection, between 2013 and 2016.

4. Never overcrowded stands for not overcrowded at T1 or T2.

of the psychological distress or the household overcrowding measure being used (Tables 2 and 3).

### Moderation by sex of the association between household overcrowding and psychological distress

To verify if the association between household overcrowding and psychological distress depends of the

participants' sex, moderation by sex analysis while controlling for SES were conducted. As shown in Tables 4 and 5, we found no moderation by sex of the associations between household overcrowding and depressive symptoms and suicidal thoughts, with the exception of the association between dichotomous household overcrowding and suicidal thoughts when both were measured at adolescence (Table 5). For this last model, the slope was only significant for boys, although it was

**Table 4.** Moderation models: association of household crowding with depressive symptoms, moderated by sex, taking SES<sup>1</sup> into account.

Predictors	Coefficient	p	R <sup>2</sup> change
<b>Model 1: Longitudinal, prediction by household overcrowding at T1<sup>2</sup> (people/room &gt; 1; n = 195)</b>			
Sex	-0.09	0.92	R <sup>2</sup> = 0.00
Household overcrowding	-0.46	0.62	F(3, 191) = 0.20
Household overcrowding × Sex	0.66	0.60	p = 0.89
<b>Model 2: Longitudinal, prediction by household crowding at T1 (continuous ratio of people/room; n = 195)</b>			
Sex	-1.42	0.46	R <sup>2</sup> = 0.01
Household crowding	-0.03	0.98	F(3, 191) = 0.73
Household crowding × Sex	1.39	0.33	p = 0.53
<b>Model 3: Cross-sectional, prediction by household overcrowding at T2<sup>3</sup> (people/room &gt; 1; n = 199)</b>			
Sex	0.14	0.86	R <sup>2</sup> = 0.01
Household overcrowding	-1.03	0.23	F(3,197) = 0.78
Household overcrowding × Sex	0.55	0.64	p = 0.51
<b>Model 4: Cross-sectional, Prediction by household crowding at T2 (continuous ratio of people/room; n = 199)</b>			
Sex	-0.41	0.81	R <sup>2</sup> = 0.02
Household crowding	-1.57	0.14	F(3, 197) = 1.12
Household crowding × Sex	0.75	0.61	p = 0.34

1. Socioeconomic status (Hollingshead, 1957).

2. Time 1 of the Nunavik Child Development Study data collection, between 2005 and 2010.

3. Time 2 of the Nunavik Child Development Study data collection, between 2013 and 2016.

**Table 5.** Moderation models: association of household crowding with suicidal thoughts, moderated by sex, taking SES<sup>1</sup> into account.

Predictors	Coefficient	p	R <sup>2</sup> change
<b>Model 1: Longitudinal, prediction by household overcrowding at T1<sup>2</sup> (people/room &gt; 1; n = 194)</b>			
Sex	-0.23	0.70	Nagelkerke R <sup>2</sup> : 0.05
Household overcrowding	-0.99	0.11	-2LL: 179.70
Household overcrowding × Sex	1.13	0.15	p = 0.17
<b>Model 2: Longitudinal, prediction by household crowding at T1 (continuous ratio of people/room; n = 194)</b>			
Sex	-1.71	0.22	Nagelkerke R <sup>2</sup> : 0.07
Household crowding	-1.90	0.06	-2LL: 177.76
Household crowding × Sex	1.77	0.12	p = 0.08
<b>Model 3: Cross-sectional, prediction by household overcrowding at T2<sup>3</sup> (people/room &gt; 1; n = 199)</b>			
Sex	-0.45	0.34	Nagelkerke R <sup>2</sup> : 0.08
Household overcrowding	-1.89	0.02*	-2LL: 169.06
Household overcrowding × Sex	2.24	0.02*	p = 0.05*
<b>Model 4: Cross-sectional, prediction by household crowding at T2 (continuous ratio of people/room; n = 199)</b>			
Sex	-1.64	0.19	Nagelkerke R <sup>2</sup> : 0.05
Household crowding	-1.72	0.08	-2LL: 173.16
Household crowding × Sex	1.86	0.11	p = 0.23

1. Socioeconomic status (Hollingshead, 1957).

2. Time 1 of the Nunavik Child Development Study data collection, between 2005 and 2010.

3. Time 2 of the Nunavik Child Development Study data collection, between 2013 and 2016.

\* p ≤ 0.05

negative and suggesting that a non-overcrowded household is associated with no serious suicidal thoughts in the year preceding the survey.

## Discussion

The first aim of this study was to determine whether household overcrowding experienced during childhood predicts psychological distress during adolescence among the Nunavik Inuit. Our results did not show any long-term effect of household overcrowding on adolescents' psychological distress. The second objective of this study was to determine whether household overcrowding is associated with psychological distress when both are assessed during adolescence, and the

hypothesised association was not supported by our results.

The third objective was to assess whether the association between household overcrowding and psychological distress changed according to the respondent's sex, with the expectation that the association would be stronger in women. Results showed that it was not the case for all the models excepted the significant association between dichotomous household overcrowding and suicidal thoughts when both were measured at adolescence. In this model, to the opposite of our expectations, the association between dichotomous household overcrowding and suicidal thoughts was not stronger in women. For men, the results indicated that men living in an overcrowded household had less chance of having seriously thought about taking their

life in the year preceding the survey. We however did not have a specific hypothesis about the protective effect of household crowding for men, and this result needs to be replicated to be better understood. The absence of a moderation by sex of the associations examined in the present study contradicts the results reported in a recent study conducted among Greenlandic Inuit adults [33]. This discrepancy between results from both studies could however be explained by the different measures being used: the present study used a 10-item questionnaire to assess depressive symptoms, whereas Riva and her collaborators used another single dichotomous question to assess perceived psychological distress. Their study's age group also differed with a mean of 44 years compared to 18 years in the present study.

The lack of association observed in our results has been observed before in studies that assessed household overcrowding prior to the distress symptoms; however, in contrast with the present study, they considered household overcrowding as one factor among others associated to housing and poverty [24,26,48]. Our results also contradict those of cross-sectional studies conducted in various cultural contexts [19–22]. The lack of association between household overcrowding and psychological distress could be explained by the instability of the exposure to household crowding that characterises Inuit children and adolescents in Nunavik. The system for attribution of social housing and hidden homelessness together bring the number of people living under a same roof to vary often, more than in the general population [6,10]. Although not formally documented, specific factors may impact exposure to household overcrowding or experience of living in overcrowded households: adolescents have the freedom of sleeping at their parent's home, at relatives' or friends' home, at their romantic partner's home, etc. The decrease in household overcrowding prevalence between childhood and adolescence observed in this study could therefore be related to the adolescents' choice to live in a house that best suits their needs [49]. However, because many households are overcrowded, their options can be limited. Also, not documented in this study is how household crowding varied during the years between the childhood and adolescence assessments. Finally, the household composition and the quality of the relationships between tenants can influence greatly the experience people have of their housing conditions and it was not taken into account in this study. The number of people living in the household reported by the participants at testing time could therefore represent a single snapshot that cannot best capture the experience of participants,

which would decrease the likelihood of finding significant associations with mental health outcomes.

There is currently no scientific consensus about the best way to measure household crowding. Lauster and Tester [39] have discussed that subjective measures are better portrayal of household crowding because they take cultural differences into account. However, a recent study conducted in Nunavik and Nunavut observed that both objective and subjective measures are equally specific and sensible [25], with the objective measure having the advantage of not being influenced by participants' mood when answering the subjective household crowding question.

The absence of an association between household overcrowding and psychological distress among Nunavik Inuit adolescents could also be explained by the developmental period during which the participants were seen. During adolescence, many other factors not included in the present study can influence the experience of depressive symptoms and suicidal thoughts, thus diminishing the relative prominence of household overcrowding as a causal factor. Identity and personality maturation [50] as well as brain development [51] are characteristics of this period that can lead to distress in all adolescents. However, some other factors are more prevalent for Inuit children and adolescents because of the culture and the historical context unique to Nunavik. For example, barriers to participation in culturally meaningful activities, acculturation and rapid social changes [1,52,53], high rates of violence in the communities [37], food insecurity [38], alcohol and substance abuse as well as sexual violence [54] could be causal factors of psychological distress of primary importance for Inuit children and adolescents.

In this study, household overcrowding was not found as a risk factor of psychological distress by itself, but could be part of a wider and complex combination of health determinants for Nunavik Inuit adolescents. For example, the difficulty to escape negative interactions because of household overcrowding could in itself be the source of psychological distress, and not the quantity of those interactions [49]. The quality of the relationships between household members, for example whether many generations live in the same household or whether conflicts or violence exist in the house, might be linked with overcrowding. They were not however considered in this study, although they may be related to the psychological distress of adolescents [49]. Women living in overcrowded households suffer particularly important consequences such as few options for fleeing domestic violence, substance abuse, unhealthy relationships and lack of space to



raise their children safely [49]. The poor quality of housing and the major repairs that are needed in a large proportion of the houses can also compromise the health and well-being of Inuit children and adolescents [4] as it was found among low-income urban women [55]. Thus, household overcrowding may have an impact on psychological distress only in addition to, or in interaction with, other factors related to housing for Nunavik Inuit adolescents. Therefore, measuring household overcrowding but no other aspects of housing could have led to an underestimation of its real importance [56].

Finally, household overcrowding could be associated with other problems than depressive symptoms and suicidal thoughts in adolescents, such as perceived stress and food insecurity [25,38] or stress-related physiological dysregulation [57]. The definition of one's identity and role in society, two tasks that characterise childhood and adolescence, could be specifically challenged by household overcrowding. The lack of privacy and the inequality of housing opportunities compared to Southern Canada may exacerbate the difficulties associated with household overcrowding at this critical developmental period [58]. Household overcrowding experienced by children can also compromise their security and development by making them witnesses of conflicts exacerbated by the lack of intimacy. So, household overcrowding could be deleterious only when considered in interaction with other housing-related factors, explaining the lack of association between household overcrowding and psychological distress observed in the current study.

Some limits and strengths characterise the present study. First, other predictors of psychological distress for adolescents, either related to the developmental period in itself or to the cultural context, were not taken into account. A better way to measure household crowding situation would require assessments of all the houses where adolescents spend time in order to grasp the whole variability of housing conditions experienced during this developmental period and during the time between data collections. A second limit is that other aspects of housing, for example the relationships between household members, the presence of adults with specific problems [49], the disrepair that characterises many housing units in Nunavik [6] or community characteristics [59] were not taken into account, therefore not allowing to fully grasp how housing affects psychological distress in Nunavik. Also, the measurements of household overcrowding were taken at two specific moments in time, and it is possible that they do not reflect the general situation of adolescents throughout the years. Finally, self-reported psychological

distress measures at Time 1 were not included to this Nunavik Child Development Study's data collection, but it would have been interesting to be able to use it, even though we measured at Time 2 a psychological state that can be transient and not a psychiatric illness. However, we did not measure a psychological illness, but rather a psychological state that can fluctuate with life events. Nonetheless, this study is the first to use a longitudinal design to assess the association between household overcrowding during childhood and psychological distress among Inuit adolescents. Using objective rather than subjective measures of household overcrowding is also a strength of this study because no characteristic inherent of the adolescent (like personality traits, difficulties or distress level) could have influenced the perception of household crowding [60].

To conclude, even though it did not predict psychological distress during adolescence among the participants to this study, household overcrowding during childhood and adolescence remains a prevalent and important issue whose consequences remain hard to grasp. To better understand this important public health issue, future studies should acknowledge the instability of this factor during childhood and adolescence. Addressing the research gap of how household overcrowding works as a health determinant in interaction with other factors related with housing or poverty is also a main concern for Inuit public health.

## Disclaimer

The views expressed in the submitted article are the author's own, and not an official position of an institution or funder.

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